

ASME B16.5-2017
(Revision of ASME B16.5-2013)

Pipe Flanges and Flanged Fittings

NPS ½ Through NPS 24
Metric/Inch Standard

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

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**The American Society of
Mechanical Engineers**

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FOREWORD

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

The Committee soon recognized the need for standardization of steel pipe flanges. In May 1923, Subcommittee 3 was organized to develop such standards for pressures in the 250-psi to 3,200-psi range and for elevated temperatures. Active work began in October, including steel flanged fittings. The first proposed standard was submitted to the Committee in April 1926 and approved by letter ballot in December. After favorable review by the three sponsor organizations, the Standard was approved as American Tentative Standard B16e in June 1927.

Experience in using the Standard showed the need for hub dimensions of companion flanges and for other changes, including rerating of 250-lb and 1,350-lb flanges and development of flanged fittings with integral bases. An investigation was made into the factors determining stiffness of flanges and flange hubs. The revised edition was approved as ASA B16E-1932.

A revision was initiated in 1936, stimulated by suggestions from Committee members and industrial users. The resulting 1939 edition contained standards for welding neck flanges (completed in March 1937), 1,500-lb flanges in the 14-in. through 24-in. range, 2,500-lb flanges and flanged fittings in the $\frac{1}{2}$ -in. through 12-in. range, and dimensions for a full line of ring joint flanges developed by the American Petroleum Institute. Pressure-temperature ratings for alloy steel flanges and fittings, developed by Subcommittee 4, were included for the first time.

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

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

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

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

A new joint study of ratings between Subcommittees 3 and 4 was initiated before the next revision. Based on the Subcommittee 4 report, the rating procedure was revised, and a rating basis for Class 150 (150 lb) flanges was developed. New product forms, bar and plate, were added for special applications, including fabricated flanged valves and fittings. Reference to welding-end valves was not included, because a separate standard for them was 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 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 Code allowable stresses, Subcommittee C and Subcommittee N agreed that ratings would be left alone unless the relevant Code stress values were changed by more than 10%. After final approval by the Standards Committee, cosponsors, and the American National Standards Institute (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 Standard Committee and ASME, approval as an American National Standard was given by ANSI on April 7, 1988, with the new designation ASME/ANSI B16.5-1988.

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

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

All pressure-temperature ratings were recalculated using data from the latest edition of the ASME Boiler and Pressure Vessel Code, Section II, Part D. Annex F was added to cover pressure-temperature ratings and dimensional data for 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 the Materials [paragraph 5.1](#) and included 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 includes the use of bar stock for blind flanges without hubs; adds requirements for forgings, size NPS 22; and updates materials and working pressures.

Following approval of the Standards Committee and ASME, approval for the new edition was granted by the ANSI on February 14, 2017.

ASME B16 COMMITTEE

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

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

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

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Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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

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ASME B16.5-2017

SUMMARY OF CHANGES

Following approval by the ASME Committee and ASME, and after public review, ASME B16.5-2017 was approved by the American National Standards Institute on February 14, 2017.

ASME B16.5-2017 includes the following changes identified by a margin note, (17).

The Record Number listed below is 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>
4	5.1	Revised (10-511, 11-544)
5	Table 1A	(1) Fifth entry under Nominal Designation for Material Group 2.8, fifth entry under Nominal Designation revised (15-1970) (2) Fourth and fifth entries under Castings for Material Group 2.8, fourth and fifth entries under Castings revised (15-1970)
12	6.9.5	Revised (11-545)
13	Get more FREE standards from Standard Shaping Group at ASME.org/Standards	(1) Note 1 deleted (14-2174) (2) First entry under Carbon Steel and Alloy Steel revised (14-2174)
37	Table 2-1.18	Last row, third and fifth through eighth columns revised (15-1921)
45	Table 2-2.8	(1) Fifth entry under Nominal Designation revised (15-1970) (2) Fourth, fifth, and sixth entries under Castings revised (15-1970)
65	Table 3	Second-to-last row added (12-566)
66	Table 4	Row for NPS 22 added (12-566)
69	Table 5	Entries for NPS 22 added (12-566)
76	Table 7	Row for NPS 22 added (12-566)
77	Table 8	Row for NPS 22 added (12-566)
85	Table 10	Row for NPS 22 added (12-566)
86	Table 11	(1) Illustration for “Threaded” revised (15-842) (2) Row for NPS 22 added (12-566)
93	Table 13	Row for NPS 22 added (12-566)
94	Table 14	Row for NPS 22 added (12-566)
96	Table 15	Row for NPS 22 added (12-566)
97	Table 16	Row for NPS 22 added (12-566)
129	Table II-2-1.18	Last row, third and fifth through eighth columns revised (15-1921)

137	Table II-2-2.8	(1) Fifth row under Nominal Designation revised (15-1970)
155	Table II-3	(2) Fourth, fifth, and sixth entries under Castings revised (15-1970)
156	Table II-4	Row for NPS 22 added (12-566)
159	Table II-5	Row for NPS 22 added (12-566)
166	Table II-7	Entries for NPS 22 added (12-566)
167	Table II-8	Row for NPS 22 added (12-566)
173	Table II-10	Row for NPS 22 added (12-566)
174	Table II-11	(1) Illustration for "Threaded" revised (15-842) (2) Row for NPS 22 added (12-566)
181	Table II-13	Row for NPS 22 added (12-566)
182	Table II-14	Row for NPS 22 added (12-566)
184	Table II-15	Row for NPS 22 added (12-566)
185	Table II-16	Row for NPS 22 added (12-566)
195	Mandatory Appendix III	Revised (14-2174)

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
10-511	Revised para 5.1(a) to add use of bar stock for blind flanges without hubs.
11-544	Revised para. 5 to explicitly require forgings to be made near the shape of the finished flange.
11-545	Revised para 6.9.5 to correct thread gage plane reference.
12-566	Added NPS 22 to Tables 3, 4, 5, 7, 8, 10, 11, 13, 14, 15, 16, II-3, II-4, II-5, II-7, II-8, II-10, II-11, II-13, II-14, II-15, II-16 .
14-2174	Revised references for stud bolts in Table 1C and Mandatory Appendix III .
15-842	Revised illustrations for "Threaded" in Tables 11 and II-11 .
15-1921	Revised pressure-temperature working pressures in Tables 2-1.18 and II-2-1.18 .
15-1970	In Table 1A , changed A351 Gr CE8MN to A995 Gr CE8MN, in Tables 2-2.8 and II-2-2.8 , changed A351 to A995 for CD4MCu and CD3MWCuN.

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PIPE FLANGES AND FLANGED FITTINGS

NPS $\frac{1}{2}$ THROUGH NPS 24 METRIC/INCH STANDARD

1 SCOPE

1.1 General

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

(1) flanges with rating class designations 150, 300, 400, 600, 900, 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

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

1.2 References

Codes, standards, and specifications, containing provisions to the extent referenced herein, constitute requirements of this Standard. These reference documents are listed in [Mandatory Appendix III](#).

1.3 Time of Purchase, Manufacture, or Installation

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

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

1.4 User Accountability

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

1.5 Quality Systems

Requirements relating to the product manufacturer's Quality System Program are described in [Nonmandatory Appendix D](#).

1.6 Relevant Units

This Standard states values in both 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 that appear in [Mandatory Appendix II](#). The values stated in each system are not exact equivalents; therefore, it is required that each system of units be used independently of the other. Except for diameter of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard.

1.7 Selection of Materials

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

1.8 Convention

For 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
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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
½	15
¾	20
1	25
1¼	32
1½	40
2	50
2½	65
3	80
4	100

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

2 PRESSURE-TEMPERATURE RATINGS

2.1 General

Pressure–temperature ratings are maximum allowable working gage pressures in bar units at the temperatures in degrees Celsius shown in Tables 2-1.1 through 2-3.19 for the applicable material and class designation. Tables II-2-1.1 through II-2-3.19 of Mandatory Appendix II list pressure–temperature ratings using psi units for pressure at the temperature in degrees Fahrenheit. For intermediate temperatures, linear interpolation is permitted. Interpolation between class designations is not permitted.

2.2 Flanged Joints

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

2.3 Ratings of Flanged Joints

2.3.1 Basis. Pressure–temperature ratings apply to flanged joints that conform to the limitations on bolting in para. 5.3 and on gaskets in para. 5.4, which are made up in accordance with good practice for align-

ment and assembly (see para. 2.2). Use of these ratings for flanged joints not conforming to these limitations is the responsibility of the user.

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

2.4 Rating Temperature

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

2.5 Temperature Considerations

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

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

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

2.6 System Hydrostatic Testing

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

2.7 Welding Neck Flanges

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

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

where

A_h = tabulated hub diameter, beginning of chamfer as listed in the dimensional tables

B_{\max} = maximum permissible diameter for the bore of a welding neck flange

C_o = 14.5 when p_c is expressed in bar units or 1.0 when p_c is expressed in psi units from Standard Sharing Group and our chats

p_c = ceiling pressure value at 38°C (100°F), Tables A-1 and A-2 of Nonmandatory Appendix A

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

The tabulated ratings for welding neck flanges are independent of components to which they may be attached, and the pressure rating of the flange shall not be exceeded. Attachment welds should be made in accordance with the applicable code or regulation. See para. 6.7 and 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, 2.8.3, and 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 II-8, II-11, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II). In Figure 4 the tolerances described in para. 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 shall be equal to B dimension of the welding neck flange. Other bores may be furnished by agreement between the end user and manufacturer. In no case shall the bore diameter exceed the bore of the same size and class lapped flange.

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

2.9 Multiple Material Grades

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

3 COMPONENT SIZE

3.1 Nominal Pipe Size

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

3.2 Reducing Fittings

Reducing fittings shall be designated by the NPS for the openings in the sequence indicated in the sketches of Figure 5.

3.3 Reducing Flanges

Reducing flanges shall be designated by the NPS for each opening. See examples in Note (4) of Table 6 (Table II-6 of Mandatory Appendix II).

4 MARKING

4.1 General

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

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

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,² grade identification symbol (letters and numbers), and the melt number or melt identification.

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

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

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

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

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

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

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

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

4.2.8 Multiple Material Marking. Material for components that meet the requirements for more than one specification or grade of a specification listed in [Table 1A](#) may, at the manufacturer's option, be marked with more than one of the applicable specification or grade symbols. These identification markings shall be placed so as to avoid confusion in identification. The multiple marking shall

be in accordance with the guidelines set out in ASME Boiler and Pressure Vessel Code, Section II, Part D, Mandatory Appendix 7.

5 MATERIALS

5.1 General

(17)

(a) Materials required for flanges and flanged fittings are listed in [Table 1A](#) 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 1B](#) (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 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; Section II, Part D, Nonmandatory Appendix A; and Section III, Division 1, Nonmandatory Appendix W of the ASME Boiler and Pressure Vessel Code.

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

5.1.3 Responsibility. When service conditions dictate the implementation of special material requirements [e.g., using a Group 2 material above 538°C ($1,000^{\circ}\text{F}$)], it is the user's responsibility to so specify

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

(17)

Table 1A List of Material Specifications

Material Group	Nominal Designation	Pressure-Temperature Rating Table	Applicable ASTM Specifications [Note (1)]		
			Forgings	Castings	Plates
1.1	C-Si	2-1.1	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	1¼Cr-½Mo	2-1.9	...	A217 Gr. WC6	...
	1¼Cr-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	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	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
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

(17)

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

Material Group	Nominal Designation	Pressure-Temperature Rating Table	Applicable ASTM Specifications [Note (1)]		
			Forgings	Castings	Plates
2.2	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
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. F310	...	A240 Gr. 310H
2.8	20Cr-18Ni-6Mo	2-2.8	A182 Gr. F44	A351 Gr. CK3MCuN	A240 Gr. S31254
	22Cr-5Ni-3Mo-N	2-2.8	A182 Gr. F51	...	A240 Gr. S31803
	25Cr-7Ni-4Mo-N	2-2.8	A182 Gr. F53	...	A240 Gr. S32750
	24Cr-10Ni-4Mo-V	2-2.8	...	A995 Gr. CE8MN	...
	25Cr-5Ni-2Mo-3Cu-N	2-2.8	...	A995 Gr. CD4MCuN	...
	25Cr-7Ni-3.5Mo-W-Cb	2-2.8	...	A995 Gr. CD3MWCuN	...
	25Cr-7.5Ni-3.5Mo-N-Cu-W	2-2.8	A182 Gr. F55	...	A240 Gr. S32760
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	...
3.1	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	...	B127 Gr. N04400
3.5	72Ni-15Cr-8Fe	2-3.5	B564 Gr. N06600	...	B168 Gr. N06600

(17)

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

Material Group	Nominal Designation	Pressure-Temperature Rating Table	Applicable ASTM Specifications [Note (1)]		
			Forgings	Castings	Plates
3.6	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
	64Ni-29.5Mo-2Cr-2Fe-Mn-W	2-3.7	B462 Gr. N10675	...	B333 Gr. N10675
3.8	54Ni-16Mo-15Cr	2-3.8	B462 Gr. N10276	...	B575 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-23Cr-16Mo-1.6Cu	2-3.8	B462 Gr. N06200	...	B575 Gr. N06200
3.9	47Ni-22Cr-9Mo-I8Fe	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	B599 Gr. N08700
3.11	44Fe-25Ni-21Cr-Mo	2-3.11	A479 Gr. N08904	...	A240 Gr. N08904
3.12	26Ni-43Fe-22Cr-5Mo 47Ni-22Cr-20Fe-7Mo 46Fe-24Ni-21Cr-6Mo-Cu-N	2-3.12	B620 Gr. N08320
		2-3.12	B582 Gr. N06985
		2-3.12	B462 Gr. N08367	A351 Gr. CN3MN	B688 Gr. N08367
3.13	49Ni-25Cr-18Fe-6Mo Ni-Fe-Cr-Mo-Cu-Low C	2-3.13	B582 Gr. N06975
		2-3.13	B564 Gr. N08031	...	B625 Gr. N08031
3.14	47Ni-22Cr-19Fe-6Mo 40Ni-29Cr-15Fe-5Mo 58Ni-33Cr-8Mo	2-3.14	B582 Gr. N06007
		2-3.14	B462 Gr. N06030	...	B582 Gr. N06030
		2-3.14	B462 Gr. N06035	...	B575 Gr. N06035
3.15	42Ni-42Fe-21Cr	2-3.15	B564 Gr. N08810	...	B409 Gr. N08810
3.16	35Ni-19Cr-1 $\frac{1}{4}$ Si	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 II-2-1.1](#) through [II-2-3.17](#) of [Mandatory Appendix II](#).
- (b) Plate materials are listed only for use as blind flanges and reducing flanges without hubs (see [para. 5.1](#)). Additional plate materials listed in ASME B16.34 may also be used with corresponding B16.34, Standard Class ratings.

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

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 II-2-1.1 through II-2-3.19](#) of [Mandatory Appendix II](#)).

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

5.2 Mechanical Properties

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

5.3 Bolting

5.3.1 General. Bolting listed in [Table 1B](#) is recommended for use in flanged joints covered by this Standard. Bolting of other material may be used if permitted by the applicable code or government regulation. Bolting materials are subject to the limitations given in [paras. 5.3.2 through 5.3.5](#).

5.3.2 High-Strength Bolting. Bolting materials having allowable stresses not less than those for ASTM A193 Grade B7 are listed as high strength in [Table 1B](#). These and other materials of comparable strength may be used in any flanged joint.

5.3.3 Intermediate-Strength Bolting. Bolting materials listed as intermediate strength in [Table 1B](#), and other bolting of comparable strength, may be used in any flanged joint provided the user verifies their ability to seat the selected gasket and maintain a sealed joint under expected operating conditions.

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

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

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

(b) Where Class 150 steel flanges are bolted to Class 125 cast iron flanges, the gaskets should be made of [Nonmandatory Appendix B, Table B-1](#), Group No. 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](#).

5.4.2 Gaskets for Low-Strength Bolting. If bolting listed as low strength in [Table 1B](#) is used, gaskets shown in [Nonmandatory Appendix B, Table B-1](#), Group No. Ia are recommended.

5.4.3 Gaskets for Class 150 Flanged Joints. It is recommended that only [Nonmandatory Appendix B, Table B-1](#), Group No. I gaskets be used for Class 150 flanged joints. When the ring joint or spiral wound gasket is selected, it is recommended that line flanges be of the welding neck or lapped joint type.

6 DIMENSIONS

6.1 Flanged Fittings Wall Thickness

6.1.1 Minimum Wall Thickness. For inspection purposes, the minimum wall thickness, t_m , of flanged fittings at the time of manufacture shall be as shown in [Tables 9 and 12](#) ([Tables II-9 and II-12](#) of [Mandatory Appendix II](#)), except as provided in [para. 6.1.2](#). The

Table 1B List of Bolting Specifications: Applicable ASTM Specifications

Bolting Materials [Note (1)]											
High Strength [Note (2)]			Intermediate Strength [Note (3)]			Low Strength [Note (4)]			Nickel and Special Alloy [Note (5)]		
Spec. No.	Grade	Notes	Spec. No.	Grade	Notes	Spec. No.	Grade	Notes	Spec. No.	Grade	Notes
A193	B7	...	A193	B5	...	A193	B8 Cl. 1	(6)	B164	...	(7)–(9)
A193	B16	...	A193	B6	...	A193	B8C Cl. 1	(6)
A193	B16	...	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)
			A193	B8 Cl. 2B	(11)					N10675	(7)
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	...							B473	...	(7)
A354	BD	...	A320	B8 Cl. 2	(11)	A307	B	(12)			
			A320	B8C Cl. 2	(11)				B574	...	(7)
A540	B21	...	A320	B8F Cl. 2	(11)	A320	B8 Cl. 1	(6)			
A540	B22	...	A320	B8M Cl. 2	(11)	A320	B8C Cl. 1	(6)			
A540	B23	...	A320	B8T Cl. 2	(11)	A320	B8M Cl. 1	(6)			
A540	B24	...							A320	B8T Cl. 1	(6)
			A449		(13)						
			A453	651	(14)						
			A453	660	(14)						

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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 corresponding 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.
- (11) This austenitic stainless material has been carbide solution treated and strain hardened. Use A194 nuts of corresponding material.
- (12) This carbon steel fastener shall not be used above 200°C (400°F) or below -29°C (-20°F) [see also Note (4)]. Bolts with drilled or undersized heads shall not be used.
- (13) Acceptable nuts for use with quenched and tempered bolts are A194 Gr. 2 or Gr. 2H. Mechanical property requirements for studs shall be the same as those for bolts.
- (14) This special alloy is intended for high-temperature service with austenitic stainless steel.

additional metal thickness needed to withstand installation bolt-up assembly stresses, shapes other than circular, and stress concentrations must be determined by the manufacturer, since these factors vary widely. In particular, 45-deg laterals, true Ys, and crosses may require additional reinforcement to compensate for inherent weaknesses in these shapes.

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

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

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

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

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

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

6.2.2 Standard Fittings. Center-to-contact surface, center-to-flange edge, and center-to-end (ring joint) dimensions are shown in Tables 9 and 12 (Tables II-9 and II-12 of Mandatory Appendix II).

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

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

6.2.5 Special Degree Elbows. Special degree elbows ranging from 1 deg to 45 deg, inclusive, shall have the same center-to-contact surface dimensions as 45-deg elbows, and those over 45 deg and up to 90 deg, inclusive, shall have the same center-to-contact surface dimensions

as 90-deg elbows. The angle designation of an elbow is its deflection from straight line flow and is also the angle between the flange faces.

6.3 Flat Face Flanges

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

6.3.2 Conversion. A raised face may be removed from a raised face flange to convert it to a flat face flange, provided that the required dimension, t_f shown in Figure 6 (Figure II-6 of Mandatory Appendix II) is maintained.

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

6.4 Flange Facings

6.4.1 General. Figure 6 (Figure II-6 of Mandatory Appendix II) shows dimensional relationships for various flange types and pipe lap facings to be used with lap joints. Table 4 (Table II-4 of Mandatory Appendix II) lists dimensions for facings other than ring joint. Table 5 (Table II-5 of Mandatory Appendix II) lists dimensions for ring joint facings. Classes 150 and 300 pipe flanges and companion flanges of fittings are regularly furnished with 2 mm (0.06 in.) raised face, which is in addition to the minimum flange thickness, t_f . Classes 400, 600, 900, 1500, and 2500 pipe flanges and companion flanges of fittings are regularly furnished with 7 mm (0.25 in.) raised face, which is in addition to the minimum flange thickness, t_f .

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

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

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

6.4.3 Lapped Joint Flanges. Lapped joint flanges shall be furnished with flat faces as illustrated in Tables 8, 11, 14, 16, 18, 20, and 22 (Tables II-8, II-11, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II). Lap joint stub ends shall be in accordance with Figure 6 (Figure II-6 of Mandatory Appendix II) and paras. 6.4.3.1 through 6.4.3.3.

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

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

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

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

6.4.3.5 Lap Joint Facing Outside Diameters. The outside diameters of the lap for ring joints are shown in [Table 5 \(Table II-5 of Mandatory Appendix II\)](#), dimension K. The outside diameters of laps for large female, large tongue and groove, and small tongue and groove are shown in [Table 4 \(Table II-4 of Mandatory Appendix II\)](#). Small male and female facings for lapped joints are not covered by this Standard.

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

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

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

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

6.4.5.3 Other Flange Facings. Either a serrated concentric or serrated spiral finish having a resultant surface finish from 3.2 μm to 6.3 μm (125 $\mu\text{in.}$ to 250 $\mu\text{in.}$) average roughness shall be furnished. The cutting tool employed should have an approximate 1.5 mm

(0.06 in.) or larger radius, and there should be from 1.8 grooves/mm through 2.2 grooves/mm (45 grooves/in. through 55 grooves/in.).

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

6.5 Flange Bolt Holes

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

6.6 Bolting Bearing Surfaces

Flanges and flanged fittings shall have bearing surfaces for bolting that are parallel to the flange face within 1 deg. Any back facing or spot facing shall not reduce the flange thickness, t_f , below the dimensions given in [Tables 8, 9, 11, 12, 14, 16, 18, 20, and 22 \(Tables II-8, II-9, II-11, II-12, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II\)](#). Spot facing or back facing shall be in accordance with MSS SP-9.

6.7 Welding End Preparation for Welding Neck Flanges

6.7.1 Illustrations. Welding ends are illustrated in [Figures 7 through 10 \(Figures II-7 through II-10 of Mandatory Appendix II\)](#) and [Figures 1 through 3](#).

6.7.2 Contours. The contours of the outside of the welding neck beyond the welding groove are shown in [Figures 7 and 8 \(Figures II-7 and II-8 of Mandatory Appendix II\)](#) and [Figures 1 and 3](#).

6.7.3 Bores. Straight-through bores shown in [Figures 7 and 8 \(Figures II-7 and II-8 of Mandatory Appendix II\)](#) are standard unless specifically ordered to suit the special conditions illustrated in [Figures 9 and 10 \(Figures II-9 and II-10 of Mandatory Appendix II\)](#) and [Figures 2 and 3](#).

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

6.8 Reducing Flanges

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

6.8.2 Hub Dimensions

6.8.2.1 Threaded, Socket Weld, and Slip-On Flanges.

The hub dimension shall be at least as large as those of the standard flange of the size to which the reduction is being made. The hub may be larger or omitted as detailed in [Table 6 \(Table II-6 of Mandatory Appendix II\)](#).

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

6.9 Threaded Flanges

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

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

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

6.9.4 Reducing Flange Thread Length. The minimum length of effective thread in reducing flanges shall be at least equal to dimension T of the corresponding class of threaded flange as shown in [Tables 8, 9, 11, 12, 14, 16, 18, 20, and 22 \(Tables II-8, II-9, II-11, II-12, II-14, II-16, II-18, II-20, and II-22, of Mandatory Appendix II\)](#). Threads do not necessarily extend to the face of the flange. See [Table 6 \(Table II-6 of Mandatory Appendix II\)](#) for reducing threaded flanges.

