

**ASME B16.5-2025**  
(Revision of ASME B16.5-2020)

# Pipe Flanges and Flanged Fittings

**NPS ½ Through NPS 24**  
**Metric/Inch Standard**

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**AN AMERICAN NATIONAL STANDARD**



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**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
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# FOREWORD

In 1920, the American Engineering Standards Committee [later the American Standards Associations (ASA) and currently the American National Standards Institute (ANSI)] 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 The American Society of Mechanical Engineers (ASME), the Heating and Piping Contractors National Association [now Mechanical Contractors Association of America (MCAA)], and the Manufacturers Standardization Society of the Valves and Fittings Industry (MSS). 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 on 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 ½-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 ¼ 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 planned. Bolt length calculations based on worst case tolerances led to a revision of tabulated lengths. Testing of valves subsequently published by Subcommittee 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) continued 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 (BPVC) 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 having to make frequent and confusing changes to the ratings as a result of further changes to the BPVC-allowable stresses, Subcommittees C and N agreed that ratings would be left alone unless the relevant BPVC stress values were 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 would stand alone, with metric bolting and gaskets; hence, metric equivalents were deleted. Following approval by the Standards 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, 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 ASME BPVC, Section II, Part D. Annex F was added to cover pressure–temperature ratings and dimensional data for Classes 150 through 2500 flanges and Classes 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 Classes 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 Classes 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. The 2003 edition was approved by ANSI on July 9, 2003, with the designation ASME B16.5-2003.

The 2009 edition added new materials, updated some pressure–temperature ratings, and designated the annexes as mandatory and nonmandatory appendices. The mandatory appendices were numbered using roman numerals, and the nonmandatory appendices were referenced using capital letters. The 2009 edition was approved by ANSI on February 19, 2009, with the designation ASME B16.5-2009.

The 2013 edition included a revision to [para. 5.1](#) and the addition of perpendicularity tolerances. Additional errata and clarifying revisions were also applied. Following approval of the Standards Committee and ASME, approval for the 2013 edition was granted by ANSI on February 5, 2013.

The 2017 edition included the use of bar stock for blind flanges without hubs; added requirements for forgings, size NPS 22; and updated materials and working pressures.

In the 2020 edition, the U.S. Customary tables in former Mandatory Appendix II were relocated to the main text and redesignated with a “C” suffix (e.g., Table II-2-1.1 became Table 2-1.1C) and U.S. Customary figures were merged with SI figures. Former Mandatory Appendix II was deleted and the subsequent Mandatory Appendix redesignated. Cross-references were updated accordingly. Following approval by the ASME B16 Standards Committee, ASME B16.5-2020 was approved by ANSI as an American National Standard on January 5, 2021.

In the 2025 edition, various ASTM materials; a new appendix for determining minimum temperature limits; and definitions for *may*, *shall*, and *should* were added. After adopting revised ceiling values ([Nonmandatory Appendix A, Tables A-1 and A-2](#)), pressure–temperature ratings were revised. Lastly, various revisions to variables were made.

Following approval by the ASME B16 Standards Committee, ASME B16.5-2025 was approved by ANSI as an American National Standard on April 10, 2025.

# ASME B16 COMMITTEE

## Standardization of Valves, Flanges, Fittings, and Gaskets

(The following is the roster of the committee at the time of approval of this Standard.)

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**Revisions and Errata.** The committee processes revisions to this Standard on a continuous basis 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 in the next edition of the Standard.

In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive email notifications of posted errata.

This Standard is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number, the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

## Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

(4) to permit the use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Standard.

(c) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Standard and the paragraph, figure, or table number

(4) the editions of the Standard to which the proposed case applies

(d) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

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# ASME B16.5-2025

## SUMMARY OF CHANGES

Following approval by the ASME B16 Standards Committee and ASME, and after public review, ASME B16.5-2025 was approved by the American National Standards Institute on April 10, 2025.

In ASME B16.5-2025, titles of complementary tables have been editorially revised to indicate the applicable system of units. ASME B16.5-2025 also includes the following changes identified by a margin note, **(25)**. The Record Numbers listed below are explained in more detail in the "List of Changes in Record Number Order" following this Summary of Changes.

| <i>Page</i> | <i>Location</i> | <i>Change (Record Number)</i>  |
|-------------|-----------------|--|
| 2           | 1.11            | Added (22-2279)  |
| 2           | 2.2             | In second sentence, "must" revised to "shall" (22-2279)  |
| 2           | 2.4             | Revised (21-1888)  |
| 3           | 2.5.3           | Revised (21-1888)  |
| 3           | 2.6             | Revised (21-1849)  |
| 5           | Table 1.1-1     | (1) Revised (16-1229, 21-1888, 23-2509)<br>(2) For Material Group 3.1, Nominal Composition 35Ni-35Fe-20Cr-Cb, Forgings and Plates specifications corrected by errata (21-1145)<br>(3) For Material Group 3.6, Nominal Composition 33Ni-42Fe-21Cr, second specification under Forgings and Plates added by errata (21-1145)<br>(4) For Material Group 3.12, Nominal Composition 46Fe-24Ni-21Cr-6Mo-Cu-N, first specification under Plates corrected by errata (21-1145) |
| 8           | 5.1.2           | Revised (21-1888)  |
| 8           | 5.3.4           | Last sentence deleted (21-1888)  |
| 8           | 5.3.5           | In subpara. (a), second sentence revised (22-2279)   |
| 9           | Table 1.1-2     | (1) Under Intermediate Strength, Spec. No. A320, Grade L7M added; under Nickel and Special Alloy, Spec Nos. B511, B572, and B637 added (22-651)<br>(2) Notes revised and reordered (21-1888, 21-2211, 22-651)  |
| 10          | 6.1.1           | Second sentence revised (22-2279)  |
| 14          | 7.3             | Editorially revised  |
| 15          | 8.1             | Revised (21-1849)  |
| 15          | Figure 1        | General Note (b) revised (22-567)  |
| 15          | Figure 2        | General Note (b) revised (22-567)  |
| 20          | Figure 7        | Hub height, <i>H</i> , and Note (1) added, and subsequent Note redesignated (22-2183)  |
| 21          | Figure 8        | Hub height, <i>H</i> , and Note (1) added, and subsequent Note redesignated (22-2183)  |
| 23          | Figure 12       | U.S. Customary values added by errata (21-1122)  |
| 25          | Table 2-1.1     | Revised (21-1888, 22-564, 23-2509)   |
| 26          | Table 2-1.1C    | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) Notes revised and reordered (23-2509)  |

| <i>Page</i> | <i>Location</i> | <i>Change (Record Number)</i>  |
|-------------|-----------------|--|
| 27          | Table 2-1.2     | Revised (21-1888, 22-564, 23-2509)   |
| 28          | Table 2-1.2C    | Revised (21-1888, 23-2509)   |
| 29          | Table 2-1.3     | Revised (21-1888, 22-564, 23-2509)   |
| 30          | Table 2-1.3C    | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) Notes revised and reordered (21-1888, 23-2509)   |
| 31          | Table 2-1.4     | Revised (21-1888, 22-564, 23-2509)   |
| 32          | Table 2-1.4C    | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) Note (2) revised (21-1888, 23-2509)  |
| 33          | Table 2-1.5     | Revised (21-1888, 22-564, 23-2509)   |
| 34          | Table 2-1.5C    | (1) Revised (21-1888, 23-2509)<br>(2) Temperature in Note (1) corrected to Fahrenheit by errata<br>(21-1145)   |
| 35          | Table 2-1.7     | Revised (21-1888, 23-2509)   |
| 36          | Table 2-1.7C    | Revised (21-1888, 23-2509)   |
| 37          | Table 2-1.9     | Revised (21-1888, 22-564, 23-2509)   |
| 38          | Table 2-1.9C    | Revised (21-1888, 23-2509)   |
| 39          | Table 2-1.10    | Revised (21-1888, 22-564, 23-2509)   |
| 40          | Table 2-1.10C   | Revised (21-1888, 23-2509)   |
| 41          | Table 2-1.11    | Revised (21-1888, 22-564, 23-2509)   |
| 42          | Table 2-1.11C   | Revised (21-1888, 23-2509)   |
| 43          | Table 2-1.13    | Revised (21-1888, 23-2509)   |
| 44          | Table 2-1.13C   | Revised (21-1888, 23-2509)   |
| 45          | Table 2-1.14    | Revised (21-1888, 23-2509)   |
| 46          | Table 2-1.14C   | Revised (21-1888, 23-2509)   |
| 47          | Table 2-1.15    | Revised (21-1888, 23-2509)   |
| 48          | Table 2-1.15C   | Revised (21-1888, 23-2509)   |
| 49          | Table 2-1.17    | Revised (21-1888, 22-564, 23-2509)   |
| 50          | Table 2-1.17C   | Revised (21-1888, 23-2509)   |
| 51          | Table 2-1.18    | Revised (21-1888, 22-564, 23-2509)   |
| 52          | Table 2-1.18C   | Revised (21-1888, 23-2509)   |
| 53          | Table 2-2.1     | Revised (21-1888, 22-564, 23-2509)   |
| 54          | Table 2-2.1C    | Revised (21-1888, 23-2509)   |
| 55          | Table 2-2.2     | Revised (21-1888, 22-564, 23-2509)   |
| 56          | Table 2-2.2C    | Revised (21-1888, 23-2509)   |
| 57          | Table 2-2.3     | Revised (21-1888, 22-564, 23-2509)   |
| 58          | Table 2-2.3C    | (1) Under Forgings and Plates, references to Note (1) added<br>(23-2509)<br>(2) Under Temp., °F, first entry revised (21-1888)<br>(3) Note (1) revised and Note (2) added (21-1888, 23-2509) |
| 59          | Table 2-2.4     | Revised (21-1888, 22-564, 23-2509)   |
| 60          | Table 2-2.4C    | Revised (21-1888, 23-2509)   |
| 61          | Table 2-2.5     | Revised (21-1888, 22-564, 23-2509)   |
| 62          | Table 2-2.5C    | Revised (21-1888, 23-2509)   |
| 63          | Table 2-2.6     | Revised (21-1888, 23-2509)   |
| 64          | Table 2-2.6C    | Revised (21-1888, 23-2509)   |
| 65          | Table 2-2.7     | Revised (21-1888, 22-564, 23-2509)   |

| <i>Page</i> | <i>Location</i> | <i>Change (Record Number)</i>  |
|-------------|-----------------|--|
| 66          | Table 2-2.7C    | Revised (21-1888, 23-2509)   |
| 67          | Table 2-2.8     | Revised (21-1888, 22-564, 23-2509)   |
| 67          | Table 2-2.8C    | Revised (21-1888, 23-2509)   |
| 68          | Table 2-2.9     | Revised (21-1888, 22-564, 23-2509)   |
| 69          | Table 2-2.9C    | Revised (21-1888, 23-2509)   |
| 70          | Table 2-2.10    | Revised (21-1888, 23-2509)   |
| 71          | Table 2-2.10C   | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) For 1,000°F, Working Pressure for Classes 400 through 2500 revised (23-2509)<br>(3) Note (2) added (21-1888) |
| 72          | Table 2-2.11    | Revised (21-1888, 23-2509)   |
| 73          | Table 2-2.11C   | Revised (21-1888, 23-2509)   |
| 74          | Table 2-2.12    | Revised (21-1888, 23-2509)   |
| 75          | Table 2-2.12C   | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) For 1,000°F, Working Pressure for Classes 400 through 2500 revised (23-2509)<br>(3) Note (2) added (21-1888) |
| 76          | Table 2-2.13    | Added (21-1888, 23-2509)   |
| 77          | Table 2-2.13C   | Added (21-1888, 23-2509)   |
| 78          | Table 2-3.1     | Revised (21-1888, 23-2509)   |
| 78          | Table 2-3.1C    | Revised (21-1888, 23-2509)   |
| 79          | Table 2-3.2     | Revised (21-1888, 23-2509)   |
| 79          | Table 2-3.2C    | Revised (21-1888)  |
| 80          | Table 2-3.3     | Revised (21-1888, 23-2509)   |
| 81          | Table 2-3.3C    | Revised (21-1888, 23-2509)   |
| 82          | Table 2-3.4     | Revised (21-1888, 23-2509)   |
| 83          | Table 2-3.4C    | (1) Castings materials and Note (2) added (21-1888, 23-2509)<br>(2) Under Temp., °F, first entry revised (21-1888)   |
| 84          | Table 2-3.5     | Revised (21-1888, 23-2509)   |
| 85          | Table 2-3.5C    | Revised (21-1888, 23-2509)   |
| 86          | Table 2-3.6     | (1) Revised (21-1888, 23-2509)<br>(2) For Nominal Designation 33Ni-42Fe-21Cr, entries for Forgings and Plates corrected by errata (21-1145)                            |
| 87          | Table 2-3.6C    | (1) Revised (21-1888, 23-2509)<br>(2) For Nominal Designation 33Ni-42Fe-21Cr, entries for Forgings and Plates corrected by errata (21-1145)                            |
| 88          | Table 2-3.7     | Revised (16-1229, 21-1888, 23-2509)  |
| 88          | Table 2-3.7C    | Revised (21-1888, 23-2509)   |
| 89          | Table 2-3.8     | Revised (16-1229, 21-1888, 22-564, 23-2509)  |
| 90          | Table 2-3.8C    | Revised (21-1888, 23-2509)   |
| 91          | Table 2-3.9     | Revised (21-1888, 23-2509)   |
| 92          | Table 2-3.9C    | (1) Revised (21-1888, 23-2509)<br>(2) Under Forgings, references to Note (2) added by errata (21-1145)   |
| 93          | Table 2-3.10    | Revised (21-1888, 23-2509)   |
| 93          | Table 2-3.10C   | Revised (21-1888)  |
| 94          | Table 2-3.11    | Revised (21-1888, 23-2509)   |

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|-------------|-----------------|--|
| 94          | Table 2-3.11C   | (1) Under Temp., °F, first entry revised (21-1888)<br>(2) Note (2) revised (21-1888, 23-2509)  |
| 95          | Table 2-3.12    | (1) Revised (16-1229, 21-1888, 23-2509)<br>(2) For Nominal Designation 46Fe-24Ni-21Cr-6Mo-Cu-N, entry for Castings corrected by errata (21-1145)   |
| 96          | Table 2-3.12C   | (1) Revised (21-1888, 23-2509)<br>(2) For Nominal Designation 46Fe-24Ni-21Cr-6Mo-Cu-N, entry for Castings corrected by errata (21-1145)  |
| 97          | Table 2-3.13    | Revised (16-1229, 21-1888, 23-2509)  |
| 97          | Table 2-3.13C   | Revised (21-1888, 23-2509)   |
| 98          | Table 2-3.14    | Revised (16-1229, 21-1888, 22-564, 23-2509)  |
| 99          | Table 2-3.14C   | Revised (21-1888, 23-2509)   |
| 100         | Table 2-3.15    | Revised (21-1888, 23-2509)   |
| 101         | Table 2-3.15C   | Revised (21-1888, 23-2509)   |
| 102         | Table 2-3.16    | Revised (21-1888, 23-2509)   |
| 103         | Table 2-3.16C   | Revised (21-1888, 23-2509)   |
| 104         | Table 2-3.17    | Revised (21-1888, 23-2509)   |
| 104         | Table 2-3.17C   | Revised (21-1888)  |
| 105         | Table 2-3.19    | Revised (21-1888, 23-2509)   |
| 106         | Table 2-3.19C   | Revised (21-1888, 23-2509)   |
| 114         | Table 5         | For Class 2500 NPS 2½, groove depth <i>E</i> corrected by errata from 9.522 to 9.53 (21-1372)  |
| 122         | Table 5C        | Under NPS 24, dimensionless row deleted and table alignment corrected by errata (22-1148)  |
| 131         | Table 7         | For NPS 20, outside diameter of flange, <i>O</i> , corrected by errata from 693 to 698 (21-1134)   |
| 133         | Table 8         | (1) Figure revised (21-579, 22-2183, 23-628)<br>(2) For NPS 14, outside diameter of flange, <i>O</i> , corrected by errata from 553 to 533 (21-1133)<br>(3) Note (2) added and subsequent Notes redesignated (22-2183) |
| 136         | Table 8C        | (1) Figure revised (21-579, 22-2183, 23-628)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 153         | Table 11        | (1) Figure revised (21-579, 22-2183, 23-628)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 156         | Table 11C       | (1) Figure revised (21-579, 22-2183, 23-628)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 169         | Table 14        | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 171         | Table 14C       | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 175         | Table 16        | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 178         | Table 16C       | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 183         | Table 18        | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |
| 186         | Table 18C       | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183)   |

| <i>Page</i> | <i>Location</i>         | <i>Change (Record Number)</i>  |
|-------------|-------------------------|--|
| 191         | Table 20                | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183) |
| 193         | Table 20C               | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183) |
| 197         | Table 22                | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183) |
| 199         | Table 22C               | (1) Figure revised (21-579, 22-2183)<br>(2) Note (2) added and subsequent Notes redesignated (22-2183) |
| 203         | Mandatory Appendix II   | Updated (23-2265)  |
| 209         | Table A-1               | Revised (21-1888, 22-2110)   |
| 210         | Table A-2               | Revised (21-1888, 22-2110)   |
| 247         | Nonmandatory Appendix G | Added (21-1888)  |

## LIST OF CHANGES IN RECORD NUMBER ORDER

| Record Number | Change  |
|---------------|---|
| 16-1229       | Added ASTM B462 and ASTM B564 forging specification materials in Tables 1.1-1, 2-3.7, 2-3.8, 2-3.12, 2-3.13, 2-3.14, II-2-3.7, II-2-3.8, and II-2-3.12 through II-2-3.14.   |
| 21-579        | Revised “B” dimension for slip-on, socket welding, welding neck, lapped flange figures in Tables 8, 11, 14, 16, 18, 20, and 22 (Tables 8C, 11C, 14C, 16C, 18C, 20C, and 22C).   |
| 21-1133       | Errata correction. See Summary of Changes for details.  |
| 21-1134       | Errata correction. See Summary of Changes for details.  |
| 21-1145       | Errata corrections. See Summary of Changes for details.   |
| 21-1372       | Errata correction. See Summary of Changes for details.  |
| 21-1849       | Revised requirements in paras. 2.6 and 8.1 for system hydrostatic testing.  |
| 21-1888       | Added guidance in paras. 2.4, 2.5.3, 5.1.2, and 5.3.4; General Notes in Tables 1.1-1 and 1.1-2, Tables 2-1.1 through 2-3.19 (Tables 2-1.1C through 2.3.19C), A-1, and A-2; and Nonmandatory Appendix G for determining minimum temperature for materials. |
| 21-2211       | Revised language to clarify “corresponding material” in Table 1.1-2 Notes (6) and (11).   |
| 22-564        | Revised metric temperatures to the nearest degree in notes in Tables 2-1.1 through 2-1.5, 2-1.9 through 2-1.11, 2-1.17, 2-1.18, 2-2.1 through 2-2.5, 2-2.7 through 2-2.9, 2-3.8, and 2-3.14.  |
| 22-567        | Revised General Note (b) in Figures 1 and 2.  |
| 22-651        | Added ASTM A320 L7M, ASTM B511 N08830, ASTM B572 N06230, ASTM B637 N07740, and ASTM B637 N07718 materials in Table 1.1-2.   |
| 22-1148       | Errata correction. See Summary of Changes for details.  |
| 22-2110       | Revised ceiling pressures in Tables A-1 and A-2.  |
| 22-2183       | Revised method to determine the minimum hub height in Figures 7 and 8 and Tables 8, 11, 14, 16, 18, 20, 22 (Tables 8C, 11C, 14C, 16C, 18C, 20C, and 22C).   |
| 22-2279       | Added para. 1.11 to define “may,” “shall,” and “should. Revised paras. 5.3.4 and 6.1.1 to align with the added definitions.   |
| 23-628        | Revised Table 8 (Table 8C) Class 150 threaded figure to have the threads continue to the flanged face. Revised Table 11 (Table 11C) Class 300 threaded figures to include a counterbore.  |
| 23-2265       | Updated references in Mandatory Appendix II.  |
| 23-2509       | Revised pressure–temperature ratings in Tables 2-1.1 through 2-3.19 (Tables 2-1.1C through 2-3.19C). Added Table 2-2.13 (Table 2-2.13C) for group material 2.13 for duplex materials. Revised Table 1.1-1.  |

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# PIPE FLANGES AND FLANGED FITTINGS

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

### 1 GENERAL

#### 1.1 Scope

(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  $\frac{1}{2}$  through NPS 24 and flanges with rating class designation 2500 in sizes NPS  $\frac{1}{2}$  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  $\frac{1}{2}$  through NPS 24, with requirements given in both metric and U.S. Customary units with diameter of bolts and flange bolt holes expressed in inch units

(3) flanged fittings with rating class designation 400, 600, 900, and 1500 in sizes NPS  $\frac{1}{2}$  through NPS 24 and flanged fittings with rating class designation 2500 in sizes  $\frac{1}{2}$  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 (see [Tables 1.1-1 through 1.1-3](#))

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 II](#).

#### 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 SI (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 following the SI 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. [Nonmandatory Appendix F](#) describes how the values expressed in SI units were established.

#### 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 determining conformance with this Standard, the convention for fixing significant digits where limits (maximum and minimum values) are specified shall be as defined in ASTM E29. This requires that an observed

or calculated value 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  |
|-------|-----|
| 1/2   | 15  |
| 3/4   | 20  |
| 1     | 25  |
| 1 1/4 | 32  |
| 1 1/2 | 40  |
| 2     | 50  |
| 2 1/2 | 65  |
| 3     | 80  |
| 4     | 100 |

GENERAL NOTE: For NPS ≥ 4, the related DN = 25 multiplied by the NPS number.

**1.10 Cases**

ASME issues Cases that are applicable to this Standard by, e.g., adding new materials or alternative construction requirements. The Cases

- (a) modify the requirements of this Standard.
- (b) are applicable from their issue dates until the Cases are annulled.
- (c) may be used only when agreed to by the purchaser and the manufacturer, and when a Case has been so agreed to, the marking on the flange shall include the Case number.

(25) **1.11 Definitions**

- may*: the term used to denote permission, neither a requirement nor a recommendation.
- shall*: the term used to denote a requirement.
- should*: the term used to denote a recommendation.

**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 [2-3.19](#) for the applicable material and class designation. [Tables 2-1.1C](#) through [2-3.19C](#) 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**

(25)

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 shall 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**

(25)

The temperature shown for a corresponding pressure rating is the temperature of the pressure-containing shell of the component. For any temperature below 38°C (100°F), the rating shall be no greater than the 38°C (100°F) rating. 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.

- (25) **2.5.3 Low Temperature.** Some of the materials listed in [Tables 1.1-1](#) and [1.1-2](#), 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. Codes and regulations may have requirements for low-temperature applications that are a function of the flange dimensions as well as the material. See [Nonmandatory Appendix G](#) for a further explanation. 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.
- (25) **2.6 System Hydrostatic Testing**

Flanged joints and flanged fittings may be subjected to system hydrostatic tests at a pressure of up to 1.6 times the 38°C (100°F) rating. Testing at any higher pressure is the responsibility of the user.

## 2.7 Welding Neck Flanges

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

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

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), [Nonmandatory Appendix A, Tables A-1](#) and [A-2](#)

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

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

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 [Figures 1](#) through [3](#) for weld end dimensional requirements.

## 2.8 Straight Hub Welding Flanges

**2.8.1 Hub Dimensions.** Straight hub welding flanges have hubs of uniform thickness (see [Figure 4](#)). Except as described in [paras. 2.8.2](#) through [2.8.4](#), the straight hub welding flanges shall have dimensions and tolerances of the welding neck flanges of the same size and class set forth in [Tables 8, 11, 14, 16, 18, 20, and 22](#) ([Tables 8C, 11C, 14C, 16C, 18C, 20C, and 22C](#)). In [Figure 4](#) the tolerances described in [section 7](#) are applicable.

**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  $B$  shall be equal to the  $B$  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 1.1-1](#). 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 [Figure 5](#).

### 3.3 Reducing Flanges

Reducing flanges shall be designated by the NPS for each opening. See examples in [Table 6 \(Table 6C\)](#), Note (4).

## 4 MARKING

### 4.1 General

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

### 4.2 Identification Markings

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

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

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

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

(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 1.1-1](#) (see [para. 4.2.8](#)).

(e) Marking of the ASTM specification number or trade designation is the manufacturer's assurance that the material is in full compliance with that specification or specifications when multiple certifications apply.

**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 1.1-1](#) 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, Mandatory Appendix 7.

**4.2.9 Case Number.** When a flange or flanged fitting relies on and meets the requirements of a Case, the Case number shall be included in the markings as "Case ##."

## 5 MATERIALS

### 5.1 General

(a) Materials required for flanges and flanged fittings are listed in [Table 1.1-1](#) with the following restrictions:

(1) Plate and flat bar materials may be used only for blind flanges and reducing flanges without hubs.

(2) Flanges and flanged fittings shall be manufactured as one piece in accordance with the applicable material specification. Assembly of multiple pieces into the finished product by welding or other means is not permitted by this Standard.

(b) Each forged flange shall be finished from a part that is brought as nearly as practicable to the finished shape and size by a compressive plastic hot-working operation that consolidates the material to produce an essentially wrought structure, and shall be so processed during the operation as to cause metal flow in the direction most favorable for resisting the stress encountered in service.

(c) Recommended bolting materials are listed in [Table 1.1-2](#) (see [para. 5.3](#)).

(d) 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

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

**Table 1.1-1  
List of Material Specifications**

(25)

| Material Group No.       | Nominal Designation | Pressure-Temperature Rating Table | Applicable ASTM Specifications (1) |               |                   |
|--------------------------|---------------------|-----------------------------------|------------------------------------|---------------|-------------------|
|                          |                     |                                   | Forgings                           | Castings      | Plates            |
| <b>Group 1 Materials</b> |                     |                                   |                                    |               |                   |
| 1.1                      | C-Si                | 2-1.1                             | A105                               | A216 Gr. WCB  | A515 Gr. 70       |
|                          | C-Mn-Si             | 2-1.1                             | A350 Gr. LF2                       | ...           | A516 Gr. 70       |
|                          | C-Mn-Si             | 2-1.1                             | ...                                | ...           | A537 Cl. 1        |
|                          | C-Mn-Si-V           | 2-1.1                             | A350 Gr. LF6 Cl. 1                 | ...           | ...               |
|                          | 3½Ni                | 2-1.1                             | A350 Gr. LF3                       | ...           | ...               |
| 1.2                      | C-Mn-Si             | 2-1.2                             | ...                                | A216 Gr. WCC  | ...               |
|                          | C-Mn-Si             | 2-1.2                             | ...                                | A352 Gr. LCC  | ...               |
|                          | C-Mn-Si-V           | 2-1.2                             | A350 Gr. LF6 Cl. 2                 | ...           | ...               |
|                          | 2½Ni                | 2-1.2                             | ...                                | A352 Gr. LC2  | A203 Gr. B        |
|                          | 3½Ni                | 2-1.2                             | ...                                | A352 Gr. LC3  | A203 Gr. E        |
| 1.3                      | C-Si                | 2-1.3                             | ...                                | A352 Gr. LCB  | A515 Gr. 65       |
|                          | C-Mn-Si             | 2-1.3                             | ...                                | ...           | A516 Gr. 65       |
|                          | 2½Ni                | 2-1.3                             | ...                                | ...           | A203 Gr. A        |
|                          | 3½Ni                | 2-1.3                             | ...                                | ...           | A203 Gr. D        |
|                          | C-½Mo               | 2-1.3                             | ...                                | A217 Gr. WC1  | ...               |
|                          | C-½Mo               | 2-1.3                             | ...                                | A352 Gr. LC1  | ...               |
| 1.4                      | C-Si                | 2-1.4                             | ...                                | ...           | A515 Gr. 60       |
|                          | C-Mn-Si             | 2-1.4                             | A350 Gr. LF1 Cl. 1                 | ...           | A516 Gr. 60       |
| 1.5                      | C-½Mo               | 2-1.5                             | A182 Gr. F1                        | ...           | A204 Gr. A        |
|                          | C-½Mo               | 2-1.5                             | ...                                | ...           | A204 Gr. B        |
| 1.7                      | ½Cr-½Mo             | 2-1.7                             | A182 Gr. F2                        | ...           | ...               |
|                          | Ni-½Cr-½Mo          | 2-1.7                             | ...                                | A217 Gr. WC4  | ...               |
|                          | ¾Ni-¾Cr-1Mo         | 2-1.7                             | ...                                | A217 Gr. WC5  | ...               |
| 1.9                      | ¼Cr-½Mo             | 2-1.9                             | ...                                | A217 Gr. WC6  | ...               |
|                          | ¼Cr-½Mo-Si          | 2-1.9                             | A182 Gr. F11 CL.2                  | ...           | A387 Gr. 11 Cl. 2 |
| 1.10                     | 2¼Cr-1Mo            | 2-1.10                            | A182 Gr. F22 Cl. 3                 | A 217 Gr. WC9 | A387 Gr. 22 Cl. 2 |
| 1.11                     | 3Cr-1Mo             | 2-1.11                            | A182 Gr. F21                       | ...           | A387 Gr. 21 Cl. 2 |
|                          | C-½Mo               | 2-1.11                            | ...                                | ...           | A204 Gr. C        |
| 1.13                     | 5Cr-½Mo             | 2-1.13                            | A182 Gr. F5a                       | A217 Gr. C5   | ...               |
| 1.14                     | 9Cr-1Mo             | 2-1.14                            | A182 Gr. F9                        | A217 Gr. C12  | ...               |
| 1.15                     | 9Cr-1Mo-V           | 2-1.15                            | A182 Gr. F91 Type 1                | A217 Gr. C12A | A387 Gr. 91 Cl. 2 |
| 1.17                     | 1Cr-½Mo             | 2-1.17                            | A182 Gr. F12 Cl. 2                 | ...           | ...               |
|                          | 5Cr-½Mo             | 2-1.17                            | A182 Gr. F5                        | ...           | ...               |
| 1.18                     | 9Cr-2W-V            | 2-1.18                            | A182 Gr. F92                       | ...           | ...               |
| <b>Group 2 Materials</b> |                     |                                   |                                    |               |                   |
| 2.1                      | 18Cr-8Ni            | 2-2.1                             | A182 Gr. F304                      | A351 Gr. CF3  | A240 Gr. 304      |
|                          | 18Cr-8Ni            | 2-2.1                             | A182 Gr. F304H                     | A351 Gr. CF8  | A240 Gr. 304H     |
| 2.2                      | 16Cr-12Ni-2Mo       | 2-2.2                             | A182 Gr. F316                      | A351 Gr. CF3M | A240 Gr. 316      |
|                          | 16Cr-12Ni-2Mo       | 2-2.2                             | A182 Gr. F316H                     | A351 Gr. CF8M | A240 Gr. 316H     |
|                          | 18Cr-13Ni-3Mo       | 2-2.2                             | A182 Gr. F317                      | ...           | A240 Gr. 317      |
|                          | 19Cr-10Ni-3Mo       | 2-2.2                             | ...                                | A351 Gr. CG8M | ...               |
| 2.3                      | 18Cr-8Ni            | 2-2.3                             | A182 Gr. F304L                     | ...           | A240 Gr. 304L     |
|                          | 16Cr-12Ni-2Mo       | 2-2.3                             | A182 Gr. F316L                     | ...           | A240 Gr. 316L     |
|                          | 18Cr-13Ni-3Mo       | 2-2.3                             | A182 Gr. F317L                     | ...           | ...               |
| 2.4                      | 18Cr-10Ni-Ti        | 2-2.4                             | A182 Gr. F321                      | ...           | A240 Gr. 321      |
|                          | 18Cr-10Ni-Ti        | 2-2.4                             | A182 Gr. F321H                     | ...           | A240 Gr. 321H     |

**Table 1.1-1  
List of Material Specifications (Cont'd)**

| Material Group No.                | Nominal Designation      | Pressure-Temperature Rating Table | Applicable ASTM Specifications (1) |                        |                 |
|-----------------------------------|--------------------------|-----------------------------------|------------------------------------|------------------------|-----------------|
|                                   |                          |                                   | Forgings                           | Castings               | Plates          |
| <b>Group 2 Materials (Cont'd)</b> |                          |                                   |                                    |                        |                 |
| 2.5                               | 18Cr-10Ni-Cb             | 2-2.5                             | A182 Gr. F347                      | ...                    | A240 Gr. 347    |
|                                   | 18Cr-10Ni-Cb             | 2-2.5                             | A182 Gr. F347H                     | ...                    | A240 Gr. 347H   |
|                                   | 18Cr-10Ni-Cb             | 2-2.5                             | A182 Gr. F348                      | ...                    | A240 Gr. 348    |
|                                   | 18Cr-10Ni-Cb             | 2-2.5                             | A182 Gr. F348H                     | ...                    | A240 Gr. 348H   |
| 2.6                               | 23Cr-12Ni                | 2-2.6                             | ...                                | ...                    | A240 Gr. 309H   |
| 2.7                               | 25Cr-20Ni                | 2-2.7                             | A182 Gr. 310H                      | ...                    | A240 Gr. 310H   |
| 2.8                               | 20Cr-18Ni-6Mo            | 2-2.8                             | A182 Gr. F44                       | A351 Gr. CK3MCuN       | A240 Gr. S31254 |
| 2.9                               | 23Cr-12Ni                | 2-2.9                             | ...                                | ...                    | A240 Gr. 309S   |
|                                   | 25Cr-12Ni                | 2-2.9                             | ...                                | ...                    | A240 Gr. 310S   |
| 2.10                              | 25Cr-12Ni                | 2-2.10                            | ...                                | A351 Gr. CH8           | ...             |
|                                   | 25Cr-12Ni                | 2-2.10                            | ...                                | A351 Gr. CH20          | ...             |
| 2.11                              | 18Cr-10Ni-Cb             | 2-2.11                            | ...                                | A351 Gr. CF8C          | ...             |
| 2.12                              | 25Cr-20Ni                | 2-2.12                            | ...                                | A351 Gr. CK20          | ...             |
| 2.13                              | 22Cr-5Ni-3Mo-N           | 2-2.13                            | A182 Gr. F51                       | A995 Gr. CD3MN (4A)    | A240 Gr. S31803 |
|                                   | 22Cr-5Ni-3Mo-N           | 2-2.13                            | A182 Gr. F60                       | ...                    | ...             |
|                                   | 22Cr-5Ni-3Mo-N           | 2-2.13                            | ...                                | ...                    | A240 Gr. S32205 |
|                                   | 25Cr-5Ni-3Mo-2Cu         | 2-2.13                            | ...                                | ...                    | A240 Gr. S32550 |
|                                   | 25Cr-7Ni-4Mo-N           | 2-2.13                            | A182 Gr. F53                       | ...                    | A240 Gr. S32750 |
|                                   | 24Cr-10Ni-4Mo-V          | 2-2.13                            | ...                                | A995 Gr. CE8MN (2A)    | ...             |
|                                   | 25Cr-5Ni-2Mo-3Cu-N       | 2-2.13                            | ...                                | A995 Gr. CD4MCuN (1B)  | ...             |
|                                   | 25Cr-7Ni-3.5Mo-W-Cb      | 2-2.13                            | ...                                | A995 Gr. CD3MWCuN (6A) | ...             |
| 25Cr-7Ni-3.5Mo-N-Cu-W             | 2-2.13                   | A182 Gr. F55                      | ...                                | A240 Gr. S32760        |                 |
| <b>Group 3 Materials</b>          |                          |                                   |                                    |                        |                 |
| 3.1                               | 35Ni-35Fe-20Cr-Cb        | 2-3.1                             | A182 Gr. N08020                    | ...                    | A240 Gr. N08020 |
|                                   | 35Ni-35Fe-20Cr-Cb        | 2-3.1                             | B462 Gr. N08020                    | ...                    | B463 Gr. N08020 |
| 3.2                               | 99.0Ni                   | 2-3.2                             | B564 Gr. N02200                    | ...                    | B162 Gr. N02200 |
| 3.3                               | 99.0Ni-Low C             | 2-3.3                             | ...                                | ...                    | B162 Gr. N02201 |
| 3.4                               | 67Ni-30Cu                | 2-3.4                             | B564 Gr. N04400                    | A494 Gr. M35-1         | B127 Gr. N04400 |
|                                   | 67Ni-30Cu                | 2-3.4                             | ...                                | A494 Gr. M35-2         | ...             |
| 3.5                               | 72Ni-15Cr-8Fe            | 2-3.5                             | B564 Gr. N06600                    | ...                    | B168 Gr. N06600 |
| 3.6                               | 33Ni-42Fe-21Cr           | 2-3.6                             | A182 Gr. N08800                    | ...                    | A182 Gr. N08800 |
|                                   | 33Ni-42Fe-21Cr           | 2-3.6                             | B564 Gr. N08800                    | ...                    | B409 Gr. N08800 |
| 3.7                               | 65Ni-28Mo-2Fe            | 2-3.7                             | B462 Gr. N10665                    | ...                    | B333 Gr. N10665 |
|                                   | 65Ni-28Mo-2Fe            | 2-3.7                             | B564 Gr. N10665                    | ...                    | ...             |
|                                   | 64Ni-29.5Mo-2Cr-2Fe-Mn-W | 2-3.7                             | B462 Gr. N10675                    | ...                    | B333 Gr. N10675 |
|                                   | 64Ni-29.5Mo-2Cr-2Fe-Mn-W | 2-3.7                             | B564 Gr. N10675                    | ...                    | ...             |

**Table 1.1-1  
List of Material Specifications (Cont'd)**

| Material Group No.                | Nominal Designation        | Pressure-Temperature Rating Table | Applicable ASTM Specifications (1) |                  |                 |
|-----------------------------------|----------------------------|-----------------------------------|------------------------------------|------------------|-----------------|
|                                   |                            |                                   | Forgings                           | Castings         | Plates          |
| <b>Group 3 Materials (Cont'd)</b> |                            |                                   |                                    |                  |                 |
| 3.8                               | 54Ni-16Mo-15Cr             | 2-3.8                             | B462 Gr. N10276                    | ...              | B575 Gr. N10276 |
|                                   | 54Ni-16Mo-15Cr             | 2-3.8                             | B564 Gr. N10276                    | ...              | ...             |
|                                   | 60Ni-22Cr-9Mo-3.5Cb        | 2-3.8                             | B564 Gr. N06625                    | ...              | B443 Gr. N06625 |
|                                   | 62Ni-28Mo-5Fe              | 2-3.8                             | ...                                | ...              | B333 Gr. N10001 |
|                                   | 70Ni-16Mo-7Cr-5Fe          | 2-3.8                             | ...                                | ...              | B434 Gr. N10003 |
|                                   | 61Ni-16Mo-16Cr             | 2-3.8                             | ...                                | ...              | B575 Gr. N06455 |
|                                   | 42Ni-21.5Cr-3Mo-2.3Cu      | 2-3.8                             | B564 Gr. N08825                    | ...              | B424 Gr. N08825 |
|                                   | 55Ni-21Cr-13.5Mo           | 2-3.8                             | B462 Gr. N06022                    | ...              | B575 Gr. N06022 |
|                                   | 55Ni-21Cr-13.5Mo           | 2-3.8                             | B564 Gr. N06022                    | ...              | ...             |
| 3.9                               | 55Ni-23Cr-16Mo-1.6Cu       | 2-3.8                             | B462 Gr. N06200                    | ...              | B575 Gr. N06200 |
|                                   | 55Ni-23Cr-16Mo-1.6Cu       | 2-3.8                             | B564 Gr. N06200                    | ...              | ...             |
| 3.9                               | 47Ni-22Cr-9Mo-18Fe         | 2-3.9                             | B572 Gr. N06002                    | ...              | B435 Gr. N06002 |
|                                   | 21Ni-30Fe-22Cr-18Co-3Mo-3W | 2-3.9                             | B572 Gr. R30556                    | ...              | B435 Gr. R30556 |
| 3.10                              | 25Ni-47Fe-21Cr-5Mo         | 2-3.10                            | ...                                | ...              | A240 Gr. N08700 |
|                                   | 25Ni-47Fe-21Cr-5Mo         | 2-3.10                            | ...                                | ...              | B599 Gr. N08700 |
| 3.11                              | 44Fe-25Ni-21Cr-Mo          | 2-3.11                            | A182 Gr. N08904                    | ...              | A240 Gr. N08904 |
| 3.12                              | 26Ni-43Fe-22Cr-5Mo         | 2-3.12                            | ...                                | ...              | B620 Gr. N08320 |
|                                   | 47Ni-22Cr-20Fe-7Mo         | 2-3.12                            | ...                                | ...              | B582 Gr. N06985 |
|                                   | 46Fe-24Ni-21Cr-6Mo-Cu-N    | 2-3.12                            | A182 Gr. N08367                    | A351 Gr. CN3MN   | A240 Gr. N08367 |
|                                   | 46Fe-24Ni-21Cr-6Mo-Cu-N    | 2-3.12                            | B462 Gr. N08367                    | ...              | B688 Gr. N08367 |
|                                   | 46Fe-24Ni-21Cr-6Mo-Cu-N    | 2-3.12                            | B564 Gr. N08367                    | ...              | ...             |
|                                   | 58Ni-33Cr-8Mo              | 2-3.12                            | B462 Gr. N06035                    | ...              | B574 Gr. N06035 |
| 3.13                              | 58Ni-33Cr-8Mo              | 2-3.12                            | B564 Gr. N06035                    | ...              | B575 Gr. N06035 |
|                                   | 49Ni-25Cr-18Fe-6Mo         | 2-3.13                            | ...                                | ...              | B582 Gr. N06975 |
|                                   | Ni-Fe-Cr-Mo-Cu-Low C       | 2-3.13                            | B564 Gr. N08031                    | ...              | B625 Gr. N08031 |
| 3.14                              | Ni-Fe-Cr-Mo-Cu-Low C       | 2-3.13                            | B462 Gr. N08031                    | ...              | ...             |
|                                   | 47Ni-22Cr-19Fe-6Mo         | 2-3.14                            | ...                                | ...              | B582 Gr. N06007 |
|                                   | 40Ni-29Cr-15Fe-5Mo         | 2-3.14                            | B462 Gr. N06030                    | ...              | B582 Gr. N06030 |
| 3.15                              | 58Ni-33Cr-8Mo              | 2-3.14                            | B564 Gr. N06035                    | ...              | ...             |
|                                   | 42Ni-33Ni-21Cr             | 2-3.15                            | A182 Gr. N08810                    | ...              | A240 Gr. N08810 |
|                                   | 42Ni-33Ni-21Cr             | 2-3.15                            | B564 Gr. N08810                    | ...              | B409 Gr. N08810 |
|                                   | 62Ni-28Mo-5Fe              | 2-3.15                            | ...                                | A494 Gr. N-12MW  | ...             |
| 3.16                              | 53Ni-17Mo-16Cr-6Fe-5W      | 2-3.15                            | ...                                | A494 Gr. CW-12MW | ...             |
|                                   | 35Ni-19Cr-1¼Si             | 2-3.16                            | B511 Gr. N08330                    | ...              | B536 Gr. N08330 |
| 3.17                              | 29Ni-20.5Cr-3.5Cu-2.5Mo    | 2-3.17                            | ...                                | A351 Gr. CN7M    | ...             |
| 3.19                              | 57Ni-22Cr-14W-2Mo-La       | 2-3.19                            | B564 Gr. N06230                    | ...              | B435 Gr. N06230 |

## GENERAL NOTES:

(a) For temperature limitations, see notes in [Tables 2-1.1C](#) through [2-3.17C](#).(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.

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, Nonmandatory Appendix F and in the ASME Boiler and Pressure Vessel Code, Section II, Part D, Nonmandatory Appendix A and Section III, Division 1, Nonmandatory Appendix W.

(25) **5.1.2 Toughness.** Some of the materials listed in [Table 1.1-1](#) undergo a decrease in toughness when used at low temperatures, to the extent that Codes referencing this Standard may require impact tests for application even at the ambient temperature. It is the responsibility of the user to ensure that such testing is performed. See [para. 2.5.3](#).

**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°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 [2-3.19](#) ([Tables 2-1.1C](#) through [2-3.19C](#)).

**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 1.1-2](#) 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 A193 Grade B7 are listed as high strength in [Table 1.1-2](#). 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 1.1-2](#), and other bolting of comparable strength, may be used in any flanged joint provided the user verifies their ability to seat the selected gasket and maintain a sealed joint under expected operating conditions.

**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 1.1-2](#). These materials and others of comparable strength are to be used only in Class 150 and 300 flanged joints (see [para. 5.4.2](#) and [Nonmandatory Appendix B](#)).

**5.3.5 Bolting to Gray Cast Iron Flanges.** The following recommendations are made in recognition of the low ductility of gray cast iron: (25)

(a) Alignment of flange faces is essential, along with control of assembly bolt torque, so as not to overstress the cast iron flanges. Care should also be exercised to ensure that piping loads transmitted to cast iron flanges are controlled, taking into account cast iron's 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. Ia 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. Ia 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 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](#).

**Table 1.1-2  
List of Bolting Specifications: Applicable ASTM Specifications**

(25)

| Bolting Materials (1) |       |       |                           |            |       |                  |           |       |                              |        |         |
|-----------------------|-------|-------|---------------------------|------------|-------|------------------|-----------|-------|------------------------------|--------|---------|
| High Strength (2)     |       |       | Intermediate Strength (3) |            |       | Low Strength (4) |           |       | Nickel and Special Alloy (5) |        |         |
| Spec. No.             | Grade | Notes | Spec. No.                 | Grade      | Notes | Spec. No.        | Grade     | Notes | Spec. No.                    | Grade  | Notes   |
| A193                  | B7    | ...   | A193                      | B5         | ...   | A193             | B8 Cl. 1  | (6)   | B164                         | ...    | (7)-(9) |
| A193                  | B16   | ...   | A193                      | B6         | ...   | A193             | B8C Cl. 1 | (6)   | ...                          | ...    | ...     |
|                       |       | ...   | A193                      | B6X        | ...   | A193             | B8M Cl. 1 | (6)   | B166                         | ...    | (7)-(9) |
| A320                  | L7    | (10)  | A193                      | B7M        | ...   | A193             | B8T Cl. 1 | (6)   | ...                          | ...    | ...     |
| A320                  | L7A   | (10)  |                           |            |       |                  |           |       |                              |        |         |
| A320                  | L7B   | (10)  | A193                      | B8 Cl. 2   | (11)  | A193             | B8A       | (6)   | B335                         | N10665 | (7)     |
|                       |       |       |                           |            |       |                  |           |       |                              | N10675 | (7)     |
|                       |       |       | A193                      | B8 Cl. 2B  | (11)  |                  |           |       |                              |        |         |
| A320                  | L7C   | (10)  | A193                      | B8C Cl. 2  | (11)  | A193             | B8CA      | ...   |                              |        |         |
| A320                  | L43   | (10)  | A193                      | B8M Cl. 2  | (11)  | A193             | B8MA      | ...   | B408                         | ...    | (7)-(9) |
|                       |       |       | A193                      | B8M Cl. 2B | (11)  |                  |           |       |                              |        |         |
|                       |       |       | A193                      | B8T Cl. 2  | (11)  | A193             | B8TA      | (6)   |                              |        |         |
| A354                  | BC    | ...   | A320                      | L7M        | (10)  |                  |           |       | B473                         | ...    | (7)     |
| A354                  | BD    | ...   | A320                      | B8 Cl. 2   | (11)  | A307             | B         | ...   | B511                         | N08830 | (7)     |
|                       |       |       | A320                      | B8C Cl. 2  | (11)  |                  |           |       | B574                         | ...    | (7)     |
| A540                  | B21   | ...   | A320                      | B8F Cl. 2  | (11)  | A320             | B8 Cl. 1  | (6)   | B572                         | N06230 | (7)     |
| A540                  | B22   | ...   | A320                      | B8M Cl. 2  | (11)  | A320             | B8C Cl. 1 | (6)   | B637                         | N07740 | (7)     |
| A540                  | B23   | ...   | A320                      | B8T Cl. 2  | (11)  | A320             | B8M Cl. 1 | (6)   | B637                         | N07718 | (7)     |
| A540                  | B24   | ...   |                           |            |       | A320             | B8T Cl. 1 | (6)   |                              |        |         |
|                       |       |       | A449                      |            | (12)  |                  |           |       |                              |        |         |
|                       |       |       | A453                      | 651        | (13)  |                  |           |       |                              |        |         |
|                       |       |       | A453                      | 660        | (13)  |                  |           |       |                              |        |         |

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 A194 nuts of a compatible material.
- (7) Nuts may be machined from the same material or of a compatible grade of ASTM A194.
- (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 who heats or works these parts last 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 A194 Gr. 4 or Gr. 7 nuts. For A320-L7M bolting use A194 Grs. 7M or 2HM nuts.
- (11) This austenitic stainless material has been carbide solution treated and strain hardened. Use A194 nuts of a compatible material.
- (12) Acceptable nuts for use with quenched and tempered bolts are A194 Gr. 2 or Gr. 2H. Mechanical property requirements for studs shall be the same as those for bolts.
- (13) This special alloy is intended for high-temperature service with austenitic stainless steel.

**5.4.2 Gaskets for Low-Strength Bolting.** If bolting listed as low strength in [Table 1.1-2](#) 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

(25) **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 9C](#) and [12C](#)), 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 shall 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 9C](#) and [12C](#)).

**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 combina-

tions 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 [Figure 6](#) 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 6](#) shows dimensional relationships for various flange types and pipe lap facings to be used with lap joints. [Table 4](#) ([Table 4C](#)) lists dimensions for facings other than ring joint. [Table 5](#) ([Table 5C](#)) lists dimensions for ring joint facings. Classes 150 and 300 pipe flanges and companion flanges of fittings are regularly furnished with 1.5 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 6.4 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 8C, 11C, 14C, 16C, 18C, 20C, and 22C](#)). Lap joint stub ends shall be in accordance with [Figure 6](#) 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 6.4 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 5C](#)), 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 4C](#)). 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 9C and 12C](#)) 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 9C and 12C](#)). Machining of the depressed center is not required.

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

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

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

**6.4.5.3 Other Flange Facings.** Either a serrated concentric or serrated spiral finish having a resultant surface finish from 3.2  $\mu\text{m}$  to 6.3  $\mu\text{m}$  (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 3C](#)). 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 8C, 9C, 11C, 12C, 14C, 16C, 18C, 20C, and 22C](#)). Spot facing or back facing shall be in accordance with MSS SP-9.

## 6.7 Welding Neck Flanges Hub and Welding End Profiles

**6.7.1 Welding End Profiles.** Welding end profiles are illustrated in [Figures 1 through 3](#) and [Figures 7 through 10](#). Other welding end profiles furnished by agreement between the purchaser and manufacturer shall not invalidate compliance with this Standard.

**6.7.2 Hubs.** Acceptable profiles of the hub from the welding end to the back of the flange are shown in [Figures 1, 3, 7, and 8](#).

**6.7.3 Bores.** Straight-through bores shown in [Figures 7 and 8](#) are required unless the special conditions illustrated in [Figures 2, 3, 9, and 10](#) are furnished by agreement between the purchaser and manufacturer.

## 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 \(Table 6C\)](#).

**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 [Figure 6](#), Note (3) and [Table 4 \(Table 4C\)](#), Note (1), 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 \(Tables 8C, 9C, 11C, 12C, 14C, 16C, 18C, 20C, and 22C\)](#). Threads do not necessarily extend to the face of the flange. See [Table 6 \(Table 6C\)](#) for reducing threaded flanges.

**6.9.5 Thread Gaging.** Internal threads of flanges shall be checked with gages having a gaging notch. Variations in threading shall be limited to one turn large or one turn small from the gaging notch when using working gages. The reference point for chamfered thread (Class 150) gaging is the starting end of the threaded flange, provided the thread chamfer does not exceed the major diameter of

the internal thread. When a chamfer on the internal thread exceeds this limit, the reference point becomes the last thread scratch on this chamfer cone. The reference point for counterbored thread (Classes 300 through 2500) gaging shall be the last thread scratch on the chamfer cone.

**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 1.1-3](#). 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 \(Tables 7C, 10C, 13C, 15C, 17C, 19C, and 21C\)](#). 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 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 [Figure 6](#).

**Table 1.1-3  
Flange Bolting Dimensional Recommendations**

| Product                               | Carbon Steel                           | Alloy Steel   |
|---------------------------------------|--|---|
| Stud bolts                            | ASME B18.31.2                          | ASME B18.31.2   |
| Bolts smaller than 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 3/4 in. | ASME B18.2.1, square or heavy hex head | ASME B18.2.1, heavy hex head  |
| Nuts smaller than 3/4 in.             | ASME B18.2.2, heavy hex                | ASME B18.2.2, heavy hex   |
| Nuts equal to or larger than 3/4 in.  | ASME B18.2.2, hex or heavy hex         | ASME B18.2.2, heavy hex   |
| External threads                      | ASME B1.1, Cl. 2A coarse series        | ASME B1.1, Cl. 2A coarse series up through 1 in.;<br>eight thread series for larger bolts |
| Internal threads                      | ASME B1.1, Cl. 2B coarse series        | ASME B1.1, Cl. 2B coarse series up through 1 in.;<br>eight thread series for larger bolts |

**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 the ASME Boiler and Pressure Vessel Code, Section IX.

**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 Figure 11. 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 Figure 12. Where the wall thickness is insufficient, or the size of the connection requires opening reinforcement, a boss shall be added (see Figure 13).

**6.12.4 Butt Welding.** Connections may be attached by butt welding directly to the wall of the fitting (see Figure 14). 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 Figure 13, and the height shall provide lengths as specified in Figure 11 or Figure 12.

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

| Fitting Size | Connection Size (NPS) |
|--------------|-----------------------|
| 2 ≤ NPS ≤ 4  | 1/2                   |
| 5 ≤ NPS ≤ 8  | 3/4                   |
| NPS ≥ 10     | 1                     |

**6.12.7 Designating Locations.** The designation of locations for auxiliary connections for flanged fittings is shown in Figure 15. 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 E29. 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, mm (in.) |
|----------|---------------------|
| NPS ≤ 10 | ±1.0 (±0.04)        |
| NPS ≥ 12 | ±1.5 (±0.06)        |

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

| Size     | Tolerance, mm (in.) |
|----------|---------------------|
| NPS ≤ 10 | ±1.0 (±0.04)        |
| NPS ≥ 12 | ±1.5 (±0.06)        |

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

| Size     | Tolerance, mm (in.) |
|----------|---------------------|
| NPS ≤ 10 | ±2.0 (±0.08)        |
| NPS ≥ 12 | ±3.0 (±0.12)        |

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

| Size     | Tolerance, mm (in.) |
|----------|---------------------|
| NPS ≤ 10 | ±2.0 (±0.08)        |
| NPS ≥ 12 | ±3.0 (±0.12)        |

(25) **7.3 Facings**

**7.3.1 Flanges and Flanged Fittings.** Tolerances that apply to both flange and flanged fitting facings are as follows:

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

(b) Outside diameter, 1.5 mm (0.06 in.) raised face,  $\pm 1.0$  mm ( $\pm 0.04$  in.).

(c) Outside diameter, 6.4 mm (0.25 in.) raised face,  $\pm 0.5$  mm ( $\pm 0.02$  in.).

(d) Ring joint groove tolerances are shown in Table 5 (Table 5C).

**7.3.2 Flanges.** Tolerances that apply to flanges are as follows:

Perpendicularity of the face with the bore

| Size         | Tolerance, deg |
|--------------|----------------|
| NPS $\leq$ 5 | 1              |
| NPS $\geq$ 6 | 0.5            |

**7.4 Flange Thickness**

Required tolerances for flange thickness are as follows:

| Size          | Tolerance, mm (in.)       |
|---------------|---------------------------|
| NPS $\leq$ 18 | +3.0, -0.0 (+0.12, -0.00) |
| NPS $\geq$ 20 | +5.0, -0.0 (+0.20, -0.00) |

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 Figures 7 and 8 of welding ends of welding neck flanges are as follows:

| Size         | Tolerance, mm (in.)       |
|--------------|---------------------------|
| NPS $\leq$ 5 | +2.0, -1.0 (+0.08, -0.04) |
| NPS $\geq$ 6 | +4.0, -1.0 (+0.16, -0.04) |

**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 Figures 4, 7, and 8, the tolerances are

| Size                    | Tolerance, mm (in.)       |
|-------------------------|---------------------------|
| NPS $\leq$ 10           | $\pm 1.0$ ( $\pm 0.04$ )  |
| 12 $\leq$ NPS $\leq$ 18 | $\pm 1.5$ ( $\pm 0.06$ )  |
| NPS $\geq$ 20           | +3.0, -1.5 (+0.12, -0.06) |

(b) For Figure 9, the tolerances are

| Size          | Tolerance, mm (in.)      |
|---------------|--------------------------|
| NPS $\leq$ 10 | +0.0, -1.0 (+0.0, -0.04) |
| NPS $\geq$ 12 | +0.0, -1.5 (+0.0, -0.06) |

**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 Figures 9 and 10 are as follows:

| Size                   | Tolerance, mm (in.)       |
|------------------------|---------------------------|
| 2 $\leq$ NPS $\leq$ 24 | +0.25, -0.0 (+0.01, -0.0) |

**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, mm (in.)       |
|------------------------|---------------------------|
| NPS $\leq$ 4           | $\pm 1.5$ ( $\pm 0.06$ )  |
| 5 $\leq$ NPS $\leq$ 10 | +1.5, -3.0 (+0.06, -0.12) |
| NPS $\geq$ 12          | +3.0, -5.0 (+0.12, -0.20) |

**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, mm (in.)      |
|---------------|--------------------------|
| NPS $\leq$ 10 | +1.0, -0.0 (+0.04, -0.0) |
| NPS $\geq$ 12 | +1.5, -0.0 (+0.06, -0.0) |

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

| Size          | Tolerance, mm (in.)      |
|---------------|--------------------------|
| NPS $\leq$ 10 | +1.0, -0.0 (+0.04, -0.0) |
| NPS $\geq$ 12 | +1.5, -0.0 (+0.06, -0.0) |

**7.7.3 Counterbores, Socket Welding Flanges.** The required tolerance for socket end counterbores is as follows:

| Size                  | Tolerance, mm (in.)        |
|-----------------------|----------------------------|
| ½ $\leq$ NPS $\leq$ 3 | $\pm 0.25$ ( $\pm 0.010$ ) |

**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 machine facing diameters are as follows:

| Size                    | Tolerance, mm (in.) |
|-------------------------|---------------------|
| NPS $\leq 2\frac{1}{2}$ | 0.8 (0.03)          |
| NPS $\geq 3$            | 1.5 (0.06)          |

**8 PRESSURE TESTING**

(25) **8.1 Flange Test**

Flanges are not required to be pressure tested by the manufacturer. Flanges are tested as part of the system pressure test when required by the applicable code or regulation.

**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).

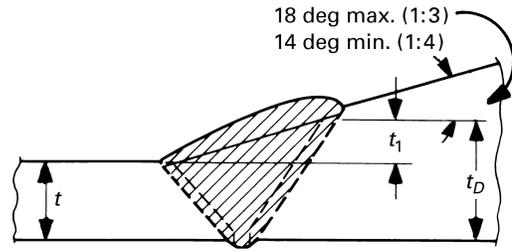
**8.2.4 Test Duration.** The test duration shall be as follows:

| Fitting Size                          | Duration, sec |
|---------------------------------------|---------------|
| NPS $\leq 2$                          | 60            |
| $2\frac{1}{2} \leq \text{NPS} \leq 8$ | 120           |
| NPS $\geq 10$                         | 180           |

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

**Figure 1  
Bevel for Outside Thickness**

(25)



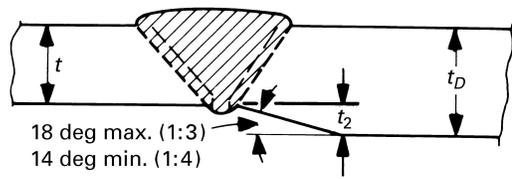
**Welding Ends  
(Welding Neck Flanges)  
Additional Thickness for  
Welding to Higher Strength Pipe**

GENERAL NOTES:

- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b)  $t_1$ , shall not exceed  $0.5t$ .
- (c) 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.
- (d) Welding shall be in accordance with the applicable code.

**Figure 2  
Bevel for Inside Thickness**

(25)

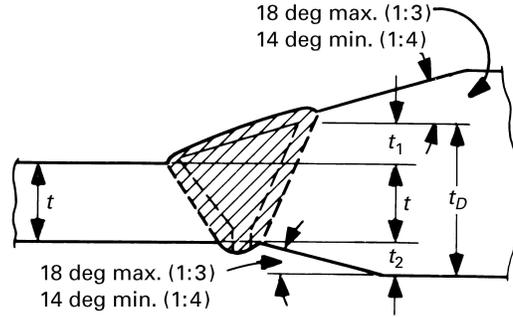


**Welding Ends  
(Welding Neck Flanges)  
Additional Thickness for  
Welding to Higher Strength Pipe**

GENERAL NOTES:

- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b)  $t_2$ , shall not exceed  $0.5t$ .
- (c) 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.
- (d) Welding shall be in accordance with the applicable code.

**Figure 3**  
**Bevel for Combined Thickness**

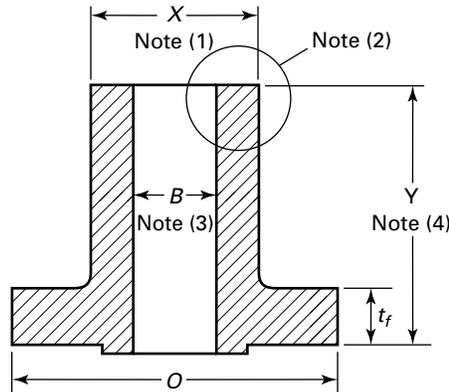


**Welding Ends**  
**(Welding Neck Flanges)**  
**Additional Thickness for**  
**Welding to Higher Strength Pipe**

GENERAL NOTES:

- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b) Neither  $t_1$  or  $t_2$ , nor their sum  $t_1 + t_2$ , shall exceed  $0.5t$ .
- (c) 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.
- (d) Welding shall be in accordance with the applicable code.

**Figure 4**  
**Straight Hub Welding Flanges**



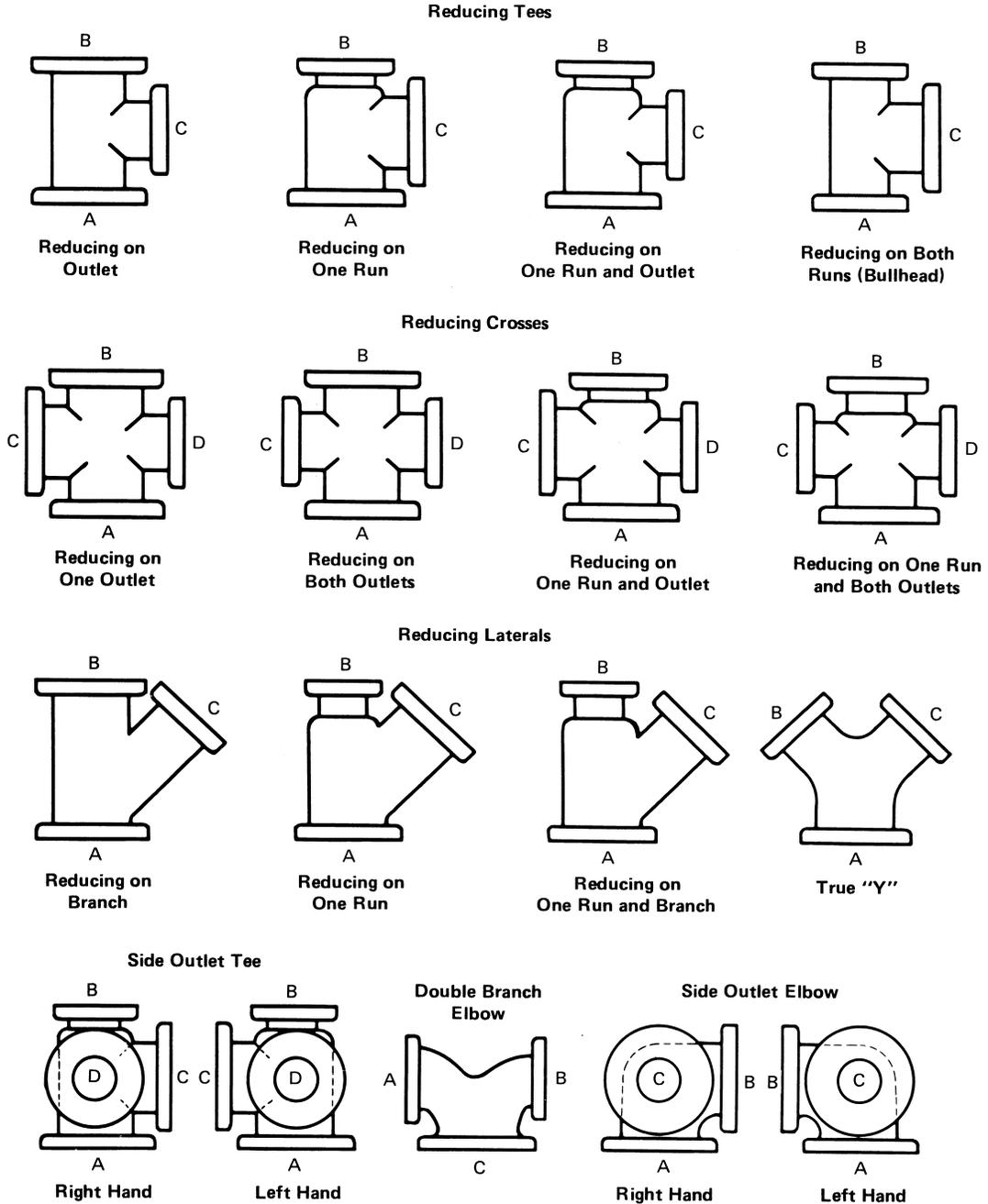
GENERAL NOTES:

- (a)  $O$  = outside diameter of flange (see para. 2.8)
- (b)  $t_f$  = minimum thickness of flange (see para. 2.8)

NOTES:

- (1)  $X$  = diameter of hub (see para. 2.8). Tolerance +3.0 mm, -0.0 mm (+0.12 in., -0.00 in.).
- (2) Hub end (see para. 2.8.4).
- (3)  $B$  = bore (see paras. 2.8.3 and 7.5.2).
- (4)  $Y$  = length through hub (see para. 2.8.2).

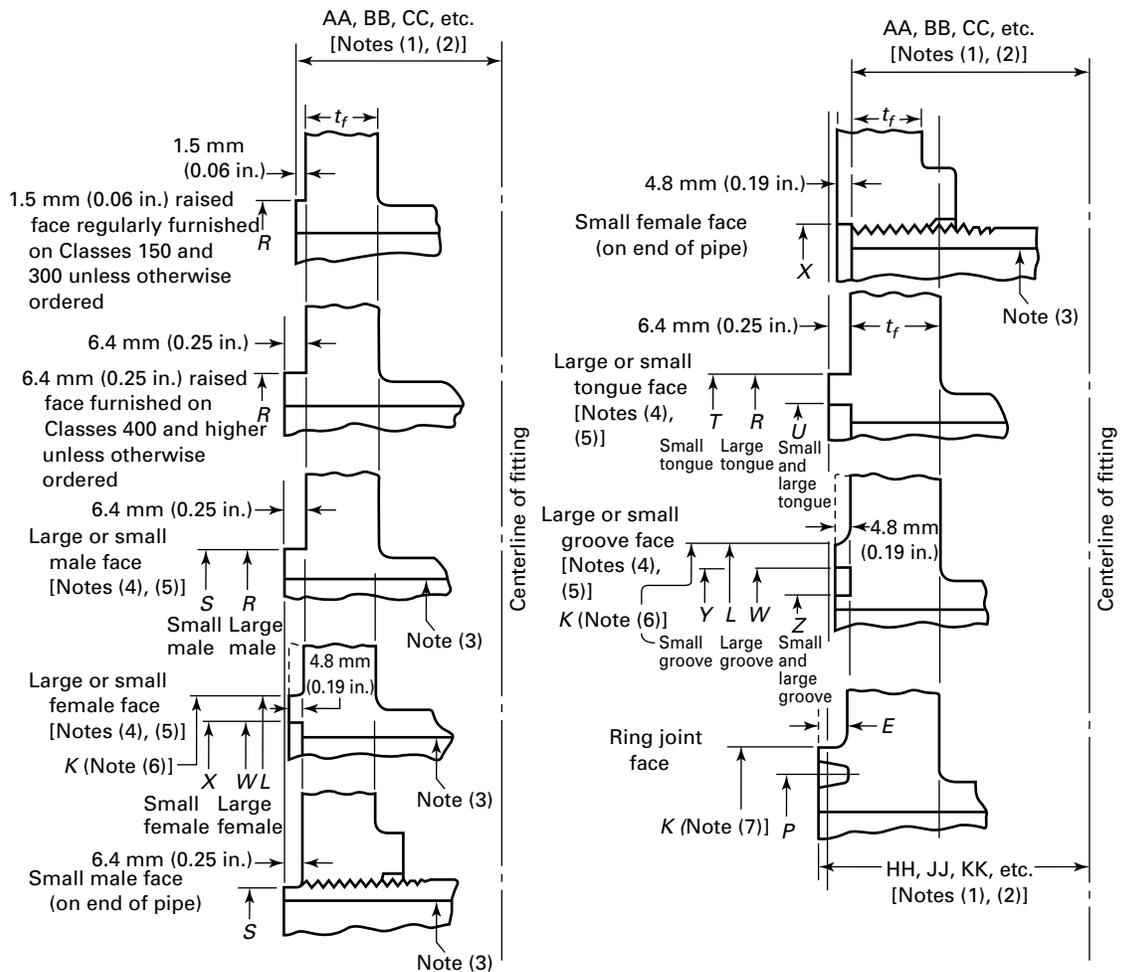
**Figure 5  
Method of Designating Outlets of Reducing Fittings in Specifications  
(Flanged Fittings)**



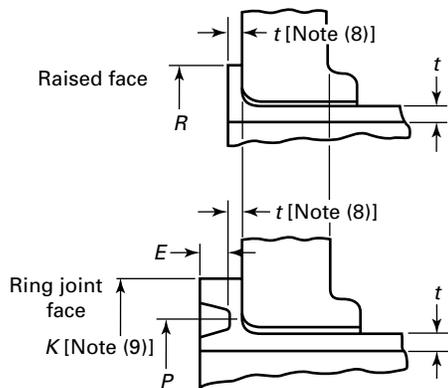
**GENERAL NOTES:**

- (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](#)).

**Figure 6**  
**End Flange Facings and Their Relationship to Flange Thickness and**  
**Center-to-End and End-to-End Dimensions**



**End Flange Facings**  
**Flange Thickness and Center-to-End Dimensions**  
**Classes 150 through 2500**



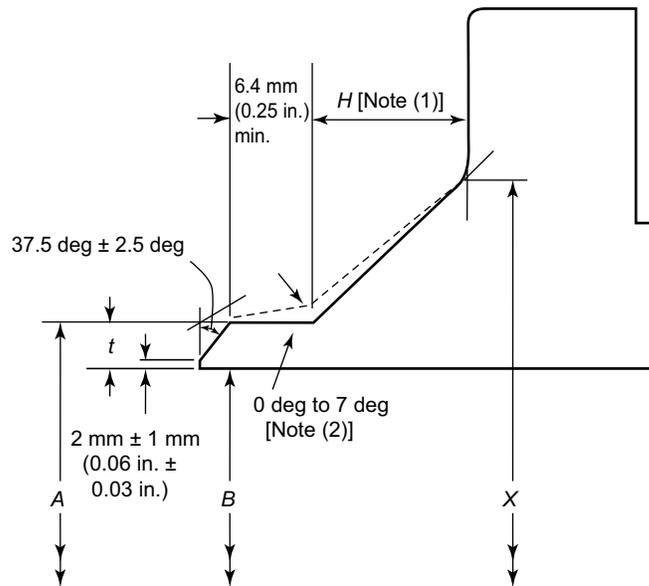
**Lap Joint Stub End**  
**Facings and Thickness**  
**Lapped Joints**

**Figure 6**  
**End Flange Facings and Their Relationship to Flange Thickness and**  
**Center-to-End and End-to-End Dimensions (Cont'd)**

NOTES:

- (1) See [paras. 6.2](#) and [6.4](#).
- (2) See [Tables 7](#) through [22](#) ([Tables 7C](#) through [22C](#)).
- (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 \(Table 4C\)](#)]. 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 \(Table 4C\)](#) for dimensions of facings (other than ring joint) and [Table 5 \(Table 5C\)](#) 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 \(Table 4C\)](#).
- (7) See [Table 5 \(Table 5C\)](#).
- (8) See [para. 6.4.3](#).
- (9) See [para. 6.4.3.5](#) and [Table 5 \(Table 5C\)](#).

**Figure 7**  
**Welding Neck Flange Hub and Welding End Profiles for Wall Thicknesses  $t$**   
**From 5 mm (0.19 in.) to 22 mm (0.88 in.)**



Welding Ends (Welding Neck Flanges, No Backing Rings)

$A$  = nominal outside diameter of pipe

$B$  = nominal inside diameter of pipe

$H$  = hub height

$t$  = nominal wall thickness of pipe

$x$  = diameter of hub (see dimensional tables)

GENERAL NOTES:

(a) See paras. 6.7, 6.8, and 7.4 for details and tolerances.

(b) See Figures 9 and 10 for additional details of welding ends.

(c) 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 Figures 1 through 3).

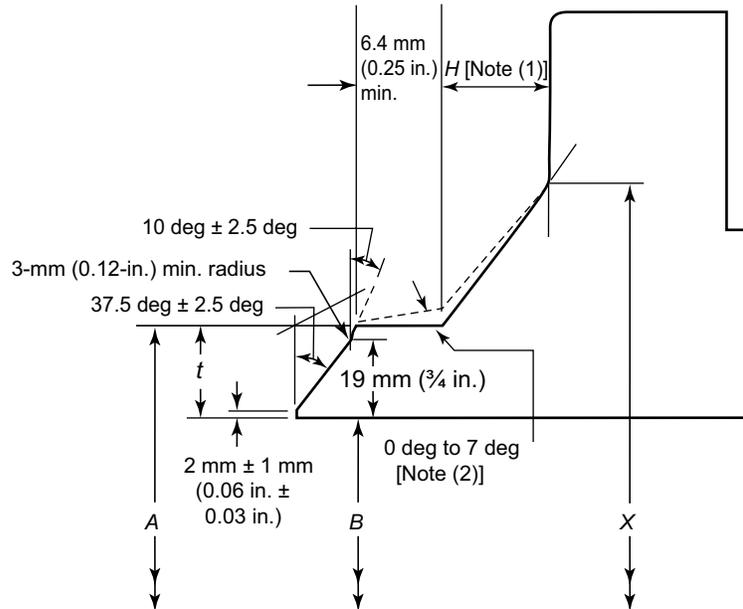
(d) For welding end dimensions, refer to ASME B16.25.