(17) **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 1C](#). See [para. 5.3](#) for bolting material recommendations.

6.10.2 Bolt Lengths. Stud bolt lengths, including the height of two heavy hexagon nuts, are shown as dimension L in [Tables 7, 10, 13, 15, 17, 19, and 21 \(Tables II-7, II-10, II-13, II-15, II-17, II-19, and II-21 of Mandatory Appendix II\)](#). The tabulated stud bolt length L does not include the height of end points. An end point is defined as an unthreaded length, such as a chamfer, which extends beyond the thread. The method of calculating bolt lengths is explained in [Nonmandatory Appendix C](#). The tabulated bolt lengths are reference dimensions. Users may select other bolting lengths.

6.10.3 Bolting Recommendations. For flange joints, stud bolts with a nut at each end are recommended 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

(17)

Table 1C Flange Bolting Dimensional Recommendations

Product	Carbon Steel	Alloy Steel
Stud bolts	ASME B18.31.2	ASME B18.31.2
Bolts smaller than $\frac{3}{4}$ in.	ASME B18.2.1, square or heavy hex head	ASME B18.2.1, heavy hex head
Bolts equal to or larger than $\frac{3}{4}$ in.	ASME B18.2.1, square or heavy hex head	ASME B18.2.1, heavy hex head
Nuts smaller than $\frac{3}{4}$ in.	ASME B18.2.2, heavy hex	ASME B18.2.2, heavy hex
Nuts equal to or larger than $\frac{3}{4}$ in.	ASME B18.2.2, hex or heavy hex	ASME B18.2.2, heavy hex
External threads	ASME B1.1, Cl. 2A coarse series	ASME B1.1, Cl. 2A coarse series up through 1 in.; 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.; eight thread series for larger bolts

on the end of the pipe as shown in [Figure 6](#) ([Figure II-6 of Mandatory Appendix II](#)).

6.12 Auxiliary Connections

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

6.12.2 Pipe Thread Tapping. Holes may be tapped in the wall of a fitting if the metal is thick enough to allow the effective thread length specified in [Figure 11](#) ([Figure II-11 of Mandatory Appendix II](#)). Where thread length is insufficient or the tapped hole needs reinforcement, a boss shall be added.

6.12.3 Sockets. Sockets for socket welding connections may be provided in the wall of a fitting if the metal is thick enough to afford the depth of socket and retaining wall specified in [Figure 12](#) ([Figure II-12 of Mandatory Appendix II](#)). Where the wall thickness is insufficient, or the size of the connection requires opening reinforcement, a boss shall be added [see [Figure 13](#) ([Figure II-13 of Mandatory Appendix II](#))].

6.12.4 Butt Welding. Connections may be attached by butt welding directly to the wall of the fitting [see [Figure 14](#) ([Figure II-14 of Mandatory Appendix II](#))]. Where the size of an opening requires reinforcement, a boss shall be added.

6.12.5 Bosses. Where bosses are required, the diameters shall be no less than those shown in [Figure 13](#) ([Figure II-13 of Mandatory Appendix II](#)), and the height shall provide lengths as specified in [Figure 11](#) or [12](#) ([Figure II-11 or II-12 of Mandatory Appendix II](#)).

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

Fitting Size	Connection Size (NPS)
$2 \leq NPS \leq 4$	$\frac{1}{2}$
$5 \leq NPS \leq 8$	$\frac{3}{4}$
$NPS \geq 10$	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
$NPS \leq 10$	$\pm 1.0 \text{ mm } (\pm 0.03 \text{ in.})$
$NPS \geq 12$	$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$

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

Size	Tolerance
$NPS \leq 10$	$\pm 1.0 \text{ mm } (\pm 0.03 \text{ in.})$
$NPS \geq 12$	$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$

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

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

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

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

7.3 Facings

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, ±0.5 mm (±0.02 in.).

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

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

(d) Ring joint groove tolerances are shown in **Table 5 (Table II-5 of Mandatory Appendix II)**.

Tolerances that apply to flanges are as follows:

(e) Perpendicularity of the face with the bore

Size	Tolerance
NPS ≤ 5	1 deg
NPS ≥ 6	0.5 deg

7.4 Flange Thickness

Required tolerances for flange thickness are as follows:

Size	Tolerance
NPS ≤ 18	+3.0, -0.0 mm (+0.12, -0.00 in.)
NPS ≥ 20	+5.0, -0.0 mm (+0.19, -0.00 in.)

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

7.5 Welding End Flange Ends and Hubs

7.5.1 Outside Diameter. Required tolerances for the nominal outside diameter dimension *A* of **Figures 7 and 8 (Figures II-7 and II-8 of Mandatory Appendix II)** of welding ends of welding neck flanges are as follows:

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

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

(a) For **Figures 7 and 8 (Figures II-7 and II-8 of Mandatory Appendix II)** and **Figure 4**, the tolerances are

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

(b) For **Figure 9 (Figure II-9 of Mandatory Appendix II)**, the tolerances are

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

7.5.3 Backing Ring Contact Surface. Required tolerances for the bore of the backing ring contact surface of welding neck flanges, dimension *C* of **Figures 9 and 10 (Figures II-9 and II-10 of Mandatory Appendix II)** are as follows:

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

7.5.4 Hub Thickness. Despite the tolerances specified for dimensions *A* and *B*, the thickness of the hub at the welding end shall not be less than $87\frac{1}{2}\%$ of the nominal thickness of the pipe, having an under-tolerance of 12.5% for the pipe wall thickness to which the flange is to be attached or the minimum wall thickness as specified by the purchaser.

7.6 Length Through Hub on Welding Neck Flanges

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

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

7.7 Flange Bore Diameter

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

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

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

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

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

Size	Tolerance
$\frac{1}{2} \leq \text{NPS} \leq 3$	$\pm 0.25 \text{ mm } (\pm 0.010 \text{ in.})$

7.8 Drilling and Facing

7.8.1 Bolt Circle Diameter. The required tolerance for all bolt circle diameters is as follows:

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

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

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

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

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

8 PRESSURE TESTING

8.1 Flange Test more FREE standards from Standard Sharing Group and our chats

Flanges are not required to be pressure tested.

8.2 Flanged Fitting Test

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

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

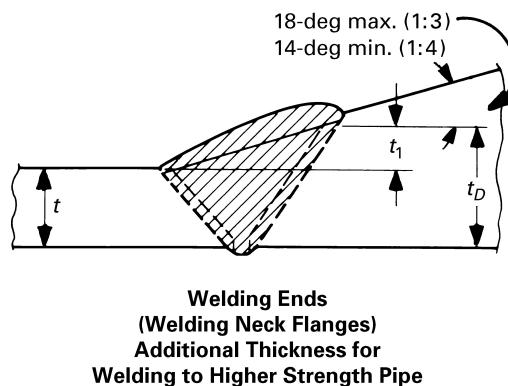
8.2.3 Test Fluid. The pressure test shall be made using water, which may contain a corrosion inhibitor or kerosene as the test fluid. Other suitable test fluids may be used provided their viscosity is no greater than that of water. The test fluid temperature shall not exceed 50°C (125°F).

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

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

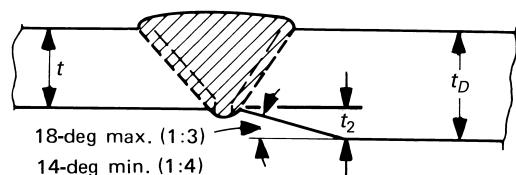
8.2.5 Acceptance. No visible leakage is permitted through the pressure boundary wall.

Figure 1 Bevel for Outside Thickness



GENERAL NOTES:

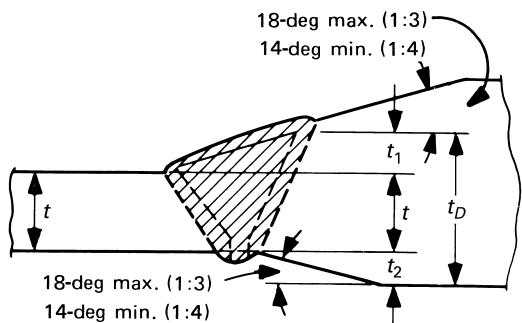
- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b) Neither t_1 , t_2 , nor their sum $t_1 + t_2$ shall exceed 0.5t.
- (c) When the minimum specified yield strengths of the sections to be joined are unequal, the value 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 2 Bevel for Inside Thickness

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

GENERAL NOTES:

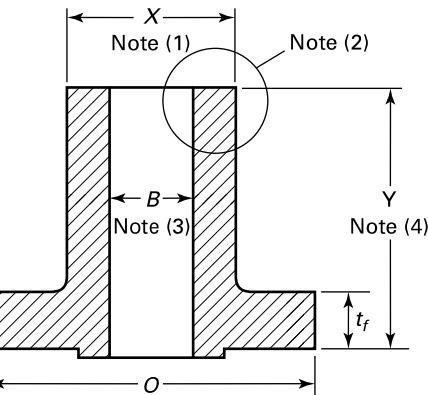
- (a) When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- (b) Neither t_1 , t_2 , nor their sum $t_1 + t_2$ shall exceed 0.5t.
- (c) When the minimum specified yield strengths of the sections to be joined are unequal, the value 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 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 , 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

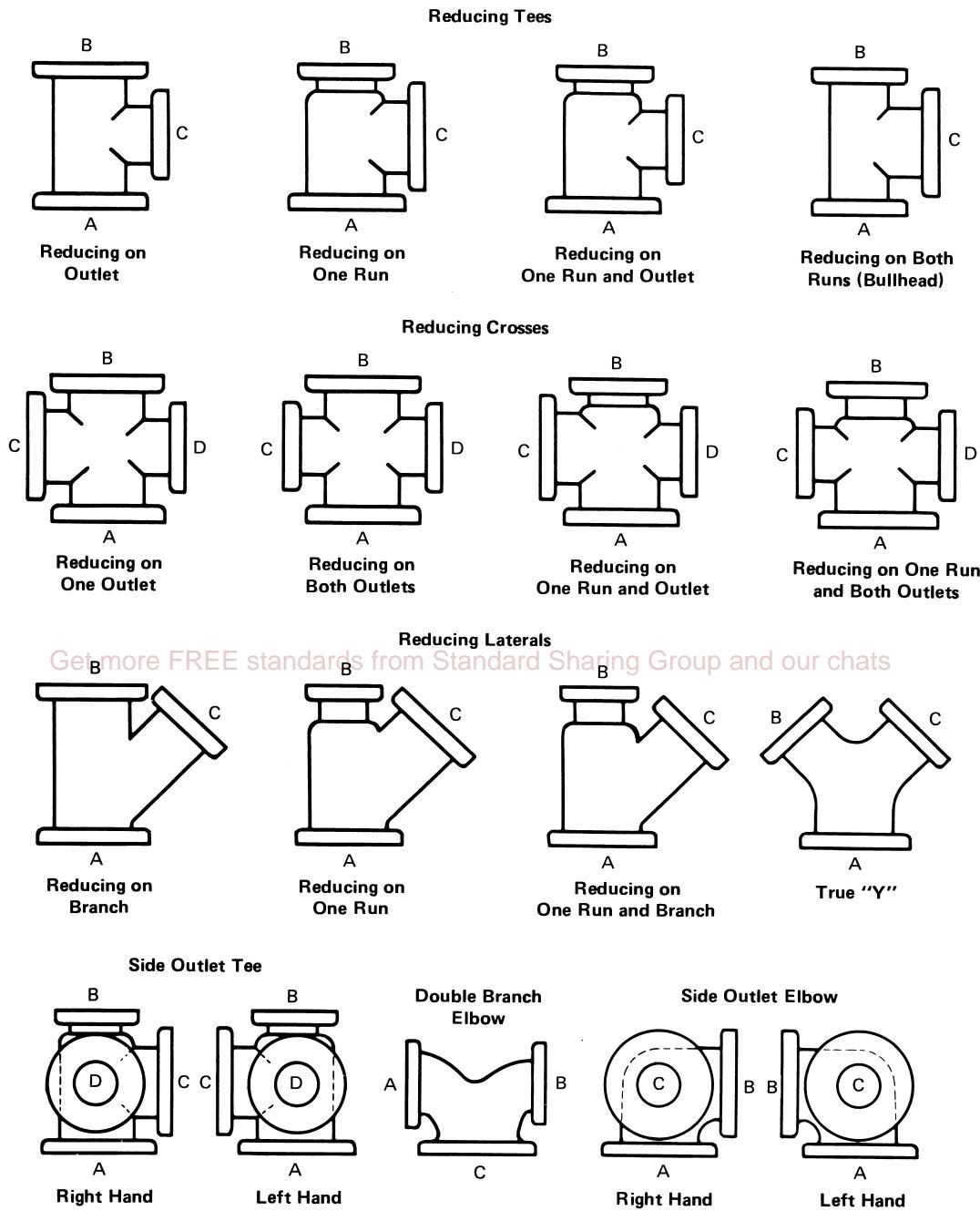
GENERAL NOTES:

- (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, -0.0 mm (+0.12, -0.00 in.).
- (2) Hub end (see para. 2.8.4).
- (3) B = bore (see para. 2.8.3 and 7.5.2).
- (4) Y = length through hub (see para. 2.8.2).

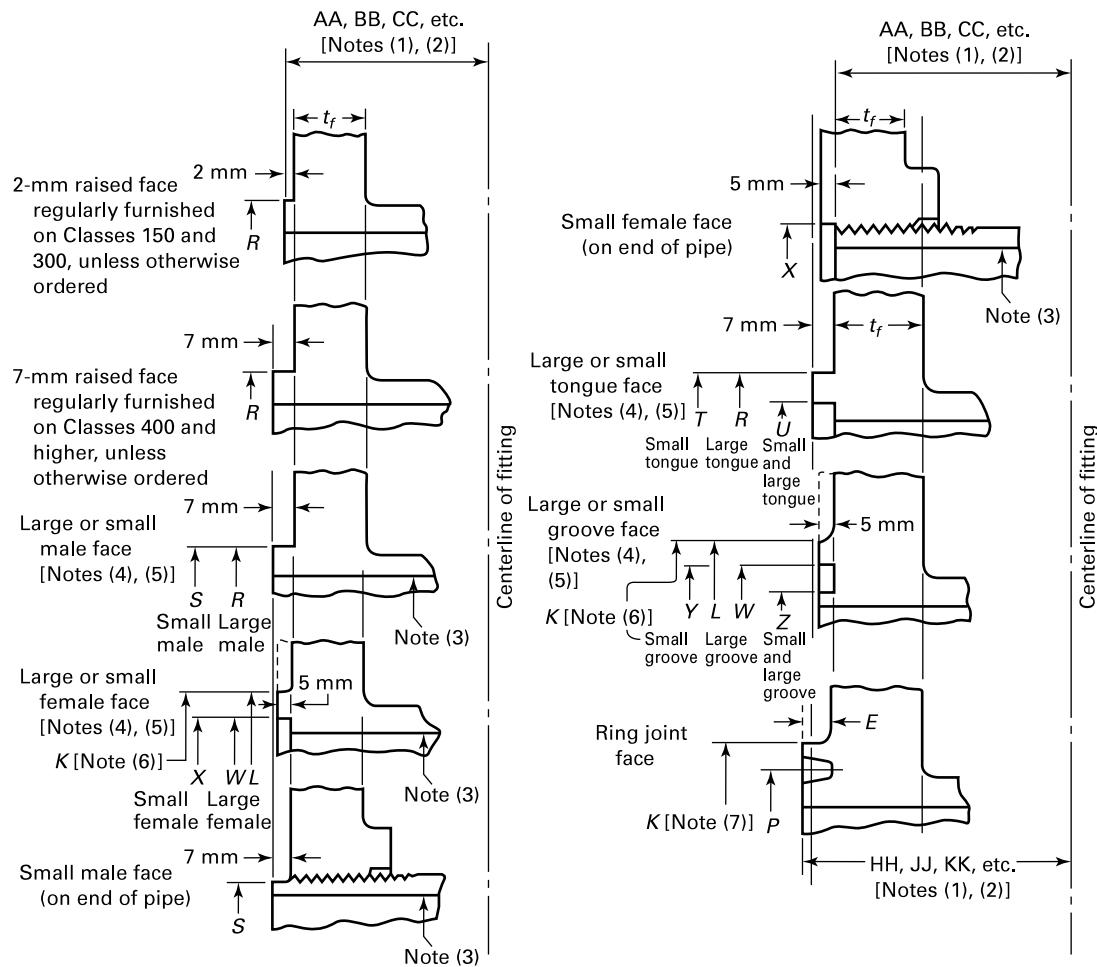
**Figure 5 Method of Designating Outlets of Reducing Fittings in Specifications
(Flanged Fittings)**



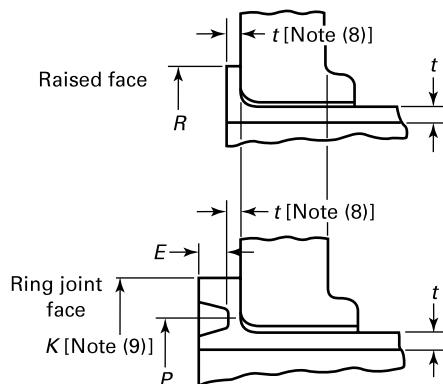
GENERAL NOTES:

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

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**

GENERAL NOTE: Dimensions are in millimeters. For dimensions in inches, refer to [Mandatory Appendix II, Figure II-6](#).

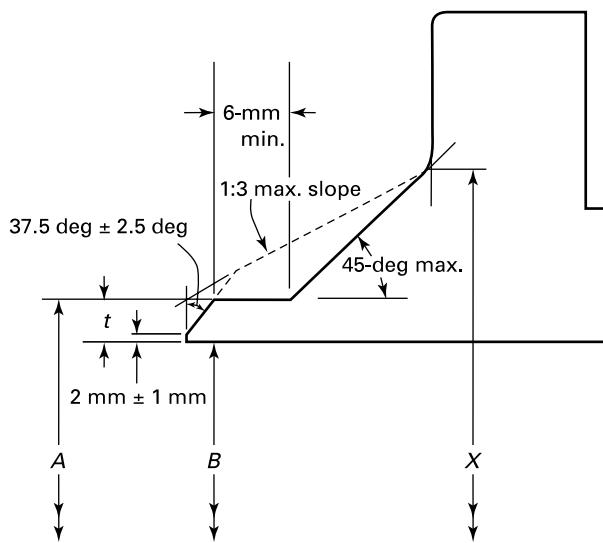
Figure 6 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions (Cont'd)

NOTES:

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

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Figure 7 Bevel for Wall Thicknesses t From 5 mm to 22 mm Inclusive



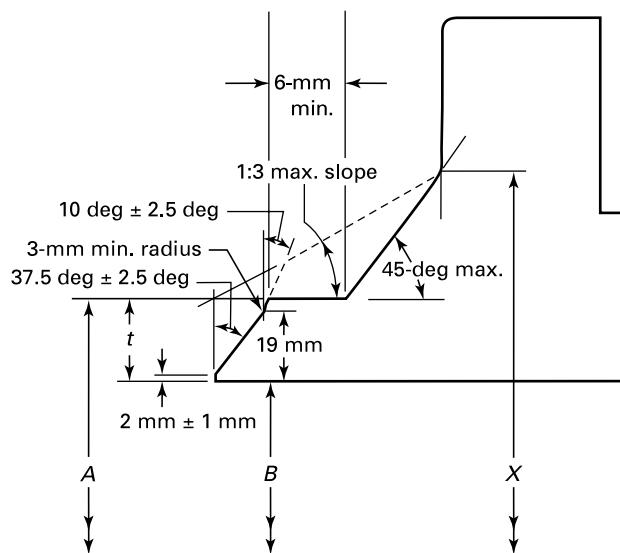
Welding Ends (Welding Neck Flanges, No Backing Rings)

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

GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inches, refer to [Mandatory Appendix II, Figures II-7 and II-8](#).
- (b) See paras. 6.7, 6.8, and [7.4](#) for details and tolerances.
- (c) See [Figures 9](#) and [10](#) for additional details of welding ends.
- (d) When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be used, or, alternatively, the greater outside diameter may be tapered at the same maximum slope or less, from a point on the welding bevel equal to the outside diameter of the mating pipe. Similarly, when the greater thickness is provided on the inside of the flange, it shall be taper-bored from the welding end at a slope not exceeding 1 to 3. When flanges covered by this Standard are intended for services with light wall, higher strength pipe, the thickness of the hub at the bevel may be greater than that of the pipe to which the flange is joined. Under these conditions, a single taper hub may be provided. The additional thickness may be provided on either inside or outside or partially on each side, but the total additional thickness shall not exceed one-half times the nominal wall thickness of intended mating pipe (see [Figures 1](#) through [3](#)).
- (e) The hub transition from the A diameter to the X diameter shall fall within the maximum and minimum envelope outlined by the 1:3 max. slope and solid line.
- (f) For welding end dimensions, refer to ASME B16.25.
- (g) The 6-mm min. dimension applies only to the solid line configuration.

Figure 8 Bevel for Wall Thicknesses t Greater Than 22 mm

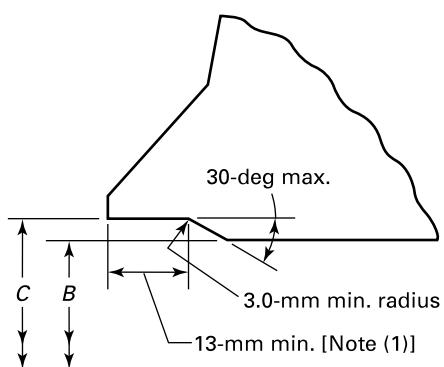


Welding Ends (Welding Neck Flanges, No Backing Rings)

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

GENERAL NOTE: Please see General Notes for [Figure 7](#).

Figure 9 Inside Contour for Use With Rectangular Backing Ring



Welding Ends (Welding Neck Flanges)

A = nominal outside diameter of welding end, mm

B = nominal inside diameter of pipe ($-A - 2t$), mm

$C = A - 0.79 - 1.75t - 0.25$, mm

t = nominal wall thickness of pipe, mm

0.79 mm = minus tolerance on outside diameter of pipe to ASTM 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

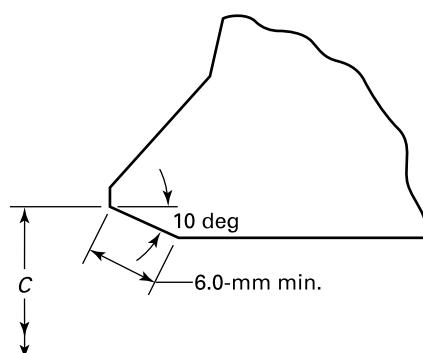
0.25 mm = plus tolerance on diameter C , mm (see para. 7.5.3)

GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inches, refer to [Mandatory Appendix II, Figure II-9](#).
- (b) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (c) See [Figures 7 and 8](#) for welding end details of welding neck flanges.
- (d) For dimensions, see ASME B16.25.

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

Figure 10 Inside Contour for Use With Taper Backing Ring



Welding Ends (Welding Neck Flanges)

A = nominal outside diameter of welding end, mm

B = nominal inside diameter of pipe ($-A - 2t$), mm

$C = A - 0.79 - 1.75t - 0.25$, mm

t = nominal wall thickness of pipe, mm

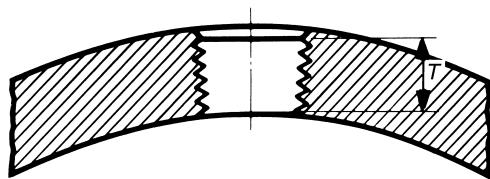
0.79 mm = minus tolerance on outside diameter of pipe to ASTM A106, etc.

$1.75t = 87\frac{1}{2}\%$ 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)

GENERAL NOTES:

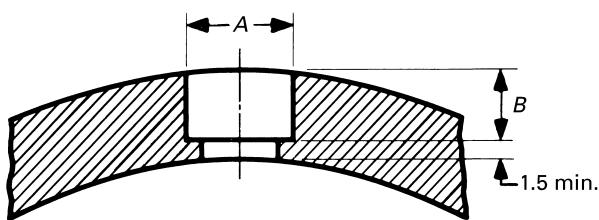
- (a) Dimensions are in millimeters. For dimensions in inches, refer to [Mandatory Appendix II, Figure II-10](#).
- (b) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (c) See [Figures 7 and 8](#) for welding end details of welding neck flanges.
- (d) For dimensions, see ASME B16.25.

Figure 11 Thread Length for Connection Tapping

Connection Size, NPS	Thread Length, T , mm
$\frac{3}{8}$	10.5
$\frac{1}{2}$	13.5
$\frac{3}{4}$	14.0
1	17.5
$1\frac{1}{4}$	18.1
$1\frac{1}{2}$	18.3
2	19.4

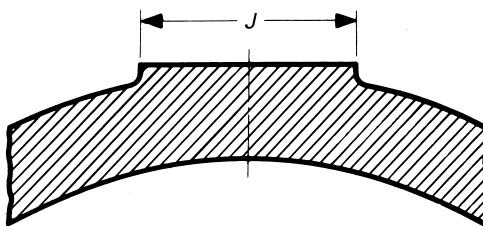
GENERAL NOTES:

- (a) See paras. 6.12.2, 6.12.5, and 6.12.6.
- (b) 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 12 Socket Welding for Connections

Connection Size, NPS	Minimum Diameter of Socket, A , mm	Minimum Depth, B , mm
$\frac{3}{8}$	17.5	4.8
$\frac{1}{2}$	21.8	4.8
$\frac{3}{4}$	26.9	6.4
1	33.8	6.4
$1\frac{1}{4}$	42.7	6.4
$1\frac{1}{2}$	48.8	6.4
2	61.2	7.9

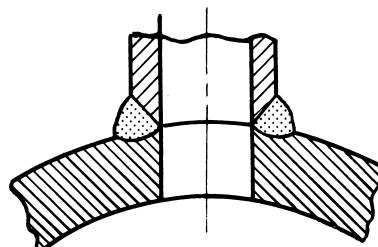
GENERAL NOTE: See paras. 6.12.3, 6.12.5, and 6.12.6.

Figure 13 Bosses for Connections

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

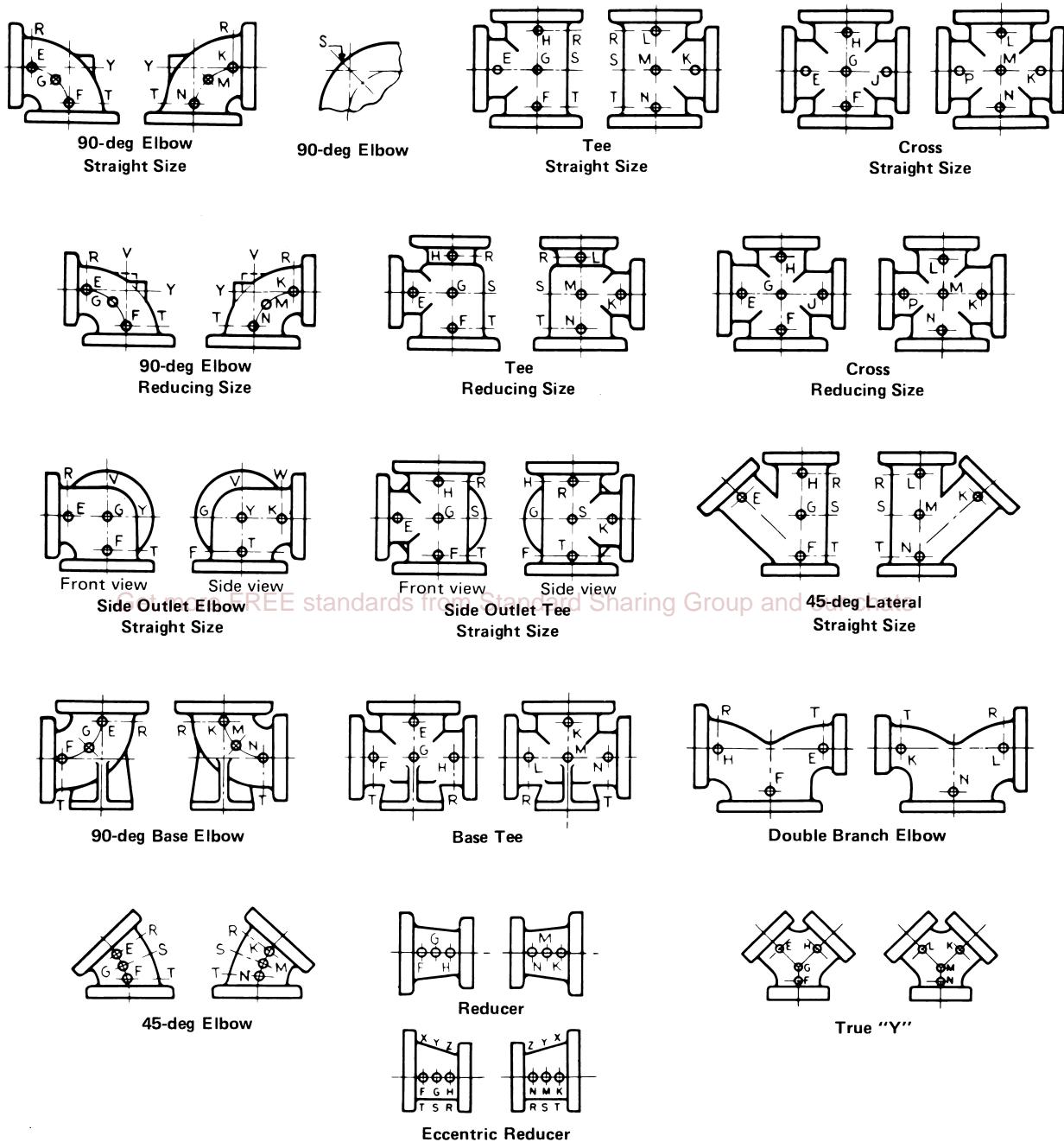
GENERAL NOTES:

- (a) See para. 6.12.5.
- (b) Dimensions are in millimeters. For dimensions in inches, refer to Mandatory Appendix II, Figures II-11 through II-14.

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

Nominal Designation	Forgings	Castings	Plates				
C-Si	A105 (1)	A216 Gr. WCB (1)	A515 Gr. 70 (1)				
C-Mn-Si	A350 Gr. LF2 (1)	...	A516 Gr. 70 (1), (2)				
C-Mn-Si-V	A350 Gr. LF6 Cl. 1 (3)	...	A537 Cl. 1 (4)				
Working Pressures by Classes, bar							
	Class						
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.6	51.1	68.1	102.1	153.2	255.3	425.5
50	19.2	50.1	66.8	100.2	150.4	250.6	417.7
100	17.7	46.6	62.1	93.2	139.8	233.0	388.3
150	15.8	45.1	60.1	90.2	135.2	225.4	375.6
200	13.8	43.8	58.4	87.6	131.4	219.0	365.0
250	12.1	41.9	55.9	83.9	125.8	209.7	349.5
300	10.2	39.8	53.1	79.6	119.5	199.1	331.8
325	9.3	38.7	51.6	77.4	116.1	193.6	322.6
350	8.4	37.6	50.1	75.1	112.7	187.8	313.0
375	7.4	36.4	48.5	72.7	109.1	181.8	303.1
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7
475	3.7	17.4	23.2	34.9	52.3	87.2	145.3
500	2.8	11.8	15.7	23.5	35.3	58.8	97.9
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

NOTES:

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

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

Nominal Designation		Forgings		Castings		Plates					
C-Mn-Si		...		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		A203 Gr. B (1)					
3½Ni		...		A352 Gr. LC3 (2)		A203 Gr. E (1)					
Working Pressures by Classes, bar											
Temp., °C		Class									
150	300	400	600	900	1500	2500					
-29 to 38	19.8	51.7	68.9	103.4	155.1	258.6	430.9				
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9				
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4				
150	15.8	50.2	66.8	100.3	150.5	250.8	418.1				
200	13.8	48.6	64.8	97.2	145.8	243.2	405.4				
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2				
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1				
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3				
350	8.4	40.0	53.4	80.0	120.1	200.1	333.5				
375	7.4	37.8	50.4	75.7	113.5	189.2	315.3				
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3				
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7				
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7				
475	3.7	17.1	22.8	34.2	51.3	85.4	142.4				
500	2.8	11.6	15.4	23.2	34.7	57.9	96.5				
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2				

NOTES:

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

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

Nominal Designation	Forgings	Castings	Plates				
C-Si	...	A352 LCB (1)	A515 Gr. 65 (2)				
C-Mn-Si	A516 Gr. 65 (2), (3)				
2½Ni	A203 Gr. A (2)				
3½Ni	A203 Gr. D (2)				
C-½Mo	...	A217 Gr. WC1 (4)–(6)	...				
C-½Mo	...	A352 Gr. LC1 (1)	...				
Working Pressures by Classes, bar							
Class							
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	18.4	48.0	64.0	96.0	144.1	240.1	400.1
50	18.2	47.5	63.3	94.9	142.4	237.3	395.6
100	17.4	45.3	60.5	90.7	136.0	226.7	377.8
150	15.8	43.9	58.6	87.9	131.8	219.7	366.1
200	13.8	42.5	56.7	85.1	127.6	212.7	354.4
250	12.1	40.8	54.4	81.6	122.3	203.9	339.8
300	10.2	38.7	51.6	77.4	116.1	193.4	322.4
325	9.3	37.6	50.1	75.2	112.7	187.9	313.1
350	8.4	36.4	48.5	72.8	109.2	182.0	303.3
375	7.4	35.0	46.6	69.9	104.9	174.9	291.4
400	6.5	32.6	43.5	65.2	97.9	163.1	271.9
425	5.5	27.3	36.4	54.6	81.9	136.5	227.5
450	4.6	21.6	28.8	43.2	64.8	107.9	179.9
475	3.7	15.7	20.9	31.3	47.0	78.3	130.6
500	2.8	11.1	14.8	22.1	33.2	55.4	92.3
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

NOTES:

- (1) Not to be used over 340°C.
- (2) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 425°C.
- (3) Not to be used over 455°C.
- (4) Upon prolonged exposure to temperatures above 465°C, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 465°C.
- (5) Use normalized and tempered material only.
- (6) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

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

Nominal Designation		Forgings		Castings		Plates					
C-Si	A515 Gr. 60 (1)							
C-Mn-Si	A350 Gr. LF1, Cl. 1 (1)	A516 Gr. 60 (1), (2)							
Working Pressures by Classes, bar											
Temp., °C		Class									
	150	300	400	600	900	1500	2500				
-29 to 38	16.3	42.6	56.7	85.1	127.7	212.8	354.6				
50	16.0	41.8	55.7	83.5	125.3	208.9	348.1				
100	14.9	38.8	51.8	77.7	116.5	194.2	323.6				
150	14.4	37.6	50.1	75.1	112.7	187.8	313.0				
200	13.8	36.4	48.5	72.8	109.2	182.1	303.4				
250	12.1	34.9	46.6	69.8	104.7	174.6	291.0				
300	10.2	33.2	44.2	66.4	99.5	165.9	276.5				
325	9.3	32.2	43.0	64.5	96.7	161.2	268.6				
350	8.4	31.2	41.7	62.5	93.7	156.2	260.4				
375	7.4	30.4	40.5	60.7	91.1	151.8	253.0				
400	6.5	29.3	39.1	58.7	88.0	146.7	244.5				
425	5.5	25.8	34.4	51.5	77.3	128.8	214.7				
450	4.6	21.4	28.5	42.7	64.1	106.8	178.0				
475	3.7	14.1	18.8	28.2	42.3	70.5	117.4				
500	2.8	10.3	13.7	20.6	30.9	51.5	85.9				
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2				

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

(2) Not to be used over 455°C.

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

Nominal Designation		Forgings		Castings		Plates					
C- $\frac{1}{2}$ Mo		A182 Gr. F1 (1)		...		A204 Gr. A (1)					
C- $\frac{1}{2}$ Mo			A204 Gr. B (1)					
Working Pressures by Classes, bar											
Temp., °C		Class									
		150	300	400	600	900	1500	2500			
-29 to 38		18.4	48.0	64.0	96.0	144.1	240.1	400.1			
50		18.4	48.0	64.0	96.0	144.1	240.1	400.1			
100		17.7	47.9	63.9	95.9	143.8	239.7	399.5			
150		15.8	47.3	63.1	94.7	142.0	236.7	394.5			
200		13.8	45.8	61.1	91.6	137.4	229.0	381.7			
250		12.1	44.5	59.3	89.0	133.5	222.5	370.9			
300		10.2	42.9	57.0	85.7	128.6	214.4	357.1			
325		9.3	41.4	55.0	82.6	124.0	206.6	344.3			
350		8.4	40.3	53.6	80.4	120.7	201.1	335.3			
375		7.4	38.9	51.6	77.6	116.5	194.1	323.2			
400		6.5	36.5	48.9	73.3	109.8	183.1	304.9			
425		5.5	35.2	46.5	70.0	105.1	175.1	291.6			
450		4.6	33.7	45.1	67.7	101.4	169.0	281.8			
475		3.7	31.7	42.3	63.4	95.1	158.2	263.9			
500		2.8	24.1	32.1	48.1	72.2	120.3	200.5			
538		1.4	11.3	15.1	22.7	34.0	56.7	94.6			

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

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

Nominal Designation		Forgings		Castings		Plates	
$\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$	A182 Gr. F2 (1)			
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							
Class							
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.8	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	26.7	35.6	53.4	80.1	133.4	222.4
538	1.4	13.9	18.6	27.9	41.8	69.7	116.2
550	...	12.6	16.8	25.2	37.8	63.0	105.0
575	...	7.2	9.6	14.4	21.5	35.9	59.8

NOTES:

- (1) Not to be used over 538°C.
 (2) Use normalized and tempered material only.
 (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

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

Nominal Designation	Forgings		Castings		Plates		
	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	...	A217 Gr. WC6 (1)-(3)	
	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo-Si	A182 Gr. F11 Cl. 2 (1), (4)	...	A387 Gr. 11 Cl. 2 (4)	
Working Pressures by Classes, bar							
Class							
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.8	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.6	103.0	154.4	257.4	429.0
150	15.8	49.7	66.3	99.5	149.2	248.7	414.5
200	13.8	48.0	63.9	95.9	143.9	239.8	399.6
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	25.7	34.3	51.5	77.2	128.6	214.4
538	1.4	14.9	19.9	29.8	44.7	74.5	124.1
550	...	12.7	16.9	25.4	38.1	63.5	105.9
575	...	8.8	11.7	17.6	26.4	44.0	73.4
600	...	6.1	8.1	12.2	18.3	30.5	50.9
625	...	4.3	5.7	8.5	12.8	21.3	35.5
650	...	2.8	3.8	5.7	8.5	14.2	23.6

NOTES:

- (1) Use normalized and tempered material only.
- (2) Not to be used over 590°C.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) Permissible but not recommended for prolonged use above 590°C.

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

Nominal Designation	Forgings		Castings		Plates	
	2¹/₄Cr-1Mo	A182 Gr. F22 Cl. 3 (1)	A217 Gr. WC9 (2)-(4)	A387 Gr. 22 Cl. 2 (1)		
Working Pressures by Classes, bar						
Temp., °C	Class					
	150	300	400	600	900	1500
-29 to 38	19.8	51.7	68.9	103.4	155.1	258.6
50	19.5	51.7	68.9	103.4	155.1	258.6
100	17.7	51.5	68.7	103.0	154.6	257.6
150	15.8	50.3	66.8	100.3	150.6	250.8
200	13.8	48.6	64.8	97.2	145.8	243.4
250	12.1	46.3	61.7	92.7	139.0	231.8
300	10.2	42.9	57.0	85.7	128.6	214.4
325	9.3	41.4	55.0	82.6	124.0	206.6
350	8.4	40.3	53.6	80.4	120.7	201.1
375	7.4	38.9	51.6	77.6	116.5	194.1
400	6.5	36.5	48.9	73.3	109.8	183.1
425	5.5	35.2	46.5	70.0	105.1	175.1
450	4.6	33.7	45.1	67.7	101.4	169.0
475	3.7	31.7	42.3	63.4	95.1	158.2
500	2.8	28.2	37.6	56.5	84.7	140.9
538	1.4	18.4	24.6	36.9	55.3	92.2
550	...	15.6	20.8	31.3	46.9	78.2
575	...	10.5	14.0	21.1	31.6	52.6
600	...	6.9	9.2	13.8	20.7	34.4
625	...	4.5	6.0	8.9	13.4	22.3
650	...	2.8	3.8	5.7	8.5	14.2
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NOTES:

- (1) Permissible but not recommended for prolonged use above 590°C.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 590°C.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

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

Nominal Designation	Forgings		Castings		Plates	
	C- $\frac{1}{2}$ Mo	A204 Gr. C (1)	
Working Pressures by Classes, bar						
Temp., °C	Class					
	150	300	400	600	900	1500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6
50	19.5	51.7	68.9	103.4	155.1	258.6
100	17.7	51.5	68.7	103.0	154.6	257.6
150	15.8	50.3	66.8	100.3	150.6	250.8
200	13.8	48.6	64.8	97.2	145.8	243.4
250	12.1	46.3	61.7	92.7	139.0	231.8
300	10.2	42.9	57.0	85.7	128.6	214.4
325	9.3	41.4	55.0	82.6	124.0	206.6
350	8.4	40.3	53.6	80.4	120.7	201.1
375	7.4	38.9	51.6	77.6	116.5	194.1
400	6.5	36.5	48.9	73.3	109.8	183.1
425	5.5	35.2	46.5	70.0	105.1	175.1
450	4.6	33.7	45.1	67.7	101.4	169.0
475	3.7	31.7	42.3	63.4	95.1	158.2
500	2.8	23.6	31.4	47.1	70.7	117.8
538	1.4	11.3	15.3	22.7	34.4	56.7
550	...	11.3	15.3	22.7	34.4	56.7
575	...	10.1	13.6	20.1	30.2	50.3
600	...	7.1	9.5	14.2	21.3	35.6
625	...	5.3	7.1	10.6	15.9	26.5
650	...	3.1	4.1	6.1	9.2	15.4
						25.6

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

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

Nominal Designation	Forgings			Castings		Plates		
	5Cr- $\frac{1}{2}$ Mo	A182 Gr. F5a	A217 Gr. C5 (1), (2)			...		
Temp., °C	Working Pressures by Classes, bar							
	150	300	400	600	900	1500	2500	
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9	
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9	
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4	
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2	
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4	
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2	
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1	
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3	
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3	
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2	
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9	
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6	
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8	
475	3.7	27.9	37.1	55.7	83.6	139.3	232.1	
500	2.8	21.4	28.5	42.8	64.1	106.9	178.2	
538	1.4	13.7	18.3	27.4	41.1	68.6	114.3	
550	...	12.0	16.1	24.1	36.1	60.2	100.4	
575	...	8.9	11.8	17.8	26.7	44.4	74.0	
600	...	6.2	8.3	12.5	18.7	31.2	51.9	
625	...	4.0	5.3	8.0	12.0	20.0	33.3	
650	...	2.4	3.2	4.7	7.1	11.8	19.7	

NOTES:

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

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

Nominal Designation		Forgings		Castings		Plates	
9Cr-1Mo		A182 Gr. F9		A217 Gr. C12 (1), (2)		...	
Temp., °C		Working Pressures by Classes, bar					
		150	300	400	600	900	1500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	17.5	23.3	35.0	52.5	87.5	145.8
550	...	15.0	20.0	30.0	45.0	75.0	125.0
575	...	10.5	13.9	20.9	31.4	52.3	87.1
600	...	7.2	9.6	14.4	21.5	35.9	59.8
625	...	5.0	6.6	9.9	14.9	24.8	41.4
650	...	3.5	4.7	7.1	10.6	17.7	29.5

NOTES:

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

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

Nominal Designation	Forgings		Castings		Plates		
	9Cr-1Mo-V	A182 Gr. F91	A217 Gr. C12A (1)	A387 Gr. 91 Cl. 2			
Temp., °C	Working Pressures by Classes, bar						
			Class				
150	300	400	600	900	1500	2500	
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	...	24.0	31.9	47.9	71.8	119.7	199.5
600	...	19.5	26.0	39.0	58.5	97.5	162.5
625	...	14.6	19.5	29.2	43.8	73.0	121.7
650	...	9.9	13.2	19.9	29.8	49.6	82.7

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

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

Nominal Designation		Forgings		Castings		Plates					
1Cr- $\frac{1}{2}$ Mo		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					
-29 to 38		51.7		68.9		103.4					
50		51.5		68.7		103.0					
100		50.4		67.3		100.9					
150		48.2		64.2		96.4					
200		46.3		61.7		92.5					
250		44.8		59.8		89.6					
300		42.9		57.0		85.7					
325		41.4		55.0		82.6					
350		40.3		53.6		80.4					
375		38.9		51.6		77.6					
400		36.5		48.9		73.3					
425		35.2		46.5		70.0					
450		33.7		45.1		67.7					
475		27.9		37.1		55.7					
500		21.4		28.5		42.8					
538		13.7		18.3		27.4					
550		12.0		16.1		24.1					
575		8.8		11.7		17.6					
600		6.1		8.1		12.1					
625		4.0		5.3		8.0					
650		2.4		3.2		4.7					

(17)

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

Nominal Designation	Forgings			Castings		Plates	
	9Cr-2W-V	A 182 Gr. F92 (1)		
Temp., °C	Working Pressures by Classes, bar						
	150	300	400	600	900	1500	2500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	1.4	25.0	33.3	49.8	74.8	124.9	208.0
575	1.4	24.0	31.9	47.9	71.8	119.7	199.5
600	1.4	21.6	28.6	42.9	64.2	107.0	178.5
625	1.4	18.3	24.3	36.6	54.9	91.2	152.0
650	1.4	13.2	18.9	26.5	39.7	66.2	110.3

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

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

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

NOTES:

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

(2) Not to be used over 425°C.

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

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

NOTES:

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

(2) Not to be used over 455°C.

(3) Not to be used over 538°C.

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

Nominal Designation		Forgings		Castings		Plates							
18Cr-8Ni		A182 Gr. F304L (1)		...		A240 Gr. 304L (1)							
16Cr-12Ni-2Mo		A182 Gr. F316L		...		A240 Gr. 316L							
18Cr-13Ni-3Mo		A182 Gr. F317L								
Working Pressures by Classes, bar													
Class													
Temp., °C	150	300	400	600	900	1500	2500						
-29 to 38	15.9	41.4	55.2	82.7	124.1	206.8	344.7						
50	15.3	40.0	53.4	80.0	120.1	200.1	333.5						
100	13.3	34.8	46.4	69.6	104.4	173.9	289.9						
150	12.0	31.4	41.9	62.8	94.2	157.0	261.6						
200	11.2	29.2	38.9	58.3	87.5	145.8	243.0						
250	10.5	27.5	36.6	54.9	82.4	137.3	228.9						
300	10.0	26.1	34.8	52.1	78.2	130.3	217.2						
325	9.3	25.5	34.0	51.0	76.4	127.4	212.3						
350	8.4	25.1	33.4	50.1	75.2	125.4	208.9						
375	7.4	24.8	33.0	49.5	74.3	123.8	206.3						
400	6.5	24.3	32.4	48.6	72.9	121.5	202.5						
425	5.5	23.9	31.8	47.7	71.6	119.3	198.8						
450	4.6	23.4	31.2	46.8	70.2	117.1	195.1						

NOTE: (1) Not to be used over 425°C.