NOTES:

(1) The minimum hub height,  $H$ , shall be  $2(Y - t)/3$

(2) For manufacturing purposes, the straight turn from the bevel is permitted to have a taper with the angle not exceeding 7 deg.

**Figure 8**  
**Welding Neck Flange Hub and Welding End Profiles for Wall Thicknesses  $t$  Greater Than 22 mm (0.88 in.)** (25)



Welding Ends (Welding Neck Flanges, No Backing Rings)

$A$  = nominal outside diameter of pipe

$B$  = nominal inside diameter of pipe

$H$  = hub height

$t$  = nominal wall thickness of pipe

$x$  = diameter of hub (see dimensional tables)

GENERAL NOTES:

(a) See paras. 6.7, 6.8, and 7.4 for details and tolerances.

(b) See Figures 9 and 10 for additional details of welding ends.

(c) 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 Figures 1 through 3).

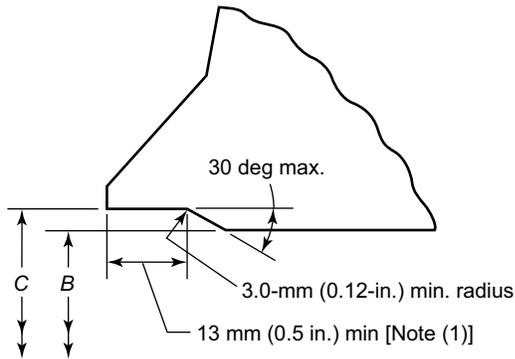
(d) For welding end dimensions, refer to ASME B16.25.

NOTES:

(1) The minimum hub height,  $H$ , shall be  $2(Y - t)/3$

(2) For manufacturing purposes, the straight turn from the bevel is permitted to have a taper with the angle not exceeding 7 deg.

**Figure 9**  
**Inside Contour for Use With Rectangular Backing Ring**



Welding Ends (Welding Neck Flanges)

(SI Units)

$A$  = 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 A106, etc.

$1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A106, etc.) multiplied by two to convert into terms of diameter

0.25 mm = plus tolerance on diameter  $C$ , mm (see [para. 7.5.3](#))

(U.S. Customary Units)

$A$  = 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 A106, etc.

$1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A106, etc.) multiplied by two to convert into terms of diameter

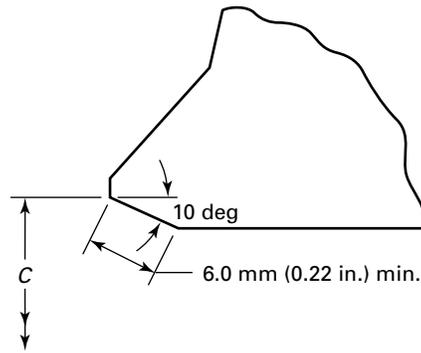
0.010 in. = plus tolerance on diameter  $C$ , in. (see [para. 7.5.3](#))

GENERAL NOTES:

- (a) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (b) See [Figures 7 and 8](#) for welding end details of welding neck flanges.
- (c) For dimensions, see ASME B16.25.

NOTE: (1) 13-mm (0.5-in.) depth based on use of 19-mm (0.75-in.) wide backing ring.

**Figure 10**  
**Inside Contour for Use With Taper Backing Ring**



Welding Ends (Welding Neck Flanges)

(SI Units)

$A$  = 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 A106, etc.

$1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A106, etc.) multiplied by two to convert into terms of diameter

0.25 mm = plus tolerance on diameter  $C$ , mm (see [para. 7.5.3](#))

(U.S. Customary Units)

$A$  = 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 A106, etc.

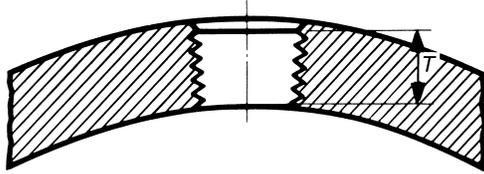
$1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A106, etc.) multiplied by two to convert into terms of diameter

0.010 in. = plus tolerance on diameter  $C$ , in. (see [para. 7.5.3](#))

GENERAL NOTES:

- (a) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (b) See [Figures 7 and 8](#) for welding end details of welding neck flanges.
- (c) For dimensions, see ASME B16.25.

**Figure 11**  
**Thread Length for Connection Tapping**

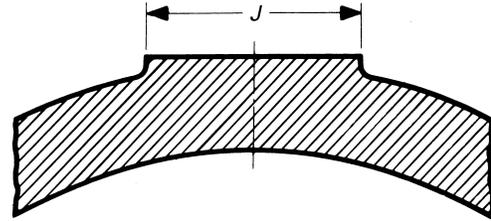


| Connection Size, NPS | Thread Length, <i>T</i> , mm (in.) [Note (1)] |
|----------------------|---|
| 3/8                  | 10.4 (0.41)                                   |
| 1/2                  | 13.5 (0.53)                                   |
| 3/4                  | 14.0 (0.55)                                   |
| 1                    | 17.3 (0.68)                                   |
| 1 1/4                | 18.0 (0.71)                                   |
| 1 1/2                | 18.3 (0.72)                                   |
| 2                    | 19.3 (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).

**Figure 13**  
**Bosses for Connections**

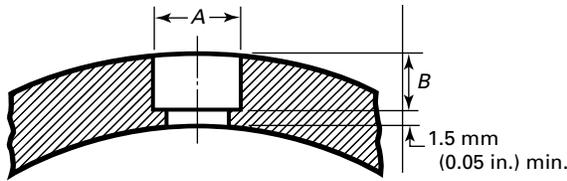


| Connection Size, NPS | Minimum Boss Diameter, <i>J</i> , mm (in.) |
|----------------------|--|
| 3/8                  | 31.8 (1.25)                                |
| 1/2                  | 38.1 (1.50)                                |
| 3/4                  | 44.4 (1.75)                                |
| 1                    | 53.8 (2.12)                                |
| 1 1/4                | 63.5 (2.50)                                |
| 1 1/2                | 69.8 (2.75)                                |
| 2                    | 85.9 (3.38)                                |

GENERAL NOTE: See para. 6.12.5.

**Figure 12**  
**Socket Welding for Connections**

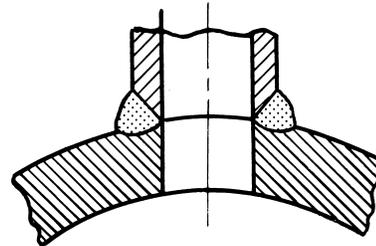
(25)



| Connection Size, NPS | Minimum Diameter of Socket, <i>A</i> , mm (in.) | Minimum Depth, <i>B</i> , mm (in.) |
|----------------------|---|------------------------------------|
| 3/8                  | 17.5 (0.69)                                     | 4.8 (0.19)                         |
| 1/2                  | 21.8 (0.86)                                     | 4.8 (0.19)                         |
| 3/4                  | 26.9 (1.06)                                     | 6.4 (0.25)                         |
| 1                    | 33.8 (1.33)                                     | 6.4 (0.25)                         |
| 1 1/4                | 42.7 (1.68)                                     | 6.4 (0.25)                         |
| 1 1/2                | 48.8 (1.92)                                     | 6.4 (0.25)                         |
| 2                    | 61.2 (2.41)                                     | 7.9 (0.31)                         |

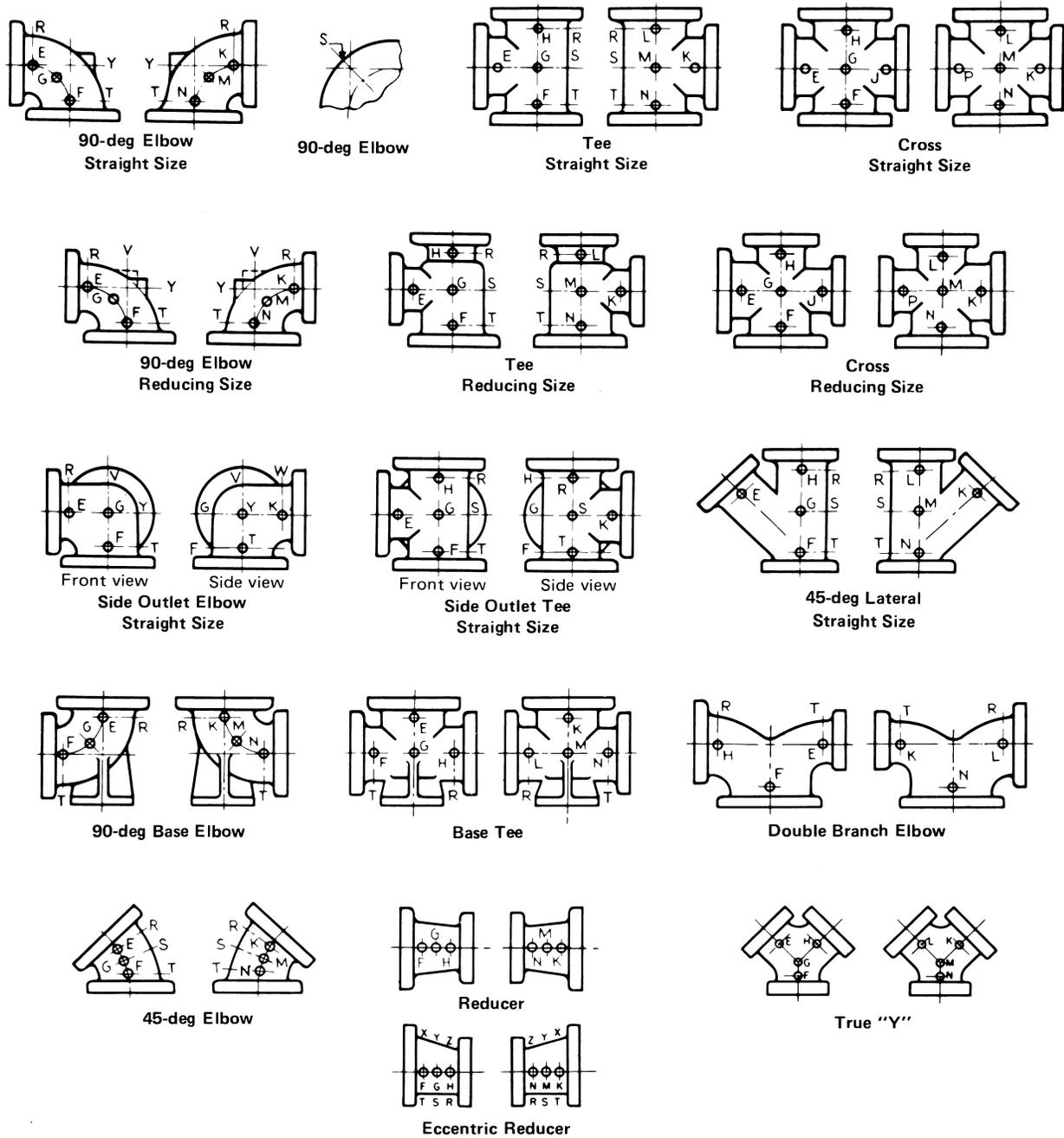
GENERAL NOTE: See paras. 6.12.3, 6.12.5, and 6.12.6.

**Figure 14**  
**Butt Welding for Connections**



GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

**Figure 15**  
**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).

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

(25)

| Nominal Designation              | Forgings               | Castings         | Plates               |
|----------------------------------|------------------------|------------------|----------------------|
| C–Si                             | A105 (1), (2)          | A216 Gr. WCB (1) | A515 Gr. 70 (1)      |
| C–Mn–Si                          | A350 Gr. LF2 (1)       | ...              | A516 Gr. 70 (1), (3) |
| C–Mn–Si                          | ...                    | ...              | A537 Cl. 1 (4)       |
| C–Mn–Si–V                        | A350 Gr. LF6 Cl. 1 (3) | ...              | ...                  |
| 3 <sup>1</sup> / <sub>2</sub> Ni | A350 Gr. LF3 (5)       | ...              | ...                  |

| Working Pressures by Classes, bar |       |      |      |       |       |       |       |
|-----------------------------------|-------|------|------|-------|-------|-------|-------|
| Temp., °C                         | Class |      |      |       |       |       |       |
|                                   | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (6)]             | 19.6  | 51.0 | 68.0 | 102.0 | 153.1 | 255.1 | 425.1 |
| 50                                | 19.1  | 49.8 | 66.4 | 99.6  | 149.3 | 248.9 | 414.9 |
| 100                               | 17.7  | 46.7 | 62.3 | 93.4  | 140.1 | 233.5 | 389.1 |
| 150                               | 15.8  | 45.1 | 60.1 | 90.1  | 135.2 | 225.3 | 375.4 |
| 200                               | 13.8  | 43.8 | 58.4 | 87.6  | 131.5 | 219.1 | 365.1 |
| 250                               | 12.1  | 42.0 | 56.0 | 83.9  | 125.9 | 209.8 | 349.7 |
| 300                               | 10.2  | 39.9 | 53.2 | 79.8  | 119.7 | 199.5 | 332.6 |
| 325                               | 9.3   | 38.7 | 51.6 | 77.3  | 116.0 | 193.4 | 322.3 |
| 350                               | 8.4   | 37.6 | 50.2 | 75.3  | 112.9 | 188.2 | 313.7 |
| 375                               | 7.4   | 36.4 | 48.5 | 72.8  | 109.2 | 182.1 | 303.4 |
| 400                               | 6.5   | 34.6 | 46.2 | 69.3  | 103.9 | 173.1 | 288.6 |
| 425                               | 5.5   | 28.7 | 38.3 | 57.5  | 86.2  | 143.7 | 239.4 |
| 450                               | 4.6   | 23.0 | 30.6 | 45.9  | 68.9  | 114.9 | 191.4 |
| 475                               | 3.7   | 17.5 | 23.3 | 35.0  | 52.5  | 87.4  | 145.7 |
| 500                               | 2.8   | 11.5 | 15.4 | 23.0  | 34.6  | 57.6  | 96.0  |
| 538                               | 1.4   | 5.8  | 7.7  | 11.6  | 17.4  | 29.0  | 48.4  |

NOTES:

- (1) Prolonged use above 427°C is permissible but not recommended. Prolonged exposure above 427°C may cause the carbide phase of steel to convert to graphite.
- (2) Only killed steel shall be used above 455°C.
- (3) Not to be used over 260°C.
- (4) Not to be used over 371°C.
- (5) Not to be used over 343°C.
- (6) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.1C**  
**Pressure–Temperature Ratings for Group 1.1 Materials — U.S. Customary Units**

| Nominal Designation              | Forgings               | Castings         | Plates               |
|----------------------------------|------------------------|------------------|----------------------|
| C–Si                             | A105 (1), (2)          | A216 Gr. WCB (1) | A515 Gr. 70 (1)      |
| C–Mn–Si                          | A350 Gr. LF2 (1)       | ...              | A516 Gr. 70 (1), (3) |
| C–Mn–Si                          | ...                    | ...              | A537 Cl. 1 (4)       |
| C–Mn–Si–V                        | A350 Gr. LF6 Cl. 1 (3) | ...              | ...                  |
| 3 <sup>1</sup> / <sub>2</sub> Ni | A350 Gr. LF3 (5)       | ...              | ...                  |

| Working Pressures by Classes, psig |       |     |     |       |       |       |       |
|------------------------------------|-------|-----|-----|-------|-------|-------|-------|
| Temp., °F                          | Class |     |     |       |       |       |       |
|                                    | 150   | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (6)]             | 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) Prolonged use above 800°F is permissible but not recommended. Prolonged exposure above 800°F may cause the carbide phase of steel to convert to graphite.
- (2) Only killed steel shall be used above 850°F.
- (3) Not to be used over 500°F.
- (4) Not to be used over 700°F.
- (5) Not to be used over 650°F.
- (6) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation | Forgings              | Castings         | Plates         |
|---------------------|-----------------------|------------------|----------------|
| C–Mn–Si             | ...                   | A216 Gr. WCC (1) | ...            |
| C–Mn–Si             | ...                   | A352 Gr. LCC (2) | ...            |
| C–Mn–Si–V           | A350 Gr. LF6 Cl.2 (3) | ...              | ...            |
| 2½Ni                | ...                   | A352 Gr. LC2 (4) | A203 Gr. B (1) |
| 3½Ni                | ...                   | A352 Gr. LC3 (4) | A203 Gr. E (1) |

| Working Pressures by Classes, bar |       |      |      |       |       |       |       |
|-----------------------------------|-------|------|------|-------|-------|-------|-------|
| Temp., °C                         | Class |      |      |       |       |       |       |
|                                   | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (5)]             | 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 | 66.9 | 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 | 61.8 | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2  | 43.6 | 58.1 | 87.2  | 130.8 | 218.1 | 363.4 |
| 325                               | 9.3   | 42.0 | 56.0 | 83.9  | 125.9 | 209.8 | 349.7 |
| 350                               | 8.4   | 40.1 | 53.5 | 80.2  | 120.3 | 200.6 | 334.3 |
| 375                               | 7.4   | 38.1 | 50.7 | 76.1  | 114.2 | 190.3 | 317.1 |
| 400                               | 6.5   | 34.6 | 46.2 | 69.3  | 103.9 | 173.1 | 288.6 |
| 425                               | 5.5   | 28.7 | 38.3 | 57.5  | 86.2  | 143.7 | 239.4 |
| 450                               | 4.6   | 23.0 | 30.6 | 45.9  | 68.9  | 114.9 | 191.4 |
| 475                               | 3.7   | 16.9 | 22.6 | 33.9  | 50.8  | 84.7  | 141.1 |
| 500                               | 2.8   | 11.5 | 15.4 | 23.0  | 34.6  | 57.6  | 96.0  |
| 538                               | 1.4   | 5.8  | 7.7  | 11.6  | 17.4  | 29.0  | 48.4  |

## NOTES:

- (1) Prolonged use above 427°C is permissible but not recommended. Prolonged exposure above 427°C may cause the carbide phase of steel to convert to graphite.
- (2) Not to be used over 371°C.
- (3) Not to be used over 260°C.
- (4) Not to be used over 343°C.
- (5) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.2C**  
**Pressure–Temperature Ratings for Group 1.2 Materials — U.S. Customary Units**

| Nominal Designation | Forgings               | Castings         | Plates         |
|---------------------|------------------------|------------------|----------------|
| C–Mn–Si             | ...                    | A216 Gr. WCC (1) | ...            |
| C–Mn–Si             | ...                    | A352 Gr. LCC (2) | ...            |
| C–Mn–Si–V           | A350 Gr. LF6 Cl. 2 (3) | ...              | ...            |
| 2½Ni                | ...                    | A352 Gr. LC2 (4) | A203 Gr. B (1) |
| 3½Ni                | ...                    | A352 Gr. LC3 (4) | A203 Gr. E (1) |

| Working Pressures by Classes, psig |       |     |       |       |       |       |       |
|------------------------------------|-------|-----|-------|-------|-------|-------|-------|
| Temp., °F                          | Class |     |       |       |       |       |       |
|                                    | 150   | 300 | 400   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (5)]             | 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   | 615 | 825   | 1,235 | 1,850 | 3,085 | 5,145 |
| 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) Prolonged use above 800°F is permissible but not recommended. Prolonged exposure above 800°F may cause the carbide phase of steel to convert to graphite.
- (2) Not to be used over 700°F.
- (3) Not to be used over 500°F.
- (4) Not to be used over 650°F.
- (5) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings | Castings             |      |      |       | Plates          |       |
|-----------------------------------|----------|----------------------|------|------|-------|-----------------|-------|
| C-Si                              | ...      | A352 LCB (1)         |      |      |       | A515 Gr. 65 (2) |       |
| C-Mn-Si                           | ...      | ...                  |      |      |       | A516 Gr. 65 (2) |       |
| 2½Ni                              | ...      | ...                  |      |      |       | A203 Gr. A      |       |
| 3½Ni                              | ...      | ...                  |      |      |       | A203 Gr. D      |       |
| C-½Mo                             | ...      | A217 Gr. WC1 (3)–(5) |      |      |       | ...             |       |
| C-½Mo                             | ...      | A352 Gr. LC1 (1)     |      |      |       | ...             |       |
| Working Pressures by Classes, bar |          |                      |      |      |       |                 |       |
| Temp., °C                         | Class    |                      |      |      |       |                 |       |
|                                   | 150      | 300                  | 400  | 600  | 900   | 1500            | 2500  |
| Min. to 38 [Note (6)]             | 18.4     | 48.0                 | 64.0 | 96.0 | 144.0 | 240.0           | 400.0 |
| 50                                | 18.4     | 48.0                 | 64.0 | 96.0 | 144.0 | 240.0           | 400.0 |
| 100                               | 17.3     | 45.3                 | 60.3 | 90.5 | 135.8 | 226.3           | 377.1 |
| 150                               | 15.8     | 44.0                 | 58.7 | 88.0 | 132.1 | 220.1           | 366.9 |
| 200                               | 13.8     | 42.6                 | 56.8 | 85.2 | 127.7 | 212.9           | 354.9 |
| 250                               | 12.1     | 40.7                 | 54.3 | 81.5 | 122.2 | 203.7           | 339.4 |
| 300                               | 10.2     | 38.7                 | 51.6 | 77.3 | 116.0 | 193.4           | 322.3 |
| 325                               | 9.3      | 37.6                 | 50.2 | 75.3 | 112.9 | 188.2           | 313.7 |
| 350                               | 8.4      | 36.4                 | 48.5 | 72.8 | 109.2 | 182.1           | 303.4 |
| 375                               | 7.4      | 35.0                 | 46.6 | 69.9 | 104.9 | 174.9           | 291.4 |
| 400                               | 6.5      | 32.6                 | 43.4 | 65.1 | 97.7  | 162.9           | 271.4 |
| 425                               | 5.5      | 27.3                 | 36.4 | 54.6 | 81.9  | 136.5           | 227.4 |
| 450                               | 4.6      | 21.7                 | 28.9 | 43.3 | 65.0  | 108.3           | 180.6 |
| 475                               | 3.7      | 15.5                 | 20.7 | 31.1 | 46.6  | 77.7            | 129.4 |
| 500                               | 2.8      | 10.9                 | 14.5 | 21.7 | 32.6  | 54.3            | 90.6  |
| 538                               | 1.4      | 5.8                  | 7.7  | 11.6 | 17.4  | 29.0            | 48.4  |

## NOTES:

- (1) Not to be used over 371°C.
- (2) Prolonged use above 427°C is permissible but not recommended. Prolonged exposure above 427°C may cause the carbide phase of steel to convert to graphite.
- (3) Prolonged use above 470°C is permissible but not recommended. Prolonged exposure above 470°C may cause the carbide phase of steel to convert to graphite.
- (4) Use normalized and tempered material only.
- (5) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (6) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.3C  
Pressure–Temperature Ratings for Group 1.3 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings | Castings             | Plates          |       |       |       |       |
|------------------------------------|----------|----------------------|-----------------|-------|-------|-------|-------|
| C-Si                               | ...      | A352 Gr. LCB (1)     | A515 Gr. 65 (2) |       |       |       |       |
| C-Mn-Si                            | ...      | ...                  | A516 Gr. 65 (2) |       |       |       |       |
| 2½Ni                               | ...      | ...                  | A203 Gr. A      |       |       |       |       |
| 3½Ni                               | ...      | ...                  | A203 Gr. D      |       |       |       |       |
| C-½Mo                              | ...      | A217 Gr. WC1 (3)–(5) | ...             |       |       |       |       |
| C-½Mo                              | ...      | A352 Gr. LC1 (1)     | ...             |       |       |       |       |
| Working Pressures by Classes, psig |          |                      |                 |       |       |       |       |
| Temp., °F                          | Class    |                      |                 |       |       |       |       |
|                                    | 150      | 300                  | 400             | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (6)]             | 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 700°F.
- (2) Prolonged use above 800°F is permissible but not recommended. Prolonged exposure above 800°F may cause the carbide phase of steel to convert to graphite.
- (3) Prolonged use above 875°F is permissible but not recommended. Prolonged exposure above 875°F may cause the carbide phase of steel to convert to graphite.
- (4) Use normalized and tempered material only.
- (5) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (6) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings                | Castings | Plates          |      |       |       |       |
|-----------------------------------|-------------------------|----------|-----------------|------|-------|-------|-------|
| C-Si                              | ...                     | ...      | A515 Gr. 60 (1) |      |       |       |       |
| C-Mn-Si                           | A350 Gr. LF1, Cl. 1 (1) | ...      | A516 Gr. 60 (1) |      |       |       |       |
| Working Pressures by Classes, bar |                         |          |                 |      |       |       |       |
| Temp., °C                         | Class                   |          |                 |      |       |       |       |
|                                   | 150                     | 300      | 400             | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 16.3                    | 42.6     | 56.8            | 85.2 | 127.7 | 212.9 | 354.9 |
| 50                                | 15.9                    | 41.6     | 55.5            | 83.2 | 124.8 | 208.0 | 346.6 |
| 100                               | 14.9                    | 38.9     | 51.8            | 77.8 | 116.6 | 194.4 | 324.0 |
| 150                               | 14.4                    | 37.6     | 50.2            | 75.3 | 112.9 | 188.2 | 313.7 |
| 200                               | 13.8                    | 36.4     | 48.5            | 72.8 | 109.2 | 182.1 | 303.4 |
| 250                               | 12.1                    | 35.0     | 46.6            | 69.9 | 104.9 | 174.9 | 291.4 |
| 300                               | 10.2                    | 33.1     | 44.2            | 66.2 | 99.4  | 165.6 | 276.0 |
| 325                               | 9.3                     | 32.3     | 43.1            | 64.6 | 96.9  | 161.5 | 269.1 |
| 350                               | 8.4                     | 31.3     | 41.7            | 62.5 | 93.8  | 156.3 | 260.6 |
| 375                               | 7.4                     | 30.4     | 40.6            | 60.9 | 91.3  | 152.2 | 253.7 |
| 400                               | 6.5                     | 29.4     | 39.2            | 58.8 | 88.3  | 147.1 | 245.1 |
| 425                               | 5.5                     | 25.8     | 34.4            | 51.6 | 77.5  | 129.1 | 215.1 |
| 450                               | 4.6                     | 21.5     | 28.6            | 42.9 | 64.4  | 107.3 | 178.9 |
| 475                               | 3.7                     | 13.4     | 17.9            | 26.9 | 40.3  | 67.2  | 112.0 |
| 500                               | 2.8                     | 10.3     | 13.8            | 20.6 | 31.0  | 51.6  | 86.0  |
| 538                               | 1.4                     | 5.9      | 7.8             | 11.7 | 17.6  | 29.3  | 48.9  |

NOTES:

- (1) Prolonged use above 427°C is permissible but not recommended. Prolonged exposure above 427°C may cause the carbide phase of steel to convert to graphite.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.4C**  
**Pressure–Temperature Ratings for Group 1.4 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings               |     |     | Castings |       | Plates          |       |
|------------------------------------|------------------------|-----|-----|----------|-------|-----------------|-------|
| C–Si                               | ...                    |     |     | ...      |       | A515 Gr. 60 (1) |       |
| C–Mn–Si                            | A350 Gr. LF1 Cl. 1 (1) |     |     | ...      |       | A516 Gr. 60 (1) |       |
| Working Pressures by Classes, psig |                        |     |     |          |       |                 |       |
| Temp., °F                          | Class                  |     |     |          |       |                 |       |
|                                    | 150                    | 300 | 400 | 600      | 900   | 1500            | 2500  |
| Min. to 100 [Note (2)]             | 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) Prolonged use above 800°F is permissible but not recommended. Prolonged exposure above 800°F may cause the carbide phase of steel to convert to graphite.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation                      | Forgings        |      | Castings |      | Plates         |       |       |
|--|-----------------|------|----------|------|----------------|-------|-------|
|  |                 |      |          |      |                |       |       |
| C- <sup>1</sup> / <sub>2</sub> Mo        | A182 Gr. F1 (1) |      | ...      |      | A204 Gr. A (1) |       |       |
| C- <sup>1</sup> / <sub>2</sub> Mo        | ...             |      | ...      |      | A204 Gr. B (1) |       |       |
| <b>Working Pressures by Classes, bar</b> |                 |      |          |      |                |       |       |
|  | <b>Class</b>    |      |          |      |                |       |       |
| Temp., °C                                | 150             | 300  | 400      | 600  | 900            | 1500  | 2500  |
| Min. to 38 [Note (2)]                    | 18.4            | 48.0 | 64.0     | 96.0 | 144.0          | 240.0 | 400.0 |
| 50                                       | 18.4            | 48.0 | 64.0     | 96.0 | 144.0          | 240.0 | 400.0 |
| 100                                      | 17.7            | 48.0 | 64.0     | 96.0 | 144.0          | 240.0 | 400.0 |
| 150                                      | 15.8            | 47.3 | 63.1     | 94.6 | 141.9          | 236.6 | 394.3 |
| 200                                      | 13.8            | 45.9 | 61.2     | 91.7 | 137.6          | 229.4 | 382.3 |
| 250                                      | 12.1            | 44.4 | 59.2     | 88.9 | 133.3          | 222.2 | 370.3 |
| 300                                      | 10.2            | 43.2 | 57.6     | 86.4 | 129.6          | 216.0 | 360.0 |
| 325                                      | 9.3             | 42.6 | 56.8     | 85.2 | 127.7          | 212.9 | 354.9 |
| 350                                      | 8.4             | 41.9 | 55.8     | 83.6 | 125.5          | 209.1 | 348.7 |
| 375                                      | 7.4             | 40.5 | 53.9     | 80.7 | 121.2          | 201.9 | 336.1 |
| 400                                      | 6.5             | 38.0 | 50.7     | 76.2 | 114.2          | 190.4 | 317.1 |
| 425                                      | 5.5             | 36.8 | 48.9     | 73.2 | 109.8          | 183.0 | 304.7 |
| 450                                      | 4.6             | 35.4 | 47.3     | 71.1 | 106.5          | 177.5 | 295.9 |
| 475                                      | 3.7             | 34.4 | 45.9     | 68.8 | 103.2          | 171.6 | 286.3 |
| 500                                      | 2.8             | 23.3 | 31.1     | 46.7 | 70.0           | 116.7 | 194.6 |
| 538                                      | 1.4             | 11.2 | 14.9     | 22.4 | 33.5           | 55.9  | 93.2  |

NOTE:

(1) Upon prolonged exposure to temperatures above 470°C, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible but not recommended for prolonged use above 470°C.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.5C**  
**Pressure–Temperature Ratings for Group 1.5 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings        | Castings | Plates         |       |       |       |       |
|------------------------------------|-----------------|----------|----------------|-------|-------|-------|-------|
| C- $\frac{1}{2}$ Mo                | A182 Gr. F1 (1) | ...      | A204 Gr. A (1) |       |       |       |       |
| C- $\frac{1}{2}$ Mo                | ...             | ...      | A204 Gr. B (1) |       |       |       |       |
| Working Pressures by Classes, psig |                 |          |                |       |       |       |       |
| Temp., °F                          | Class           |          |                |       |       |       |       |
|                                    | 150             | 300      | 400            | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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             | 620      | 830            | 1,245 | 1,865 | 3,105 | 5,175 |
| 650                                | 125             | 610      | 815            | 1,220 | 1,835 | 3,055 | 5,090 |
| 700                                | 110             | 600      | 795            | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95              | 555      | 745            | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80              | 535      | 710            | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65              | 510      | 685            | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50              | 470      | 625            | 940   | 1,410 | 2,350 | 3,915 |
| 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.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation                                    | Forgings        | Castings              | Plates |
|--|-----------------|-----------------------|--------|
| $\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$            | A182 Gr. F2 (1) | ...                   | ...    |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$  | ...             | A217 Gr. WC4 (1)–(3)  | ...    |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ | ...             | A217 Gr. WC5 (2), (3) | ...    |

| Working Pressures by Classes, bar |       |      |      |       |       |       |       |
|-----------------------------------|-------|------|------|-------|-------|-------|-------|
| Temp., °C                         | Class |      |      |       |       |       |       |
|                                   | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (4)]             | 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 | 67.0 | 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 | 61.8 | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2  | 45.0 | 60.0 | 90.0  | 135.0 | 225.1 | 375.0 |
| 325                               | 9.3   | 43.3 | 57.6 | 86.3  | 129.6 | 215.9 | 359.8 |
| 350                               | 8.4   | 41.9 | 55.8 | 83.6  | 125.5 | 209.1 | 348.7 |
| 375                               | 7.4   | 40.5 | 53.9 | 80.7  | 121.2 | 201.9 | 336.1 |
| 400                               | 6.5   | 38.0 | 50.7 | 76.2  | 114.2 | 190.4 | 317.1 |
| 425                               | 5.5   | 36.8 | 48.9 | 73.2  | 109.8 | 183.0 | 304.7 |
| 450                               | 4.6   | 35.4 | 47.3 | 71.1  | 106.5 | 177.5 | 295.9 |
| 475                               | 3.7   | 34.4 | 45.9 | 68.8  | 103.2 | 171.6 | 286.3 |
| 500                               | 2.8   | 26.3 | 35.0 | 52.5  | 78.8  | 131.3 | 218.9 |
| 538                               | 1.4   | 13.4 | 17.8 | 26.7  | 40.1  | 66.8  | 111.4 |
| 550                               | ...   | 13.4 | 17.8 | 26.7  | 40.1  | 66.8  | 111.4 |
| 575                               | ...   | 9.4  | 12.5 | 18.8  | 28.2  | 47.0  | 78.3  |
| 593                               | ...   | 6.7  | 8.9  | 13.3  | 20.0  | 33.2  | 55.5  |

## 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 A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.7C**  
**Pressure–Temperature Ratings for Group 1.7 Materials — U.S. Customary Units**

| Nominal Designation                    | Forgings        |     | Castings              |       | Plates |       |       |
|--|-----------------|-----|-----------------------|-------|--------|-------|-------|
|  |                 |     |                       |       |        |       |       |
| $\frac{1}{2}$ Cr- $\frac{1}{2}$ Mo     | A182 Gr. F2 (1) |     | ...                   |       | ...    |       |       |
| Ni- $\frac{1}{2}$ Cr- $\frac{1}{2}$ Mo | ...             |     | A217 Gr. WC4 (1)-(3)  |       | ...    |       |       |
| $\frac{3}{4}$ Ni- $\frac{3}{4}$ Cr-1Mo | ...             |     | A217 Gr. WC5 (2), (3) |       | ...    |       |       |
| Working Pressures by Classes, psig     |                 |     |                       |       |        |       |       |
| Temp., °F                              | Class           |     |                       |       |        |       |       |
|  | 150             | 300 | 400                   | 600   | 900    | 1500  | 2500  |
| Min. to 100 [Note (4)]                 | 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             | 630 | 840                   | 1,260 | 1,890  | 3,145 | 5,240 |
| 650                                    | 125             | 615 | 820                   | 1,230 | 1,845  | 3,070 | 5,125 |
| 700                                    | 110             | 600 | 795                   | 1,190 | 1,790  | 2,980 | 4,965 |
| 750                                    | 95              | 555 | 745                   | 1,120 | 1,675  | 2,795 | 4,650 |
| 800                                    | 80              | 535 | 710                   | 1,065 | 1,600  | 2,665 | 4,440 |
| 850                                    | 65              | 510 | 685                   | 1,030 | 1,540  | 2,570 | 4,285 |
| 900                                    | 50              | 475 | 635                   | 955   | 1,430  | 2,380 | 3,970 |
| 950                                    | 35              | 315 | 420                   | 630   | 945    | 1,575 | 2,630 |
| 1,000                                  | 20              | 200 | 270                   | 405   | 605    | 1,010 | 1,685 |
| 1,050                                  | 20              | 160 | 210                   | 315   | 475    | 790   | 1,315 |
| 1,100                                  | 20              | 95  | 130                   | 190   | 290    | 480   | 800   |

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 A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation                      | Forgings                    |            |            | Castings             |            | Plates                |             |
|--|-----------------------------|------------|------------|----------------------|------------|-----------------------|-------------|
| 1¼Cr–½Mo                                 | ...                         |            |            | A217 Gr. WC6 (1)–(3) |            | ...                   |             |
| 1¼Cr–½Mo–Si                              | A182 Gr. F11 Cl. 2 (1), (4) |            |            | ...                  |            | A387 Gr. 11 Cl. 2 (4) |             |
| <b>Working Pressures by Classes, bar</b> |                             |            |            |                      |            |                       |             |
|  | <b>Class</b>                |            |            |                      |            |                       |             |
| <b>Temp., °C</b>                         | <b>150</b>                  | <b>300</b> | <b>400</b> | <b>600</b>           | <b>900</b> | <b>1500</b>           | <b>2500</b> |
| Min. to 38 [Note (5)]                    | 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                        | 49.8       | 66.4       | 99.6                 | 149.3      | 248.9                 | 414.9       |
| 200                                      | 13.8                        | 47.9       | 63.9       | 95.9                 | 143.8      | 239.7                 | 399.4       |
| 250                                      | 12.1                        | 46.3       | 61.7       | 92.6                 | 138.9      | 231.4                 | 385.7       |
| 300                                      | 10.2                        | 45.0       | 60.0       | 90.0                 | 135.0      | 225.1                 | 375.0       |
| 325                                      | 9.3                         | 43.3       | 57.6       | 86.3                 | 129.6      | 215.9                 | 358.9       |
| 350                                      | 8.4                         | 41.9       | 55.8       | 83.6                 | 125.5      | 209.1                 | 348.7       |
| 375                                      | 7.4                         | 40.5       | 53.9       | 80.7                 | 121.2      | 201.9                 | 336.1       |
| 400                                      | 6.5                         | 38.0       | 50.7       | 76.2                 | 114.2      | 190.4                 | 317.1       |
| 425                                      | 5.5                         | 36.8       | 48.9       | 73.2                 | 109.8      | 183.0                 | 304.7       |
| 450                                      | 4.6                         | 35.4       | 47.3       | 71.1                 | 106.5      | 177.5                 | 295.9       |
| 475                                      | 3.7                         | 34.4       | 45.9       | 68.8                 | 103.2      | 171.6                 | 286.3       |
| 500                                      | 2.8                         | 25.0       | 33.3       | 50.0                 | 75.0       | 125.0                 | 208.3       |
| 538                                      | 1.4                         | 15.1       | 20.1       | 30.1                 | 45.2       | 75.3                  | 125.5       |
| 550                                      | ...                         | 12.4       | 16.6       | 24.9                 | 37.3       | 62.2                  | 103.7       |
| 575                                      | ...                         | 8.6        | 11.5       | 17.3                 | 25.9       | 43.2                  | 72.0        |
| 600                                      | ...                         | 6.0        | 8.0        | 12.1                 | 18.1       | 30.2                  | 50.3        |
| 625                                      | ...                         | 4.3        | 5.7        | 8.5                  | 12.8       | 21.3                  | 35.5        |
| 649                                      | ...                         | 2.8        | 3.8        | 5.7                  | 8.5        | 14.1                  | 23.6        |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Not to be used over 593°C.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) Prolonged use above 595°C is permissible but not recommended.
- (5) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.9C**  
**Pressure–Temperature Ratings for Group 1.9 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings                    | Castings             | Plates                |       |       |       |       |
|------------------------------------|-----------------------------|----------------------|-----------------------|-------|-------|-------|-------|
| 1¼Cr-½Mo                           | ...                         | A217 Gr. WC6 (1)-(3) | ...                   |       |       |       |       |
| 1¼Cr-½Mo-Si                        | A182 Gr. F11 Cl. 2 (1), (4) | ...                  | A387 Gr. 11 Cl. 2 (4) |       |       |       |       |
| Working Pressures by Classes, psig |                             |                      |                       |       |       |       |       |
| Temp., °F                          | Class                       |                      |                       |       |       |       |       |
|                                    | 150                         | 300                  | 400                   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (5)]             | 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                         | 630                  | 840                   | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125                         | 615                  | 820                   | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110                         | 600                  | 795                   | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95                          | 555                  | 745                   | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                          | 535                  | 710                   | 1,065 | 1,600 | 2,665 | 4,400 |
| 850                                | 65                          | 510                  | 685                   | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50                          | 470                  | 625                   | 940   | 1,410 | 2,350 | 3,915 |
| 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 A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) Prolonged use above 1,100°F is permissible but not recommended.
- (5) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.10**  
**Pressure-Temperature Ratings for Group 1.10 Materials — SI Units**

(25)

| Nominal Designation               | Forgings               |      |      | Castings              |       | Plates                |       |
|-----------------------------------|------------------------|------|------|-----------------------|-------|-----------------------|-------|
| 2 $\frac{1}{4}$ Cr-1Mo            | A182 Gr. F22 Cl. 3 (1) |      |      | A217 Gr. WC9 (2), (3) |       | A387 Gr. 22 Cl. 2 (1) |       |
| Working Pressures by Classes, bar |                        |      |      |                       |       |                       |       |
| Temp., °C                         | Class                  |      |      |                       |       |                       |       |
|                                   | 150                    | 300  | 400  | 600                   | 900   | 1500                  | 2500  |
| Min. to 38 [Note (4)]             | 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 | 67.0 | 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 | 61.8 | 92.7                  | 139.0 | 231.8                 | 386.2 |
| 300                               | 10.2                   | 45.0 | 60.0 | 90.0                  | 135.0 | 225.1                 | 375.0 |
| 325                               | 9.3                    | 43.3 | 57.6 | 86.3                  | 129.6 | 215.9                 | 359.8 |
| 350                               | 8.4                    | 41.9 | 55.8 | 83.6                  | 125.5 | 209.1                 | 348.7 |
| 375                               | 7.4                    | 40.5 | 53.9 | 80.7                  | 121.2 | 201.9                 | 336.1 |
| 400                               | 6.5                    | 38.0 | 50.7 | 76.2                  | 114.2 | 190.4                 | 317.1 |
| 425                               | 5.5                    | 36.8 | 48.9 | 73.2                  | 109.8 | 183.0                 | 304.7 |
| 450                               | 4.6                    | 35.4 | 47.3 | 71.1                  | 106.5 | 177.5                 | 295.9 |
| 475                               | 3.7                    | 34.4 | 45.9 | 68.8                  | 103.2 | 171.6                 | 286.3 |
| 500                               | 2.8                    | 30.7 | 40.9 | 61.3                  | 92.0  | 153.3                 | 255.4 |
| 538                               | 1.4                    | 18.6 | 24.7 | 37.1                  | 55.7  | 92.8                  | 154.6 |
| 550                               | ...                    | 15.4 | 20.5 | 30.8                  | 46.2  | 77.0                  | 128.3 |
| 575                               | ...                    | 10.3 | 13.8 | 20.6                  | 31.0  | 51.6                  | 86.0  |
| 600                               | ...                    | 6.8  | 9.0  | 13.5                  | 20.3  | 33.8                  | 56.3  |
| 625                               | ...                    | 4.4  | 5.9  | 8.8                   | 13.3  | 22.1                  | 36.9  |
| 649                               | ...                    | 2.8  | 3.8  | 5.7                   | 8.5   | 14.1                  | 23.6  |

## NOTES:

- (1) Prolonged use above 595°C is permissible but not recommended.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.10C**  
**Pressure-Temperature Ratings for Group 1.10 Materials — U.S. Customary Units**

| Nominal Designation                  | Forgings               | Castings              | Plates                |       |       |       |       |
|--------------------------------------|------------------------|-----------------------|-----------------------|-------|-------|-------|-------|
| 2 <sup>1</sup> / <sub>4</sub> Cr-1Mo | A182 Gr. F22 Cl. 3 (1) | A217 Gr. WC9 (2), (3) | A387 Gr. 22 Cl. 2 (1) |       |       |       |       |
| Working Pressures by Classes, psig   |                        |                       |                       |       |       |       |       |
| Temp., °F                            | Class                  |                       |                       |       |       |       |       |
|                                      | 150                    | 300                   | 400                   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (4)]               | 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                    | 630                   | 840                   | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                  | 125                    | 615                   | 820                   | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                  | 110                    | 600                   | 795                   | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                  | 95                     | 555                   | 745                   | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                  | 80                     | 535                   | 710                   | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                  | 65                     | 510                   | 685                   | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                  | 50                     | 475                   | 635                   | 955   | 1,430 | 2,380 | 3,970 |
| 950                                  | 35                     | 390                   | 520                   | 780   | 1,175 | 1,955 | 3,225 |
| 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) Prolonged use above 1,100°F is permissible but not recommended.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.11  
Pressure-Temperature Ratings for Group 1.11 Materials — SI Units**

(25)

| Nominal Designation               | Forgings         | Castings | Plates                 |       |       |       |       |
|-----------------------------------|------------------|----------|------------------------|-------|-------|-------|-------|
| 3Cr-1Mo                           | A182 Gr. F21 (1) | ...      | A387 Gr. 21, Cl. 2 (1) |       |       |       |       |
| C- <sup>1</sup> / <sub>2</sub> Mo | ...              | ...      | A204 Gr. C (2), (3)    |       |       |       |       |
| Working Pressures by Classes, bar |                  |          |                        |       |       |       |       |
| Temp., °C                         | Class            |          |                        |       |       |       |       |
|                                   | 150              | 300      | 400                    | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (4)]             | 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     | 67.0                   | 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     | 61.8                   | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2             | 45.0     | 60.0                   | 90.0  | 135.0 | 225.1 | 375.0 |
| 325                               | 9.3              | 43.3     | 57.6                   | 86.3  | 129.6 | 215.9 | 359.8 |
| 350                               | 8.4              | 41.9     | 55.8                   | 83.6  | 125.5 | 209.1 | 348.7 |
| 375                               | 7.4              | 40.5     | 53.9                   | 80.7  | 121.2 | 201.9 | 336.1 |
| 400                               | 6.5              | 38.0     | 50.7                   | 76.2  | 114.2 | 190.4 | 317.1 |
| 425                               | 5.5              | 36.8     | 48.9                   | 73.2  | 109.8 | 183.0 | 304.7 |
| 450                               | 4.6              | 35.4     | 47.3                   | 71.1  | 106.5 | 177.5 | 295.9 |
| 475                               | 3.7              | 34.3     | 45.7                   | 68.6  | 102.9 | 171.4 | 285.7 |
| 500                               | 2.8              | 23.0     | 30.7                   | 46.1  | 69.1  | 115.2 | 192.0 |
| 538                               | 1.4              | 11.2     | 14.9                   | 22.4  | 33.6  | 56.0  | 93.3  |
| 550                               | ...              | 11.2     | 14.9                   | 22.4  | 33.6  | 56.0  | 93.3  |
| 575                               | ...              | 10.1     | 13.4                   | 20.2  | 30.2  | 50.4  | 84.0  |
| 600                               | ...              | 7.0      | 9.3                    | 14.0  | 21.0  | 35.0  | 58.3  |
| 625                               | ...              | 5.4      | 7.2                    | 10.8  | 16.1  | 26.9  | 44.9  |
| 649                               | ...              | 3.1      | 4.1                    | 6.1   | 9.2   | 15.3  | 25.5  |

NOTES:

- (1) Permissible, but not recommended for prolonged use above 595°C.
- (2) Upon prolonged exposure to temperatures above 470°C, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible but not recommended for prolonged use above 470°C.
- (3) Not to be used over 538°C.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.11C**  
**Pressure–Temperature Ratings for Group 1.11 Materials — U.S. Customary Units**

| Nominal Designation                       | Forgings     |     | Castings |       | Plates                 |       |       |
|---|--------------|-----|----------|-------|------------------------|-------|-------|
|   |              |     |          |       |                        |       |       |
| 3Cr–1Mo                                   | A182 F21 (1) |     | ...      |       | A387 Gr. 21, Cl. 2 (1) |       |       |
| C- <sup>1</sup> / <sub>2</sub> Mo         | ...          |     | ...      |       | A204 Gr. C (2), (3)    |       |       |
| <b>Working Pressures by Classes, psig</b> |              |     |          |       |                        |       |       |
|   | <b>Class</b> |     |          |       |                        |       |       |
| Temp., °F                                 | 150          | 300 | 400      | 600   | 900                    | 1500  | 2500  |
| Min. to 100 [Note (4)]                    | 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          | 630 | 840      | 1,260 | 1,890                  | 3,145 | 5,240 |
| 650                                       | 125          | 615 | 820      | 1,230 | 1,845                  | 3,070 | 5,125 |
| 700                                       | 110          | 600 | 795      | 1,190 | 1,790                  | 2,980 | 4,965 |
| 750                                       | 95           | 555 | 745      | 1,120 | 1,675                  | 2,795 | 4,650 |
| 800                                       | 80           | 535 | 710      | 1,065 | 1,600                  | 2,665 | 4,440 |
| 850                                       | 65           | 510 | 685      | 1,030 | 1,540                  | 2,570 | 4,285 |
| 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   |

NOTES:

- (1) Permissible, but not recommended for prolonged use above 1,100°F.
- (2) 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.
- (3) Not to be used over 1,000°F.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.13**  
**Pressure-Temperature Ratings for Group 1.13 Materials — SI Units**

(25)

| Nominal Designation               | Forgings     |      |      | Castings             |       |       | Plates |
|-----------------------------------|--------------|------|------|----------------------|-------|-------|--------|
| 5Cr- $\frac{1}{2}$ Mo             | A182 Gr. F5a |      |      | A217 Gr. C5 (1), (2) |       |       | ...    |
| Working Pressures by Classes, bar |              |      |      |                      |       |       |        |
| Temp., °C                         | Class        |      |      |                      |       |       |        |
|                                   | 150          | 300  | 400  | 600                  | 900   | 1500  | 2500   |
| Min. to 38 [Note (3)]             | 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 | 67.0 | 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 | 61.8 | 92.7                 | 139.0 | 231.8 | 386.2  |
| 300                               | 10.2         | 45.0 | 60.0 | 90.0                 | 135.0 | 225.1 | 375.0  |
| 325                               | 9.3          | 43.3 | 57.6 | 86.3                 | 129.6 | 215.9 | 359.8  |
| 350                               | 8.4          | 41.9 | 55.8 | 83.6                 | 125.5 | 209.1 | 348.7  |
| 375                               | 7.4          | 40.5 | 53.9 | 80.7                 | 121.2 | 201.9 | 336.1  |
| 400                               | 6.5          | 38.0 | 50.7 | 76.2                 | 114.2 | 190.4 | 317.1  |
| 425                               | 5.5          | 36.8 | 48.9 | 73.2                 | 109.8 | 183.0 | 304.7  |
| 450                               | 4.6          | 35.3 | 47.1 | 70.6                 | 105.9 | 176.6 | 294.3  |
| 475                               | 3.7          | 27.6 | 36.8 | 55.3                 | 82.9  | 138.2 | 230.3  |
| 500                               | 2.8          | 21.3 | 28.3 | 42.5                 | 63.8  | 106.3 | 177.1  |
| 538                               | 1.4          | 13.8 | 18.4 | 27.6                 | 41.5  | 69.1  | 115.2  |
| 550                               | ...          | 11.9 | 15.9 | 23.9                 | 35.8  | 59.7  | 99.4   |
| 575                               | ...          | 8.8  | 11.8 | 17.7                 | 26.5  | 44.2  | 73.7   |
| 600                               | ...          | 6.2  | 8.2  | 12.3                 | 18.5  | 30.9  | 51.4   |
| 625                               | ...          | 3.9  | 5.3  | 7.9                  | 11.8  | 19.7  | 32.9   |
| 649                               | ...          | 2.4  | 3.1  | 4.7                  | 7.1   | 11.8  | 19.6   |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.13C**  
**Pressure-Temperature Ratings for Group 1.13 Materials — U.S. Customary Units**

| Nominal Designation                 | Forgings     |     | Castings             |       |       | Plates |       |
|-------------------------------------|--------------|-----|----------------------|-------|-------|--------|-------|
| 5Cr- <sup>1</sup> / <sub>2</sub> Mo | A182 Gr. F5a |     | A217 Gr. C5 (1), (2) |       |       | ...    |       |
| Working Pressures by Classes, psig  |              |     |                      |       |       |        |       |
| Temp., °F                           | Class        |     |                      |       |       |        |       |
|                                     | 150          | 300 | 400                  | 600   | 900   | 1500   | 2500  |
| Min. to 100 [Note (3)]              | 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          | 630 | 840                  | 1,260 | 1,890 | 3,145  | 5,240 |
| 650                                 | 125          | 615 | 820                  | 1,230 | 1,845 | 3,070  | 5,125 |
| 700                                 | 110          | 600 | 795                  | 1,190 | 1,790 | 2,980  | 4,965 |
| 750                                 | 95           | 555 | 745                  | 1,120 | 1,675 | 2,795  | 4,650 |
| 800                                 | 80           | 535 | 710                  | 1,065 | 1,600 | 2,665  | 4,440 |
| 850                                 | 65           | 490 | 655                  | 980   | 1,470 | 2,450  | 4,085 |
| 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   |

NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.14**  
**Pressure-Temperature Ratings for Group 1.14 Materials — SI Units**

(25)

| Nominal Designation               | Forgings    |      |      | Castings              |       |       | Plates |
|-----------------------------------|-------------|------|------|-----------------------|-------|-------|--------|
| 9Cr-1Mo                           | A182 Gr. F9 |      |      | A217 Gr. C12 (1), (2) |       |       | ...    |
| Working Pressures by Classes, bar |             |      |      |                       |       |       |        |
| Temp., °C                         | Class       |      |      |                       |       |       |        |
|                                   | 150         | 300  | 400  | 600                   | 900   | 1500  | 2500   |
| Min. to 38 [Note (3)]             | 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 | 67.0 | 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 | 61.8 | 92.7                  | 139.0 | 231.8 | 386.2  |
| 300                               | 10.2        | 45.0 | 60.0 | 90.0                  | 135.0 | 225.1 | 375.0  |
| 325                               | 9.3         | 43.3 | 57.6 | 86.3                  | 129.6 | 215.9 | 359.8  |
| 350                               | 8.4         | 41.9 | 55.8 | 83.6                  | 125.5 | 209.1 | 348.7  |
| 375                               | 7.4         | 40.5 | 53.9 | 80.7                  | 121.2 | 201.9 | 336.1  |
| 400                               | 6.5         | 38.0 | 50.7 | 76.2                  | 114.2 | 190.4 | 317.1  |
| 425                               | 5.5         | 36.8 | 48.9 | 73.2                  | 109.8 | 183.0 | 304.7  |
| 450                               | 4.6         | 35.4 | 47.3 | 71.1                  | 106.5 | 177.5 | 295.9  |
| 475                               | 3.7         | 34.4 | 45.9 | 68.8                  | 103.2 | 171.6 | 286.3  |
| 500                               | 2.8         | 30.2 | 40.3 | 60.5                  | 90.7  | 151.2 | 252.0  |
| 538                               | 1.4         | 17.7 | 23.6 | 35.3                  | 53.0  | 88.4  | 147.3  |
| 550                               | ...         | 14.7 | 19.7 | 29.5                  | 44.2  | 73.7  | 122.9  |
| 575                               | ...         | 10.3 | 13.7 | 20.6                  | 30.9  | 51.4  | 85.7   |
| 600                               | ...         | 7.1  | 9.4  | 14.1                  | 21.2  | 35.3  | 58.9   |
| 625                               | ...         | 4.9  | 6.6  | 9.9                   | 14.8  | 24.7  | 41.1   |
| 649                               | ...         | 3.6  | 4.7  | 7.1                   | 10.7  | 17.8  | 29.6   |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-1.14C**  
**Pressure-Temperature Ratings for Group 1.14 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings    | Castings              | Plates |       |       |       |       |
|------------------------------------|-------------|-----------------------|--------|-------|-------|-------|-------|
| 9Cr-1Mo                            | A182 Gr. F9 | A217 Gr. C12 (1), (2) | ...    |       |       |       |       |
| Working Pressures by Classes, psig |             |                       |        |       |       |       |       |
| Temp., °F                          | Class       |                       |        |       |       |       |       |
|                                    | 150         | 300                   | 400    | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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         | 630                   | 840    | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125         | 615                   | 820    | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110         | 600                   | 795    | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95          | 555                   | 745    | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80          | 535                   | 710    | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65          | 510                   | 685    | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50          | 475                   | 635    | 955   | 1,430 | 2,380 | 3,970 |
| 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   |

NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.15**  
**Pressure-Temperature Ratings for Group 1.15 Materials — SI Units**

(25)

| Nominal Designation               | Forgings            |      |      | Castings          |       | Plates            |       |
|-----------------------------------|---------------------|------|------|-------------------|-------|-------------------|-------|
| 9Cr-1Mo-V                         | A182 Gr. F91 Type 1 |      |      | A217 Gr. C12A (1) |       | A387 Gr. 91 Cl. 2 |       |
| Working Pressures by Classes, bar |                     |      |      |                   |       |                   |       |
| Temp., °C                         | Class               |      |      |                   |       |                   |       |
|                                   | 150                 | 300  | 400  | 600               | 900   | 1500              | 2500  |
| Min. to 38 [Note (2)]             | 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 | 67.0 | 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 | 61.8 | 92.7              | 139.0 | 231.8             | 386.2 |
| 300                               | 10.2                | 45.0 | 60.0 | 90.0              | 135.0 | 225.1             | 375.0 |
| 325                               | 9.3                 | 43.3 | 57.6 | 86.3              | 129.6 | 215.9             | 359.8 |
| 350                               | 8.4                 | 41.9 | 55.8 | 83.6              | 125.5 | 209.1             | 348.7 |
| 375                               | 7.4                 | 40.5 | 53.9 | 80.7              | 121.2 | 201.9             | 336.1 |
| 400                               | 6.5                 | 38.0 | 50.7 | 76.2              | 114.2 | 190.4             | 317.1 |
| 425                               | 5.5                 | 36.8 | 48.9 | 73.2              | 109.8 | 183.0             | 304.7 |
| 450                               | 4.6                 | 35.4 | 47.3 | 71.1              | 106.5 | 177.5             | 295.9 |
| 475                               | 3.7                 | 34.4 | 45.9 | 68.8              | 103.2 | 171.6             | 286.3 |
| 500                               | 2.8                 | 32.1 | 42.9 | 64.4              | 96.6  | 160.6             | 267.9 |
| 538                               | 1.4                 | 29.0 | 38.5 | 57.5              | 86.5  | 144.3             | 240.2 |
| 550                               | ...                 | 28.8 | 38.3 | 57.3              | 86.0  | 143.6             | 239.2 |
| 575                               | ...                 | 25.9 | 34.5 | 51.8              | 77.7  | 129.4             | 215.7 |
| 600                               | ...                 | 18.6 | 24.8 | 37.2              | 55.9  | 93.1              | 155.1 |
| 625                               | ...                 | 12.6 | 16.8 | 25.2              | 37.9  | 63.1              | 105.1 |
| 649                               | ...                 | 8.4  | 11.2 | 16.8              | 25.2  | 42.0              | 70.0  |

## NOTES:

(1) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

(2) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

(25) **Table 2-1.15C**  
**Pressure-Temperature Ratings for Group 1.15 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings            | Castings          | Plates            |       |       |       |       |
|------------------------------------|---------------------|-------------------|-------------------|-------|-------|-------|-------|
| 9Cr-1Mo-V                          | A182 Gr. F91 Type 1 | A217 Gr. C12A (1) | A387 Gr. 91 Cl. 2 |       |       |       |       |
| Working Pressures by Classes, psig |                     |                   |                   |       |       |       |       |
| Temp., °F                          | Class               |                   |                   |       |       |       |       |
|                                    | 150                 | 300               | 400               | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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                 | 630               | 840               | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125                 | 615               | 820               | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110                 | 600               | 795               | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95                  | 555               | 745               | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                  | 535               | 710               | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65                  | 510               | 685               | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50                  | 475               | 635               | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                  | 425               | 570               | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                  | 415               | 550               | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | ...                 | 410               | 545               | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | ...                 | 300               | 400               | 595   | 895   | 1,490 | 2,485 |
| 1,150                              | ...                 | 195               | 260               | 390   | 585   | 975   | 1,630 |
| 1,200                              | ...                 | 120               | 160               | 240   | 360   | 600   | 1,000 |

NOTES:

(1) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-1.17**  
**Pressure-Temperature Ratings for Group 1.17 Materials — SI Units**

(25)

| Nominal Designation               | Forgings                    |      | Castings |       | Plates |       |       |
|-----------------------------------|-----------------------------|------|----------|-------|--------|-------|-------|
| 1Cr- $\frac{1}{2}$ Mo             | A182 Gr. F12 Cl. 2 (1), (2) |      | ...      |       | ...    |       |       |
| 5Cr- $\frac{1}{2}$ Mo             | A182 Gr. F5                 |      | ...      |       | ...    |       |       |
| Working Pressures by Classes, bar |                             |      |          |       |        |       |       |
| Temp., °C                         | Class                       |      |          |       |        |       |       |
|                                   | 150                         | 300  | 400      | 600   | 900    | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 19.8                        | 51.7 | 68.9     | 103.4 | 155.1  | 258.6 | 430.9 |
| 50                                | 19.5                        | 51.6 | 68.7     | 103.1 | 154.7  | 257.8 | 429.6 |
| 100                               | 17.7                        | 50.6 | 67.4     | 101.1 | 151.7  | 252.9 | 421.4 |
| 150                               | 15.8                        | 48.1 | 64.2     | 96.3  | 144.4  | 240.7 | 401.1 |
| 200                               | 13.8                        | 46.3 | 61.7     | 92.6  | 138.9  | 231.4 | 385.7 |
| 250                               | 12.1                        | 44.8 | 59.8     | 89.7  | 134.5  | 224.2 | 373.7 |
| 300                               | 10.2                        | 43.6 | 58.1     | 87.2  | 130.8  | 218.1 | 363.4 |
| 325                               | 9.3                         | 43.0 | 57.3     | 86.0  | 129.0  | 215.0 | 358.3 |
| 350                               | 8.4                         | 41.9 | 55.8     | 83.6  | 125.5  | 209.1 | 348.7 |
| 375                               | 7.4                         | 40.5 | 53.9     | 80.7  | 121.2  | 201.9 | 336.1 |
| 400                               | 6.5                         | 38.0 | 50.7     | 76.2  | 114.2  | 190.4 | 317.1 |
| 425                               | 5.5                         | 36.8 | 48.9     | 73.2  | 109.8  | 183.0 | 304.7 |
| 450                               | 4.6                         | 35.0 | 46.6     | 69.9  | 104.9  | 174.9 | 291.4 |
| 475                               | 3.7                         | 27.8 | 37.1     | 55.6  | 83.4   | 139.0 | 231.7 |
| 500                               | 2.8                         | 21.2 | 28.3     | 42.4  | 63.6   | 105.9 | 176.6 |
| 538                               | 1.4                         | 13.8 | 18.4     | 27.6  | 41.5   | 69.1  | 115.2 |
| 550                               | ...                         | 11.9 | 15.9     | 23.8  | 35.7   | 59.5  | 99.1  |
| 575                               | ...                         | 8.8  | 11.8     | 17.7  | 26.5   | 44.2  | 73.7  |
| 600                               | ...                         | 5.9  | 7.9      | 11.9  | 17.8   | 29.7  | 49.4  |
| 625                               | ...                         | 3.9  | 5.3      | 7.9   | 11.8   | 19.7  | 32.9  |
| 649                               | ...                         | 2.4  | 3.1      | 4.7   | 7.1    | 11.8  | 19.6  |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Prolonged use above 595°C is permissible but not recommended.
- (3) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

**Table 2-1.17C**

(25) **Pressure–Temperature Ratings for Group 1.17 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings                    |     | Castings |       | Plates |       |       |
|------------------------------------|-----------------------------|-----|----------|-------|--------|-------|-------|
| 1Cr- $\frac{1}{2}$ Mo              | A182 Gr. F12 Cl. 2 (1), (2) |     | ...      |       | ...    |       |       |
| 5Cr- $\frac{1}{2}$ Mo              | A182 Gr. F5                 |     | ...      |       | ...    |       |       |
| Working Pressures by Classes, psig |                             |     |          |       |        |       |       |
| Temp., °F                          | Class                       |     |          |       |        |       |       |
|                                    | 150                         | 300 | 400      | 600   | 900    | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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                         | 625 | 835      | 1,255 | 1,880  | 3,135 | 5,230 |
| 650                                | 125                         | 615 | 820      | 1,230 | 1,845  | 3,070 | 5,125 |
| 700                                | 110                         | 600 | 795      | 1,190 | 1,790  | 2,980 | 4,965 |
| 750                                | 95                          | 555 | 745      | 1,120 | 1,675  | 2,795 | 4,650 |
| 800                                | 80                          | 535 | 710      | 1,065 | 1,600  | 2,665 | 4,440 |
| 850                                | 65                          | 490 | 655      | 980   | 1,470  | 2,450 | 4,085 |
| 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) Prolonged use above 1,100°F is permissible but not recommended.
- (3) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

**Table 2-1.18**  
**Pressure-Temperature Ratings for Group 1.18 Materials — SI Units**

(25)

| Nominal Designation               | Forgings      |      |      | Castings |       |       | Plates |
|-----------------------------------|---------------|------|------|----------|-------|-------|--------|
| 9Cr-2W-V                          | A 182 Gr. F92 |      |      | ...      |       |       | ...    |
| Working Pressures by Classes, bar |               |      |      |          |       |       |        |
| Temp., °C                         | Class         |      |      |          |       |       |        |
|                                   | 150           | 300  | 400  | 600      | 900   | 1500  | 2500   |
| Min. to 38 [Note (1)]             | 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          | 45.0 | 60.0 | 90.0     | 135.0 | 225.1 | 375.0  |
| 325                               | 9.3           | 43.3 | 57.6 | 86.3     | 129.6 | 215.9 | 359.8  |
| 350                               | 8.4           | 41.9 | 55.8 | 83.6     | 125.5 | 209.1 | 348.7  |
| 375                               | 7.4           | 40.5 | 53.9 | 80.7     | 121.2 | 201.9 | 336.1  |
| 400                               | 6.5           | 38.0 | 50.7 | 76.2     | 114.2 | 190.4 | 317.1  |
| 425                               | 5.5           | 36.8 | 48.9 | 73.2     | 109.8 | 183.0 | 304.7  |
| 450                               | 4.6           | 35.4 | 47.3 | 71.1     | 106.5 | 177.5 | 295.9  |
| 475                               | 3.7           | 34.4 | 45.9 | 68.8     | 103.2 | 171.6 | 286.3  |
| 500                               | 2.8           | 32.1 | 42.9 | 64.4     | 96.6  | 160.6 | 267.9  |
| 538                               | 1.4           | 29.0 | 38.5 | 57.5     | 86.5  | 144.3 | 240.2  |
| 550                               | 1.4           | 28.8 | 38.3 | 57.3     | 86.0  | 143.6 | 239.2  |
| 575                               | 1.4           | 27.8 | 37.1 | 55.6     | 83.3  | 138.9 | 231.4  |
| 600                               | 1.4           | 25.3 | 33.6 | 50.2     | 75.1  | 125.2 | 208.8  |
| 625                               | 1.4           | 19.4 | 25.8 | 38.7     | 58.1  | 96.9  | 161.4  |
| 649                               | 1.4           | 13.4 | 17.8 | 26.8     | 40.1  | 66.9  | 111.5  |

NOTE: (1) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

(25) **Table 2-1.18C**  
**Pressure-Temperature Ratings for Group 1.18 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings     | Castings | Plates |       |       |       |       |
|------------------------------------|--------------|----------|--------|-------|-------|-------|-------|
| 9Cr-2W-V                           | A182 Gr. F92 | ...      | ...    |       |       |       |       |
| Working Pressures by Classes, psig |              |          |        |       |       |       |       |
| Temp., °F                          | Class        |          |        |       |       |       |       |
|                                    | 150          | 300      | 400    | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (1)]             | 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          | 630      | 840    | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125          | 615      | 820    | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110          | 600      | 795    | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95           | 555      | 745    | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80           | 535      | 710    | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65           | 510      | 685    | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50           | 475      | 635    | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35           | 425      | 570    | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20           | 415      | 550    | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | 20           | 410      | 545    | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | 20           | 375      | 500    | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | 20           | 285      | 380    | 570   | 855   | 1,425 | 2,370 |
| 1,200                              | 20           | 180      | 240    | 365   | 545   | 910   | 1,515 |

NOTE: (1) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings          |                  | Castings         |      | Plates |       |       |
|-----------------------------------|-------------------|------------------|------------------|------|--------|-------|-------|
|                                   |                   |                  |                  |      |        |       |       |
| 18Cr–8Ni                          | A182 Gr. F304 (1) | A351 Gr. CF3 (2) | A240 Gr. 304 (1) |      |        |       |       |
| 18Cr–8Ni                          | A182 Gr. F304H    | A351 Gr. CF8 (1) | A240 Gr. 304H    |      |        |       |       |
| Working Pressures by Classes, bar |                   |                  |                  |      |        |       |       |
| Temp., °C                         | Class             |                  |                  |      |        |       |       |
|                                   | 150               | 300              | 400              | 600  | 900    | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 19.1              | 49.7             | 66.3             | 99.4 | 149.1  | 248.6 | 414.3 |
| 50                                | 18.5              | 48.3             | 64.5             | 96.7 | 145.0  | 241.7 | 402.9 |
| 100                               | 15.6              | 40.8             | 54.4             | 81.6 | 122.4  | 204.0 | 340.0 |
| 150                               | 14.2              | 37.0             | 49.4             | 74.1 | 111.1  | 185.1 | 308.6 |
| 200                               | 13.1              | 34.3             | 45.7             | 68.6 | 102.9  | 171.4 | 285.7 |
| 250                               | 12.1              | 32.2             | 42.9             | 64.3 | 96.5   | 160.8 | 268.0 |
| 300                               | 10.2              | 31.0             | 41.3             | 61.9 | 92.9   | 154.8 | 258.0 |
| 325                               | 9.3               | 30.2             | 40.3             | 60.5 | 90.7   | 151.2 | 252.0 |
| 350                               | 8.4               | 29.5             | 39.4             | 59.0 | 88.6   | 147.6 | 246.0 |
| 375                               | 7.4               | 29.0             | 38.7             | 58.1 | 87.1   | 145.2 | 242.0 |
| 400                               | 6.5               | 28.3             | 37.8             | 56.6 | 85.0   | 141.6 | 236.0 |
| 425                               | 5.5               | 28.1             | 37.4             | 56.2 | 84.2   | 140.4 | 234.0 |
| 450                               | 4.6               | 27.4             | 36.5             | 54.7 | 82.1   | 136.8 | 228.0 |
| 475                               | 3.7               | 26.9             | 35.8             | 53.8 | 80.6   | 134.4 | 224.0 |
| 500                               | 2.8               | 26.4             | 35.2             | 52.8 | 79.2   | 132.0 | 220.0 |
| 538                               | 1.4               | 24.4             | 32.5             | 48.8 | 73.2   | 122.1 | 203.4 |
| 550                               | ...               | 24.0             | 32.0             | 48.0 | 72.0   | 120.0 | 200.0 |
| 575                               | ...               | 21.0             | 28.0             | 42.0 | 62.9   | 104.9 | 174.9 |
| 600                               | ...               | 16.8             | 22.4             | 33.6 | 50.4   | 84.0  | 140.0 |
| 625                               | ...               | 13.7             | 18.3             | 27.5 | 41.2   | 68.7  | 114.6 |
| 650                               | ...               | 11.2             | 15.0             | 22.5 | 33.7   | 56.2  | 93.7  |
| 675                               | ...               | 9.3              | 12.4             | 18.7 | 28.0   | 46.6  | 77.7  |
| 700                               | ...               | 8.0              | 10.7             | 16.0 | 24.1   | 40.1  | 66.9  |
| 725                               | ...               | 6.7              | 9.0              | 13.4 | 20.2   | 33.6  | 56.0  |
| 750                               | ...               | 5.7              | 7.6              | 11.5 | 17.2   | 28.6  | 47.7  |
| 775                               | ...               | 4.8              | 6.4              | 9.5  | 14.3   | 23.8  | 39.7  |
| 800                               | ...               | 3.8              | 5.1              | 7.6  | 11.4   | 19.0  | 31.7  |
| 816                               | ...               | 3.3              | 4.4              | 6.6  | 9.9    | 16.4  | 27.4  |

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) Not to be used over 427°C.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25)

**Table 2-2.1C  
Pressure–Temperature Ratings for Group 2.1 Materials — U.S. Customary Units**

| Nominal Designation | Forgings          | Castings         | Plates           |
|---------------------|-------------------|------------------|------------------|
| 18Cr–8Ni            | A182 Gr. F304 (1) | A351 Gr. CF3 (2) | A240 Gr. 304 (1) |
| 18Cr–8Ni            | A182 Gr. F304H    | A351 Gr. CF8 (1) | A240 Gr. 304H    |

| Temp., °F              | Working Pressures by Classes, psig |     |     |       |       |       |       |
|------------------------|------------------------------------|-----|-----|-------|-------|-------|-------|
|                        | Class                              |     |     |       |       |       |       |
|                        | 150                                | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)] | 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 | 990   | 1,485 | 2,470 | 4,120 |
| 500                    | 170                                | 465 | 620 | 925   | 1,390 | 2,315 | 3,860 |
| 600                    | 140                                | 440 | 590 | 885   | 1,325 | 2,210 | 3,680 |
| 650                    | 125                                | 430 | 575 | 860   | 1,290 | 2,150 | 3,580 |
| 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 | 475 | 715   | 1,070 | 1,785 | 2,970 |
| 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                  | ...                                | 80  | 105 | 160   | 235   | 395   | 655   |
| 1,450                  | ...                                | 60  | 80  | 125   | 185   | 310   | 515   |
| 1,500                  | ...                                | 50  | 65  | 95    | 145   | 245   | 400   |

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.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation | Forgings          | Castings          | Plates           |
|---------------------|-------------------|-------------------|------------------|
| 16Cr–12Ni–2Mo       | A182 Gr. F316 (1) | A351 Gr. CF3M (2) | A240 Gr. 316 (1) |
| 16Cr–12Ni–2Mo       | A182 Gr. F316H    | A351 Gr. CF8M (1) | A240 Gr. 316H    |
| 18Cr–13Ni–3Mo       | A182 Gr. F317 (1) | ...               | A240 Gr. 317 (1) |
| 19Cr–10Ni–3Mo       | ...               | A351 Gr. CG8M (3) | ...              |

| Working Pressures by Classes, bar |       |      |      |      |       |       |       |
|-----------------------------------|-------|------|------|------|-------|-------|-------|
| Temp., °C                         | Class |      |      |      |       |       |       |
|                                   | 150   | 300  | 400  | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (4)]             | 19.1  | 49.7 | 66.3 | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                | 18.5  | 48.3 | 64.5 | 96.7 | 145.0 | 241.7 | 402.9 |
| 100                               | 16.2  | 42.2 | 56.2 | 84.3 | 126.5 | 210.9 | 351.4 |
| 150                               | 14.7  | 38.4 | 51.2 | 76.8 | 115.2 | 192.0 | 320.0 |
| 200                               | 13.7  | 35.7 | 47.5 | 71.3 | 107.0 | 178.3 | 297.1 |
| 250                               | 12.1  | 33.4 | 44.5 | 66.7 | 100.1 | 166.8 | 278.0 |
| 300                               | 10.2  | 31.4 | 41.9 | 62.9 | 94.3  | 157.2 | 262.0 |
| 325                               | 9.3   | 31.0 | 41.3 | 61.9 | 92.9  | 154.8 | 258.0 |
| 350                               | 8.4   | 30.2 | 40.3 | 60.5 | 90.7  | 151.2 | 252.0 |
| 375                               | 7.4   | 29.8 | 39.7 | 59.5 | 89.3  | 148.8 | 248.0 |
| 400                               | 6.5   | 29.5 | 39.4 | 59.0 | 88.6  | 147.6 | 246.0 |
| 425                               | 5.5   | 29.0 | 38.7 | 58.1 | 87.1  | 145.2 | 242.0 |
| 450                               | 4.6   | 28.8 | 38.4 | 57.6 | 86.4  | 144.0 | 240.0 |
| 475                               | 3.7   | 28.6 | 38.1 | 57.1 | 85.7  | 142.8 | 238.0 |
| 500                               | 2.8   | 28.3 | 37.8 | 56.6 | 85.0  | 141.6 | 236.0 |
| 538                               | 1.4   | 26.7 | 35.6 | 53.4 | 80.1  | 133.5 | 222.6 |
| 550                               | ...   | 26.6 | 35.5 | 53.2 | 79.8  | 133.0 | 221.7 |
| 575                               | ...   | 25.3 | 33.7 | 50.5 | 75.8  | 126.3 | 210.6 |
| 600                               | ...   | 19.9 | 26.5 | 39.7 | 59.6  | 99.3  | 165.4 |
| 625                               | ...   | 15.8 | 21.0 | 31.5 | 47.3  | 78.9  | 131.4 |
| 650                               | ...   | 12.7 | 16.9 | 25.3 | 38.0  | 63.3  | 105.4 |
| 675                               | ...   | 10.3 | 13.8 | 20.6 | 31.0  | 51.6  | 86.0  |
| 700                               | ...   | 8.3  | 11.1 | 16.7 | 25.0  | 41.7  | 69.4  |
| 725                               | ...   | 7.0  | 9.3  | 13.9 | 20.9  | 34.8  | 58.0  |
| 750                               | ...   | 5.8  | 7.8  | 11.7 | 17.5  | 29.1  | 48.6  |
| 775                               | ...   | 4.6  | 6.1  | 9.2  | 13.8  | 23.0  | 38.3  |
| 800                               | ...   | 3.6  | 4.8  | 7.1  | 10.7  | 17.8  | 29.7  |
| 816                               | ...   | 3.1  | 4.1  | 6.1  | 9.2   | 15.3  | 25.4  |

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) Not to be used over 454°C.
- (3) Not to be used over 538°C.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.2C**  
**Pressure–Temperature Ratings for Group 2.2 Materials — U.S. Customary Units**

(25)

| Nominal Designation | Forgings          | Castings          | Plates           |
|---------------------|-------------------|-------------------|------------------|
| 16Cr–12Ni–2Mo       | A182 Gr. F316 (1) | A351 Gr. CF3M (2) | A240 Gr. 316 (1) |
| 16Cr–12Ni–2Mo       | A182 Gr. F316H    | A351 Gr. CF8M (1) | A240 Gr. 316H    |
| 18Cr–13Ni–3Mo       | A182 Gr. F317 (1) | ...               | A240 Gr. 317 (1) |
| 19Cr–10Ni–3Mo       | ...               | A351 Gr. CG8M (3) | ...              |

| Temp., °F              | Working Pressures by Classes, psig |     |     |       |       |       |       |
|------------------------|------------------------------------|-----|-----|-------|-------|-------|-------|
|                        | Class                              |     |     |       |       |       |       |
|                        | 150                                | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (4)] | 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 | 550 | 825   | 1,240 | 2,065 | 3,440 |
| 950                    | 35                                 | 410 | 545 | 815   | 1,225 | 2,040 | 3,400 |
| 1,000                  | 20                                 | 385 | 515 | 775   | 1,160 | 1,935 | 3,230 |
| 1,050                  | ...                                | 385 | 510 | 770   | 1,150 | 1,920 | 3,200 |
| 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                  | ...                                | 80  | 105 | 160   | 235   | 395   | 655   |
| 1,450                  | ...                                | 60  | 80  | 115   | 175   | 290   | 485   |
| 1,500                  | ...                                | 45  | 60  | 90    | 135   | 225   | 370   |

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.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.3**  
**Pressure–Temperature Ratings for Group 2.3 Materials — SI Units**

(25)

| Nominal Designation               | Forgings           | Castings | Plates            |      |       |       |       |
|-----------------------------------|--------------------|----------|-------------------|------|-------|-------|-------|
| 18Cr–8Ni                          | A182 Gr. F304L (1) | ...      | A240 Gr. 304L (1) |      |       |       |       |
| 16Cr–12Ni–2Mo                     | A182 Gr. F316L (1) | ...      | A240 Gr. 316L (1) |      |       |       |       |
| 18Cr–13Ni–3Mo                     | A182 Gr. F317L (1) | ...      | ...               |      |       |       |       |
| Working Pressures by Classes, bar |                    |          |                   |      |       |       |       |
| Temp., °C                         | Class              |          |                   |      |       |       |       |
|                                   | 150                | 300      | 400               | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 15.8               | 41.1     | 54.9              | 82.3 | 123.4 | 205.7 | 342.9 |
| 50                                | 15.5               | 40.5     | 53.9              | 80.9 | 121.4 | 202.3 | 337.1 |
| 100                               | 13.4               | 35.0     | 46.6              | 69.9 | 104.9 | 174.9 | 291.4 |
| 150                               | 12.1               | 31.4     | 41.9              | 62.9 | 94.3  | 157.2 | 262.0 |
| 200                               | 11.1               | 29.0     | 38.7              | 58.1 | 87.1  | 145.2 | 242.0 |
| 250                               | 10.5               | 27.4     | 36.5              | 54.7 | 82.1  | 136.8 | 228.0 |
| 300                               | 9.9                | 25.9     | 34.6              | 51.8 | 77.8  | 129.6 | 216.0 |
| 325                               | 9.3                | 25.4     | 33.9              | 50.9 | 76.3  | 127.2 | 212.0 |
| 350                               | 8.4                | 25.0     | 33.3              | 49.9 | 74.9  | 124.8 | 208.0 |
| 375                               | 7.4                | 24.7     | 33.0              | 49.4 | 74.2  | 123.6 | 206.0 |
| 400                               | 6.5                | 24.2     | 32.3              | 48.5 | 72.7  | 121.2 | 202.0 |
| 425                               | 5.5                | 23.9     | 31.8              | 47.7 | 71.6  | 119.3 | 198.9 |
| 454                               | 4.6                | 23.4     | 31.2              | 46.8 | 70.3  | 117.1 | 195.1 |

## NOTES:

(1) Not to be used over 454°C.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-2.3C**  
**Pressure–Temperature Ratings for Group 2.3 Materials — U.S. Customary Units**

| Nominal Designation | Forgings           | Castings | Plates            |
|---------------------|--------------------|----------|-------------------|
| 18Cr-8Ni            | A182 Gr. F304L (1) | ...      | A240 Gr. 304L (1) |
| 16Cr-12Ni-2Mo       | A182 Gr. F316L (1) | ...      | A240 Gr. 316L (1) |
| 18Cr-13Ni-3Mo       | A182 Gr. F317L (1) | ...      | ...               |

| Working Pressures by Classes, psig |       |     |     |       |       |       |       |
|------------------------------------|-------|-----|-----|-------|-------|-------|-------|
| Temp., °F                          | Class |     |     |       |       |       |       |
|                                    | 150   | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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 |

NOTES:

(1) Not to be used over 850°F.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings           | Castings | Plates            |      |       |       |       |
|-----------------------------------|--------------------|----------|-------------------|------|-------|-------|-------|
| 18Cr–10Ni–Ti                      | A182 Gr. F321 (1)  | ...      | A240 Gr. 321 (1)  |      |       |       |       |
| 18Cr–10Ni–Ti                      | A182 Gr. F321H (2) | ...      | A240 Gr. 321H (2) |      |       |       |       |
| Working Pressures by Classes, bar |                    |          |                   |      |       |       |       |
| Temp., °C                         | Class              |          |                   |      |       |       |       |
|                                   | 150                | 300      | 400               | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 19.1               | 49.7     | 66.3              | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                | 18.7               | 48.7     | 64.9              | 97.4 | 146.1 | 243.4 | 405.7 |
| 100                               | 17.0               | 44.2     | 59.0              | 88.5 | 132.7 | 221.1 | 368.6 |
| 150                               | 15.8               | 41.1     | 54.9              | 82.3 | 123.4 | 205.7 | 342.9 |
| 200                               | 13.8               | 38.4     | 51.2              | 76.8 | 115.2 | 192.0 | 320.0 |
| 250                               | 12.1               | 36.0     | 48.0              | 72.0 | 108.0 | 180.0 | 300.0 |
| 300                               | 10.2               | 34.1     | 45.4              | 68.2 | 102.2 | 170.4 | 284.0 |
| 325                               | 9.3                | 33.4     | 44.5              | 66.7 | 100.1 | 166.8 | 278.0 |
| 350                               | 8.4                | 32.6     | 43.5              | 65.3 | 97.9  | 163.2 | 272.0 |
| 375                               | 7.4                | 31.9     | 42.6              | 63.8 | 95.8  | 159.6 | 266.0 |
| 400                               | 6.5                | 31.7     | 42.2              | 63.4 | 95.0  | 158.4 | 264.0 |
| 425                               | 5.5                | 31.2     | 41.6              | 62.4 | 93.6  | 156.0 | 260.0 |
| 450                               | 4.6                | 30.7     | 41.0              | 61.4 | 92.2  | 153.6 | 256.0 |
| 475                               | 3.7                | 30.5     | 40.6              | 61.0 | 91.4  | 152.4 | 254.0 |
| 500                               | 2.8                | 30.2     | 40.3              | 60.5 | 90.7  | 151.2 | 252.0 |
| 538                               | 1.4                | 27.5     | 36.7              | 55.0 | 82.5  | 137.5 | 229.1 |
| 550                               | ...                | 27.5     | 36.7              | 55.0 | 82.5  | 137.5 | 229.1 |
| 575                               | ...                | 26.6     | 35.5              | 53.3 | 79.9  | 133.2 | 220.0 |
| 600                               | ...                | 20.1     | 26.8              | 40.3 | 60.4  | 100.6 | 167.7 |
| 625                               | ...                | 15.8     | 21.0              | 31.5 | 47.3  | 78.9  | 131.4 |
| 650                               | ...                | 12.7     | 16.9              | 25.3 | 38.0  | 63.3  | 105.4 |
| 675                               | ...                | 9.8      | 13.1              | 19.7 | 29.5  | 49.2  | 82.0  |
| 700                               | ...                | 7.9      | 10.5              | 15.7 | 23.6  | 39.3  | 65.4  |
| 725                               | ...                | 6.3      | 8.4               | 12.6 | 18.9  | 31.5  | 52.6  |
| 750                               | ...                | 4.9      | 6.6               | 9.9  | 14.8  | 24.7  | 41.1  |
| 775                               | ...                | 3.9      | 5.3               | 7.9  | 11.8  | 19.7  | 32.9  |
| 800                               | ...                | 3.1      | 4.2               | 6.3  | 9.4   | 15.7  | 26.2  |
| 816                               | ...                | 2.6      | 3.5               | 5.2  | 7.8   | 12.9  | 21.6  |

## NOTES:

- (1) Not to be used over 538°C.  
(2) At temperatures over 538°C, use only if the material is heat treated to a minimum temperature of 1 093°C.  
(3) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

(25)

**Table 2-2.4C**  
**Pressure–Temperature Ratings for Group 2.4 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings           | Castings | Plates            |       |       |       |       |
|------------------------------------|--------------------|----------|-------------------|-------|-------|-------|-------|
| 18Cr–10Ni–Ti                       | A182 Gr. F321 (1)  | ...      | A240 Gr. 321 (1)  |       |       |       |       |
| 18Cr–10Ni–Ti                       | A182 Gr. F321H (2) | ...      | A240 Gr. 321H (2) |       |       |       |       |
| Working Pressures by Classes, psig |                    |          |                   |       |       |       |       |
| Temp., °F                          | Class              |          |                   |       |       |       |       |
|                                    | 150                | 300      | 400               | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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                 | 425      | 570               | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                 | 410      | 550               | 825   | 1,235 | 2,055 | 3,430 |
| 1,050                              | ...                | 410      | 545               | 815   | 1,225 | 2,040 | 3,400 |
| 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 to a minimum temperature of 2,000°F.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings           | Castings | Plates            |      |       |       |       |
|-----------------------------------|--------------------|----------|-------------------|------|-------|-------|-------|
| 18Cr–10Ni–Cb                      | A182 Gr. F347 (1)  | ...      | A240 Gr. 347 (1)  |      |       |       |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F347H (2) | ...      | A240 Gr. 347H (2) |      |       |       |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F348 (1)  | ...      | A240 Gr. 348 (1)  |      |       |       |       |
| 18Cr–10Ni–Cb                      | A182 Gr. F348H (2) | ...      | A240 Gr. 348H (3) |      |       |       |       |
| Working Pressures by Classes, bar |                    |          |                   |      |       |       |       |
| Temp., °C                         | Class              |          |                   |      |       |       |       |
|                                   | 150                | 300      | 400               | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (4)]             | 19.1               | 49.7     | 66.3              | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                | 18.8               | 49.0     | 65.4              | 98.1 | 147.1 | 245.1 | 408.6 |
| 100                               | 17.3               | 45.3     | 60.3              | 90.5 | 135.8 | 226.3 | 377.1 |
| 150                               | 15.8               | 42.5     | 56.7              | 85.0 | 127.5 | 212.6 | 354.3 |
| 200                               | 13.8               | 39.8     | 53.0              | 79.5 | 119.3 | 198.9 | 331.4 |
| 250                               | 12.1               | 37.7     | 50.3              | 75.4 | 113.1 | 188.6 | 314.3 |
| 300                               | 10.2               | 36.0     | 48.0              | 72.0 | 108.0 | 180.0 | 300.0 |
| 325                               | 9.3                | 35.3     | 47.1              | 70.6 | 105.9 | 176.6 | 294.3 |
| 350                               | 8.4                | 35.0     | 46.6              | 69.9 | 104.9 | 174.9 | 291.4 |
| 375                               | 7.4                | 34.1     | 45.4              | 68.2 | 102.2 | 170.4 | 284.0 |
| 400                               | 6.5                | 33.8     | 45.1              | 67.7 | 101.5 | 169.2 | 282.0 |
| 425                               | 5.5                | 33.6     | 44.8              | 67.2 | 100.8 | 168.0 | 280.0 |
| 450                               | 4.6                | 33.4     | 44.5              | 66.7 | 100.1 | 166.8 | 278.0 |
| 475                               | 3.7                | 33.4     | 44.5              | 66.7 | 100.1 | 166.8 | 278.0 |
| 500                               | 2.8                | 32.1     | 42.9              | 64.4 | 96.6  | 160.6 | 267.9 |
| 538                               | 1.4                | 29.0     | 38.5              | 57.5 | 86.5  | 144.3 | 240.2 |
| 550                               | ...                | 28.8     | 38.3              | 57.3 | 86.0  | 143.6 | 239.2 |
| 575                               | ...                | 27.8     | 37.1              | 55.6 | 83.3  | 138.9 | 231.4 |
| 600                               | ...                | 25.3     | 33.6              | 50.2 | 75.1  | 125.2 | 208.8 |
| 625                               | ...                | 21.5     | 28.7              | 43.0 | 64.5  | 107.2 | 178.6 |
| 650                               | ...                | 16.6     | 22.1              | 33.2 | 50.2  | 83.4  | 138.9 |
| 675                               | ...                | 14.2     | 18.9              | 28.4 | 42.6  | 71.0  | 118.3 |
| 700                               | ...                | 10.9     | 14.5              | 21.8 | 32.7  | 54.5  | 90.9  |
| 725                               | ...                | 8.2      | 10.9              | 16.4 | 24.6  | 41.0  | 68.3  |
| 750                               | ...                | 6.4      | 8.6               | 12.9 | 19.3  | 32.2  | 53.7  |
| 775                               | ...                | 5.0      | 6.7               | 10.0 | 15.0  | 25.0  | 41.7  |
| 800                               | ...                | 3.7      | 4.9               | 7.4  | 11.1  | 18.5  | 30.9  |
| 816                               | ...                | 3.1      | 4.1               | 6.1  | 9.2   | 15.3  | 25.4  |

## 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 1 093°C.  
(3) Not to be used over 425°C.  
(4) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

**Table 2-2.5C**  
**Pressure–Temperature Ratings for Group 2.5 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings           | Castings | Plates            |       |       |       |       |
|------------------------------------|--------------------|----------|-------------------|-------|-------|-------|-------|
| 18Cr–10Ni–Cb                       | A182 Gr. F347 (1)  | ...      | A240 Gr. 347 (1)  |       |       |       |       |
| 18Cr–10Ni–Cb                       | A182 Gr. F347H (2) | ...      | A240 Gr. 347H (2) |       |       |       |       |
| 18Cr–10Ni–Cb                       | A182 Gr. F348 (1)  | ...      | A240 Gr. 348 (1)  |       |       |       |       |
| 18Cr–10Ni–Cb                       | A182 Gr. F348H (2) | ...      | A240 Gr. 348H (3) |       |       |       |       |
| Working Pressures by Classes, psig |                    |          |                   |       |       |       |       |
| Temp., °F                          | Class              |          |                   |       |       |       |       |
|                                    | 150                | 300      | 400               | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (4)]             | 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                 | 475      | 635               | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                 | 425      | 570               | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                 | 415      | 550               | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | ...                | 410      | 545               | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | ...                | 375      | 500               | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | ...                | 320      | 425               | 640   | 960   | 1,595 | 2,660 |
| 1,200                              | ...                | 240      | 320               | 480   | 725   | 1,205 | 2,005 |
| 1,250                              | ...                | 200      | 270               | 405   | 605   | 1,010 | 1,685 |
| 1,300                              | ...                | 150      | 200               | 300   | 455   | 755   | 1,255 |
| 1,350                              | ...                | 110      | 145               | 220   | 330   | 550   | 915   |
| 1,400                              | ...                | 85       | 115               | 170   | 255   | 430   | 715   |
| 1,450                              | ...                | 60       | 80                | 125   | 185   | 310   | 515   |
| 1,500                              | ...                | 45       | 60                | 90    | 135   | 225   | 370   |

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.
- (3) Not to be used over 800°F.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings |      | Castings |      |       | Plates        |       |
|-----------------------------------|----------|------|----------|------|-------|---------------|-------|
| 23Cr–12Ni                         | ...      |      | ...      |      |       | A240 Gr. 309H |       |
| Working Pressures by Classes, bar |          |      |          |      |       |               |       |
| Temp., °C                         | Class    |      |          |      |       |               |       |
|                                   | 150      | 300  | 400      | 600  | 900   | 1500          | 2500  |
| Min. to 38 [Note (1)]             | 19.1     | 49.7 | 66.3     | 99.4 | 149.1 | 248.6         | 414.3 |
| 50                                | 18.5     | 48.3 | 64.5     | 96.7 | 145.0 | 241.7         | 402.9 |
| 100                               | 16.4     | 42.9 | 57.1     | 85.7 | 128.6 | 214.3         | 357.1 |
| 150                               | 15.4     | 40.1 | 53.5     | 80.2 | 120.3 | 200.6         | 334.3 |
| 200                               | 13.8     | 37.7 | 50.3     | 75.4 | 113.1 | 188.6         | 314.3 |
| 250                               | 12.1     | 36.0 | 48.0     | 72.0 | 108.0 | 180.0         | 300.0 |
| 300                               | 10.2     | 35.0 | 46.6     | 69.9 | 104.9 | 174.9         | 291.4 |
| 325                               | 9.3      | 34.3 | 45.7     | 68.6 | 102.9 | 171.4         | 285.7 |
| 350                               | 8.4      | 33.8 | 45.1     | 67.7 | 101.5 | 169.2         | 282.0 |
| 375                               | 7.4      | 33.4 | 44.5     | 66.7 | 100.1 | 166.8         | 278.0 |
| 400                               | 6.5      | 33.1 | 44.2     | 66.2 | 99.4  | 165.6         | 276.0 |
| 425                               | 5.5      | 32.6 | 43.5     | 65.3 | 97.9  | 163.2         | 272.0 |
| 450                               | 4.6      | 32.2 | 42.9     | 64.3 | 96.5  | 160.8         | 268.0 |
| 475                               | 3.7      | 31.7 | 42.2     | 63.4 | 95.0  | 158.4         | 264.0 |
| 500                               | 2.8      | 31.2 | 41.6     | 62.4 | 93.6  | 156.0         | 260.0 |
| 538                               | 1.4      | 28.1 | 37.5     | 56.2 | 84.3  | 140.6         | 234.3 |
| 550                               | ...      | 27.1 | 36.1     | 54.1 | 81.2  | 135.3         | 225.4 |
| 575                               | ...      | 22.4 | 29.6     | 44.7 | 67.1  | 111.8         | 186.3 |
| 600                               | ...      | 16.7 | 22.2     | 33.3 | 50.0  | 83.3          | 138.9 |
| 625                               | ...      | 12.4 | 16.6     | 24.9 | 37.3  | 62.2          | 103.7 |
| 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      | 10.9 | 16.4  | 27.3          | 45.4  |
| 725                               | ...      | 4.3  | 5.7      | 8.6  | 12.9  | 21.4          | 35.7  |
| 750                               | ...      | 3.4  | 4.5      | 6.8  | 10.2  | 17.0          | 28.3  |
| 775                               | ...      | 2.7  | 3.6      | 5.3  | 8.0   | 13.3          | 22.2  |
| 800                               | ...      | 2.1  | 2.8      | 4.2  | 6.3   | 10.5          | 17.5  |
| 816                               | ...      | 1.8  | 2.3      | 3.5  | 5.3   | 8.8           | 14.7  |

NOTE: (1) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-2.6C**  
**Pressure–Temperature Ratings for Group 2.6 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings | Castings | Plates        |       |       |       |       |
|------------------------------------|----------|----------|---------------|-------|-------|-------|-------|
| 23Cr-12Ni                          | ...      | ...      | A240 Gr. 309H |       |       |       |       |
| Working Pressures by Classes, psig |          |          |               |       |       |       |       |
| Temp., °F                          | Class    |          |               |       |       |       |       |
|                                    | 150      | 300      | 400           | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (1)]             | 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       | 460      | 610           | 915   | 1,375 | 2,290 | 3,820 |
| 950                                | 35       | 425      | 570           | 885   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20       | 415      | 550           | 825   | 1,245 | 2,075 | 3,455 |
| 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   |

NOTE: (1) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation                      | Forgings       | Castings | Plates        |      |       |       |       |
|--|----------------|----------|---------------|------|-------|-------|-------|
| 25Cr–20Ni                                | A182 Gr. F310H | ...      | A240 Gr. 310H |      |       |       |       |
| <b>Working Pressures by Classes, bar</b> |                |          |               |      |       |       |       |
|  | <b>Class</b>   |          |               |      |       |       |       |
| Temp., °C                                | 150            | 300      | 400           | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (1)]                    | 19.1           | 49.7     | 66.3          | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                       | 18.7           | 48.7     | 64.9          | 97.4 | 146.1 | 243.4 | 405.7 |
| 100                                      | 16.7           | 43.5     | 58.1          | 87.1 | 130.6 | 217.7 | 362.9 |
| 150                                      | 15.4           | 40.1     | 53.5          | 80.2 | 120.3 | 200.6 | 334.3 |
| 200                                      | 13.8           | 37.7     | 50.3          | 75.4 | 113.1 | 188.6 | 314.3 |
| 250                                      | 12.1           | 35.7     | 47.5          | 71.3 | 107.0 | 178.3 | 297.1 |
| 300                                      | 10.2           | 34.6     | 46.2          | 69.3 | 103.9 | 173.1 | 288.6 |
| 325                                      | 9.3            | 33.8     | 45.1          | 67.7 | 101.5 | 169.2 | 282.0 |
| 350                                      | 8.4            | 33.4     | 44.5          | 66.7 | 100.1 | 166.8 | 278.0 |
| 375                                      | 7.4            | 32.9     | 43.8          | 65.8 | 98.6  | 164.4 | 274.0 |
| 400                                      | 6.5            | 32.4     | 43.2          | 64.8 | 97.2  | 162.0 | 270.0 |
| 425                                      | 5.5            | 32.2     | 42.9          | 64.3 | 96.5  | 160.8 | 268.0 |
| 450                                      | 4.6            | 31.7     | 42.2          | 63.4 | 95.0  | 158.4 | 264.0 |
| 475                                      | 3.7            | 31.2     | 41.6          | 62.4 | 93.6  | 156.0 | 260.0 |
| 500                                      | 2.8            | 30.7     | 41.0          | 61.4 | 92.2  | 153.6 | 256.0 |
| 538                                      | 1.4            | 28.0     | 37.4          | 56.1 | 84.1  | 140.2 | 233.7 |
| 550                                      | ...            | 27.4     | 36.5          | 54.7 | 82.1  | 136.8 | 228.0 |
| 575                                      | ...            | 22.2     | 29.6          | 44.4 | 66.5  | 110.9 | 184.9 |
| 600                                      | ...            | 16.7     | 22.2          | 33.3 | 50.0  | 83.3  | 138.9 |
| 625                                      | ...            | 12.4     | 16.5          | 24.8 | 37.2  | 62.1  | 103.4 |
| 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           | 10.9 | 16.4  | 27.3  | 45.4  |
| 725                                      | ...            | 4.3      | 5.7           | 8.6  | 12.9  | 21.4  | 35.7  |
| 750                                      | ...            | 3.4      | 4.5           | 6.8  | 10.2  | 17.0  | 28.3  |
| 775                                      | ...            | 2.6      | 3.5           | 5.2  | 7.9   | 13.1  | 21.8  |
| 800                                      | ...            | 2.0      | 2.7           | 4.1  | 6.1   | 10.2  | 17.1  |
| 816                                      | ...            | 1.8      | 2.3           | 3.5  | 5.3   | 8.8   | 14.7  |

NOTE: (1) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

(25) **Table 2-2.7C**  
**Pressure–Temperature Ratings for Group 2.7 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings       | Castings | Plates        |       |       |       |       |
|------------------------------------|----------------|----------|---------------|-------|-------|-------|-------|
| 25Cr-20Ni                          | A182 Gr. F310H | ...      | A240 Gr. 310H |       |       |       |       |
| Working Pressures by Classes, psig |                |          |               |       |       |       |       |
| Temp., °F                          | Class          |          |               |       |       |       |       |
|                                    | 150            | 300      | 400           | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (1)]             | 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   | 1,355 | 2,255 | 3,760 |
| 950                                | 35             | 425      | 570           | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20             | 415      | 550           | 825   | 1,245 | 2,075 | 3,455 |
| 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   |

NOTE: (1) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings     |      |      | Castings         |       | Plates          |       |
|-----------------------------------|--------------|------|------|------------------|-------|-----------------|-------|
| 20Cr–18Ni–6Mo                     | A182 Gr. F44 |      |      | A351 Gr. CK3MCuN |       | A240 Gr. S31254 |       |
| Working Pressures by Classes, bar |              |      |      |                  |       |                 |       |
| Temp., °C                         | Class        |      |      |                  |       |                 |       |
|                                   | 150          | 300  | 400  | 600              | 900   | 1500            | 2500  |
| Min. to 38 [Note (1)]             | 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 | 67.7 | 101.5            | 152.2 | 253.7           | 430.9 |
| 150                               | 15.8         | 45.9 | 61.3 | 91.9             | 137.8 | 229.7           | 425.0 |
| 200                               | 13.8         | 42.9 | 57.1 | 85.7             | 128.6 | 214.3           | 396.4 |
| 250                               | 12.1         | 40.5 | 53.9 | 80.9             | 121.4 | 202.3           | 375.0 |
| 300                               | 10.2         | 38.7 | 51.7 | 77.5             | 116.2 | 193.7           | 360.7 |
| 325                               | 9.3          | 38.1 | 50.7 | 76.1             | 114.2 | 190.3           | 355.0 |
| 350                               | 8.4          | 37.7 | 50.3 | 75.4             | 113.1 | 188.6           | 350.4 |
| 375                               | 7.4          | 37.4 | 49.8 | 74.7             | 112.1 | 186.9           | 348.2 |
| 399                               | 6.5          | 37.0 | 49.4 | 74.1             | 111.1 | 185.1           | 343.9 |

NOTE: (1) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.8C**  
**Pressure–Temperature Ratings for Group 2.8 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings     |     |       | Castings         |       | Plates          |       |
|------------------------------------|--------------|-----|-------|------------------|-------|-----------------|-------|
| 20Cr–18Ni–6Mo                      | A182 Gr. F44 |     |       | A351 Gr. CK3MCuN |       | A240 Gr. S31254 |       |
| Working Pressures by Classes, psig |              |     |       |                  |       |                 |       |
| Temp., °F                          | Class        |     |       |                  |       |                 |       |
|                                    | 150          | 300 | 400   | 600              | 900   | 1500            | 2500  |
| Min. to 100 [Note (1)]             | 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           | 540 | 715   | 1,075            | 1,615 | 2,690           | 4,480 |

NOTE: (1) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings |      | Castings |      |       | Plates                |       |
|-----------------------------------|----------|------|----------|------|-------|-----------------------|-------|
| 23Cr–12Ni                         | ...      | ...  | ...      | ...  | ...   | A240 Gr. 309S (1)–(3) |       |
| 25Cr–20Ni                         | ...      | ...  | ...      | ...  | ...   | A240 Gr. 310S (1)–(3) |       |
| Working Pressures by Classes, bar |          |      |          |      |       |                       |       |
| Temp., °C                         | Class    |      |          |      |       |                       |       |
|                                   | 150      | 300  | 400      | 600  | 900   | 1500                  | 2500  |
| Min. to 38 [Note (4)]             | 19.1     | 49.7 | 66.3     | 99.4 | 149.1 | 248.6                 | 414.3 |
| 50                                | 18.5     | 48.3 | 64.5     | 96.7 | 145.0 | 241.7                 | 402.9 |
| 100                               | 16.4     | 42.9 | 57.1     | 85.7 | 128.6 | 214.3                 | 357.1 |
| 150                               | 15.4     | 40.1 | 53.5     | 80.2 | 120.3 | 200.6                 | 334.3 |
| 200                               | 13.8     | 37.7 | 50.3     | 75.4 | 113.1 | 188.6                 | 314.3 |
| 250                               | 12.1     | 35.7 | 47.5     | 71.3 | 107.0 | 178.3                 | 297.1 |
| 300                               | 10.2     | 34.6 | 46.2     | 69.3 | 103.9 | 173.1                 | 288.6 |
| 325                               | 9.3      | 33.8 | 45.1     | 67.7 | 101.5 | 169.2                 | 282.0 |
| 350                               | 8.4      | 33.4 | 44.5     | 66.7 | 100.1 | 166.8                 | 278.0 |
| 375                               | 7.4      | 32.9 | 43.8     | 65.8 | 98.6  | 164.4                 | 274.0 |
| 400                               | 6.5      | 32.4 | 43.2     | 64.8 | 97.2  | 162.0                 | 270.0 |
| 425                               | 5.5      | 32.2 | 42.9     | 64.3 | 96.5  | 160.8                 | 268.0 |
| 450                               | 4.6      | 31.7 | 42.2     | 63.4 | 95.0  | 158.4                 | 264.0 |
| 475                               | 3.7      | 31.2 | 41.6     | 62.4 | 93.6  | 156.0                 | 260.0 |
| 500                               | 2.8      | 30.7 | 41.0     | 61.4 | 92.2  | 153.6                 | 256.0 |
| 538                               | 1.4      | 23.3 | 31.1     | 46.7 | 70.0  | 116.7                 | 194.6 |
| 550                               | ...      | 20.3 | 27.1     | 40.6 | 60.9  | 101.5                 | 169.1 |
| 575                               | ...      | 15.2 | 20.2     | 30.3 | 45.5  | 75.8                  | 126.3 |
| 600                               | ...      | 10.9 | 14.5     | 21.8 | 32.7  | 54.5                  | 90.9  |
| 625                               | ...      | 8.1  | 10.8     | 16.3 | 24.4  | 40.6                  | 67.7  |
| 650                               | ...      | 5.8  | 7.7      | 11.6 | 17.4  | 29.0                  | 48.3  |
| 675                               | ...      | 3.7  | 4.9      | 7.3  | 11.0  | 18.3                  | 30.6  |
| 700                               | ...      | 2.1  | 2.8      | 4.2  | 6.3   | 10.5                  | 17.4  |
| 725                               | ...      | 1.3  | 1.7      | 2.6  | 3.9   | 6.5                   | 10.8  |
| 750                               | ...      | 1.0  | 1.4      | 2.0  | 3.0   | 5.1                   | 8.5   |
| 775                               | ...      | 0.8  | 1.1      | 1.6  | 2.5   | 4.1                   | 6.9   |
| 800                               | ...      | 0.6  | 0.8      | 1.2  | 1.8   | 3.0                   | 5.0   |
| 816                               | ...      | 0.5  | 0.6      | 0.9  | 1.4   | 2.3                   | 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 1040°C, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 566°C and above only when assurance is provided that grain size is not finer than ASTM No. 6.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.9C**  
**Pressure–Temperature Ratings for Group 2.9 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings | Castings | Plates                |       |       |       |       |
|------------------------------------|----------|----------|-----------------------|-------|-------|-------|-------|
| 23Cr–12Ni                          | ...      | ...      | A240 Gr. 309S (1)–(3) |       |       |       |       |
| 25Cr–20Ni                          | ...      | ...      | A240 Gr. 310S (1)–(3) |       |       |       |       |
| Working Pressures by Classes, psig |          |          |                       |       |       |       |       |
| Temp., °F                          | Class    |          |                       |       |       |       |       |
|                                    | 150      | 300      | 400                   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (4)]             | 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   | 1,355 | 2,255 | 3,760 |
| 950                                | 35       | 425      | 570                   | 885   | 1,275 | 2,125 | 3,540 |
| 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 No. 6.
- (4) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.10**  
**Pressure-Temperature Ratings for Group 2.10 Materials — SI Units**

(25)

| Nominal Designation               | Forgings |      | Castings          |      |       | Plates |       |
|-----------------------------------|----------|------|-------------------|------|-------|--------|-------|
| 25Cr-12Ni                         | ...      |      | A351 Gr. CH8 (1)  |      |       | ...    |       |
| 25Cr-12Ni                         | ...      |      | A351 Gr. CH20 (1) |      |       | ...    |       |
| Working Pressures by Classes, bar |          |      |                   |      |       |        |       |
| Temp., °C                         | Class    |      |                   |      |       |        |       |
|                                   | 150      | 300  | 400               | 600  | 900   | 1500   | 2500  |
| Min. to 38 [Note (2)]             | 17.7     | 46.3 | 61.7              | 92.6 | 138.9 | 231.4  | 385.7 |
| 50                                | 17.2     | 44.9 | 59.9              | 89.8 | 134.7 | 224.6  | 374.3 |
| 100                               | 14.3     | 37.4 | 49.8              | 74.7 | 112.1 | 186.9  | 311.4 |
| 150                               | 13.4     | 35.0 | 46.6              | 69.9 | 104.9 | 174.9  | 291.4 |
| 200                               | 12.9     | 33.6 | 44.8              | 67.2 | 100.8 | 168.0  | 280.0 |
| 250                               | 12.1     | 32.6 | 43.5              | 65.3 | 97.9  | 163.2  | 272.0 |
| 300                               | 10.2     | 31.7 | 42.2              | 63.4 | 95.0  | 158.4  | 264.0 |
| 325                               | 9.3      | 31.2 | 41.6              | 62.4 | 93.6  | 156.0  | 260.0 |
| 350                               | 8.4      | 30.5 | 40.6              | 61.0 | 91.4  | 152.4  | 254.0 |
| 375                               | 7.4      | 29.8 | 39.7              | 59.5 | 89.3  | 148.8  | 248.0 |
| 400                               | 6.5      | 29.0 | 38.7              | 58.1 | 87.1  | 145.2  | 242.0 |
| 425                               | 5.5      | 28.3 | 37.8              | 56.6 | 85.0  | 141.6  | 236.0 |
| 450                               | 4.6      | 27.6 | 36.8              | 55.2 | 82.8  | 138.0  | 230.0 |
| 475                               | 3.7      | 26.6 | 35.5              | 53.3 | 79.9  | 133.2  | 222.0 |
| 500                               | 2.8      | 25.9 | 34.6              | 51.8 | 77.8  | 129.6  | 216.0 |
| 538                               | 1.4      | 22.8 | 30.4              | 45.7 | 68.5  | 114.2  | 190.3 |
| 550                               | ...      | 21.9 | 29.2              | 43.8 | 65.7  | 109.5  | 182.6 |
| 575                               | ...      | 18.4 | 24.5              | 36.8 | 55.2  | 92.1   | 153.4 |
| 600                               | ...      | 14.4 | 19.2              | 28.9 | 43.3  | 72.2   | 120.3 |
| 625                               | ...      | 11.4 | 15.2              | 22.8 | 34.1  | 56.9   | 94.9  |
| 650                               | ...      | 8.9  | 11.8              | 17.8 | 26.6  | 44.4   | 74.0  |
| 675                               | ...      | 7.0  | 9.3               | 13.9 | 20.9  | 34.8   | 58.0  |
| 700                               | ...      | 5.6  | 7.5               | 11.2 | 16.9  | 28.1   | 46.9  |
| 725                               | ...      | 4.6  | 6.1               | 9.1  | 13.7  | 22.8   | 38.0  |
| 750                               | ...      | 3.5  | 4.7               | 7.0  | 10.5  | 17.5   | 29.1  |
| 775                               | ...      | 2.5  | 3.3               | 5.0  | 7.5   | 12.4   | 20.7  |
| 800                               | ...      | 2.0  | 2.6               | 3.9  | 5.9   | 9.8    | 16.4  |
| 816                               | ...      | 1.9  | 2.5               | 3.8  | 5.6   | 9.4    | 15.7  |

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.10C**  
**Pressure-Temperature Ratings for Group 2.10 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings | Castings          |     | Plates |       |       |       |
|------------------------------------|----------|-------------------|-----|--------|-------|-------|-------|
| 25Cr-12Ni                          | ...      | A351 Gr. CH8 (1)  |     | ...    |       |       |       |
| 25Cr-12Ni                          | ...      | A351 Gr. CH20 (1) |     | ...    |       |       |       |
| Working Pressures by Classes, psig |          |                   |     |        |       |       |       |
| Temp., °F                          | Class    |                   |     |        |       |       |       |
|                                    | 150      | 300               | 400 | 600    | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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               | 455 | 680    | 1,020 | 1,695 | 2,830 |
| 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   |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.11  
Pressure-Temperature Ratings for Group 2.11 Materials — SI Units**

(25)

| Nominal Designation               | Forgings |      | Castings          |      |       | Plates |       |
|-----------------------------------|----------|------|-------------------|------|-------|--------|-------|
| 18Cr-10Ni-Cb                      | ...      |      | A351 Gr. CF8C (1) |      |       | ...    |       |
| Working Pressures by Classes, bar |          |      |                   |      |       |        |       |
| Temp., °C                         | Class    |      |                   |      |       |        |       |
|                                   | 150      | 300  | 400               | 600  | 900   | 1500   | 2500  |
| Min. to 38 [Note (2)]             | 19.1     | 49.7 | 66.3              | 99.4 | 149.1 | 248.6  | 414.3 |
| 50                                | 18.8     | 49.0 | 65.4              | 98.1 | 147.1 | 245.1  | 408.6 |
| 100                               | 17.3     | 45.3 | 60.3              | 90.5 | 135.8 | 226.3  | 377.1 |
| 150                               | 15.8     | 42.5 | 56.7              | 85.0 | 127.5 | 212.6  | 354.3 |
| 200                               | 13.8     | 39.8 | 53.0              | 79.5 | 119.3 | 198.9  | 331.4 |
| 250                               | 12.1     | 37.7 | 50.3              | 75.4 | 113.1 | 188.6  | 314.3 |
| 300                               | 10.2     | 36.0 | 48.0              | 72.0 | 108.0 | 180.0  | 300.0 |
| 325                               | 9.3      | 35.3 | 47.1              | 70.6 | 105.9 | 176.6  | 294.3 |
| 350                               | 8.4      | 35.0 | 46.6              | 69.9 | 104.9 | 174.9  | 291.4 |
| 375                               | 7.4      | 34.1 | 45.4              | 68.2 | 102.2 | 170.4  | 284.0 |
| 400                               | 6.5      | 33.8 | 45.1              | 67.7 | 101.5 | 169.2  | 282.0 |
| 425                               | 5.5      | 33.6 | 44.8              | 67.2 | 100.8 | 168.0  | 280.0 |
| 450                               | 4.6      | 33.4 | 44.5              | 66.7 | 100.1 | 166.8  | 278.0 |
| 475                               | 3.7      | 33.4 | 44.5              | 66.7 | 100.1 | 166.8  | 278.0 |
| 500                               | 2.8      | 32.1 | 42.9              | 64.4 | 96.6  | 160.6  | 267.9 |
| 538                               | 1.4      | 29.0 | 38.5              | 57.5 | 86.5  | 144.3  | 240.2 |
| 550                               | ...      | 28.8 | 38.3              | 57.3 | 86.0  | 143.6  | 239.2 |
| 575                               | ...      | 26.5 | 35.3              | 52.9 | 79.4  | 132.3  | 220.6 |
| 600                               | ...      | 19.8 | 26.4              | 39.6 | 59.3  | 98.9   | 164.9 |
| 625                               | ...      | 13.7 | 18.2              | 27.4 | 41.0  | 68.4   | 114.0 |
| 650                               | ...      | 10.3 | 13.7              | 20.6 | 30.9  | 51.4   | 85.7  |
| 675                               | ...      | 8.0  | 10.6              | 15.9 | 23.9  | 39.8   | 66.3  |
| 700                               | ...      | 5.6  | 7.5               | 11.2 | 16.8  | 27.9   | 46.6  |
| 725                               | ...      | 3.8  | 5.1               | 7.7  | 11.5  | 19.2   | 32.0  |
| 750                               | ...      | 3.1  | 4.1               | 6.1  | 9.2   | 15.3   | 25.5  |
| 775                               | ...      | 2.4  | 3.2               | 4.9  | 7.3   | 12.1   | 20.2  |
| 800                               | ...      | 2.0  | 2.6               | 4.0  | 5.9   | 9.9    | 16.5  |
| 816                               | ...      | 1.9  | 2.5               | 3.8  | 5.6   | 9.4    | 15.7  |

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.11C**  
**Pressure-Temperature Ratings for Group 2.11 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings | Castings          |     |       |       | Plates |       |
|------------------------------------|----------|-------------------|-----|-------|-------|--------|-------|
| 18Cr-10Ni-Cb                       | ...      | A351 Gr. CF8C (1) |     |       |       | ...    |       |
| Working Pressures by Classes, psig |          |                   |     |       |       |        |       |
| Temp., °F                          | Class    |                   |     |       |       |        |       |
|                                    | 150      | 300               | 400 | 600   | 900   | 1500   | 2500  |
| Min. to 100 [Note (2)]             | 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       | 475               | 635 | 955   | 1,430 | 2,380  | 3,970 |
| 950                                | 35       | 425               | 570 | 855   | 1,275 | 2,125  | 3,540 |
| 1,000                              | 20       | 415               | 550 | 825   | 1,245 | 2,075  | 3,455 |
| 1,050                              | ...      | 410               | 545 | 820   | 1,230 | 2,050  | 3,420 |
| 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   |

## NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.  
(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.12**  
**Pressure-Temperature Ratings for Group 2.12 Materials — SI Units**

(25)

| 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  |
| Min. to 38 [Note (2)]             | 17.7     | 46.3 | 61.7              | 92.6 | 138.9 | 231.4  | 385.7 |
| 50                                | 17.2     | 44.9 | 59.9              | 89.8 | 134.7 | 224.6  | 374.3 |
| 100                               | 14.3     | 37.4 | 49.8              | 74.7 | 112.1 | 186.9  | 311.4 |
| 150                               | 13.4     | 35.0 | 46.6              | 69.9 | 104.9 | 174.9  | 291.4 |
| 200                               | 12.9     | 33.6 | 44.8              | 67.2 | 100.8 | 168.0  | 280.0 |
| 250                               | 12.1     | 32.6 | 43.5              | 65.3 | 97.9  | 163.2  | 272.0 |
| 300                               | 10.2     | 31.7 | 42.2              | 63.4 | 95.0  | 158.4  | 264.0 |
| 325                               | 9.3      | 31.2 | 41.6              | 62.4 | 93.6  | 156.0  | 260.0 |
| 350                               | 8.4      | 30.5 | 40.6              | 61.0 | 91.4  | 152.4  | 254.0 |
| 375                               | 7.4      | 29.8 | 39.7              | 59.5 | 89.3  | 148.8  | 248.0 |
| 400                               | 6.5      | 29.0 | 38.7              | 58.1 | 87.1  | 145.2  | 242.0 |
| 425                               | 5.5      | 28.3 | 37.8              | 56.6 | 85.0  | 141.6  | 236.0 |
| 450                               | 4.6      | 27.6 | 36.8              | 55.2 | 82.8  | 138.0  | 230.0 |
| 475                               | 3.7      | 26.6 | 35.5              | 53.3 | 79.9  | 133.2  | 222.0 |
| 500                               | 2.8      | 25.9 | 34.6              | 51.8 | 77.8  | 129.6  | 216.0 |
| 538                               | 1.4      | 23.4 | 31.2              | 46.8 | 70.1  | 116.9  | 194.9 |
| 550                               | ...      | 23.0 | 30.6              | 45.9 | 68.9  | 114.9  | 191.4 |
| 575                               | ...      | 21.7 | 28.9              | 43.3 | 65.0  | 108.3  | 180.6 |
| 600                               | ...      | 19.5 | 26.0              | 38.9 | 58.4  | 97.4   | 162.3 |
| 625                               | ...      | 16.8 | 22.4              | 33.7 | 50.5  | 84.2   | 140.3 |
| 650                               | ...      | 14.1 | 18.7              | 28.1 | 42.2  | 70.3   | 117.1 |
| 675                               | ...      | 11.5 | 15.4              | 23.0 | 34.6  | 57.6   | 96.0  |
| 700                               | ...      | 8.7  | 11.7              | 17.5 | 26.2  | 43.7   | 72.9  |
| 725                               | ...      | 6.3  | 8.4               | 12.5 | 18.8  | 31.4   | 52.3  |
| 750                               | ...      | 4.4  | 5.9               | 8.8  | 13.2  | 21.9   | 36.6  |
| 775                               | ...      | 3.1  | 4.1               | 6.1  | 9.2   | 15.3   | 25.5  |
| 800                               | ...      | 2.3  | 3.0               | 4.5  | 6.8   | 11.3   | 18.8  |
| 816                               | ...      | 1.9  | 2.5               | 3.8  | 5.6   | 9.4    | 15.6  |

NOTES:

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

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.12C**  
**Pressure-Temperature Ratings for Group 2.12 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings |     |     | Castings          |       | Plates |       |
|------------------------------------|----------|-----|-----|-------------------|-------|--------|-------|
| 25Cr-20Ni                          | ...      |     |     | A351 Gr. CK20 (1) |       | ...    |       |
| Working Pressures by Classes, psig |          |     |     |                   |       |        |       |
| Temp., °F                          | Class    |     |     |                   |       |        |       |
|                                    | 150      | 300 | 400 | 600               | 900   | 1500   | 2500  |
| Min. to 100 [Note (2)]             | 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 | 455 | 680               | 1,020 | 1,695  | 2,830 |
| 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   |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.13**  
**Pressure-Temperature Ratings for Group 2.13 Materials — SI Units**

(25)

| Nominal Designation   | Forgings         | Castings                   | Plates              |
|-----------------------|------------------|----------------------------|---------------------|
| 22Cr-5Ni-3Mo-N        | A182 Gr. F51 (1) | A995 Gr. CD3MN (4A) (2)    | A240 Gr. S31803 (1) |
| 22Cr-5Ni-3Mo-N        | A182 Gr. F60 (1) | ...                        | A240 Gr. S32205 (1) |
| 22Cr-5Ni-3Mo-2Cu      | ...              | ...                        | A240 Gr. S32550 (2) |
| 25Cr-7Ni-4Mo-N        | A182 Gr. F53 (1) | ...                        | A240 Gr. S32750 (1) |
| 24Cr-10Ni-4Mo-V       | ...              | A995 Gr. CE8MN (2A) (1)    | ...                 |
| 25Cr-5Ni-2Mo-3Cu-N    | ...              | A995 Gr. CD4MCuN (1B) (1)  | ...                 |
| 25Cr-7Ni-3.5Mo-W-Cb   | ...              | A995 Gr. CD3MWCuN (6A) (1) | ...                 |
| 25Cr-7Ni-3.5Mo-N-Cu-W | A182 Gr. F55 (1) | ...                        | A240 Gr. S32760 (1) |

| Working Pressures by Classes, bar |       |      |      |       |       |       |       |
|-----------------------------------|-------|------|------|-------|-------|-------|-------|
| Temp., °C                         | Class |      |      |       |       |       |       |
|                                   | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 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 | 67.0 | 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 | 61.8 | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2  | 45.0 | 60.0 | 90.0  | 135.0 | 225.1 | 375.0 |
| 316                               | 9.6   | 43.9 | 58.5 | 87.6  | 131.5 | 219.2 | 365.3 |

NOTES:

(1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 316°C.

(2) Not to be used over 260°C.

(3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-2.13C**  
**Pressure-Temperature Ratings for Group 2.13 Materials — U.S. Customary Units**

(25)

| Nominal Designation   | Forgings         | Castings                   | Plates              |
|-----------------------|------------------|----------------------------|---------------------|
| 22Cr-5Ni-3Mo-N        | A182 Gr. F51 (1) | A995 Gr. CD3MN (4A) (2)    | A240 Gr. S31803 (1) |
| 22Cr-5Ni-3Mo-N        | A182 Gr. F60 (1) | ...                        | A240 Gr. S32205 (1) |
| 22Cr-5Ni-3Mo-2Cu      | ...              | ...                        | A240 Gr. S32550 (2) |
| 25Cr-7Ni-4Mo-N        | A182 Gr. F53 (1) | ...                        | A240 Gr. S32750 (1) |
| 24Cr-10Ni-4Mo-V       | ...              | A995 Gr. CE8MN (2A) (1)    | ...                 |
| 25Cr-5Ni-2Mo-3Cu-N    | ...              | A995 Gr. CD4MCuN (1B) (1)  | ...                 |
| 25Cr-7Ni-3.5Mo-W-Cb   | ...              | A995 Gr. CD3MWCuN (6A) (1) | ...                 |
| 25Cr-7Ni-3.5Mo-N-Cu-W | A182 Gr. F55 (1) | ...                        | A240 Gr. S32760 (1) |

| Working Pressures by Classes, psig |       |     |       |       |       |       |       |
|------------------------------------|-------|-----|-------|-------|-------|-------|-------|
| Temp., °F                          | Class |     |       |       |       |       |       |
|                                    | 150   | 300 | 400   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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   | 630 | 840   | 1,260 | 1,890 | 3,145 | 5,240 |

## NOTES:

- (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 600°F.  
(2) Not to be used over 500°F.  
(3) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |       |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 35Ni–35Fe–20Cr–Cb                 | A182 Gr. N08020 (1) | ...      | A240 Gr. N08020 (1) |       |       |       |       |
| 35Ni–35Fe–20Cr–Cb                 | B462 Gr. N08020 (1) | ...      | B463 Gr. N08020 (1) |       |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |       |       |       |       |
| Temp., °C                         | Class               |          |                     |       |       |       |       |
|                                   | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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     | 67.7                | 101.5 | 152.2 | 253.7 | 422.9 |
| 150                               | 15.8                | 49.0     | 65.4                | 98.1  | 147.1 | 245.1 | 408.6 |
| 200                               | 13.8                | 47.0     | 62.6                | 93.9  | 140.9 | 234.9 | 391.4 |
| 250                               | 12.1                | 45.3     | 60.3                | 90.5  | 135.8 | 226.3 | 377.1 |
| 300                               | 10.2                | 44.2     | 59.0                | 88.5  | 132.7 | 221.1 | 368.6 |
| 325                               | 9.3                 | 43.3     | 57.6                | 86.3  | 129.6 | 215.9 | 359.8 |
| 350                               | 8.4                 | 41.9     | 55.8                | 83.6  | 125.5 | 209.1 | 348.7 |
| 375                               | 7.4                 | 40.5     | 53.9                | 80.7  | 121.2 | 201.9 | 336.1 |
| 400                               | 6.5                 | 38.0     | 50.7                | 76.2  | 114.2 | 190.4 | 317.1 |
| 425                               | 5.5                 | 36.8     | 48.9                | 73.2  | 109.8 | 183.0 | 304.7 |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.1C  
Pressure–Temperature Ratings for Group 3.1 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 35Ni–35Fe–20Cr–Cb                  | A182 Gr. N08020 (1) | ...      | A240 Gr. N08020 (1) |       |       |       |       |
| 35Ni–35Fe–20Cr–Cb                  | B462 Gr. N08020 (1) | ...      | B463 Gr. N08020 (1) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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                 | 630      | 840                 | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125                 | 615      | 820                 | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110                 | 600      | 795                 | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95                  | 555      | 745                 | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                  | 535      | 710                 | 1,065 | 1,600 | 2,665 | 4,440 |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            |      |      | Castings |      | Plates              |       |
|-----------------------------------|---------------------|------|------|----------|------|---------------------|-------|
| 99.0Ni                            | B564 Gr. N02200 (1) |      |      | ...      |      | B162 Gr. N02200 (1) |       |
| Working Pressures by Classes, bar |                     |      |      |          |      |                     |       |
| Temp., °C                         | Class               |      |      |          |      |                     |       |
|                                   | 150                 | 300  | 400  | 600      | 900  | 1500                | 2500  |
| Min. to 38 [Note (2)]             | 12.7                | 33.1 | 44.2 | 66.2     | 99.4 | 165.6               | 276.0 |
| 50                                | 12.7                | 33.1 | 44.2 | 66.2     | 99.4 | 165.6               | 276.0 |
| 100                               | 12.7                | 33.1 | 44.2 | 66.2     | 99.4 | 165.6               | 276.0 |
| 150                               | 12.7                | 33.1 | 44.2 | 66.2     | 99.4 | 165.6               | 276.0 |
| 200                               | 12.7                | 33.1 | 44.2 | 66.2     | 99.4 | 165.6               | 276.0 |
| 250                               | 12.1                | 31.7 | 42.2 | 63.4     | 95.0 | 158.4               | 264.0 |
| 300                               | 10.2                | 29.3 | 39.0 | 58.6     | 87.8 | 146.4               | 244.0 |
| 316                               | 9.6                 | 28.3 | 37.8 | 56.6     | 85.0 | 141.6               | 236.0 |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.2C**  
**Pressure–Temperature Ratings for Group 3.2 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            |     |     | Castings |       | Plates              |       |
|------------------------------------|---------------------|-----|-----|----------|-------|---------------------|-------|
| 99.0Ni                             | B564 Gr. N02200 (1) |     |     | ...      |       | B162 Gr. N02200 (1) |       |
| Working Pressures by Classes, psig |                     |     |     |          |       |                     |       |
| Temp., °F                          | Class               |     |     |          |       |                     |       |
|                                    | 150                 | 300 | 400 | 600      | 900   | 1500                | 2500  |
| Min. to 100 [Note (2)]             | 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) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings |      | Castings |      |      | Plates              |       |
|-----------------------------------|----------|------|----------|------|------|---------------------|-------|
| 99.0Ni–Low C                      | ...      |      | ...      |      |      | B162 Gr. N02201 (1) |       |
| Working Pressures by Classes, bar |          |      |          |      |      |                     |       |
| Temp., °C                         | Class    |      |          |      |      |                     |       |
|                                   | 150      | 300  | 400      | 600  | 900  | 1500                | 2500  |
| Min. to 38 [Note (2)]             | 6.3      | 16.5 | 22.0     | 33.1 | 49.6 | 82.6                | 137.7 |
| 50                                | 6.3      | 16.3 | 21.8     | 32.6 | 49.0 | 81.6                | 136.0 |
| 100                               | 6.1      | 15.9 | 21.2     | 31.7 | 47.6 | 79.4                | 132.3 |
| 150                               | 6.0      | 15.6 | 20.8     | 31.1 | 46.7 | 77.8                | 129.7 |
| 200                               | 6.0      | 15.6 | 20.8     | 31.1 | 46.7 | 77.8                | 129.7 |
| 250                               | 6.0      | 15.6 | 20.8     | 31.1 | 46.7 | 77.8                | 129.7 |
| 300                               | 6.0      | 15.6 | 20.8     | 31.1 | 46.7 | 77.8                | 129.7 |
| 325                               | 5.9      | 15.5 | 20.7     | 31.0 | 46.5 | 77.5                | 129.1 |
| 350                               | 5.9      | 15.4 | 20.5     | 30.8 | 46.2 | 77.0                | 128.2 |
| 375                               | 5.9      | 15.4 | 20.5     | 30.8 | 46.2 | 77.0                | 128.3 |
| 400                               | 5.8      | 15.2 | 20.3     | 30.4 | 45.7 | 76.1                | 126.9 |
| 425                               | 5.5      | 14.9 | 19.9     | 29.8 | 44.7 | 74.6                | 124.3 |
| 450                               | 4.6      | 14.3 | 19.1     | 28.7 | 43.0 | 71.7                | 119.4 |
| 475                               | 3.7      | 11.3 | 15.1     | 22.6 | 33.9 | 56.6                | 94.3  |
| 500                               | 2.8      | 9.3  | 12.3     | 18.5 | 27.8 | 46.3                | 77.1  |
| 538                               | 1.4      | 7.1  | 9.5      | 14.2 | 21.3 | 35.5                | 59.1  |
| 550                               | ...      | 6.4  | 8.5      | 12.8 | 19.2 | 32.1                | 53.4  |
| 575                               | ...      | 5.3  | 7.1      | 10.7 | 16.0 | 26.7                | 44.6  |
| 600                               | ...      | 4.5  | 5.9      | 8.9  | 13.4 | 22.3                | 37.1  |
| 625                               | ...      | 3.4  | 4.6      | 6.8  | 10.2 | 17.1                | 28.5  |
| 649                               | ...      | 2.7  | 3.7      | 5.5  | 8.2  | 13.7                | 22.9  |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.3C**  
**Pressure–Temperature Ratings for Group 3.3 Materials — U.S. Customary Units**

(25)

| Nominal Designation                       | Forgings     | Castings | Plates              |     |     |       |       |
|---|--------------|----------|---------------------|-----|-----|-------|-------|
| 99.0Ni–Low C                              | ...          | ...      | B162 Gr. N02201 (1) |     |     |       |       |
| <b>Working Pressures by Classes, psig</b> |              |          |                     |     |     |       |       |
|   | <b>Class</b> |          |                     |     |     |       |       |
| Temp., °F                                 | 150          | 300      | 400                 | 600 | 900 | 1500  | 2500  |
| Min. to 100 [Note (2)]                    | 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           | 200      | 265                 | 400 | 595 | 995   | 1,655 |
| 900                                       | 50           | 155      | 205                 | 310 | 465 | 770   | 1,285 |
| 950                                       | 35           | 125      | 170                 | 255 | 380 | 635   | 1,055 |
| 1,000                                     | 20           | 105      | 135                 | 205 | 310 | 515   | 855   |
| 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   |

## NOTES:

- (1) Use annealed material only.  
(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings       | Plates              |      |       |       |       |
|-----------------------------------|---------------------|----------------|---------------------|------|-------|-------|-------|
| 67Ni-30Cu                         | B564 Gr. N04400 (1) | A494 Gr. M35-1 | B127 Gr. N04400 (1) |      |       |       |       |
| 67Ni-30Cu                         | ...                 | A494 Gr. M35-2 | ...                 |      |       |       |       |
| Working Pressures by Classes, bar |                     |                |                     |      |       |       |       |
| Temp., °C                         | Class               |                |                     |      |       |       |       |
|                                   | 150                 | 300            | 400                 | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 15.8                | 41.1           | 54.9                | 82.3 | 123.4 | 205.7 | 342.9 |
| 50                                | 15.5                | 40.5           | 53.9                | 80.9 | 121.4 | 202.3 | 337.1 |
| 100                               | 13.7                | 35.7           | 47.5                | 71.3 | 107.0 | 178.3 | 297.1 |
| 150                               | 13.0                | 33.8           | 45.1                | 67.7 | 101.5 | 169.2 | 282.0 |
| 200                               | 12.5                | 32.6           | 43.5                | 65.3 | 97.9  | 163.2 | 272.0 |
| 250                               | 12.1                | 32.6           | 43.5                | 65.3 | 97.9  | 163.2 | 272.0 |
| 300                               | 10.2                | 32.6           | 43.5                | 65.3 | 97.9  | 163.2 | 272.0 |
| 325                               | 9.3                 | 32.6           | 43.5                | 65.3 | 97.9  | 163.2 | 272.0 |
| 350                               | 8.4                 | 32.6           | 43.5                | 65.3 | 97.9  | 163.2 | 272.0 |
| 375                               | 7.4                 | 32.4           | 43.2                | 64.8 | 97.2  | 162.0 | 270.0 |
| 400                               | 6.5                 | 32.2           | 42.9                | 64.3 | 96.5  | 160.8 | 268.0 |
| 425                               | 5.5                 | 31.7           | 42.2                | 63.4 | 95.0  | 158.4 | 264.0 |
| 450                               | 4.6                 | 26.9           | 35.9                | 53.8 | 80.7  | 134.6 | 224.3 |
| 475                               | 3.7                 | 20.6           | 27.5                | 41.3 | 61.9  | 103.2 | 172.0 |
| 482                               | 3.4                 | 18.8           | 25.1                | 37.8 | 56.6  | 94.4  | 157.3 |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.4C**  
**Pressure–Temperature Ratings for Group 3.4 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings       | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------------|---------------------|-------|-------|-------|-------|
| 67Ni–30Cu                          | B564 Gr. N04400 (1) | A494 Gr. M35-1 | B127 Gr. N04400 (1) |       |       |       |       |
| 67Ni–30Cu                          | ...                 | A494 Gr. M35-2 | ...                 |       |       |       |       |
| Working Pressures by Classes, psig |                     |                |                     |       |       |       |       |
| Temp., °F                          | Class               |                |                     |       |       |       |       |
|                                    | 150                 | 300            | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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 |

## NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            |      |      | Castings |       | Plates              |       |
|-----------------------------------|---------------------|------|------|----------|-------|---------------------|-------|
| 72Ni–15Cr–8Fe                     | B564 Gr. N06600 (1) |      |      | ...      |       | B168 Gr. N06600 (1) |       |
| Working Pressures by Classes, bar |                     |      |      |          |       |                     |       |
| Temp., °C                         | Class               |      |      |          |       |                     |       |
|                                   | 150                 | 300  | 400  | 600      | 900   | 1500                | 2500  |
| Min. to 38 [Note (2)]             | 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 | 67.0 | 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 | 61.8 | 92.7     | 139.0 | 231.8               | 386.2 |
| 300                               | 10.2                | 45.0 | 60.0 | 90.0     | 135.0 | 225.1               | 375.0 |
| 325                               | 9.3                 | 43.3 | 57.6 | 86.3     | 129.6 | 215.9               | 359.8 |
| 350                               | 8.4                 | 41.9 | 55.8 | 83.6     | 125.5 | 209.1               | 348.7 |
| 375                               | 7.4                 | 40.5 | 53.9 | 80.7     | 121.2 | 201.9               | 336.1 |
| 400                               | 6.5                 | 38.0 | 50.7 | 76.2     | 114.2 | 190.4               | 317.1 |
| 425                               | 5.5                 | 36.8 | 48.9 | 73.2     | 109.8 | 183.0               | 304.7 |
| 450                               | 4.6                 | 35.4 | 47.3 | 71.1     | 106.5 | 177.5               | 295.9 |
| 475                               | 3.7                 | 34.4 | 45.9 | 68.8     | 103.2 | 171.6               | 286.3 |
| 500                               | 2.8                 | 29.7 | 39.5 | 59.3     | 89.0  | 148.3               | 247.1 |
| 538                               | 1.4                 | 16.8 | 22.4 | 33.6     | 50.4  | 84.0                | 140.0 |
| 550                               | ...                 | 13.7 | 18.3 | 27.4     | 41.1  | 68.6                | 114.3 |
| 575                               | ...                 | 9.2  | 12.3 | 18.4     | 27.6  | 45.9                | 76.6  |
| 600                               | ...                 | 6.5  | 8.7  | 13.0     | 19.5  | 32.6                | 54.3  |
| 625                               | ...                 | 5.1  | 6.8  | 10.1     | 15.2  | 25.4                | 42.3  |
| 649                               | ...                 | 4.8  | 6.4  | 9.6      | 14.4  | 24.0                | 40.0  |

## NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.5C**  
**Pressure–Temperature Ratings for Group 3.5 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            |     | Castings |       |       | Plates              |       |
|------------------------------------|---------------------|-----|----------|-------|-------|---------------------|-------|
| 72Ni–15Cr–8Fe                      | B564 Gr. N06600 (1) |     | ...      |       |       | B168 Gr. N06600 (1) |       |
| Working Pressures by Classes, psig |                     |     |          |       |       |                     |       |
| Temp., °F                          | Class               |     |          |       |       |                     |       |
|                                    | 150                 | 300 | 400      | 600   | 900   | 1500                | 2500  |
| Min. to 100 [Note (2)]             | 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                 | 630 | 840      | 1,260 | 1,890 | 3,145               | 5,240 |
| 650                                | 125                 | 615 | 820      | 1,230 | 1,845 | 3,070               | 5,125 |
| 700                                | 110                 | 600 | 795      | 1,190 | 1,790 | 2,980               | 4,965 |
| 750                                | 95                  | 555 | 745      | 1,120 | 1,675 | 2,795               | 4,650 |
| 800                                | 80                  | 535 | 710      | 1,065 | 1,600 | 2,665               | 4,440 |
| 850                                | 65                  | 510 | 685      | 1,030 | 1,540 | 2,570               | 4,285 |
| 900                                | 50                  | 475 | 635      | 955   | 1,430 | 2,380               | 3,970 |
| 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   |

## NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |      |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|------|-------|-------|-------|
| 33Ni–42Fe–21Cr                    | A182 Gr. N08800 (1) | ...      | A240 Gr. N08800 (1) |      |       |       |       |
| 33Ni–42Fe–21Cr                    | B564 Gr. N08800 (1) | ...      | B409 Gr. N08800 (1) |      |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |      |       |       |       |
| Temp., °C                         | Class               |          |                     |      |       |       |       |
|                                   | 150                 | 300      | 400                 | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 19.1                | 49.7     | 66.3                | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                | 18.8                | 49.0     | 65.4                | 98.1 | 147.1 | 245.1 | 408.6 |
| 100                               | 17.5                | 45.6     | 60.8                | 91.2 | 136.8 | 228.0 | 380.0 |
| 150                               | 15.8                | 43.9     | 58.5                | 87.8 | 131.7 | 219.4 | 365.7 |
| 200                               | 13.8                | 42.9     | 57.1                | 85.7 | 128.6 | 214.3 | 357.1 |
| 250                               | 12.1                | 41.8     | 55.8                | 83.7 | 125.5 | 209.1 | 348.6 |
| 300                               | 10.2                | 40.8     | 54.4                | 81.6 | 122.4 | 204.0 | 340.0 |
| 325                               | 9.3                 | 40.5     | 53.9                | 80.9 | 121.4 | 202.3 | 337.1 |
| 350                               | 8.4                 | 39.8     | 53.0                | 79.5 | 119.3 | 198.9 | 331.4 |
| 375                               | 7.4                 | 39.4     | 52.6                | 78.9 | 118.3 | 197.1 | 328.6 |
| 400                               | 6.5                 | 38.0     | 50.7                | 76.2 | 114.2 | 190.4 | 317.1 |
| 425                               | 5.5                 | 36.8     | 48.9                | 73.2 | 109.8 | 183.0 | 304.7 |
| 450                               | 4.6                 | 35.4     | 47.3                | 71.1 | 106.5 | 177.5 | 295.9 |
| 475                               | 3.7                 | 34.0     | 45.9                | 68.8 | 103.2 | 171.6 | 286.3 |
| 500                               | 2.8                 | 32.1     | 42.9                | 64.4 | 96.6  | 160.6 | 267.9 |
| 538                               | 1.4                 | 29.0     | 38.5                | 57.5 | 86.5  | 144.3 | 240.2 |
| 550                               | ...                 | 28.8     | 38.3                | 57.3 | 86.0  | 143.6 | 239.2 |
| 575                               | ...                 | 27.8     | 37.1                | 55.6 | 83.3  | 138.9 | 231.4 |
| 600                               | ...                 | 25.3     | 33.6                | 50.2 | 75.1  | 125.2 | 208.8 |
| 625                               | ...                 | 21.5     | 28.7                | 43.0 | 64.5  | 107.2 | 178.6 |
| 650                               | ...                 | 15.4     | 20.5                | 30.7 | 46.1  | 76.8  | 128.0 |
| 675                               | ...                 | 10.3     | 13.7                | 20.6 | 30.9  | 51.4  | 85.7  |
| 700                               | ...                 | 5.3      | 7.1                 | 10.6 | 15.9  | 26.6  | 44.3  |
| 725                               | ...                 | 3.9      | 5.2                 | 7.7  | 11.6  | 19.4  | 32.3  |
| 750                               | ...                 | 3.0      | 4.0                 | 6.0  | 9.1   | 15.1  | 25.2  |
| 775                               | ...                 | 2.4      | 3.2                 | 4.8  | 7.2   | 12.0  | 19.9  |
| 800                               | ...                 | 2.2      | 2.9                 | 4.4  | 6.6   | 11.0  | 18.4  |
| 816                               | ...                 | 1.9      | 2.5                 | 3.8  | 5.7   | 9.4   | 15.7  |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.6C**  
**Pressure–Temperature Ratings for Group 3.6 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 33Ni–42Fe–21Cr                     | A182 Gr. N08800 (1) | ...      | A240 Gr. N08800 (1) |       |       |       |       |
| 33Ni–42Fe–21Cr                     | B564 Gr. N08800 (1) | ...      | B409 Gr. N08800 (1) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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      | 760                 | 1,140 | 1,715 | 2,855 | 4,760 |
| 750                                | 95                  | 555      | 745                 | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                  | 535      | 710                 | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65                  | 510      | 685                 | 1,030 | 1,540 | 2,570 | 4,295 |
| 900                                | 50                  | 475      | 635                 | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                  | 425      | 570                 | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                  | 415      | 550                 | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | ...                 | 410      | 545                 | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | ...                 | 375      | 500                 | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | ...                 | 320      | 425                 | 640   | 960   | 1,595 | 2,660 |
| 1,200                              | ...                 | 225      | 300                 | 455   | 680   | 1,130 | 1,885 |
| 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   |

NOTES:

- (1) Use annealed material only.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |       |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 65Ni–28Mo–2Fe                     | B462 Gr. N10665 (1) | ...      | B333 Gr. N10665 (1) |       |       |       |       |
| 65Ni–28Mo–2Fe                     | B564 Gr. N10665 (1) | ...      | ...                 |       |       |       |       |
| 64Ni–29.5Mo–2Fe–2Cr–Mn–W          | B462 Gr. N10675 (1) | ...      | B333 Gr. N10675 (1) |       |       |       |       |
| 65Ni–29.5Mo–2Fe–2Cr               | B564 Gr. N10675 (1) | ...      | ...                 |       |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |       |       |       |       |
| Temp., °C                         | Class               |          |                     |       |       |       |       |
|                                   | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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     | 67.0                | 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     | 61.8                | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2                | 45.0     | 60.0                | 90.0  | 135.0 | 225.0 | 375.0 |
| 325                               | 9.3                 | 43.3     | 57.6                | 86.3  | 130.0 | 216.0 | 360.0 |
| 350                               | 8.4                 | 41.9     | 55.8                | 83.6  | 126.0 | 209.0 | 349.0 |
| 375                               | 7.4                 | 40.5     | 53.9                | 80.7  | 121.0 | 202.0 | 336.0 |
| 400                               | 6.5                 | 38.0     | 50.7                | 76.2  | 114.0 | 190.0 | 317.0 |
| 425                               | 5.5                 | 36.8     | 48.9                | 73.2  | 110.0 | 183.0 | 305.0 |

NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.7C**  
**Pressure–Temperature Ratings for Group 3.7 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 65Ni–28Mo–2Fe                      | B462 Gr. N10665 (1) | ...      | B333 Gr. N10665 (1) |       |       |       |       |
| 65Ni–28Mo–2Fe                      | B564 Gr. N10665 (1) | ...      | ...                 |       |       |       |       |
| 65Ni–29.5Mo–2Fe–2Cr–Mn–W           | B462 Gr. N10675 (1) | ...      | B333 Gr. N10675 (1) |       |       |       |       |
| 65Ni–29.5Mo–2Fe–2Cr                | B564 Gr. N10675 (1) | ...      | ...                 |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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                 | 630      | 840                 | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125                 | 615      | 820                 | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110                 | 600      | 795                 | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95                  | 555      | 745                 | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                  | 535      | 710                 | 1,065 | 1,600 | 2,665 | 4,440 |

NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation   | Forgings                      | Castings | Plates                        |
|-----------------------|-------------------------------|----------|-------------------------------|
| 54Ni–16Mo–15Cr        | B462 Gr. N10276 (1), (2)      | ...      | B575 Gr. N10276 (1), (2)      |
| 54Ni–16Mo–15Cr        | B564 Gr. N10276 (1), (2)      | ...      | ...                           |
| 60Ni–22Cr–9Mo–3.5Cb   | B564 Gr. N06625 (3), (4)      | ...      | B443 Gr. N06625 (3), (4)      |
| 62Ni–28Mo–5Fe         | ...                           | ...      | B333 Gr. N10001 (5), (3)      |
| 70Ni–16Mo–7Cr–5Fe     | ...                           | ...      | B434 Gr. N10003 (3)           |
| 61Ni–16Mo–16Cr        | ...                           | ...      | B575 Gr. N06455 (1), (5)      |
| 42Ni–21.5Cr–3Mo–2.3Cu | B564 Gr. N08825 (3), (6)      | ...      | B424 Gr. N08825 (3), (6)      |
| 55Ni–21Cr–13.5Mo      | B462 Gr. N06022 (1), (5), (7) | ...      | B575 Gr. N06022 (1), (2), (7) |
| 55Ni–23Cr–16Mo–1.6Cu  | B462 Gr. N06200 (1), (5)      | ...      | B575 Gr. N06200 (1), (5)      |

**Working Pressures by Classes, bar**

| Temp., °C  | Class |      |      |       |       |       |       |
|------------|-------|------|------|-------|-------|-------|-------|
|            | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| Min. 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  | 50.1 | 66.7 | 100.1 | 150.2 | 250.3 | 417.1 |
| 200        | 13.8  | 48.0 | 64.0 | 96.0  | 144.0 | 240.0 | 400.0 |
| 250        | 12.1  | 45.9 | 61.3 | 91.9  | 137.8 | 229.7 | 382.9 |
| 300        | 10.2  | 44.6 | 59.4 | 89.1  | 133.7 | 222.9 | 371.4 |
| 325        | 9.3   | 43.3 | 57.6 | 86.3  | 129.6 | 215.9 | 359.8 |
| 350        | 8.4   | 41.9 | 55.8 | 83.6  | 125.5 | 209.1 | 348.7 |
| 375        | 7.4   | 40.5 | 53.9 | 80.7  | 121.2 | 201.9 | 336.1 |
| 400        | 6.5   | 38.0 | 50.7 | 76.2  | 114.2 | 190.4 | 317.1 |
| 425        | 5.5   | 36.8 | 48.9 | 73.2  | 109.8 | 183.0 | 304.7 |
| 450        | 4.6   | 35.4 | 47.3 | 71.1  | 106.5 | 177.5 | 295.9 |
| 475        | 3.7   | 34.4 | 45.9 | 68.8  | 103.2 | 171.6 | 286.3 |
| 500        | 2.8   | 32.1 | 42.9 | 64.4  | 96.6  | 160.6 | 267.9 |
| 538        | 1.4   | 29.0 | 38.5 | 57.5  | 86.5  | 144.3 | 240.2 |
| 550        | ...   | 28.8 | 38.3 | 57.3  | 86.0  | 143.6 | 239.2 |
| 575        | ...   | 27.8 | 37.1 | 55.6  | 83.3  | 138.9 | 231.4 |
| 600        | ...   | 25.3 | 33.6 | 50.2  | 75.1  | 125.2 | 208.8 |
| 625        | ...   | 20.8 | 27.7 | 41.6  | 62.4  | 104.1 | 173.4 |
| 650        | ...   | 14.0 | 18.7 | 28.0  | 42.0  | 69.9  | 116.6 |
| 675        | ...   | 11.5 | 15.3 | 23.0  | 34.5  | 57.4  | 95.7  |
| 700        | ...   | 8.8  | 11.7 | 17.6  | 26.4  | 44.1  | 73.4  |
| 725        | ...   | 8.8  | 11.7 | 17.6  | 26.4  | 44.1  | 73.4  |
| 750        | ...   | 7.3  | 9.7  | 14.4  | 21.6  | 36.4  | 60.4  |
| 775        | ...   | 5.6  | 7.4  | 11.0  | 16.7  | 27.8  | 46.4  |
| 800        | ...   | 4.3  | 5.8  | 8.7   | 13.0  | 21.6  | 36.2  |
| 816        | ...   | 3.5  | 4.8  | 7.4   | 10.8  | 17.8  | 30.0  |

## NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 675°C.
- (3) Use annealed material only.
- (4) Not to be used over 645°C. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 538°C to 760°C.
- (5) Not to be used over 425°C.
- (6) Not to be used over 538°C.
- (7) 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.
- (8) See [para. 2.5.3](#) for guidance on how to determine minimum temperatures.