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

Nominal Designation	Forgings		Castings		Plates					
18Cr-10Ni-Ti	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				
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2				
50	18.6	48.6	64.7	97.1	145.7	242.8				
100	17.0	44.2	59.0	88.5	132.7	221.2				
150	15.7	41.0	54.6	82.0	122.9	204.9				
200	13.8	38.3	51.1	76.6	114.9	191.5				
250	12.1	36.0	48.0	72.0	108.1	180.1				
300	10.2	34.1	45.5	68.3	102.4	170.7				
325	9.3	33.3	44.4	66.6	99.9	166.5				
350	8.4	32.6	43.5	65.2	97.8	163.0				
375	7.4	32.0	42.7	64.1	96.1	160.2				
400	6.5	31.6	42.1	63.2	94.8	157.9				
425	5.5	31.1	41.5	62.3	93.4	155.7				
450	4.6	30.8	41.1	61.7	92.5	154.2				
475	3.7	30.5	40.7	61.1	91.6	152.7				
500	2.8	28.2	37.6	56.5	84.7	140.9				
538	1.4	25.2	33.4	50.0	75.2	125.5				
550	...	25.0	33.3	49.8	74.8	124.9				
575	...	24.0	31.9	47.9	71.8	119.7				
600	...	20.3	27.0	40.5	60.8	101.3				
625	...	15.8	21.1	31.6	47.4	79.1				
650	...	12.6	16.9	25.3	37.9	63.2				
675	...	9.9	13.2	19.8	29.6	49.4				
700	...	7.9	10.5	15.8	23.7	39.5				
725	...	6.3	8.5	12.7	19.0	31.7				
750	...	5.0	6.7	10.0	15.0	25.0				
775	...	4.0	5.3	8.0	11.9	19.9				
800	...	3.1	4.2	6.3	9.4	15.6				
816	...	2.6	3.5	5.2	7.8	13.0				
21.7										

NOTES:

(1) Not to be used over 538°C.

(2) At temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1 095°C.

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

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

NOTES:

(1) Not to be used over 538°C.

(2) For temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1 095°C.

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

Nominal Designation	Forgings		Castings		Plates		
	23Cr-12Ni	A240 Gr. 309H		
Temp., °C	Working Pressures by Classes, bar						
	150	300	400	600	900	1500	2500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2	413.7
50	18.5	48.3	64.4	96.6	144.9	241.5	402.5
100	16.5	43.1	57.5	86.2	129.3	215.5	359.2
150	15.3	40.0	53.3	80.0	120.0	200.0	333.3
200	13.8	37.8	50.3	75.5	113.3	188.8	314.7
250	12.1	36.1	48.1	72.1	108.2	180.4	300.6
300	10.2	34.8	46.4	69.6	104.4	173.9	289.9
325	9.3	34.2	45.7	68.5	102.7	171.2	285.4
350	8.4	33.8	45.1	67.6	101.4	169.0	281.7
375	7.4	33.4	44.5	66.8	100.1	166.9	278.2
400	6.5	33.1	44.1	66.1	99.2	165.4	275.6
425	5.5	32.6	43.5	65.3	97.9	163.1	271.9
450	4.6	32.2	42.9	64.4	96.5	160.9	268.2
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	Get more FREE standards from Standard Publishing Group and our website.	22.2	29.6	44.4	66.5	110.9	184.8
600	...	16.8	22.4	33.5	50.3	83.9	139.8
625	...	12.5	16.7	25.0	37.5	62.5	104.2
650	...	9.4	12.5	18.7	28.1	46.8	78.0
675	...	7.2	9.6	14.5	21.7	36.2	60.3
700	...	5.5	7.3	11.0	16.5	27.5	45.9
725	...	4.3	5.8	8.7	13.0	21.6	36.0
750	...	3.4	4.6	6.8	10.2	17.1	28.4
775	...	2.7	3.6	5.4	8.1	13.5	22.4
800	...	2.1	2.8	4.2	6.3	10.5	17.5
816	...	1.8	2.4	3.5	5.3	8.9	14.8

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

Nominal Designation	Forgings		Castings		Plates	
	25Cr-20Ni	A182 Gr. F310 (1), (2)	...		A240 Gr. 310H	
Working Pressures by Classes, bar						
Temp., °C	Class					
	150	300	400	600	900	1500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2
50	18.5	48.4	64.5	96.7	145.1	241.8
100	16.6	43.4	57.9	86.8	130.2	217.0
150	15.3	40.0	53.3	80.0	120.0	200.0
200	13.8	37.6	50.1	75.2	112.8	188.0
250	12.1	35.8	47.7	71.5	107.3	178.8
300	10.2	34.5	45.9	68.9	103.4	172.3
325	9.3	33.9	45.2	67.7	101.6	169.3
350	8.4	33.3	44.4	66.6	99.9	166.5
375	7.4	32.9	43.8	65.7	98.6	164.3
400	6.5	32.4	43.2	64.8	97.3	162.1
425	5.5	32.1	42.8	64.2	96.4	160.6
450	4.6	31.7	42.2	63.4	95.1	158.4
475	3.7	31.2	41.7	62.5	93.7	156.2
500	2.8	28.2	37.6	56.5	84.7	140.9
538	1.4	25.2	33.4	50.0	75.2	125.5
550	...	25.0	33.3	49.8	74.8	124.9
575	...	22.2	29.6	44.4	66.5	110.9
600	...	16.8	22.4	33.5	50.3	83.9
625	...	12.5	16.7	25.0	37.5	62.5
650	...	9.4	12.5	18.7	28.1	46.8
675	...	7.2	9.6	14.5	21.7	36.2
700	...	5.5	7.3	11.0	16.5	27.5
725	...	4.3	5.8	8.7	13.0	21.6
750	...	3.4	4.6	6.8	10.2	17.1
775	...	2.7	3.5	5.3	8.0	13.3
800	...	2.1	2.8	4.1	6.2	10.3
816	...	1.8	2.4	3.5	5.3	8.9
						14.8

NOTES:

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

(2) Service temperatures of 565°C and above should be used only when assurance is provided that grain size is not finer than ASTM No. 6.

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

Nominal Designation	Forgings	Castings	Plates				
20Cr-18Ni-6Mo	A182 Gr. F44	A351 Gr. CK3MCuN	A240 Gr. S31254				
22Cr-5Ni-3Mo-N	A182 Gr. F51 (1)	...	A240 Gr. S31803 (1)				
25Cr-7Ni-4Mo-N	A182 Gr. F53 (1)	...	A240 Gr. S32750 (1)				
24Cr-10Ni-4Mo-V	...	A995 Gr. CE8MN (1)	...				
25Cr-5Ni-2Mo-3Cu-N	...	A995 Gr. CD4MCuN (1)	...				
25Cr-7Ni-3.5Mo-W-Cb	...	A995 Gr. CD3MWCuN (1)	...				
25Cr-7Ni-3.5Mo-N-Cu-W	A182 Gr. F55 (1)	...	A240 Gr. S32760 (1)				
Working Pressures by Classes, bar							
		Class					
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	50.7	67.5	101.3	152.0	253.3	422.2
150	15.8	45.9	61.2	91.9	137.8	229.6	382.7
200	13.8	42.7	56.9	85.3	128.0	213.3	355.4
250	12.1	40.5	53.9	80.9	121.4	202.3	337.2
300	10.2	38.9	51.8	77.7	116.6	194.3	323.8
325	9.3	38.2	50.9	76.3	114.5	190.8	318.0
350	8.4	37.6	50.2	75.3	112.9	188.2	313.7
375	7.4	37.4	49.8	74.7	112.1	186.8	311.3
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9

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

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

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					
-29 to 38		19.0	49.6	66.2	99.3	148.9	248.2					
50		18.5	48.3	64.4	96.6	144.9	241.5					
100		16.5	43.1	57.5	86.2	129.3	215.5					
150		15.3	40.0	53.3	80.0	120.0	200.0					
200		13.8	37.6	50.1	75.2	112.8	188.0					
250		12.1	35.8	47.7	71.5	107.3	178.8					
300		10.2	34.5	45.9	68.9	103.4	172.3					
325		9.3	33.9	45.2	67.7	101.6	169.3					
350		8.4	33.3	44.4	66.6	99.9	166.5					
375		7.4	32.9	43.8	65.7	98.6	164.3					
400		6.5	32.4	43.2	64.8	97.3	162.1					
425		5.5	32.1	42.8	64.2	96.4	160.6					
450		4.6	31.7	42.2	63.4	95.1	158.4					
475		3.7	31.2	41.7	62.5	93.7	156.2					
500		2.8	28.2	37.6	56.5	84.7	140.9					
538		1.4	23.4	31.2	46.8	70.2	117.0					
550		...	20.5	27.3	41.0	61.5	102.5					
575		...	15.1	20.1	30.2	45.3	75.5					
600		...	11.0	14.7	22.1	33.1	55.1					
625		...	8.1	10.9	16.3	24.4	40.7					
650		...	5.8	7.8	11.6	17.4	29.1					
675		...	3.7	4.9	7.4	11.1	18.4					
700		...	2.2	2.9	4.3	6.5	10.8					
725		...	1.4	1.8	2.7	4.1	6.8					
750		...	1.0	1.4	2.1	3.1	5.2					
775		...	0.8	1.1	1.6	2.5	4.1					
800		...	0.6	0.8	1.2	1.8	3.0					
816		...	0.5	0.6	0.9	1.4	2.4					

NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 538°C, use only if the material is solution heat treated to the minimum temperature specified in the specification but not lower than 1 035°C, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 565°C and above only when assurance is provided that grain size is not finer than ASTM No. 6.

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

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					
-29 to 38		46.3		61.8		92.7					
50		44.5		59.3		89.0					
100		37.5		50.0		75.1					
150		34.9		46.5		69.8					
200		33.5		44.7		67.1					
250		32.6		43.5		65.2					
300		31.7		42.3		63.4					
325		31.2		41.6		62.4					
350		30.6		40.8		61.2					
375		29.8		39.8		59.7					
400		29.1		38.8		58.2					
425		28.3		37.8		56.7					
450		27.6		36.8		55.2					
475		26.7		35.6		53.5					
500		25.8		34.5		51.7					
538		23.3		31.1		46.6					
550		21.9		29.2		43.8					
575		18.5		24.6		37.0					
600		14.5		19.4		29.0					
625		11.4		15.2		22.8					
650		8.9		11.9		17.8					
675		7.0		9.3		14.0					
700		5.7		7.6		11.3					
725		4.6		6.1		9.1					
750		3.5		4.7		7.0					
775		2.6		3.4		5.1					
800		2.0		2.7		4.0					
816		1.9		2.5		3.8					
816		1.9		2.5		3.8					

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

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

Nominal Designation	Forgings			Castings		Plates	
	18Cr-10Ni-Cb	A351 Gr. CF8C (1)	
	Working Pressures by Classes, bar						
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2	413.7
50	18.7	48.8	65.0	97.5	146.3	243.8	406.4
100	17.4	45.3	60.4	90.6	135.9	226.5	377.4
150	15.8	42.5	56.6	84.9	127.4	212.4	353.9
200	13.8	39.9	53.3	79.9	119.8	199.7	332.8
250	12.1	37.8	50.4	75.6	113.4	189.1	315.1
300	10.2	36.1	48.1	72.2	108.3	180.4	300.7
325	9.3	35.4	47.1	70.7	106.1	176.8	294.6
350	8.4	34.8	46.3	69.5	104.3	173.8	289.6
375	7.4	34.2	45.6	68.4	102.6	171.0	285.1
400	6.5	33.9	45.2	67.8	101.7	169.5	282.6
425	5.5	33.6	44.8	67.2	100.8	168.1	280.1
450	4.6	33.5	44.6	66.9	100.4	167.3	278.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	...	24.0	31.9	47.9	71.8	119.7	199.5
600	...	19.8	26.4	39.6	59.4	99.0	165.1
625	...	13.9	18.5	27.7	41.6	69.3	115.5
650	...	10.3	13.7	20.6	30.9	51.5	85.8
675	...	8.0	10.6	15.9	23.9	39.8	66.3
700	...	5.6	7.5	11.2	16.8	28.1	46.8
725	...	4.0	5.3	8.0	11.9	19.9	33.1
750	...	3.1	4.1	6.2	9.3	15.5	25.8
775	...	2.5	3.3	4.9	7.4	12.3	20.4
800	...	2.0	2.7	4.0	6.1	10.1	16.9
816	...	1.9	2.5	3.8	5.7	9.5	15.8

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

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

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

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

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

Nominal Designation		Forgings		Castings		Plates	
35Ni-35Fe-20Cr-Cb		B462 Gr. N08020 (1)		...		B463 Gr. N08020 (1)	
Working Pressures by Classes, bar							
Temp., °C		150	300	400	600	900	1500
-29 to 38		20.0	51.7	68.9	103.4	155.1	258.6
50		19.5	51.7	68.9	103.4	155.1	258.6
100		17.7	50.9	67.8	101.7	152.6	254.4
150		15.8	48.9	65.3	97.9	146.8	244.7
200		13.8	47.2	62.9	94.3	141.5	235.8
250		12.1	45.5	60.7	91.0	136.5	227.5
300		10.2	42.9	57.0	85.7	128.6	214.4
325		9.3	41.4	55.0	82.6	124.0	206.6
350		8.4	40.3	53.6	80.4	120.7	201.1
375		7.4	38.9	51.6	77.6	116.5	194.1
400		6.5	36.5	48.9	73.3	109.8	183.1
425		5.5	35.2	46.5	70.0	105.1	175.1
							291.6

NOTE: (1) Use annealed material only.

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

Nominal Designation		Forgings		Castings		Plates	
99.0Ni		B564 Gr. N02200 (1)		...		B162 Gr. N02200 (1)	
Working Pressures by Classes, bar							
Temp., °C		150	300	400	600	900	1500
-29 to 38		12.7	33.1	44.1	66.2	99.3	165.5
50		12.7	33.1	44.1	66.2	99.3	165.5
100		12.7	33.1	44.1	66.2	99.3	165.5
150		12.7	33.1	44.1	66.2	99.3	165.5
200		12.7	33.1	44.1	66.2	99.3	165.5
250		12.1	31.6	42.1	63.2	94.8	158.0
300		10.2	29.2	39.0	58.5	87.7	146.2
325		7.2	18.8	25.0	37.6	56.4	93.9
							156.5

NOTE: (1) Use annealed material only.

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

Nominal Designation		Forgings		Castings		Plates	
99.0Ni-Low C			B162 Gr. N02201 (1)	
Temp., °C		Working Pressures by Classes, bar					
		150	300	400	600	900	1500
-29 to 38	6.3	16.5	22.1	33.1	49.6	82.7	137.9
50	6.3	16.4	21.9	32.8	49.2	82.0	136.7
100	6.1	15.8	21.1	31.7	47.5	79.2	132.0
150	6.0	15.6	20.7	31.1	46.7	77.8	129.6
200	6.0	15.6	20.7	31.1	46.7	77.8	129.6
250	6.0	15.6	20.7	31.1	46.7	77.8	129.6
300	6.0	15.6	20.7	31.1	46.7	77.8	129.6
325	5.9	15.5	20.7	31.0	46.5	77.5	129.2
350	5.9	15.4	20.5	30.8	46.2	76.9	128.2
375	5.9	15.4	20.5	30.7	46.1	76.8	128.0
400	5.8	15.2	20.3	30.4	45.6	76.1	126.8
425	5.5	14.9	19.9	29.8	44.7	74.6	124.3
450	4.6	14.6	19.5	29.2	43.8	73.1	121.8
475	3.7	14.3	19.1	28.6	43.0	71.6	119.3
500	2.8	13.8	18.4	27.6	41.4	69.0	115.1
538	1.4	13.1	17.4	26.1	39.2	65.4	108.9
550	...	9.8	13.1	19.6	29.5	49.1	81.8
575	...	5.4	7.1	10.7	16.1	26.8	44.6
600	...	4.4	5.9	8.9	13.3	22.2	37.0
625	...	3.4	4.6	6.9	10.3	17.2	28.7
650	...	2.8	3.8	5.7	8.5	14.2	23.6

NOTE: (1) Use annealed material only.

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

Nominal Designation	Forgings			Castings		Plates	
	67Ni-30Cu	B564 Gr. N04400 (1)		...		B127 Gr. N04400 (1)	
Working Pressures by Classes, bar							
	Class						
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	15.9	41.4	55.2	82.7	124.1	206.8	344.7
50	15.4	40.2	53.7	80.5	120.7	201.2	335.3
100	13.8	35.9	47.9	71.9	107.8	179.7	299.5
150	12.9	33.7	45.0	67.5	101.2	168.7	281.1
200	12.5	32.7	43.6	65.4	98.1	163.5	272.4
250	12.1	32.6	43.5	65.2	97.8	163.0	271.7
300	10.2	32.6	43.5	65.2	97.8	163.0	271.7
325	9.3	32.6	43.5	65.2	97.8	163.0	271.7
350	8.4	32.6	43.4	65.1	97.7	162.8	271.3
375	7.4	32.4	43.2	64.8	97.2	161.9	269.9
400	6.5	32.1	42.8	64.2	96.2	160.4	267.4
425	5.5	31.6	42.2	63.3	94.9	158.2	263.6
450	4.6	26.9	35.9	53.8	80.7	134.5	224.2
475	3.7	20.8	27.7	41.5	62.3	103.8	173.0

NOTE: (1) Use annealed material only.

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

Nominal Designation	Forgings			Castings		Plates	
	72Ni-15Cr-8Fe	B564 Gr. N06600 (1)		...		B168 Gr. N06600 (1)	
Temp., °C	Working Pressures by Classes, bar						
				Class			
150	300	400	600	900	1500	2500	
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	16.5	22.1	33.1	49.6	82.7	137.9
550	...	13.9	18.6	27.9	41.8	69.7	116.2
575	...	9.4	12.6	18.9	28.3	47.2	78.6
600	...	6.6	8.9	13.3	19.9	33.2	55.3
625	...	5.1	6.8	10.3	15.4	25.7	42.8
650	...	4.7	6.3	9.5	14.2	23.6	39.4

NOTE: (1) Use annealed material only.

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

Nominal Designation	Forgings		Castings		Plates	
	33Ni-42Fe-21Cr	B564 Gr. N08800 (1)	B409 Gr. N08800 (1)	
Working Pressures by Classes, bar						
Temp., °C	150	300	400	600	900	1500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2
50	18.7	48.8	65.1	97.6	146.4	244.0
100	17.5	45.6	60.8	91.2	136.9	228.1
150	15.8	44.0	58.7	88.0	132.0	219.9
200	13.8	42.8	57.1	85.6	128.4	214.0
250	12.1	41.7	55.7	83.5	125.2	208.7
300	10.2	40.8	54.4	81.6	122.5	204.1
325	9.3	40.3	53.8	80.6	120.9	201.6
350	8.4	39.8	53.0	79.5	119.3	198.8
375	7.4	38.9	51.6	77.6	116.5	194.1
400	6.5	36.5	48.9	73.3	109.8	183.1
425	5.5	35.2	46.5	70.0	105.1	175.1
450	4.6	33.7	45.1	67.7	101.4	169.0
475	3.7	31.7	42.3	63.4	95.1	158.2
500	2.8	28.2	37.6	56.5	84.7	140.9
538	1.4	25.2	33.4	50.0	75.2	125.5
550	...	25.0	33.3	49.8	74.8	124.9
575	...	24.0	31.9	47.9	71.8	119.7
600	...	21.6	28.6	42.9	64.2	107.0
625	...	18.3	24.3	36.6	54.9	91.2
650	...	14.1	18.9	28.1	42.5	70.7
675	...	10.3	13.7	20.5	30.8	51.3
700	...	5.6	7.4	11.1	16.7	27.8
725	...	4.0	5.4	8.1	12.1	20.1
750	...	3.0	4.0	6.1	9.1	15.1
775	...	2.5	3.3	4.9	7.4	12.4
800	...	2.2	2.9	4.3	6.5	10.8
816	...	1.9	2.5	3.8	5.7	9.5
						15.8

NOTE: (1) Use annealed material only.

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

Nominal Designation		Forgings		Castings		Plates					
65Ni-28Mo-2Fe		B462 Gr. N10665 (1)		...		B333 Gr. N10665 (1)					
64Ni-29.5Mo-2Cr-2Fe-Mn-W		B462 Gr. N10675 (1)		...		B333 Gr. N10675 (1)					
Working Pressures by Classes, bar											
Temp., °C		Class									
150		300	400	600	900	1500	2500				
-29 to 38		20.0	51.7	68.9	103.4	155.1	258.6				
50		19.5	51.7	68.9	103.4	155.1	258.6				
100		17.7	51.5	68.7	103.0	154.6	257.6				
150		15.8	50.3	66.8	100.3	150.6	250.8				
200		13.8	48.6	64.8	97.2	145.8	243.4				
250		12.1	46.3	61.7	92.7	139.0	231.8				
300		10.2	42.9	57.0	85.7	128.6	214.4				
325		9.3	41.4	55.0	82.6	124.0	206.6				
350		8.4	40.3	53.6	80.4	120.7	201.1				
375		7.4	38.9	51.6	77.6	116.5	194.1				
400		6.5	36.5	48.9	73.3	109.8	183.1				
425		5.5	35.2	46.5	70.0	105.1	175.1				

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings	Castings	Plates				
54Ni-16Mo-15Cr	B462 Gr. N10276 (1), (2)	...	B575 Gr. N10276 (1), (2)				
60Ni-22Cr-9Mo-3.5Cb	B564 Gr. N06625 (3)-(5)	...	B443 Gr. N06625 (3)-(5)				
62Ni-28Mo-5Fe	B333 Gr. N10001 (1), (6)				
70Ni-16Mo-7Cr-5Fe	B434 Gr. N10003 (3)				
61Ni-16Mo-16Cr	B575 Gr. N06455 (1), (6)				
42Ni-21.5Cr-3Mo-2.3Cu	B564 Gr. N08825 (3), (7)	...	B424 Gr. N08825 (3), (7)				
55Ni-21Cr-13.5Mo	B462 Gr. N06022 (1), (2), (8)	...	B575 Gr. N06022 (1), (2), (8)				
55Ni-23Cr-16Mo-1.6Cu	B462 Gr. N06200 (1), (6)	...	B575 Gr. N06200 (1), (6)				
Working Pressures by Classes, bar							
Class							
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.3	64.5	96.7	145.0	241.7	402.8
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	...	24.0	31.9	47.9	71.8	119.7	199.5
600	...	21.6	28.6	42.9	64.2	107.0	178.5
625	...	18.3	24.3	36.6	54.9	91.2	152.0
650	...	14.1	18.8	28.1	42.2	70.4	117.3
675	...	11.5	15.4	23.0	34.6	57.6	96.0
700	...	8.8	11.7	17.5	26.3	43.8	73.0

NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 675°C.
- (3) Use annealed material only.
- (4) Not to be used over 645°C. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 538°C to 760°C.
- (5) Grade 1.
- (6) Not to be used over 425°C.
- (7) Not to be used over 538°C.
- (8) Alloy N06022 in the solution annealed condition is subject to severe loss of impact strength at room temperature after exposure to temperatures in the range of 538°C to 675°C.