**Table 2-3.8C**  
**Pressure–Temperature Ratings for Group 3.8 Materials — U.S. Customary Units**

(25)

| Nominal Designation   | Forgings                      | Castings | Plates                        |
|-----------------------|-------------------------------|----------|-------------------------------|
| 54Ni–16Mo–15Cr        | B462 Gr. N10276 (1), (2)      | ...      | B575 Gr. N10276 (1), (2)      |
| 54Ni–16Mo–15Cr        | B564 Gr. N10276 (1), (2)      | ...      | ...                           |
| 60Ni–22Cr–9Mo–3.5Cb   | B564 Gr. N06625 (3), (4)      | ...      | B443 Gr. N06625 (3), (4)      |
| 62Ni–28Mo–5Fe         | ...                           | ...      | B333 Gr. N10001 (5), (3)      |
| 70Ni–16Mo–7Cr–5Fe     | ...                           | ...      | B434 Gr. N10003 (3)           |
| 61Ni–16Mo–16Cr        | ...                           | ...      | B575 Gr. N06455 (1), (5)      |
| 42Ni–21.5Cr–3Mo–2.3Cu | B564 Gr. N08825 (3), (6)      | ...      | B424 Gr. N08825 (3), (6)      |
| 55Ni–21Cr–13.5Mo      | B462 Gr. N06022 (1), (5), (7) | ...      | B575 Gr. N06022 (1), (2), (7) |
| 55Ni–23Cr–16Mo–1.6Cu  | B462 Gr. N06200 (1), (5)      | ...      | B575 Gr. N06200 (1), (5)      |

| Working Pressures by Classes, psig |       |     |       |       |       |       |       |
|------------------------------------|-------|-----|-------|-------|-------|-------|-------|
| Temp., °F                          | Class |     |       |       |       |       |       |
|                                    | 150   | 300 | 400   | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (8)]             | 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   | 630 | 840   | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125   | 615 | 820   | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110   | 600 | 795   | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95    | 555 | 745   | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80    | 535 | 710   | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65    | 510 | 685   | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50    | 475 | 635   | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35    | 425 | 570   | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20    | 415 | 550   | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | ...   | 410 | 545   | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | ...   | 375 | 500   | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | ...   | 320 | 425   | 640   | 955   | 1,595 | 2,655 |
| 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                              | ...   | 120 | 160   | 240   | 360   | 600   | 1,000 |
| 1,400                              | ...   | 90  | 120   | 185   | 275   | 465   | 775   |
| 1,450                              | ...   | 75  | 100   | 145   | 220   | 360   | 605   |
| 1,500                              | ...   | 50  | 70    | 105   | 160   | 260   | 435   |

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) Not to be used over 800°F.
- (6) Not to be used over 1,000°F.
- (7) Alloy N06022 in the solution annealed condition is subject to severe loss of impact strength at room temperatures in the range of 1,000°F to 1,250°F.
- (8) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |       |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 47Ni–22Cr–9Mo–18Fe                | B572 Gr. N06002 (1) | ...      | B435 Gr. N06002 (1) |       |       |       |       |
| 21Ni–30Fe–22Cr–18Co–3Mo–3W        | B572 Gr. R30556 (1) | ...      | B435 Gr. R30556 (1) |       |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |       |       |       |       |
| Temp., °C                         | Class               |          |                     |       |       |       |       |
|                                   | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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                | 47.7     | 63.5                | 95.3  | 143.0 | 238.3 | 397.1 |
| 200                               | 13.8                | 44.6     | 59.4                | 89.1  | 133.7 | 222.9 | 371.4 |
| 250                               | 12.1                | 41.5     | 55.3                | 83.0  | 124.5 | 207.4 | 345.7 |
| 300                               | 10.2                | 39.4     | 52.6                | 78.9  | 118.3 | 197.1 | 328.6 |
| 325                               | 9.3                 | 38.7     | 51.7                | 77.5  | 116.2 | 193.7 | 322.9 |
| 350                               | 8.4                 | 38.1     | 50.7                | 76.1  | 114.2 | 190.3 | 317.1 |
| 375                               | 7.4                 | 37.4     | 49.8                | 74.7  | 112.1 | 186.9 | 311.4 |
| 400                               | 6.5                 | 37.0     | 49.4                | 74.1  | 111.1 | 185.1 | 308.6 |
| 425                               | 5.5                 | 36.3     | 48.5                | 72.7  | 109.0 | 181.7 | 302.9 |
| 450                               | 4.6                 | 35.4     | 47.3                | 71.1  | 106.5 | 177.5 | 295.9 |
| 475                               | 3.7                 | 34.4     | 45.9                | 68.8  | 103.2 | 171.6 | 286.3 |
| 500                               | 2.8                 | 32.1     | 42.9                | 64.4  | 96.6  | 160.6 | 267.9 |
| 538                               | 1.4                 | 29.0     | 38.5                | 57.5  | 86.5  | 144.3 | 240.2 |
| 550                               | ...                 | 28.8     | 38.3                | 57.3  | 86.0  | 143.6 | 239.2 |
| 575                               | ...                 | 27.8     | 37.1                | 55.6  | 83.3  | 138.9 | 231.4 |
| 600                               | ...                 | 25.3     | 33.6                | 50.2  | 75.1  | 125.2 | 208.8 |
| 625                               | ...                 | 21.5     | 28.7                | 43.0  | 64.5  | 107.2 | 178.6 |
| 650                               | ...                 | 16.6     | 22.1                | 33.2  | 50.2  | 83.4  | 138.9 |
| 675                               | ...                 | 14.8     | 19.9                | 30.0  | 44.7  | 74.6  | 124.4 |
| 700                               | ...                 | 12.1     | 16.1                | 24.0  | 35.8  | 59.6  | 99.6  |
| 725                               | ...                 | 9.6      | 12.6                | 18.6  | 28.1  | 46.7  | 77.9  |
| 750                               | ...                 | 7.3      | 9.7                 | 14.4  | 21.6  | 36.4  | 60.4  |
| 775                               | ...                 | 5.6      | 7.4                 | 11.0  | 16.7  | 27.8  | 46.4  |
| 800                               | ...                 | 4.3      | 5.8                 | 8.7   | 13.0  | 21.6  | 36.2  |
| 816                               | ...                 | 3.5      | 4.8                 | 7.4   | 10.8  | 17.8  | 30.0  |

NOTES:

- (1) Use annealed material only.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.9C**  
**Pressure–Temperature Ratings for Group 3.9 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 47Ni–22Cr–9Mo–18Fe                 | B572 Gr. N06002 (1) | ...      | B435 Gr. N06002 (1) |       |       |       |       |
| 21Ni–30Fe–22Cr–18Co–3Mo–3W         | B572 Gr. R30556 (1) | ...      | B435 Gr. R30556 (1) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (20)]            | 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                  | 535      | 715                 | 1,070 | 1,605 | 2,675 | 4,460 |
| 800                                | 80                  | 530      | 705                 | 1,060 | 1,590 | 2,650 | 4,420 |
| 850                                | 65                  | 510      | 685                 | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50                  | 475      | 635                 | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                  | 425      | 570                 | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                  | 415      | 550                 | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | ...                 | 410      | 545                 | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | ...                 | 375      | 500                 | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | ...                 | 320      | 425                 | 640   | 960   | 1,595 | 2,660 |
| 1,200                              | ...                 | 240      | 320                 | 480   | 725   | 1,205 | 2,005 |
| 1,250                              | ...                 | 210      | 285                 | 430   | 645   | 1,075 | 1,790 |
| 1,300                              | ...                 | 165      | 220                 | 325   | 490   | 815   | 1,365 |
| 1,350                              | ...                 | 125      | 165                 | 250   | 375   | 625   | 1,040 |
| 1,400                              | ...                 | 90       | 120                 | 185   | 275   | 465   | 775   |
| 1,450                              | ...                 | 75       | 100                 | 145   | 220   | 360   | 605   |
| 1,500                              | ...                 | 50       | 70                  | 105   | 160   | 260   | 435   |

NOTES:

- (1) Use annealed material only.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings | Castings |      | Plates              |       |       |       |
|-----------------------------------|----------|----------|------|---------------------|-------|-------|-------|
| 25Ni–47Fe–21Cr–5Mo                | ...      | ...      |      | A240 Gr. N08700 (1) |       |       |       |
| 25Ni–47Fe–21Cr–5Mo                | ...      | ...      |      | B599 Gr. N08700 (1) |       |       |       |
| Working Pressures by Classes, bar |          |          |      |                     |       |       |       |
| Temp., °C                         | Class    |          |      |                     |       |       |       |
|                                   | 150      | 300      | 400  | 600                 | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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     | 47.0     | 62.6 | 93.9                | 140.9 | 234.9 | 391.4 |
| 200                               | 13.8     | 44.2     | 59.0 | 88.5                | 132.7 | 221.1 | 368.6 |
| 250                               | 12.1     | 42.9     | 57.1 | 85.7                | 128.6 | 214.3 | 357.1 |
| 300                               | 10.2     | 41.5     | 55.3 | 83.0                | 124.5 | 207.4 | 345.7 |
| 325                               | 9.3      | 40.5     | 53.9 | 80.9                | 121.4 | 202.3 | 337.1 |
| 343                               | 8.7      | 39.4     | 52.6 | 78.9                | 118.3 | 197.1 | 328.6 |

## NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.10C**  
**Pressure–Temperature Ratings for Group 3.10 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings | Castings |       | Plates              |       |       |       |
|------------------------------------|----------|----------|-------|---------------------|-------|-------|-------|
| 25Ni–47Fe–21Cr–5Mo                 | ...      | ...      |       | A240 Gr. N08700 (1) |       |       |       |
| 25Ni–47Fe–21Cr–5Mo                 | ...      | ...      |       | B599 Gr. N08700 (1) |       |       |       |
| Working Pressures by Classes, psig |          |          |       |                     |       |       |       |
| Temp., °F                          | Class    |          |       |                     |       |       |       |
|                                    | 150      | 300      | 400   | 600                 | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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 |

## NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.11  
Pressure–Temperature Ratings for Group 3.11 Materials — SI Units**

| Nominal Designation               | Forgings            |      | Castings |       | Plates              |       |       |
|-----------------------------------|---------------------|------|----------|-------|---------------------|-------|-------|
| 44Fe–25Ni–21Cr–Mo                 | A182 Gr. N08904 (1) |      | ...      |       | A240 Gr. N08904 (1) |       |       |
| Working Pressures by Classes, bar |                     |      |          |       |                     |       |       |
| Temp., °C                         | Class               |      |          |       |                     |       |       |
|                                   | 150                 | 300  | 400      | 600   | 900                 | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 19.7                | 51.4 | 68.6     | 102.9 | 154.3               | 257.1 | 428.6 |
| 50                                | 19.1                | 49.7 | 66.3     | 99.4  | 149.1               | 248.6 | 414.3 |
| 100                               | 15.8                | 41.1 | 54.9     | 82.3  | 123.4               | 205.7 | 342.9 |
| 150                               | 14.3                | 37.4 | 49.8     | 74.7  | 112.1               | 186.9 | 311.4 |
| 200                               | 13.3                | 34.6 | 46.2     | 69.3  | 103.9               | 173.1 | 288.6 |
| 250                               | 12.1                | 31.9 | 42.6     | 63.8  | 95.8                | 159.6 | 266.0 |
| 300                               | 10.2                | 30.0 | 40.0     | 60.0  | 90.0                | 150.0 | 250.0 |
| 325                               | 9.3                 | 29.3 | 39.0     | 58.6  | 87.8                | 146.4 | 244.0 |
| 350                               | 8.4                 | 28.6 | 38.1     | 57.1  | 85.7                | 142.8 | 238.0 |
| 371                               | 7.6                 | 28.3 | 37.8     | 56.6  | 85.0                | 141.6 | 236.0 |

NOTES:

(1) Use annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.11C  
Pressure–Temperature Ratings for Group 3.11 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings            |     | Castings |       | Plates              |       |       |
|------------------------------------|---------------------|-----|----------|-------|---------------------|-------|-------|
| 44Fe–25Ni–21Cr–Mo                  | A182 Gr. N08904 (1) |     | ...      |       | A240 Gr. N08904 (1) |       |       |
| Working Pressures by Classes, psig |                     |     |          |       |                     |       |       |
| Temp., °F                          | Class               |     |          |       |                     |       |       |
|                                    | 150                 | 300 | 400      | 600   | 900                 | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.12**  
**Pressure-Temperature Ratings for Group 3.12 Materials — SI Units**

(25)

| Nominal Designation     | Forgings            | Castings           | Plates              |
|-------------------------|---------------------|--------------------|---------------------|
| 26Ni-43Fe-22Cr-5Mo      | ...                 | ...                | B620 Gr. N08320 (1) |
| 47Ni-22Cr-20Fe-7Mo      | ...                 | ...                | B582 Gr. N06985 (2) |
| 46Fe-24Ni-21Cr-6Mo-Cu-N | A182 Gr. N08367 (1) | A351 Gr. CN3MN (1) | A240 Gr. N08367 (1) |
| 46Fe-24Ni-21Cr-6Mo-Cu-N | B462 Gr. N08367 (1) | ...                | B688 Gr. N08367 (1) |
| 58Ni-33Cr-8Mo           | B462 Gr. N06035 (1) | ...                | B574 Gr. N06035 (1) |
| 58Ni-33Cr-8Mo           | B462 Gr. N06035 (1) | ...                | B575 Gr. N06035 (1) |

| Working Pressures by Classes, bar |       |      |      |      |       |       |       |
|-----------------------------------|-------|------|------|------|-------|-------|-------|
| Temp., °C                         | Class |      |      |      |       |       |       |
|                                   | 150   | 300  | 400  | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 17.7  | 46.3 | 61.7 | 92.6 | 138.9 | 231.4 | 385.7 |
| 50                                | 17.5  | 45.6 | 60.8 | 91.2 | 136.8 | 228.0 | 380.0 |
| 100                               | 16.3  | 42.5 | 56.7 | 85.0 | 127.5 | 212.6 | 354.3 |
| 150                               | 15.4  | 40.1 | 53.5 | 80.2 | 120.3 | 200.6 | 334.3 |
| 200                               | 13.8  | 37.4 | 49.8 | 74.7 | 112.1 | 186.9 | 311.4 |
| 250                               | 12.1  | 35.0 | 46.6 | 69.9 | 104.9 | 174.9 | 291.4 |
| 300                               | 10.2  | 33.1 | 44.2 | 66.2 | 99.4  | 165.6 | 276.0 |
| 325                               | 9.3   | 32.4 | 43.2 | 64.8 | 97.2  | 162.0 | 270.0 |
| 350                               | 8.4   | 31.7 | 42.2 | 63.4 | 95.0  | 158.4 | 264.0 |
| 375                               | 7.4   | 31.0 | 41.3 | 61.9 | 92.9  | 154.8 | 258.0 |
| 400                               | 6.5   | 30.5 | 40.6 | 61.0 | 91.4  | 152.4 | 254.0 |
| 425                               | 5.5   | 29.8 | 39.7 | 59.5 | 89.3  | 148.8 | 248.0 |

## NOTES:

- (1) Use solution annealed material only.  
(2) Use annealed material only.  
(3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.12C**  
**Pressure–Temperature Ratings for Group 3.12 Materials — U.S. Customary Units**

| Nominal Designation     | Forgings            | Castings           | Plates              |
|-------------------------|---------------------|--------------------|---------------------|
| 26Ni–43Fe–22Cr–5Mo      | ...                 | ...                | B620 Gr. N08320 (1) |
| 47Ni–22Cr–20Fe–7Mo      | ...                 | ...                | B582 Gr. N06985 (2) |
| 46Fe–24Ni–21Cr–6Mo–Cu–N | A182 Gr. N08367 (1) | A351 Gr. CN3MN (1) | A240 Gr. N08367 (1) |
| 46Fe–24Ni–21Cr–6Mo–Cu–N | B462 Gr. N08367 (1) | ...                | B688 Gr. N08367 (1) |
| 58Ni–33Cr–8Mo           | B462 Gr. N06035 (1) | ...                | B574 Gr. N06035 (1) |
| 58Ni–33Cr–8Mo           | B564 Gr. N06035 (1) | ...                | B575 Gr. N06035 (1) |

| Working Pressures by Classes, psig |       |     |     |       |       |       |       |
|------------------------------------|-------|-----|-----|-------|-------|-------|-------|
| Temp., °F                          | Class |     |     |       |       |       |       |
|                                    | 150   | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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 |

## NOTES:

(1) Use solution annealed material only.

(2) Use annealed material only.

(3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |       |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 49Ni–25Cr–18Fe–6Mo                | ...                 | ...      | B582 Gr. N06975 (1) |       |       |       |       |
| Ni–Fe–Cr–Mo–Cu–Low C              | B564 Gr. N08031 (1) | ...      | B625 Gr. N08031 (1) |       |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |       |       |       |       |
| Temp., °C                         | Class               |          |                     |       |       |       |       |
|                                   | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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                | 48.3     | 64.5                | 96.7  | 145.0 | 241.7 | 402.9 |
| 150                               | 15.8                | 45.9     | 61.3                | 91.9  | 137.8 | 229.7 | 382.9 |
| 200                               | 13.8                | 43.5     | 58.1                | 87.1  | 130.6 | 217.7 | 362.9 |
| 250                               | 12.1                | 41.5     | 55.3                | 83.0  | 124.5 | 207.4 | 345.7 |
| 300                               | 10.2                | 39.4     | 52.6                | 78.9  | 118.3 | 197.1 | 328.6 |
| 325                               | 9.3                 | 38.4     | 51.2                | 76.8  | 115.2 | 192.0 | 320.0 |
| 350                               | 8.4                 | 37.7     | 50.3                | 75.4  | 113.1 | 188.6 | 314.3 |
| 375                               | 7.4                 | 37.4     | 49.8                | 74.7  | 112.1 | 186.9 | 311.4 |
| 400                               | 6.5                 | 36.7     | 48.9                | 73.4  | 110.1 | 183.4 | 305.7 |
| 425                               | 5.5                 | 36.3     | 48.5                | 72.7  | 109.0 | 181.7 | 302.9 |

## NOTES:

- (1) Use solution annealed material only.  
(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.13C**  
**Pressure–Temperature Ratings for Group 3.13 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 49Ni–25Cr–18Fe–6Mo                 | ...                 | ...      | B582 Gr. N06975 (1) |       |       |       |       |
| Ni–Fe–Cr–Mo–Cu–Low C               | B564 Gr. N08031 (1) | ...      | B625 Gr. N08031 (1) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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                  | 535      | 710                 | 1,065 | 1,600 | 2,665 | 4,440 |
| 800                                | 80                  | 530      | 705                 | 1,055 | 1,585 | 2,640 | 4,400 |

## NOTES:

- (1) Use solution annealed material only.  
(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.14**  
**Pressure-Temperature Ratings for Group 3.14 Materials — SI Units**

(25)

| Nominal Designation               | Forgings                 | Castings | Plates                   |      |       |       |       |
|-----------------------------------|--------------------------|----------|--------------------------|------|-------|-------|-------|
| 47Ni-22Cr-19Fe-6Mo                | ...                      | ...      | B582 Gr. N06007 (1)      |      |       |       |       |
| 40Ni-29Cr-15Fe-5Mo                | B462 Gr. N06030 (1), (2) | ...      | B582 Gr. N06030 (1), (2) |      |       |       |       |
| Working Pressures by Classes, bar |                          |          |                          |      |       |       |       |
| Temp., °C                         | Class                    |          |                          |      |       |       |       |
|                                   | 150                      | 300      | 400                      | 600  | 900   | 1500  | 2500  |
| Min. to 38 [Note (3)]             | 19.1                     | 49.7     | 66.3                     | 99.4 | 149.1 | 248.6 | 414.3 |
| 50                                | 18.7                     | 48.7     | 64.9                     | 97.4 | 146.1 | 243.4 | 405.7 |
| 100                               | 17.0                     | 44.2     | 59.0                     | 88.5 | 132.7 | 221.1 | 368.6 |
| 150                               | 15.8                     | 41.1     | 54.9                     | 82.3 | 123.4 | 205.7 | 342.9 |
| 200                               | 13.8                     | 39.1     | 52.1                     | 78.2 | 117.3 | 195.4 | 325.7 |
| 250                               | 12.1                     | 37.4     | 49.8                     | 74.7 | 112.1 | 186.9 | 311.4 |
| 300                               | 10.2                     | 36.0     | 48.0                     | 72.0 | 108.0 | 180.0 | 300.0 |
| 325                               | 9.3                      | 35.7     | 47.5                     | 71.3 | 107.0 | 178.3 | 297.1 |
| 350                               | 8.4                      | 35.0     | 46.6                     | 69.9 | 104.9 | 174.9 | 291.4 |
| 375                               | 7.4                      | 35.0     | 46.6                     | 69.9 | 104.9 | 174.9 | 291.4 |
| 400                               | 6.5                      | 34.6     | 46.2                     | 69.3 | 103.9 | 173.1 | 288.6 |
| 425                               | 5.5                      | 34.3     | 45.7                     | 68.6 | 102.9 | 171.4 | 285.7 |
| 450                               | 4.6                      | 34.3     | 45.7                     | 68.6 | 102.9 | 171.4 | 285.7 |
| 475                               | 3.7                      | 34.1     | 45.4                     | 68.2 | 102.2 | 170.4 | 284.0 |
| 500                               | 2.8                      | 32.1     | 42.9                     | 64.4 | 96.6  | 160.6 | 267.9 |
| 538                               | 1.4                      | 29.0     | 38.5                     | 57.5 | 86.5  | 144.3 | 240.2 |

NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 427°C.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.14C**  
**Pressure-Temperature Ratings for Group 3.14 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings                 | Castings | Plates                   |       |       |       |       |
|------------------------------------|--------------------------|----------|--------------------------|-------|-------|-------|-------|
| 47Ni-22Cr-19Fe-6Mo                 | ...                      | ...      | B582 Gr. N06007 (1)      |       |       |       |       |
| 40Ni-29Cr-15Fe-5Mo                 | B462 Gr. N06030 (1), (2) | ...      | B582 Gr. N06030 (1), (2) |       |       |       |       |
| Working Pressures by Classes, psig |                          |          |                          |       |       |       |       |
| Temp., °F                          | Class                    |          |                          |       |       |       |       |
|                                    | 150                      | 300      | 400                      | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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                       | 495      | 660                      | 995   | 1,490 | 2,485 | 4,140 |
| 900                                | 50                       | 475      | 635                      | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                       | 425      | 570                      | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                       | 415      | 550                      | 825   | 1,245 | 2,075 | 3,455 |

## NOTES:

- (1) Use solution annealed material only.  
(2) Not to be used over 800°F.  
(3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

(25)

| Nominal Designation               | Forgings            |      | Castings |                           |       | Plates              |       |
|-----------------------------------|---------------------|------|----------|---------------------------|-------|---------------------|-------|
|                                   | 150                 | 300  | 400      | 600                       | 900   | 1500                | 2500  |
| 42Fe–33Ni –21Cr                   | A182 Gr. N08810 (1) | ...  | ...      | ...                       | ...   | A240 Gr. N08810 (1) | ...   |
| 42Fe–33Ni –21Cr                   | B564 Gr. N08810 (1) | ...  | ...      | ...                       | ...   | B409 Gr. N08810 (1) | ...   |
| 62Ni–28Mo–5Fe                     | ...                 | ...  | ...      | A494 Gr. N-12W (1), (2)   | ...   | ...                 | ...   |
| 53Ni–17Mo–16Cr-6Fe-5W             | ...                 | ...  | ...      | A494 Gr. CW-12MW (1), (2) | ...   | ...                 | ...   |
| Working Pressures by Classes, bar |                     |      |          |                           |       |                     |       |
| Temp., °C                         | Class               |      |          |                           |       |                     |       |
|                                   | 150                 | 300  | 400      | 600                       | 900   | 1500                | 2500  |
| Min. to 38 [Note (3)]             | 15.8                | 41.1 | 54.9     | 82.3                      | 123.4 | 205.7               | 342.9 |
| 50                                | 15.6                | 40.8 | 54.4     | 81.6                      | 122.4 | 204.0               | 340.0 |
| 100                               | 14.5                | 37.7 | 50.3     | 75.4                      | 113.1 | 188.6               | 314.3 |
| 150                               | 13.7                | 35.7 | 47.5     | 71.3                      | 107.0 | 178.3               | 297.1 |
| 200                               | 13.0                | 33.8 | 45.1     | 67.7                      | 101.5 | 169.2               | 282.0 |
| 250                               | 12.1                | 32.2 | 42.9     | 64.3                      | 96.5  | 160.8               | 268.0 |
| 300                               | 10.2                | 30.7 | 41.0     | 61.4                      | 92.2  | 153.6               | 256.0 |
| 325                               | 9.3                 | 30.0 | 40.0     | 60.0                      | 90.0  | 150.0               | 250.0 |
| 350                               | 8.4                 | 29.5 | 39.4     | 59.0                      | 88.6  | 147.6               | 246.0 |
| 375                               | 7.4                 | 28.8 | 38.4     | 57.6                      | 86.4  | 144.0               | 240.0 |
| 400                               | 6.5                 | 28.3 | 37.8     | 56.6                      | 85.0  | 141.6               | 236.0 |
| 425                               | 5.5                 | 27.6 | 36.8     | 55.2                      | 82.8  | 138.0               | 230.0 |
| 450                               | 4.6                 | 27.1 | 36.2     | 54.2                      | 81.4  | 135.6               | 226.0 |
| 475                               | 3.7                 | 26.9 | 35.8     | 53.8                      | 80.6  | 134.4               | 224.0 |
| 500                               | 2.8                 | 26.4 | 35.2     | 52.8                      | 79.2  | 132.0               | 220.0 |
| 538                               | 1.4                 | 25.2 | 33.6     | 50.4                      | 75.6  | 126.0               | 210.0 |
| 550                               | ...                 | 24.7 | 33.0     | 49.4                      | 74.2  | 123.6               | 206.0 |
| 575                               | ...                 | 24.2 | 32.3     | 48.5                      | 72.7  | 121.2               | 202.0 |
| 600                               | ...                 | 23.7 | 31.6     | 47.5                      | 71.2  | 118.6               | 197.7 |
| 625                               | ...                 | 21.5 | 28.6     | 42.9                      | 64.4  | 107.2               | 178.6 |
| 650                               | ...                 | 16.6 | 22.1     | 33.2                      | 50.2  | 83.4                | 138.9 |
| 675                               | ...                 | 14.1 | 18.8     | 28.3                      | 42.4  | 70.6                | 117.7 |
| 700                               | ...                 | 11.5 | 15.4     | 23.0                      | 34.6  | 57.6                | 96.0  |
| 725                               | ...                 | 9.5  | 12.6     | 18.6                      | 28.1  | 46.7                | 77.9  |
| 750                               | ...                 | 7.3  | 9.7      | 14.4                      | 21.6  | 36.4                | 60.4  |
| 775                               | ...                 | 5.6  | 7.4      | 11.0                      | 16.7  | 27.8                | 46.4  |
| 800                               | ...                 | 4.3  | 5.8      | 8.7                       | 13.0  | 21.6                | 36.2  |
| 816                               | ...                 | 3.5  | 4.8      | 7.4                       | 10.8  | 17.8                | 30.0  |

NOTES:

- (1) Use annealed material only.
- (2) Not to be used over 538°C.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.15C**  
**Pressure-Temperature Ratings for Group 3.15 Materials — U.S. Customary Units**

(25)

| Nominal Designation   | Forgings            | Castings                  | Plates              |
|-----------------------|---------------------|---------------------------|---------------------|
| 33Ni-42Fe-21Cr        | A182 Gr. N08810 (1) | ...                       | A240 Gr. N08810 (1) |
| 33Ni-42Fe-21Cr        | B564 Gr. N08810 (1) | ...                       | B409 Gr. N08810 (1) |
| 62Ni-28Mo-5Fe         | ...                 | A494 Gr. N-12W (1), (2)   | ...                 |
| 53Ni-17Mo-16Cr-6Fe-5W | ...                 | A494 Gr. CW-12MW (1), (2) | ...                 |

| Temp., °F              | Working Pressures by Classes, psig |     |     |       |       |       |       |
|------------------------|------------------------------------|-----|-----|-------|-------|-------|-------|
|                        | Class                              |     |     |       |       |       |       |
|                        | 150                                | 300 | 400 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)] | 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                                 | 370 | 495 | 745   | 1,115 | 1,860 | 3,100 |
| 1,050                  | ...                                | 350 | 465 | 700   | 1,050 | 1,750 | 2,915 |
| 1,100                  | ...                                | 345 | 455 | 685   | 1,030 | 1,715 | 2,855 |
| 1,150                  | ...                                | 320 | 425 | 640   | 955   | 1,595 | 2,655 |
| 1,200                  | ...                                | 240 | 320 | 480   | 725   | 1,205 | 2,005 |
| 1,250                  | ...                                | 200 | 270 | 405   | 605   | 1,010 | 1,685 |
| 1,300                  | ...                                | 160 | 215 | 320   | 485   | 805   | 1,345 |
| 1,350                  | ...                                | 125 | 165 | 250   | 375   | 625   | 1,040 |
| 1,400                  | ...                                | 90  | 120 | 185   | 275   | 465   | 775   |
| 1,450                  | ...                                | 75  | 100 | 145   | 220   | 360   | 605   |
| 1,500                  | ...                                | 50  | 70  | 105   | 160   | 260   | 455   |

## NOTES:

- (1) Use annealed material only.  
(2) Not to be used over 1,000°F.  
(3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.16**  
**Pressure-Temperature Ratings for Group 3.16 Materials — SI Units**

(25)

| Nominal Designation                        | Forgings            |      | Castings |      |       | Plates                   |       |
|--|---------------------|------|----------|------|-------|--------------------------|-------|
| 35Ni-19Cr-1 <sup>1</sup> / <sub>4</sub> Si | B511 Gr. N08330 (2) |      | ...      |      |       | B536 Gr. N08330 (1), (2) |       |
| Working Pressures by Classes, bar          |                     |      |          |      |       |                          |       |
| Temp., °C                                  | Class               |      |          |      |       |                          |       |
|  | 150                 | 300  | 400      | 600  | 900   | 1500                     | 2500  |
| Min. to 38 [Note (3)]                      | 19.1                | 49.7 | 66.3     | 99.4 | 149.1 | 248.6                    | 414.3 |
| 50   | 18.7                | 48.7 | 64.9     | 97.4 | 146.1 | 243.4                    | 405.7 |
| 100  | 16.7                | 43.5 | 58.1     | 87.1 | 130.6 | 217.7                    | 362.9 |
| 150  | 15.6                | 40.8 | 54.4     | 81.6 | 122.4 | 204.0                    | 340.0 |
| 200  | 13.8                | 38.7 | 51.7     | 77.5 | 116.2 | 193.7                    | 322.9 |
| 250  | 12.1                | 36.7 | 48.9     | 73.4 | 110.1 | 183.4                    | 305.7 |
| 300  | 10.2                | 35.3 | 47.1     | 70.6 | 105.9 | 176.6                    | 294.3 |
| 325  | 9.3                 | 34.6 | 46.2     | 69.3 | 103.9 | 173.1                    | 288.6 |
| 350  | 8.4                 | 33.8 | 45.1     | 67.7 | 101.5 | 169.2                    | 282.0 |
| 375  | 7.4                 | 33.1 | 44.2     | 66.2 | 99.4  | 165.6                    | 276.0 |
| 400  | 6.5                 | 32.6 | 43.5     | 65.3 | 97.9  | 163.2                    | 272.0 |
| 425  | 5.5                 | 31.9 | 42.6     | 63.8 | 95.8  | 159.6                    | 266.0 |
| 450  | 4.6                 | 31.4 | 41.9     | 62.9 | 94.3  | 157.2                    | 262.0 |
| 475  | 3.7                 | 30.7 | 41.0     | 61.4 | 92.2  | 153.6                    | 256.0 |
| 500  | 2.8                 | 30.2 | 40.3     | 60.5 | 90.7  | 151.2                    | 252.0 |
| 538  | 1.4                 | 29.0 | 38.5     | 57.5 | 86.5  | 144.3                    | 240.2 |
| 550  | ...                 | 28.8 | 38.3     | 57.3 | 86.0  | 143.6                    | 239.2 |
| 575  | ...                 | 21.8 | 29.1     | 43.7 | 65.5  | 109.2                    | 182.0 |
| 600  | ...                 | 17.3 | 23.1     | 34.6 | 51.9  | 86.6                     | 144.3 |
| 625  | ...                 | 13.7 | 18.2     | 27.4 | 41.0  | 68.4                     | 114.0 |
| 650  | ...                 | 11.0 | 14.7     | 22.0 | 33.0  | 55.0                     | 91.7  |
| 675  | ...                 | 9.1  | 12.1     | 18.2 | 27.3  | 45.4                     | 75.7  |
| 700  | ...                 | 7.6  | 10.1     | 15.2 | 22.7  | 37.9                     | 63.1  |
| 725  | ...                 | 6.1  | 8.1      | 12.2 | 18.3  | 30.5                     | 50.9  |
| 750  | ...                 | 4.7  | 6.3      | 9.4  | 14.3  | 23.5                     | 39.1  |
| 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  | ...                 | 2.7  | 3.6      | 5.3  | 8.0   | 13.4                     | 22.3  |

NOTES:

- (1) Use annealed material only.
- (2) At temperatures over 538°C, these ratings apply only when the carbon is 0.040% or higher.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.16C**  
**Pressure–Temperature Ratings for Group 3.16 Materials — U.S. Customary Units**

(25)

| Nominal Designation                | Forgings            | Castings | Plates                   |       |       |       |       |
|------------------------------------|---------------------|----------|--------------------------|-------|-------|-------|-------|
| 35Ni–19Cr–1¼Si                     | B511 Gr. N08330 (2) | ...      | B536 Gr. N08330 (1), (2) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                          |       |       |       |       |
| Temp., °F                          | Class               |          |                          |       |       |       |       |
|                                    | 150                 | 300      | 400                      | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (3)]             | 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                  | 425      | 570                      | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                  | 415      | 550                      | 825   | 1,245 | 2,075 | 3,455 |
| 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   |

## NOTES:

- (1) Use annealed material only.
- (2) At temperatures over 1,000°F, these ratings apply only when the carbon is 0.040% or higher.
- (3) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.17**  
**Pressure–Temperature Ratings for Group 3.17 Materials — SI Units**

| Nominal Designation               | Forgings |      |      | Castings          |       | Plates |       |
|-----------------------------------|----------|------|------|-------------------|-------|--------|-------|
| 29Ni–20.5Cr–3.5Cu–2.5Mo           | ...      |      |      | A351 Gr. CN7M (1) |       | ...    |       |
| Working Pressures by Classes, bar |          |      |      |                   |       |        |       |
| Temp., °C                         | Class    |      |      |                   |       |        |       |
|                                   | 150      | 300  | 400  | 600               | 900   | 1500   | 2500  |
| Min. to 38 [Note (2)]             | 15.8     | 41.1 | 54.9 | 82.3              | 123.4 | 205.7  | 342.9 |
| 50                                | 15.5     | 40.5 | 53.9 | 80.9              | 121.4 | 202.3  | 337.1 |
| 100                               | 13.5     | 35.3 | 47.1 | 70.6              | 105.9 | 176.6  | 294.3 |
| 150                               | 12.2     | 31.9 | 42.6 | 63.8              | 95.8  | 159.6  | 266.0 |
| 200                               | 11.2     | 29.3 | 39.0 | 58.6              | 87.8  | 146.4  | 244.0 |
| 250                               | 10.4     | 27.1 | 36.2 | 54.2              | 81.4  | 135.6  | 226.0 |
| 300                               | 9.8      | 25.4 | 33.9 | 50.9              | 76.3  | 127.2  | 212.0 |
| 316                               | 9.5      | 24.7 | 33.0 | 49.4              | 74.2  | 123.6  | 206.0 |

NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.17C**  
**Pressure–Temperature Ratings for Group 3.17 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings |     |     | Castings          |       | Plates |       |
|------------------------------------|----------|-----|-----|-------------------|-------|--------|-------|
| 29Ni–20.5Cr–3.5Cu–2.5Mo            | ...      |     |     | A351 Gr. CN7M (1) |       | ...    |       |
| Working Pressures by Classes, psig |          |     |     |                   |       |        |       |
| Temp., °F                          | Class    |     |     |                   |       |        |       |
|                                    | 150      | 300 | 400 | 600               | 900   | 1500   | 2500  |
| Min. to 100 [Note (2)]             | 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 |

NOTES:

(1) Use solution annealed material only.

(2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

**Table 2-3.19**  
**Pressure-Temperature Ratings for Group 3.19 Materials — SI Units**

(25)

| Nominal Designation               | Forgings            | Castings | Plates              |       |       |       |       |
|-----------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 57Ni-22Cr-14W-2Mo-La              | B564 Gr. N06230 (1) | ...      | B435 Gr. N06230 (1) |       |       |       |       |
| Working Pressures by Classes, bar |                     |          |                     |       |       |       |       |
| Temp., °C                         | Class               |          |                     |       |       |       |       |
|                                   | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 38 [Note (2)]             | 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     | 67.0                | 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     | 61.8                | 92.7  | 139.0 | 231.8 | 386.2 |
| 300                               | 10.2                | 45.0     | 60.0                | 90.0  | 135.0 | 225.1 | 375.0 |
| 325                               | 9.3                 | 43.3     | 57.6                | 86.3  | 129.6 | 215.9 | 359.8 |
| 350                               | 8.4                 | 41.9     | 55.8                | 83.6  | 125.5 | 209.1 | 348.7 |
| 375                               | 7.4                 | 40.5     | 53.9                | 80.7  | 121.2 | 201.9 | 336.1 |
| 400                               | 6.5                 | 38.0     | 50.7                | 76.2  | 114.2 | 190.4 | 317.1 |
| 425                               | 5.5                 | 36.8     | 48.9                | 73.2  | 109.8 | 183.0 | 304.7 |
| 450                               | 4.6                 | 35.4     | 47.3                | 71.1  | 106.5 | 177.5 | 295.9 |
| 475                               | 3.7                 | 34.4     | 45.9                | 68.8  | 103.2 | 171.6 | 286.3 |
| 500                               | 2.8                 | 32.1     | 42.9                | 64.4  | 96.6  | 160.6 | 267.9 |
| 538                               | 1.4                 | 29.0     | 38.5                | 57.5  | 86.5  | 144.3 | 240.2 |
| 550                               | 1.4                 | 28.8     | 38.3                | 57.3  | 86.0  | 143.6 | 239.2 |
| 575                               | 1.4                 | 27.8     | 37.1                | 55.6  | 83.3  | 138.9 | 231.4 |
| 600                               | 1.4                 | 25.3     | 33.6                | 50.2  | 75.1  | 125.2 | 208.8 |
| 625                               | 1.4                 | 21.5     | 28.7                | 43.0  | 64.5  | 107.2 | 178.6 |
| 650                               | 1.4                 | 16.6     | 22.1                | 33.2  | 50.2  | 83.4  | 138.9 |
| 675                               | 1.4                 | 14.8     | 19.9                | 30.0  | 44.7  | 74.6  | 124.4 |
| 700                               | 1.4                 | 12.1     | 16.1                | 24.0  | 35.8  | 59.6  | 99.6  |
| 725                               | 1.4                 | 9.6      | 12.6                | 18.6  | 28.1  | 46.7  | 77.9  |
| 750                               | 1.4                 | 7.3      | 9.7                 | 14.4  | 21.6  | 36.4  | 60.4  |
| 775                               | 1.4                 | 5.6      | 7.4                 | 11.0  | 16.7  | 27.8  | 46.4  |
| 800                               | 1.4                 | 4.3      | 5.8                 | 8.7   | 13.0  | 21.6  | 36.2  |
| 816                               | 1.4                 | 3.5      | 4.8                 | 7.4   | 10.8  | 17.8  | 30.0  |

NOTES:

- (1) Use solution annealed material only.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

(25) **Table 2-3.19C**  
**Pressure-Temperature Ratings for Group 3.19 Materials — U.S. Customary Units**

| Nominal Designation                | Forgings            | Castings | Plates              |       |       |       |       |
|------------------------------------|---------------------|----------|---------------------|-------|-------|-------|-------|
| 57Ni-22Cr-14W-2Mo-La               | B564 Gr. N06230 (1) | ...      | B435 Gr. N06230 (1) |       |       |       |       |
| Working Pressures by Classes, psig |                     |          |                     |       |       |       |       |
| Temp., °F                          | Class               |          |                     |       |       |       |       |
|                                    | 150                 | 300      | 400                 | 600   | 900   | 1500  | 2500  |
| Min. to 100 [Note (2)]             | 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                 | 630      | 840                 | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                                | 125                 | 615      | 820                 | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                                | 110                 | 600      | 795                 | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                                | 95                  | 555      | 745                 | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                                | 80                  | 535      | 710                 | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                                | 65                  | 510      | 685                 | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                                | 50                  | 475      | 635                 | 955   | 1,430 | 2,380 | 3,970 |
| 950                                | 35                  | 425      | 570                 | 855   | 1,275 | 2,125 | 3,540 |
| 1,000                              | 20                  | 415      | 550                 | 825   | 1,245 | 2,075 | 3,455 |
| 1,050                              | 20                  | 410      | 545                 | 820   | 1,230 | 2,050 | 3,420 |
| 1,100                              | 20                  | 375      | 500                 | 750   | 1,120 | 1,870 | 3,115 |
| 1,150                              | 20                  | 320      | 425                 | 640   | 960   | 1,595 | 2,660 |
| 1,200                              | 20                  | 240      | 320                 | 480   | 725   | 1,205 | 2,005 |
| 1,250                              | 20                  | 210      | 285                 | 430   | 645   | 1,075 | 1,790 |
| 1,300                              | 20                  | 165      | 220                 | 325   | 490   | 815   | 1,365 |
| 1,350                              | 20                  | 125      | 165                 | 250   | 375   | 625   | 1,040 |
| 1,400                              | 20                  | 90       | 120                 | 185   | 275   | 465   | 775   |
| 1,450                              | 20                  | 75       | 100                 | 145   | 220   | 360   | 605   |
| 1,500                              | 20                  | 50       | 70                  | 105   | 160   | 260   | 435   |

NOTES:

- (1) Use solution annealed material only.
- (2) See para. 2.5.3 for guidance on how to determine minimum temperatures.

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

| NPS   | Maximum Radial Projection of Imperfections That Are No Deeper Than the Bottom of the Serrations, mm | Maximum Radial Projection of Imperfections That Are Deeper Than the Bottom of the Serrations, mm | Maximum Depth of Imperfections That Are Deeper Than the Bottom of the Serrations, mm |
|-------|---|--|--|
| 1/2   | 3.0   | 1.5  | 1.5  |
| 3/4   | 3.0   | 1.5  | 1.5  |
| 1     | 3.0   | 1.5  | 1.5  |
| 1 1/4 | 3.0   | 1.5  | 1.5  |
| 1 1/2 | 3.0   | 1.5  | 1.5  |
| 2     | 3.0   | 1.5  | 1.5  |
| 2 1/2 | 3.0   | 1.5  | 1.5  |
| 3     | 4.6   | 1.5  | 1.5  |
| 3 1/2 | 6.4   | 3.0  | 3.0  |
| 4     | 6.4   | 3.0  | 3.0  |
| 5     | 6.4   | 3.0  | 3.0  |
| 6     | 6.4   | 3.0  | 3.0  |
| 8     | 7.9   | 4.6  | 4.6  |
| 10    | 7.9   | 4.6  | 4.6  |
| 12    | 7.9   | 4.6  | 4.6  |
| 14    | 7.9   | 4.6  | 4.6  |
| 16    | 9.6   | 4.6  | 4.6  |
| 18    | 12.7  | 6.4  | 6.4  |
| 20    | 12.7  | 6.4  | 6.4  |
| 22    | 12.7  | 6.4  | 6.4  |
| 24    | 12.7  | 6.4  | 6.4  |

**Table 3C**  
**Permissible Imperfections in Flange Facing Finish for Raised Face and Large Male and Female Flanges —**  
**U.S. Customary Units**

| <b>NPS</b> | <b>Maximum Radial<br/>Projection of<br/>Imperfections That<br/>Are No Deeper Than<br/>the Bottom of the<br/>Serrations, in.</b> | <b>Maximum Radial Projection of<br/>Imperfections That<br/>Are Deeper Than the<br/>Bottom of the<br/>Serrations, in.</b> | <b>Maximum Depth of<br/>Imperfections That<br/>Are Deeper Than the<br/>Bottom of the<br/>Serrations, in.</b> |
|------------|---|--|--|
| 1/2        | 0.12  | 0.06   | 0.06   |
| 3/4        | 0.12  | 0.06   | 0.06   |
| 1          | 0.12  | 0.06   | 0.06   |
| 1 1/4      | 0.12  | 0.06   | 0.06   |
| 1 1/2      | 0.12  | 0.06   | 0.06   |
| 2          | 0.12  | 0.06   | 0.06   |
| 2 1/2      | 0.12  | 0.06   | 0.06   |
| 3          | 0.18  | 0.06   | 0.06   |
| 3 1/2      | 0.25  | 0.12   | 0.12   |
| 4          | 0.25  | 0.12   | 0.12   |
| 5          | 0.25  | 0.12   | 0.12   |
| 6          | 0.25  | 0.12   | 0.12   |
| 8          | 0.31  | 0.18   | 0.18   |
| 10         | 0.31  | 0.18   | 0.18   |
| 12         | 0.31  | 0.18   | 0.18   |
| 14         | 0.31  | 0.18   | 0.18   |
| 16         | 0.38  | 0.18   | 0.18   |
| 18         | 0.50  | 0.25   | 0.25   |
| 20         | 0.50  | 0.25   | 0.25   |
| 22         | 0.50  | 0.25   | 0.25   |
| 24         | 0.50  | 0.25   | 0.25   |

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

| 1                       | 2   | 3                       | 4                     | 5  | 6  | 7   | 8                         | 9                     | 10  | 11                         | 12   | 13   | 14   | 15                                     |
|-------------------------|---|-------------------------|-----------------------|--|--|---|---------------------------|-----------------------|---|----------------------------|--|--|--|--|
| Nominal<br>Pipe<br>Size | Outside Diameter  |                         |                       |  |  | Outside Diameter                                |                           |                       |   | Height                     |  |  | Minimum<br>Outside Diameter<br>of Raised Portion<br>(6), (7) |  |
|                         | Raised<br>Face<br>Large<br>Male<br>and<br>Large<br>Tongue,<br>R | Small<br>Male,<br>S (1) | Small<br>Tongue,<br>T | Inside<br>Diameter<br>of Large<br>and<br>Small<br>Tongue,<br>U | Inside<br>Diameter<br>of Small<br>Tongue (1) | Large<br>Female<br>and<br>Large<br>Groove,<br>W | Small<br>Female,<br>X (1) | Small<br>Groove,<br>Y | Inside<br>Diameter<br>of Large<br>and Small<br>Groove,<br>Z | Raised<br>Face<br>(2), (3) | Large<br>and Small<br>Male and<br>Tongue<br>(2), (4) | Depth of<br>Groove<br>or<br>Female<br>(2), (5) | Small<br>Female<br>and<br>Groove,<br>K                       | Large<br>Female<br>and<br>Groove,<br>L |
|                         |   |                         |                       |  |  |   |                           |                       |   |                            |  |  |  |  |
| 1/2                     | 35.1  | 18.3                    | 35.1                  | 25.4   | ...  | 36.6  | 19.8                      | 36.6                  | 23.9  | ...                        | ...  | ...  | 44   | 46                                     |
| 3/4                     | 42.9  | 23.9                    | 42.9                  | 33.3   | ...  | 44.4  | 25.4                      | 44.4                  | 31.8  | ...                        | ...  | ...  | 52   | 54                                     |
| 1                       | 50.8  | 30.2                    | 47.8                  | 38.1   | ...  | 52.3  | 31.8                      | 49.3                  | 36.6  | ...                        | ...  | ...  | 57   | 62                                     |
| 1 1/4                   | 63.5  | 38.1                    | 57.2                  | 47.8   | ...  | 65.1  | 39.6                      | 58.7                  | 46.0  | ...                        | ...  | ...  | 67   | 75                                     |
| 1 1/2                   | 73.0  | 44.4                    | 63.5                  | 53.8   | ...  | 74.7  | 46.0                      | 65.0                  | 52.3  | ...                        | ...  | ...  | 73   | 84                                     |
| 2                       | 91.9  | 57.2                    | 82.6                  | 73.2   | ...  | 93.7  | 58.7                      | 84.1                  | 71.4  | ...                        | ...  | ...  | 92   | 103                                    |
| 2 1/2                   | 104.6   | 68.3                    | 95.2                  | 85.9   | ...  | 106.4   | 69.8                      | 96.8                  | 84.1  | ...                        | ...  | ...  | 105  | 116                                    |
| 3                       | 127.0   | 84.1                    | 117.3                 | 108.0  | ...  | 128.5   | 85.9                      | 119.1                 | 106.4   | ...                        | ...  | ...  | 127  | 138                                    |
| 3 1/2                   | 139.7   | 96.8                    | 130.0                 | 120.6  | ...  | 141.2   | 98.6                      | 131.8                 | 119.1   | ...                        | ...  | ...  | 140  | 151                                    |
| 4                       | 157.2   | 109.5                   | 144.5                 | 131.8  | ...  | 158.8   | 111.3                     | 146.0                 | 130.0   | ...                        | ...  | ...  | 157  | 168                                    |
| 5                       | 185.7   | 136.7                   | 173.0                 | 160.3  | ...  | 187.5   | 138.2                     | 174.8                 | 158.8   | ...                        | ...  | ...  | 186  | 197                                    |
| 6                       | 215.9   | 162.1                   | 203.2                 | 190.5  | ...  | 217.4   | 163.6                     | 204.7                 | 189.0   | ...                        | ...  | ...  | 216  | 227                                    |
| 8                       | 269.7   | 212.9                   | 254.0                 | 238.3  | ...  | 271.5   | 214.4                     | 255.5                 | 236.5   | ...                        | ...  | ...  | 270  | 281                                    |
| 10                      | 323.8   | 266.7                   | 304.8                 | 285.8  | ...  | 325.4   | 268.2                     | 306.3                 | 284.2   | ...                        | ...  | ...  | 324  | 335                                    |
| 12                      | 381.0   | 317.5                   | 362.0                 | 342.9  | ...  | 382.5   | 319.0                     | 363.5                 | 341.4   | ...                        | ...  | ...  | 381  | 392                                    |
| 14                      | 412.8   | 349.2                   | 393.7                 | 374.6  | ...  | 414.3   | 350.8                     | 395.2                 | 373.1   | ...                        | ...  | ...  | 413  | 424                                    |
| 16                      | 469.9   | 400.0                   | 447.5                 | 425.4  | ...  | 471.4   | 401.6                     | 449.3                 | 423.9   | ...                        | ...  | ...  | 470  | 481                                    |
| 18                      | 533.4   | 450.8                   | 512.0                 | 489.0  | ...  | 534.9   | 452.4                     | 512.8                 | 487.4   | ...                        | ...  | ...  | 533  | 545                                    |
| 20                      | 584.2   | 501.6                   | 558.8                 | 533.4  | ...  | 585.7   | 503.2                     | 560.3                 | 531.9   | ...                        | ...  | ...  | 584  | 595                                    |
| 22                      | 641.4   | ...                     | ...                   | ...  | ...  | ...   | ...                       | ...                   | ...   | ...                        | ...  | ...  | ...  | ...                                    |
| 24                      | 692.2   | 603.2                   | 666.8                 | 641.4  | ...  | 693.7   | 604.8                     | 668.3                 | 639.8   | ...                        | ...  | ...  | 692  | 703                                    |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For facing requirements for flanges and flanged fittings, see paras. 6.3 and 6.4 and Figure 6.
- (c) For facing requirements for lapped joints, see para. 6.4.3 and Figure 6.

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

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GENERAL NOTES: (Cont'd)

(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 [Figure 6](#) for thickness and outside diameters of laps.
- (3) The height of the raised face is either 1.5 mm or 6.4 mm (see [para. 6.4.1](#)).
- (4) The height of the large and small male and tongue is 6.4 mm.
- (5) The depth of the groove or female is 4.8 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 4C**  
**Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes) — U.S. Customary Units**

| 1                       | 2  | 3                       | 4                     | 5   | 6  | 7  | 8                         | 9                     | 10  | 11                         | 12   | 13   | 14  | 15                               |
|-------------------------|--|-------------------------|-----------------------|---|--|--|---------------------------|-----------------------|---|----------------------------|--|--|---|----------------------------------|
| Nominal<br>Pipe<br>Size | Outside Diameter                         |                         |                       | Inside<br>Diameter of<br>Large and<br>Small<br>Tongue,<br>U | Inside<br>Diameter<br>of Small<br>Male (1) | Outside Diameter                             |                           |                       | Inside<br>Diameter of<br>Large and<br>Small<br>Groove,<br>Z | Height                     |  | Depth of<br>Groove<br>or<br>Female<br>(2), (5) | Minimum Outside Diameter<br>of Raised Portion<br>(6), (7) |                                  |
|                         | Raised Face<br>and Large<br>Tongue,<br>R | Small<br>Male,<br>S (1) | Small<br>Tongue,<br>T |   |  | Large<br>Female<br>and Large<br>Groove,<br>W | Small<br>Female,<br>X (1) | Small<br>Groove,<br>Y |   | Raised<br>Face<br>(2), (3) | Large and<br>Small<br>Male and<br>Tongue<br>(2), (4) |  | Small Female<br>and Groove,<br>K                          | Large Female<br>and Groove,<br>L |
|                         |  |                         |                       |   |  |  |                           |                       |   |                            |  |  |   |                                  |
| 1/2                     | 1.38                                     | 0.72                    | 1.38                  | 1.00  | ...  | 1.44   | 0.78                      | 1.44                  | 0.94  | ...                        | ...  | ...  | 1.75  | 1.81                             |
| 3/4                     | 1.69                                     | 0.94                    | 1.69                  | 1.31  | ...  | 1.75   | 1.00                      | 1.75                  | 1.25  | ...                        | ...  | ...  | 2.06  | 2.12                             |
| 1                       | 2.00                                     | 1.19                    | 1.88                  | 1.50  | ...  | 2.06   | 1.25                      | 1.94                  | 1.44  | ...                        | ...  | ...  | 2.25  | 2.44                             |
| 1 1/4                   | 2.50                                     | 1.50                    | 2.25                  | 1.88  | ...  | 2.56   | 1.56                      | 2.31                  | 1.81  | ...                        | ...  | ...  | 2.62  | 2.94                             |
| 1 1/2                   | 2.88                                     | 1.75                    | 2.50                  | 2.12  | ...  | 2.94   | 1.81                      | 2.56                  | 2.06  | ...                        | ...  | ...  | 2.88  | 3.31                             |
| 2                       | 3.62                                     | 2.25                    | 3.25                  | 2.88  | ...  | 3.69   | 2.31                      | 3.31                  | 2.81  | ...                        | ...  | ...  | 3.62  | 4.06                             |
| 2 1/2                   | 4.12                                     | 2.69                    | 3.75                  | 3.38  | ...  | 4.19   | 2.75                      | 3.81                  | 3.31  | ...                        | ...  | ...  | 4.12  | 4.56                             |
| 3                       | 5.00                                     | 3.31                    | 4.62                  | 4.25  | ...  | 5.06   | 3.38                      | 4.69                  | 4.19  | ...                        | ...  | ...  | 5.00  | 5.44                             |
| 3 1/2                   | 5.50                                     | 3.81                    | 5.12                  | 4.75  | ...  | 5.56   | 3.88                      | 5.19                  | 4.69  | ...                        | ...  | ...  | 5.50  | 5.94                             |
| 4                       | 6.19                                     | 4.31                    | 5.69                  | 5.19  | ...  | 6.25   | 4.38                      | 5.75                  | 5.12  | ...                        | ...  | ...  | 6.19  | 6.62                             |
| 5                       | 7.31                                     | 5.38                    | 6.81                  | 6.31  | ...  | 7.38   | 5.44                      | 6.88                  | 6.25  | ...                        | ...  | ...  | 7.31  | 7.75                             |
| 6                       | 8.50                                     | 6.38                    | 8.00                  | 7.50  | ...  | 8.56   | 6.44                      | 8.06                  | 7.44  | ...                        | ...  | ...  | 8.50  | 8.94                             |
| 8                       | 10.62                                    | 8.38                    | 10.00                 | 9.38  | ...  | 10.69  | 8.44                      | 10.06                 | 9.31  | ...                        | ...  | ...  | 10.62   | 11.06                            |
| 10                      | 12.75                                    | 10.50                   | 12.00                 | 11.25   | ...  | 12.81  | 10.56                     | 12.06                 | 11.19   | ...                        | ...  | ...  | 12.75   | 13.19                            |
| 12                      | 15.00                                    | 12.50                   | 14.25                 | 13.50   | ...  | 15.06  | 12.56                     | 14.31                 | 13.44   | ...                        | ...  | ...  | 15.00   | 15.44                            |
| 14                      | 16.25                                    | 13.75                   | 15.50                 | 14.75   | ...  | 16.31  | 13.81                     | 15.56                 | 14.69   | ...                        | ...  | ...  | 16.25   | 16.69                            |
| 16                      | 18.50                                    | 15.75                   | 17.62                 | 16.75   | ...  | 18.56  | 15.81                     | 17.69                 | 16.69   | ...                        | ...  | ...  | 18.50   | 18.94                            |
| 18                      | 21.00                                    | 17.75                   | 20.12                 | 19.25   | ...  | 21.06  | 17.81                     | 20.19                 | 19.19   | ...                        | ...  | ...  | 21.00   | 21.44                            |
| 20                      | 23.00                                    | 19.75                   | 22.00                 | 21.00   | ...  | 23.06  | 19.81                     | 22.06                 | 20.94   | ...                        | ...  | ...  | 23.00   | 23.44                            |
| 22                      | 25.25                                    | ...                     | ...                   | ...   | ...  | ...  | ...                       | ...                   | ...   | ...                        | ...  | ...  | ...   | ...                              |
| 24                      | 27.25                                    | 23.75                   | 26.25                 | 25.25   | ...  | 27.31  | 23.81                     | 26.31                 | 25.19   | ...                        | ...  | ...  | 27.25   | 27.69                            |

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For facing requirements for flanges and flanged fittings, see paras. 6.3 and 6.4 and Figure 6.
- (c) For facing requirements for lapped joints, see para. 6.4.3 and Figure 6.
- (d) For facing tolerances, see para. 7.3.

**Table 4C**  
**Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**

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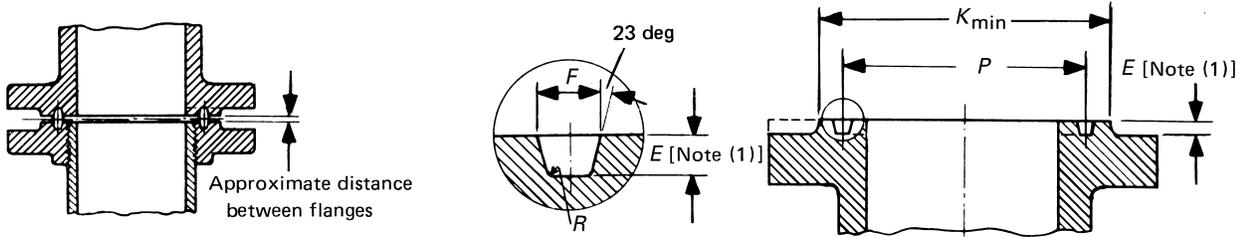
NOTES:

- (1) For small male and female joints, care should be taken in the use of these dimensions to ensure that the inside diameter of 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 Locknut Thread (NPSL).
- (2) See [para. 6.4.3](#) and [Figure 6](#) for thickness and outside diameters of laps.
- (3) The height of the raised face is either 0.06 in. or 0.25 in. (see [para. 6.4.1](#)).
- (4) The height of the large and small male and tongue is 0.25 in.
- (5) The depth of the groove or female is 0.19 in.
- (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 STARTS ON NEXT PAGE

**Table 5**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — SI Units**

(25)

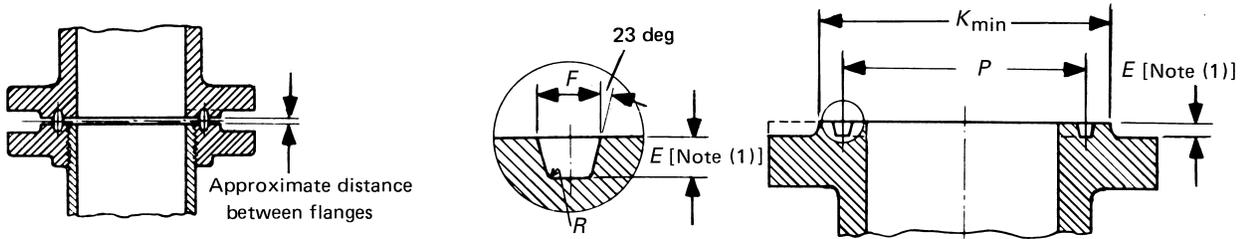


| Nominal Size  |               |                   |               |                   |                |                | Groove Dimensions |                   |              |          | Radius              |
|---------------|---------------|-------------------|---------------|-------------------|----------------|----------------|-------------------|-------------------|--------------|----------|---------------------|
| Class 150 NPS | Class 300 NPS | Class 400 NPS (2) | Class 600 NPS | Class 900 NPS (3) | Class 1500 NPS | Class 2500 NPS | Groove Number     | Pitch Diameter, P | Depth, E (1) | Width, F | Radius at Bottom, R |
| ...           | 1/2           | ...               | 1/2           | ...               | ...            | ...            | 11                | 34.14             | 5.56         | 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                | 47.62             | 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                | 68.28             | 6.35         | 8.74     | 0.8                 |
| ...           | ...           | ...               | ...           | ...               | ...            | 1 1/4          | 21                | 72.24             | 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                | 111.12            | 9.53         | 13.49    | 1.5                 |
| 3             | ...           | ...               | ...           | ...               | ...            | ...            | 29                | 114.30            | 6.35         | 8.74     | 0.8                 |
| ...           | (4)           | ...               | (4)           | ...               | ...            | ...            | 30                | 117.48            | 7.92         | 11.91    | 0.8                 |
| ...           | 3 (4)         | ...               | 3 (4)         | 3                 | ...            | ...            | 31                | 123.82            | 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                | 136.52            | 7.92         | 11.91    | 0.8                 |
| 4             | ...           | ...               | ...           | ...               | ...            | ...            | 36                | 149.22            | 6.35         | 8.74     | 0.8                 |
| ...           | 4             | 4                 | 4             | 4                 | ...            | ...            | 37                | 149.22            | 7.92         | 11.91    | 0.8                 |
| ...           | ...           | ...               | ...           | ...               | ...            | 4              | 38                | 157.18            | 11.13        | 16.66    | 1.5                 |
| ...           | ...           | ...               | ...           | ...               | 4              | ...            | 39                | 161.92            | 7.92         | 11.91    | 0.8                 |
| 5             | ...           | ...               | ...           | ...               | ...            | ...            | 40                | 171.45            | 6.35         | 8.74     | 0.8                 |

**Table 5**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — SI Units**

| 13                                   | 14    | 15    | 16    | 17    | 18                                   | 19    | 20    | 21    | 22    | 23    | 24    |      |      |
|--------------------------------------|-------|-------|-------|-------|--------------------------------------|-------|-------|-------|-------|-------|-------|------|------|
| Diameter of Raised Portion, <i>K</i> |       |       |       |       | Approximate Distance Between Flanges |       |       |       |       |       |       |      |      |
| Class                                | Class | Class | Class | Class | Class                                | Class | Class | Class | Class | Class | Class |      |      |
| 150                                  | 300   | 400   | 600   | 900   | 1500                                 | 2500  | 150   | 300   | 400   | 600   | 900   | 1500 | 2500 |
| ...                                  | 51.0  | ...   | ...   | ...   | ...                                  | 3     | ...   | 3     | ...   | ...   | ...   | ...  | ...  |
| ...                                  | ...   | ...   | 60.5  | ...   | ...                                  | ...   | ...   | ...   | ...   | ...   | 4     | ...  | ...  |
| ...                                  | 63.5  | ...   | ...   | 65.0  | ...                                  | 4     | ...   | 4     | ...   | ...   | ...   | 4    | ...  |
| ...                                  | ...   | ...   | 66.5  | ...   | ...                                  | ...   | ...   | ...   | ...   | ...   | 4     | ...  | ...  |
| 63.5                                 | ...   | ...   | ...   | ...   | 4                                    | ...   | ...   | ...   | ...   | ...   | ...   | ...  | ...  |
| ...                                  | 69.8  | ...   | 71.4  | 73.2  | ...                                  | 4     | ...   | 4     | ...   | 4     | 4     | 4    | 4    |
| 73.2                                 | ...   | ...   | ...   | ...   | 4                                    | ...   | ...   | ...   | ...   | ...   | ...   | ...  | ...  |
| ...                                  | 79.2  | ...   | 81.0  | 82.6  | ...                                  | 4     | ...   | 4     | ...   | 4     | 4     | 4    | 4    |
| 82.6                                 | ...   | ...   | ...   | ...   | 4                                    | ...   | ...   | ...   | ...   | ...   | ...   | ...  | ...  |
| ...                                  | 90.4  | ...   | 91.9  | ...   | ...                                  | 4     | ...   | 4     | ...   | 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   | 155   | ...   | ...   | ...                                  | 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                                    | ...   | ...   | ...   | ...   | ...   | ...   | ...  | ...  |

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

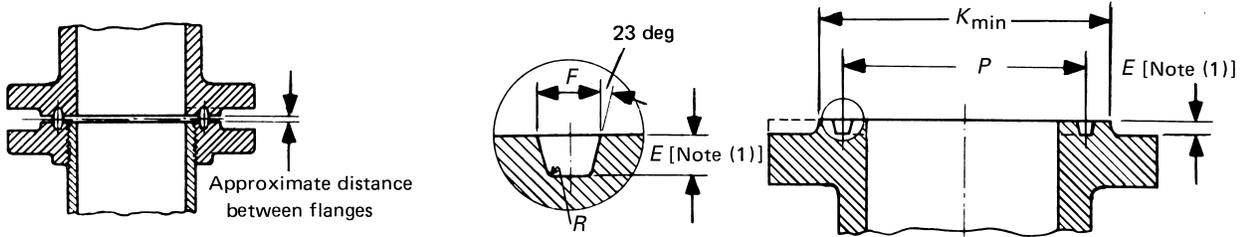


| Nominal Size  |               |                   |               |                   |                |                | Groove Dimensions |                   |              |          | Radius at Bottom, R |
|---------------|---------------|-------------------|---------------|-------------------|----------------|----------------|-------------------|-------------------|--------------|----------|---------------------|
| Class 150 NPS | Class 300 NPS | Class 400 NPS (2) | Class 600 NPS | Class 900 NPS (3) | Class 1500 NPS | Class 2500 NPS | Groove Number     | Pitch Diameter, P | Depth, E (1) | Width, F |                     |
| ...           | 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            | 9.52         | 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                 |
| ...           | ...           | ...               | ...           | ...               | 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    | 2.3                 |
| 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    | 2.3                 |
| ...           | 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    | 2.3                 |
| 16            | ...           | ...               | ...           | ...               | ...            | ...            | 64                | 454.02            | 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    | 2.3                 |
| 18            | ...           | ...               | ...           | ...               | ...            | ...            | 68                | 517.52            | 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    | 2.3                 |

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

| 13                                   | 14           | 15           | 16           | 17            | 18                                   | 19           | 20           | 21           | 22           | 23           | 24            |               |
|--------------------------------------|--------------|--------------|--------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, <i>K</i> |              |              |              |               | Approximate Distance Between Flanges |              |              |              |              |              |               |               |
| Class<br>150                         | Class<br>300 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500                        | Class<br>150 | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| ...                                  | 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            | ...          | ...           | ...           |
| ...                                  | ...          | ...          | 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             | ...           |

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



| Nominal Size  |               |                   |               |                   |                |                | Groove Dimensions |                          |                     |                 | Radius at Bottom, <i>R</i> |
|---------------|---------------|-------------------|---------------|-------------------|----------------|----------------|-------------------|--------------------------|---------------------|-----------------|----------------------------|
| Class 150 NPS | Class 300 NPS | Class 400 NPS (2) | Class 600 NPS | Class 900 NPS (3) | Class 1500 NPS | Class 2500 NPS | Groove Number     | Pitch Diameter, <i>P</i> | Depth, <i>E</i> (1) | Width, <i>F</i> |                            |
| 20            | ...           | ...               | ...           | ...               | ...            | ...            | 72                | 558.80                   | 6.35                | 8.74            | 0.8                        |
| ...           | 20            | 20                | 20            | ...               | ...            | ...            | 73                | 584.20                   | 9.52                | 13.49           | 1.5                        |
| ...           | ...           | ...               | ...           | 20                | ...            | ...            | 74                | 584.20                   | 12.70               | 19.84           | 1.5                        |
| ...           | ...           | ...               | ...           | ...               | 20             | ...            | 75                | 584.20                   | 17.48               | 33.32           | 2.3                        |
| 22            | ...           | ...               | ...           | ...               | ...            | ...            | 80                | 615.95                   | 6.35                | 8.74            | 0.8                        |
| ...           | 22            | 22                | 22            | ...               | ...            | ...            | 81                | 635.00                   | 11.13               | 15.09           | 1.5                        |
| 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           | 2.3                        |
| ...           | ...           | ...               | ...           | ...               | 24             | ...            | 79                | 692.15                   | 20.62               | 36.53           | 2.3                        |

**Table 5**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — SI Units (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                                | Class 300 |     | Class 900 | Class 1500 | Class 2500                           | Class 150 | Class 300 | Class 400 | Class 600 | Class 900 | Class 1500 | Class 2500 |
| 597                                  | ...       | ... | ...       | ...        | ...                                  | 3         | ...       | ...       | ...       | ...       | ...        | ...        |
| ...                                  | 635       | ... | ...       | ...        | ...                                  | ...       | 6         | 6         | 5         | ...       | ...        | ...        |
| ...                                  | ...       | 648 | ...       | ...        | ...                                  | ...       | ...       | ...       | ...       | 5         | ...        | ...        |
| ...                                  | ...       | ... | 673       | ...        | ...                                  | ...       | ...       | ...       | ...       | ...       | 10         | ...        |
| 648                                  | ...       | ... | ...       | ...        | ...                                  | 3         | ...       | ...       | ...       | ...       | ...        | ...        |
| ...                                  | 686       | ... | ...       | ...        | ...                                  | ...       | 6         | 6         | 6         | ...       | ...        | ...        |
| 711                                  | ...       | ... | ...       | ...        | ...                                  | 3         | ...       | ...       | ...       | ...       | ...        | ...        |
| ...                                  | 749       | ... | ...       | ...        | ...                                  | ...       | 6         | 6         | 6         | ...       | ...        | ...        |
| ...                                  | ...       | 772 | ...       | ...        | ...                                  | ...       | ...       | ...       | ...       | 6         | ...        | ...        |
| ...                                  | ...       | ... | 794       | ...        | ...                                  | ...       | ...       | ...       | ...       | ...       | 11         | ...        |

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

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## GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For facing requirements for flanges and flanged fitting, see [para. 6.4.1](#) and [Figure 6](#).
- (c) For facing requirements for lapped joints, see [para. 6.4.3](#) and [Figure 6](#).
- (d) See [para. 4.2.7](#) for marking requirements.

## 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) 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 is used instead of R31.

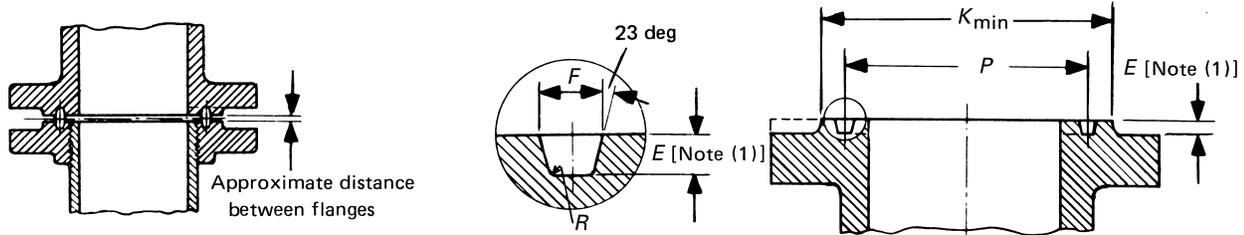
## TOLERANCES:

- $E$  = (depth) +0.41, -0.00 mm
- $F$  = (width)  $\pm 0.20$  mm
- $P$  = (pitch diameter)  $\pm 0.13$  mm
- $R$  = (radius at bottom)
  - =  $R \leq 1.5$  + 0.8, -0.0 mm
  - =  $R > 1.5$   $\pm 0.8$  mm
- 23 = deg (angle)  $\pm \frac{1}{2}$  deg

TABLE STARTS ON NEXT PAGE

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units**

(25)

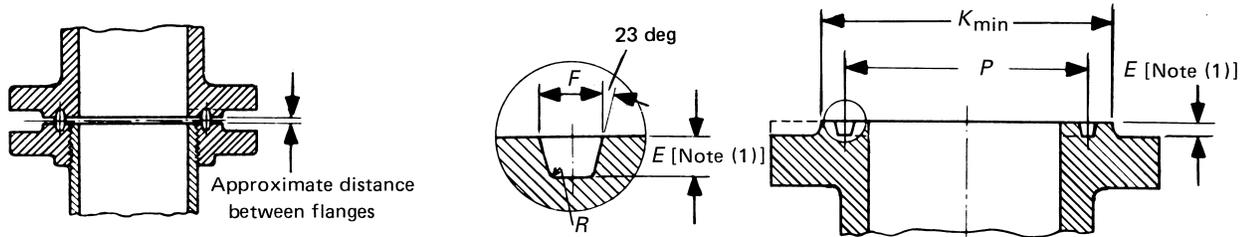


| Nominal Pipe Size |           |               |           |               |            |            | Groove Dimensions |                   |              |          |                     |
|-------------------|-----------|---------------|-----------|---------------|------------|------------|-------------------|-------------------|--------------|----------|---------------------|
| Class 150         | Class 300 | Class 400 (2) | Class 600 | Class 900 (3) | Class 1500 | Class 2500 | Groove Number     | Pitch Diameter, P | Depth, E (1) | Width, F | Radius at Bottom, R |
| ...               | 1/2       | ...           | 1/2       | ...           | ...        | ...        | R11               | 1.344             | 0.219        | 0.281    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | 1/2        | ...        | 12                | 1.562             | 0.250        | 0.344    | 0.03                |
| ...               | 3/4       | ...           | 3/4       | ...           | ...        | 1/2        | 13                | 1.688             | 0.250        | 0.344    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | 3/4        | ...        | 14                | 1.750             | 0.250        | 0.344    | 0.03                |
| 1                 | ...       | ...           | ...       | ...           | ...        | ...        | 15                | 1.875             | 0.250        | 0.344    | 0.03                |
| ...               | 1         | ...           | 1         | ...           | 1          | 3/4        | 16                | 2.000             | 0.250        | 0.344    | 0.03                |
| 1 1/4             | ...       | ...           | ...       | ...           | ...        | ...        | 17                | 2.250             | 0.250        | 0.344    | 0.03                |
| ...               | 1 1/4     | ...           | 1 1/4     | ...           | 1 1/4      | 1          | 18                | 2.375             | 0.250        | 0.344    | 0.03                |
| 1 1/2             | ...       | ...           | ...       | ...           | ...        | ...        | 19                | 2.562             | 0.250        | 0.344    | 0.03                |
| ...               | 1 1/2     | ...           | 1 1/2     | ...           | 1 1/2      | ...        | 20                | 2.688             | 0.250        | 0.344    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | ...        | 1 1/4      | 21                | 2.844             | 0.312        | 0.469    | 0.03                |
| 2                 | ...       | ...           | ...       | ...           | ...        | ...        | 22                | 3.250             | 0.250        | 0.344    | 0.03                |
| ...               | 2         | ...           | 2         | ...           | ...        | 1 1/2      | 23                | 3.250             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | 2          | ...        | 24                | 3.750             | 0.312        | 0.469    | 0.03                |
| 2 1/2             | ...       | ...           | ...       | ...           | ...        | ...        | 25                | 4.000             | 0.250        | 0.344    | 0.03                |
| ...               | 2 1/2     | ...           | 2 1/2     | ...           | ...        | 2          | 26                | 4.000             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | 2 1/2      | ...        | 27                | 4.250             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | ...        | 2 1/2      | 28                | 4.375             | 0.375        | 0.531    | 0.06                |
| 3                 | ...       | ...           | ...       | ...           | ...        | ...        | 29                | 4.500             | 0.250        | 0.344    | 0.03                |
| ...               | (4)       | ...           | (4)       | ...           | ...        | ...        | 30                | 4.625             | 0.312        | 0.469    | 0.03                |
| ...               | 3 (4)     | ...           | 3 (4)     | 3             | ...        | ...        | 31                | 4.875             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | ...        | 3          | 32                | 5.000             | 0.375        | 0.531    | 0.06                |
| 3 1/2             | ...       | ...           | ...       | ...           | ...        | ...        | 33                | 5.188             | 0.250        | 0.344    | 0.03                |
| ...               | 3 1/2     | ...           | 3 1/2     | ...           | ...        | ...        | 34                | 5.188             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | 3          | ...        | 35                | 5.375             | 0.312        | 0.469    | 0.03                |
| 4                 | ...       | ...           | ...       | ...           | ...        | ...        | 36                | 5.875             | 0.250        | 0.344    | 0.03                |
| ...               | 4         | 4             | 4         | 4             | ...        | ...        | 37                | 5.875             | 0.312        | 0.469    | 0.03                |
| ...               | ...       | ...           | ...       | ...           | ...        | 4          | 38                | 6.188             | 0.438        | 0.656    | 0.06                |
| ...               | ...       | ...           | ...       | ...           | 4          | ...        | 39                | 6.375             | 0.312        | 0.469    | 0.03                |
| 5                 | ...       | ...           | ...       | ...           | ...        | ...        | 40                | 6.750             | 0.250        | 0.344    | 0.03                |

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units**

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

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**

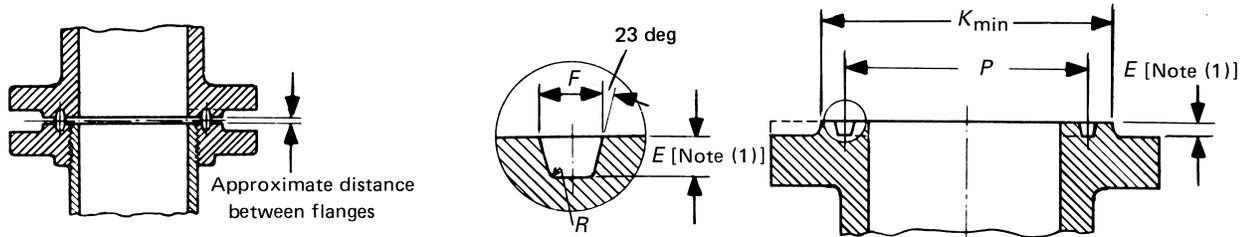


| Nominal Pipe Size |           |               |           |               |            |            | Groove Dimensions |                   |              |          |                     |
|-------------------|-----------|---------------|-----------|---------------|------------|------------|-------------------|-------------------|--------------|----------|---------------------|
| Class 150         | Class 300 | Class 400 (2) | Class 600 | Class 900 (3) | Class 1500 | Class 2500 | Groove Number     | Pitch Diameter, P | Depth, E (1) | Width, F | Radius at Bottom, R |
| ...               | 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                |
| ...               | ...       | ...           | ...       | ...           | ...        | 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                |

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**

| 13                            | 14                         | 15           | 16            | 17            | 18                                   | 19           | 20           | 21           | 22           | 23            | 24            |
|-------------------------------|----------------------------|--------------|---------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, K |                            |              |               |               | Approximate Distance Between Flanges |              |              |              |              |               |               |
| Class<br>150                  | Class<br>300<br>400<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 | Class<br>150                         | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| ...                           | 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          | ...           |
| ...                           | ...                        | ...          | ...           | 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          | ...           |

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**



| Nominal Pipe Size |           |               |           |               |            |            | Groove Dimensions |                          |                     |                 |                            |
|-------------------|-----------|---------------|-----------|---------------|------------|------------|-------------------|--------------------------|---------------------|-----------------|----------------------------|
| Class 150         | Class 300 | Class 400 (2) | Class 600 | Class 900 (3) | Class 1500 | Class 2500 | Groove Number     | Pitch Diameter, <i>P</i> | Depth, <i>E</i> (1) | Width, <i>F</i> | Radius at Bottom, <i>R</i> |
| 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                       |
| 22                | ...       | ...           | ...       | ...           | ...        | ...        | 80                | 24.250                   | 0.250               | 0.344           | 0.03                       |
| ...               | 22        | 22            | 22        | ...           | ...        | ...        | 81                | 25.000                   | 0.438               | 0.594           | 0.06                       |
| 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 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**

| 13                                   | 14                         | 15           | 16            | 17            | 18                                   | 19           | 20           | 21           | 22           | 23            | 24            |
|--------------------------------------|----------------------------|--------------|---------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, <i>K</i> |                            |              |               |               | Approximate Distance Between Flanges |              |              |              |              |               |               |
| Class<br>150                         | Class<br>300<br>400<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 | Class<br>150                         | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| 23.50                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 25.00                      | ...          | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | ...          | ...           | ...           |
| ...                                  | ...                        | 25.50        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.19         | ...           | ...           |
| ...                                  | ...                        | ...          | 26.50         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.38          | ...           |
| 25.50                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 27.00                      | ...          | ...           | ...           | ...                                  | 0.25         | 0.25         | 0.22         | ...          | ...           | ...           |
| 28.00                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 29.50                      | ...          | ...           | ...           | ...                                  | 0.25         | 0.25         | 0.22         | ...          | ...           | ...           |
| ...                                  | ...                        | 30.38        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.22         | ...           | ...           |
| ...                                  | ...                        | ...          | 31.25         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.44          | ...           |

**Table 5C**  
**Dimensions of Ring Joint Facings (All Pressure Rating Classes) — U.S. Customary Units (Cont'd)**

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## GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For facing requirements for flanges and flanged fittings, see [para. 6.4.1](#) and [Figure 6](#).
- (c) For facing requirements for lapped joints, see [para. 6.4.3](#) and [Figure 6](#).
- (d) See [para 4.2.7](#) for marking requirements.

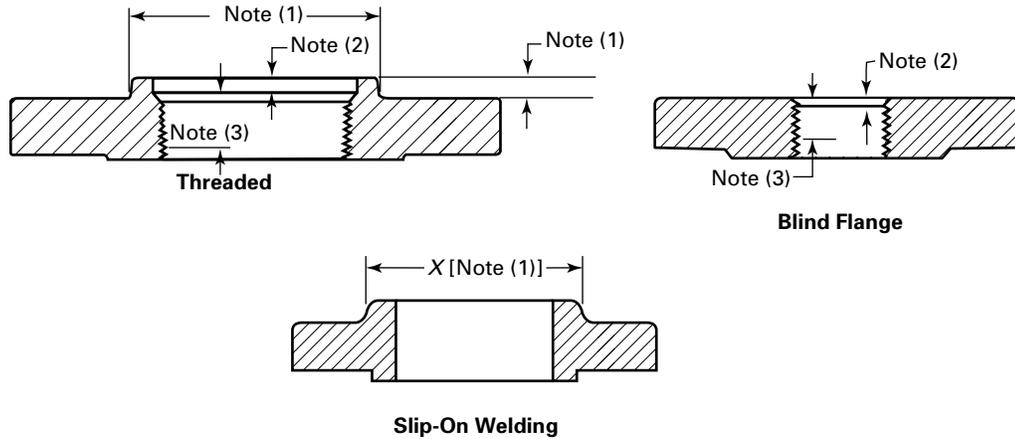
## NOTES:

- (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, -0.000 in.
- $F$  = (width)  $\pm 0.008$  in.
- $P$  = (pitch diameter)  $\pm 0.005$  in.
- $R$  = (radius at bottom)
  - =  $R \leq 0.06$  +0.03, -0.00 in.
  - =  $R > 0.06$   $\pm 0.03$  in.
- 23 deg = (angle)  $\pm \frac{1}{2}$  deg

**Table 6**  
**Reducing Threaded and Slip-On Pipe Flanges for Classes 150 Through 2500 Pipe Flanges — SI Units**



| 1                    | 2  | 3                     | 4  | 5                     | 6  |
|----------------------|--|-----------------------|--|-----------------------|--|
| Nominal Pipe Size(4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) | Nominal Pipe Size (4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) | Nominal Pipe Size (4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) |
| NPS                  | NPS  | NPS                   | NPS  | NPS                   | NPS  |
| 1                    | 1/2  | 3 1/2                 | 1 1/2  | 12                    | 3 1/2  |
| 1 1/4                | 1/2  | 4                     | 1 1/2  | 14                    | 3 1/2  |
| 1 1/2                | 1/2  | 5                     | 1 1/2  | 16                    | 4  |
| 2                    | 1  | 6                     | 2 1/2  | 18                    | 4  |
| 2 1/2                | 1 1/4  | 8                     | 3  | 20                    | 4  |
| 3                    | 1 1/4  | 10                    | 3 1/2  | 24                    | 4  |

GENERAL NOTE: Dimensions are in millimeters.

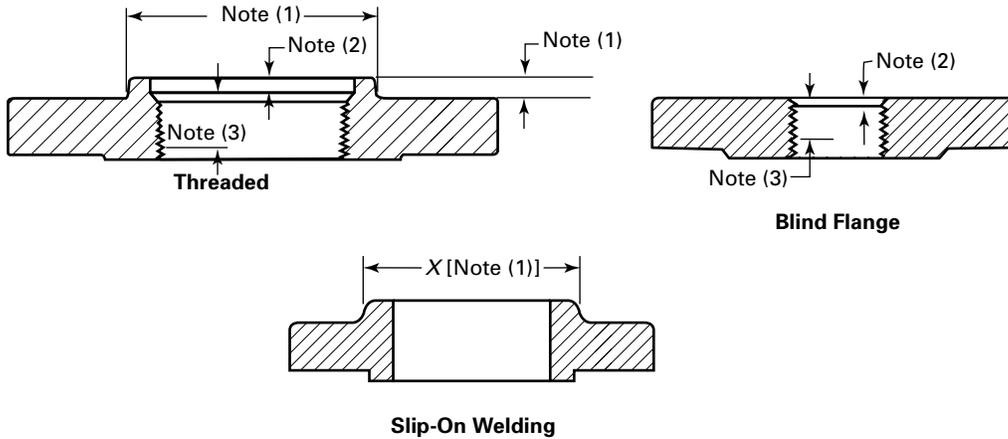
NOTES:

- (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).
- (2) Class 150 flanges do not have a counterbore. Class 300 and higher pressure flanges will have depth of counterbore  $Q$  of 6.4 mm for NPS 2 and smaller tapping and 9.7 mm for NPS 2 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 × 2 1/2 — Class 300 reducing threaded flange. This flange has the following dimensions:  
 NPS 2 1/2 = taper pipe thread tapping (ASME B1.20.1)  
 318 mm = diameter of regular NPS 6 Class 300 threaded flange  
 35.1 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 1/2 would be the smallest acceptable.  
 15.7 mm = height of hub for regular NPS 5 Class 300 threaded flange
- (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 6C**  
**Reducing Threaded and Slip-On Pipe Flanges for Classes 150 Through 2500 Pipe Flanges — U.S. Customary Units**



| 1                     | 2  | 3                     | 4  | 5                     | 6  |
|-----------------------|--|-----------------------|--|-----------------------|--|
| Nominal Pipe Size (4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) | Nominal Pipe Size (4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) | Nominal Pipe Size (4) | Smallest Size of Reducing Outlet Requiring Hub Flanges (1) |
| 1                     | 1/2  | 3 1/2                 | 1 1/2  | 12                    | 3 1/2  |
| 1 1/4                 | 1/2  | 4                     | 1 1/2  | 14                    | 3 1/2  |
| 1 1/2                 | 1/2  | 5                     | 1 1/2  | 16                    | 4  |
| 2                     | 1  | 6                     | 2 1/2  | 18                    | 4  |
| 2 1/2                 | 1 1/4  | 8                     | 3  | 20                    | 4  |
| 3                     | 1 1/4  | 10                    | 3 1/2  | 24                    | 4  |

GENERAL NOTE: Dimensions are in inches.

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 2).
- (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 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:

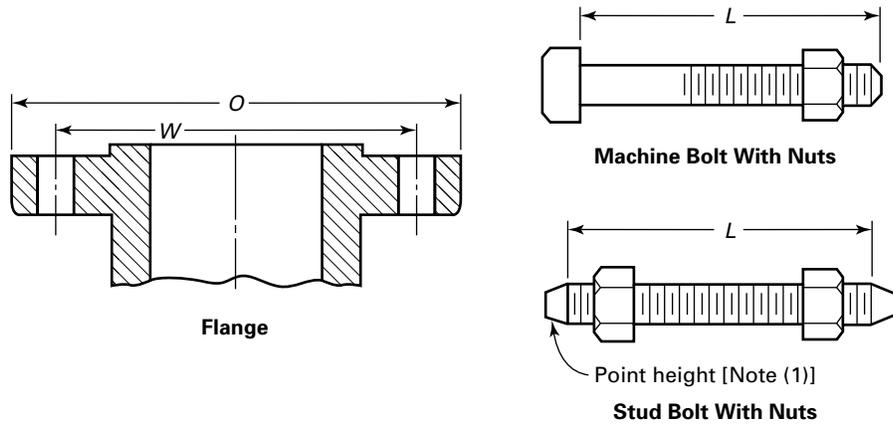
- (1) The size designation is NPS 6 × 2 1/2 — Class 300 reducing threaded flange. This flange has the following dimensions:  
 NPS 2 1/2 = taper pipe thread tapping (ASME B1.20.1)  
 12.50 in. = diameter of regular NPS 6 Class 300 threaded flange  
 1.38 in. = thickness of regular NPS 6 Class 300 threaded flange  
 7.00 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 1/2 would be the smallest acceptable.  
 0.63 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 12C

- (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 7**  
**Templates for Drilling Class 150 Pipe Flanges and Flanged Fittings — SI Units**

(25)



| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                             |                 |                        | Length of Bolts, <i>L</i> (4) |            |                    |
|-------------------|--------------------------------------|-----------------------------------|-----------------------------|-----------------|------------------------|-------------------------------|------------|--------------------|
|                   |                                      | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | Stud Bolts (1)                |            | Machine Bolts      |
|                   |                                      |                                   |                             |                 |                        | 1.5-mm Raised Face            | Ring Joint | 1.5-mm Raised Face |
| 1/2               | 89                                   | 60.5                              | 5/8                         | 4               | 1/2                    | 55                            | ...        | 50                 |
| 3/4               | 99                                   | 69.8                              | 5/8                         | 4               | 1/2                    | 65                            | ...        | 50                 |
| 1                 | 108                                  | 79.2                              | 5/8                         | 4               | 1/2                    | 65                            | 75         | 55                 |
| 1 1/4             | 117                                  | 88.9                              | 5/8                         | 4               | 1/2                    | 70                            | 85         | 55                 |
| 1 1/2             | 127                                  | 98.6                              | 5/8                         | 4               | 1/2                    | 70                            | 85         | 65                 |
| 2                 | 152                                  | 120.6                             | 3/4                         | 4               | 5/8                    | 85                            | 95         | 70                 |
| 2 1/2             | 178                                  | 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             | 216                                  | 177.8                             | 3/4                         | 8               | 5/8                    | 90                            | 100        | 75                 |
| 4                 | 229                                  | 190.5                             | 3/4                         | 8               | 5/8                    | 90                            | 100        | 75                 |
| 5                 | 254                                  | 215.9                             | 7/8                         | 8               | 3/4                    | 95                            | 110        | 85                 |
| 6                 | 279                                  | 241.3                             | 7/8                         | 8               | 3/4                    | 100                           | 115        | 85                 |
| 8                 | 343                                  | 298.4                             | 7/8                         | 8               | 3/4                    | 110                           | 120        | 90                 |
| 10                | 406                                  | 362.0                             | 1                           | 12              | 7/8                    | 115                           | 125        | 100                |
| 12                | 483                                  | 431.8                             | 1                           | 12              | 7/8                    | 120                           | 135        | 100                |
| 14                | 533                                  | 476.2                             | 1 1/8                       | 12              | 1                      | 135                           | 145        | 115                |
| 16                | 597                                  | 539.8                             | 1 1/8                       | 16              | 1                      | 135                           | 145        | 115                |
| 18                | 635                                  | 577.8                             | 1 1/4                       | 16              | 1 1/8                  | 145                           | 160        | 125                |
| 20                | 698                                  | 635.0                             | 1 1/4                       | 20              | 1 1/8                  | 160                           | 170        | 140                |
| 22                | 749                                  | 692.2                             | 1 3/8                       | 20              | 1 1/4                  | 170                           | 185        | 150                |
| 24                | 813                                  | 749.3                             | 1 3/8                       | 20              | 1 1/4                  | 170                           | 185        | 150                |

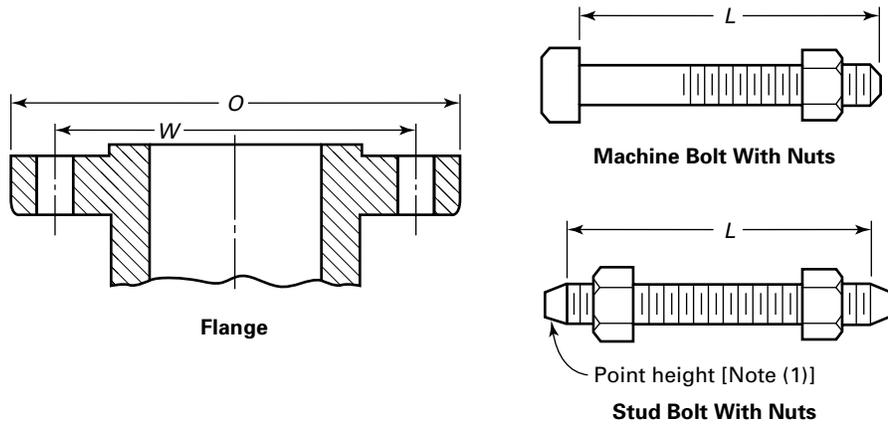
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which are in inches.
- (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 7C**  
**Templates for Drilling Class 150 Pipe Flanges and Flanged Fittings — U.S. Customary Units**



| 1                               | 2   | 3                                       | 4                         | 5                  | 6                    | 7                             | 8             | 9                       |
|---------------------------------|---|---|---------------------------|--------------------|----------------------|-------------------------------|---------------|-------------------------|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Diameter of<br>Bolt Circle,<br><i>W</i> | Diameter of<br>Bolt Holes | Number<br>of Bolts | Diameter<br>of Bolts | Drilling (2), (3)             |               |                         |
|                                 |   |   |                           |                    |                      | Length of Bolts, <i>L</i> (4) |               |                         |
|                                 |   |   |                           |                    |                      | Stud Bolts (1)                |               | Machine<br>Bolts        |
|                                 |   |   |                           |                    |                      | Raised<br>Face<br>0.06 in.    | Ring<br>Joint | Raised Face<br>0.06 in. |
| 1/2                             | 3.50  | 2.38                                    | 5/8                       | 4                  | 1/2                  | 2.25                          | ...           | 2.00                    |
| 3/4                             | 3.88  | 2.75                                    | 5/8                       | 4                  | 1/2                  | 2.50                          | ...           | 2.00                    |
| 1                               | 4.25  | 3.12                                    | 5/8                       | 4                  | 1/2                  | 2.50                          | 3.00          | 2.25                    |
| 1 1/4                           | 4.62  | 3.50                                    | 5/8                       | 4                  | 1/2                  | 2.75                          | 3.25          | 2.25                    |
| 1 1/2                           | 5.00  | 3.88                                    | 5/8                       | 4                  | 1/2                  | 2.75                          | 3.25          | 2.50                    |
| 2                               | 6.00  | 4.75                                    | 3/4                       | 4                  | 5/8                  | 3.25                          | 3.75          | 2.75                    |
| 2 1/2                           | 7.00  | 5.50                                    | 3/4                       | 4                  | 5/8                  | 3.50                          | 4.00          | 3.00                    |
| 3                               | 7.50  | 6.00                                    | 3/4                       | 4                  | 5/8                  | 3.50                          | 4.00          | 3.00                    |
| 3 1/2                           | 8.50  | 7.00                                    | 3/4                       | 8                  | 5/8                  | 3.50                          | 4.00          | 3.00                    |
| 4                               | 9.00  | 7.50                                    | 3/4                       | 8                  | 5/8                  | 3.50                          | 4.00          | 3.00                    |
| 5                               | 10.00   | 8.50                                    | 7/8                       | 8                  | 3/4                  | 3.75                          | 4.25          | 3.25                    |
| 6                               | 11.00   | 9.50                                    | 7/8                       | 8                  | 3/4                  | 4.00                          | 4.50          | 3.25                    |
| 8                               | 13.50   | 11.75                                   | 7/8                       | 8                  | 3/4                  | 4.25                          | 4.75          | 3.50                    |
| 10                              | 16.00   | 14.25                                   | 1                         | 12                 | 7/8                  | 4.50                          | 5.00          | 4.00                    |
| 12                              | 19.00   | 17.00                                   | 1                         | 12                 | 7/8                  | 4.75                          | 5.25          | 4.00                    |
| 14                              | 21.00   | 18.75                                   | 1 1/8                     | 12                 | 1                    | 5.25                          | 5.75          | 4.50                    |
| 16                              | 23.50   | 21.25                                   | 1 1/8                     | 16                 | 1                    | 5.25                          | 5.75          | 4.50                    |
| 18                              | 25.00   | 22.75                                   | 1 1/4                     | 16                 | 1 1/8                | 5.75                          | 6.25          | 5.00                    |
| 20                              | 27.50   | 25.00                                   | 1 1/4                     | 20                 | 1 1/8                | 6.25                          | 6.75          | 5.50                    |
| 22                              | 29.50   | 27.25                                   | 1 3/8                     | 20                 | 1 1/4                | 6.75                          | 7.25          | 6.00                    |
| 24                              | 32.00   | 29.50                                   | 1 3/8                     | 20                 | 1 1/4                | 6.75                          | 7.25          | 6.00                    |

GENERAL NOTES:

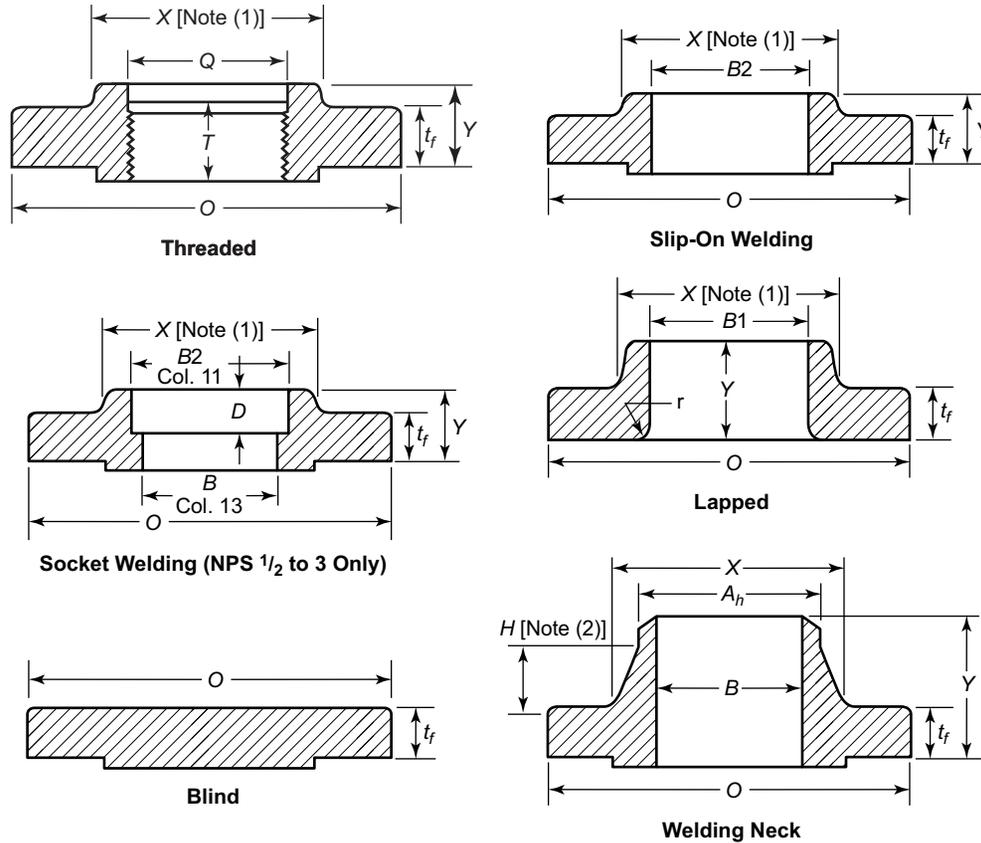
- (a) Dimensions are in inches.
- (b) For other dimensions, see Tables 8C and 9C.

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 — SI Units**

(25)



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| 1                      | 2                             | 3  | 4                                  | 5                  | 6  | Length Through Hub                 |           |                 | 10                                    | Bore                               |                    | 13                                 | 14  | 15                 |
|------------------------|-------------------------------|--|------------------------------------|--------------------|--|------------------------------------|-----------|-----------------|---------------------------------------|------------------------------------|--------------------|------------------------------------|---|--------------------|
|                        |                               |  |                                    |                    |  | 7                                  | 8         | 9               |                                       | 11                                 | 12                 |                                    |   |                    |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, $t_f$ (3)–(5) | Minimum Thickness Lap Joint, $t_f$ | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding Neck, A <sub>h</sub> (6) | Threaded/Slip-on/Socket Welding, Y | Lapped, Y | Welding Neck, Y | Minimum Thread Length Threaded, T (7) | Minimum Slip-on/Socket Welding, B2 | Minimum Lapped, B1 | Welding Neck/Socket Welding, B (8) | Corner Bore Radius of Lapped Flange and Pipe, r | Depth of Socket, D |
| 1/2                    | 89                            | 9.7  | 11.2                               | 30                 | 21.3   | 14                                 | 16        | 46              | 16                                    | 22.4                               | 22.9               | 15.7                               | 3   | 10                 |
| 3/4                    | 99                            | 11.2                                       | 12.7                               | 38                 | 26.7   | 14                                 | 16        | 51              | 16                                    | 27.7                               | 28.2               | 20.8                               | 3   | 11                 |

**Table 8**  
**Dimensions of Class 150 Flanges — SI Units (Cont'd)**

| 1                               | 2   | 3   | 4   | 5                        | 6  | 7  |              |                       | 10  | 11  |                          | 12  | 13  | 14                          | 15 |
|---------------------------------|---|---|---|--------------------------|--|--|--------------|-----------------------|---|---|--------------------------|---|---|-----------------------------|----|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Minimum<br>Thickness<br>of<br>Flange,<br>$t_f$<br>(3)-(5) | Minimum<br>Thickness<br>Lap Joint,<br>$t_f$ | Diameter<br>of Hub,<br>X | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br>$A_h$ (6) | Length Through Hub                               |              |                       | Minimum<br>Thread<br>Length<br>Threaded,<br>T (7) | Bore  |                          | Welding<br>Neck/<br>Socket<br>Welding,<br>B (8) | Corner<br>Bore<br>Radius<br>of<br>Lapped<br>Flange<br>and<br>Pipe,<br>r | Depth<br>of<br>Socket,<br>D |    |
|                                 |   |   |   |                          |  | Threaded/<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y |   | Minimum<br>Slip-on/<br>Socket<br>Welding,<br>B2 | Minimum<br>Lapped,<br>B1 |   |   |                             |    |
| 1                               | 108                                       | 12.7  | 14.2  | 49                       | 33.5   | 16   | 18           | 54                    | 18  | 34.5  | 35.1                     | 26.7  | 3   | 13                          |    |
| 1¼                              | 117                                       | 14.2  | 15.7  | 59                       | 42.2   | 19   | 21           | 56                    | 21  | 43.2  | 43.7                     | 35.1  | 5   | 14                          |    |
| 1½                              | 127                                       | 15.9  | 17.5  | 65                       | 48.3   | 21   | 22           | 60                    | 22  | 49.5  | 50.0                     | 40.9  | 6   | 16                          |    |
| 2                               | 152                                       | 17.5  | 19.0  | 78                       | 60.5   | 24   | 25           | 62                    | 25  | 61.9  | 62.5                     | 52.6  | 8   | 18                          |    |
| 2½                              | 178                                       | 20.6  | 22.4  | 90                       | 73.2   | 27   | 28           | 68                    | 28  | 74.7  | 75.4                     | 62.7  | 8   | 19                          |    |
| 3                               | 190                                       | 22.4  | 23.9  | 108                      | 88.9   | 28   | 30           | 68                    | 30  | 90.7  | 91.4                     | 78.0  | 10  | 21                          |    |
| 3½                              | 216                                       | 22.4  | 23.9  | 122                      | 101.6  | 30   | 32           | 70                    | 32  | 103.4   | 104.1                    | 90.2  | 10  | ...                         |    |
| 4                               | 229                                       | 22.4  | 23.9  | 135                      | 114.3  | 32   | 33           | 75                    | 33  | 116.1   | 116.8                    | 102.4   | 11  | ...                         |    |
| 5                               | 254                                       | 22.4  | 23.9  | 164                      | 141.2  | 35   | 37           | 87                    | 37  | 143.8   | 144.5                    | 128.3   | 11  | ...                         |    |
| 6                               | 279                                       | 23.9  | 25.4  | 192                      | 168.4  | 38   | 40           | 87                    | 40  | 170.7   | 171.4                    | 154.2   | 13  | ...                         |    |
| 8                               | 343                                       | 26.9  | 28.4  | 246                      | 219.2  | 43   | 44           | 100                   | 44  | 221.5   | 222.2                    | 202.7   | 13  | ...                         |    |
| 10                              | 406                                       | 28.4  | 30.2  | 305                      | 273.0  | 48   | 49           | 100                   | 49  | 276.4   | 277.4                    | 254.5   | 13  | ...                         |    |
| 12                              | 483                                       | 30.2  | 31.8  | 365                      | 323.8  | 54   | 56           | 113                   | 56  | 327.2   | 328.2                    | 304.8   | 13  | ...                         |    |
| 14                              | 533                                       | 33.3  | 35.1  | 400                      | 355.6  | 56   | 79           | 125                   | 57  | 359.2   | 360.2                    | (9)   | 13  | ...                         |    |
| 16                              | 597                                       | 35.1  | 36.6  | 457                      | 406.4  | 62   | 87           | 125                   | 64  | 410.5   | 411.2                    | (9)   | 13  | ...                         |    |
| 18                              | 635                                       | 38.1  | 39.6  | 505                      | 457.2  | 67   | 97           | 138                   | 68  | 461.8   | 462.3                    | (9)   | 13  | ...                         |    |
| 20                              | 698                                       | 41.1  | 42.9  | 559                      | 508.0  | 71   | 103          | 143                   | 73  | 513.1   | 514.4                    | (9)   | 13  | ...                         |    |
| 22                              | 749                                       | 44.4  | 46.0  | 610                      | 558.8  | 78   | 108          | 148                   | ...   | 564.4   | 565.2                    | (9)   | 13  | ...                         |    |
| 24                              | 813                                       | 46.0  | 47.8  | 663                      | 609.6  | 81   | 111          | 151                   | 83  | 616.0   | 616.0                    | (9)   | 13  | ...                         |    |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (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](#).

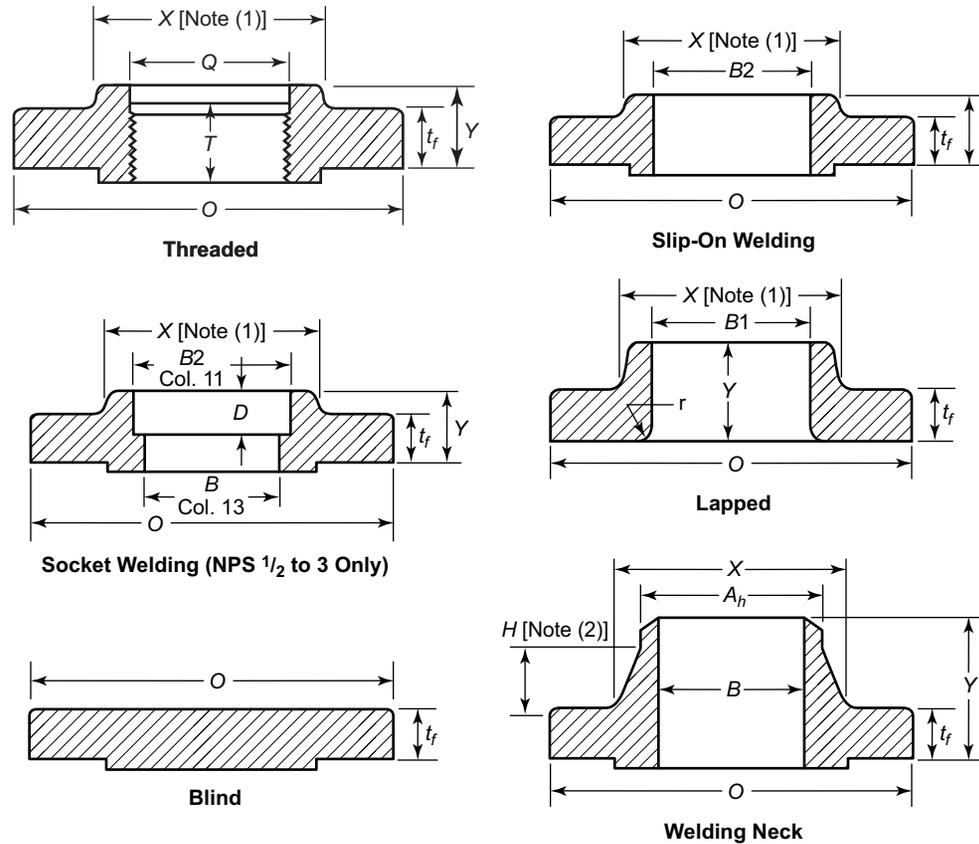
**Table 8**  
**Dimensions of Class 150 Flanges — SI Units (Cont'd)**

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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 hub height,  $H$ , shall be  $2(Y-t_f)/3$ .
- (3) The minimum thickness of these loose flanges, in sizes NPS 3<sup>1</sup>/<sub>2</sub> 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.
- (4) 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.
- (5) The flange dimensions illustrated are for regularly furnished 1.5-mm raised face (except lapped); for requirements of other facings, see [Figure 6](#).
- (6) For welding end bevel (see [para. 6.7](#)).
- (7) For thread of threaded flanges, see [para. 6.9](#).
- (8) 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.
- (9) To be specified by the purchaser.

**Table 8C**  
**Dimensions of Class 150 Flanges — U.S. Customary Units**



| 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, $t_f$ (3)-(5) | Minimum Thickness Lap Joint | Diameter of Hub, $X$ | Diameter Beginning of Chamfer Welding Neck, $A_h$ (6) | Length Through Hub                   |             |                   | Minimum Thread Length Threaded, $T$ (7) | Bore                                |                     | Welding Neck/Socket Welding, $B$ (8) | 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, $B$ |                                      |   |                      |
| 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                 |

**Table 8C**  
**Dimensions of Class 150 Flanges — U.S. Customary Units (Cont'd)**

| 1                    | 2   | 3  | 4                                 | 5                               | 6  | 7   | 8                   | 9                            | 10   | 11   | 12                             | 13   | 14   | 15                                 |
|----------------------|---|--|-----------------------------------|---------------------------------|--|---|---------------------|------------------------------|--|--|--------------------------------|--|--|------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Minimum<br>Thickness<br>of<br>Flange,<br><i>t<sub>f</sub></i><br>(3)–(5) | Minimum<br>Thickness<br>Lap Joint | Diameter<br>of Hub,<br><i>X</i> | Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br><i>A<sub>n</sub></i> (6) | Length Through Hub                                    |                     |                              | Minimum<br>Thread<br>Length<br>Threaded,<br><i>T</i> (7) | Bore   |                                |  | Corner<br>Bore<br>Radius of<br>Lapped<br>Flange<br>and Pipe,<br><i>r</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                      |   |  |                                   |                                 |  | Threaded<br>Slip-On<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> |  | Minimum<br>Slip-On<br>Socket<br>Welding,<br><i>B</i> | Minimum<br>Lapped,<br><i>B</i> | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> (8) |  |                                    |
| 1½                   | 5.00  | 0.62   | 0.69                              | 2.56                            | 1.90   | 0.81  | 0.88                | 2.38                         | 0.88   | 1.95   | 1.97                           | 1.61   | 0.25   | 0.62                               |
| 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                          | (9)  | 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                          | (9)  | 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                          | (9)  | 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                          | (9)  | 0.50   | ...                                |
| 22                   | 29.50   | 1.75   | 1.81                              | 24.00                           | 22.00  | 3.06  | 4.25                | 5.82                         | ...  | 22.22  | 22.25                          | (9)  | 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                          | (9)  | 0.50   | ...                                |

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 7C.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6C.
- (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 hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) The minimum thickness of these loose flanges, in sizes NPS 3½ and smaller, is slightly greater than the thickness of flanges on fittings, Table 9C, which are reinforced by being cast integral with the body of the fitting.
- (4) When these flanges are required with flat face, the flat face may be either the full *t<sub>f</sub>* dimension thickness plus 0.06 in. or the *t<sub>f</sub>* dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.

**Table 8C**  
**Dimensions of Class 150 Flanges — U.S. Customary Units (Cont'd)**

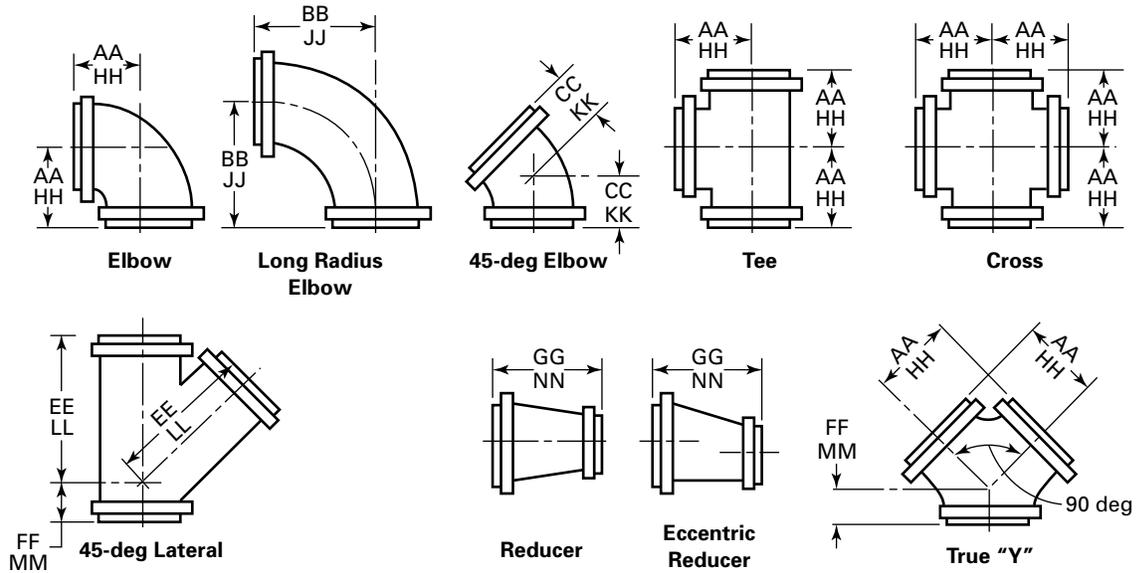
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NOTES: (Cont'd)

- (5) The flange dimensions illustrated are for regularly furnished 0.06-in. raised face (except lapped); for requirements of other facings, see [Figure 6](#).
- (6) For welding end bevel, see [para. 6.7](#).
- (7) For thread of threaded flanges, see [para. 6.9](#).
- (8) 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 specked by the purchaser.
- (9) To be specified by the purchaser.

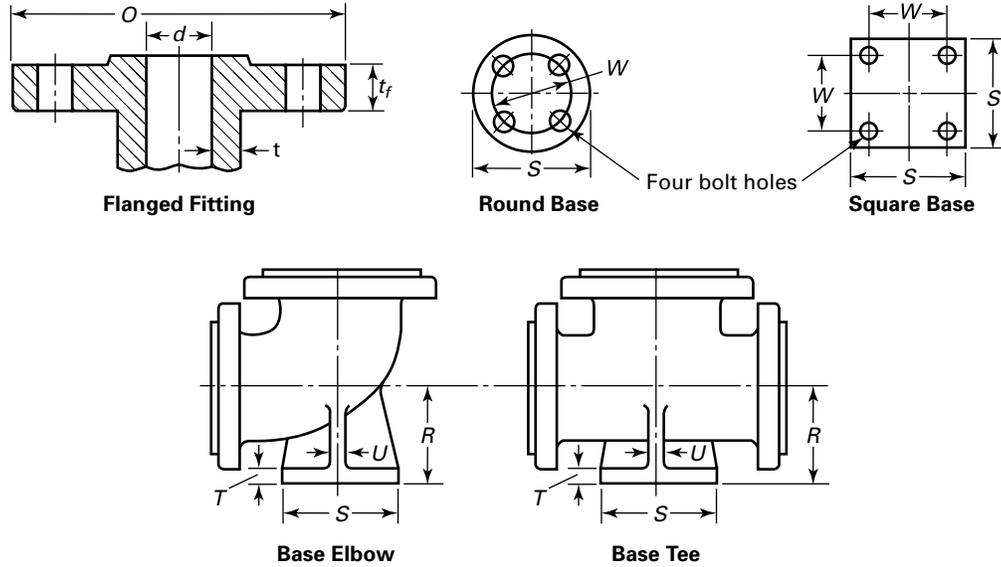
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**Table 9**  
**Dimensions of Class 150 Flanged Fittings — SI Units**



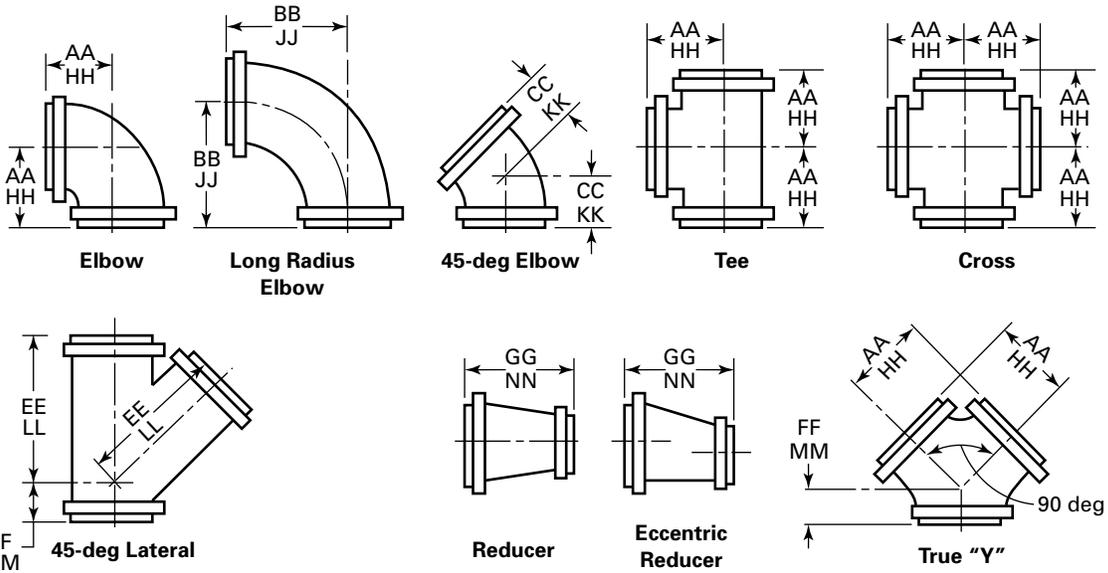
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> (1)–(3) | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | 1.5-mm Raised Face (4)   |   |   |   |   |  | Ring Joint (4)  |
|------------------------|--------------------------------------|---|---|--------------------------------------|--|---|---|---|---|--|---|
|                        |                                      |   |   |                                      | Center-to-Surface of Raised Face Elbow, Tee, Cross, and True “Y,” AA | Center-to-Surface of Raised Face Long Radius vElbow, BB | Center-to-Surface of Raised Face 45-deg Elbow, CC | Long Center-to-Surface of Raised Face Lateral, EE | Short Center-to-Surface of Raised Face True “Y,” FF | Contact Surface of Raised Face Reducer, GG (5) | Center-to-End Elbow, Tee, Cross, and True “Y,” HH (6) |
|                        |                                      |   |   |                                      | 6  | 7   | 8   | 9   | 10  | 11   | 12  |
| 1/2                    | 89                                   | 7.9   | 2.8   | 13                                   | ...  | ...   | ...   | ...   | ...   | ...  | ...   |
| 3/4                    | 99                                   | 8.6   | 3.0   | 19                                   | ...  | ...   | ...   | ...   | ...   | ...  | ...   |
| 1                      | 108                                  | 9.7   | 4.1   | 25                                   | 89   | 127   | 44  | 146   | 44  | 114  | 95  |
| 1 1/4                  | 117                                  | 11.2  | 4.8   | 32                                   | 95   | 140   | 51  | 159   | 44  | 114  | 102   |
| 1 1/2                  | 127                                  | 12.7  | 4.8   | 38                                   | 102  | 152   | 57  | 178   | 51  | 114  | 108   |
| 2                      | 152                                  | 14.2  | 5.6   | 51                                   | 114  | 165   | 64  | 203   | 64  | 127  | 121   |
| 2 1/2                  | 178                                  | 15.7  | 5.6   | 64                                   | 127  | 178   | 76  | 241   | 64  | 140  | 133   |
| 3                      | 190                                  | 17.5  | 5.6   | 76                                   | 140  | 197   | 76  | 254   | 76  | 152  | 146   |
| 3 1/2                  | 216                                  | 19.0  | 6.4   | 89                                   | 152  | 216   | 89  | 292   | 76  | 165  | 159   |
| 4                      | 229                                  | 22.4  | 6.4   | 102                                  | 165  | 229   | 102   | 305   | 76  | 178  | 171   |
| 5                      | 254                                  | 22.5  | 7.1   | 127                                  | 190  | 260   | 114   | 343   | 89  | 203  | 197   |
| 6                      | 279                                  | 23.9  | 7.1   | 152                                  | 203  | 292   | 127   | 368   | 89  | 229  | 210   |
| 8                      | 343                                  | 26.9  | 7.9   | 203                                  | 229  | 356   | 140   | 444   | 114   | 279  | 235   |
| 10                     | 406                                  | 28.4  | 8.6   | 254                                  | 279  | 419   | 165   | 521   | 127   | 305  | 286   |
| 12                     | 483                                  | 30.2  | 9.7   | 305                                  | 305  | 483   | 190   | 622   | 140   | 356  | 311   |
| 14                     | 533                                  | 33.3  | 10.4  | 337                                  | 356  | 546   | 190   | 686   | 152   | 406  | 362   |

**Table 9**  
**Dimensions of Class 150 Flanged Fittings — SI Units**



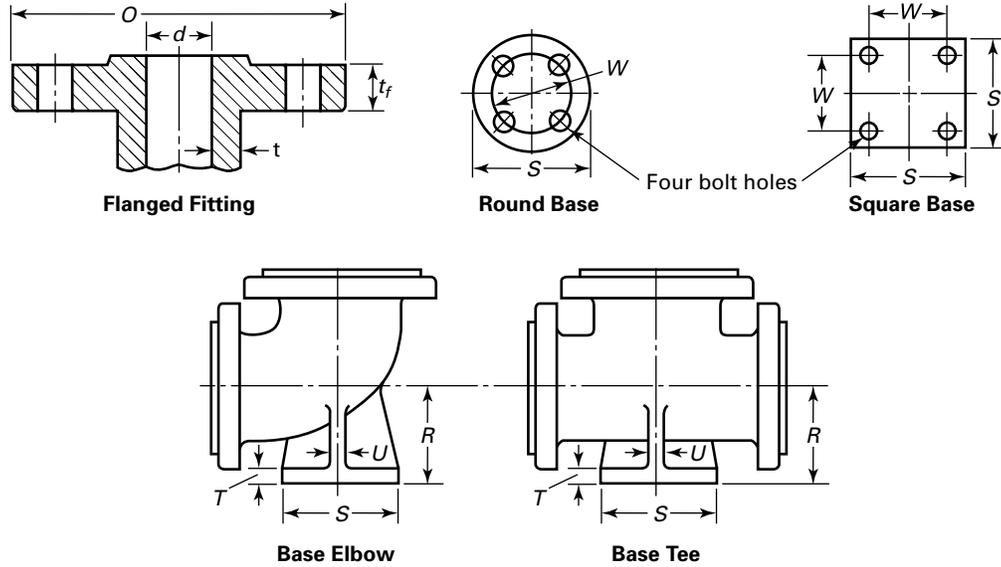
| Ring Joint (4)                          |                                    |                                    |  |                                 |                           |   |                               |                          |                                | Base Drilling (11)        |       | Nominal Pipe Size, NPS |
|---|------------------------------------|------------------------------------|--|---------------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|-------|------------------------|
| Center-to-End Long Radius Elbow, JJ (6) | Center-to-End 45-deg Elbow, KK (6) | Long Center-to-End Lateral, LL (6) | Short Center-to-End Lateral and End-to-End True "Y," NN (5), (6) | End-to-End Reducer, NN (5), (6) | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes |       |                        |
| ...                                     | ...                                | ...                                | ...  | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1/2   |                        |
| ...                                     | ...                                | ...                                | ...  | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 3/4   |                        |
| 133                                     | 51                                 | 152                                | 51   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1     |                        |
| 146                                     | 57                                 | 165                                | 51   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1 1/4 |                        |
| 159                                     | 64                                 | 184                                | 57   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1 1/2 |                        |
| 171                                     | 70                                 | 210                                | 70   | ...                             | 105                       | 117   | 13                            | 13                       | 88.9                           | 5/8                       | 2     |                        |
| 184                                     | 83                                 | 248                                | 70   | ...                             | 114                       | 117   | 13                            | 13                       | 88.9                           | 5/8                       | 2 1/2 |                        |
| 203                                     | 83                                 | 260                                | 83   | ...                             | 124                       | 127   | 14                            | 14                       | 98.6                           | 5/8                       | 3     |                        |
| 222                                     | 95                                 | 298                                | 83   | ...                             | 133                       | 127   | 14                            | 14                       | 98.6                           | 5/8                       | 3 1/2 |                        |
| 235                                     | 108                                | 311                                | 83   | ...                             | 140                       | 152   | 16                            | 16                       | 120.6                          | 3/4                       | 4     |                        |
| 267                                     | 121                                | 349                                | 95   | ...                             | 159                       | 178   | 18                            | 18                       | 139.7                          | 3/4                       | 5     |                        |
| 298                                     | 133                                | 375                                | 95   | ...                             | 178                       | 178   | 18                            | 18                       | 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    |                        |

**Table 9**  
**Dimensions of Class 150 Flanged Fittings — SI Units (Cont'd)**



|                        |                               |  |  |                               | 1.5-mm Raised Face (4)   |   |   |   |   |  | Ring Joint (4)  |
|------------------------|-------------------------------|--|--|-------------------------------|--|---|---|---|---|--|---|
|                        |                               |  |  |                               | Center-to-Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to-Surface of Raised Face Long Radius vElbow, BB | Center-to-Surface of Raised Face 45-deg Elbow, CC | Long Center-to-Surface of Raised Face Lateral, EE | Short Center-to-Surface of Raised Face True "Y," FF | Contact Surface of Raised Face Reducer, GG (5) | Center-to-End Elbow, Tee, Cross, and True "Y," HH (6) |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, $t_f$ (1)-(3) | Minimum Wall Thickness of Fitting, $t_m$ | Inside Diameter of Fitting, d | AA   | BB  | CC  | EE  | FF  | GG (5)   | HH (6)  |
| 16                     | 597                           | 35.1                                       | 11.2                                     | 387                           | 381  | 610   | 203   | 762   | 165   | 457  | 387   |
| 18                     | 635                           | 38.1                                       | 11.9                                     | 438                           | 419  | 673   | 216   | 813   | 178   | 483  | 425   |
| 20                     | 698                           | 41.1                                       | 12.7                                     | 489                           | 457  | 737   | 241   | 889   | 203   | 508  | 464   |
| 24                     | 813                           | 46.0                                       | 14.5                                     | 591                           | 559  | 864   | 279   | 1029  | 229   | 610  | 565   |

**Table 9**  
**Dimensions of Class 150 Flanged Fittings — SI Units (Cont'd)**



| 13                                      | 14                                 | 15                                 | 16   | 17                              | 18                        | 19  | 20                            | 21                       | 22                             | 23                        | 1                      |  |
|---|------------------------------------|------------------------------------|--|---------------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|------------------------|--|
| Ring Joint (4)                          |                                    |                                    |  |                                 |                           |   |                               |                          |                                | Base Drilling (11)        |                        |  |
| Center-to-End Long Radius Elbow, JJ (6) | Center-to-End 45-deg Elbow, KK (6) | Long Center-to-End Lateral, LL (6) | Short Center-to-End Lateral and True "Y," MM (6) | End-to-End Reducer, NN (5), (6) | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |  |
| 616                                     | 210                                | 768                                | 171  | ...                             | 349                       | 279   | 25                            | 25                       | 241.3                          | 7/8                       | 16                     |  |
| 679                                     | 222                                | 819                                | 184  | ...                             | 381                       | 343   | 28                            | 28                       | 298.4                          | 7/8                       | 18                     |  |
| 743                                     | 248                                | 895                                | 210  | ...                             | 406                       | 343   | 28                            | 28                       | 298.4                          | 7/8                       | 20                     |  |
| 870                                     | 286                                | 1035                               | 235  | ...                             | 470                       | 343   | 28                            | 28                       | 298.4                          | 7/8                       | 24                     |  |

**Table 9**  
**Dimensions of Class 150 Flanged Fittings — SI Units (Cont'd)**

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## GENERAL NOTES:

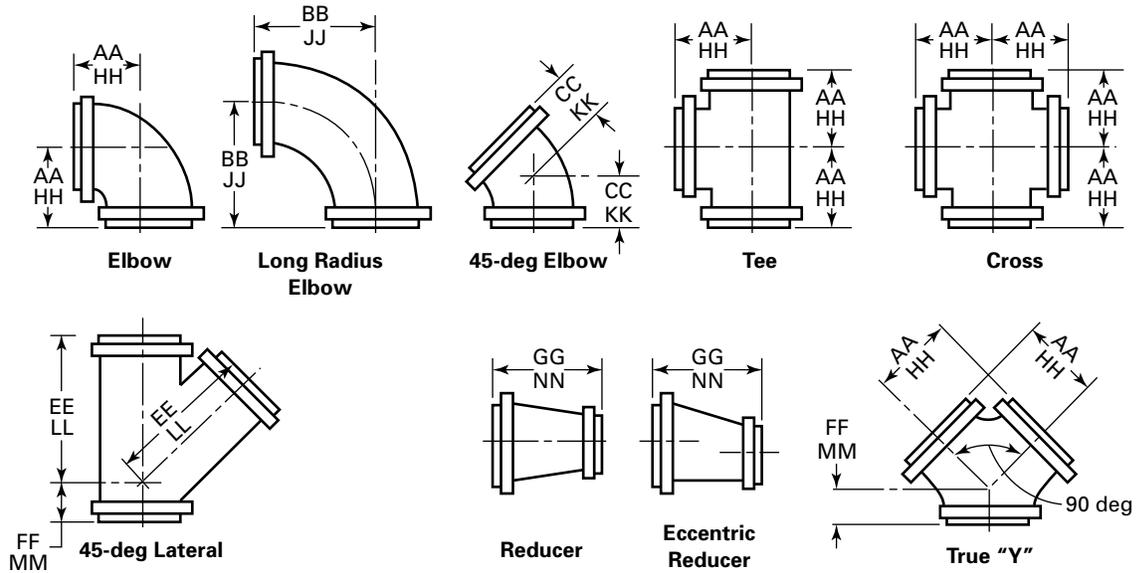
- (a) Dimensions are in millimeters.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 8](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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 1.5 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 1.5-mm raised face (except lapped); for thickness requirements of other facings, see [Figure 6](#).
- (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 1.5 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.

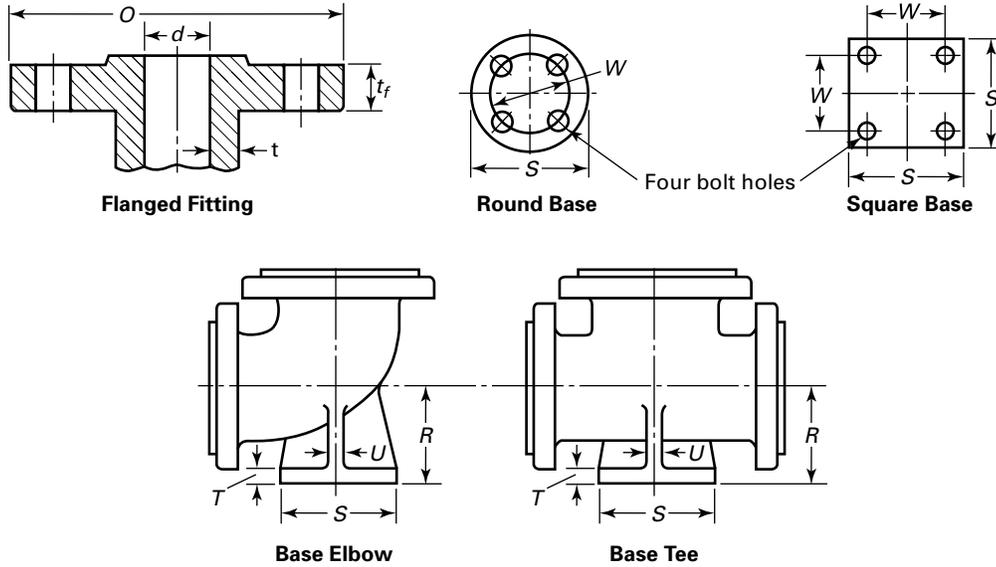
TABLE STARTS ON NEXT PAGE

**Table 9C**  
**Dimensions of Class 150 Flanged Fittings — U.S. Customary Units**



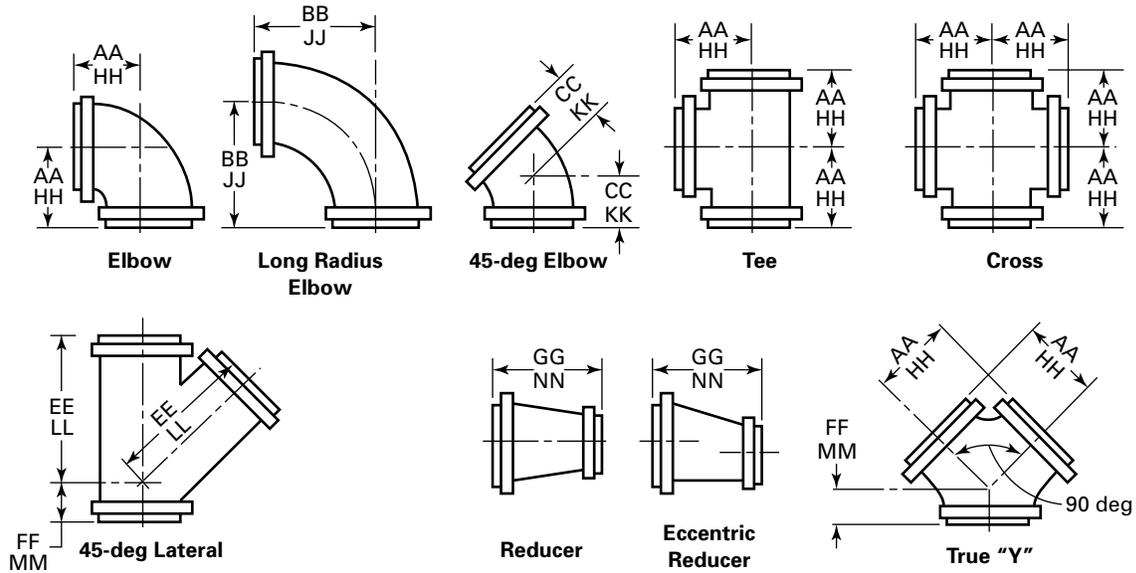
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, $t_f$ (1)-(3) | Minimum Wall Thickness of Fitting, $t_m$ | Inside Diameter of Fitting, d | 0.06-in. Raised Face (Flange Edge) (4)                                       |  |   |   |   |   | Ring Joint (4)  |
|------------------------|-------------------------------|--|--|-------------------------------|--|--|---|---|---|---|---|
|                        |                               |  |  |                               | Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to-Contact Surface of Raised Face Long Radius Elbow, BB | Center-to-Contact Surface of Raised Face 45-deg Elbow, CC | Long Center-to-Contact Surface of Raised Face Lateral, EE | Short Center-to-Contact Surface of Raised Face True "Y," FF | Contact Surface-to-Contact Surface of Raised Face Reducer, GG (5) | Center-to-End Elbow, Tee, Cross, and True "Y," HH (6) |
|                        |                               |  |  |                               | 6  | 7  | 8   | 9   | 10  | 11  | 12  |
| 1/2                    | 3.50                          | 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                          | 0.50                                       | 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  |
| 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   | 5.50  | 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   |

**Table 9C**  
**Dimensions of Class 150 Flanged Fittings — U.S. Customary Units**



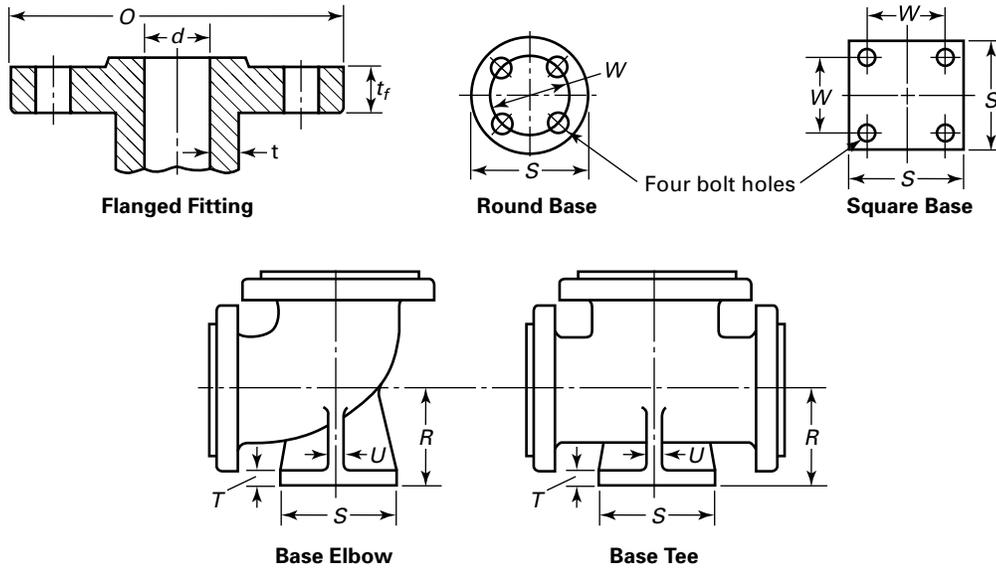
| 13                                      | 14                                 | 15                                 | 16   | 17                              | 18                        | 19  | 20                            | 21                       | 22                             | 23                        | 1                      |  |
|---|------------------------------------|------------------------------------|--|---------------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|------------------------|--|
| Ring Joint (4)                          |                                    |                                    |  |                                 |                           |   |                               |                          |                                | Base Drilling (11)        |                        |  |
| Center-to-End Long Radius Elbow, JJ (6) | Center-to-End 45-deg Elbow, KK (6) | Long Center-to-End Lateral, LL (6) | Short Center-to-End Lateral and True "Y," MM (6) | End-to-End Reducer, NN (5), (6) | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |  |
| ...                                     | ...                                | ...                                | ...  | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1/2                    |  |
| ...                                     | ...                                | ...                                | ...  | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 3/4                    |  |
| 5.25                                    | 2.00                               | 6.00                               | 2.00   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1                      |  |
| 5.75                                    | 2.25                               | 6.50                               | 2.00   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1 1/4                  |  |
| 6.25                                    | 2.50                               | 7.25                               | 2.25   | ...                             | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1 1/2                  |  |
| 6.75                                    | 2.75                               | 8.25                               | 2.75   | ...                             | 4.12                      | 4.62  | 0.50                          | 0.50                     | 3.50                           | 5/8                       | 2                      |  |
| 7.25                                    | 3.25                               | 9.75                               | 2.75   | ...                             | 4.50                      | 4.62  | 0.50                          | 0.50                     | 3.50                           | 5/8                       | 2 1/2                  |  |
| 8.00                                    | 3.25                               | 10.25                              | 3.25   | ...                             | 4.88                      | 5.00  | 0.56                          | 0.56                     | 3.88                           | 5/8                       | 3                      |  |
| 8.75                                    | 3.75                               | 11.75                              | 3.25   | ...                             | 5.25                      | 5.00  | 0.56                          | 0.56                     | 3.88                           | 5/8                       | 3 1/2                  |  |
| 9.25                                    | 4.25                               | 12.25                              | 3.25   | ...                             | 5.50                      | 6.00  | 0.62                          | 0.62                     | 4.75                           | 3/4                       | 4                      |  |
| 10.50                                   | 4.75                               | 13.75                              | 3.75   | ...                             | 6.25                      | 7.00  | 0.69                          | 0.65                     | 5.50                           | 3/4                       | 5                      |  |
| 11.75                                   | 5.25                               | 14.75                              | 3.75   | ...                             | 7.00                      | 7.00  | 0.69                          | 0.65                     | 5.50                           | 3/4                       | 6                      |  |
| 14.25                                   | 5.75                               | 17.75                              | 4.75   | ...                             | 8.38                      | 9.00  | 0.94                          | 0.94                     | 7.50                           | 3/4                       | 8                      |  |
| 16.75                                   | 6.75                               | 20.75                              | 5.25   | ...                             | 9.75                      | 9.00  | 0.94                          | 0.94                     | 7.50                           | 3/4                       | 10                     |  |
| 19.25                                   | 7.75                               | 24.75                              | 5.75   | ...                             | 11.25                     | 11.00   | 1.00                          | 1.00                     | 9.50                           | 7/8                       | 12                     |  |
| 21.75                                   | 7.75                               | 27.25                              | 6.25   | ...                             | 12.50                     | 11.00   | 1.00                          | 1.00                     | 9.50                           | 7/8                       | 14                     |  |

**Table 9C**  
**Dimensions of Class 150 Flanged Fittings — U.S. Customary Units (Cont'd)**



|                        |                               |  |  |                               | 0.06-in. Raised Face (Flange Edge) (4)                               |  |   |   |   |   | Ring Joint (4)  |
|------------------------|-------------------------------|--|--|-------------------------------|--|--|---|---|---|---|---|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, $t_f$ (1)-(3) | Minimum Wall Thickness of Fitting, $t_m$ | Inside Diameter of Fitting, d | Center-to-Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to-Surface of Raised Face Long Radius Elbow, BB | Center-to-Surface of Raised Face 45-deg Elbow, CC | Long Center-to-Surface of Raised Face Lateral, EE | Short Center-to-Surface of Raised Face True "Y," FF | Contact Surface-to-Surface of Raised Face Reducer, GG (5) | Center-to-End Elbow, Tee, Cross, and True "Y," HH (6) |
| 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                         | 1.50                                       | 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 9C**  
**Dimensions of Class 150 Flanged Fittings — U.S. Customary Units (Cont'd)**



| 13                                      | 14                                 | 15                                 | 16   | 17                              | 18                        | 19  | 20                            | 21                       | 22                             | 23                        | 1                      |  |
|---|------------------------------------|------------------------------------|--|---------------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|------------------------|--|
| Ring Joint (4)                          |                                    |                                    |  |                                 |                           |   |                               |                          |                                | Base Drilling (11)        |                        |  |
| Center-to-End Long Radius Elbow, JJ (6) | Center-to-End 45-deg Elbow, KK (6) | Long Center-to-End Lateral, LL (6) | Short Center-to-End Lateral and True "Y," MM (6) | End-to-End Reducer, NN (5), (6) | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |  |
| 24.25                                   | 8.25                               | 30.25                              | 6.75   | ...                             | 13.75                     | 11.00   | 1.00                          | 1.00                     | 9.50                           | 7/8                       | 16                     |  |
| 26.75                                   | 8.75                               | 32.25                              | 7.25   | ...                             | 15.00                     | 13.50   | 1.12                          | 1.12                     | 11.75                          | 7/8                       | 18                     |  |
| 29.25                                   | 9.75                               | 35.25                              | 8.25   | ...                             | 16.00                     | 13.50   | 1.12                          | 1.12                     | 11.75                          | 7/8                       | 20                     |  |
| 34.25                                   | 11.25                              | 40.75                              | 9.25   | ...                             | 18.50                     | 13.50   | 1.12                          | 1.12                     | 11.75                          | 7/8                       | 24                     |  |