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

Nominal Designation		Forgings		Castings		Plates					
47Ni-22Cr-9Mo-18Fe		B572 Gr. N06002 (1), (2)		...		B435 Gr. N06002 (1)					
21Ni-30Fe-22Cr-18Co-3Mo-3W		B572 Gr. R30556 (1), (2)		...		B435 Gr. R30556 (1)					
Working Pressures by Classes, bar											
Temp., °C		Class									
150		300	400	600	900	1500	2500				
-29 to 38		20.0	51.7	68.9	103.4	155.1	258.6				
50		19.5	51.7	68.9	103.4	155.1	258.6				
100		17.7	51.5	68.7	103.0	154.6	257.6				
150		15.8	47.6	63.4	95.2	142.8	237.9				
200		13.8	44.3	59.1	88.6	132.9	221.5				
250		12.1	41.6	55.4	83.1	124.7	207.9				
300		10.2	39.5	52.7	79.0	118.5	197.4				
325		9.3	38.6	51.5	77.2	115.8	193.0				
350		8.4	37.9	50.5	75.8	113.7	189.5				
375		7.4	37.3	49.8	74.7	112.0	186.6				
400		6.5	36.5	48.9	73.3	109.8	183.1				
425		5.5	35.2	46.5	70.0	105.1	175.1				
450		4.6	33.7	45.1	67.7	101.4	169.0				
475		3.7	31.7	42.3	63.4	95.1	158.2				
500		2.8	28.2	37.6	56.5	84.7	140.9				
538		1.4	25.2	33.4	50.0	75.2	125.5				
550		...	25.0	33.3	49.8	74.8	124.9				
575		...	24.0	31.9	47.9	71.8	119.7				
600		...	21.6	28.6	42.9	64.2	107.0				
625		...	18.3	24.3	36.6	54.9	91.2				
650		...	14.1	18.9	28.1	42.5	70.7				
675		...	12.4	16.9	25.2	37.6	62.7				
700		...	10.1	13.4	20.0	29.8	49.7				
725		...	7.9	10.5	15.4	23.2	38.6				
750		...	5.9	7.9	11.7	17.6	29.6				
775		...	4.6	6.2	9.0	13.7	22.8				
800		...	3.5	4.8	7.0	10.5	17.4				
816		...	2.8	3.8	5.9	8.6	14.1				
23.8											

NOTES:

- (1) Use solution annealed material only.
 (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B564.

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

Nominal Designation		Forgings		Castings		Plates	
25Ni-47Fe-21Cr-5Mo			B599 Gr. N08700 (1)	
Working Pressures by Classes, bar							
Temp., °C		150	300	400	600	900	1500
-29 to 38		20.0	51.7	68.9	103.4	155.1	258.6
50		19.5	51.7	68.9	103.4	155.1	258.6
100		17.7	51.5	68.7	103.0	154.6	257.6
150		15.8	47.1	62.8	94.2	141.3	235.5
200		13.8	44.3	59.0	88.5	132.8	221.3
250		12.1	42.8	57.1	85.6	128.4	214.0
300		10.2	41.3	55.1	82.7	124.0	206.7
325		9.3	40.4	53.8	80.7	121.1	201.8
350		8.4	38.9	51.9	77.8	116.7	194.5
							324.2

NOTE: (1) Use solution annealed material only.

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

Nominal Designation		Forgings		Castings		Plates	
44Fe-25Ni-21Cr-Mo		A479 Gr. N08904 (1), (2)		...		A240 Gr. N08904 (1)	
Working Pressures by Classes, bar							
Temp., °C		150	300	400	600	900	1500
-29 to 38		19.7	51.3	68.4	102.6	153.9	256.5
50		18.8	49.1	65.5	98.3	147.4	245.7
100		15.7	41.1	54.7	82.1	123.2	205.3
150		14.4	37.5	50.0	75.0	112.5	187.5
200		13.3	34.7	46.2	69.3	104.0	173.4
250		12.1	32.0	42.6	64.0	95.9	159.9
300		10.2	30.0	40.0	60.0	90.0	150.1
325		9.3	29.2	39.0	58.5	87.7	146.1
350		8.4	28.7	38.2	57.3	86.0	143.4
375		7.4	28.2	37.7	56.5	84.7	141.2
							235.4

NOTES:

(1) Use annealed material only.

(2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B564.

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

Nominal Designation		Forgings		Castings		Plates					
26Ni-43Fe-22Cr-5Mo			B620 Gr. N08320 (1)					
47Ni-22Cr-20Fe-7Mo			B582 Gr. N06985 (1)					
46Fe-24Ni-21Cr-6Mo-Cu-N		B462 Gr. N08367 (1)		A351 Gr. CN3MN (1)		B688 Gr. N08367 (1)					
Working Pressures by Classes, bar											
Temp., °C		Class									
150	300	400	600	900	1500	2500					
-29 to 38	17.8	46.3	61.8	92.7	139.0	231.7	386.1				
50	17.5	45.6	60.8	91.1	136.7	227.8	379.7				
100	16.3	42.5	56.7	85.1	127.6	212.7	354.5				
150	15.4	40.1	53.5	80.3	120.4	200.7	334.6				
200	13.8	37.3	49.8	74.6	112.0	186.6	311.0				
250	12.1	34.9	46.5	69.8	104.7	174.5	290.8				
300	10.2	33.1	44.1	66.2	99.3	165.5	275.9				
325	9.3	32.3	43.1	64.6	97.0	161.6	269.3				
350	8.4	31.6	42.1	63.2	94.8	158.1	263.4				
375	7.4	31.0	41.4	62.0	93.0	155.1	258.5				
400	6.5	30.4	40.6	60.8	91.3	152.1	253.5				
425	5.5	29.8	39.8	59.7	89.5	149.1	248.5				

NOTE: (1) Use solution annealed material only.

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

Nominal Designation		Forgings		Castings		Plates					
49Ni-25Cr-18Fe-6Mo			B582 Gr. N06975 (1)					
Ni-Fe-Cr-Mo-Cu-Low C		B564 Gr. N08031 (2)		...		B625 Gr. N08031 (2)					
Working Pressures by Classes, bar											
Temp., °C		Class									
150	300	400	600	900	1500	2500					
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9				
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9				
100	17.7	48.2	64.2	96.3	144.5	240.8	401.4				
150	15.8	45.8	61.0	91.6	137.4	228.9	381.6				
200	13.8	43.6	58.1	87.1	130.7	217.8	362.9				
250	12.1	41.5	55.3	82.9	124.4	207.3	345.5				
300	10.2	39.4	52.5	78.7	118.1	196.8	328.1				
325	9.3	38.4	51.3	76.9	115.3	192.2	320.3				
350	8.4	37.7	50.3	75.5	113.2	188.7	314.5				
375	7.4	37.2	49.5	74.3	111.5	185.8	309.7				
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9				
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6				

NOTES:

(1) Use solution annealed material only.

(2) Use annealed material only.

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

Nominal Designation	Forgings	Castings	Plates				
47Ni-22Cr-19Fe-6Mo	B582 Gr. N06007 (1)				
40Ni-29Cr-15Fe-5Mo	B462 Gr. N06030 (1), (2)	...	B582 Gr. N06030 (1), (2)				
58Ni-33Cr-8Mo	B462 Gr. N06035 (1), (2)	...	B575 Gr. N06035 (1), (2)				
Working Pressures by Classes, bar							
	Class						
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2	413.7
50	18.6	48.6	64.7	97.1	145.7	242.8	404.6
100	17.0	44.3	59.0	88.6	132.8	221.4	369.0
150	15.8	41.3	55.1	82.6	124.0	206.6	344.3
200	13.8	39.1	52.1	78.2	117.3	195.4	325.7
250	12.1	37.4	49.9	74.8	112.2	187.0	311.6
300	10.2	36.1	48.2	72.2	108.3	180.6	300.9
325	9.3	35.6	47.4	71.1	106.7	177.9	296.4
350	8.4	35.2	46.9	70.3	105.5	175.8	293.1
375	7.4	34.9	46.5	69.7	104.6	174.3	290.6
400	6.5	34.6	46.1	69.2	103.7	172.9	288.1
425	5.5	34.4	45.9	68.9	103.3	172.1	286.9
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9

NOTES:

(1) Use solution annealed material only.

(2) Not to be used over 425°C.

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

Nominal Designation	Forgings		Castings		Plates		
	33Ni-42Fe-21Cr	B564 Gr. N08810 (1)	...	B409 Gr. N08810 (1)			
	Working Pressures by Classes, bar						
Temp., °C	Class						
150	300	400	600	900	1500	2500	
-29 to 38	15.9	41.4	55.2	82.7	124.1	206.8	
50	15.6	40.6	54.2	81.3	121.9	203.2	
100	14.5	37.8	50.4	75.6	113.4	189.0	
150	13.7	35.9	47.8	71.7	107.6	179.3	
200	13.0	33.9	45.2	67.9	101.8	169.6	
250	12.1	32.3	43.0	64.5	96.8	161.3	
300	10.2	30.7	41.0	61.5	92.2	153.7	
325	9.3	30.1	40.1	60.1	90.2	150.3	
350	8.4	29.4	39.2	58.8	88.3	147.1	
375	7.4	28.7	38.3	57.4	86.2	143.6	
400	6.5	28.3	37.7	56.5	84.8	141.3	
425	5.5	27.7	36.9	55.3	83.0	138.4	
450	4.6	27.2	36.3	54.4	81.7	136.1	
475	3.7	26.8	35.7	53.5	80.3	133.9	
500	2.8	26.3	35.1	52.6	79.0	131.6	
538	1.4	25.2	33.4	50.0	75.2	125.5	
550	...	25.0	33.3	49.8	74.8	124.9	
575	...	24.0	31.9	47.9	71.8	119.7	
600	...	21.6	28.6	42.9	64.2	107.0	
625	...	18.3	24.3	36.6	54.9	91.2	
650	...	14.1	18.9	28.1	42.5	70.7	
675	...	12.4	16.9	25.2	37.6	62.7	
700	...	10.1	13.4	20.0	29.8	49.7	
725	...	7.9	10.5	15.4	23.2	38.6	
750	...	5.9	7.9	11.7	17.6	29.6	
775	...	4.6	6.2	9.0	13.7	22.8	
800	...	3.5	4.8	7.0	10.5	17.4	
816	...	2.8	3.8	5.9	8.6	14.1	

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings		Castings		Plates	
	35Ni-19Cr-1 $\frac{1}{4}$ Si	B511 Gr. N08330	B536 Gr. N08330 (1)	...
Working Pressures by Classes, bar						
			Class			
Temp., °C	150	300	400	600	900	1500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2
50	18.5	48.4	64.5	96.7	145.1	241.8
100	16.7	43.5	58.0	87.0	130.5	217.5
150	15.6	40.8	54.4	81.6	122.5	204.1
200	13.8	38.6	51.5	77.2	115.8	192.9
250	12.1	36.8	49.0	73.5	110.3	183.8
300	10.2	35.2	47.0	70.4	105.6	176.1
325	9.3	34.5	46.0	69.0	103.6	172.6
350	8.4	33.9	45.2	67.8	101.7	169.4
375	7.4	33.2	44.2	66.3	99.5	165.8
400	6.5	32.6	43.4	65.1	97.7	162.9
425	5.5	32.0	42.6	64.0	95.9	159.9
450	4.6	31.4	41.8	62.8	94.1	156.9
475	3.7	30.8	41.0	61.6	92.4	153.9
500	2.8	28.2	37.6	56.5	84.7	140.9
538	1.4	25.2	33.4	50.0	75.2	125.5
550	...	25.0	33.3	49.8	74.8	124.9
575	...	21.9	29.2	43.7	65.6	109.4
600	...	17.4	23.2	34.8	52.3	87.1
625	...	13.8	18.3	27.5	41.3	68.8
650	...	11.0	14.7	22.1	33.1	55.1
675	...	9.1	12.1	18.2	27.3	45.6
700	...	7.6	10.1	15.2	22.8	38.0
725	...	6.1	8.1	12.2	18.3	30.5
750	...	4.8	6.4	9.5	14.3	23.8
775	...	3.9	5.2	7.7	11.6	19.4
800	...	3.1	4.2	6.3	9.4	15.6
816	...	2.6	3.5	5.2	7.8	13.0
						21.7

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings		Castings		Plates		
29Ni-20.5Cr-3.5Cu-2.5Mo	A351 Gr. CN7M (1)	
Temp., °C	Working Pressures by Classes, bar						
	150	300	400	600	900	1500	2500
-29 to 38	15.9	41.4	55.2	82.7	124.1	206.8	344.7
50	15.4	40.1	53.5	80.3	120.4	200.7	334.4
100	13.5	35.3	47.1	70.6	105.9	176.5	294.2
150	12.3	32.0	42.7	64.1	96.1	160.2	267.0
200	11.3	29.4	39.1	58.7	88.1	146.8	244.7
250	10.4	27.2	36.3	54.4	81.7	136.1	226.9
300	9.7	25.4	33.8	50.8	76.1	126.9	211.5
325	9.3	24.4	32.6	48.8	73.3	122.1	203.5

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings		Castings		Plates		
	57Ni-22Cr-14W-2Mo-La	B564 Gr. N06230	...		B435 Gr. N06230		
Temp., °C	Working Pressures by Classes, bar						
	150	300	400	600	900	1500	2500
-29 to 38	20.0	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.3	66.8	100.3	150.6	250.8	418.2
200	13.8	48.6	64.8	97.2	145.8	243.4	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.3	53.6	80.4	120.7	201.1	335.3
375	7.4	38.9	51.6	77.6	116.5	194.1	323.2
400	6.5	36.5	48.9	73.3	109.8	183.1	304.9
425	5.5	35.2	46.5	70.0	105.1	175.1	291.6
450	4.6	33.7	45.1	67.7	101.4	169.0	281.8
475	3.7	31.7	42.3	63.4	95.1	158.2	263.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	1.4	25.0	33.3	49.8	74.8	124.9	208.0
575	1.4	24.0	31.9	47.9	71.8	119.7	199.5
600	1.4	21.6	28.6	42.9	64.2	107.0	178.5
625	1.4	18.3	24.3	36.6	54.9	91.2	152.0
650	1.4	14.1	18.9	28.1	42.5	70.7	117.7
675	1.4	12.4	16.9	25.2	37.6	62.7	104.5
700	1.4	10.1	13.4	20.0	29.8	49.7	83.0
725	1.4	7.9	10.5	15.4	23.2	38.6	64.4
750	1.4	5.9	7.9	11.5	17.6	29.6	49.1
775	1.4	4.6	6.2	9.0	13.7	22.8	38.0
800	1.4	3.5	4.8	7.0	10.5	17.4	29.2
816	1.4	2.8	3.8	5.9	8.6	14.1	23.8

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

NPS	Maximum Radial Projection of Imperfections That Are No Deeper Than the Bottom of the Serrations, mm	Maximum Depth and Radial Projection of Imperfections That Are Deeper Than the Bottom of the Serrations, mm
$\frac{1}{2}$	3.0	1.5
$\frac{3}{4}$	3.0	1.5
1	3.0	1.5
$1\frac{1}{4}$	3.0	1.5
$1\frac{1}{2}$	3.0	1.5
2	3.0	1.5
$2\frac{1}{2}$	3.0	1.5
3	4.5	1.5
$3\frac{1}{2}$	6.0	3.0
4	6.0	3.0
5	6.0	3.0
6	6.0	3.0
8	8.0	4.5
10	8.0	4.5
12	8.0	4.5
14	8.0	4.5
16	10.0	4.5
18	12.0	6.0
20	12.0	6.0
22	12.0	6.0
24	12.0	6.0

GENERAL NOTE: For permissible imperfections in inch units, refer to [Mandatory Appendix II, Table II-3](#).

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Minimum Outside Diameter of Raised Portion [Notes (6), (7)]
Nominal Pipe Size	Outside Diameter				Outside Diameter				Height							
	Raised Face Large Male and Large Tongue, R	Small Male, S [Note (1)]	Small Tongue, T	Inside Diameter of Large and Small Tongue, U	Inside Diameter of Small Tongue [Note (1)]	Large Female and Large Groove, W	Small Female, X [Note (1)]	Small Groove, Y	Inside Diameter of Large and Small Groove, Z	Raised Face [Notes (2), (3)]	Large and Small Male and Tongue [Notes (2), (4)]	Depth of Groove or Female [Notes (2), (5)]	Small Female and Groove, K	Large Female and Groove, L		
1/2	34.9	18.3	35.1	25.4	...	36.5	19.9	36.5	23.8	44	46		
3/4	42.9	23.8	42.9	33.3	...	44.4	25.4	44.4	31.8	52	54		
1	50.8	30.2	47.8	38.1	...	52.4	31.8	49.2	36.5	57	62		
1 1/4	63.5	38.1	57.2	47.6	...	65.1	39.7	58.7	46.0	67	75		
1 1/2	73.0	44.4	63.5	54.0	...	74.6	46.0	65.1	52.4	73	84		
2	92.1	57.2	82.6	73.0	...	93.7	58.8	84.1	71.4	92	103		
2 1/2	104.8	68.3	95.2	85.7	...	106.4	69.8	96.8	84.1	105	116		
3	127.0	84.1	117.5	108.0	...	128.6	85.7	119.1	106.4	127	138		
3 1/2	139.7	96.8	130.2	120.6	...	141.3	98.4	131.8	119.1	140	151		
4	157.2	109.5	144.5	131.8	...	158.8	111.1	146.0	130.2	157	168		
5	185.7	136.5	173.0	160.3	...	187.3	138.1	174.6	158.8	186	197		
6	215.9	161.9	203.2	190.5	...	217.5	163.5	204.8	188.9	216	227		
8	269.9	212.7	254.0	238.1	...	271.5	214.3	255.6	236.5	270	281		
10	323.8	266.7	304.8	285.8	...	325.4	268.3	306.4	284.2	324	335		
12	381.0	317.5	362.0	342.9	...	382.6	319.1	363.5	341.3				381	392		
14	412.8	349.2	393.7	374.6	...	414.3	350.8	395.3	373.1	413	424		
16	469.9	400.0	447.5	425.4	...	471.5	401.6	449.3	423.9	470	481		
18	533.4	450.8	511.2	489.0	...	535.0	452.4	512.8	487.4	533	544		
20	584.2	501.6	558.8	533.4	...	585.8	503.2	560.4	531.8	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. For dimensions in inch units, refer to [Table II-4 of Mandatory Appendix II](#).
- (b) For facing requirements for flanges and flanged fittings, see [paras. 6.3 and 6.4](#) and [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](#).

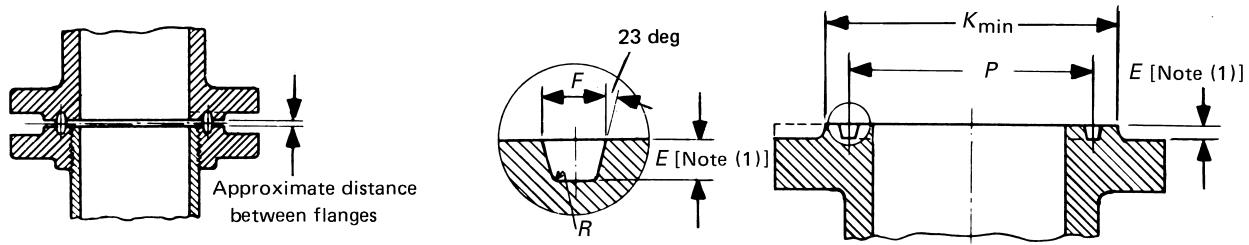
Table 4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes) (Cont'd)

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 2 mm or 7 mm (see [para. 6.4.1](#)).
- (4) The height of the large and small male and tongue is 7 mm.
- (5) The depth of the groove or female is 5 mm.
- (6) The raised portion of the full face may be furnished unless otherwise specified on order.
- (7) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

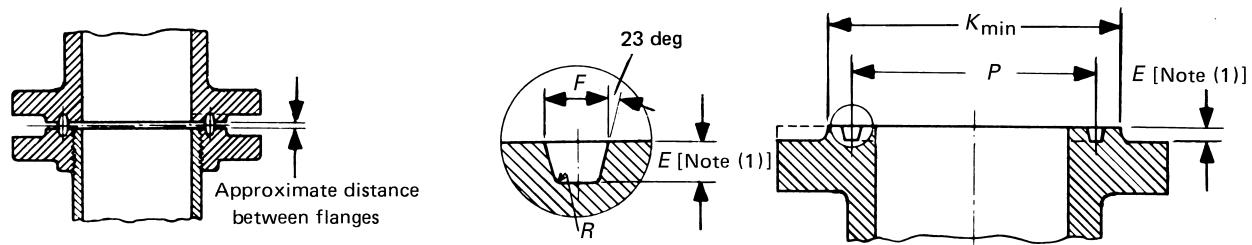
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Table 5 Dimensions of Ring Joint Facings (All Pressure Rating Classes)

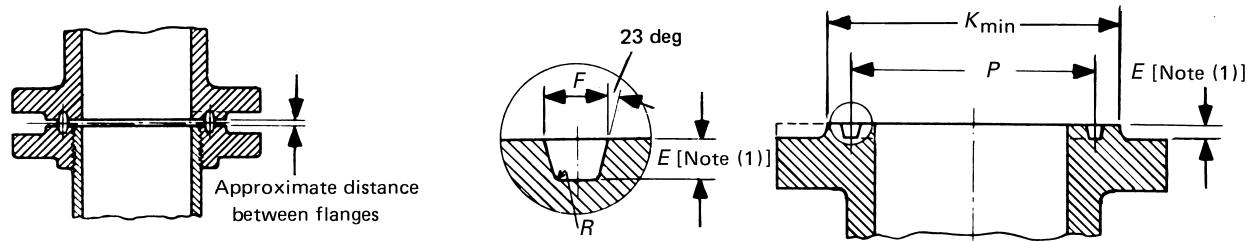
1	2	3	4	5	6	7	8	9	10	11	12
Nominal Size											
Class 150 NPS	Class 300 NPS	Class 400 NPS [Note (2)]	Class 600 NPS	Class 900 NPS [Note (3)]	Class 1500 NPS	Class 2500 NPS	Groove Number	Groove Dimensions			Radius at Bottom, R
...	1/2	...	1/2	11	Pitch Diameter, P	5.54	7.14	0.8
...	1/2	...	12	34.14	39.67	6.35	0.8
...	3/4	...	3/4	1/2	13	42.88	44.45	8.74	0.8
...	3/4	...	14	44.45	47.63	6.35	0.8
1	15	47.63	50.80	8.74	0.8
...	1	...	1	...	1	3/4	16	57.15	60.33	8.74	0.8
1 1/4	17	65.07	68.27	6.35	0.8
...	1 1/4	...	1 1/4	...	1 1/4	1	18	72.23	7.92	11.91	0.8
1 1/2	19	82.55	82.55	8.74	0.8
...	1 1/2	...	1 1/2	...	1 1/2	...	20	95.25	101.60	6.35	0.8
...	1 1/4	21	107.95	111.13	11.91	0.8
2	22	114.30	117.48	7.92	0.8
...	2	...	2	1 1/2	23	123.83	127.00	9.53	0.8
...	2	...	24	131.78	131.78	13.49	1.5
2 1/2	25	149.23	157.18	6.35	0.8
...	2 1/2	...	2 1/2	2	26	161.93	171.45	8.74	0.8
...	2 1/2	...	27	171.45	180.98	7.92	0.8
...	2 1/2	28	180.98	195.25	11.91	0.8
3	29	195.25	207.95	11.91	0.8
...	[Note (4)]	...	[Note (4)]	30	207.95	214.30	11.91	0.8
...	3 [Note (4)]	...	3 [Note (4)]	3	31	214.30	223.83	11.91	0.8
...	3	32	223.83	231.78	13.49	1.5
3 1/2	33	231.78	249.23	8.74	0.8
...	3 1/2	...	3 1/2	4	34	249.23	267.00	11.91	0.8
...	3	...	35	267.00	285.25	11.91	0.8
4	36	285.25	303.78	8.74	0.8
...	4	4	4	4	4	...	37	303.78	323.83	11.91	0.8
...	4	38	323.83	344.30	16.66	1.5
5	4	39	344.30	365.25	11.91	0.8
...	5	5	5	5	40	365.25	387.00	8.74	0.8
...	5	5	5	5	41	387.00	410.00	11.91	0.8

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

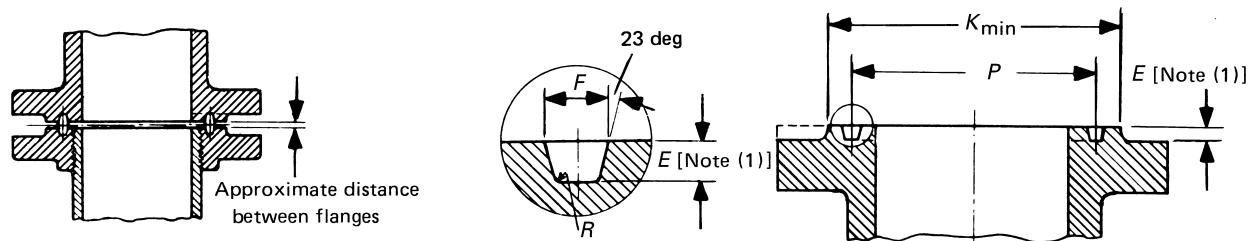
13	14	15	16	17	18	19	20	21	22	23	24
Diameter of Raised Portion, <i>K</i>					Approximate Distance Between Flanges						
Class 150	Class 300 400 600	Class 900	Class 1500	Class 2500	Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500
...	51.0	3	...	3
...	60.5	4	...
...	63.5	65.0	...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

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

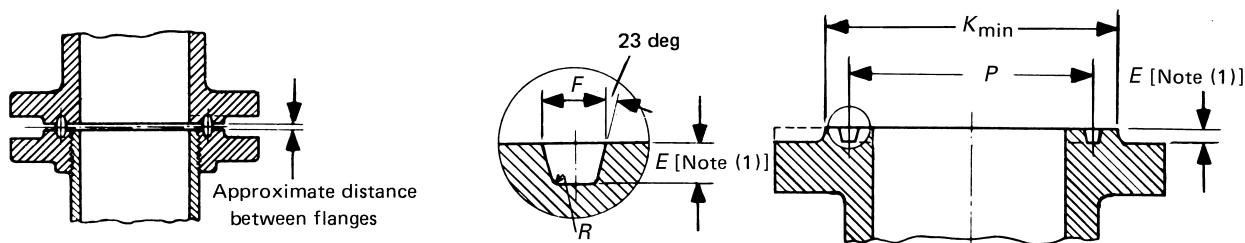
1 Class 150 NPS	2 Class 300 NPS	Nominal Size				5 Class 400 NPS [Note (2)]	6 Class 600 NPS	7 Class 900 NPS [Note (3)]	8 Class 1500 NPS	9 Class 2500 NPS	Groove Dimensions			Radius at Bottom, R
		Groove Number	Pitch Diameter, P	Depth, E [Note (1)]	Width, F									
...	190.50	12.70	19.84	1.5								
6	...	43	193.68	6.35	8.74	0.8								
...	...	44	193.68	7.92	11.91	0.8								
...	6	45	211.12	7.92	11.91	0.8								
...	...	46	211.14	9.53	13.49	1.5								
...	...	47	228.60	12.70	19.84	1.5								
8	...	48	247.65	6.35	8.74	0.8								
...	8	49	269.88	7.92	11.91	0.8								
...	...	50	269.88	11.13	16.66	1.5								
...	...	51	279.40	14.27	23.01	1.5								
10	...	52	304.80	6.35	8.74	0.8								
...	10	53	323.85	7.92	11.91	0.8								
...	...	54	323.85	11.13	16.66	1.5								
...	...	55	342.90	17.48	30.18	2.4								
12	...	56	381.00	6.35	8.74	0.8								
...	12	57	381.00	7.92	11.91	0.8								
...	...	58	381.00	14.27	23.01	1.5								
14	...	59	396.88	6.35	8.74	0.8								
...	...	60	406.40	17.48	33.32	2.4								
...	14	61	419.10	7.92	11.91	0.8								
...	...	62	419.10	11.13	16.66	1.5								
...	...	63	419.10	15.88	26.97	2.4								
16	...	64	454.03	6.35	8.74	0.8								
...	16	65	469.90	7.92	11.91	0.8								
...	...	66	469.90	11.13	16.66	1.5								
...	...	67	469.90	17.48	30.18	2.4								
18	...	68	517.53	6.35	8.74	0.8								
...	18	69	533.40	7.92	11.91	0.8								
...	...	70	533.40	12.70	19.84	1.5								
...	...	71	533.40	17.48	30.18	2.4								
20	...	72	558.80	6.35	8.74	0.8								
...	20	73	584.20	9.53	13.49	1.5								

(17)

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

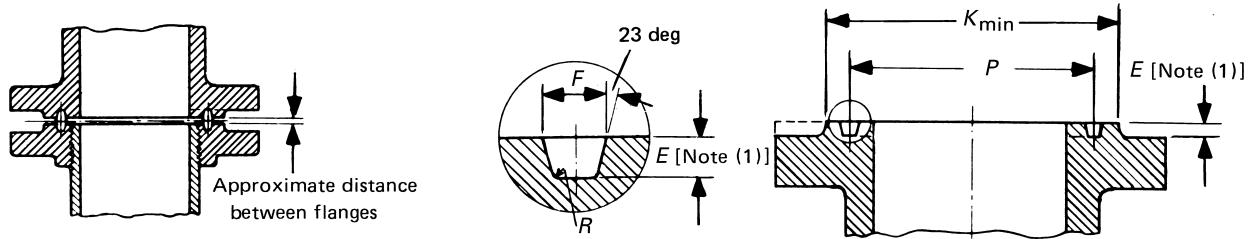
13	14	15	16	17	18	19	20	21	22	23	24		
Diameter of Raised Portion, <i>K</i>					Approximate Distance Between Flanges								
Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500	Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500
...	241	4
219	4
...	229	3	...
...	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	...
597	3
...	635	6	6	5

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

1 Class 150 NPS	2 Class 300 NPS	Nominal Size				6 Class 1500 NPS	7 Class 2500 NPS	Groove Dimensions			Radius at Bottom, <i>R</i>
		3 Class 400 NPS [Note (2)]	4 Class 600 NPS	5 Class 900 NPS [Note (3)]	8 Groove Number			9 Pitch Diameter, <i>P</i>	10 Depth, <i>E</i> [Note (1)]	11 Width, <i>F</i>	
...	20	74	584.20	12.70	19.84	1.5
...	20	...	75	584.20	17.48	33.32	2.4
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	2.4
...	24	...	79	692.15	20.62	36.53	2.4

(17)

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

13	14	15	16	17	18	19	20	21	22	23	24		
Diameter of Raised Portion, <i>K</i>					Approximate Distance Between Flanges								
Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500	Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500
...	...	648	5
...	673	10	...
648	3
...	686	6	6	6
711	3
...	749	6	6	6
...	...	772	6
...	794	11	...

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

GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inch units, refer to [Table II-5 of Mandatory Appendix II](#).
- (b) For facing requirements for flanges and flanged fitting, see [para. 6.4.1](#) and [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) $+0.40, -0.00$ mm

F (width) ± 0.20 mm

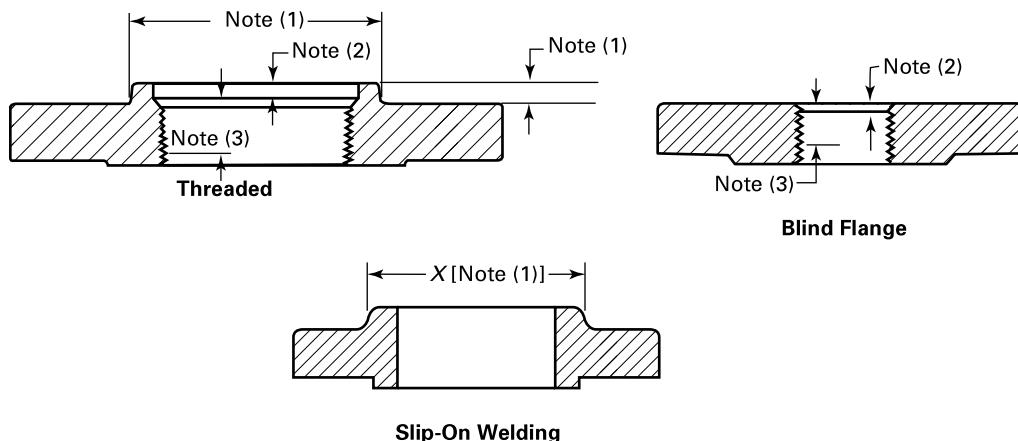
P (pitch diameter) ± 0.013 mm

R (radius at bottom)

$R \leq 2 + 0.8, -0.00$ mm

$R > 2 \pm 0.8$ mm

23 deg (angle) $\pm \frac{1}{2}$ deg

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

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

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

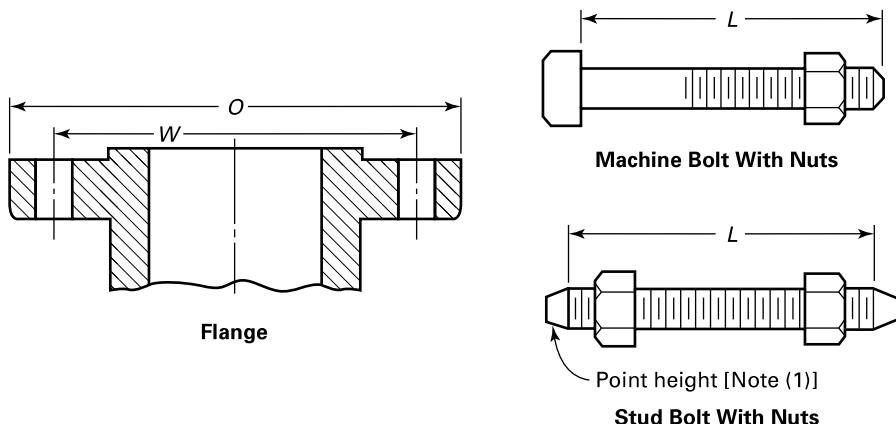
NOTES:

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

EXAMPLES:

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

(17)

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

Nominal Pipe Size	Outside Diameter of Flange, <i>O</i>	Drilling [Notes (2), (3)]					Length of Bolts, <i>L</i> [Note (4)]		
		Diameter of Bolt Circle, <i>W</i>	Diameter of Bolt Holes, in.	Number of Bolts	Diameter of Bolts, in.	2-mm Raised Face	Ring Joint	Stud Bolts [Note (1)]	Machine Bolts
								2-mm Raised Face	2-mm Raised Face
1/2	90	60.3	5/8	4	1/2	55	...	50	
3/4	100	69.9	5/8	4	1/2	65	...	50	
1	110	79.4	5/8	4	1/2	65	75	55	
1 1/4	115	88.9	5/8	4	1/2	70	85	55	
1 1/2	125	98.4	5/8	4	1/2	70	85	65	
2	150	120.7	3/4	4	5/8	85	95	70	
2 1/2	180	139.7	3/4	4	5/8	90	100	75	
3	190	152.4	3/4	4	5/8	90	100	75	
3 1/2	215	177.8	3/4	8	5/8	90	100	75	
4	230	190.5	3/4	8	5/8	90	100	75	
5	255	215.9	7/8	8	3/4	95	110	85	
6	280	241.3	7/8	8	3/4	100	115	85	
8	345	298.5	7/8	8	3/4	110	120	90	
10	405	362.0	1	12	7/8	115	125	100	
12	485	431.8	1	12	7/8	120	135	100	
14	535	476.3	1 1/8	12	1	135	145	115	
16	595	539.8	1 1/8	16	1	135	145	115	
18	635	577.9	1 1/4	16	1 1/8	145	160	125	
20	700	635.0	1 1/4	20	1 1/8	160	170	140	
22	750	692.2	1 3/8	20	1 1/4	170	185	150	
24	815	749.3	1 3/8	20	1 1/4	170	185	150	

GENERAL NOTES:

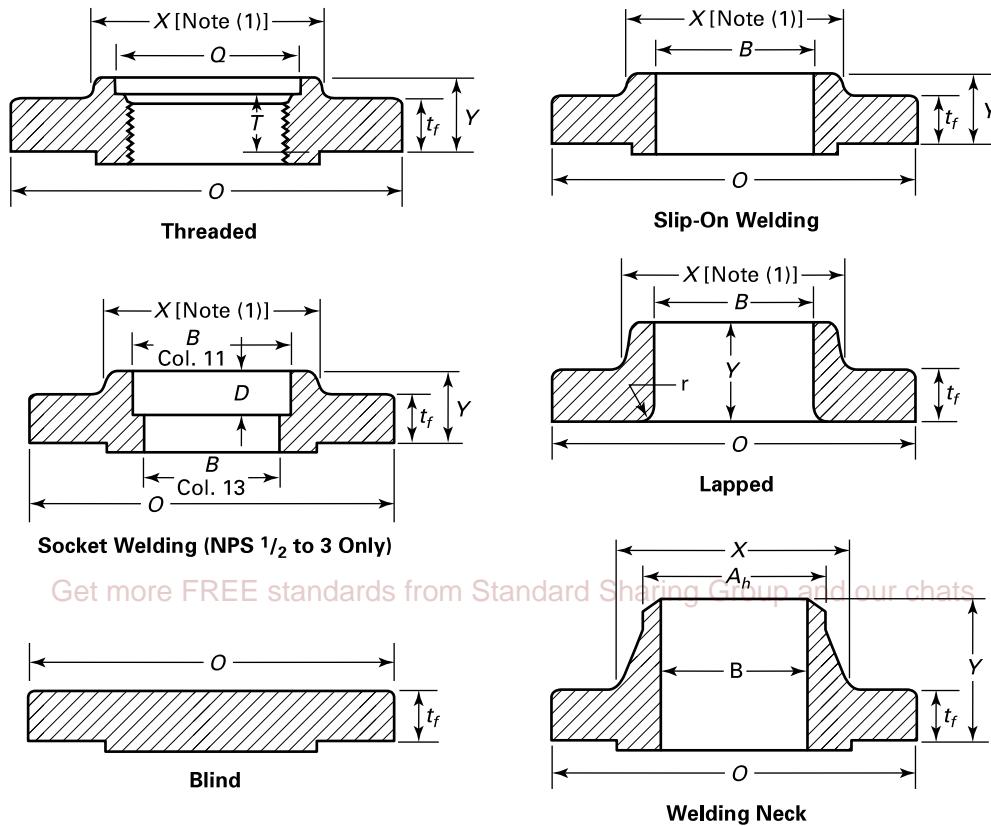
- (a) Dimensions of [Table 7](#) are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-7](#).
- (b) For other dimensions, see [Tables 8 and 9](#).

NOTES:

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

(17)

Table 8 Dimensions of Class 150 Flanges



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Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)-(4)]	Minimum Thickness Lap Joint, t_f	Diameter of Hub, X	Hub Diameter Beginning of Chamfer [Note (5)]	Length Through Hub			Bore			Corner Bore Radius of Lapped Flange and Pipe, r	Depth of Socket, D	
						Threaded/ Slip-on/ Socket Welding, Y	Lapped, Y	Welding Neck, Y	Minimum Thread Length Threaded, T [Note (6)]	Minimum Slip-on/ Socket Welding, B	Minimum Lapped, B			
$\frac{1}{2}$	90	9.6	11.2	30	21.3	14	16	46	16	22.2	22.9	15.8	3	10
$\frac{3}{4}$	100	11.2	12.7	38	26.7	14	16	51	16	27.7	28.2	20.9	3	11
1	110	12.7	14.3	49	33.4	16	17	54	17	34.5	34.9	26.6	3	13
$1\frac{1}{4}$	115	14.3	15.9	59	42.2	19	21	56	21	43.2	43.7	35.1	5	14
$1\frac{1}{2}$	125	15.9	17.5	65	48.3	21	22	60	22	49.5	50.0	40.9	6	16

(17)

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

Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)-(4)]	Minimum Thickness Lap Joint, t_f	Diameter of Hub, X	Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (5)]	Length Through Hub			Bore			Corner Bore Radius of Lapped Flange and Pipe, r			
						Threaded/Slip-on/Socket Welding, Y			Welded, Y			Threaded, T			
						Y	Lapped, Y	Welding Neck, Y	[Note (6)]	Y	Welding Neck, Y	T	Y	Welding Neck/Socket Welding, B [Note (7)]	
8	2	150	17.5	19.1	78	60.3	24	25	62	25	61.9	62.5	52.5	8	17
	2½	180	20.7	22.3	90	73.0	27	29	68	29	74.6	75.4	62.7	8	19
	3	190	22.3	23.9	108	88.9	29	30	68	30	90.7	91.4	77.9	10	21
	3½	215	22.3	23.9	122	101.6	30	32	70	32	103.4	104.1	90.1	10	...
	4	230	22.3	23.9	135	114.3	32	33	75	33	116.1	116.8	102.3	11	...
	5	255	22.3	23.9	164	141.3	35	36	87	36	143.8	144.4	128.2	11	...
	6	280	23.9	25.4	192	168.3	38	40	87	40	170.7	171.4	154.1	13	...
	8	345	27.0	28.6	246	219.1	43	44	100	44	221.5	222.2	202.7	13	...
	10	405	28.6	30.2	305	273.0	48	49	100	49	276.2	277.4	254.6	13	...
	12	485	30.2	31.8	365	323.8	54	56	113	56	327.0	328.2	304.8	13	...
	14	535	33.4	35.0	400	355.6	56	79	125	57	359.2	360.2	Note (8)	13	...
	16	595	35.0	36.6	457	406.4	62	87	125	64	410.5	411.2	Note (8)	13	...
	18	635	38.1	39.7	505	457.0	67	97	138	68	461.8	462.3	Note (8)	13	...
	20	700	41.3	42.9	559	508.0	71	103	143	73	513.1	514.4	Note (8)	13	...
	22	750	44.5	46.1	610	558.8	78	108	148	...	564.4	565.2	Note (8)	13	...
	24	815	46.1	47.7	663	610.0	81	111	151	83	616.0	616.0	Note (8)	13	...

GENERAL NOTES:

(a) Dimensions of Table 8 are in millimeters. For dimensions in inches, refer to Table II-8 of Mandatory Appendix II.

(b) For tolerance, see section 7.

(c) For facings, see para. 6.4.

(d) For flange bolt holes, see para. 6.5 and Table 7.

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

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

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

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

NOTES:

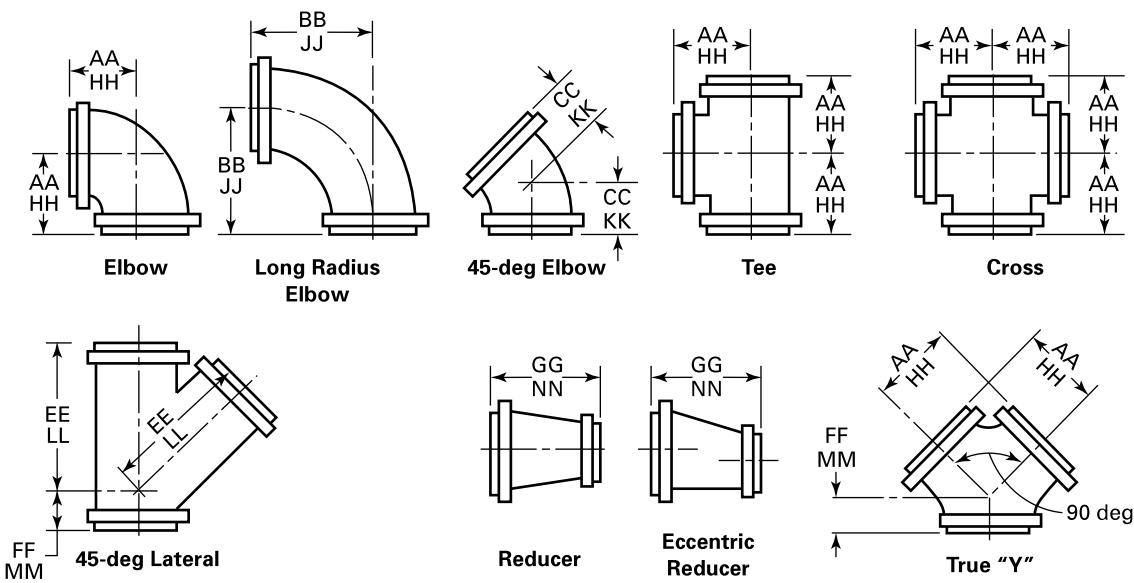
(1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and back face of the flange.

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

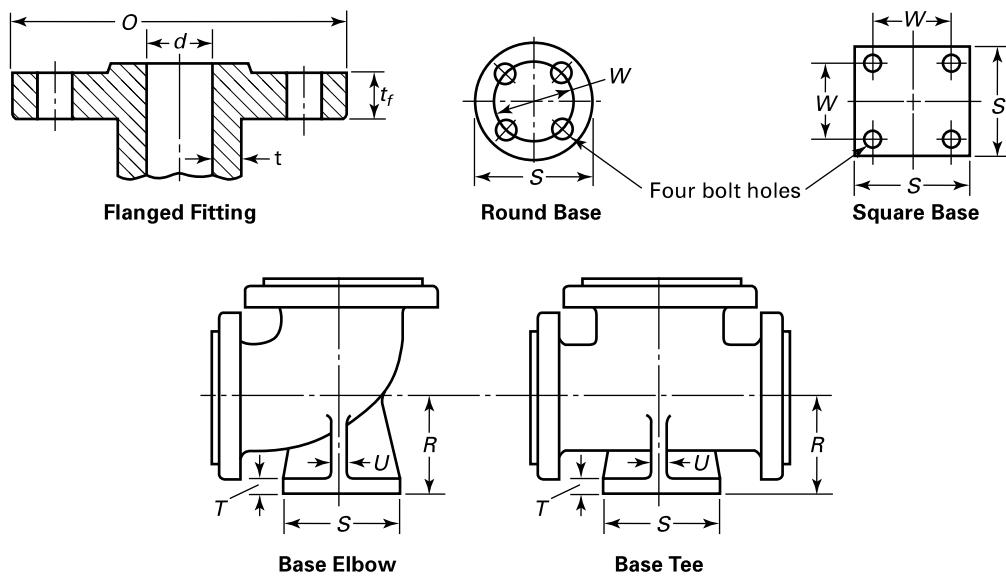
NOTES (Cont'd):

- (2) The minimum thickness of these loose flanges, in sizes NPS 3½ and smaller, is slightly greater than the thickness of flanges on fittings, [Table 9](#), which are reinforced by being cast integral with the body of the fitting.
- (3) These flanges may be supplied with a flat face. The flat face may be either the full t_f dimension of thickness plus 2 mm or the t_f dimension thickness without the raised face height. See [para 6.3.2](#) for additional restrictions.
- (4) The flange dimensions illustrated are for regularly furnished 2-mm raised face (except lapped); for requirements of other facings, see [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. Thickness of standard wall is the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in [para. 7.5.2](#) apply. These bore sizes are furnished unless otherwise specified by the purchaser.
- (8) To be specified by the purchaser.