**Table 9C**  
**Dimensions of Class 150 Flanged Fittings — U.S. Customary Units (Cont'd)**

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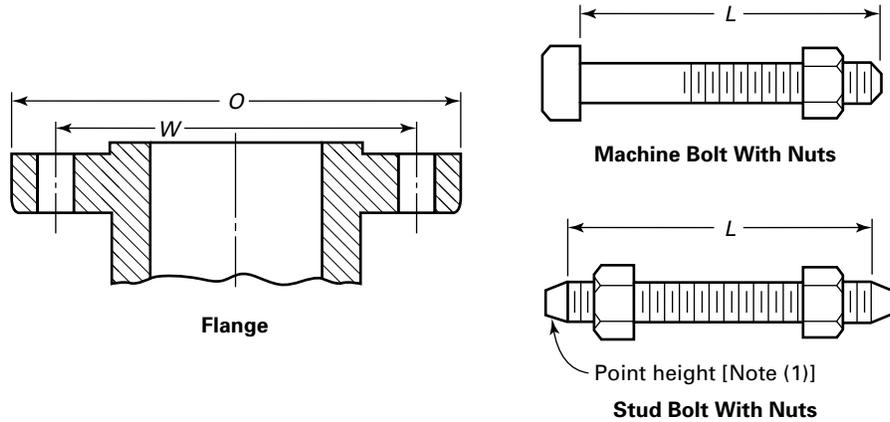
## GENERAL NOTE:

- (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 7C](#).
- (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 9C](#), 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.
- (2) These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 0.06 in. or the  $t_f$  dimension thickness without the raised face height. See [para. 6.3.2](#) for additional restrictions.
- (3) The thickness of the flange dimension illustrated is for regularly furnished 0.06-in. raised face (except lapped); for thickness requirements of other facings, see [Figure 6](#).
- (4) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (5) For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see [para. 6.2.3](#).
- (6) These dimensions apply to straight sizes only (see [paras. 6.2.3](#) and [6.4.2.2](#)). For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 0.06-in. raised face (flange edge) for the largest opening, and add the proper height to provide for ring joint groove applying to each flange. See [Table 5C](#) 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 — SI Units**



| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Drilling (2), (3)          |                             |                 |                        | Length of Bolts, L (4) |            |                    |
|------------------------|-------------------------------|----------------------------|-----------------------------|-----------------|------------------------|------------------------|------------|--------------------|
|                        |                               | Diameter of Bolt Circle, W | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | Stud Bolts (1)         |            | Machine Bolts      |
|                        |                               |                            |                             |                 |                        | 1.5-mm Raised Face     | Ring Joint | 1.5-mm Raised Face |
| 1/2                    | 95                            | 66.5                       | 5/8                         | 4               | 1/2                    | 65                     | 75         | 55                 |
| 3/4                    | 117                           | 82.6                       | 3/4                         | 4               | 5/8                    | 75                     | 90         | 65                 |
| 1                      | 124                           | 88.9                       | 3/4                         | 4               | 5/8                    | 75                     | 90         | 65                 |
| 1 1/4                  | 133                           | 98.6                       | 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                           | 149.4                      | 7/8                         | 8               | 3/4                    | 100                    | 115        | 85                 |
| 3                      | 210                           | 168.1                      | 7/8                         | 8               | 3/4                    | 110                    | 120        | 90                 |
| 3 1/2                  | 229                           | 184.2                      | 7/8                         | 8               | 3/4                    | 110                    | 125        | 95                 |
| 4                      | 254                           | 200.2                      | 7/8                         | 8               | 3/4                    | 115                    | 125        | 95                 |
| 5                      | 279                           | 235.0                      | 7/8                         | 8               | 3/4                    | 120                    | 135        | 110                |
| 6                      | 318                           | 269.7                      | 7/8                         | 12              | 3/4                    | 120                    | 140        | 110                |
| 8                      | 381                           | 330.2                      | 1                           | 12              | 7/8                    | 140                    | 150        | 120                |
| 10                     | 444                           | 387.4                      | 1 1/8                       | 16              | 1                      | 160                    | 170        | 140                |
| 12                     | 521                           | 450.8                      | 1 1/4                       | 16              | 1 1/8                  | 170                    | 185        | 145                |
| 14                     | 584                           | 514.4                      | 1 1/4                       | 20              | 1 1/8                  | 180                    | 190        | 160                |
| 16                     | 648                           | 571.5                      | 1 3/8                       | 20              | 1 1/4                  | 190                    | 205        | 165                |
| 18                     | 711                           | 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                |
| 22                     | 838                           | 743.0                      | 1 5/8                       | 24              | 1 1/2                  | 230                    | 255        | 205                |
| 24                     | 914                           | 812.8                      | 1 5/8                       | 24              | 1 1/2                  | 230                    | 255        | 205                |

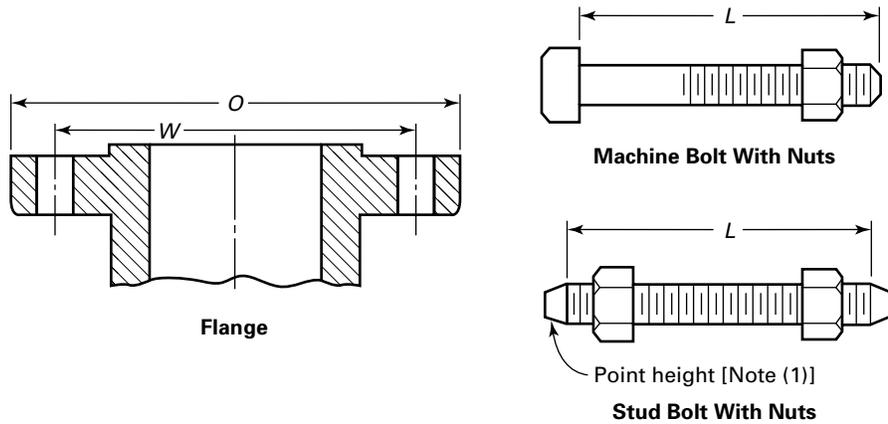
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which are in inches.
- (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 10C**  
**Templates for Drilling Class 300 Pipe Flanges and Flanged Fittings — U.S. Customary Units**



| 1                       | 2                                      | 3                                | 4                         | 5                  | 6                    | 7                          | 8             | 9                       |
|-------------------------|--|----------------------------------|---------------------------|--------------------|----------------------|----------------------------|---------------|-------------------------|
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of Flange,<br>O | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number<br>of Bolts | Diameter of<br>Bolts | Length of Bolts, L (4)     |               |                         |
|                         |  |                                  |                           |                    |                      | Stud Bolts (1)             |               | Machine<br>Bolts        |
|                         |  |                                  |                           |                    |                      | Raised<br>Face<br>0.06 in. | Ring<br>Joint | Raised Face<br>0.06 in. |
|                         |  |                                  |                           |                    |                      | Drilling (2), (3)          |               |                         |
| 1/2                     | 3.75                                   | 2.62                             | 5/8                       | 4                  | 1/2                  | 2.50                       | 3.00          | 2.25                    |
| 3/4                     | 4.62                                   | 3.25                             | 3/4                       | 4                  | 5/8                  | 3.00                       | 3.50          | 2.50                    |
| 1                       | 4.88                                   | 3.50                             | 3/4                       | 4                  | 5/8                  | 3.00                       | 3.50          | 2.50                    |
| 1 1/4                   | 5.25                                   | 3.88                             | 3/4                       | 4                  | 5/8                  | 3.25                       | 3.75          | 2.75                    |
| 1 1/2                   | 6.12                                   | 4.50                             | 7/8                       | 4                  | 3/4                  | 3.50                       | 4.00          | 3.00                    |
| 2                       | 6.50                                   | 5.00                             | 3/4                       | 8                  | 5/8                  | 3.50                       | 4.00          | 3.00                    |
| 2 1/2                   | 7.50                                   | 5.88                             | 7/8                       | 8                  | 3/4                  | 4.00                       | 4.50          | 3.25                    |
| 3                       | 8.25                                   | 6.62                             | 7/8                       | 8                  | 3/4                  | 4.25                       | 4.75          | 3.50                    |
| 3 1/2                   | 9.00                                   | 7.25                             | 7/8                       | 8                  | 3/4                  | 4.25                       | 5.00          | 3.75                    |
| 4                       | 10.00                                  | 7.88                             | 7/8                       | 8                  | 3/4                  | 4.50                       | 5.00          | 3.75                    |
| 5                       | 11.00                                  | 9.25                             | 7/8                       | 8                  | 3/4                  | 4.75                       | 5.25          | 4.25                    |
| 6                       | 12.50                                  | 10.62                            | 7/8                       | 12                 | 3/4                  | 4.75                       | 5.50          | 4.25                    |
| 8                       | 15.00                                  | 13.00                            | 1                         | 12                 | 7/8                  | 5.50                       | 6.00          | 4.75                    |
| 10                      | 17.50                                  | 15.25                            | 1 1/8                     | 16                 | 1                    | 6.25                       | 6.75          | 5.50                    |
| 12                      | 20.50                                  | 17.75                            | 1 1/4                     | 16                 | 1 1/8                | 6.75                       | 7.25          | 5.75                    |
| 14                      | 23.00                                  | 20.25                            | 1 1/4                     | 20                 | 1 1/8                | 7.00                       | 7.50          | 6.25                    |
| 16                      | 25.50                                  | 22.50                            | 1 3/8                     | 20                 | 1 1/4                | 7.50                       | 8.00          | 6.50                    |
| 18                      | 28.00                                  | 24.75                            | 1 3/8                     | 24                 | 1 1/4                | 7.75                       | 8.25          | 6.75                    |
| 20                      | 30.50                                  | 27.00                            | 1 3/8                     | 24                 | 1 1/4                | 8.00                       | 8.75          | 7.25                    |
| 22                      | 33.00                                  | 29.25                            | 1 5/8                     | 24                 | 1 1/2                | 9.00                       | 10.00         | 8.00                    |
| 24                      | 36.00                                  | 32.00                            | 1 5/8                     | 24                 | 1 1/2                | 9.00                       | 10.00         | 8.00                    |

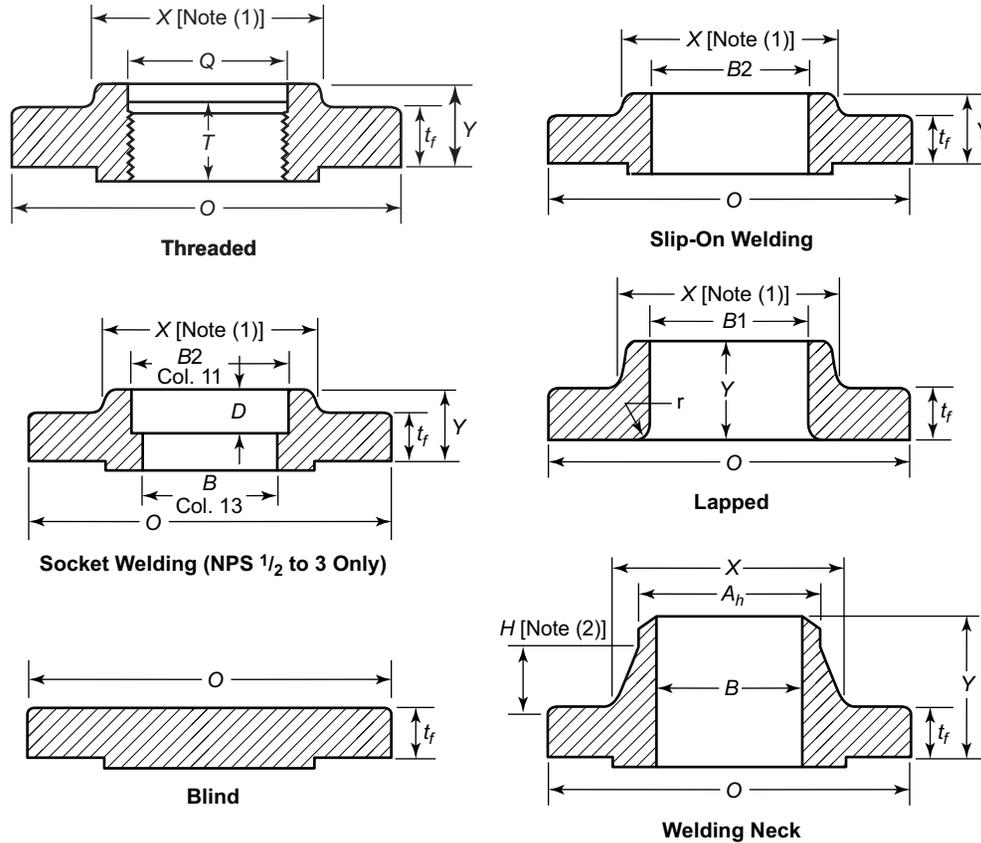
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For other dimensions see, [Tables 11C and 12C](#).

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 11**  
**Dimensions of Class 300 Flanges — SI Units**



| 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, $t_f$ (3)-(5) | Minimum Thickness Lap Joint, $t_f$ | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding Neck, $A_h$ (5) | Hub Length Through Hub               |           |                 | Minimum Thread Length Threaded, T (6) | Bore                                |                    |                                     | 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, B2 | Minimum Lapped, B1 | Welding Neck/ Socket Welding, B (7) |  |   |                    |
| 1/2                   | 95                            | 12.7                                       | 14.2                               | 38                 | 21.3  | 21                                   | 22        | 51              | 16                                    | 22.4                                | 22.9               | 15.7                                | 3  | 23.6                                    | 10                 |
| 3/4                   | 117                           | 14.2                                       | 15.7                               | 48                 | 26.7  | 24                                   | 25        | 56              | 16                                    | 27.7                                | 28.2               | 20.8                                | 3  | 29.0                                    | 11                 |
| 1                     | 124                           | 15.7                                       | 17.5                               | 54                 | 33.5  | 25                                   | 27        | 60              | 18                                    | 34.5                                | 35.1               | 26.7                                | 3  | 35.8                                    | 13                 |

**Table 11**  
**Dimensions of Class 300 Flanges — SI Units (Cont'd)**

| 1                           | 2  | 3   | 4  | 5                               | 6   | 7   | 8                   | 9                            | 10   | 11   | 12                              | 13   | 14   | 15   | 16                                 |
|-----------------------------|--|---|--|---------------------------------|---|---|---------------------|------------------------------|--|--|---------------------------------|--|--|--|------------------------------------|
| Nominal<br>Pipe Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i><br>(3)-(5) | Minimum<br>Thickness<br>Lap Joint,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck, <i>A<sub>h</sub></i><br>(5) | Length Through Hub                                      |                     |                              | Minimum<br>Thread<br>Length<br>Threaded,<br><i>T</i> (6) | Bore   |                                 |  | Corner<br>Radius<br>of Bore<br>of<br>Lapped<br>Flange<br>and<br>Pipe, <i>r</i> | Minimum<br>Counter-<br>bore<br>Threaded<br>Flange,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                             |  |   |  |                                 |   | Threaded/<br>Slip-On/<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> |  | Minimum<br>Slip-On/<br>Socket<br>Welding,<br><i>B2</i> | Minimum<br>Lapped,<br><i>B1</i> | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> (7) |  |  |                                    |
| 1¼                          | 133  | 17.5  | 19.0   | 64                              | 42.2  | 25  | 27                  | 64                           | 21   | 43.2   | 43.7                            | 35.1   | 5  | 44.4   | 14                                 |
| 1½                          | 155  | 19.0  | 20.6   | 70                              | 48.3  | 29  | 30                  | 67                           | 22   | 49.5   | 50.0                            | 40.9   | 6  | 50.3   | 16                                 |
| 2                           | 165  | 20.6  | 22.4   | 84                              | 60.5  | 32  | 33                  | 68                           | 28   | 62.0   | 62.5                            | 52.6   | 8  | 63.5   | 17                                 |
| 2½                          | 190  | 23.9  | 25.4   | 100                             | 73.2  | 37  | 38                  | 75                           | 32   | 74.7   | 75.4                            | 62.7   | 8  | 76.2   | 19                                 |
| 3                           | 210  | 26.9  | 28.4   | 117                             | 88.9  | 41  | 43                  | 78                           | 32   | 90.7   | 91.4                            | 78.0   | 10   | 92.2   | 21                                 |
| 3½                          | 229  | 28.4  | 30.2   | 133                             | 101.6   | 43  | 44                  | 80                           | 37   | 103.4  | 104.1                           | 90.2   | 10   | 104.9  | ...                                |
| 4                           | 254  | 30.2  | 31.8   | 146                             | 114.3   | 46  | 48                  | 84                           | 37   | 116.1  | 116.8                           | 102.4  | 11   | 117.6  | ...                                |
| 5                           | 279  | 33.3  | 35.1   | 178                             | 141.2   | 49  | 51                  | 97                           | 43   | 143.8  | 144.5                           | 128.3  | 11   | 144.5  | ...                                |
| 6                           | 318  | 35.1  | 36.6   | 206                             | 168.4   | 51  | 52                  | 97                           | 46   | 170.7  | 171.4                           | 154.2  | 13   | 171.4  | ...                                |
| 8                           | 381  | 39.6  | 41.1   | 260                             | 219.2   | 60  | 62                  | 110                          | 51   | 221.5  | 222.2                           | 202.7  | 13   | 222.2  | ...                                |
| 10                          | 444  | 46.0  | 47.8   | 321                             | 273.0   | 65  | 95                  | 116                          | 56   | 276.4  | 277.4                           | 254.5  | 13   | 276.4  | ...                                |
| 12                          | 521  | 49.3  | 50.8   | 375                             | 323.8   | 72  | 102                 | 129                          | 60   | 327.2  | 328.2                           | 304.8  | 13   | 328.7  | ...                                |
| 14                          | 584  | 52.3  | 53.8   | 425                             | 355.6   | 75  | 111                 | 141                          | 64   | 359.2  | 360.2                           | (8)  | 13   | 360.4  | ...                                |
| 16                          | 648  | 55.6  | 57.2   | 483                             | 406.4   | 81  | 121                 | 145                          | 68   | 410.5  | 411.2                           | (8)  | 13   | 411.2  | ...                                |
| 18                          | 711  | 58.7  | 60.5   | 533                             | 457.2   | 87  | 130                 | 157                          | 70   | 461.8  | 462.3                           | (8)  | 13   | 462.0  | ...                                |
| 20                          | 775  | 62.0  | 63.5   | 587                             | 508.0   | 94  | 140                 | 161                          | 73   | 513.1  | 514.4                           | (8)  | 13   | 512.8  | ...                                |
| 22                          | 838  | 65.0  | 66.5   | 641                             | 558.8   | 100   | 145                 | 164                          | ...  | 564.4  | 565.2                           | (8)  | 13   | ...  | ...                                |
| 24                          | 914  | 68.3  | 68.8   | 702                             | 609.6   | 105   | 152                 | 167                          | 83   | 616.0  | 616.0                           | (8)  | 13   | 614.4  | ...                                |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (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) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .

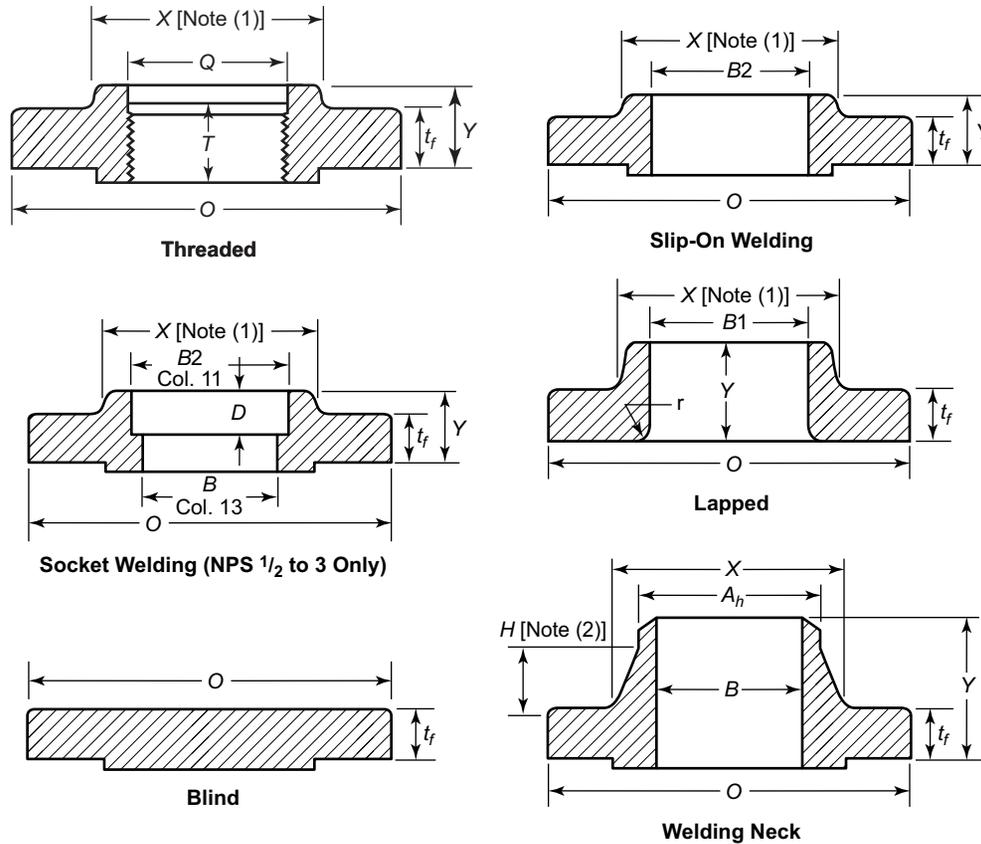
**Table 11**  
**Dimensions of Class 300 Flanges — SI Units (Cont'd)**

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NOTES: (Cont'd)

- (3) These flanges may be supplied with a flat face. The flat face may be either the full  $t_f$  dimension thickness plus 1.5 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 1.5-mm raised face (except lapped); for requirements of other facings, see [Figure 6](#).
- (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. 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.
- (8) To be specified by the purchaser.

**Table 11C**  
**Dimensions of Class 300 Flanges — U.S. Customary Units**



| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, $t_f$ (3)-(5) | Thickness of Lap Joint, $t_f$ | Diameter of Hub, <i>X</i> | Diameter Beginning of Chamfer Welding Neck, $A_h$ (5) | Length Through Hub                        |                  |                        | Bore   |   |                           | Welding Neck/Socket Welding, <i>B</i> (7) | 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 Thread Length Threaded, <i>T</i> (6) | Minimum Slip-On Socket Welding, <i>B2</i> | Minimum Lapped, <i>B1</i> |   |  |  |                           |
| 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                      |

**Table 11C**  
**Dimensions of Class 300 Flanges — U.S. Customary Units (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, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> (3)–(5) | Thickness of Lap Joint, <i>t<sub>l</sub></i> | Diameter of Hub, <i>X</i> | Diameter Beginning of Chamfer of Welding Neck, <i>A<sub>h</sub></i> (5) | Length Through Hub                        |                  |                        | Minimum Thread Length Threaded, <i>T</i> (6) | 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 Slip-On Socket Welding, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> |  | Minimum Slip-On Socket Welding, <i>B2</i> | Minimum Lapped, <i>B1</i> | Welding Neck/Socket Welding, <i>B</i> (7) |  |  |                           |
| 1¼                | 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                      |
| 1½                | 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                      |
| 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                     | (8)                                       | 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                     | (8)                                       | 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                     | (8)                                       | 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                     | (8)                                       | 0.50   | 20.19  | ...                       |
| 22                | 33.00                                | 2.56  | 2.62   | 25.25                     | 22.00   | 3.94                                      | 5.69             | 6.44                   | ...  | 22.22                                     | 22.25                     | (8)                                       | 0.50   | ...  | ...                       |
| 24                | 36.00                                | 2.69  | 2.75   | 27.62                     | 24.00   | 4.13                                      | 6.00             | 6.56                   | 3.25   | 24.25                                     | 24.25                     | (8)                                       | 0.50   | 24.19  | ...                       |

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 10C.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6C.
- (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) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .

**Table 11C**  
**Dimensions of Class 300 Flanges — U.S. Customary Units (Cont'd)**

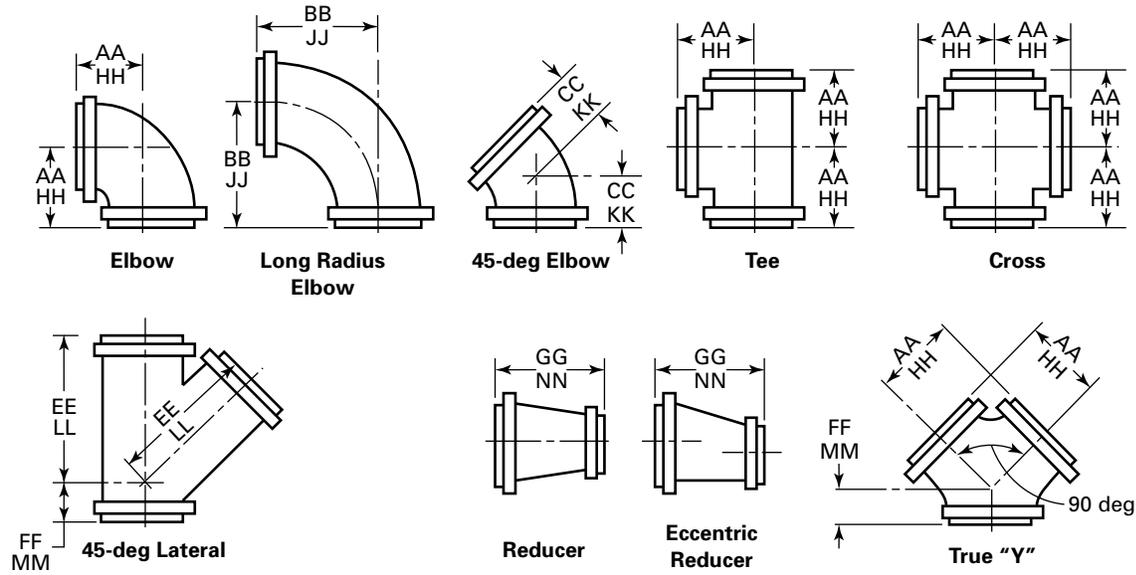
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NOTES: (Cont'd)

- (3) 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.
- (4) The flange dimensions illustrated are for regularly furnished 0.06-in. raised face (except lapped); for requirements of other facings, see [Figure 6](#).
- (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. 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.
- (8) To be specified by the purchaser.

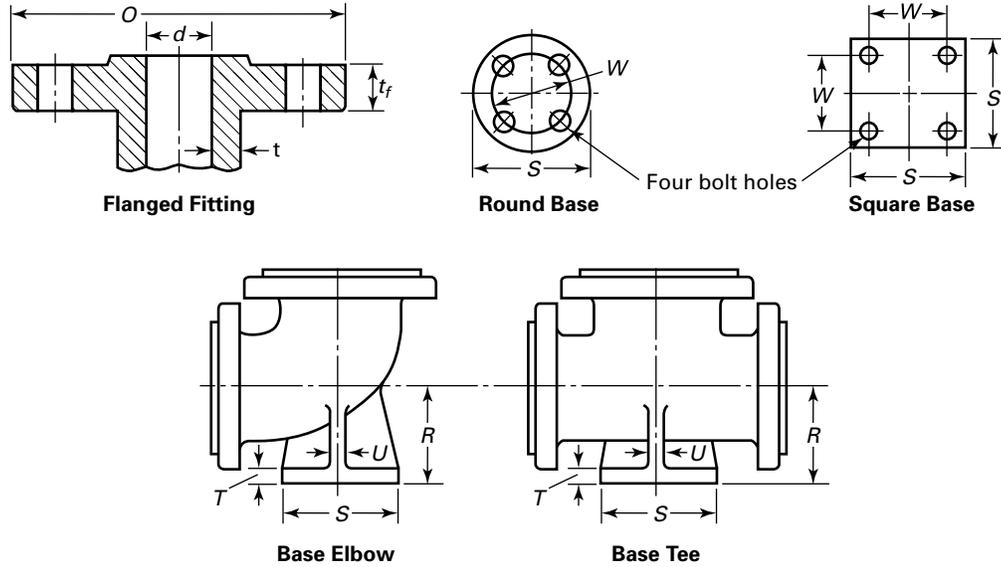
TABLE STARTS ON NEXT PAGE

**Table 12**  
**Dimensions of Class 300 Flanged Fittings — SI Units**



| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> (1)-(4) | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | 1.5-mm Raised Face (Flange Edge) (4)  |   |  |  |  |  | Ring Joint (4)   |
|------------------------|--------------------------------------|---|---|--------------------------------------|---|---|--|--|--|--|--|
|                        |                                      |   |   |                                      | Center-to-Surface of Raised Face Elbow, Tee, Cross, and True "Y," <i>AA</i> | Center-to-Surface of Raised Face Long Radius Elbow, <i>BB</i> | Center-to-Surface of Raised Face 45-deg Elbow, <i>CC</i> | Long Center-to-Surface of Raised Face Lateral, <i>EE</i> | Short Center-to-Surface of Raised Face Lateral and True "Y," <i>FF</i> | Contact Surface-to-Surface of Raised Face Reducer, <i>GG</i> (5) | Center-to-End Elbow, Tee, Cross, and True "Y," <i>HH</i> (6) |
|                        |                                      |   |   |                                      | <i>AA</i>   | <i>BB</i>   | <i>CC</i>  | <i>EE</i>  | <i>FF</i>  | <i>GG</i> (5)  |  |
| 1                      | 124                                  | 15.7  | 4.8   | 25                                   | 102   | 127   | 57   | 165  | 51   | 114  | 108  |
| 1¼                     | 133                                  | 17.5  | 4.8   | 32                                   | 108   | 140   | 64   | 184  | 57   | 114  | 114  |
| 1½                     | 155                                  | 19.0  | 4.8   | 38                                   | 114   | 152   | 70   | 216  | 64   | 114  | 121  |
| 2                      | 165                                  | 20.6  | 6.4   | 51                                   | 127   | 165   | 76   | 229  | 64   | 127  | 135  |
| 2½                     | 190                                  | 23.9  | 6.4   | 64                                   | 140   | 178   | 89   | 267  | 64   | 140  | 148  |
| 3                      | 210                                  | 26.9  | 7.1   | 76                                   | 152   | 197   | 89   | 279  | 76   | 152  | 160  |
| 3½                     | 229                                  | 28.4  | 7.4   | 89                                   | 165   | 216   | 102  | 318  | 76   | 165  | 173  |
| 4                      | 254                                  | 30.2  | 7.9   | 102                                  | 178   | 229   | 114  | 343  | 76   | 178  | 186  |
| 5                      | 279                                  | 33.3  | 9.7   | 127                                  | 203   | 260   | 127  | 381  | 89   | 203  | 211  |
| 6                      | 318                                  | 35.1  | 9.7   | 152                                  | 216   | 292   | 140  | 444  | 102  | 229  | 224  |
| 8                      | 381                                  | 39.6  | 11.2  | 203                                  | 254   | 356   | 152  | 521  | 127  | 279  | 262  |
| 10                     | 444                                  | 46.0  | 12.7  | 254                                  | 292   | 419   | 178  | 610  | 140  | 305  | 300  |
| 12                     | 521                                  | 49.3  | 14.2  | 305                                  | 330   | 483   | 203  | 698  | 152  | 356  | 338  |
| 14                     | 584                                  | 52.3  | 15.7  | 337                                  | 381   | 546   | 216  | 787  | 165  | 406  | 389  |
| 16                     | 648                                  | 55.6  | 17.5  | 387                                  | 419   | 610   | 241  | 876  | 190  | 457  | 427  |
| 18                     | 711                                  | 58.7  | 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                     | 914                                  | 68.3  | 23.9  | 584                                  | 572   | 864   | 305  | 1206   | 254  | 610  | 583  |

**Table 12**  
**Dimensions of Class 300 Flanged Fittings — SI Units**



| 13                                      | 14                                 | 15                                 | 16   | 17                     | 18                        | 19  | 20                            | 21                       | 22                             | 23                        | 1                      |  |
|---|------------------------------------|------------------------------------|--|------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|------------------------|--|
| Ring Joint (5)                          |                                    |                                    |  |                        | Base Drilling (11)        |   |                               |                          |                                |                           |                        |  |
| Center-to-End Long Radius Elbow, JJ (7) | Center-to-End 45-deg Elbow, KK (7) | Long Center-to-End Lateral, LL (7) | Short Center-to-End Lateral and True "Y," MM (7) | End-to-End Reducer, NN | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |  |
| 133                                     | 64                                 | 171                                | 57   | ...                    | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1                      |  |
| 146                                     | 70                                 | 191                                | 64   | ...                    | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1¼                     |  |
| 159                                     | 76                                 | 222                                | 70   | ...                    | ...                       | ...   | ...                           | ...                      | ...                            | ...                       | 1½                     |  |
| 173                                     | 84                                 | 236                                | 71   | ...                    | 114                       | 133   | 19                            | 13                       | 98.6                           | ¾                         | 2                      |  |
| 186                                     | 97                                 | 275                                | 71   | ...                    | 121                       | 133   | 19                            | 13                       | 98.6                           | ¾                         | 2½                     |  |
| 205                                     | 97                                 | 287                                | 84   | ...                    | 133                       | 155   | 21                            | 16                       | 114.3                          | ⅞                         | 3                      |  |
| 224                                     | 109                                | 325                                | 84   | ...                    | 143                       | 155   | 21                            | 16                       | 114.3                          | ⅞                         | 3½                     |  |
| 236                                     | 124                                | 351                                | 84   | ...                    | 152                       | 165   | 22                            | 16                       | 127.0                          | ¾                         | 4                      |  |
| 268                                     | 135                                | 389                                | 97   | ...                    | 171                       | 190   | 25                            | 19                       | 149.4                          | ⅞                         | 5                      |  |
| 300                                     | 148                                | 452                                | 109  | ...                    | 190                       | 190   | 25                            | 19                       | 149.4                          | ⅞                         | 6                      |  |
| 363                                     | 160                                | 529                                | 135  | ...                    | 229                       | 254   | 32                            | 22                       | 200.2                          | ⅞                         | 8                      |  |
| 427                                     | 186                                | 617                                | 148  | ...                    | 267                       | 254   | 32                            | 22                       | 200.2                          | ⅞                         | 10                     |  |
| 490                                     | 211                                | 706                                | 160  | ...                    | 305                       | 318   | 37                            | 25                       | 269.7                          | ⅞                         | 12                     |  |
| 554                                     | 224                                | 795                                | 173  | ...                    | 343                       | 318   | 37                            | 25                       | 269.7                          | ⅞                         | 14                     |  |
| 617                                     | 249                                | 884                                | 198  | ...                    | 375                       | 318   | 37                            | 28                       | 269.7                          | ⅞                         | 16                     |  |
| 681                                     | 262                                | 960                                | 211  | ...                    | 413                       | 381   | 41                            | 28                       | 330.2                          | 1                         | 18                     |  |
| 746                                     | 276                                | 1038                               | 226  | ...                    | 454                       | 381   | 41                            | 32                       | 330.2                          | 1                         | 20                     |  |
| 875                                     | 316                                | 1218                               | 265  | ...                    | 527                       | 444   | 48                            | 32                       | 387.4                          | 1½                        | 24                     |  |

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

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## GENERAL NOTES:

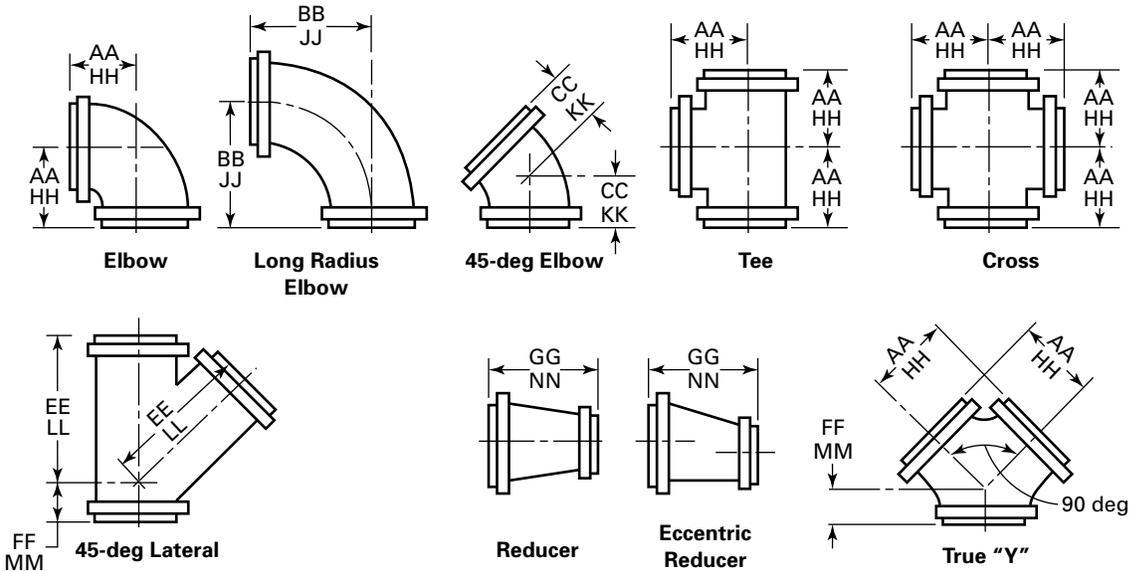
- (a) Dimensions are in millimeters.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 8](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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. 6.1.1](#).
- (i) For drains, see [para. 6.12](#).

## NOTES:

- (1) These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 1.5 mm or the  $t_f$  dimension thickness without the raised face height. See [para. 6.3.2](#) for additional restrictions.
- (2) The thickness of the flange dimension illustrated is for regularly furnished 1.5-mm raised face (except lapped); for thickness requirements of other facings, see [Figure 6](#).
- (3) The thickness of flange minimum dimensions for loose flanges, [Table 9](#), size NPS 3½ and smaller, are slightly heavier than for flanges on these fittings that are reinforced by being cast integral with the body of fitting.
- (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 1.5-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.
- (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.

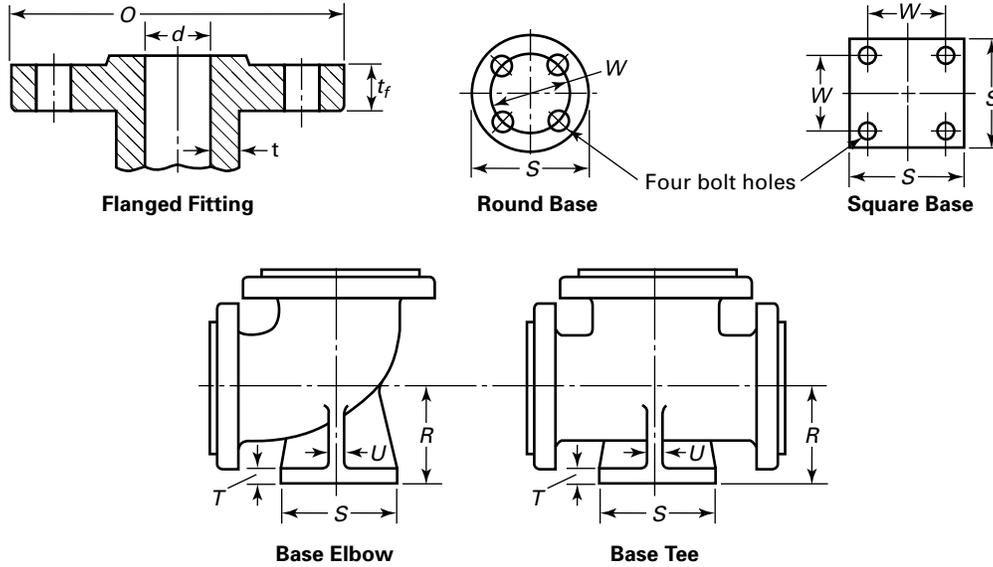
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**Table 12C**  
**Dimensions of Class 300 Flanged Fittings — U.S. Customary Units**



|                        |                               |  |  |                               | 0.06-in. Raised Face (Flange Edge) (4)                               |  |   |   |   |   | Ring Joint (4)                                       |
|------------------------|-------------------------------|--|--|-------------------------------|--|--|---|---|---|---|--|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, $t_f$ (1)-(4) | Minimum Wall Thickness of Fitting, $t_m$ | Inside Diameter of Fitting, d | Center-to-Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to-Surface of Raised Face Long Radius Elbow, BB | Center-to-Surface of Raised Face 45-deg Elbow, CC | Long Center-to-Surface of Raised Face Lateral, EE | Short Center-to-Surface of Raised Face Lateral and True "Y," FF | Contact Surface-to-Surface of Raised Face Reducer, GG (5) | Center-to-End Elbow Tee, Cross, and True "Y," HH (6) |
|                        |                               |  |  |                               | 2  | 3  | 4   | 5   | 6   | 7   | 8  |
| 1                      | 4.88                          | 0.62                                       | 0.19                                     | 1.00                          | 4.00   | 5.00   | 2.25  | 6.50  | 2.00  | 4.50  | 4.25   |
| 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   |
| 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 12C**  
**Dimensions of Class 300 Flanged Fittings — U.S. Customary Units**



| 13                                      | 14                                 | 15                                 | 16   | 17                     | 18                        | 19  | 20                            | 21                       | 22                             | 23                        | 1                      |
|---|------------------------------------|------------------------------------|--|------------------------|---------------------------|---|-------------------------------|--------------------------|--------------------------------|---------------------------|------------------------|
| Ring Joint (5)                          |                                    |                                    |  |                        |                           |   |                               |                          |                                | Base Drilling (11)        |                        |
| Center-to-End Long Radius Elbow, JJ (7) | Center-to-End 45-deg Elbow, KK (7) | Long Center-to-End Lateral, LL (7) | Short Center-to-End Lateral and True "Y," MM (7) | End-to-End Reducer, NN | Center-to-Base, R (7)-(9) | Diameter of Round Base or Width of Square Base, S (7) | Thickness of Base, T (7)-(10) | Thickness of Ribs, U (7) | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |
| 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                           | ⅞                         | 3                      |
| 8.81                                    | 4.31                               | 12.81                              | 3.31   | ...                    | 5.62                      | 6.12  | 0.81                          | 0.62                     | 4.50                           | ⅞                         | 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                           | ⅞                         | 5                      |
| 11.81                                   | 5.81                               | 17.81                              | 4.31   | ...                    | 7.50                      | 7.50  | 1.00                          | 0.75                     | 5.88                           | ⅞                         | 6                      |
| 14.31                                   | 6.31                               | 20.81                              | 5.31   | ...                    | 9.00                      | 10.00   | 1.25                          | 0.88                     | 7.88                           | ⅞                         | 8                      |
| 16.81                                   | 7.31                               | 24.31                              | 5.81   | ...                    | 10.50                     | 10.00   | 1.25                          | 0.88                     | 7.88                           | ⅞                         | 10                     |
| 19.31                                   | 8.31                               | 27.81                              | 6.31   | ...                    | 12.00                     | 12.50   | 1.44                          | 1.00                     | 10.62                          | ⅞                         | 12                     |
| 21.81                                   | 8.81                               | 31.31                              | 6.81   | ...                    | 13.50                     | 12.50   | 1.44                          | 1.00                     | 10.62                          | ⅞                         | 14                     |
| 24.31                                   | 9.81                               | 34.81                              | 7.81   | ...                    | 14.75                     | 12.50   | 1.44                          | 1.12                     | 10.62                          | ⅞                         | 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                          | 1⅛                        | 24                     |

**Table 12C**  
**Dimensions of Class 300 Flanged Fittings — U.S. Customary Units (Cont'd)**

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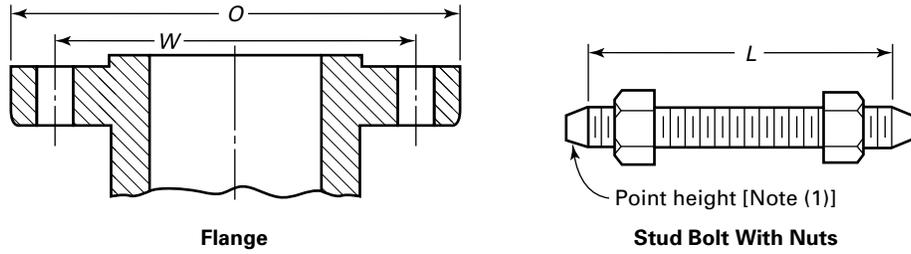
## GENERAL NOTES:

- (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 10C](#).
- (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. 6.1.1](#).
- (i) For drains, see [para. 6.12](#).

## NOTES:

- (1) 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.
- (2) 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 [Figure 6](#).
- (3) 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.
- (4) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (5) For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see [para. 6.2.3](#).
- (6) These dimensions apply to straight sizes only (see [paras. 6.2.3](#) and [6.4.2.2](#)). For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 0.06-in. raised face (flange edge) for the largest opening, and add the proper height to provide for the ring joint groove applying to each flange. See [Table 5C](#) for ring joint facing dimensions.
- (7) The base dimensions apply to all straight and reducing sizes.
- (8) 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.
- (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 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 13**  
**Templates for Drilling Class 400 Pipe Flanges — SI Units**



| 1                      | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|------------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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                    | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3/4                    | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1                      | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/4                  | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/2                  | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2                      | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2 1/2                  | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3                      | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3 1/2                  | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 4                      | 254                                  | 200.2                             | 1                      | 8               | 7/8               | 140                                | 135                               | 140        |
| 5                      | 279                                  | 235.0                             | 1                      | 8               | 7/8               | 145                                | 135                               | 145        |
| 6                      | 318                                  | 269.7                             | 1                      | 12              | 7/8               | 150                                | 145                               | 150        |
| 8                      | 381                                  | 330.2                             | 1 1/8                  | 12              | 1                 | 170                                | 165                               | 170        |
| 10                     | 444                                  | 387.4                             | 1 1/4                  | 16              | 1 1/8             | 190                                | 185                               | 190        |
| 12                     | 521                                  | 450.8                             | 1 3/8                  | 16              | 1 1/4             | 205                                | 195                               | 205        |
| 14                     | 584                                  | 514.4                             | 1 3/8                  | 20              | 1 1/4             | 210                                | 205                               | 210        |
| 16                     | 648                                  | 571.5                             | 1 1/2                  | 20              | 1 3/8             | 220                                | 215                               | 220        |
| 18                     | 711                                  | 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        |
| 22                     | 838                                  | 743.0                             | 1 3/4                  | 24              | 1 5/8             | 255                                | 250                               | 260        |
| 24                     | 914                                  | 812.8                             | 1 7/8                  | 24              | 1 3/4             | 265                                | 260                               | 280        |

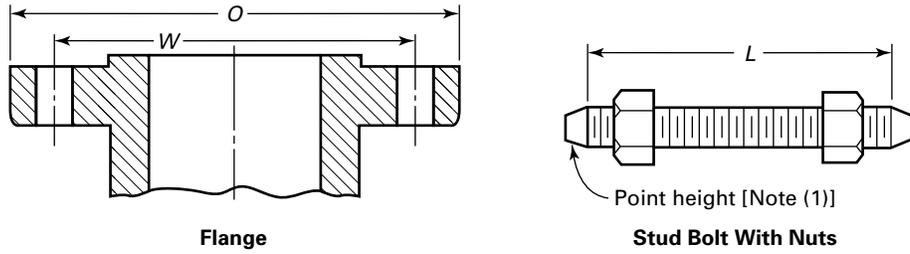
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which are in inches.
- (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](#)).
- (5) Use Class 600 dimensions in this size.

**Table 13C**  
**Templates for Drilling Class 400 Pipe Flanges — U.S. Customary Units**



| 1                 | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|-------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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               | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3/4               | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1                 | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/4             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/2             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2                 | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2 1/2             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3                 | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3 1/2             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 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       |
| 22                | 33.00                                | 29.25                             | 1 3/4                  | 24              | 1 5/8             | 10.00                              | 9.75                              | 10.25      |
| 24                | 36.00                                | 32.00                             | 1 7/8                  | 24              | 1 3/4             | 10.50                              | 10.25                             | 11.00      |

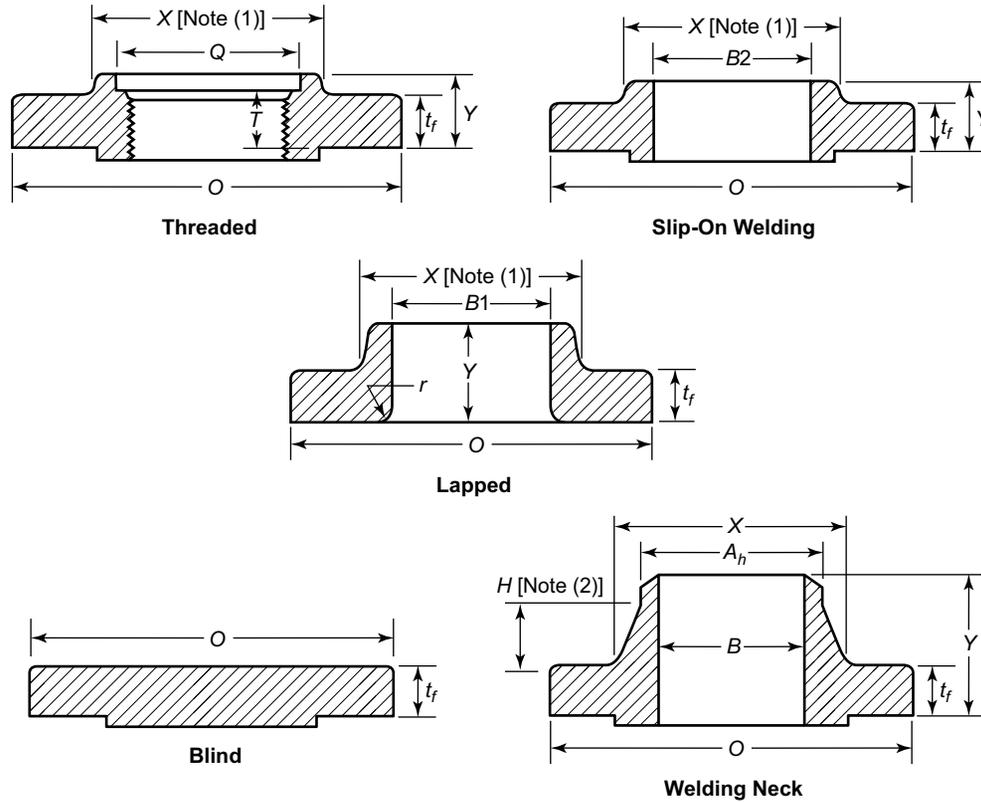
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For other dimensions, see [Table 14C](#).

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](#)).
- (5) Use Class 600 dimensions in this size.

**Table 14**  
**Dimensions of Class 400 Flanges — SI Units**



| 1                            | 2  | 3   | 4                          | 5  | 6                            |                |                         | 9   | 10  |                          |                         | 13   | 14   |
|------------------------------|--|---|----------------------------|--|------------------------------|----------------|-------------------------|---|---|--------------------------|-------------------------|--|--|
|                              |  |   |                            |  | Threaded/<br>Slip-On,<br>$Y$ | Lapped,<br>$Y$ | Welding<br>Neck,<br>$Y$ |   | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br>$T$ (4) | Min.<br>Slip-On,<br>$B2$ | Min.<br>Lapped,<br>$B1$ |  |  |
| Nom.<br>Pipe<br>Size,<br>NPS | Outside<br>Diam.<br>of<br>Flange,<br>$O$ | Min.<br>Thickness<br>of<br>Flange,<br>$t_f$ | Diam.<br>of<br>Hub,<br>$X$ | Hub Diam.<br>Beginning<br>of Chamfer<br>of Welding<br>Neck,<br>$A_h$ (3) | Length Through Hub           |                |                         | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br>$T$ (4) | Bore  |                          |                         | Corner<br>Bore<br>Radius of<br>Lapped<br>Flange and<br>Pipe, $r$ | Minimum<br>Counterbore<br>Threaded<br>Flange,<br>$Q$ |
| 1/2                          | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |
| 3/4                          | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |
| 1                            | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |
| 1 1/4                        | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |
| 1 1/2                        | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |
| 2                            | (5)                                      | (5)   | (5)                        | (5)  | (5)                          | (5)            | (5)                     | (5)   | (5)   | (5)                      | (5)                     | (5)  | (5)  |

**Table 14**  
**Dimensions of Class 400 Flanges — SI Units (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 of Welding Neck, $A_h$ (3) | Length Through Hub     |             |     | Welding Neck, $Y$ | Minimum Thread Length Threaded Flange, $T$ (4) | Bore               |                   |                   | Corner Bore Radius of Lapped Flange and Pipe, $r$ | Minimum Counterbore Threaded Flange, $Q$ |     |     |    |
|                     |                              |                                 |                   |   | Threaded/ Slip-On, $Y$ | Lapped, $Y$ |     |                   |  | Min. Slip-On, $B2$ | Min. Lapped, $B1$ | Welding Neck, $B$ |   |  |     |     |    |
| 2½                  | (5)                          | (5)                             | (5)               | (5)   | (5)                    | (5)         | (5) | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      | (5) | (5) |    |
| 3                   | (5)                          | (5)                             | (5)               | (5)   | (5)                    | (5)         | (5) | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      | (5) | (5) |    |
| 3½                  | (5)                          | (5)                             | (5)               | (5)   | (5)                    | (5)         | (5) | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      | (5) | (5) |    |
| 4                   | 254                          | 35.1                            | 146               | 114.3   | 51                     | 51          | 89  | 37                | 116.1  | 116.8              | (6)               | 11                | 117.6   |  |     |     |    |
| 5                   | 279                          | 38.1                            | 178               | 141.2   | 54                     | 54          | 102 | 43                | 143.8  | 144.5              | (6)               | 11                | 144.5   |  |     |     |    |
| 6                   | 318                          | 41.1                            | 206               | 168.4   | 57                     | 57          | 103 | 46                | 170.7  | 171.4              | (6)               | 13                | 171.4   |  |     |     |    |
| 8                   | 381                          | 47.8                            | 260               | 219.2   | 68                     | 68          | 117 | 51                | 221.5  | 222.2              | (6)               | 13                | 222.2   |  |     |     |    |
| 10                  | 444                          | 53.8                            | 321               | 273.0   | 73                     | 102         | 124 | 56                | 276.4  | 277.4              | (6)               | 13                | 276.4   |  |     |     |    |
| 12                  | 521                          | 57.2                            | 375               | 323.8   | 79                     | 108         | 137 | 60                | 327.2  | 328.2              | (6)               | 13                | 328.7   |  |     |     |    |
| 14                  | 584                          | 60.5                            | 425               | 355.6   | 84                     | 117         | 149 | 64                | 359.2  | 360.2              | (6)               | 13                | 360.4   |  |     |     |    |
| 16                  | 648                          | 63.5                            | 483               | 406.4   | 94                     | 127         | 152 | 68                | 410.5  | 411.2              | (6)               | 13                | 411.2   |  |     |     |    |
| 18                  | 711                          | 66.5                            | 533               | 457.2   | 99                     | 137         | 165 | 70                | 461.8  | 462.3              | (6)               | 13                | 462.0   |  |     |     |    |
| 20                  | 775                          | 69.8                            | 587               | 508.0   | 102                    | 146         | 168 | 73                | 513.1  | 514.4              | (6)               | 13                | 512.8   |  |     |     |    |
| 22                  | 838                          | 73.2                            | 641               | 558.8   | 108                    | 152         | 171 | ...               | 564.4  | 565.2              | (6)               | 13                | ...   |  |     |     |    |
| 24                  | 914                          | 76.2                            | 702               | 609.6   | 114                    | 159         | 175 | 83                | 616.0  | 616.0              | (6)               | 13                | 614.4   |  |     |     |    |

GENERAL NOTES:

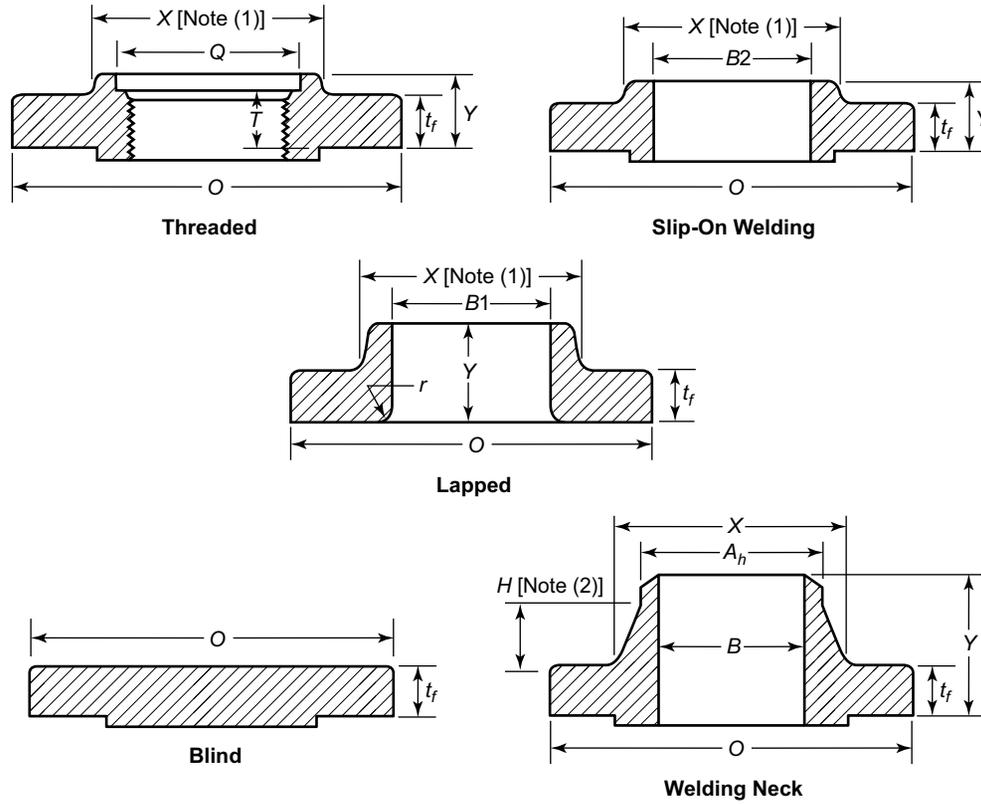
- (a) Dimensions are in millimeters, except for the diameter of bolts and bolt holes, which are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 13](#).
- (e) For spot facing, see [para 6.6](#).
- (f) 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) The minimum hub height,  $H$ , shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For thread of threaded flanges, see [para. 6.9](#).
- (5) Use Class 600 dimensions in this size.
- (6) To be specified by the purchaser.

**Table 14C**  
**Dimensions of Class 400 Flanges — U.S. Customary Units**

(25)



| 1              | 2                            | 3                               | 4                 | 5  | Length Through Hub    |             |                   | 8  | Bore               |                   |                   | 13  | 14                                       |
|----------------|------------------------------|---------------------------------|-------------------|--|-----------------------|-------------|-------------------|--|--------------------|-------------------|-------------------|---|--|
|                |                              |                                 |                   |  | 6                     | 7           | 8                 |  | 9                  | 10                | 11                |   |  |
| Nom. Pipe Size | Outside Diam. of Flange, $O$ | Min. Thickness of Flange, $t_f$ | Diam. of Hub, $X$ | Hub Diam. Beginning of Chamfer Welding Neck, $A_h$ (3) | Threaded Slip-On, $Y$ | Lapped, $Y$ | Welding Neck, $Y$ | Minimum Thread Length Threaded Flange, $T$ (4) | Min. Slip-On, $B2$ | Min. Lapped, $B1$ | Welding Neck, $B$ | Corner Bore Radius of Lapped Flange and Pipe, $r$ | Minimum Counterbore Threaded Flange, $Q$ |
| $\frac{1}{2}$  | (5)                          | (5)                             | (5)               | (5)  | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| $\frac{3}{4}$  | (5)                          | (5)                             | (5)               | (5)  | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| 1              | (5)                          | (5)                             | (5)               | (5)  | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| $1\frac{1}{4}$ | (5)                          | (5)                             | (5)               | (5)  | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| $1\frac{1}{2}$ | (5)                          | (5)                             | (5)               | (5)  | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |

**Table 14C**  
**Dimensions of Class 400 Flanges — U.S. Customary Units (Cont'd)**

| 1              | 2                                 | 3  | 4                      | 5  | 6                          | 7                | 8                      | 9  | 10                      | 11                     | 12                     | 13   | 14   |
|----------------|-----------------------------------|--|------------------------|--|----------------------------|------------------|------------------------|--|-------------------------|------------------------|------------------------|--|--|
| Nom. Pipe Size | Outside Diam. of Flange, <i>O</i> | Min. Thickness of Flange, <i>t<sub>f</sub></i> | Diam. of Hub, <i>X</i> | Hub Diam. Beginning of Chamfer of Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub         |                  |                        | Minimum Thread Length of Threaded Flange, <i>T</i> (4) | Bore                    |                        |                        | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore of Threaded Flange, <i>Q</i> |
|                |                                   |  |                        |  | Threaded Slip-On, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> |  | Min. Slip-On, <i>B2</i> | Min. Lapped, <i>B1</i> | Welding Neck, <i>B</i> |  |  |
| 2              | (5)                               | (5)  | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)  | (5)                     | (5)                    | (5)                    | (5)  | (5)  |
| 2½             | (5)                               | (5)  | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)  | (5)                     | (5)                    | (5)                    | (5)  | (5)  |
| 3              | (5)                               | (5)  | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)  | (5)                     | (5)                    | (5)                    | (5)  | (5)  |
| 3½             | (5)                               | (5)  | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)  | (5)                     | (5)                    | (5)                    | (5)  | (5)  |
| 4              | 10.00                             | 1.38   | 5.75                   | 4.50   | 2.00                       | 2.00             | 3.50                   | 1.44   | 4.57                    | 4.60                   | (6)                    | 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                   | (6)                    | 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                   | (6)                    | 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                   | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 0.50   | 20.19  |
| 22             | 33.00                             | 2.88   | 25.25                  | 22.00  | 4.25                       | 6.00             | 6.75                   | ...  | 22.22                   | 22.25                  | (6)                    | 0.50   | ...  |
| 24             | 36.00                             | 3.00   | 27.62                  | 24.00  | 4.50                       | 6.25             | 6.88                   | 3.25   | 24.25                   | 24.25                  | (6)                    | 0.50   | 24.19  |

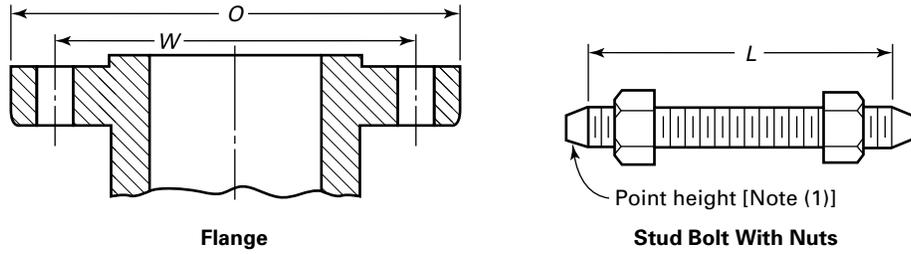
GENERAL NOTES:

- (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 13C.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6C.
- (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) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see para. 6.7.
- (4) For thread in threaded flanges, see para. 6.9.
- (5) Use Class 600 dimensions in this size.
- (6) To be specified by the purchaser.

**Table 15**  
**Templates for Drilling Class 600 Pipe Flanges and Flanged Fittings — SI Units**



| 1                      | 2                                    | 3                                 | 4                           | 5               | 6                      | 7                                  | 8                                 | 9          |
|------------------------|--------------------------------------|-----------------------------------|-----------------------------|-----------------|------------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                             |                 |                        | Length of Bolts, <i>L</i> (1), (4) |                                   |            |
|                        |                                      | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | 6.4-mm Raised Face                 | Male and Female/Tongue and Groove | Ring Joint |
| 1/2                    | 95                                   | 66.5                              | 5/8                         | 4               | 1/2                    | 75                                 | 70                                | 75         |
| 3/4                    | 117                                  | 82.6                              | 3/4                         | 4               | 5/8                    | 90                                 | 85                                | 90         |
| 1                      | 124                                  | 88.9                              | 3/4                         | 4               | 5/8                    | 90                                 | 85                                | 90         |
| 1 1/4                  | 133                                  | 98.6                              | 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                                  | 149.4                             | 7/8                         | 8               | 3/4                    | 120                                | 115                               | 120        |
| 3                      | 210                                  | 168.1                             | 7/8                         | 8               | 3/4                    | 125                                | 120                               | 125        |
| 3 1/2                  | 229                                  | 184.2                             | 1                           | 8               | 7/8                    | 140                                | 135                               | 140        |
| 4                      | 273                                  | 215.9                             | 1                           | 8               | 7/8                    | 145                                | 140                               | 145        |
| 5                      | 330                                  | 266.7                             | 1 1/8                       | 8               | 1                      | 165                                | 160                               | 165        |
| 6                      | 356                                  | 292.1                             | 1 1/8                       | 12              | 1                      | 170                                | 165                               | 170        |
| 8                      | 419                                  | 349.2                             | 1 1/4                       | 12              | 1 1/8                  | 190                                | 185                               | 195        |
| 10                     | 508                                  | 431.8                             | 1 3/8                       | 16              | 1 1/4                  | 215                                | 210                               | 215        |
| 12                     | 559                                  | 489.0                             | 1 3/8                       | 20              | 1 1/4                  | 220                                | 215                               | 220        |
| 14                     | 603                                  | 527.0                             | 1 1/2                       | 20              | 1 3/8                  | 235                                | 230                               | 235        |
| 16                     | 686                                  | 603.2                             | 1 5/8                       | 20              | 1 1/2                  | 255                                | 250                               | 255        |
| 18                     | 743                                  | 654.0                             | 1 3/4                       | 20              | 1 5/8                  | 275                                | 265                               | 275        |
| 20                     | 813                                  | 723.9                             | 1 3/4                       | 24              | 1 5/8                  | 285                                | 280                               | 290        |
| 22                     | 870                                  | 777.7                             | 1 7/8                       | 24              | 1 3/4                  | 305                                | ...                               | 310        |
| 24                     | 940                                  | 838.2                             | 2                           | 24              | 1 7/8                  | 330                                | 325                               | 335        |

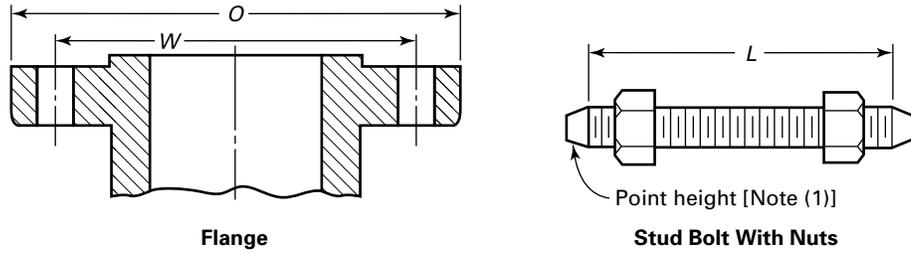
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for the diameters of the bolts and bolt holes, which are expressed in inches.
- (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 15C**  
**Templates for Drilling Class 600 Pipe Flanges and Flanged Fittings — U.S. Customary Units**



| 1                 | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|-------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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      |
| 22                | 34.25                                | 30.62                             | 1 7/8                  | 24              | 1 3/4             | 12.00                              | ...                               | 12.25      |
| 24                | 37.00                                | 33.00                             | 2                      | 24              | 1 7/8             | 13.00                              | 12.75                             | 13.25      |

GENERAL NOTES:

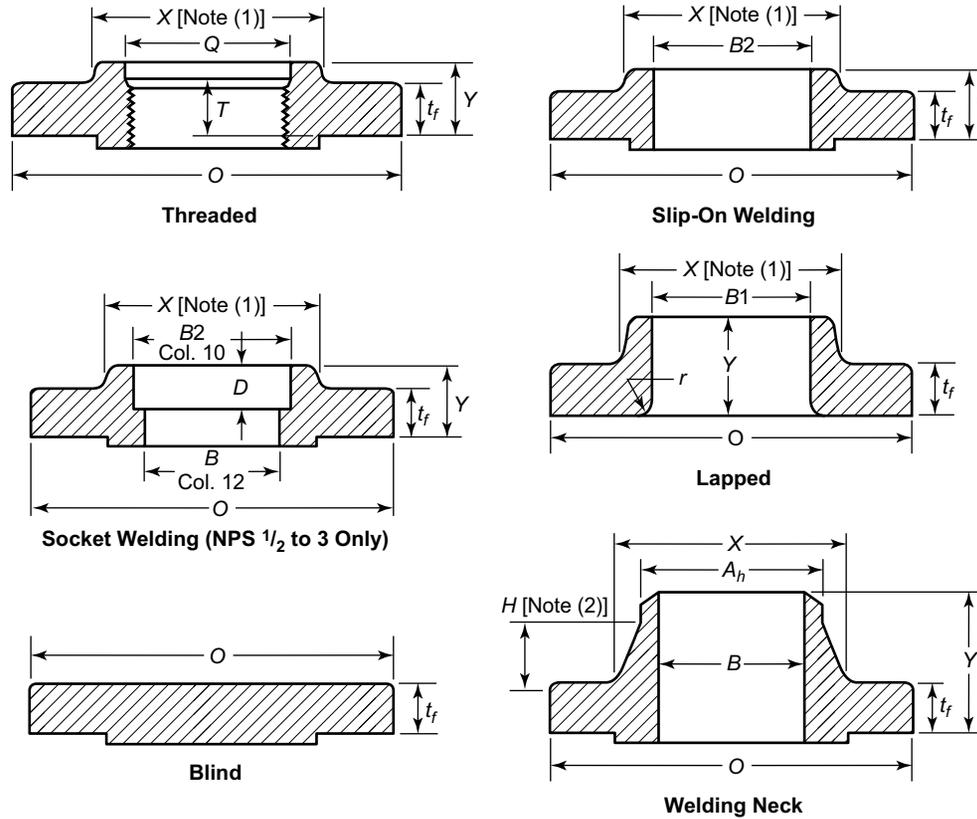
- (a) Dimensions are in inches.
- (b) For other dimensions, see [Table 16C](#).

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 16**  
**Dimensions of Class 600 Flanges — SI Units**

(25)



| 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 <sub>h</sub> (3) | Length Through Hub                   |           |    | Welding Neck, Y | Minimum Thread Length Threaded Flange, T (4) | Bore                                |                    |                                 | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q | Depth of Socket, D |
|                        |                               |                                    |                    |  | Threaded/ Slip-On/ Socket Welding, Y | Lapped, Y |    |                 |  | Minimum Slip-On/ Socket Welding, B2 | Minimum Lapped, B1 | Welding Neck/ Socket Welding, B |   |  |                    |
| 1/2                    | 95                            | 14.2                               | 38                 | 21.3   | 22                                   | 22        | 52 | 16              | 22.4   | 22.9                                | (5)                | 3                               | 23.6  | 10                                     |                    |
| 3/4                    | 117                           | 15.7                               | 48                 | 26.7   | 25                                   | 25        | 57 | 16              | 27.7   | 28.2                                | (5)                | 3                               | 29.0  | 11                                     |                    |
| 1                      | 124                           | 17.5                               | 54                 | 33.5   | 27                                   | 27        | 62 | 18              | 34.5   | 35.1                                | (5)                | 3                               | 35.8  | 13                                     |                    |

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**Table 16**  
**Dimensions of Class 600 Flanges — SI Units (Cont'd)**

| 1                               | 2  | 3  | 4                               | 5   | 6   |                     |  | 8                            | 9  | 10                              |     | 12   | 13   | 14  | 15                                 |
|---------------------------------|--|--|---------------------------------|---|---|---------------------|--|------------------------------|--|---------------------------------|-----|--|--|---|------------------------------------|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br><i>A<sub>h</sub></i> (3) | Length Through Hub                                      |                     |  | Welding<br>Neck,<br><i>Y</i> | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br><i>T</i> (4) | Bore                            |     | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> | Corner<br>Bore<br>Radius<br>of<br>Lapped<br>Flange<br>and<br>Pipe,<br><i>r</i> | Minimum<br>Counterbore<br>Threaded<br>Flange,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                                 |  |  |                                 |   | Threaded/<br>Slip-On/<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Minimum<br>Slip-On/<br>Socket<br>Welding,<br><i>B2</i> |                              |  | Minimum<br>Lapped,<br><i>B1</i> |     |  |  |   |                                    |
| 1¼                              | 133  | 20.6   | 64                              | 42.2  | 28  | 28                  | 67   | 21                           | 43.2   | 43.7                            | (5) | 5  | 44.4   | 14  |                                    |
| 1½                              | 155  | 22.4   | 70                              | 48.3  | 32  | 32                  | 70   | 22                           | 49.5   | 50.0                            | (5) | 6  | 50.5   | 16  |                                    |
| 2                               | 165  | 25.4   | 84                              | 60.5  | 37  | 37                  | 73   | 28                           | 62.0   | 62.5                            | (5) | 8  | 63.5   | 18  |                                    |
| 2½                              | 190  | 28.4   | 100                             | 73.2  | 41  | 41                  | 79   | 32                           | 74.7   | 75.4                            | (5) | 8  | 76.2   | 19  |                                    |
| 3                               | 210  | 31.8   | 117                             | 88.9  | 46  | 46                  | 83   | 35                           | 90.7   | 91.4                            | (5) | 10   | 92.2   | 21  |                                    |
| 3½                              | 229  | 35.1   | 133                             | 101.6   | 49  | 49                  | 86   | 40                           | 103.4  | 104.1                           | (5) | 10   | 104.9  | ...   |                                    |
| 4                               | 273  | 38.1   | 152                             | 114.3   | 54  | 54                  | 102  | 41                           | 116.1  | 116.8                           | (5) | 11   | 117.6  | ...   |                                    |
| 5                               | 330  | 44.4   | 189                             | 141.2   | 60  | 60                  | 114  | 48                           | 143.8  | 144.5                           | (5) | 11   | 144.5  | ...   |                                    |
| 6                               | 356  | 47.8   | 222                             | 168.4   | 67  | 67                  | 117  | 51                           | 170.7  | 171.4                           | (5) | 13   | 171.4  | ...   |                                    |
| 8                               | 419  | 55.6   | 273                             | 219.2   | 76  | 76                  | 133  | 57                           | 221.5  | 222.2                           | (5) | 13   | 222.2  | ...   |                                    |
| 10                              | 508  | 63.5   | 343                             | 273.0   | 86  | 111                 | 152  | 65                           | 276.2  | 277.4                           | (5) | 13   | 276.4  | ...   |                                    |
| 12                              | 559  | 66.5   | 400                             | 323.8   | 92  | 117                 | 155  | 70                           | 327.0  | 328.2                           | (5) | 13   | 328.7  | ...   |                                    |
| 14                              | 603  | 69.8   | 432                             | 355.6   | 94  | 127                 | 165  | 73                           | 359.2  | 360.2                           | (5) | 13   | 360.4  | ...   |                                    |
| 16                              | 686  | 76.2   | 495                             | 406.4   | 106   | 140                 | 178  | 78                           | 410.5  | 411.2                           | (5) | 13   | 411.2  | ...   |                                    |
| 18                              | 743  | 82.6   | 546                             | 457.2   | 117   | 152                 | 184  | 79                           | 461.8  | 462.3                           | (5) | 13   | 462.0  | ...   |                                    |
| 20                              | 813  | 88.9   | 610                             | 508.0   | 127   | 165                 | 190  | 83                           | 513.1  | 514.4                           | (5) | 13   | 512.8  | ...   |                                    |
| 22                              | 870  | 95.2   | 663                             | 558.8   | 133   | 175                 | 197  | ...                          | 564.4  | 565.2                           | (5) | 13   | ...  | ...   |                                    |
| 24                              | 940  | 101.6  | 718                             | 609.6   | 140   | 184                 | 203  | 92                           | 616.0  | 616.0                           | (5) | 13   | 614.4  | ...   |                                    |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For tolerance, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 15C](#).
- (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](#).