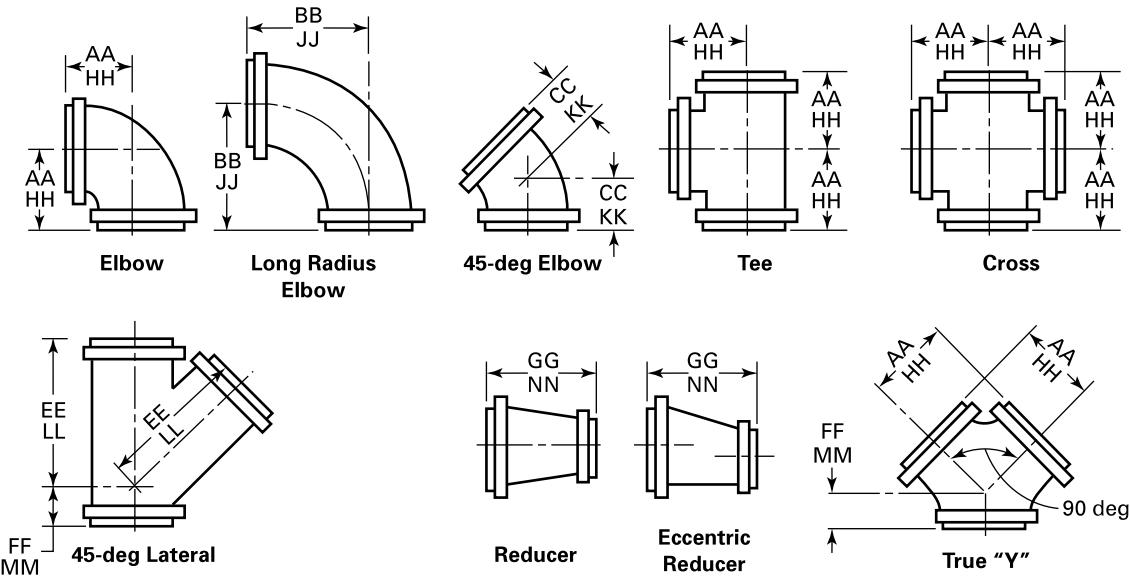
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Table 9 Dimensions of Class 150 Flanged Fittings

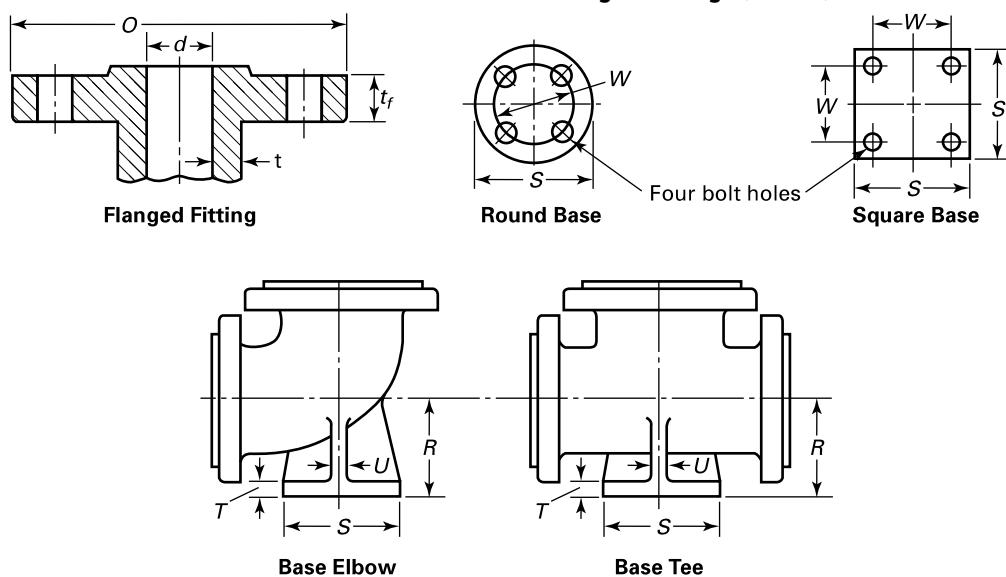
Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (1)- (3)]	Minimum Wall Thickness of Fitting, t_m	Inside Diameter of Fitting, d	2-mm Raised Face [Note (4)]							Ring Joint [Note(4)]
					Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA	Center-to-Contact Surface of Raised Face Long Radius Elbow, BB	Center-to-Contact Surface of Raised Face 45-deg Elbow, CC	Long Center-to-Contact Surface of Raised Face Lateral, EE	Short Center-to-Contact Surface of Raised Face Lateral and True "Y," FF	Contact Surface-to-Contact Surface of Raised Face Reducer, GG	[Note (5)]	
					[Note (5)]	[Note (5)]	[Note (5)]	[Note (5)]	[Note (5)]	[Note (5)]	[Note (5)]	
$\frac{1}{2}$	90	8.0	2.8	13
$\frac{3}{4}$	100	8.9	3.2	19
1	110	9.6	4.0	25	89	127	44	146	44	114	95	
$1\frac{1}{4}$	115	11.2	4.8	32	95	140	51	159	44	114	102	
$1\frac{1}{2}$	125	12.7	4.8	38	102	152	57	178	51	114	108	
2	150	14.3	5.6	51	114	165	64	203	64	127	121	
$2\frac{1}{2}$	180	15.9	5.6	64	127	178	76	241	64	140	133	
3	190	17.5	5.6	76	140	197	76	254	76	152	146	
$3\frac{1}{2}$	215	19.1	6.4	89	152	216	89	292	76	165	159	
4	230	22.3	6.4	102	165	229	102	305	76	178	171	
5	255	22.3	7.1	127	190	260	114	343	89	203	197	
6	280	23.9	7.1	152	203	292	127	368	89	229	210	
8	345	27.0	7.9	203	229	356	140	444	114	279	235	
10	405	28.6	8.7	254	279	419	165	521	127	305	286	
12	485	30.2	9.5	305	305	483	190	622	140	356	311	
14	535	33.4	10.3	337	356	546	190	686	152	406	362	
16	595	35.0	11.1	387	381	610	203	762	165	457	387	

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

13	14	15	16	17	18	19	20	21	22	23	1
Ring Joint [Note (4)]						Base Drilling [Note (11)]					
Center-to-End Long Radius Elbow, <i>JJ</i> [Note (6)]	Center-to-End 45-deg Elbow, <i>KK</i> [Note (6)]	Long Center-to-End Lateral, <i>LL</i> [Note (6)]	Center-to-End Lateral and True "Y," <i>MM</i> [Notes (5), (6)]	End-to- Reducer, <i>NN</i> [Notes (7)-(9)]	Diameter of Round Center-to-Base, <i>R</i> [Notes (7)-(9)]	Base or Width of Square Base, <i>S</i> [Note (7)]	Thickness of Base, <i>T</i> [Notes (7)- (10)]	Thickness of Ribs, <i>U</i> [Note (7)]	Bolt Circle or Bolt Spacing, <i>W</i>	Diameter of Drilled Holes	Nominal Pipe Size, NPS
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...	$\frac{1}{2}$
...	$\frac{3}{4}$
133	51	152	51	1
146	57	165	51	$1\frac{1}{4}$
159	64	184	57	$1\frac{1}{2}$
171	70	210	70	...	105	117	13	13	88.9	$\frac{5}{8}$	2
184	83	248	70	...	114	117	13	13	88.9	$\frac{5}{8}$	$2\frac{1}{2}$
203	83	260	70	...	124	127	14	14	98.4	$\frac{5}{8}$	3
222	95	298	83	...	133	127	14	14	98.4	$\frac{5}{8}$	$3\frac{1}{2}$
235	108	311	83	...	140	152	16	16	120.6	$\frac{3}{4}$	4
267	121	349	95	...	159	178	17	17	139.7	$\frac{3}{4}$	5
298	133	375	95	...	178	178	17	17	139.7	$\frac{3}{4}$	6
362	146	451	121	...	213	229	24	24	190.5	$\frac{3}{4}$	8
425	171	527	133	...	248	229	24	24	190.5	$\frac{3}{4}$	10
489	197	629	146	...	286	279	25	25	241.3	$\frac{7}{8}$	12
552	197	692	159	...	318	279	25	25	241.3	$\frac{7}{8}$	14
616	210	768	171	...	349	279	25	25	241.3	$\frac{7}{8}$	16

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

Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (1)- (3)]	Minimum Wall Thickness of Fitting, t_m	Inside Diameter, d	2-mm Raised Face [Note (4)]								Ring Joint [Note (4)]
					Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and Radius	Center-to-Contact Surface of Raised Face Long and 45-deg Elbow, CC	Center-to-Contact Surface of Raised Face Elbow, BB	Long Center-to-Contact Surface of Raised Face Lateral, EE	Short Center-to-Contact Surface of Raised Face Lateral, FF	Contact Surface of Raised Face Reducer, GG	Center-to-End Elbow, Tee, Cross, and True "Y," HH		
18	635	38.1	11.9	438	419	673	216	813	178	483	425		
20	700	41.3	12.7	489	457	737	241	889	203	508	464		
24	815	46.1	14.5	591	559	864	279	1029	229	610	565		

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

13	14	15	16	17	18	19	20	21	22	23	1
Ring Joint [Note (4)]					Base Drilling [Note (11)]						
Center-to-End Long Radius Elbow, <i>JJ</i> [Note (6)]	Center-to-End Long Center-to-End Elbow, <i>KK</i> [Note (6)]	Long Center-to-End Lateral, <i>LL</i> [Note (6)]	Center-to-End Lateral and True "Y," <i>MM</i> [Note (6)]	End-to-Reducer, True "Y," <i>NN</i> [Notes (5), (6)]	Center-to-Base, <i>R</i> [Notes (7)-(9)]	Diameter of Round Base or Width of Square Base, <i>S</i> [Note (7)]	Thickness of Base, <i>T</i> [Notes (7)-(10)]	Thickness of Base, <i>T</i> [Notes (7)]	Bolt Circle or Bolt Spacing, <i>W</i> [Note (7)]	Diameter of Drilled Holes [Note (7)]	Nominal Pipe Size, NPS
679	222	819	184	...	381	343	29	29	298.4	7/8	18
743	248	895	210	...	406	343	29	29	298.4	7/8	20
870	286	1035	235	...	470	343	29	29	298.4	7/8	24

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

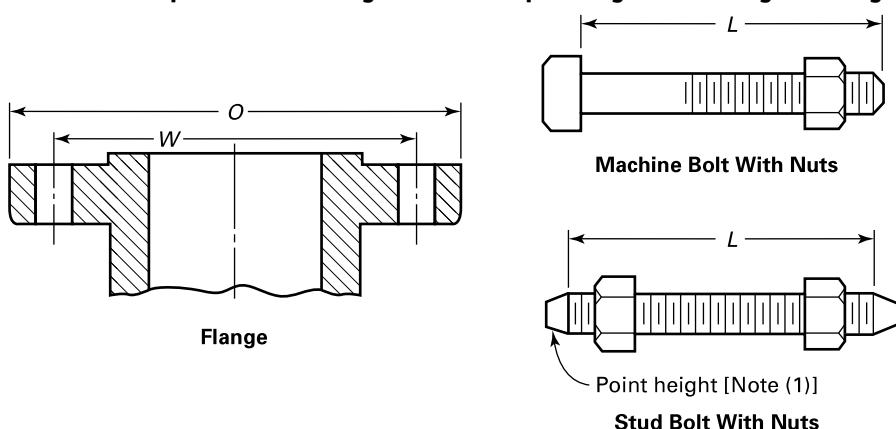
GENERAL NOTES:

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

NOTES:

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

(17)

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

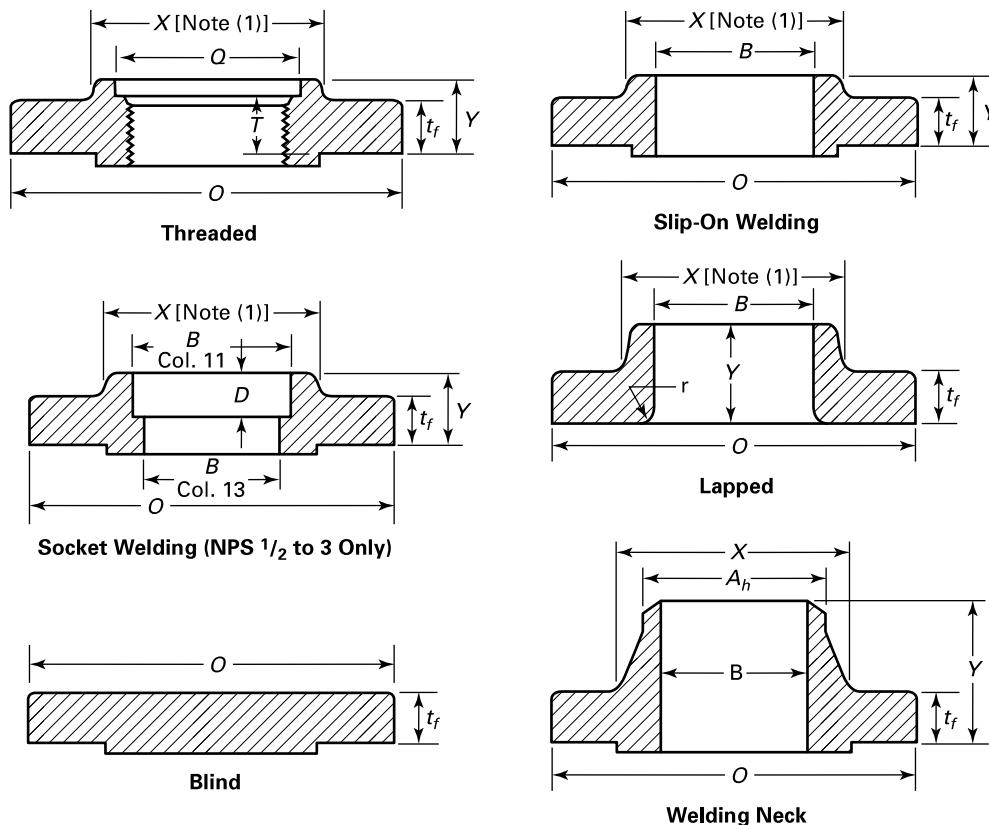
1	2	3	4	5	6	7	8	9
Nominal Pipe Size, NPS	Outside Diameter of Flange, <i>O</i>	Drilling [Notes (2), (3)]				Length of Bolts, <i>L</i> [Note (4)]		
		Diameter of Bolt Circle, <i>W</i>	Diameter of Bolt Holes, in.	Number of Bolts	Diameter of Bolts, in.	Stud Bolts [Note (1)]		Machin e Bolts
						2-mm Raised Face	Ring Joint	2-mm Raised Face
$\frac{1}{2}$	95	66.7	$\frac{5}{8}$	4	$\frac{1}{2}$	65	75	55
$\frac{3}{4}$	115	82.6	$\frac{3}{4}$	4	$\frac{5}{8}$	75	90	65
1	125	88.9	$\frac{3}{4}$	4	$\frac{5}{8}$	75	90	65
$1\frac{1}{4}$	135	98.4	$\frac{3}{4}$	4	$\frac{5}{8}$	85	95	70
$1\frac{1}{2}$	155	114.3	$\frac{7}{8}$	4	$\frac{3}{4}$	90	100	75
2	165	127.0	$\frac{3}{4}$	8	$\frac{5}{8}$	90	100	75
$2\frac{1}{2}$	190	149.2	$\frac{7}{8}$	8	$\frac{3}{4}$	100	115	85
3	210	168.3	$\frac{7}{8}$	8	$\frac{3}{4}$	110	120	90
$3\frac{1}{2}$	230	184.2	$\frac{7}{8}$	8	$\frac{3}{4}$	110	125	95
4	255	200.0	$\frac{7}{8}$	8	$\frac{3}{4}$	115	125	95
5	280	235.0	$\frac{7}{8}$	8	$\frac{3}{4}$	120	135	110
6	320	269.9	$\frac{7}{8}$	12	$\frac{3}{4}$	120	140	110
8	380	330.2	1	12	$\frac{7}{8}$	140	150	120
10	445	387.4	$1\frac{1}{8}$	16	1	160	170	140
12	520	450.8	$1\frac{1}{4}$	16	$1\frac{1}{8}$	170	185	145
14	585	514.4	$1\frac{1}{4}$	20	$1\frac{1}{8}$	180	190	160
16	650	571.5	$1\frac{3}{8}$	20	$1\frac{1}{4}$	190	205	165
18	710	628.6	$1\frac{3}{8}$	24	$1\frac{1}{4}$	195	210	170
20	775	685.8	$1\frac{3}{8}$	24	$1\frac{1}{4}$	205	220	185
22	840	743.0	$1\frac{5}{8}$	24	$1\frac{1}{2}$	230	255	205
24	915	812.8	$1\frac{5}{8}$	24	$1\frac{1}{2}$	230	255	205

GENERAL NOTES:

- (a) Dimensions of Table 10 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-10](#).
- (b) For other dimensions, see [Tables 11](#) and [12](#).

NOTES:

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

Table 11 Dimensions of Class 300 Flanges

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)- (4)]	Minimum Thickness Lap Joint, t_f	Diameter of Hub, X [Note (4)]	Hub Diameter Beginning of Chamfer Welding, Neck, A_h	Length Through Hub			Bore			Corner Radius of Bore of Lapped Flange and Pipe, r			
						Threaded/ Slip-On/ Socket Welding, Y	Lapped, Y	Welding Neck, Y	Minimum Thread Length Threaded, T [Note (5)]	Minimum Slip-On/ Socket Welding, B	Minimum Lapped, B	Welding Neck/ Socket Welding, B [Note (6)]	Minimum Counter-bore Threaded Flange, Q	Depth of Socket, D	
1/2	95	12.7	14.3	38	21.3	21	22	51	16	22.2	22.9	15.8	3	23.6	10
3/4	115	14.3	15.9	48	26.7	24	25	56	16	27.7	28.2	20.9	3	29.0	11
1	125	15.9	17.5	54	33.4	25	27	60	18	34.5	34.9	26.6	3	35.8	13
1 1/4	135	17.5	19.1	64	42.2	25	27	64	21	43.2	43.7	35.1	5	44.4	14
1 1/2	155	19.1	20.7	70	48.3	29	30	67	23	49.5	50.0	40.9	6	50.3	16

(17)

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

Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)- (4)]	Minimum Thickness Lap Joint, t_f	Diameter of Hub, X	Hub Diameter Beginning of Chamfer Welding, Neck, A_h [Note (4)]	Length Through Hub			Bore			Welding Neck/Socket Welding, B [Note (6)]	Corner Radius of Bore of Lapped Flange and Pipe, r	Minimum Counter-bore Threaded Flange, Q	Depth of Socket, D
						Threaded/Welding, Y	Slip-On/Socket Welding, Y	Lapped, Y	Minimum Thread Length, T [Note (5)]	Minimum Threaded, T	Minimum Slip-On/Socket Welding, B				
2	165	20.7	22.3	84	60.3	32	33	68	29	61.9	62.5	52.5	8	63.5	17
2½	190	23.9	25.4	100	73.0	37	38	75	32	74.6	75.4	62.7	8	76.2	19
3	210	27.0	28.6	117	88.9	41	43	78	32	90.7	91.4	77.9	10	92.2	21
3½	230	28.6	30.2	133	101.6	43	44	79	37	103.4	104.1	90.1	10	104.9	...
4	255	30.2	31.8	146	114.3	46	48	84	37	116.1	116.8	102.3	11	117.6	...
5	280	33.4	35.0	178	141.3	49	51	97	43	143.8	144.4	128.2	11	144.4	...
6	320	35.0	36.6	206	168.3	51	52	97	47	170.7	171.4	154.1	13	171.4	...
8	380	39.7	41.3	260	219.1	60	62	110	51	221.5	222.2	202.7	13	222.2	...
10	445	46.1	47.7	321	273.0	65	95	116	56	276.2	277.4	254.6	13	276.2	...
12	520	49.3	50.8	375	323.8	71	102	129	61	327.0	328.2	304.8	13	328.6	...
14	585	52.4	54.0	425	355.6	75	111	141	64	359.2	360.2	Note (7)	13	360.4	...
16	650	55.6	57.2	483	406.4	81	121	144	69	410.5	411.2	Note (7)	13	411.2	...
18	710	58.8	60.4	533	457.0	87	130	157	70	461.8	462.3	Note (7)	13	462.0	...
20	775	62.0	63.5	587	508.0	94	140	160	74	513.1	514.4	Note (7)	13	512.8	...
22	840	65.1	66.7	640	558.8	100	145	164	...	564.4	565.2	Note (7)	13
24	915	68.3	69.9	702	610.0	105	152	167	83	616.0	616.0	Note (7)	13	614.4	...

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GENERAL NOTES:

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

NOTES:

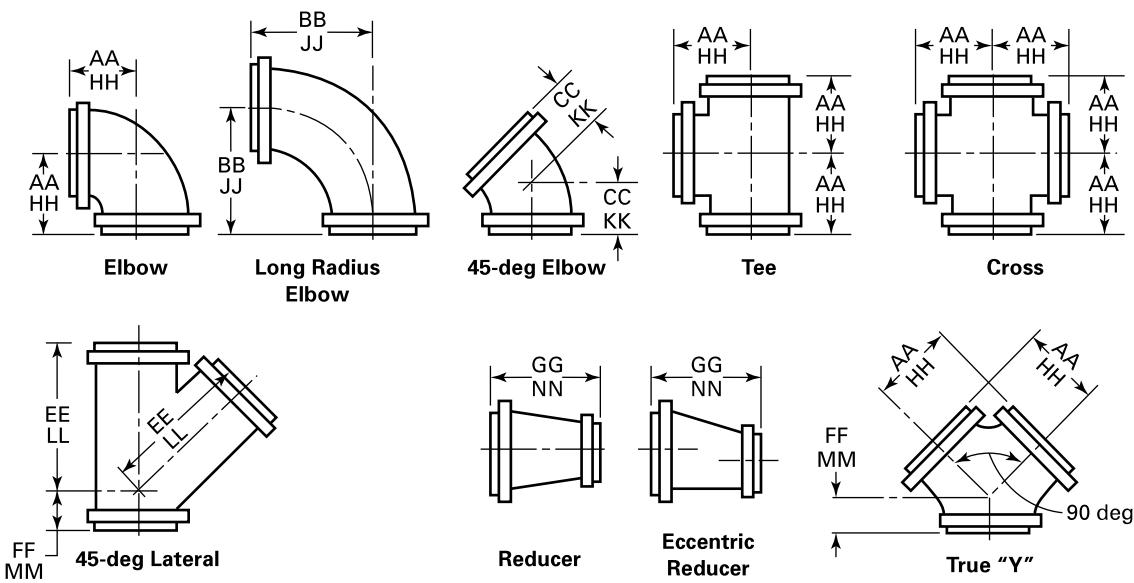
- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and back face of the flange.