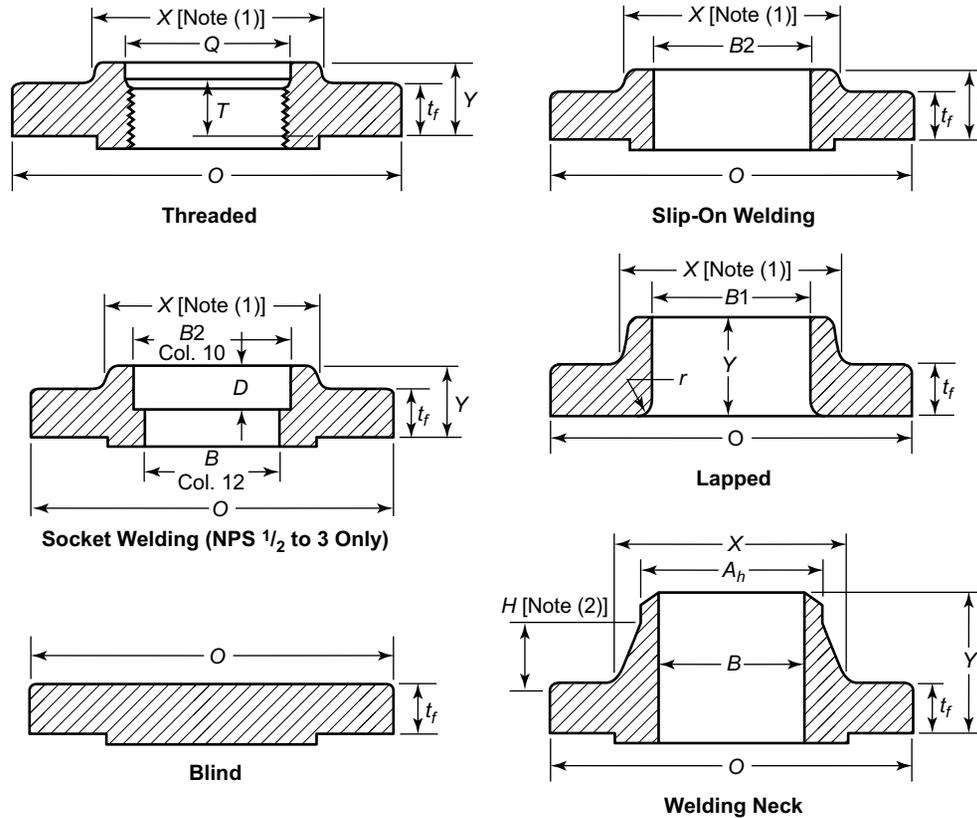
**Table 16**  
**Dimensions of Class 600 Flanges — SI Units (Cont'd)**

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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) The minimum hub height,  $H$ , shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For thread of threaded flanges, see [para. 6.9](#).
- (5) To be specified by the purchaser.

**Table 16C**  
**Dimensions of Class 600 Flanges — U.S. Customary Units**



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| 1                 | 2                               | 3                                  | 4                    | 5   | 6                                    |             |                                      | 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 of Chamfer Welding Neck, $A_h$ (3) | Length Through Hub                   |             |                                      | Welding Neck, $Y$ | Minimum Thread Length Threaded Flange, $T$ (4) | Bore                 |     | Welding Neck/Socket Welding, $B$ | Corner Bore Radius of Lapped Flange and Pipe, $r$ | Minimum Counter-bore Threaded Flange, $Q$ | Depth of Socket, $D$ |    |
|                   |                                 |                                    |                      |   | Threaded Slip-On Socket Welding, $Y$ | Lapped, $Y$ | Minimum Slip-On/Socket Welding, $B2$ |                   |  | Minimum Lapped, $B1$ |     |                                  |   |   |                      |    |
| 1/2               | 3.75                            | 0.56                               | 1.50                 | 0.84  | 0.88                                 | 0.88        | 2.06                                 | 0.62              | 0.88   | 0.90                 | (5) | 0.12                             | 0.93  | 0.38                                      |                      |    |
| 3/4               | 4.62                            | 0.62                               | 1.88                 | 1.05  | 1.00                                 | 1.00        | 2.25                                 | 0.62              | 1.09   | 1.11                 | (5) | 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                 | (5) | 0.12                             | 1.41  | 0.50                                      |                      |    |
| 1 1/4             | 5.25                            | 0.81                               | 2.50                 | 1.66  | 1.12                                 | 1.12        | 2.62                                 | 0.81              | 1.70   | 1.72                 | (5) | 0.19                             | 1.75  | 0.56                                      |                      |    |

**Table 16C**  
**Dimensions of Class 600 Flanges — U.S. Customary Units (Cont'd)**

| 1                       | 2  | 3  | 4                               | 5   | 6   |                     |  | 8                            | 9  | 10                              |     | 12   | 13  | 14   | 15                                 |
|-------------------------|--|--|---------------------------------|---|---|---------------------|--|------------------------------|--|---------------------------------|-----|--|---|--|------------------------------------|
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br><i>A<sub>h</sub></i> (3) | Length Through Hub                                    |                     |  | Welding<br>Neck,<br><i>Y</i> | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br><i>T</i> (4) | Bore                            |     | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> | Corner<br>Bore<br>Radius of<br>Lapped<br>Flange<br>and<br>Pipe,<br><i>r</i> | Minimum<br>Counter-<br>bore<br>Threaded<br>Flange,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                         |  |  |                                 |   | Threaded<br>Slip-On<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Minimum<br>Slip-On/<br>Socket<br>Welding,<br><i>B2</i> |                              |  | Minimum<br>Lapped,<br><i>B1</i> |     |  |   |  |                                    |
| 1½                      | 6.12   | 0.88   | 2.75                            | 1.90  | 1.25  | 1.25                | 2.75   | 0.88                         | 1.95   | 1.97                            | (5) | 0.25   | 1.99  | 0.62   |                                    |
| 2                       | 6.50   | 1.00   | 3.31                            | 2.38  | 1.44  | 1.44                | 2.88   | 1.12                         | 2.44   | 2.46                            | (5) | 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                            | (5) | 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                            | (5) | 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                            | (5) | 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                            | (5) | 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                            | (5) | 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                            | (5) | 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                            | (5) | 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                           | (5) | 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                           | (5) | 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                           | (5) | 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                           | (5) | 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                           | (5) | 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                           | (5) | 0.50   | 20.19   | ...  |                                    |
| 22                      | 34.25  | 3.75   | 26.25                           | 22.00   | 5.25  | 6.88                | 7.75   | ...                          | 22.22  | 22.25                           | (5) | 0.50   | ...   | ...  |                                    |
| 24                      | 37.00  | 4.00   | 28.25                           | 24.00   | 5.50  | 7.25                | 8.00   | 3.62                         | 24.25  | 24.25                           | (5) | 0.50   | 24.19   | ...  |                                    |

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 15C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table 6C](#).
- (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 hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).

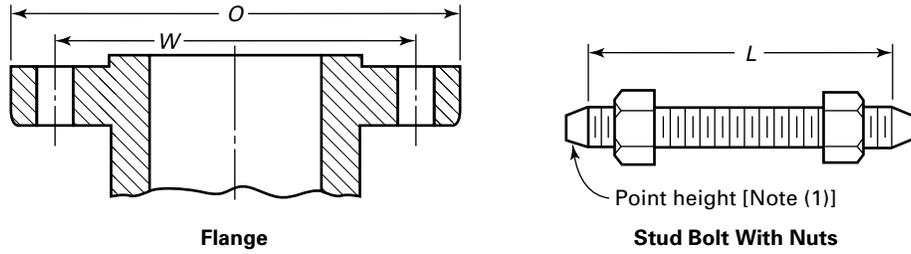
**Table 16C**  
**Dimensions of Class 600 Flanges — U.S. Customary Units (Cont'd)**

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NOTES: (Cont'd)

- (4) For threads in threaded flanges, see [para. 6.9](#).
- (5) To be specified by the purchaser.

**Table 17**  
**Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings — SI Units**



| 1                      | 2                             | Drilling (2), (3)          |                             |                 |                        | Length of Bolts, L (1), (4) |                                   |            |
|------------------------|-------------------------------|----------------------------|-----------------------------|-----------------|------------------------|-----------------------------|-----------------------------------|------------|
|                        |                               | 3                          | 4                           | 5               | 6                      | 7                           | 8                                 | 9          |
| 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. | 6.4-mm Raised Face          | Male and Female/Tongue and Groove | Ring Joint |
| 1/2                    | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 3/4                    | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 1                      | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 1 1/4                  | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 1 1/2                  | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 2                      | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 2 1/2                  | (5)                           | (5)                        | (5)                         | (5)             | (5)                    | (5)                         | (5)                               | (5)        |
| 3                      | 241                           | 190.5                      | 1                           | 8               | 7/8                    | 145                         | 140                               | 145        |
| 4                      | 292                           | 235.0                      | 1 1/4                       | 8               | 1 1/8                  | 170                         | 165                               | 170        |
| 5                      | 349                           | 279.4                      | 1 3/8                       | 8               | 1 1/4                  | 190                         | 185                               | 190        |
| 6                      | 381                           | 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                     | 546                           | 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                     | 641                           | 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                     | 787                           | 685.8                      | 2                           | 20              | 1 7/8                  | 325                         | 320                               | 335        |
| 20                     | 857                           | 749.3                      | 2 1/8                       | 20              | 2                      | 350                         | 345                               | 360        |
| 24                     | 1,041                         | 901.7                      | 2 5/8                       | 20              | 2 1/2                  | 440                         | 430                               | 455        |

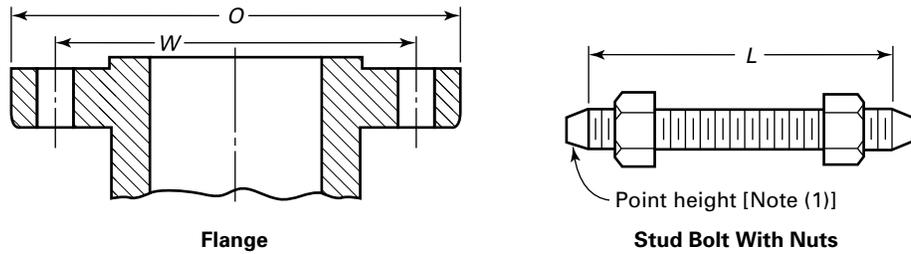
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which are in inches.
- (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](#)).
- (5) Use Class 1500 dimensions in this size.

**Table 17C**  
**Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings — U.S. Customary Units**



| 1                 | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|-------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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               | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3/4               | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1                 | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/4             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 1 1/2             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2                 | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 2 1/2             | (5)                                  | (5)                               | (5)                    | (5)             | (5)               | (5)                                | (5)                               | (5)        |
| 3                 | 9.50                                 | 7.50                              | 1                      | 8               | 7/8               | 5.75                               | 5.50                              | 5.75       |
| 4                 | 11.50                                | 9.25                              | 1 1/4                  | 8               | 1 1/8             | 6.75                               | 6.50                              | 6.75       |
| 5                 | 13.75                                | 11.00                             | 1 3/8                  | 8               | 1 1/4             | 7.50                               | 7.25                              | 7.50       |
| 6                 | 15.00                                | 12.50                             | 1 1/4                  | 12              | 1 1/8             | 7.50                               | 7.25                              | 7.75       |
| 8                 | 18.50                                | 15.50                             | 1 1/2                  | 12              | 1 3/8             | 8.75                               | 8.50                              | 8.75       |
| 10                | 21.50                                | 18.50                             | 1 1/2                  | 16              | 1 3/8             | 9.25                               | 9.00                              | 9.25       |
| 12                | 24.00                                | 21.00                             | 1 1/2                  | 20              | 1 3/8             | 10.00                              | 9.75                              | 10.00      |
| 14                | 25.25                                | 22.00                             | 1 5/8                  | 20              | 1 1/2             | 10.75                              | 10.50                             | 11.00      |
| 16                | 27.75                                | 24.25                             | 1 3/4                  | 20              | 1 5/8             | 11.25                              | 11.00                             | 11.50      |
| 18                | 31.00                                | 27.00                             | 2                      | 20              | 1 7/8             | 12.75                              | 12.50                             | 13.25      |
| 20                | 33.75                                | 29.50                             | 2 1/8                  | 20              | 2                 | 13.75                              | 13.50                             | 14.25      |
| 24                | 41.00                                | 35.50                             | 2 5/8                  | 20              | 2 1/2             | 17.25                              | 17.00                             | 18.00      |

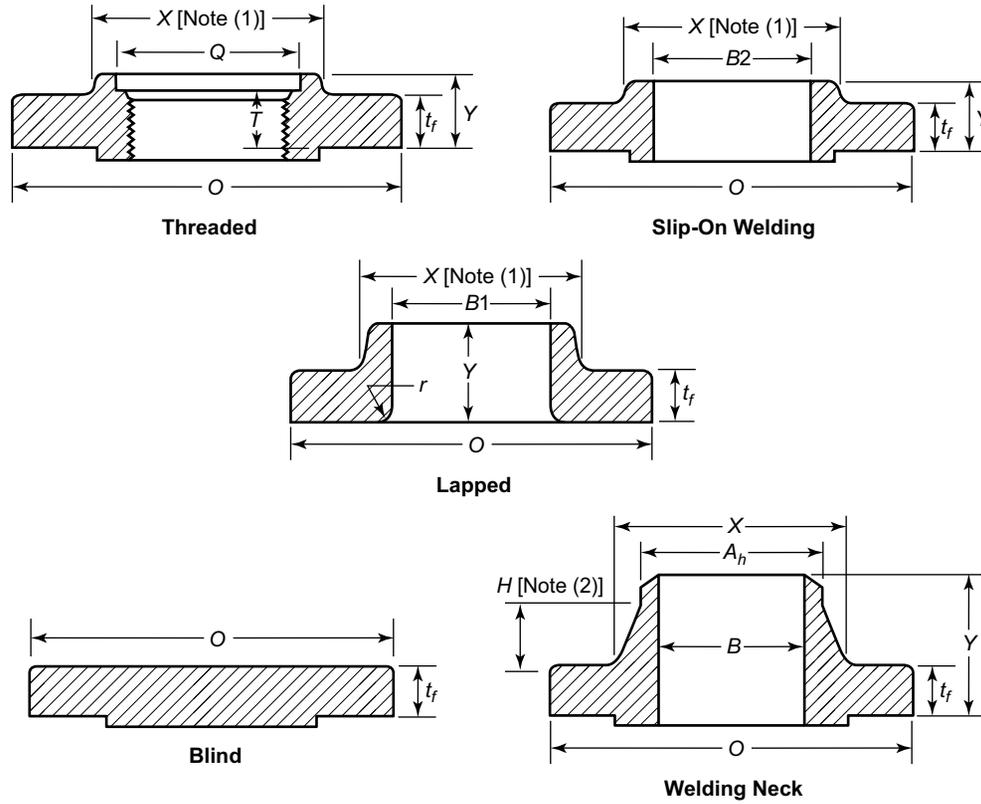
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For other dimensions, see [Table 18C](#) and [Table 19C](#).

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](#)).
- (5) Use Class 1500 dimensions in this size.

**Table 18**  
**Dimensions of Class 900 Flanges — SI Units**



| 1                   | 2                                 | 3  | 4                      | 5   | Length Through Hub          |                  |                        | 8   | Bore                    |                        |                        | 13   | 14  |
|---------------------|-----------------------------------|--|------------------------|---|-----------------------------|------------------|------------------------|---|-------------------------|------------------------|------------------------|--|---|
| Nom. Pipe Size, NPS | Outside Diam. of Flange, <i>O</i> | Min. Thickness of Flange, <i>t<sub>f</sub></i> | Diam. of Hub, <i>X</i> | Hub Diam. Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Threaded/ Slip-On, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> | Minimum Thread Length Threaded Flange, <i>T</i> (4) | Min. Slip-On, <i>B2</i> | Min. Lapped, <i>B1</i> | Welding Neck, <i>B</i> | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> |
| 1/2                 | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 3/4                 | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 1                   | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 1 1/4               | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |

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

| 1                   | 2                                 | 3  | 4                      | 5   | 6                           |                  |     | 7                      | 8   | 9                                  | 10                                |                        |  | 11  | 12  | 13  | 14 |
|---------------------|-----------------------------------|--|------------------------|---|-----------------------------|------------------|-----|------------------------|---|------------------------------------|-----------------------------------|------------------------|--|---|-----|-----|----|
| Nom. Pipe Size, NPS | Outside Diam. of Flange, <i>O</i> | Min. Thickness of Flange, <i>t<sub>f</sub></i> | Diam. of Hub, <i>X</i> | Hub Diam. Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub          |                  |     | Welding Neck, <i>Y</i> | Minimum Thread Length Threaded Flange, <i>T</i> (4) | Bore                               |                                   |                        | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> |     |     |    |
|                     |                                   |  |                        |   | Threaded/ Slip-On, <i>Y</i> | Lapped, <i>Y</i> |     |                        |   | Min. Slip-On, <i>B<sub>2</sub></i> | Min. Lapped, <i>B<sub>1</sub></i> | Welding Neck, <i>B</i> |  |   |     |     |    |
| 1½                  | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5) | (5)                    | (5)   | (5)                                | (5)                               | (5)                    | (5)  | (5)   | (5) | (5) |    |
| 2                   | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5) | (5)                    | (5)   | (5)                                | (5)                               | (5)                    | (5)  | (5)   | (5) | (5) |    |
| 2½                  | (5)                               | (5)  | (5)                    | (5)   | (5)                         | (5)              | (5) | (5)                    | (5)   | (5)                                | (5)                               | (5)                    | (5)  | (5)   | (5) | (5) |    |
| 3                   | 241                               | 38.1   | 127                    | 88.9  | 54                          | 54               | 102 | 41                     | 90.7  | 91.4                               | (6)                               | 10                     | 92.2   |   |     |     |    |
| 4                   | 292                               | 44.5   | 159                    | 114.3   | 70                          | 70               | 114 | 48                     | 116.1   | 116.8                              | (6)                               | 11                     | 117.6  |   |     |     |    |
| 5                   | 349                               | 50.8   | 190                    | 141.2   | 79                          | 79               | 127 | 54                     | 143.8   | 144.5                              | (6)                               | 11                     | 144.5  |   |     |     |    |
| 6                   | 381                               | 55.6   | 235                    | 168.4   | 86                          | 86               | 140 | 57                     | 170.7   | 171.4                              | (6)                               | 13                     | 171.4  |   |     |     |    |
| 8                   | 470                               | 63.5   | 298                    | 219.2   | 102                         | 114              | 162 | 64                     | 221.5   | 222.2                              | (6)                               | 13                     | 222.2  |   |     |     |    |
| 10                  | 546                               | 69.8   | 368                    | 273.0   | 108                         | 127              | 184 | 71                     | 276.4   | 277.4                              | (6)                               | 13                     | 276.4  |   |     |     |    |
| 12                  | 610                               | 79.2   | 419                    | 323.8   | 117                         | 143              | 200 | 76                     | 327.2   | 328.2                              | (6)                               | 13                     | 328.7  |   |     |     |    |
| 14                  | 641                               | 85.9   | 451                    | 355.6   | 130                         | 155              | 213 | 83                     | 359.2   | 360.2                              | (6)                               | 13                     | 360.4  |   |     |     |    |
| 16                  | 705                               | 88.9   | 508                    | 406.4   | 133                         | 165              | 216 | 86                     | 410.5   | 411.2                              | (6)                               | 13                     | 411.2  |   |     |     |    |
| 18                  | 787                               | 101.6  | 565                    | 457.2   | 152                         | 190              | 229 | 89                     | 461.8   | 462.3                              | (6)                               | 13                     | 462.0  |   |     |     |    |
| 20                  | 857                               | 108.0  | 622                    | 508.0   | 159                         | 210              | 248 | 92                     | 513.1   | 514.4                              | (6)                               | 13                     | 512.8  |   |     |     |    |
| 24                  | 1,041                             | 139.7  | 749                    | 609.6   | 203                         | 267              | 292 | 102                    | 616.0   | 616.0                              | (6)                               | 13                     | 614.4  |   |     |     |    |

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (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 manufacture'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) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see para. 6.7.
- (4) For thread of threaded flanges, see para. 6.9.

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

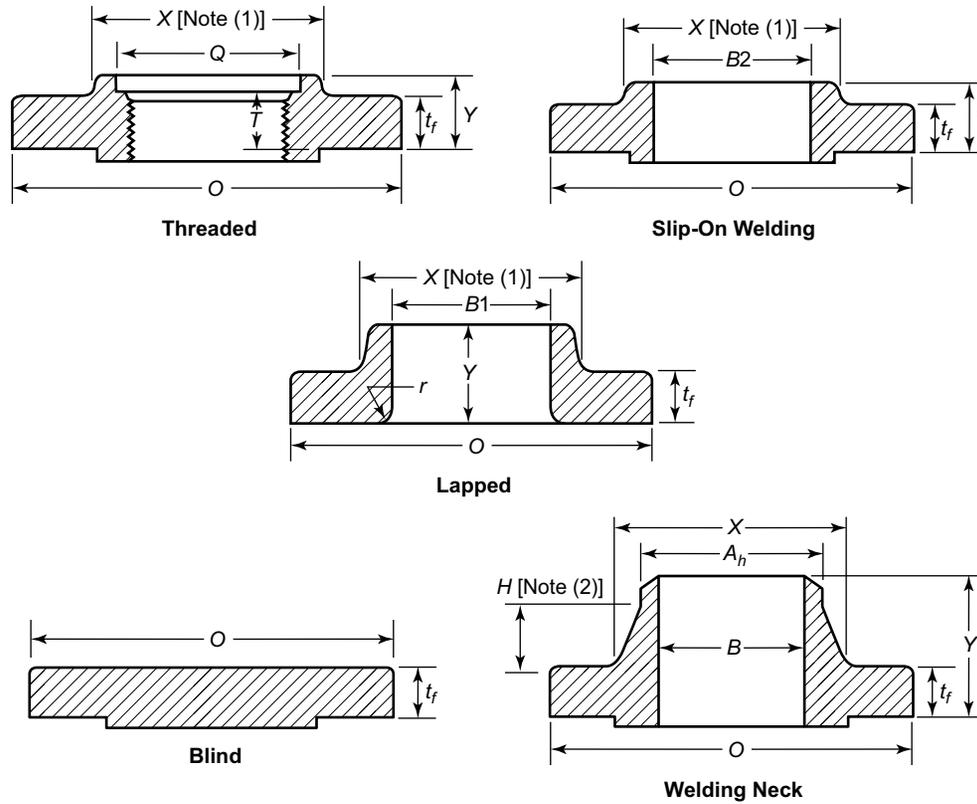
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NOTES: (Cont'd)

(5) Use Class 1500 dimensions in this size.

(6) To be specified by the purchaser.

**Table 18C**  
**Dimensions of Class 900 Flanges — U.S. Customary Units**



| 1              | 2                               | 3                                  | 4                 | 5   | 6                     | 7           | 8                 | 9  | 10                 | 11                | 12                | 13  | 14                                       |
|----------------|---------------------------------|------------------------------------|-------------------|---|-----------------------|-------------|-------------------|--|--------------------|-------------------|-------------------|---|--|
| Nom. Pipe Size | Outside Diameter of Flange, $O$ | Minimum Thickness of Flange, $t_f$ | Diam. of Hub, $X$ | Hub Diameter Beginning of Chamfer Welding Neck, $A_h$ (3) | Length Through Hub    |             |                   | Minimum Thread Length Threaded Flange, $T$ (4) | 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, $B2$ | Min. Lapped, $B1$ | Welding Neck, $B$ |   |  |
| 1/2            | (5)                             | (5)                                | (5)               | (5)   | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| 3/4            | (5)                             | (5)                                | (5)               | (5)   | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |
| 1              | (5)                             | (5)                                | (5)               | (5)   | (5)                   | (5)         | (5)               | (5)  | (5)                | (5)               | (5)               | (5)   | (5)                                      |

**Table 18C**  
**Dimensions of Class 900 Flanges — U.S. Customary Units (Cont'd)**

| 1              | 2                                    | 3   | 4                      | 5  | 6                          | 7                | 8                      | 9   | 10                      | 11                     | 12                     | 13   | 14  |
|----------------|--------------------------------------|---|------------------------|--|----------------------------|------------------|------------------------|---|-------------------------|------------------------|------------------------|--|---|
| Nom. Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Diam. of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub         |                  |                        | Minimum Thread Length Threaded Flange, <i>T</i> (4) | Bore                    |                        |                        | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> |
|                |                                      |   |                        |  | Threaded Slip-On, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> |   | Min. Slip-On, <i>B2</i> | Min. Lapped, <i>B1</i> | Welding Neck, <i>B</i> |  |   |
| 1¼             | (5)                                  | (5)   | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 1½             | (5)                                  | (5)   | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 2              | (5)                                  | (5)   | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 2½             | (5)                                  | (5)   | (5)                    | (5)  | (5)                        | (5)              | (5)                    | (5)   | (5)                     | (5)                    | (5)                    | (5)  | (5)   |
| 3              | 9.50                                 | 1.50  | 5.00                   | 3.50   | 2.12                       | 2.12             | 4.00                   | 1.62  | 3.57                    | 3.60                   | (6)                    | 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                   | (6)                    | 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                   | (6)                    | 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                   | (6)                    | 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                   | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 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                  | (6)                    | 0.50   | 24.19   |

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 17C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table 6C](#).
- (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 hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).

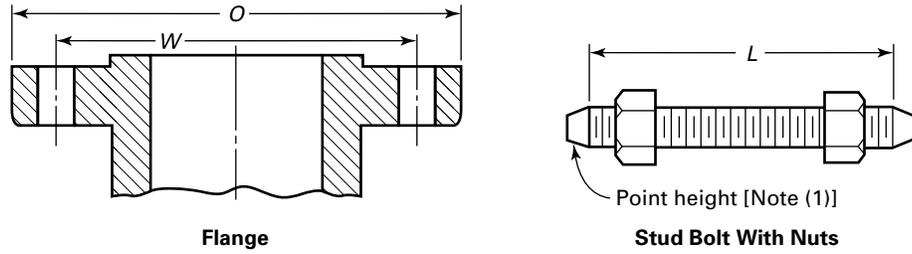
**Table 18C**  
**Dimensions of Class 900 Flanges — U.S. Customary Units (Cont'd)**

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NOTES: (Cont'd)

- (4) For threads in threaded flanges, see [para. 6.9](#).
- (5) Use Class 1500 dimensions in this size.
- (6) To be specified by the purchaser.

**Table 19**  
**Templates for Drilling Class 1500 Pipe Flanges — SI Units**



| 1                      | 2                                    | 3                                 | 4                           | 5               | 6                      | 7                                  | 8                                 | 9          |
|------------------------|--------------------------------------|-----------------------------------|-----------------------------|-----------------|------------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                             |                 |                        | Length of Bolts, <i>L</i> (1), (4) |                                   |            |
|                        |                                      | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | 6.4-mm Raised Face                 | Male and Female/Tongue and Groove | Ring Joint |
| 1/2                    | 121                                  | 82.6                              | 7/8                         | 4               | 3/4                    | 110                                | 100                               | 110        |
| 3/4                    | 130                                  | 88.9                              | 7/8                         | 4               | 3/4                    | 115                                | 110                               | 115        |
| 1                      | 149                                  | 101.6                             | 1                           | 4               | 7/8                    | 125                                | 120                               | 125        |
| 1 1/4                  | 159                                  | 111.1                             | 1                           | 4               | 7/8                    | 125                                | 120                               | 125        |
| 1 1/2                  | 178                                  | 124.0                             | 1 1/8                       | 4               | 1                      | 140                                | 135                               | 140        |
| 2                      | 216                                  | 165.1                             | 1                           | 8               | 7/8                    | 145                                | 140                               | 145        |
| 2 1/2                  | 244                                  | 190.5                             | 1 1/8                       | 8               | 1                      | 160                                | 150                               | 160        |
| 3                      | 267                                  | 203.2                             | 1 1/4                       | 8               | 1 1/8                  | 180                                | 170                               | 180        |
| 4                      | 311                                  | 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                      | 394                                  | 317.5                             | 1 1/2                       | 12              | 1 3/8                  | 260                                | 255                               | 265        |
| 8                      | 483                                  | 393.7                             | 1 3/4                       | 12              | 1 5/8                  | 290                                | 285                               | 300        |
| 10                     | 584                                  | 482.6                             | 2                           | 12              | 1 7/8                  | 335                                | 330                               | 345        |
| 12                     | 673                                  | 571.5                             | 2 1/8                       | 16              | 2                      | 375                                | 370                               | 385        |
| 14                     | 749                                  | 635.0                             | 2 3/8                       | 16              | 2 1/4                  | 405                                | 400                               | 425        |
| 16                     | 826                                  | 704.8                             | 2 5/8                       | 16              | 2 1/2                  | 445                                | 440                               | 470        |
| 18                     | 914                                  | 774.7                             | 2 7/8                       | 16              | 2 3/4                  | 495                                | 490                               | 525        |
| 20                     | 984                                  | 831.8                             | 3 1/8                       | 16              | 3                      | 540                                | 535                               | 565        |
| 24                     | 1 168                                | 990.6                             | 3 5/8                       | 16              | 3 1/2                  | 615                                | 610                               | 650        |

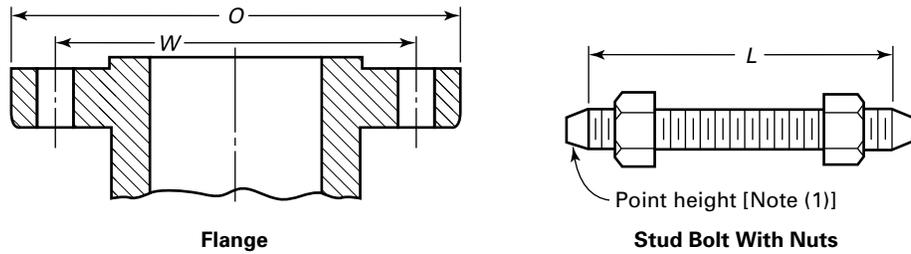
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for the diameters of the bolts and bolt holes, which are in inches.
- (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 19C**  
**Templates for Drilling Class 1500 Pipe Flanges — U.S. Customary Units**



| 1                 | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|-------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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               | 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:

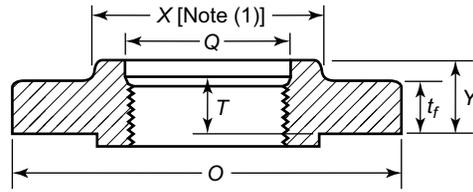
- (a) Dimensions are in inches.
- (b) For other dimensions, see [Table 20C](#).

NOTES:

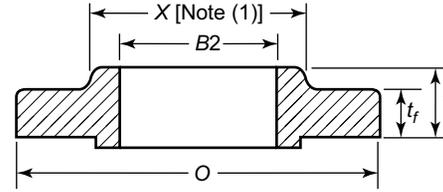
- (1) The length of the stud bolt does not include the height of the points (see [para. 6.10.2](#)).
- (2) For flange bolt holes, see [para. 6.5](#).
- (3) For spot facing, see [para. 6.6](#).
- (4) Bolt lengths not shown in the table may be determined in accordance with [Nonmandatory Appendix C](#) (see [para. 6.10.2](#)).

**Table 20**  
**Dimensions of Class 1500 Flanges — SI Units**

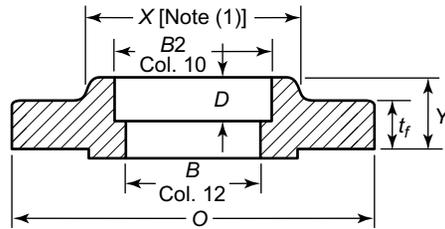
(25)



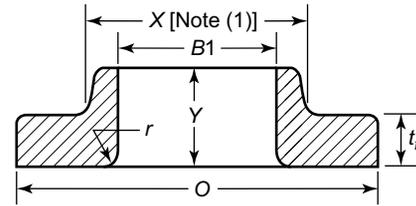
**Threaded (NPS 1/2 to 2 1/2 Only)**



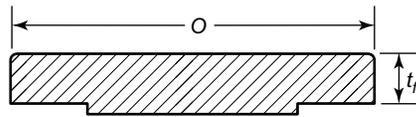
**Slip-On Welding (NPS 1/2 to 2 1/2 Only)**



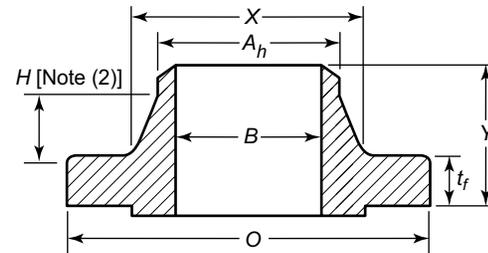
**Socket Welding (NPS 1/2 to 2 1/2 Only)**



**Lapped**



**Blind**



**Welding Neck**

| 1                      | 2                                    | 3   | 4                         | 5  | 6   | 7                | 8                      | 9   | 10   | 11                        | 12                                     | 13   | 14  | 15                        |
|------------------------|--------------------------------------|---|---------------------------|--|---|------------------|------------------------|---|--|---------------------------|--|--|---|---------------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Diameter of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub                          |                  |                        | Minimum Thread Length Threaded Flange, <i>T</i> (4) | 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> |
|                        |                                      |   |                           |  | Threaded/ Slip-On/ Socket Welding, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> |   | Minimum Slip-On/ Socket Welding, <i>B2</i> | Minimum Lapped, <i>B1</i> | Welding Neck/ Socket Welding, <i>B</i> |  |   |                           |
| 1/2                    | 121                                  | 22.4  | 38                        | 21.3   | 32  | 32               | 60                     | 22  | 22.4                                       | 22.9                      | (5)                                    | 3  | 23.6  | 10                        |
| 3/4                    | 130                                  | 25.4  | 44                        | 26.7   | 35  | 35               | 70                     | 25  | 27.7                                       | 28.2                      | (5)                                    | 3  | 29.0  | 11                        |
| 1                      | 149                                  | 28.4  | 52                        | 33.5   | 41  | 41               | 73                     | 28  | 34.5                                       | 35.4                      | (5)                                    | 3  | 35.8  | 13                        |
| 1 1/4                  | 159                                  | 28.4  | 64                        | 42.2   | 41  | 41               | 73                     | 30  | 43.2                                       | 43.7                      | (5)                                    | 5  | 44.4  | 14                        |

**Table 20**  
**Dimensions of Class 1500 Flanges — SI Units (Cont'd)**

| 1                               | 2  | 3  | 4                               | 5   | 6   |                     |  | 8                            | 9  | 10                              |     | 12   | 13   | 14  | 15                                 |
|---------------------------------|--|--|---------------------------------|---|---|---------------------|--|------------------------------|--|---------------------------------|-----|--|--|---|------------------------------------|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br><i>A<sub>h</sub></i> (3) | Length Through Hub                                      |                     |  | Welding<br>Neck,<br><i>Y</i> | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br><i>T</i> (4) | Bore                            |     | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> | Corner<br>Bore<br>Radius of<br>Lapped<br>Flange<br>and Pipe,<br><i>r</i> | Minimum<br>Counterbore<br>Threaded<br>Flange,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                                 |  |  |                                 |   | Threaded/<br>Slip-On/<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Minimum<br>Slip-On/<br>Socket<br>Welding,<br><i>B2</i> |                              |  | Minimum<br>Lapped,<br><i>B1</i> |     |  |  |   |                                    |
| 1½                              | 178  | 31.8   | 70                              | 48.3  | 44  | 44                  | 83   | 32                           | 49.5   | 50.0                            | (5) | 6  | 50.5   | 16  |                                    |
| 2                               | 216  | 38.1   | 105                             | 60.5  | 57  | 57                  | 102  | 38                           | 62.0   | 62.5                            | (5) | 8  | 63.5   | 18  |                                    |
| 2½                              | 244  | 41.1   | 124                             | 73.2  | 64  | 64                  | 105  | 48                           | 74.7   | 75.4                            | (5) | 8  | 76.2   | 19  |                                    |
| 3                               | 267  | 47.8   | 133                             | 88.9  | ...   | 73                  | 117  | ...                          | ...  | 91.4                            | (5) | 10   | ...  | ...   |                                    |
| 4                               | 311  | 53.8   | 162                             | 114.3   | ...   | 90                  | 124  | ...                          | ...  | 116.8                           | (5) | 11   | ...  | ...   |                                    |
| 5                               | 375  | 73.2   | 197                             | 141.2   | ...   | 105                 | 155  | ...                          | ...  | 144.5                           | (5) | 11   | ...  | ...   |                                    |
| 6                               | 394  | 82.6   | 229                             | 168.4   | ...   | 119                 | 171  | ...                          | ...  | 171.4                           | (5) | 13   | ...  | ...   |                                    |
| 8                               | 483  | 91.9   | 292                             | 219.2   | ...   | 143                 | 213  | ...                          | ...  | 222.2                           | (5) | 13   | ...  | ...   |                                    |
| 10                              | 584  | 108.0  | 368                             | 273.0   | ...   | 178                 | 254  | ...                          | ...  | 277.4                           | (5) | 13   | ...  | ...   |                                    |
| 12                              | 673  | 124.0  | 451                             | 323.8   | ...   | 219                 | 282  | ...                          | ...  | 328.2                           | (5) | 13   | ...  | ...   |                                    |
| 14                              | 749  | 133.4  | 495                             | 355.6   | ...   | 241                 | 298  | ...                          | ...  | 360.2                           | (5) | 13   | ...  | ...   |                                    |
| 16                              | 826  | 146.0  | 552                             | 406.4   | ...   | 260                 | 311  | ...                          | ...  | 411.2                           | (5) | 13   | ...  | ...   |                                    |
| 18                              | 914  | 162.1  | 597                             | 457.2   | ...   | 276                 | 327  | ...                          | ...  | 462.3                           | (5) | 13   | ...  | ...   |                                    |
| 20                              | 984  | 177.8  | 641                             | 508.0   | ...   | 292                 | 356  | ...                          | ...  | 514.4                           | (5) | 13   | ...  | ...   |                                    |
| 24                              | 1 168  | 203.2  | 762                             | 609.6   | ...   | 330                 | 406  | ...                          | ...  | 616.0                           | (5) | 13   | ...  | ...   |                                    |

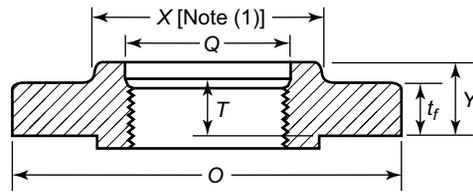
GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (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](#).

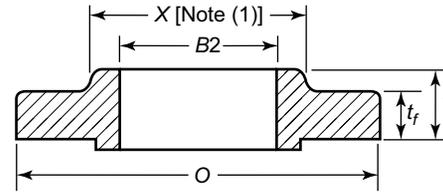
NOTES:

- (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) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For thread of threaded flanges, see [para. 6.9](#).
- (5) To be specified by the purchaser.

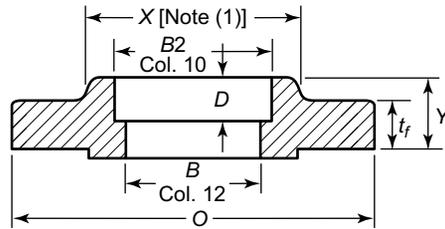
**Table 20C**  
**Dimensions of Class 1500 Flanges — U.S. Customary Units**



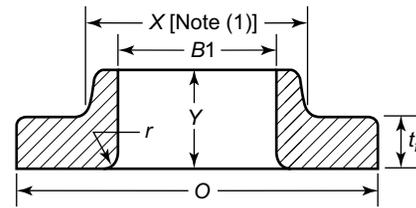
**Threaded (NPS 1/2 to 2 1/2 Only)**



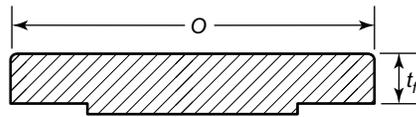
**Slip-On Welding (NPS 1/2 to 2 1/2 Only)**



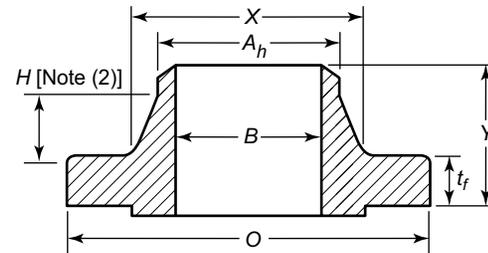
**Socket Welding (NPS 1/2 to 2 1/2 Only)**



**Lapped**



**Blind**



**Welding Neck**

| 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<sub>f</sub></i> | Diameter of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub                        |                  |                        | Minimum Thread Length Threaded Flange, <i>T</i> (4) | 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> |
|                   |                                      |   |                           |  | Threaded Slip-On Socket Welding, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck, <i>Y</i> |   | Minimum Slip-On Socket Welding, <i>B2</i> | Minimum Lapped, <i>B1</i> | Welding Neck/Socket Welding, <i>B</i> |  |   |                           |
| 1/2               | 4.75                                 | 0.88  | 1.50                      | 0.84   | 1.25                                      | 1.25             | 2.38                   | 0.88  | 0.88                                      | 0.90                      | (5)                                   | 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                      | (5)                                   | 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                      | (5)                                   | 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                      | (5)                                   | 0.19   | 1.75  | 0.56                      |

**Table 20C**  
**Dimensions of Class 1500 Flanges — U.S. Customary Units (Cont'd)**

| 1                    | 2  | 3  | 4                               | 5   | 6   |                    |   | 8                            | 9  | 10                              |     | 12   | 13  | 14  | 15                                 |
|----------------------|--|--|---------------------------------|---|---|--------------------|---|------------------------------|--|---------------------------------|-----|--|---|---|------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br><i>A<sub>h</sub></i> (3) | Length Through Hub                                    |                    |   | Welding<br>Neck,<br><i>Y</i> | Minimum<br>Thread<br>Length<br>Threaded<br>Flange,<br><i>T</i> (4) | Bore                            |     | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i> | Corner<br>Bore<br>Radius of<br>Lapped<br>Flange<br>and<br>Pipe,<br><i>r</i> | Minimum<br>Counterbore<br>Threaded<br>Flange,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                      |  |  |                                 |   | Threaded<br>Slip-On<br>Socket<br>Welding,<br><i>Y</i> | Lapped<br><i>Y</i> | Minimum<br>Slip-On<br>Socket<br>Welding,<br><i>B2</i> |                              |  | Minimum<br>Lapped,<br><i>B1</i> |     |  |   |   |                                    |
| 1½                   | 7.00   | 1.25   | 2.75                            | 1.90  | 1.75  | 1.75               | 3.25  | 1.25                         | 1.95   | 1.97                            | (5) | 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                            | (5) | 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                            | (5) | 0.31   | 3.00  | 0.75  |                                    |
| 3                    | 10.50  | 1.88   | 5.25                            | 3.50  | ...   | 2.88               | 4.62  | ...                          | ...  | 3.60                            | (5) | 0.38   | ...   | ...   |                                    |
| 4                    | 12.25  | 2.12   | 6.38                            | 4.50  | ...   | 3.56               | 4.88  | ...                          | ...  | 4.60                            | (5) | 0.44   | ...   | ...   |                                    |
| 5                    | 14.75  | 2.88   | 7.75                            | 5.56  | ...   | 4.12               | 6.12  | ...                          | ...  | 5.69                            | (5) | 0.44   | ...   | ...   |                                    |
| 6                    | 15.50  | 3.25   | 9.00                            | 6.63  | ...   | 4.69               | 6.75  | ...                          | ...  | 6.75                            | (5) | 0.50   | ...   | ...   |                                    |
| 8                    | 19.00  | 3.62   | 11.50                           | 8.63  | ...   | 5.62               | 8.38  | ...                          | ...  | 8.75                            | (5) | 0.50   | ...   | ...   |                                    |
| 10                   | 23.00  | 4.25   | 14.50                           | 10.75   | ...   | 7.00               | 10.00   | ...                          | ...  | 10.92                           | (5) | 0.50   | ...   | ...   |                                    |
| 12                   | 26.50  | 4.88   | 17.75                           | 12.75   | ...   | 8.62               | 11.12   | ...                          | ...  | 12.92                           | (5) | 0.50   | ...   | ...   |                                    |
| 14                   | 29.50  | 5.25   | 19.50                           | 14.00   | ...   | 9.50               | 11.75   | ...                          | ...  | 14.18                           | (5) | 0.50   | ...   | ...   |                                    |
| 16                   | 32.50  | 5.75   | 21.75                           | 16.00   | ...   | 10.25              | 12.25   | ...                          | ...  | 16.19                           | (5) | 0.50   | ...   | ...   |                                    |
| 18                   | 36.00  | 6.38   | 23.50                           | 18.00   | ...   | 10.88              | 12.88   | ...                          | ...  | 18.20                           | (5) | 0.50   | ...   | ...   |                                    |
| 20                   | 38.75  | 7.00   | 25.25                           | 20.00   | ...   | 11.50              | 14.00   | ...                          | ...  | 20.25                           | (5) | 0.50   | ...   | ...   |                                    |
| 24                   | 46.00  | 8.00   | 30.00                           | 24.00   | ...   | 13.00              | 16.00   | ...                          | ...  | 24.25                           | (5) | 0.50   | ...   | ...   |                                    |

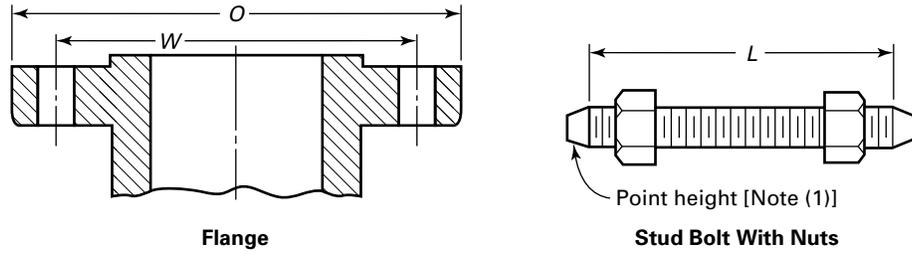
GENERAL NOTES:

- (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 19C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table 6C](#).
- (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 hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For threads in threaded flanges, see [para. 6.9](#).
- (5) To be specified by the purchaser.

**Table 21**  
**Templates for Drilling Class 2500 Pipe Flanges — SI Units**



| 1                      | 2                                    | 3                                 | 4                           | 5               | 6                      | 7                                  | 8                                 | 9          |
|------------------------|--------------------------------------|-----------------------------------|-----------------------------|-----------------|------------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                             |                 |                        | Length of Bolts, <i>L</i> (1), (4) |                                   |            |
|                        |                                      | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | 6.4-mm Raised Face                 | Male and Female/Tongue and Groove | Ring Joint |
| 1/2                    | 133                                  | 88.9                              | 7/8                         | 4               | 3/4                    | 120                                | 115                               | 120        |
| 3/4                    | 140                                  | 95.2                              | 7/8                         | 4               | 3/4                    | 125                                | 120                               | 125        |
| 1                      | 159                                  | 108.0                             | 1                           | 4               | 7/8                    | 140                                | 135                               | 140        |
| 1 1/4                  | 184                                  | 130.0                             | 1 1/8                       | 4               | 1                      | 150                                | 145                               | 150        |
| 1 1/2                  | 203                                  | 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                  | 267                                  | 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                      | 356                                  | 273.0                             | 1 5/8                       | 8               | 1 1/2                  | 255                                | 250                               | 260        |
| 5                      | 419                                  | 323.8                             | 1 7/8                       | 8               | 1 3/4                  | 300                                | 290                               | 310        |
| 6                      | 483                                  | 368.3                             | 2 1/8                       | 8               | 2                      | 345                                | 335                               | 355        |
| 8                      | 552                                  | 438.2                             | 2 1/8                       | 12              | 2                      | 380                                | 375                               | 395        |
| 10                     | 673                                  | 539.8                             | 2 5/8                       | 12              | 2 1/2                  | 490                                | 485                               | 510        |
| 12                     | 762                                  | 619.3                             | 2 7/8                       | 12              | 2 3/4                  | 540                                | 535                               | 560        |

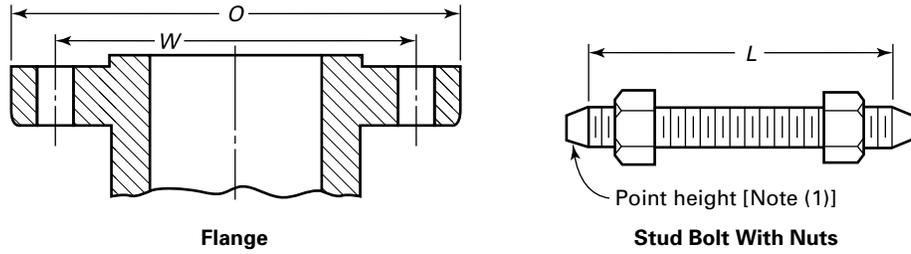
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which are in inches.
- (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 21C**  
**Templates for Drilling Class 2500 Pipe Flanges — U.S. Customary Units**



| 1                 | 2                                    | 3                                 | 4                      | 5               | 6                 | 7                                  | 8                                 | 9          |
|-------------------|--------------------------------------|-----------------------------------|------------------------|-----------------|-------------------|------------------------------------|-----------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling (2), (3)                 |                        |                 |                   | Length of Bolts, <i>L</i> (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               | 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:

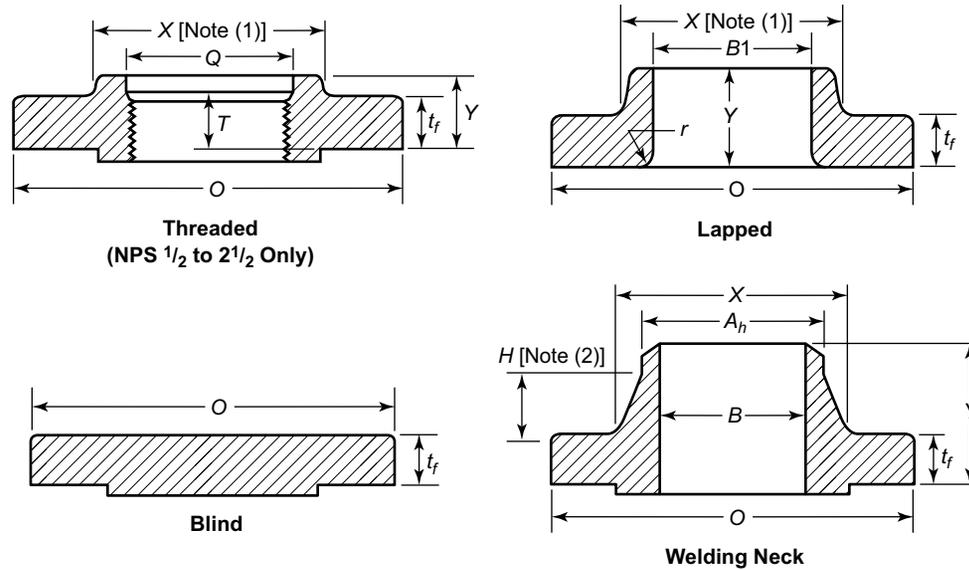
- (a) Dimensions are in inches.
- (b) For other dimensions, see [Table 22C](#).

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 22**  
**Dimensions of Class 2500 Flanges — SI Units**

(25)



| 1                   | 2                          | 3  | 4               | 5  | Length Through Hub |           |                 | Bore   |                 |                 | 12  | 13                                     |
|---------------------|----------------------------|--|-----------------|--|--------------------|-----------|-----------------|--|-----------------|-----------------|---|--|
|                     |                            |  |                 |  | 6                  | 7         | 8               | 9  | 10              | 11              |   |  |
| Nom. Pipe Size, NPS | Outside Diam. of Flange, O | Min. Thickness of Flange, t <sub>f</sub> | Diam. of Hub, X | Hub Diam. Beginning of Chamfer of Welding Neck, A <sub>h</sub> (3) | Threaded, Y        | Lapped, Y | Welding Neck, Y | Minimum Thread Length Threaded Flange, T (4) | Min. Lapped, B1 | Welding Neck, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q |
| 1/2                 | 133                        | 30.2                                     | 43              | 21.3   | 40                 | 40        | 73              | 28   | 22.9            | (5)             | 3   | 23.6                                   |
| 3/4                 | 140                        | 31.8                                     | 51              | 26.7   | 43                 | 43        | 79              | 32   | 28.2            | (5)             | 3   | 29.0                                   |
| 1                   | 159                        | 35.1                                     | 57              | 33.5   | 48                 | 48        | 89              | 35   | 35.1            | (5)             | 3   | 35.8                                   |
| 1 1/4               | 184                        | 38.1                                     | 73              | 42.2   | 52                 | 52        | 95              | 38   | 43.7            | (5)             | 5   | 44.4                                   |
| 1 1/2               | 203                        | 44.4                                     | 79              | 48.3   | 60                 | 60        | 111             | 44   | 50.0            | (5)             | 6   | 50.5                                   |
| 2                   | 235                        | 50.8                                     | 95              | 60.5   | 70                 | 70        | 127             | 51   | 62.5            | (5)             | 8   | 63.5                                   |
| 2 1/2               | 267                        | 57.2                                     | 114             | 73.2   | 79                 | 79        | 143             | 57   | 75.4            | (5)             | 8   | 76.2                                   |
| 3                   | 305                        | 66.5                                     | 133             | 88.9   | ...                | 92        | 168             | ...  | 91.4            | (5)             | 10  | ...                                    |
| 4                   | 356                        | 76.2                                     | 165             | 114.3  | ...                | 108       | 190             | ...  | 116.8           | (5)             | 11  | ...                                    |

**Table 22**  
**Dimensions of Class 2500 Flanges — SI Units (Cont'd)**

| 1                   | 2                                 | 3  | 4                      | 5   | 6                  |                  |                        | 8                      | 9   | 10                     |    | 11   | 12  | 13 |
|---------------------|-----------------------------------|--|------------------------|---|--------------------|------------------|------------------------|------------------------|---|------------------------|----|--|---|----|
| Nom. Pipe Size, NPS | Outside Diam. of Flange, <i>O</i> | Min. Thickness of Flange, <i>t<sub>f</sub></i> | Diam. of Hub, <i>X</i> | Hub Diam. Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub |                  |                        | Welding Neck, <i>Y</i> | Minimum Thread Length Threaded Flange, <i>T</i> (4) | Bore                   |    | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> |    |
|                     |                                   |  |                        |   | Threaded, <i>Y</i> | Lapped, <i>Y</i> | Min. Lapped, <i>B1</i> |                        |   | Welding Neck, <i>B</i> |    |  |   |    |
| 5                   | 419                               | 91.9   | 203                    | 141.2   | ...                | 130              | 229                    | ...                    | 144.5   | (5)                    | 11 | ...  |   |    |
| 6                   | 483                               | 108.0  | 235                    | 168.4   | ...                | 152              | 273                    | ...                    | 171.4   | (5)                    | 13 | ...  |   |    |
| 8                   | 552                               | 127.0  | 305                    | 219.2   | ...                | 178              | 318                    | ...                    | 222.2   | (5)                    | 13 | ...  |   |    |
| 10                  | 673                               | 165.1  | 375                    | 273.0   | ...                | 229              | 419                    | ...                    | 277.4   | (5)                    | 13 | ...  |   |    |
| 12                  | 762                               | 184.2  | 441                    | 323.8   | ...                | 254              | 464                    | ...                    | 328.2   | (5)                    | 13 | ...  |   |    |

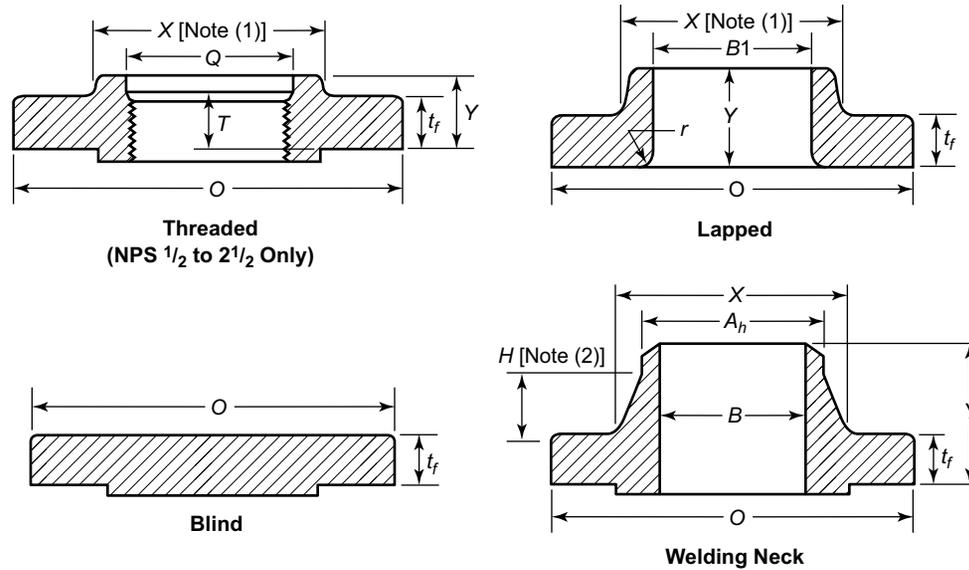
GENERAL NOTES:

- (a) Dimensions are in millimeters, except for diameters of bolts and bolt holes, which 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 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 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 hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For thread of threaded flanges, see [para. 6.9](#).
- (5) To be specified by the purchaser.

**Table 22C**  
**Dimensions of Class 2500 Flanges — U.S. Customary Units**



| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Diameter of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A<sub>h</sub></i> (3) | Length Through Hub |                  |                       | Minimum Thread Length Threaded Flange, <i>T</i> (4) | Bore                      |                        | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> |
|-------------------|--------------------------------------|---|---------------------------|--|--------------------|------------------|-----------------------|---|---------------------------|------------------------|--|---|
|                   |                                      |   |                           |  | Threaded, <i>Y</i> | Lapped, <i>Y</i> | Welding Neck <i>Y</i> |   | Minimum Lapped, <i>B1</i> | Welding Neck, <i>B</i> |  |   |
| 1/2               | 5.25                                 | 1.19  | 1.69                      | 0.84   | 1.56               | 1.56             | 2.88                  | 1.12  | 0.90                      | (5)                    | 0.12   | 0.93  |
| 3/4               | 5.50                                 | 1.25  | 2.00                      | 1.05   | 1.69               | 1.69             | 3.12                  | 1.25  | 1.11                      | (5)                    | 0.12   | 1.14  |
| 1                 | 6.25                                 | 1.38  | 2.25                      | 1.32   | 1.88               | 1.88             | 3.50                  | 1.38  | 1.38                      | (5)                    | 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                      | (5)                    | 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                      | (5)                    | 0.25   | 1.99  |
| 2                 | 9.25                                 | 2.00  | 3.75                      | 2.38   | 2.75               | 2.75             | 5.00                  | 2.00  | 2.46                      | (5)                    | 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                      | (5)                    | 0.31   | 3.00  |
| 3                 | 12.00                                | 2.62  | 5.25                      | 3.50   | ...                | 3.62             | 6.62                  | ...   | 3.60                      | (5)                    | 0.38   | ...   |
| 4                 | 14.00                                | 3.00  | 6.50                      | 4.50   | ...                | 4.25             | 7.50                  | ...   | 4.60                      | (5)                    | 0.44   | ...   |
| 5                 | 16.50                                | 3.62  | 8.00                      | 5.56   | ...                | 5.12             | 9.00                  | ...   | 5.69                      | (5)                    | 0.44   | ...   |
| 6                 | 19.00                                | 4.25  | 9.25                      | 6.63   | ...                | 6.00             | 10.75                 | ...   | 6.75                      | (5)                    | 0.50   | ...   |
| 8                 | 21.75                                | 5.00  | 12.00                     | 8.63   | ...                | 7.00             | 12.50                 | ...   | 8.75                      | (5)                    | 0.50   | ...   |

**Table 22C**  
**Dimensions of Class 2500 Flanges — U.S. Customary Units (Cont'd)**

| 1                    | 2   | 3  | 4                               | 5  | 6                     |                     |  | 7                           | 8   | 9                            | 10   |   | 11  | 12 | 13 |
|----------------------|---|--|---------------------------------|--|-----------------------|---------------------|--|-----------------------------|---|------------------------------|------|---|---|----|----|
| Nominal<br>Pipe Size | Outside<br>Diameter of<br>Flange,<br><i>O</i> | Minimum<br>Thickness of<br>Flange,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br><i>A<sub>n</sub></i> (3) | Length Through Hub    |                     |  | Welding<br>Neck<br><i>Y</i> | Minimum<br>Thread Length<br>Threaded<br>Flange,<br><i>T</i> (4) | Bore                         |      | Corner Bore<br>Radius of<br>Lapped<br>Flange and<br>Pipe,<br><i>r</i> | Minimum<br>Counterbore<br>Threaded<br>Flange,<br><i>Q</i> |    |    |
|                      |   |  |                                 |  | Threaded,<br><i>Y</i> | Lapped,<br><i>Y</i> | Minimum<br>Lapped,<br><i>B<sub>1</sub></i> |                             |   | Welding<br>Neck,<br><i>B</i> |      |   |   |    |    |
| 10                   | 26.50   | 6.50   | 14.75                           | 10.75  | ...                   | 9.00                | 16.50                                      | ...                         | 10.92   | (5)                          | 0.50 | ...   |   |    |    |
| 12                   | 30.00   | 7.25   | 17.38                           | 12.75  | ...                   | 10.00               | 18.25                                      | ...                         | 12.92   | (5)                          | 0.50 | ...   |   |    |    |

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 21C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table 6C](#).
- (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 and lapped flanges.
- (2) The minimum hub height, *H*, shall be  $2(Y-t_f)/3$ .
- (3) For welding end bevel, see [para. 6.7](#).
- (4) For threads in threaded flanges, see [para. 6.9](#).
- (5) 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   | Classes 150, 300, 400 |                 | Class 600  |      |                 | Class 900  |      |                 | Class 1500 |      |                 | Class 2500 |      |  |
|-------|-----------------------|-----------------|------------|------|-----------------|------------|------|-----------------|------------|------|-----------------|------------|------|--|
|       | Number of Turns       | Number of Turns | Projection |      |  |
|       |                       |                 | mm         | in.  |  |
| 1/2   | ...                   | (1)             | ...        | ...  | ...             | ...        | ...  | 3 1/2           | 6.4        | 0.25 | 7               | 12.7       | 0.50 |  |
| 3/4   | ...                   | (1)             | ...        | ...  | ...             | ...        | ...  | 5               | 9.5        | 0.38 | 7               | 12.7       | 0.50 |  |
| 1     | ...                   | (1)             | ...        | ...  | ...             | ...        | ...  | 5               | 11.1       | 0.44 | 7 1/2           | 16.5       | 0.65 |  |
| 1 1/4 | ...                   | (1)             | ...        | ...  | ...             | ...        | ...  | 5               | 11.1       | 0.44 | 7 1/2           | 16.5       | 0.65 |  |
| 1 1/2 | ...                   | (1)             | ...        | ...  | ...             | ...        | ...  | 5               | 11.1       | 0.44 | 7 1/2           | 16.5       | 0.65 |  |
| 2     | ...                   | (1)             | ...        | ...  | ...             | ...        | 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 1/2           | 4.8        | 0.19 | 3 1/2           | 11.1       | 0.44 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 5     | (1)                   | 1 1/2           | 4.8        | 0.19 | 3 1/2           | 11.1       | 0.44 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 6     | (1)                   | 1 1/2           | 4.8        | 0.19 | 3 1/2           | 11.1       | 0.44 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 8     | (1)                   | 2               | 6.4        | 0.25 | 4               | 12.7       | 0.50 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 10    | (1)                   | 3               | 9.5        | 0.38 | 5               | 15.9       | 0.62 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 12    | (1)                   | 3               | 9.5        | 0.38 | 5               | 15.9       | 0.62 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 14    | (1)                   | 3               | 9.5        | 0.38 | 6               | 19.0       | 0.75 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 16    | (1)                   | 3               | 9.5        | 0.38 | 6               | 19.0       | 0.75 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 18    | (1)                   | 3               | 9.5        | 0.38 | 6               | 19.0       | 0.75 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 20    | (1)                   | 3               | 9.5        | 0.38 | 6               | 19.0       | 0.75 | ...             | ...        | ...  | ...             | ...        | ...  |  |
| 24    | (1)                   | 3               | 9.5        | 0.38 | 6               | 19.0       | 0.75 | ...             | ...        | ...  | ...             | ...        | ...  |  |

NOTE: (1) Use taper pipe thread per ASME B1.20.1 for these sizes.

## MANDATORY APPENDIX II

### REFERENCES

(25)

The following is a list of standards and specifications referenced in this Standard. Products covered by each ASTM specification are listed for convenience. For ASME Codes and Standards referenced hereunder, up to and including the latest published edition in effect at the time this edition of this Standard is specified, may be used. (See specifications for exact titles and detailed contents.) Materials manufactured to other editions of the referenced ASTM specifications may be used to manufacture flanges and flanged fittings meeting the requirements of this Standard as long as the flange/fitting manufacturer verifies that the material meets the requirements of the referenced edition of the ASTM specification.

- ASME B1.1. Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms). The American Society of Mechanical Engineers.
- ASME B1.20.1. Pipe Threads, General Purpose (Inch). The American Society of Mechanical Engineers.
- ASME B16.20. Metallic Gaskets for Pipe Flanges. The American Society of Mechanical Engineers.
- ASME B16.21. Nonmetallic Flat Gaskets for Pipe Flanges. The American Society of Mechanical Engineers.
- ASME B16.25. Buttwelding Ends. The American Society of Mechanical Engineers.
- ASME B16.34. Valves — Flanged, Threaded, and Welding End. The American Society of Mechanical Engineers.
- ASME B18.2.1. Square and Hex Bolts and Screws (Inch Series). The American Society of Mechanical Engineers.
- ASME B18.2.2. Square and Hex Nuts (Inch Series). The American Society of Mechanical Engineers.
- ASME B18.31.2. Continuous Thread Stud, Double-End Stud, and Flange Bolting Stud (Stud Bolt) (Inch Series). The American Society of Mechanical Engineers.
- ASME B31T. Standard Toughness Requirements for Piping. The American Society of Mechanical Engineers.
- ASME B36.10M. Welded and Seamless Wrought Steel Pipe. The American Society of Mechanical Engineers.
- ASME B46.1. Surface Texture (Surface Roughness, Waviness, and Lay). The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section I. Power Boilers. The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section II. Materials. The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section III. Rules for Construction of Nuclear Facility Components. The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section VIII. Rules for Construction of Pressure Vessels — Division 1. The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section VIII. Rules for Construction of Pressure Vessels — Division 2, Alternative Rules. The American Society of Mechanical Engineers.
- ASME Boiler and Pressure Vessel Code, Section IX. Welding, Brazing, and Fusing Qualifications. The American Society of Mechanical Engineers.
- ASME PCC-1. Guidelines for Pressure Boundary Bolted Flange Joint Assembly. The American Society of Mechanical Engineers.
- ASTM A105/A105M-23. Carbon Steel Forgings for Piping Applications. ASTM International.
- ASTM A106/A106M-19a. Seamless Carbon Steel Pipe for High-Temperature Service. ASTM International.
- ASTM A182/A182M-23. Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service. ASTM International.
- ASTM A193/A193M-23. Alloy-Steel and Stainless Steel Bolting for High-Temperature or High-Pressure Service and Other Special Purpose Applications. ASTM International.
- ASTM A194/A194M-23. Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both. ASTM International.
- ASTM A203/A203M-23. Pressure Vessel Plates, Alloy Steel, Nickel. ASTM International.
- ASTM A204/A204M-17(2022). Pressure Vessel Plates, Alloy Steel, Molybdenum. ASTM International.
- ASTM A216/A216M-21. Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service. ASTM International.
- ASTM A217/A217M-22. Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service. ASTM International.
- ASTM A240/A240M-23. Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications. ASTM International.

- ASTM A307-21. Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength. ASTM International.
- ASTM A320/A320M-22a. Alloy Steel and Stainless Steel Bolting for Low-Temperature Service. ASTM International.
- ASTM A350/A350M-23. Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components. ASTM International.
- ASTM A351/A351M-18e1. Castings, Austenitic, for Pressure-Containing Parts. ASTM International.
- ASTM A352/A352M-21. Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service. ASTM International.
- ASTM A354-17e2. Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners. ASTM International.
- ASTM A387/A387M-17a(2023). Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum. ASTM International.
- ASTM A449-14(2020). Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use. ASTM International.
- ASTM A453/A453M-17. High-Temperature Bolting, With Expansion Coefficients Comparable to Austenitic Stainless Steels. ASTM International.
- ASTM A515/A515M-17(2022). Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service. ASTM International.
- ASTM A516/A516M-17. Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service. ASTM International.
- ASTM A537/A537M-20. Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel. ASTM International.
- ASTM A540/540M-15(2021). Alloy-Steel Bolting Materials for Special Applications. ASTM International.
- ASTM A995/A995M-20. Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts. ASTM International.
- ASTM B127-19. Nickel-Copper Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B160-05 (2019). Nickel Rod and Bar. ASTM International.
- ASTM B162-99 (2019). Nickel Plate, Sheet, and Strip. ASTM International.
- ASTM B163-22. Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes. ASTM International.
- ASTM B164-03 (2019). Nickel-Copper Alloy Rod, Bar, and Wire. ASTM International.
- ASTM B166-19. Nickel-Chromium-Aluminum Alloy, Nickel-Chromium-Iron Alloys, Nickel-Chromium-Cobalt-Molybdenum Alloy, Nickel-Iron-Chromium-Tungsten Alloy, and Nickel-Chromium-Molybdenum-Copper Alloy Rod, Bar, and Wire. ASTM International.
- ASTM B168-19e1. Nickel-Chromium-Aluminum Alloys (UNS N06699), Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06045 and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674), and Nickel-Chromium-Molybdenum-Copper Alloy (UNS N06235) Plate, Sheet, and Strip. ASTM International.
- ASTM B333-23. Nickel-Molybdenum Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B335-18. Nickel-Molybdenum Alloy Rod. ASTM International.
- ASTM B407-22. Nickel-Iron-Chromium Alloy Seamless Pipe and Tube. ASTM International.
- ASTM B408-22. Nickel-Iron-Chromium Alloy Rod and Bar. ASTM International.
- ASTM B409-22. Nickel-Iron-Chromium Alloy, Plate, Sheet, and Strip. ASTM International.
- ASTM B424-22. Nickel-Iron-Chromium-Molybdenum-Copper Alloys Plate, Sheet, and Strip. ASTM International.
- ASTM B425-19. Nickel-Iron-Chromium-Molybdenum-Copper Alloys Rod and Bar. ASTM International.
- ASTM B434-22. Nickel-Molybdenum-Chromium-Iron Alloys (UNS N10003, UNS N10242) Plate, Sheet, and Strip. ASTM International.
- ASTM B435-22. UNS N06002, UNS N06230 Heat and Corrosion Resistant High Temperature Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B443-19. Nickel-Chromium-Molybdenum-Columbium Alloy and Nickel-Chromium-Molybdenum-Silicon Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B446-19. 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. ASTM International.
- ASTM B462-18e1. Forged or Rolled Nickel Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service. ASTM International.
- ASTM B463-21. UNS N08020 Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B473-07(2018). UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire. ASTM International.
- ASTM B511/B511M-21. Nickel-Iron-Chromium-Silicon Alloy Bars and Shapes. ASTM International.
- ASTM B536-19. Nickel-Iron-Chromium-Silicon Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B564-22. Nickel Alloy Forgings. ASTM International.
- ASTM B572-06(2016). UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Rod. ASTM International.
- ASTM B573-06(2016). Nickel-Molybdenum-Chromium-Iron Alloy (UNS N10003, N10242) Rod. ASTM International.

- ASTM B574-18. Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod. ASTM International.
- ASTM B575-17(2023). Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten, and Low-Carbon Nickel-Molybdenum-Chromium Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B581-17(2023). Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod. ASTM International.
- ASTM B582-07(2018). Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B599-20. Nickel-Iron-Chromium-Molybdenum-Niobium Stabilized Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B620-03(2018). Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Plate, Sheet, and Strip. ASTM International.
- ASTM B621-21. Nickel-Iron-Chromium-Molybdenum Alloy Rod. ASTM International.
- ASTM B625-21. Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloy, Ni-Fe-Cr-Si Alloy, Cr-Ni-Fe-N Low Carbon Alloy, Fe-Ni-Cr-Mo-Cu-N Alloy, and Ni-Fe-Cr-Mo-N Alloy Plate, Sheet, and Strip. ASTM International.
- ASTM B649-21. Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys and Cr-Ni-Fe-N Low-Carbon Alloy Bar and Wire, and Ni-Cr-Fe-Mo-N Alloy Wire. ASTM International.
- ASTM B672-02(2018). Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Bar and Wire. ASTM International.
- ASTM B688-22 (R2004). Chromium-Nickel-Molybdenum-Iron Plate, Sheet, and Strip. ASTM International.
- ASTM E29-22. Using Significant Digits in Test Data to Determine Conformance with Specifications. ASTM International.
- ISO 7005-1:1980. Metallic flanges — Part 1: Steel flanges. International Organization for Standardization.<sup>1</sup>
- ISO 9000-1:2015. Quality management systems — Fundamentals and vocabulary. International Organization for Standardization.<sup>1</sup>
- ISO 9001:2015. Quality management systems — Requirements. International Organization for Standardization.<sup>1</sup>
- ISO 9004:2018. Quality management — Quality of an organization — Guidance to achieve sustained success. International Organization for Standardization.<sup>1</sup>
- MSS SP-6-2021. Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings. Pressure Testing of Steel Valves. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-9-2018. Spot Facing for Bronze, Iron, and Steel Flanges. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-25-2018. Standard Marking System for Valves, Fittings, Flanges, and Unions. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-44-2019. Steel Pipeline Flanges. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-45-2020. Bypass and Drain Connections. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-55-2011. Quality Standard for Steel Casting for Valves, Flanges, and Fittings — Visual Method for Evaluation of Surface Irregularities. Manufacturers Standardization Society of the Valve and Fittings Industry.
- MSS SP-61-2019. Pressure Testing of Steel Valves. Manufacturers Standardization Society of the Valve and Fittings Industry.

<sup>1</sup>This publication may also be obtained from the American National Standards Institute: [www.ansi.org](http://www.ansi.org).

# 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 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.<sup>1</sup> Other considerations affecting or limiting ratings include

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

#### 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).

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

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 1.1-1 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.

<sup>1</sup>This method is appropriate for materials listed in Table 1.1-1. It may not be appropriate for other materials.

## 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 1.1-1](#), 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 1.1-1](#) 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 1.1-1](#), 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. \(3\)](#) 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

$$C_2 = 21.41$$

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

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

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 —  $p_{Cr}$  bar**

(25)

| Temperature, °C | Class |      |      |       |       |       |       |
|-----------------|-------|------|------|-------|-------|-------|-------|
|                 | 150   | 300  | 400  | 600   | 900   | 1500  | 2500  |
| 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 | 67.0 | 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 | 61.8 | 92.7  | 139.0 | 231.8 | 386.2 |
| 300             | 10.2  | 45.0 | 60.0 | 90.0  | 135.0 | 225.1 | 375.0 |
| 325             | 9.3   | 43.3 | 57.6 | 86.3  | 129.6 | 215.9 | 359.8 |
| 350             | 8.4   | 41.9 | 55.8 | 83.6  | 125.5 | 209.1 | 348.7 |
| 375             | 7.4   | 40.5 | 53.9 | 80.7  | 121.2 | 201.9 | 336.1 |
| 400             | 6.5   | 38.0 | 50.7 | 76.2  | 114.2 | 190.4 | 317.1 |
| 425             | 5.5   | 36.8 | 48.9 | 73.2  | 109.8 | 183.0 | 304.7 |
| 450             | 4.6   | 35.4 | 47.3 | 71.1  | 106.5 | 177.5 | 295.9 |
| 475             | 3.7   | 34.4 | 45.9 | 68.8  | 103.2 | 171.6 | 286.3 |
| 500             | 2.8   | 32.1 | 42.9 | 64.4  | 96.6  | 160.6 | 267.9 |
| 525             | 1.9   | 29.4 | 39.2 | 58.8  | 88.2  | 147.1 | 245.0 |
| 538             | 1.4   | 29.0 | 38.5 | 57.5  | 86.5  | 144.3 | 240.2 |
| 550             | (1)   | 28.8 | 38.3 | 57.3  | 86.0  | 143.6 | 239.2 |
| 575             | (1)   | 27.8 | 37.1 | 55.6  | 83.3  | 138.9 | 231.4 |
| 600             | (1)   | 25.3 | 33.6 | 50.2  | 75.1  | 125.2 | 208.8 |
| 625             | (1)   | 21.5 | 28.7 | 43.0  | 64.5  | 107.2 | 178.6 |
| 650             | (1)   | 16.6 | 22.1 | 33.2  | 50.2  | 83.4  | 138.9 |
| 675             | (1)   | 14.8 | 19.9 | 30.0  | 44.7  | 74.6  | 124.4 |
| 700             | (1)   | 12.1 | 16.1 | 24.0  | 35.8  | 59.6  | 99.6  |
| 725             | (1)   | 9.6  | 12.6 | 18.6  | 28.1  | 46.7  | 77.9  |
| 750             | (1)   | 7.3  | 9.7  | 14.4  | 21.6  | 36.4  | 60.4  |
| 775             | (1)   | 5.6  | 7.4  | 11.0  | 16.7  | 27.8  | 46.4  |
| 800             | (1)   | 4.3  | 5.8  | 8.7   | 13.0  | 21.6  | 36.2  |
| 816             | (1)   | 3.5  | 4.8  | 7.4   | 10.8  | 17.8  | 30.0  |

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

(25)

**Table A-2**  
**Rating Ceiling Pressure —  $p_c$ , psig**

| Temperature,<br>°F | Class |     |       |       |       |       |       |
|--------------------|-------|-----|-------|-------|-------|-------|-------|
|                    | 150   | 300 | 400   | 600   | 900   | 1500  | 2500  |
| 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   | 630 | 840   | 1,260 | 1,890 | 3,145 | 5,240 |
| 650                | 125   | 615 | 820   | 1,230 | 1,845 | 3,070 | 5,125 |
| 700                | 110   | 600 | 795   | 1,190 | 1,790 | 2,980 | 4,965 |
| 750                | 95    | 555 | 745   | 1,120 | 1,675 | 2,795 | 4,650 |
| 800                | 80    | 535 | 710   | 1,065 | 1,600 | 2,665 | 4,440 |
| 850                | 65    | 510 | 685   | 1,030 | 1,540 | 2,570 | 4,285 |
| 900                | 50    | 475 | 635   | 955   | 1,430 | 2,380 | 3,970 |
| 950                | 35    | 425 | 570   | 855   | 1,275 | 2,125 | 3,540 |
| 1,000              | 20    | 415 | 550   | 825   | 1,245 | 2,075 | 3,455 |
| 1,050              | (1)   | 410 | 545   | 820   | 1,230 | 2,050 | 3,420 |
| 1,100              | (1)   | 375 | 500   | 750   | 1,120 | 1,870 | 3,115 |
| 1,150              | (1)   | 320 | 425   | 640   | 960   | 1,595 | 2,660 |
| 1,200              | (1)   | 240 | 320   | 480   | 725   | 1,205 | 2,005 |
| 1,250              | (1)   | 210 | 285   | 430   | 645   | 1,075 | 1,790 |
| 1,300              | (1)   | 165 | 220   | 325   | 490   | 815   | 1,365 |
| 1,350              | (1)   | 125 | 165   | 250   | 375   | 625   | 1,040 |
| 1,400              | (1)   | 90  | 120   | 185   | 275   | 465   | 775   |
| 1,450              | (1)   | 75  | 100   | 145   | 220   | 360   | 605   |
| 1,500              | (1)   | 50  | 70    | 105   | 160   | 260   | 435   |

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

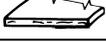
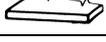
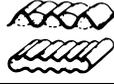
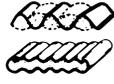
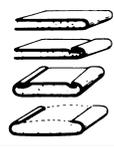
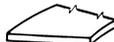
Classification of gasket materials and types is shown in [Table B-1](#). Other gaskets that result in no increase in bolt loads or flange moment over those resulting from the gaskets included in the respective groups may be used (see [para. 5.4](#)).

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

## NONMANDATORY APPENDIX C

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

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

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

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

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

(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

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

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

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,  $a = 5$  mm (0.19 in.)

$B = 2(t_f + t) + d + G + F + p - a$  (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](#))

$G = 3.0$  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 \(Table 5C\)](#)

$L_{CMB} =$  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 [Figure C-1](#))

$L_{SSB} =$  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 [Figure C-2](#))

$n =$  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)

<sup>1</sup>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](#)).

**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.) |

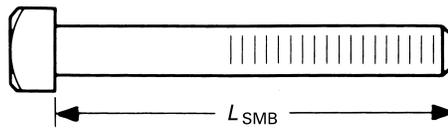
**Table C-2  
F Values**

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

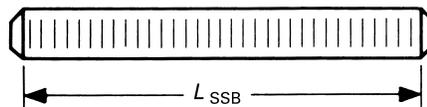
NOTE:

(1) See Figure 7 and Tables 4 and 5 (Tables 4C and 5C).

**Figure C-1  
Specified Machine Bolt Length**



**Figure C-2  
Specified Stud Bolt Length**



**Table C-3**  
***n* Values**

| Dimensions                                     | Negative Tolerance on Bolt Lengths, <i>n</i> , mm (in.) | Length, mm (in.)       |
|--|---|------------------------|
| Stud Bolt                                      |   |                        |
| <i>A</i>                                       | 1.5 (0.06)  | ≤305 (≤12)             |
| or   |   |                        |
| [ <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                | ...                    |
| or   | tolerances per ASME B18.2.1                             |                        |
| [ <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.<sup>1</sup> A determination of the need for registration and/or certification of the product manufacturer's quality system program by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demon-

strating 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.

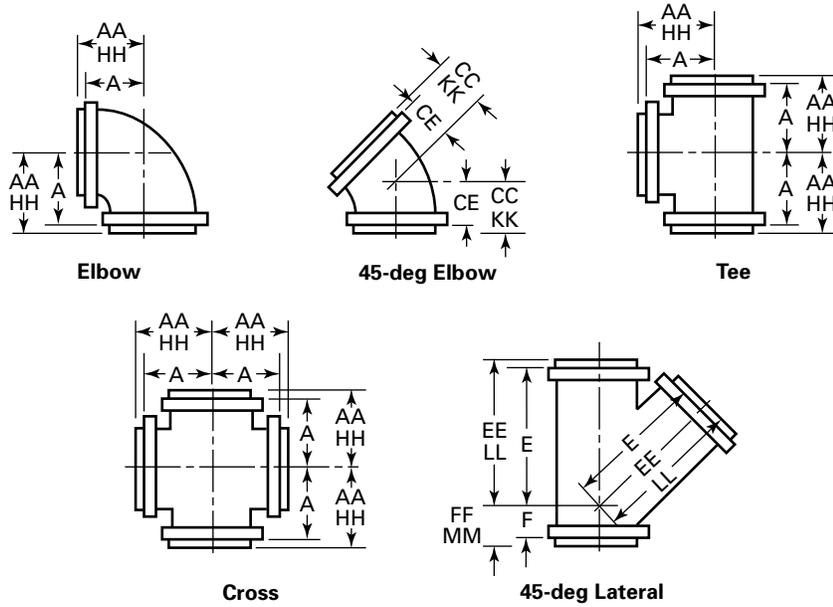
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<sup>1</sup>The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality (ASQ) as American National Standards that are identified by a prefix "Q," replacing the prefix "ISO." Each standard of the series is listed under References in [Mandatory Appendix II](#).

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

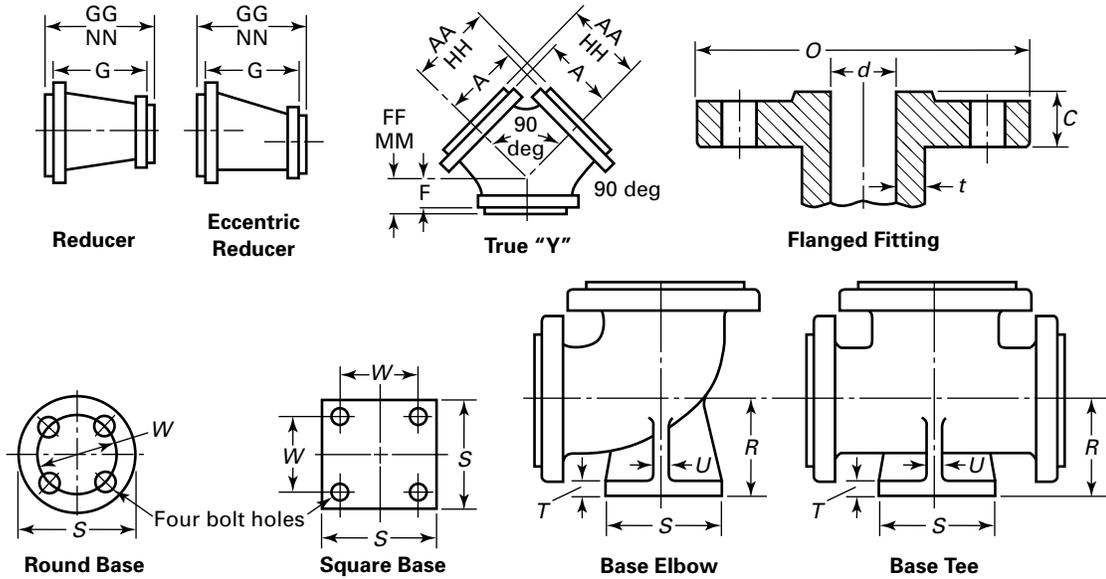
This Nonmandatory Appendix contains [Tables E-1](#) through [E-5](#).

**Table E-1  
Dimensions of Class 400 Flanged Fittings**



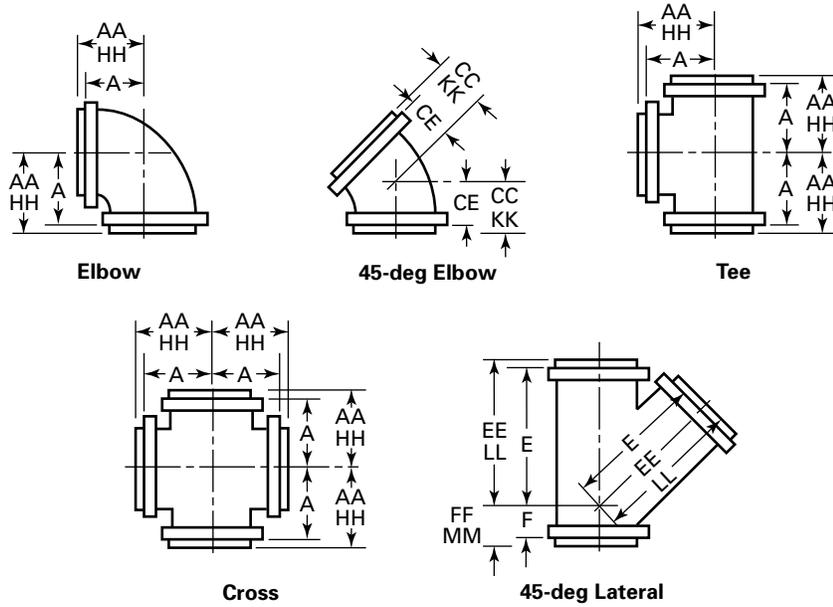
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Minimum<br>Thickness<br>of<br>Flange,<br><i>t<sub>f</sub></i> | Minimum<br>Wall<br>Thickness<br>of<br>Fitting,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of<br>Fitting,<br><i>d</i> | Flange Edge  |   |   |   |   | Raised Face<br>0.25 in. (1)  |  |  |   |
|-------------------------|--|---|--|--|--|---|---|---|---|--|--|--|---|
|                         |  |   |  |  | Center-<br>to-<br>Flange<br>Edge,<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br><i>A</i> | Center-<br>to-<br>Long<br>Center-<br>to-<br>Flange<br>Edge,<br>45-deg<br>Elbow,<br>Lateral,<br><i>C</i> | Long<br>Center-<br>to-<br>Flange<br>Edge,<br>45-deg<br>Elbow,<br>Lateral,<br><i>E</i> | Short<br>Center-<br>to-<br>Flange<br>Edge,<br>and<br>True<br>"Y,"<br><i>F</i> | Flange<br>Edge-<br>to-<br>Flange<br>Edge,<br>Reducer,<br><i>G</i> | Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br><i>AA</i> | Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>45-deg<br>Elbow,<br>Lateral,<br><i>CC</i> | Long<br>Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>Lateral,<br><i>EE</i> | Short<br>Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>True<br>"Y,"<br><i>FF</i> |
|                         |  |   |  |  |  |   |   |   |   |  |  |  |   |
| 1/2                     | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 3/4                     | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 1                       | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 1 1/4                   | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 1 1/2                   | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 2                       | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 2 1/2                   | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 3                       | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 3 1/2                   | (9)  | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)   | (9)  | (9)  | (9)  | (9)   |
| 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  |

**Table E-1  
Dimensions of Class 400 Flanged Fittings**



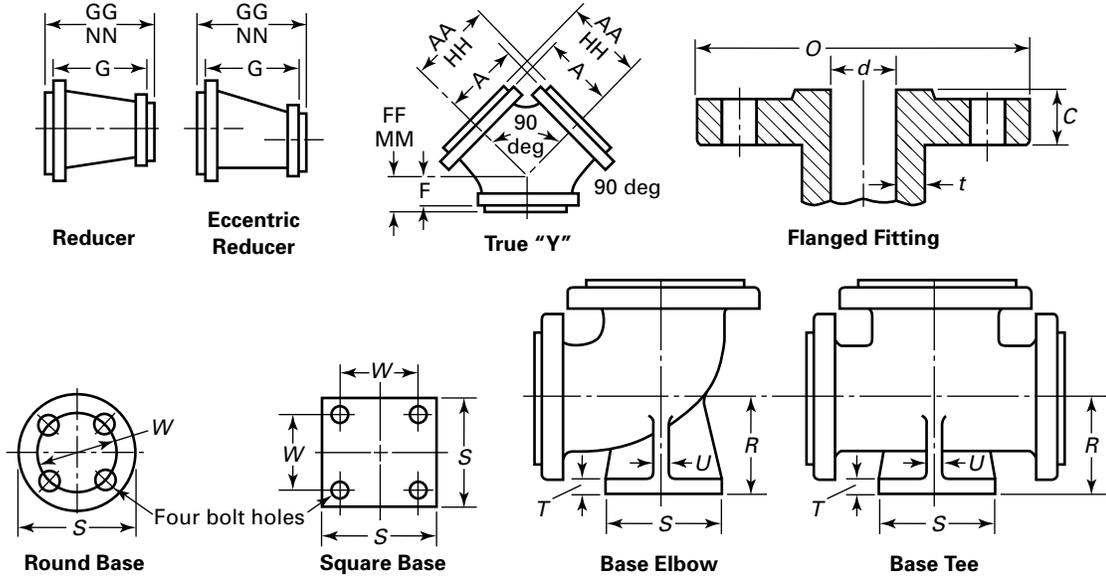
|  | 15  | 16                                  | 17                                  | 18  | 19                     | 20                        | 21   | 22   | 23   | 24                                   | 25                              | 26                                    | 1                                |                          |
|--|---|-------------------------------------|-------------------------------------|---|------------------------|---------------------------|--|------|------|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face 0.25 in. (1)</b>  | <b>Ring Joint (1)</b>                                 |                                     |                                     |   |                        |                           |  |      |      |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> |   |                                     |                                     |   |                        |                           | <b>Diameter of Round Base or Width of Square Base, S (4)</b> |      |      | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
|  | Center-to-End Elbow, Tee, Cross, and True "Y," HH (3) | Center-to-End, 45-deg Elbow, KK (3) | Long Center-to-End, Lateral, LL (3) | Short Center-to-End, Lateral and True "Y," MM (3) | End-to-End Reducer, NN | Center-to-Base, R (4)-(6) |  |      |      |                                      |                                 |                                       |                                  |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 1/2                              |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 3/4                              |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 1                                |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 1 1/4                            |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 1 1/2                            |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 2                                |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 2 1/2                            |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   | 3                                |                          |
| (9)  | (9)   | (9)                                 | (9)                                 | (9)   | (9)                    | (9)                       | (9)  | (9)  | (9)  | (9)                                  | (9)                             | (9)                                   |                                  |                          |
| 8.25   | 8.06  | 5.56                                | 16.06                               | 4.56  | (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  | (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  | (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  | (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  | (2), (3)               | 10.50                     | 10.00  | 1.25 | 0.88 | 7.88                                 | 0.88                            |                                       | 10                               |                          |

**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   |
|-------------------------|---|---|--|---|---|--|--|---|--|---|---|---|--|
|                         |   |   |  |   | Flange Edge   |  |  |   |  | Raised Face<br>0.25 in. (1)   |   |   |  |
|                         |   |   |  |   | Center-<br>to-<br>Flange<br>Edge,<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br>A | Center-<br>to-<br>Flange<br>Edge,<br>45-deg<br>Elbow,<br>Lateral,<br>"Y,"<br>C | Long<br>Center-<br>to-<br>Flange<br>Edge,<br>"Y,"<br>E | Short<br>Center-<br>to-<br>Flange<br>Edge,<br>Lateral,<br>"Y,"<br>F | Flange<br>Edge-<br>to-<br>Flange<br>Edge,<br>Reducer,<br>"Y,"<br>G | Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br>AA | Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>45-deg<br>Elbow,<br>Lateral,<br>"Y,"<br>CC | Long<br>Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>45-deg<br>Elbow,<br>Lateral,<br>"Y,"<br>EE | Short<br>Center-<br>to-<br>Contact<br>Surface<br>of<br>Raised<br>Face,<br>45-deg<br>Elbow,<br>Lateral,<br>"Y,"<br>FF |
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of<br>Flange,<br>O | Minimum<br>Thickness<br>of<br>Flange,<br>t <sub>f</sub> | Minimum<br>Wall<br>Thickness<br>of<br>Fitting,<br>t <sub>m</sub> | Inside<br>Diameter<br>of<br>Fitting,<br>d | 14.75   | 8.50   | 29.50  | 6.25  | 14.75  | 15.00   | 8.75  | 29.75   | 6.50   |
| 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)**



|  | 15   | 16    | 17   | 18   | 19   | 20                            | 21                               | 22                                 | 23                                   | 24                              | 25                                    | 26                               | 1                        |
|--|--|-------|--|--|--|-------------------------------|----------------------------------|------------------------------------|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face<br/>0.25 in.<br/>(1)</b>                                  | <b>Ring Joint (1)</b>  |       |  |  |  |                               |                                  |                                    |                                      |                                 |                                       | <b>Base Drilling (8)</b>         |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> |       | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long Center-to-End, Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, R (4)-(6)</b> | <b>Width of Square Base, S (4)</b> | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| 15.25  | 15.06  | 8.81  | 29.81                                      | 6.56                                       | (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                                       | (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                                       | (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                                       | (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                                       | (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                                      | (2), (3)   | 20.75                         | 17.50                            | 1.88                               | 1.25                                 | 15.25                           | 1.12                                  | 24                               |                          |

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

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## GENERAL NOTES:

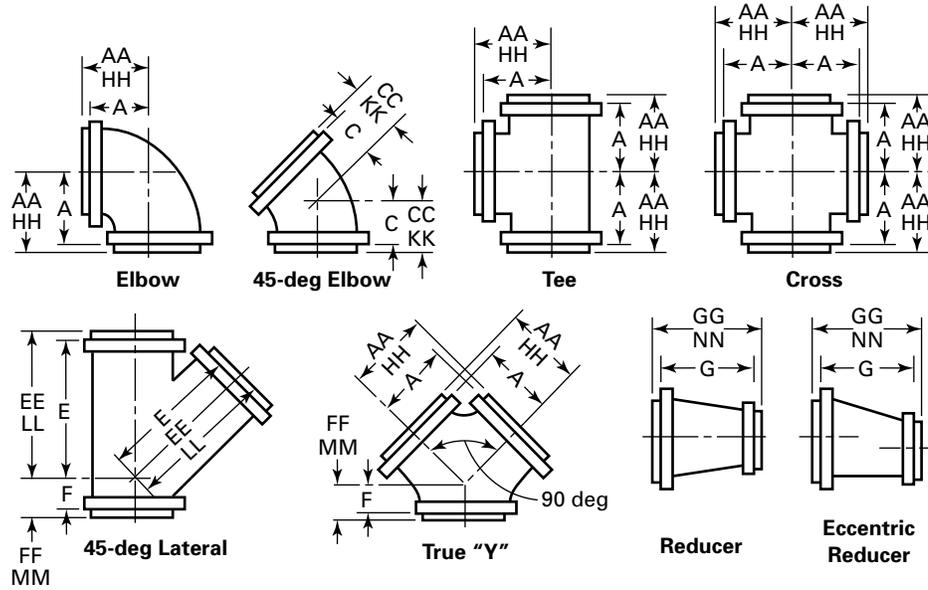
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 13C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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) 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 5C](#) for ring joint facing dimensions.
- (3) For contact surface-to-surface and end-to-end dimensions of reducers and eccentric reducers, see [para. 6.2.3](#).
- (4) The base dimensions apply to all straight and reducing sizes.
- (5) 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.
- (6) Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension  $R$  shall be the finished dimension.
- (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.
- (9) Use Class 600 dimensions in this size.

TABLE STARTS ON NEXT PAGE

**Table E-2**  
**Dimensions of Class 600 Flanged Fittings**

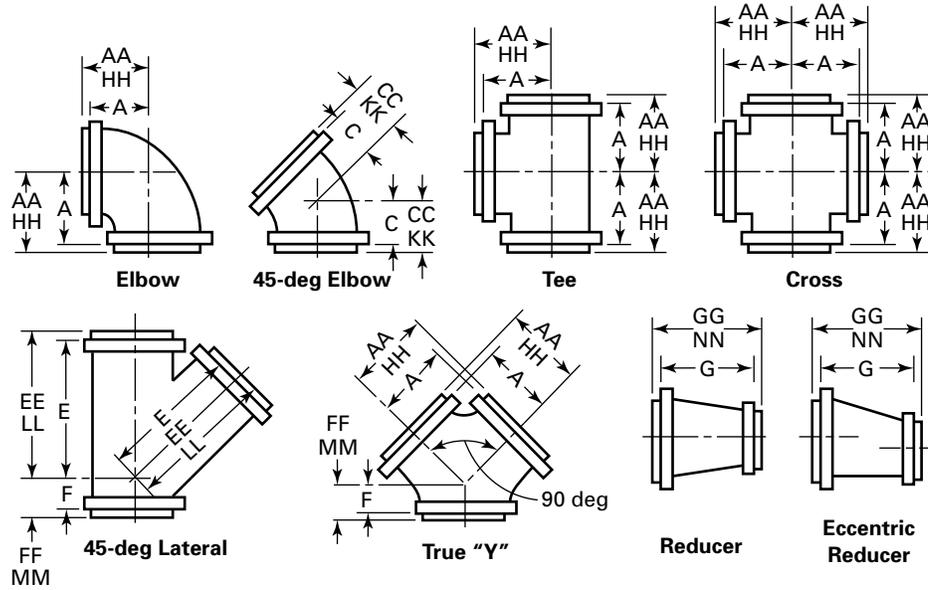


| 1                 | 2                                    | 3   | 4   | 5                                    | 6   | 7   | 8  | 9  | 10  | 11  | 12   | 13  | 14  |
|-------------------|--------------------------------------|---|---|--------------------------------------|---|---|--|--|---|---|--|---|---|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>m</sub></i> | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge   |   |  |  |   | Raised Face 0.25 in. (1)  |  |   |   |
|                   |                                      |   |   |                                      | Center-to-Flange Edge, Tee, Cross, and True "Y," <i>A</i> | Center-to-Flange Edge, 45-deg Elbow, Lateral, "Y," <i>C</i> | Long Center-to-Flange Edge, Lateral, "Y," <i>E</i> | Short Center-to-Flange Edge, Lateral, True "Y," <i>F</i> | Flange Edge-to-Flange Edge, Reducer, <i>G</i> | Center-to-Contact Surface of Raised Face, Tee, Cross, and True "Y," <i>AA</i> | Center-to-Contact Surface of Raised Face, 45-deg Elbow, Lateral, <i>CC</i> | Long Contact Surface of Raised Face, Lateral, and True "Y," <i>EE</i> | Short Contact Surface of Raised Face, <i>FF</i> |
|                   |                                      |   |   |                                      |   |   |  |  |   |   |  |   |   |
| 1/2               | 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  |
| 3/4               | 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  |
| 1 1/4             | 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  |
| 1 1/2             | 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  |
| 2 1/2             | 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  |
| 3 1/2             | 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  |
| 5                 | 13.00                                | 1.75  | 0.44  | 5.00                                 | 9.75  | 6.75  | 19.25  | 5.75   | 9.75  | 10.00   | 7.00   | 19.50   | 6.00  |
| 6                 | 14.00                                | 1.88  | 0.50  | 6.00                                 | 10.75   | 7.25  | 20.75  | 6.25   | 10.75   | 11.00   | 7.50   | 21.00   | 6.50  |
| 8                 | 16.50                                | 2.19  | 0.62  | 7.88                                 | 12.75   | 8.25  | 24.25  | 6.75   | 12.75   | 13.00   | 8.50   | 24.50   | 7.00  |
| 10                | 20.00                                | 2.50  | 0.75  | 9.75                                 | 15.25   | 9.25  | 29.25  | 7.75   | 15.25   | 15.50   | 9.50   | 29.50   | 8.00  |
| 12                | 22.00                                | 2.62  | 0.91  | 11.75                                | 16.25   | 9.75  | 31.25  | 8.25   | 16.25   | 16.50   | 10.00  | 31.50   | 8.50  |

**Table E-2**  
**Dimensions of Class 600 Flanged Fittings**

| 15   | 16   | 17   | 18  | 19  | 20                            | 21                               | 22   | 23                                   | 24                              | 25                                    | 26                               | 1                        |
|--|--|--|---|---|-------------------------------|----------------------------------|--|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face<br/>0.25 in.<br/>(1)</b>                                  | <b>Ring Joint (1)</b>  |  |   |   |                               |                                  |  |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long Center-to-End Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral, and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, R (4)-(6)</b> | <b>Diameter of Round Base or Width of Square Base, S (4)</b> | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| 5.00   | 3.22   | 1.97                                       | 5.72                                      | 1.72  | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 1/2                      |
| 5.00   | 3.75   | 2.50                                       | 6.75                                      | 2.00  | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 3/4                      |
| 5.00   | 4.25   | 2.50                                       | 7.25                                      | 2.25  | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 1                        |
| 5.00   | 4.50   | 2.75                                       | 8.00                                      | 2.50  | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 1 1/4                    |
| 5.00   | 4.75   | 3.00                                       | 9.00                                      | 2.75  | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 1 1/2                    |
| 6.00   | 5.81   | 4.31                                       | 10.31                                     | 3.56  | (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  | (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  | (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  | (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  | (2), (3)                      | 7.00                             | 7.50   | 1.00                                 | 0.75                            | 5.88                                  | 0.88                             | 4                        |
| 10.25  | 10.06  | 7.06                                       | 19.56                                     | 6.06  | (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  | (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  | (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  | (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  | (2), (3)                      | 13.25                            | 15.00  | 1.62                                 | 1.12                            | 13.00                                 | 1.00                             | 12                       |

**Table E-2**  
**Dimensions of Class 600 Flanged Fittings (Cont'd)**



| 1                 | 2                             | 3   | 4   | 5                             | 6  | 7                                      | 8                                      | 9  | 10                                     | 11   | 12    | 13   | 14   |  |
|-------------------|-------------------------------|---|---|-------------------------------|--|--|--|--|--|--|-------|--|--|--|
|                   |                               |   |   |                               | Flange Edge  |  |  |  |  | Raised Face 0.25 in. (1)   |       |  |  |  |
|                   |                               |   |   |                               | Center-to-Flange Edge, 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, True "Y," F | Flange Edge-to-Flange Edge, Reducer, G | Center-to-Contact Surface of Raised Face, 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, True "Y," FF |
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t <sub>m</sub> | Minimum Wall Thickness of Fitting, t <sub>m</sub> | Inside Diameter of Fitting, d |  |  |  |  |  |  |       |  |  |  |
| 14                | 23.75                         | 2.75  | 0.97  | 12.88                         | 17.25  | 10.50                                  | 34.00                                  | 8.75                                     | 17.25                                  | 17.50  | 10.75 | 34.25  | 9.00   |  |
| 16                | 27.00                         | 3.00  | 1.09  | 14.75                         | 19.25  | 11.50                                  | 38.25                                  | 9.75                                     | 19.25                                  | 19.50  | 11.75 | 38.50  | 10.00  |  |
| 18                | 29.25                         | 3.25  | 1.22  | 16.50                         | 21.25  | 12.00                                  | 41.75                                  | 10.25                                    | 21.25                                  | 21.50  | 12.25 | 42.00  | 10.50  |  |
| 20                | 32.00                         | 3.50  | 1.34  | 18.25                         | 23.25  | 12.75                                  | 45.25                                  | 10.75                                    | 23.25                                  | 23.50  | 13.00 | 45.50  | 11.00  |  |
| 24                | 37.00                         | 4.00  | 1.59  | 22.00                         | 27.25  | 14.50                                  | 52.75                                  | 12.75                                    | 27.25                                  | 27.50  | 14.75 | 53.00  | 13.00  |  |

**Table E-2**  
**Dimensions of Class 600 Flanged Fittings (Cont'd)**

| 15   | 16   | 17   | 18  | 19  | 20                            | 21                               | 22   | 23                                   | 24                              | 25                                    | 26                               | 1                        |
|--|--|--|---|---|-------------------------------|----------------------------------|--|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face 0.25 in. (1)</b>  | <b>Ring Joint (1)</b>  |  |   |   |                               |                                  |  |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long Center-to-End Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral, and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, R (4)-(6)</b> | <b>Diameter of Round Base or Width of Square Base, S (4)</b> | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| 17.75  | 17.56  | 10.81                                      | 34.31                                     | 9.06  | (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   | (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   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 18                       |
| 23.75  | 23.62  | 13.12                                      | 45.62                                     | 11.12   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 20                       |
| 27.75  | 27.69  | 14.94                                      | 53.19                                     | 13.19   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 24                       |

**Table E-2**  
**Dimensions of Class 600 Flanged Fittings (Cont'd)**

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## GENERAL NOTES:

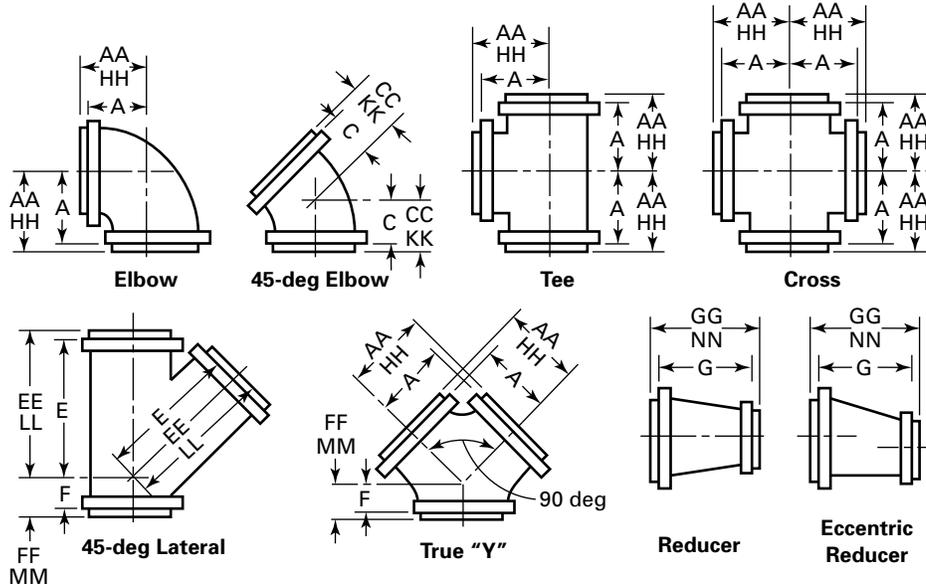
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 15C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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 end-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 5C](#) for ring joint facing dimensions.
- (4) The base dimensions apply to all straight and reducing sizes.
- (5) 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.
- (6) Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension  $R$  shall be the finished dimension.
- (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 STARTS ON NEXT PAGE

**Table E-3**  
**Dimensions of Class 900 Flanged Fittings**

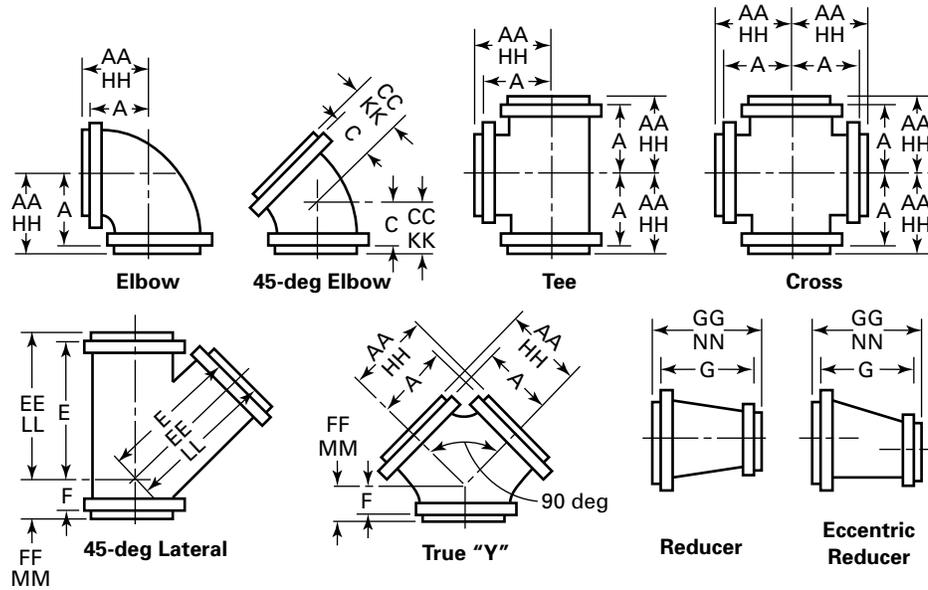


| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge   |  |  |  |   | Raised Face 0.25 in. (1)  |   |  |   |
|-------------------|--------------------------------------|---|---|--------------------------------------|---|--|--|--|---|---|---|--|---|
|                   |                                      |   |   |                                      | Center-to-Flange Edge, Tee, Cross, and True "Y," <i>A</i> | Center-to-Flange Edge, 45-deg Elbow, Lateral, <i>C</i> | Long Center-to-Flange Edge, True "Y," <i>E</i> | Short Center-to-Flange Edge, Lateral, True "Y," <i>F</i> | Flange Edge-to-Flange Edge, Reducer, <i>G</i> | Center-to-Raised Face of Elbow, Tee, Cross, and True "Y," <i>AA</i> | Center-to-Raised Face of 45-deg Elbow, Lateral, <i>CC</i> | Long Center-to-Raised Face of Lateral, <i>EE</i> | Short Center-to-Raised Face of Lateral, True "Y," <i>FF</i> |
|                   |                                      |   |   |                                      |   |  |  |  |   |   |   |  |   |
| 1/2               | 4.75                                 | 0.88  | 0.16  | 0.50                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 3/4               | 5.12                                 | 1.00  | 0.19  | 0.69                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 1                 | 5.88                                 | 1.12  | 0.22  | 0.88                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 1 1/4             | 6.25                                 | 1.12  | 0.25  | 1.12                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 1 1/2             | 7.00                                 | 1.25  | 0.28  | 1.38                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 2                 | 8.50                                 | 1.50  | 0.31  | 1.88                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 2 1/2             | 9.62                                 | 1.62  | 0.34  | 2.25                                 | (9)   | (9)  | (9)  | (9)  | (9)   | (9)   | (9)   | (9)  | (9)   |
| 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  |

**Table E-3  
Dimensions of Class 900 Flanged Fittings**

| 15                       | 16  | 17  | 18                                  | 19                                  | 20   | 21                         | 22  | 23                            | 24                       | 25                     | 26                             | 1                 |
|--------------------------|---|---|-------------------------------------|-------------------------------------|--|----------------------------|---|-------------------------------|--------------------------|------------------------|--------------------------------|-------------------|
| Raised Face 0.25 in. (1) | Ring Joint (1)  |   |                                     |                                     |  | Center-to-Base, S (4), (5) | Diameter of Round Base or Width of Square Base, S (6) | Thickness of Base, T (6), (7) | Thickness of Ribs, U (6) | Base Drilling (8)      |                                | Nominal Pipe Size |
|                          | Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2) | Center-to-End Elbow, Tee, Cross, and True "Y," HH (3) | Center-to-End, 45-deg Elbow, KK (3) | Long Center-to-End, Lateral, LL (3) | Short Center-to-End, Lateral, and True "Y," MM (3) |                            |   |                               |                          | End-to-End Reducer, NN | Bolt Circle or Bolt Spacing, W |                   |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 1/2               |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 3/4               |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 1                 |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 1 1/4             |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 1 1/2             |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 2                 |
| (9)                      | (9)   | (9)   | (9)                                 | (9)                                 | (9)  | (9)                        | (9)   | (9)                           | (9)                      | (9)                    | (9)                            | 2 1/2             |
| 7.75                     | 7.56  | 5.56  | 14.56                               | 4.56                                | (2), (3)   | 5.75                       | 6.50  | 0.88                          | 0.75                     | 5.00                   | 0.75                           | 3                 |
| 9.25                     | 9.06  | 6.56  | 17.56                               | 5.56                                | (2), (3)   | 7.00                       | 7.50  | 1.00                          | 0.75                     | 5.88                   | 0.88                           | 4                 |
| 11.25                    | 11.06   | 7.56  | 21.06                               | 6.56                                | (2), (3)   | 8.25                       | 10.00   | 1.25                          | 0.75                     | 7.88                   | 0.88                           | 5                 |
| 12.25                    | 12.06   | 8.06  | 22.56                               | 6.56                                | (2), (3)   | 9.00                       | 10.00   | 1.25                          | 0.75                     | 7.88                   | 0.88                           | 6                 |
| 14.75                    | 14.56   | 9.06  | 27.56                               | 7.56                                | (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                                | (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                                | (2), (3)   | 13.25                      | 15.00   | 1.62                          | 1.12                     | 13.00                  | 1.00                           | 12                |

**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<br>Pipe<br>Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Minimum<br>Thickness<br>of Flange,<br><i>t<sub>f</sub></i> | Minimum<br>Wall<br>Thickness<br>of Fitting,<br><i>t<sub>m</sub></i> | Inside<br>Diamete-<br>r of<br>Fitting,<br><i>d</i> | Flange Edge  |   |  |  |   | Raised Face 0.25 in. (1)  |  |  |   |
|                         |   |  |   |  | Center-<br>to-<br>Flange<br>Edge,<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br><i>A</i> | Center-<br>to-<br>Flange<br>Edge,<br>45-deg<br>Elbow,<br>Lateral,<br><i>C</i> | Long<br>Center-<br>to-<br>Flange<br>Edge,<br>and<br>Lateral,<br><i>E</i> | Short<br>Center-<br>to-<br>Flange<br>Edge,<br>True<br>"Y,"<br><i>F</i> | Flange<br>Edge-to-<br>Flange<br>Edge,<br>Reducer,<br><i>G</i> | Center-<br>to-<br>Surface<br>of<br>Raised<br>Face<br>Elbow,<br>Tee,<br>Cross,<br>and<br>True<br>"Y,"<br><i>AA</i> | Center-<br>to-<br>Surface<br>Contact<br>of<br>Raised<br>Face,<br>45-deg<br>Elbow,<br>Lateral,<br><i>CC</i> | Long<br>Center-<br>to-<br>Surface<br>Contact<br>of<br>Raised<br>Face,<br>Lateral,<br><i>EE</i> | Short<br>Center-<br>to-<br>Surface<br>Contact<br>of<br>Raised<br>Face,<br>True<br>"Y,"<br><i>FF</i> |
|                         |   |  |   |  |  |   |  |  |   |   |  |  |   |
| 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                        |
|--|--|--|-------------------------------------|---|-------------------------------|-----------------------------------|--|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face 0.25 in. (1)</b>  | <b>Ring Joint (1)</b>  |  |                                     |   |                               |                                   |  |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long to-End, Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral, and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, S (4), (5)</b> | <b>Diameter of Round Base or Width of Square Base, S (6)</b> | <b>Thickness of Base, T (6), (7)</b> | <b>Thickness of Ribs, U (6)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| 19.00  | 20.44  | 11.69                                      | 36.69                               | 9.69  | (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   | (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   | (2), (3)                      | ...                               | ...  | ...                                  | ...                             | ...                                   | ...                              | 18                       |
| 26.50  | 26.25  | 14.75                                      | 50.50                               | 13.25   | (2), (3)                      | ...                               | ...  | ...                                  | ...                             | ...                                   | ...                              | 20                       |
| 30.50  | 30.88  | 18.38                                      | 60.38                               | 15.88   | (2), (3)                      | ...                               | ...  | ...                                  | ...                             | ...                                   | ...                              | 24                       |

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

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## GENERAL NOTES:

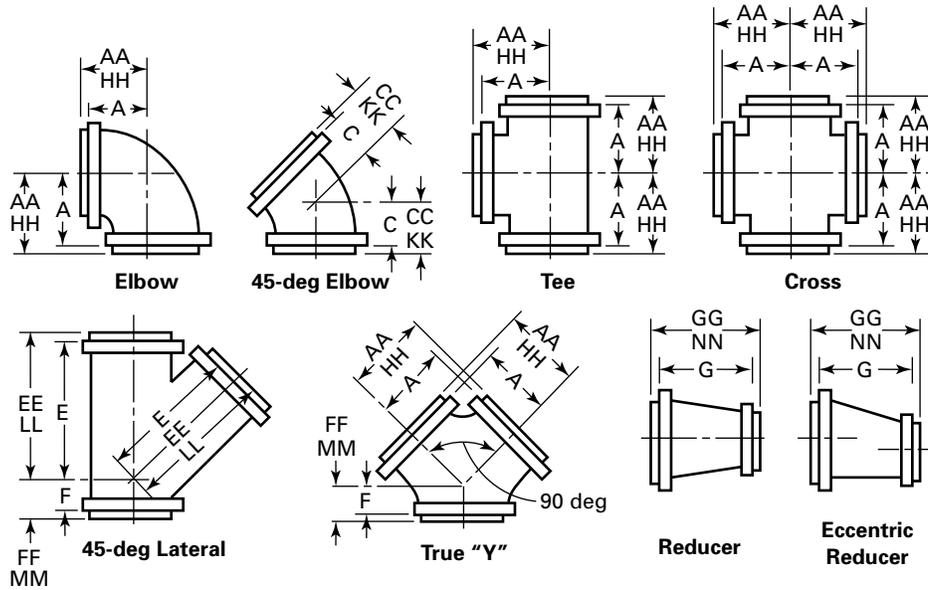
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 17C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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 5C](#) 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.
- (9) Use Class 1500 dimensions in this size.

TABLE STARTS ON NEXT PAGE

**Table E-4**  
**Dimensions of Class 1500 Flanged Fittings**

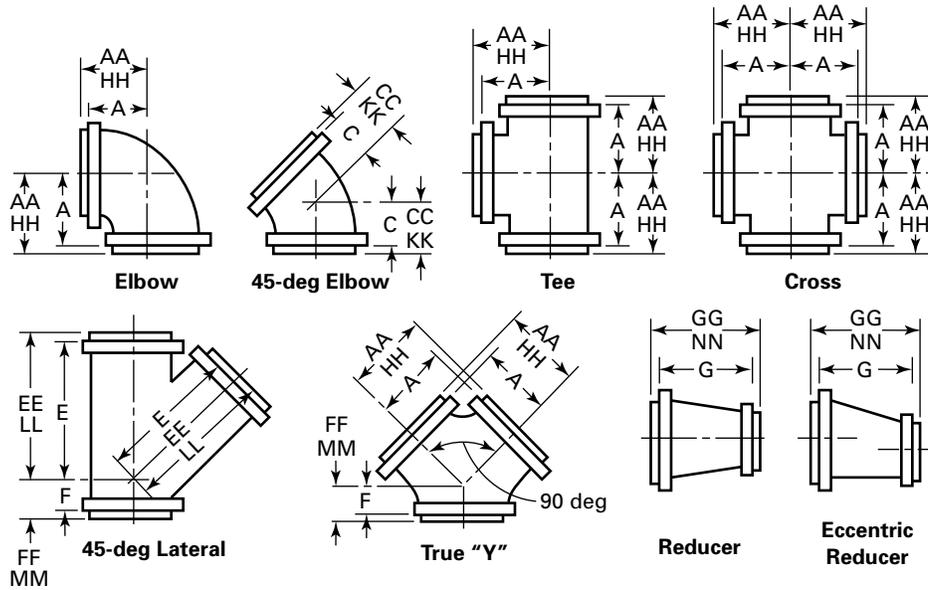


|                   | 1                                    | 2   | 3   | 4                                    | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14 |
|-------------------|--------------------------------------|---|---|--------------------------------------|---|---|---|---|---|---|---|---|---|----|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge   |   |   |   |   | Raised Face 0.25 in. (1)  |   |   |   |    |
|                   |                                      |   |   |                                      | Center-to-Flange Edge, 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, and True "Y," <i>F</i> | Flange Edge to Flange Edge, Reducer, <i>G</i> | Center-to-Contact Surface of Raised Face, Tee, Cross, and True "Y," <i>AA</i> | Center-to-Contact 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, True "Y," <i>FF</i> |    |
| 1/2               | 4.75                                 | 0.88  | 0.19  | 0.50                                 | 4.00  | 2.75  | ...   | ...   | ...   | 4.25  | 3.00  | ...   | ...   |    |
| 3/4               | 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  |    |
| 1 1/4             | 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  |    |
| 1 1/2             | 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  |    |
| 2 1/2             | 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  |    |
| 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   |    |

**Table E-4**  
**Dimensions of Class 1500 Flanged Fittings**

| 15   | 16   | 17   | 18   | 19  | 20                            | 21                               | 22                                    | 23                                   | 24                              | 25                                    | 26                               | 1                        |
|--|--|--|--|---|-------------------------------|----------------------------------|---------------------------------------|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face<br/>0.25 in.<br/>(1)</b>                                  | <b>Ring Joint (1)</b>  |  |  |   |                               |                                  |                                       |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long Center-to-End, Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral, and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, R (4)–(6)</b> | <b>or Width of Square Base, S (4)</b> | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| ...  | 4.25   | 3.00                                       | ...  | ...   | (2), (3)                      | ...                              | ...                                   | ...                                  | ...                             | ...                                   | ...                              | 1/2                      |
| ...  | 4.50   | 3.25                                       | ...  | ...   | (2), (3)                      | ...                              | ...                                   | ...                                  | ...                             | ...                                   | ...                              | 3/4                      |
| 5.00   | 5.00   | 3.50                                       | 9.00                                       | 2.50  | (2), (3)                      | ...                              | ...                                   | ...                                  | ...                             | ...                                   | ...                              | 1                        |
| 5.75   | 5.50   | 4.00                                       | 10.00                                      | 3.00  | (2), (3)                      | ...                              | ...                                   | ...                                  | ...                             | ...                                   | ...                              | 1 1/4                    |
| 6.25   | 6.00   | 4.25                                       | 11.00                                      | 3.50  | (2), (3)                      | ...                              | ...                                   | ...                                  | ...                             | ...                                   | ...                              | 1 1/2                    |
| 7.25   | 7.31   | 4.81                                       | 13.31                                      | 4.06  | (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  | (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  | (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  | (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  | (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  | (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  | (2), (3)                      | 11.50                            | 12.50                                 | 1.44                                 | 1.00                            | 10.62                                 | 0.88                             | 8                        |
| 20.25  | 19.69  | 12.19                                      | 36.19                                      | 10.44   | (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   | (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   | (2), (3)                      | 17.25                            | 17.50                                 | 1.88                                 | 1.25                            | 15.25                                 | 1.12                             | 14                       |

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



| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge   |  |                                      |  | Raised Face 0.25 in. (1)                      |   |  |  |   |
|-------------------|--------------------------------------|---|---|--------------------------------------|---|--|--------------------------------------|--|---|---|--|--|---|
|                   |                                      |   |   |                                      | Center-to-Flange Edge, Tee, Cross, and True "Y," <i>A</i> | Center-to-Flange Edge, 45-deg Elbow, Lateral, <i>C</i> | Long Center-to-Flange Edge, <i>E</i> | Short Center-to-Flange Edge, Lateral, True "Y," <i>F</i> | Flange Edge to Flange Edge, Reducer, <i>G</i> | Center-to-Contact Surface of Raised Face, Tee, Cross, and True "Y," <i>AA</i> | Center-to-Contact Surface of Raised Face, 45-deg Elbow, Lateral, <i>CC</i> | Long Contact Surface of Raised Face, <i>EE</i> | Short Contact Surface of Raised Face, True "Y," <i>FF</i> |
| 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                        |
|--|--|--|--|---|-------------------------------|----------------------------------|--|--------------------------------------|---------------------------------|---------------------------------------|----------------------------------|--------------------------|
| <b>Raised Face<br/>0.25 in.<br/>(1)</b>                                  | <b>Ring Joint (1)</b>  |  |  |   |                               |                                  |  |                                      |                                 | <b>Base Drilling (8)</b>              |                                  |                          |
| <b>Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2)</b> | <b>Center-to-End Elbow, Tee, Cross, and True "Y," HH (3)</b> | <b>Center-to-End, 45-deg Elbow, KK (3)</b> | <b>Long Center-to-End, Lateral, LL (3)</b> | <b>Short Center-to-End, Lateral, and True "Y," MM (3)</b> | <b>End-to-End Reducer, NN</b> | <b>Center-to-Base, R (4)-(6)</b> | <b>Diameter of Round Base or Width of Square Base, S (4)</b> | <b>Thickness of Base, T (4), (7)</b> | <b>Thickness of Ribs, U (4)</b> | <b>Bolt Circle or Bolt Spacing, W</b> | <b>Diameter of Drilled Holes</b> | <b>Nominal Pipe Size</b> |
| 28.25  | 27.69  | 16.69                                      | 48.69                                      | 15.19   | (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   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 18                       |
| 34.00  | 33.19  | 19.19                                      | 58.19                                      | 18.19   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 20                       |
| 39.75  | 38.81  | 21.31                                      | 67.81                                      | 21.06   | (2), (3)                      | ...                              | ...  | ...                                  | ...                             | ...                                   | ...                              | 24                       |

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

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## GENERAL NOTES:

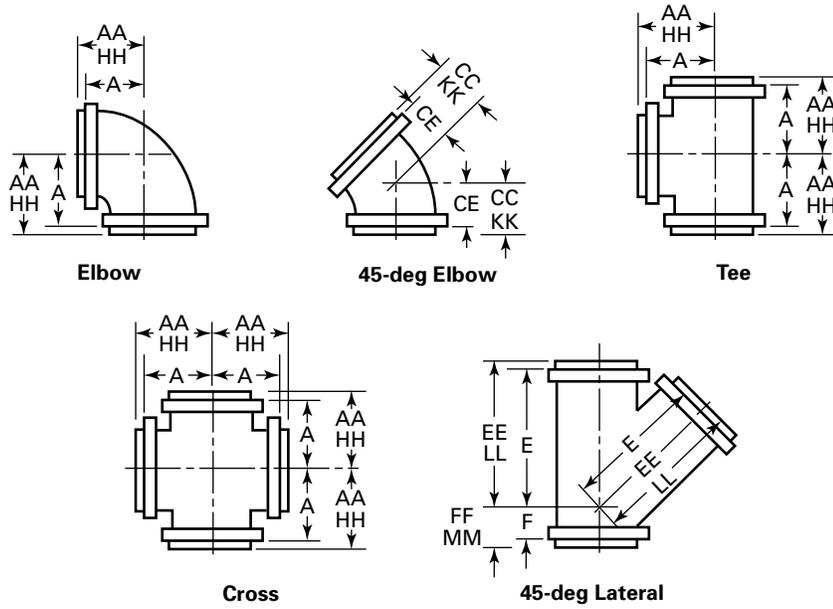
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 19C](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end 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 end-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 5C](#) for ring joint facing dimensions.
- (4) The base dimensions apply to all straight and reducing sizes.
- (5) 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.
- (6) Bases shall be plain faced unless otherwise specified, and the center-to-base dimension *R* shall be the finished dimension.
- (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 STARTS ON NEXT PAGE

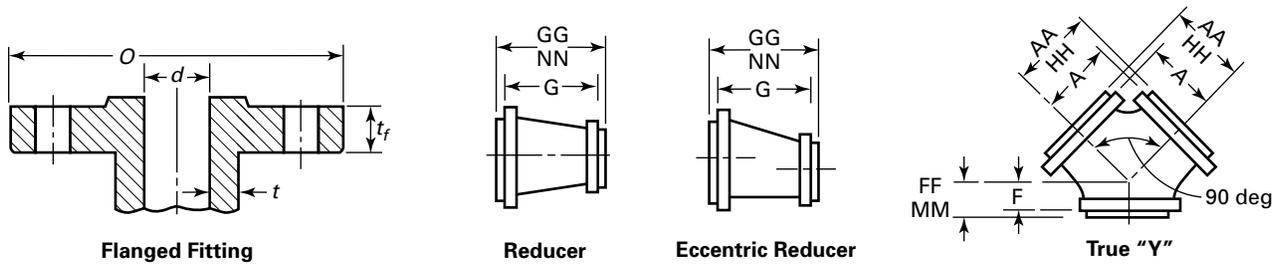
**Table E-5  
Dimensions of Class 2500 Flanged Fittings**



|             |   |   |   |   |   |   |   |   |    |
|-------------|---|---|---|---|---|---|---|---|----|
| 1           | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Flange Edge |   |   |   |   |   |   |   |   |    |

| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t<sub>f</sub></i> | Minimum Wall Thickness of Fitting, <i>t<sub>m</sub></i> | Inside Diameter of Fitting, <i>d</i> | Center-to-Flange Elbow, Tee, Cross, and True "Y," <i>A</i> | Center-to-Flange Edge, 45-deg Elbow, <i>CE</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> |
|-------------------|--------------------------------------|---|---|--------------------------------------|--|--|---|--|---|
| 1/2               | 5.25                                 | 1.19  | 0.25  | 0.44                                 | 4.94   | ...  | ...   | ...  | ...   |
| 3/4               | 5.50                                 | 1.25  | 0.28  | 0.56                                 | 5.12   | ...  | ...   | ...  | ...   |
| 1                 | 6.25                                 | 1.38  | 0.34  | 0.75                                 | 5.81   | 3.75   | ...   | ...  | ...   |
| 1 1/4             | 7.25                                 | 1.50  | 0.44  | 1.00                                 | 6.62   | 4.00   | ...   | ...  | ...   |
| 1 1/2             | 8.00                                 | 1.75  | 0.50  | 1.12                                 | 7.31   | 4.50   | ...   | ...  | ...   |
| 2                 | 9.25                                 | 2.00  | 0.62  | 1.50                                 | 8.62   | 5.50   | 15.00   | 5.00   | 9.00  |
| 2 1/2             | 10.50                                | 2.25  | 0.75  | 1.88                                 | 9.75   | 6.00   | 17.00   | 5.50   | 10.00   |
| 3                 | 12.00                                | 2.62  | 0.88  | 2.25                                 | 11.12  | 7.00   | 19.50   | 6.50   | 11.25   |
| 4                 | 14.00                                | 3.00  | 1.09  | 2.88                                 | 13.00  | 8.25   | 22.75   | 7.50   | 13.00   |
| 5                 | 16.50                                | 3.62  | 1.34  | 3.62                                 | 15.38  | 9.75   | 27.00   | 9.00   | 15.25   |
| 6                 | 19.00                                | 4.25  | 1.59  | 4.38                                 | 17.75  | 11.25  | 31.00   | 10.25  | 17.50   |
| 8                 | 21.75                                | 5.00  | 2.06  | 5.75                                 | 19.88  | 12.50  | 35.00   | 11.50  | 20.00   |
| 10                | 26.50                                | 6.50  | 2.59  | 7.25                                 | 24.75  | 15.75  | 43.00   | 14.50  | 25.00   |
| 12                | 30.00                                | 7.25  | 3.03  | 8.62                                 | 27.75  | 17.50  | 49.00   | 16.00  | 28.50   |

**Table E-5**  
**Dimensions of Class 2500 Flanged Fittings**



| 11   | 12  | 13   | 14   | 15  | 16   | 17                                  | 18                                 | 19   | 20                              | 1                 |
|--|---|--|--|---|--|-------------------------------------|------------------------------------|--|---------------------------------|-------------------|
| Raised Face 0.25 in. (1)   |   |  |  |   |  | Ring Joint (1)                      |                                    |  |                                 |                   |
| Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to-Contact Surface of Raised Face of Raised 45-deg Elbow, CC | Long Center-to-Contact Surface of Raised Face of Lateral, EE | Short Center-to-Contact Surface of Raised Face of Lateral and True "Y," FF | Contact Surface-to-Contact Surface of Raised Face Reducer, GG (2) | Center-to-End, Tee, Elbow, Cross, and True "Y," HH (3) | Center-to-End, 45-deg Elbow, KK (3) | Long Center-to-End Lateral, LL (3) | Short Center-to-End Lateral and True "Y," MM (3) | End-to-End Reducer, NN (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                |

**Table E-5**  
**Dimensions of Class 2500 Flanged Fittings (Cont'd)**

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## 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 21C](#).
- (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 end-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 5C](#) for ring joint facing dimensions.

# NONMANDATORY APPENDIX F

## METHOD USED TO ESTABLISH SI UNIT VALUES

### F-1 INTRODUCTION

The 2003 edition of ASME B16.5 contained dimensions expressed in millimeters and pressure–temperature ratings expressed in bar–Celsius, with U.S. Customary values enclosed in parentheses or listed separately from the SI values. This Appendix describes how the SI unit values were established at that time, then subsequently modified for the 2020 edition.

### F-2 SI VALUES FOR THE 2003 EDITION

The B16 Subcommittee C had two primary goals during the development of the SI values shown in ASME B16.5-2003.

(a) The dimensions expressed in millimeters should reflect the needed precision as closely as possible.

(b) Flanges manufactured using existing forging dies and machinery settings based on the inch dimensions should be able to meet the requirements for the millimeter dimensions.

#### F-2.1 Conversion From Fractional Inches

Before 1977, ASME B16.5 dimensions were expressed mostly in fractional inches instead of decimal inches. For the 1977 edition, the fractional-inch values were converted to decimal-inch values. For example,  $\frac{1}{8}$  in. was shown as 0.12 in. or 0.125 in., depending on the intended precision of the dimension.

Also, in the 1977 edition, millimeter dimensions were converted from the original fractional-inch dimensions rather than the decimal-inch dimensions. For example,  $\frac{1}{16}$  in. (0.0625 in.) was converted to 1.6 mm and 0.06 in. wherever the intended precision was 0.01 in. However, if one converts 0.06 in. to millimeters, one gets 1.5 mm, not 1.6 mm. Thus, to a user converting decimal inches to millimeters, some of the conversions in the 2003 tables would appear to be incorrect.

In the 1977 edition, the dimension  $\frac{1}{16}$  in. was sometimes converted to the nearest 0.1 mm, sometimes to the nearest 0.5 mm, and sometimes to the nearest 1 mm. The conversion depended on the intended precision of the measurement. So, the millimeter equivalent for 0.06 in. was sometimes shown as 1.6 mm, sometimes as 1.5 mm, and sometimes as 2 mm.

### F-2.2 Toleranced Dimensions

Dimensions that ensure adequate fit-up and contribute to the integrity of the pressurized flange joint require tolerances. In the 2003 edition, these toleranced dimensions were converted such that the millimeter dimensions were essentially the same as the fractional-inch dimensions, and the tolerances were selected such that the permitted deviations from the tabulated dimensions were nearly identical to those permitted by the inch dimensions. Examples include the following:

(a) Bolt circle diameter was converted to the nearest 0.1 mm. This level of precision is needed to minimize problems with fit-up to other flanges, even though the tolerance on the dimension is 1.5 mm. Converting with less precision may cause additional problems with centering metal gaskets.

(b) Length through hub was converted to the nearest 1 mm. This dimension needs to be consistent to maintain overall dimensions for fabricated spools. Maintaining this dimension to the nearest whole millimeter provides the needed precision.

### F-2.3 Untoleranced Dimensions

Dimensions that do not contribute significantly to proper fit-up or to the integrity of the pressurized flanged joint do not require tolerances. The following are examples of untoleranced dimensions and the philosophies used to convert them to the millimeter dimensions:

(a) A  $\frac{1}{16}$ -in. raised face was converted to 2 mm instead of 1.6 mm. Raised faces measuring other than 2 mm meet the requirements of the Standard. Conversion to the nearest millimeter reflects the intended precision of the dimension.

(b) Outside diameter of flanges was converted to the nearest 5 mm. For example, for NPS  $\frac{3}{4}$  Class 600 flange outside diameter,  $4\frac{5}{8}$  in. was converted to the nearest 5 mm (115 mm) instead of the nearest whole millimeter (117 mm) or tenth millimeter (117.5 mm). Outside diameters measuring other than 115 mm meet the requirements of the Standard. Conversion to the nearest 5 mm reflects the intended precision of the dimension.

(c) Bolt hole diameters were kept in fractional inches. Inch-dimension bolt holes were retained for flanges manufactured to millimeter dimensions. Inch bolts

should be used with these flanges. Extensive dimensional compatibility studies were conducted to explore the possibility of using millimeter- as well as inch-dimensioned bolting with ASME B16.5 flanges. The studies revealed that providing dimensions that allowed for the use of millimeter as well as inch-dimensioned bolts, especially when combined with metal gaskets, was impossible. This conclusion was supported by experience with some flanges manufactured to the 1980 edition of ISO 7005-1: Metallic flanges — Part 1: Steel flanges.

#### **F-2.4 In Summary**

The B16 Subcommittee C did not intentionally change any of the requirements for dimensions in the 2003 edition of ASME B16.5. The dimensions expressed in millimeters reflected the needed precision as closely as possible.

Flanges that were manufactured using existing forging dies and machinery settings based on the inch dimensions were able to meet the 2003 requirements for the millimeter dimensions. The acceptable dimension ranges for toleranced dimensions were not precisely the same in the two units of measure, but there was a significant amount of overlap. Still, it was possible for a flange to meet the requirements in one system of units and not in the other.

#### **F-3 SI VALUES FOR THE 2020 EDITION**

While the differences in inch and millimeter dimensions between the two versions of the same flange did not result in any known functional problem, the differences did confuse manufacturers and users alike. For example, since the precision of conversion of the flange outside diameter was to the nearest 5 mm, there sometimes was a difference of 2 mm to 3 mm between mating-flange outside diameters. This introduced a practical problem for users who welded attachments to mating flanges, and it also created an appearance problem. Engineers were confused when comparing inch and millimeter dimensions in the tables when the dimensions didn't match. They didn't know which dimension to use.

To address these problems, ASME B16.5-2020 features millimeter dimensions that have been converted from the decimal-inch dimensions rather than the fractional-inch dimensions and the conversions are more precise. The following are examples of changes in the 2020 edition:

(a) Outside diameters of flanges have been converted to nearest 1 mm instead of the nearest 5 mm.

(b) Raised face heights have been converted from 0.06 in. to 1.5 mm and from 0.25 in. to 6.4 mm instead of from 0.06 in. to 2 mm and from 0.25 in. to 7 mm.

(c) Inch tolerances have been revised to more closely match the millimeter tolerances.

## NONMANDATORY APPENDIX G

### LOW TEMPERATURE APPLICATIONS

(25)

#### G-1 GENERAL

Low temperature limits are typically provided by referencing codes such as the ASME B31 Piping Codes. The referencing codes do not provide identical requirements and the instructions for determining the coldest acceptable use temperature are sometimes complex.

#### G-2 EXAMPLES

ASME B31T establishes a low-temperature service limit for piping components. If the intended operating temperature is equal to or colder than the low-temperature service limit, additional requirements such as impact testing and heat treatment may be required. Examples of the requirements in the 2018 edition of ASME B31T are shown in [Table G-1](#) to help the users of this Standard understand the approach taken. These examples are simplifications of the rules in ASME B31T, i.e., not all of the provisions are explained here.

According to ASME B31T, the coldest acceptable use temperature is a function of

- (a) the material
- (b) the thickness of the material for some steels
- (c) the stresses applied to the installed flange or flanged fitting at the cold condition

ASME B31T allows flanges and flanged fittings to be qualified for colder use temperatures if impact testing demonstrates the material has adequate toughness at that condition.

It is the responsibility of the user to ensure the correct material is selected to meet the installation's cold use temperature requirements and to communicate any additional requirements (e.g., heat treatment and impact testing) to the manufacturer prior to the time of purchase.

**Table G-1**  
**Example Minimum Use Temperatures**

| Material Group                                      | Temperature Class                       | Class Specification  | Coldest Temperature Without Impact Testing | Notes    |
|---|---|--|--|----------|
| 1.1 through 1.4                                     | Normal carbon steels                    | A105   | -29°C (-20°F)                              | (1)      |
|   |   | A350 Gr. LF1   | -29°C (-20°F)                              | (2)      |
|   |   | A216 Grs. WCB, WCC,  | -29°C (-20°F)                              |          |
|   |   | A515 Grs. 65, 70   | -13°C (18°F)                               | (3)      |
|   |   | A515 Gr. 60  | -29°C (-20°F)                              | (3)      |
|   |   | A516 Grs. 65, 70 (not normalized)                                    | -29°C (-20°F)                              | (3)      |
|   | Low temperature carbon steels           | A516 Gr. 60 (not normalized)   | -48°C (-55°F)                              | (3)      |
|   |   | A516 Grs. 60, 65, 75 (normalized)                                    | -48°C (-55°F)                              | (3)      |
|   |   | A350 Gr. LF2 Cl. 2   | -46°C (-50°F)                              | (2)      |
|   |   | A350 Grs. LF6 CLs. 1, 2  | -51°C (-60°F)                              | (2)      |
|   |   | A352 Grs. LCB, LCC   | -46°C (-50°F)                              | (2)      |
|   |   | A537 CL. 1   | -48°C (-55°F)                              | (3)      |
|   | Normal low alloy steels                 | A217 WC1   | -29°C (-20°F)                              |          |
|   |   | A203 Grs. A, B, D, E   | -29°C (-20°F)                              |          |
|   | Low temperature low alloy steels        | A352 LC1   | -59°C (-75°F)                              | (2)      |
|   |   | A352 LC2   | -73°C (-100°F)                             | (2)      |
| A352 LC3  |   | -101°C (-150°F)  | (2)  |          |
| A350 LF3  |   | -101°C (-150°F)  | (2)  |          |
| 1.5 to 1.18   | Normal low alloy steels                 | A182 Grs. F1, F2, F5, 5a, F9, F11, F12, F22, F91, F92                | -29°C (-20°F)                              |          |
|   |   | A217 Grs. WC4, WC5, WC6, WC9, C5, C12, C12A                          | -29°C (-20°F)                              |          |
|   |   | A204 Grs. A, B, C  | -29°C (-20°F)                              |          |
|   |   | A387 Grs. 11, 22, 91   | -29°C (-20°F)                              |          |
| 2.1 to 2.12 (except material group 2.8. See below.) | Normal stainless steels                 | A351 Grs. CH20, CK20   | -29°C (-20°F)                              | (4)      |
|   |   | A240 Types 304, 304L, 316, 316L, 321, 347                            | -29°C (-20°F)                              | (5)      |
|   |   | A240 Types 317, 317L, 321H, 348                                      | -29°C (-20°F)                              | (5)      |
|   |   | A182 Gr. F310  | -29°C (-20°F)                              | (4), (6) |
|   |   | A240 Grs. 309S, 310S   | -29°C (-20°F)                              | (4), (5) |
|   | Low temperature stainless steels        | A182 Grs. F304H, F316H, F317L, F321, F321H, F347, F347H, F348, F348H | -198°C (-325°F)                            |          |
|   |   | A182 Gr. F310  | -198°C (-325°F)                            | (4), (8) |
|   |   | A240 Grs. 309S, 310S   | -198°C (-325°F)                            | (4), (7) |
|   |   | A240 Types 317, 317L, 321, 321H, 347, 348                            | -198°C (-325°F)                            | (7)      |
|   |   | A351 Gr. CF8C  | -198°C (-325°F)                            |          |
|   |   | A182 Grs. F304, F316, F304L, F316L,                                  | -254°C (-425°F)                            |          |
|   |   | A351 Grs. CH8, CG8M (not listed)                                     | -198°C (-325°F)                            |          |
|   |   | A351 Grs. CF3, CF8, CF3M, CF8M                                       | -254°C (-425°F)                            |          |
|   |   | A240 Types 304, 304L, 316, 316L                                      | -254°C (-425°F)                            | (7)      |
| 2.8   | Low temperature duplex stainless steels | A182 Grs. F51, F53, F55  | Not listed in B31T                         |          |
|   |   | A995 Grs. CE8MN (2A), CD3MWCuN (6A)                                  | -51°C (-60°F)                              |          |
|   |   | A995 Gr. CD4MCuN   | Not listed in B31T                         |          |
|   |   | A240 Grs. S31803, S32750   | Not listed in B31T                         |          |
|   |   | A240 Gr. S32760  | -51°C (-60°F)                              |          |
| 3.1 to 3.19   | Low temperature nickel alloys           | All listed B16.5 materials   | -198°C (-325°F)                            |          |

**Table G-1**  
**Example Minimum Use Temperatures (Cont'd)**

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NOTES:

- (1) Class 400 and higher A105 flanges require heat treatment.
- (2) Materials require impact testing.
- (3) The minimum temperature for many carbon steel flanges is subject to a governing thickness correction. Minimum temperature becomes warmer for thicker flanges. Based on the material T-Number for the carbon steel flange from ASME B31T, Table 3.2-1, determine the minimum temperature as a function of flange thickness from ASME B31T, Figure I-1 (Figure I-1M) or Table I-1.
- (4) This material may have low impact properties at room temperature after being exposed to high service temperature.
- (5) Material is not solution heat treated after forming.
- (6) Carbon content > 0.10%.
- (7) Material is solution heat treated after forming.
- (8) Carbon content ≤ 0.10%.

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

|             |   |
|-------------|---|
| B16.1-2020  | Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250   |
| B16.3-2021  | Malleable Iron Threaded Fittings: Classes 150 and 300   |
| B16.4-2021  | Gray Iron Threaded Fittings: Classes 125 and 250  |
| B16.5-2025  | Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard  |
| B16.9-2024  | Factory-Made Wrought Butt welding Fittings  |
| B16.10-2022 | Face-to-Face and End-to-End Dimensions of Valves  |
| B16.11-2021 | Forged Fittings, Socket-Welding and Threaded  |
| B16.12-2025 | Cast Iron Threaded Drainage Fittings  |
| B16.14-2024 | Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads  |
| B16.15-2024 | Cast Copper Alloy Threaded Fittings   |
| B16.18-2021 | Cast Copper Alloy Solder Joint Pressure Fittings  |
| B16.20-2023 | Metallic Gaskets for Pipe Flanges   |
| B16.21-2021 | Nonmetallic Flat Gaskets for Pipe Flanges   |
| B16.22-2021 | Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings  |
| B16.23-2021 | Cast Copper Alloy Solder Joint Drainage Fittings: DWV   |
| B16.24-2021 | Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500                        |
| B16.25-2022 | Butt welding Ends   |
| B16.26-2024 | Cast Copper Alloy Fittings for Flared Copper Tubes  |
| B16.29-2022 | Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings — DWV  |
| B16.33-2024 | Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 175 psi (Sizes NPS ½ Through NPS 2)                   |
| B16.34-2025 | Valves — Flanged, Threaded, and Welding End   |
| B16.36-2025 | Orifice Flanges   |
| B16.38-2023 | Large Metallic Valves for Gas Distribution: Manually Operated, NPS 2½ (DN 65) to NPS 12 (DN 300),<br>125 psig (8.6 bar) Maximum |
| B16.39-2025 | Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300  |
| B16.40-2024 | Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems   |
| B16.42-2021 | Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300   |
| B16.44-2023 | Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems Up to 5 psi   |
| B16.47-2025 | Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard  |
| B16.48-2025 | Line Blanks   |
| B16.49-2023 | Factory-Made, Wrought Steel, Butt welding Induction Bends for Transportation and Distribution Systems                           |
| B16.50-2021 | Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings   |
| B16.51-2021 | Copper and Copper Alloy Press-Connect Pressure Fittings   |
| B16.52-2024 | Forged Nonferrous Fittings, Socket-Welding and Threaded (Titanium, Titanium Alloys, Aluminum, and Aluminum Alloys)              |

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