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

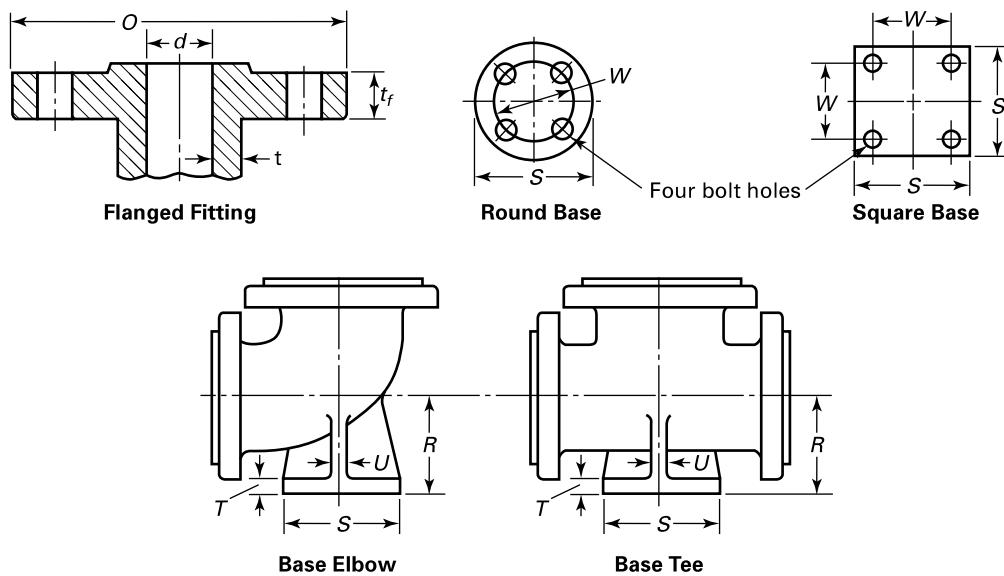
NOTES (Cont'd):

- (2) These flanges may be supplied with a flat face. The flat face may be either the full t_f dimension thickness plus 2-mm or the t_f dimension thickness without the raised face height. See [para. 6.3.2](#) for additional restrictions.
- (3) The flange dimensions illustrated are for regularly furnished 2-mm raised face (except lapped); for requirements of other facings, see [Figure 6](#).
- (4) For welding end bevel, see [para. 6.7](#).
- (5) For thread of threaded flanges, see [para. 6.9](#).
- (6) Dimensions in Column 13 correspond to the inside diameters of pipe as given in ASME B36.10M for standard wall pipe. Standard wall dimensions are the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in [para. 7.5.2](#) apply. These bore sizes are furnished unless otherwise specified by the purchaser.
- (7) To be specified by the purchaser.

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TABLE STARTS ON NEXT PAGE

Table 12 Dimensions of Class 300 Flanged Fittings

Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (1) and (4)]	Minimum Wall Thickness of Fitting, t_m	Inside Diameter of Fitting, d	2-mm Raised Face (Flange Edge) [Note (4)]							Ring Joint [Note (4)]
					Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA	Center-to-Contact Surface of Raised Face Long Radius Elbow, BB	Center-to-Contact Surface of Raised Face 45-deg Elbow, CC	Long Center-to-Contact Surface of Raised Face Lateral, EE	Short Center-to-Contact Surface of Raised Face Lateral and True "Y," FF	Contact Surface-to-Contact Surface of Raised Face Reducer, GG	Center-to-End Elbow, Tee, Cross, and True "Y," HH	
1	125	15.9	4.8	25	102	127	57	165	51	114	108	
1½	135	17.5	4.8	32	108	140	64	184	57	114	114	
2	155	19.1	4.8	38	114	152	70	216	64	114	121	
2½	165	20.7	6.4	51	127	165	76	229	64	127	135	
3	190	23.9	6.4	64	140	178	89	267	64	140	148	
3½	210	27.0	7.1	76	152	197	89	279	76	152	160	
4	230	28.6	7.4	89	165	216	102	318	76	165	173	
5	255	30.2	7.9	102	178	229	114	343	76	178	186	
6	280	33.4	9.5	127	203	260	127	381	89	203	211	
8	320	35.0	9.5	152	216	292	140	445	102	229	224	
10	380	39.7	11.1	203	254	356	152	521	127	279	262	
12	445	46.1	12.7	254	292	419	178	610	140	305	300	
14	520	49.3	14.3	305	330	483	203	698	152	356	338	
16	585	52.4	15.9	337	381	546	216	787	165	406	389	
18	650	55.6	17.5	387	419	610	241	876	190	457	427	
20	710	58.8	19.0	432	457	673	254	952	203	483	465	
24	775	62.0	20.6	483	495	737	267	1029	216	508	505	
	915	68.3	23.8	584	572	864	305	1206	254	610	583	

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

13	14	15	16	17	18	19	20	21	22	23	1
Ring Joint [Note (5)]						Base Drilling [Note (11)]					
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Center-to-End Radius Elbow, JJ [Note (7)]	Center-to-End Elbow, KK [Note (7)]	Long Center-to-End Lateral, LL [Note (7)]	Center-to-End and True "Y," MM [Note (7)]	End-to- Reducer, NN	Diameter of Round Base or Width of Square Base, R [Notes (7)-(9)]	Thickness of Base, T [Notes (7)- (10)]	Thickness of Ribs, U [Note (7)]	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size, NPS	
133	64	171	57	1
146	70	191	64	1½
159	76	222	70	1½
173	84	237	71	...	114	133	19	13	98.4	¾	2
186	97	275	71	...	121	133	19	13	98.4	¾	2½
205	97	287	84	...	133	156	21	16	114.3	⅝	3
224	110	325	84	...	143	156	21	16	114.3	⅝	3½
268	135	389	97	...	171	190	25	19	149.2	⅝	5
300	148	452	110	...	190	190	25	19	149.2	⅝	6
364	160	529	135	...	229	254	32	22	200.0	⅝	8
427	186	618	148	...	267	254	32	22	200.0	⅝	10
491	211	706	160	...	305	318	36	25	269.9	⅝	12
554	224	795	173	...	343	318	36	25	269.9	⅝	14
618	249	884	198	...	375	318	36	29	269.9	⅝	16
681	262	960	211	...	413	381	41	29	330.2	1	18
746	276	1038	225	...	454	381	41	32	330.2	1	20
875	316	1218	265	...	527	444	48	32	387.4	1½	24

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

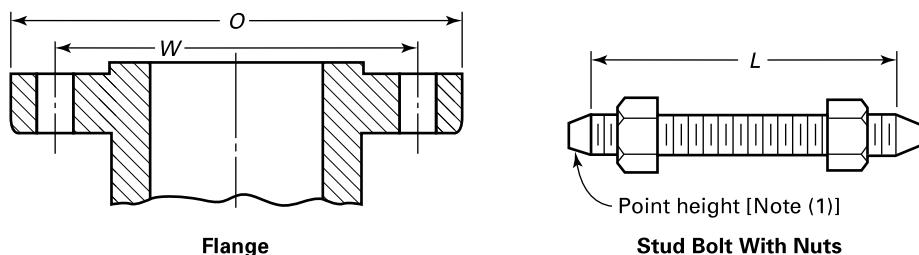
GENERAL NOTES:

- (a) Dimensions of [Table 12](#) are in millimeters. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-12](#).
- (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 2 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 2-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 $3\frac{1}{2}$ 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 2-mm raised face (flange edge) for the largest opening, and add the proper height to provide for the ring joint groove applying to each flange. See [Table 5](#) for ring joint facing dimensions.
- (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.

(17)

Table 13 Templates for Drilling Class 400 Pipe Flanges

1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, <i>O</i>	3 Diameter of Bolt Circle, <i>W</i>	Drilling [Notes (2), (3)]			6 Length of Bolts, <i>L</i> [Notes (1), (4)]	7 Male and Female/ Tongue and Groove	8 Ring Joint
$\frac{1}{2}$								
$\frac{3}{4}$								
1								
$1\frac{1}{4}$								
$1\frac{1}{2}$			Use Class 600 dimensions in these sizes					
2								
$2\frac{1}{2}$								
3								
$3\frac{1}{2}$								
4	255	more	200.0	standard	$\frac{7}{8}$	140	135	140
5	280	235.0	1	8	$\frac{7}{8}$	145	135	145
6	320	269.9	1	12	$\frac{7}{8}$	150	145	150
8	380	330.0	$1\frac{1}{8}$	12	1	170	165	170
10	445	387.4	$1\frac{1}{4}$	16	$1\frac{1}{8}$	190	185	190
12	520	450.8	$1\frac{3}{8}$	16	$1\frac{1}{4}$	205	195	205
14	585	514.4	$1\frac{3}{8}$	20	$1\frac{1}{4}$	210	205	210
16	650	571.5	$1\frac{1}{2}$	20	$1\frac{3}{8}$	220	215	220
18	710	628.6	$1\frac{1}{2}$	24	$1\frac{3}{8}$	230	220	230
20	775	685.8	$1\frac{5}{8}$	24	$1\frac{1}{2}$	240	235	250
22	840	743.0	$1\frac{3}{4}$	24	$1\frac{5}{8}$	255	250	260
24	915	812.8	$1\frac{7}{8}$	24	$1\frac{7}{8}$	265	260	280

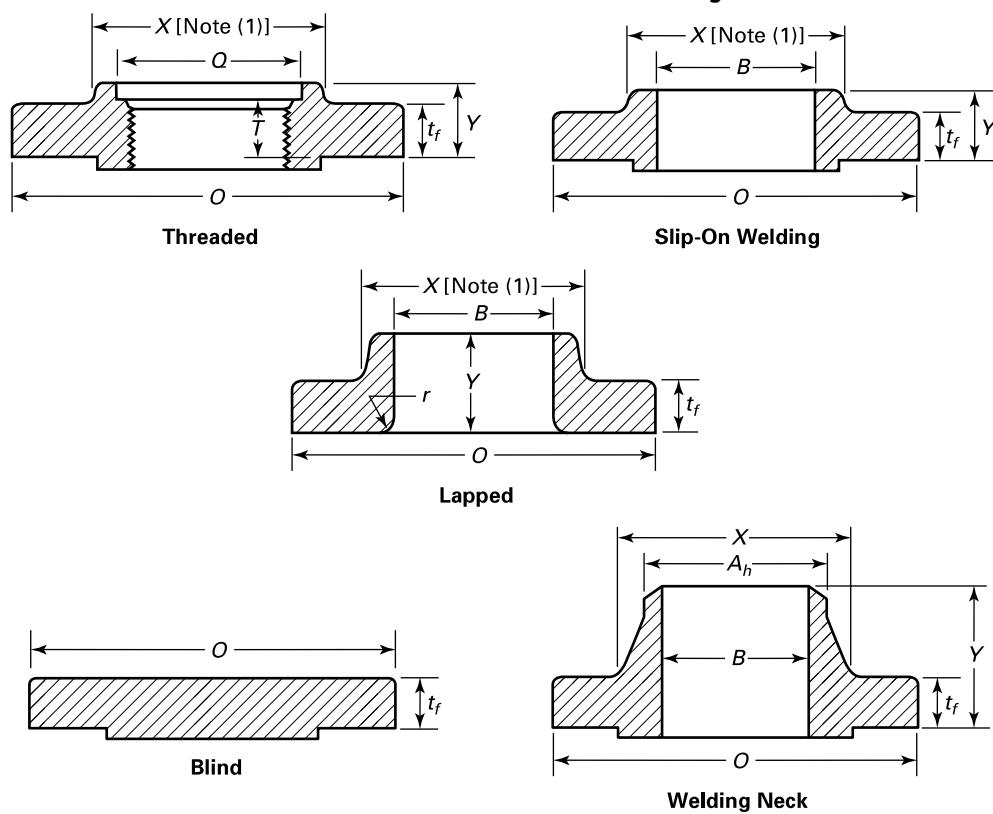
GENERAL NOTES:

- (a) Dimensions of Table 13 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-13](#).
- (b) For other dimensions, see [Table 14](#).

NOTES:

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

(17)

Table 14 Dimensions of Class 400 Flanges

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

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

(17)

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nom. Pipe Size, NPS	Outside Diam. of Flange, <i>O</i>	Min. Thickness of Flange, <i>t_f</i>	Diam. of Hub, <i>X</i>	Hub Diam. Beginning of Chamfer Welding Neck, <i>A_h</i> [Note (2)]	Length Through Hub			Minimum Thread Length Threaded Welding Flange, <i>T</i> [Note (3)]	Bore		Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>	Minimum Counterbore Threaded Flange, <i>Q</i>	
					Threaded/ Slip-On, <i>Y</i>	Lapped, <i>Y</i>	Welding Neck, <i>Y</i>		Min. Slip- On, <i>B</i>	Min. Lapped, <i>B</i>	Welding Neck, <i>B</i>		
20	775	69.9	587	508.0	102	146	168	74	513.1	514.4	Note (5)	13	512.8
22	840	73.1	640	22.0	108	152	171	...	564.4	565.2	Note (5)	13	...
24	915	76.2	702	610.0	114	159	175	83	616.0	616.0	Note (5)	13	614.4

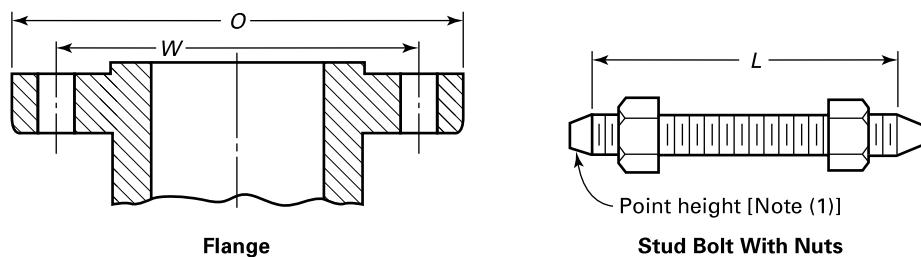
GENERAL NOTES:

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

NOTES:

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

(17)

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

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

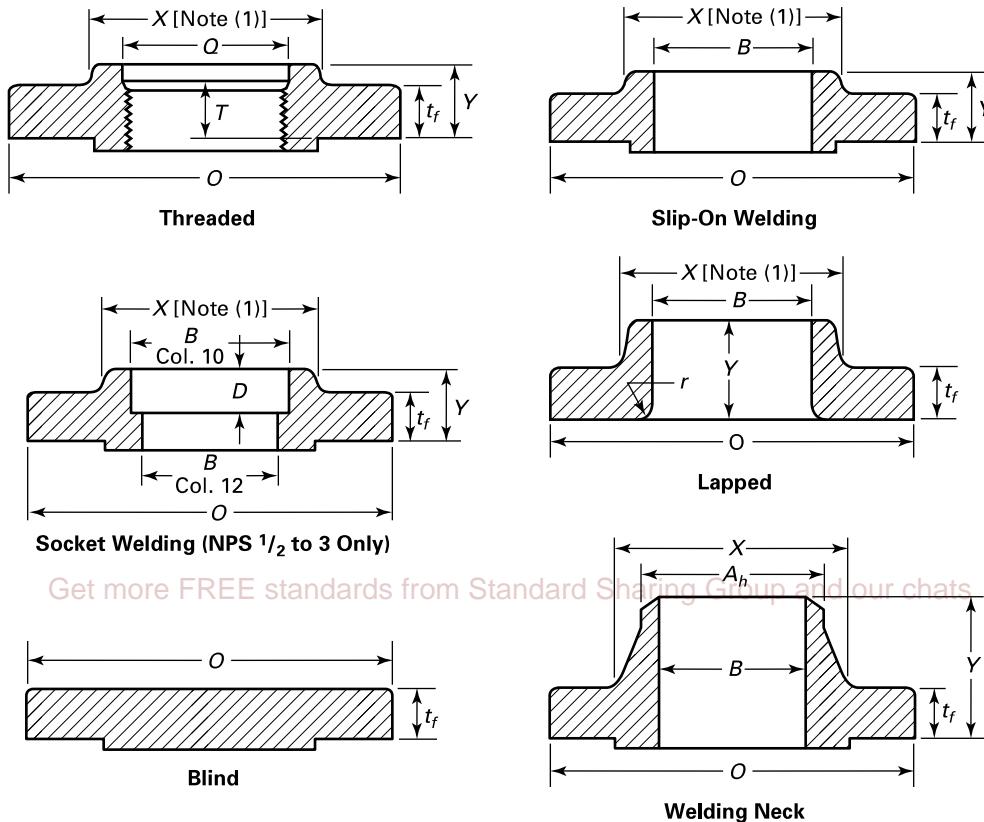
GENERAL NOTES:

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

NOTES:

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

(17)

Table 16 Dimensions of Class 600 Flanges

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Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Diameter of Hub, X	Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			Minimum Thread Length Threaded Flange, T [Note (3)]	Bore			Corner Bore Radius of Lapped Flange and Pipe, r	Minimum Counterbore Threaded Flange, Q	Depth of Socket, D
					Threaded/Slip-On/Socket Welding, Y	Lapped, Y	Welding Neck, Y		Minimum Slip-On/Socket Welding, B	Minimum Lapped, B	Welding Neck/Socket Welding, B			
1/2	95	14.3	38	21.3	22	22	52	16	22.2	22.9	Note (4)	3	23.6	10
3/4	115	15.9	48	26.7	25	25	57	16	27.7	28.2	Note (4)	3	29.0	11
1	125	17.5	54	33.4	27	27	62	18	34.5	34.9	Note (4)	3	35.8	13
1 1/4	135	20.7	64	42.2	29	29	67	21	43.2	43.7	Note (4)	5	44.4	14
1 1/2	155	22.3	70	48.3	32	32	70	23	49.5	50.0	Note (4)	6	50.6	16
2	165	25.4	84	60.3	37	37	73	29	61.9	62.5	Note (4)	8	63.5	17

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

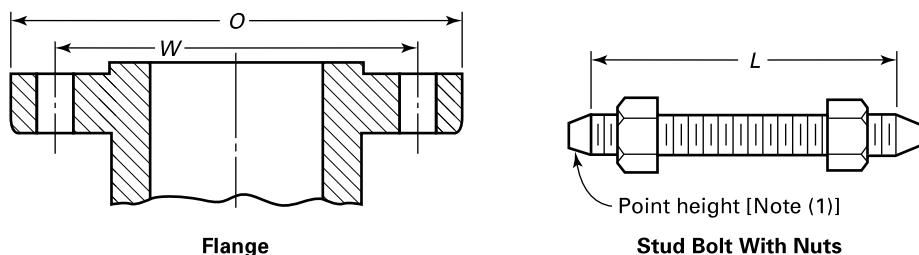
Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Diameter of Hub, X	Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			Minimum Thread Length Threaded Flange, T [Note (3)]	Bore			Welding Neck/Socket Welding, B	Corner Bore Radius of Lapped Flange and Pipe, r	Minimum Counterbore Threaded Flange, Q	Depth of Socket, D
					Threaded/Slip-On/Socket Welding, Y	Lapped, Y	Welding Neck, Y		Minimum Slip-On/Socket Welding, B	Minimum Lapped, B					
2½	190	28.6	100	73.0	41	41	79	32	74.6	75.4	Note (4)	8	76.2	19	
3	210	31.8	117	88.9	46	46	83	35	90.7	91.4	Note (4)	10	92.2	21	
3½	230	35.0	133	101.6	49	49	86	40	103.4	104.1	Note (4)	10	104.9	...	
4	275	38.1	152	114.3	54	54	102	42	116.1	116.8	Note (4)	11	117.6	...	
5	330	44.5	189	141.3	60	60	114	48	143.8	144.4	Note (4)	11	144.4	...	
6	355	47.7	222	168.3	67	67	117	51	170.7	171.4	Note (4)	13	171.4	...	
8	420	55.6	273	219.1	76	76	133	58	221.5	222.2	Note (4)	13	222.2	...	
10	510	63.5	343	273.0	86	111	152	66	276.2	277.4	Note (4)	13	276.2	...	
12	560	66.7	400	323.8	92	117	156	70	327.0	328.2	Note (4)	13	328.6	...	
14	605	69.9	432	355.6	94	127	165	74	359.2	360.2	Note (4)	13	360.4	...	
16	685	76.2	495	406.4	106	140	178	78	410.5	411.2	Note (4)	13	411.2	...	
18	745	82.6	546	457.0	117	152	184	80	461.8	462.3	Note (4)	13	462.0	...	
20	815	88.9	610	508.0	127	165	190	83	513.1	514.4	Note (4)	13	512.8	...	
22	870	95.2	663	558.8	133	175	197	...	564.4	565.2	Note (4)	13	
24	940	101.6	718	610.0	140	184	203	93	616.0	616.0	Note (4)	13	614.4	...	

GENERAL NOTES:

- (a) Dimensions of Table 16 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-16.
- (b) For tolerance, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 15.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

NOTES:

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

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

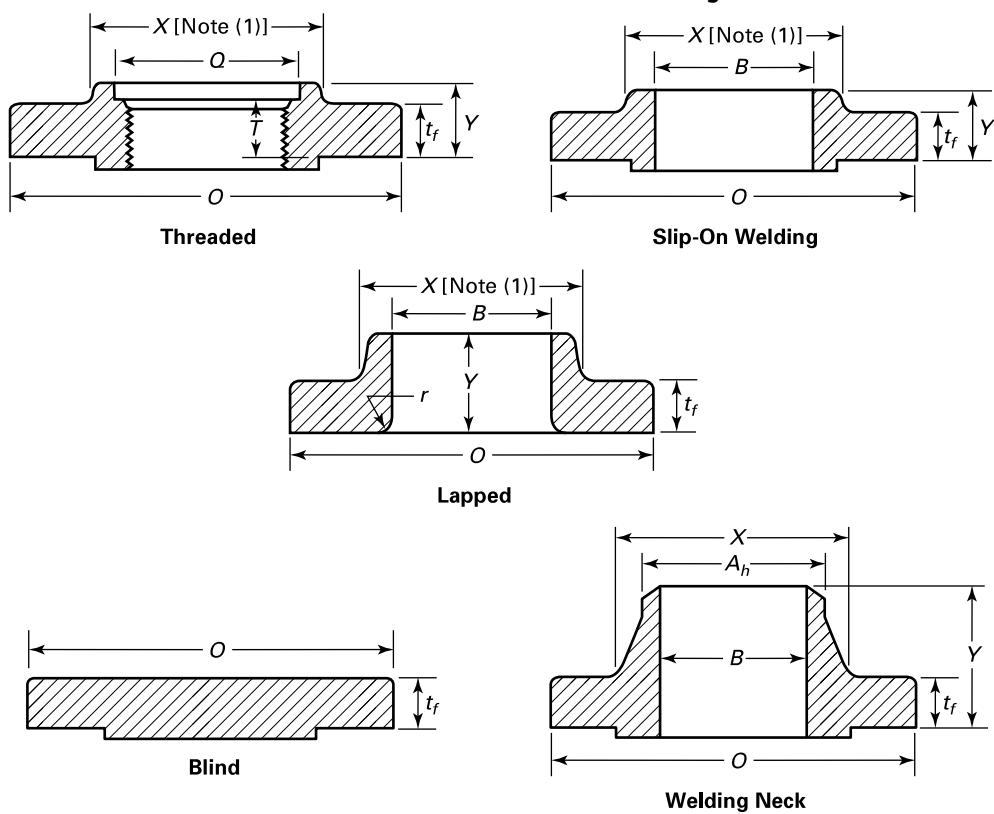
1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, O	3 Diameter of Bolt Circle, W	4 Drilling [Notes (2), (3)]	5 Diameter of Bolt Holes, in.	6 Number of Bolts	7 Diameter of Bolts, in.	8 Length of Bolts, L [Notes (1), (4)]	9 7-mm Raised Face Male and Female/ Tongue and Groove Ring Joint
$\frac{1}{2}$								
$\frac{3}{4}$								
1								
$1\frac{1}{4}$			Use Class 1500 dimensions in these sizes					
$1\frac{1}{2}$								
2								
$2\frac{1}{2}$								
3	240	190.5	1	8	$\frac{7}{8}$	145	140	145
4	290	235.0	$1\frac{1}{4}$	8	$1\frac{1}{8}$	170	165	170
5	350	279.4	$1\frac{3}{8}$	8	$1\frac{1}{4}$	190	185	190
6	380	317.5	$1\frac{1}{4}$	12	$1\frac{1}{8}$	190	185	195
8	470	393.7	$1\frac{1}{2}$	12	$1\frac{3}{8}$	220	215	220
10	545	469.9	$1\frac{1}{2}$	16	$1\frac{3}{8}$	235	230	235
12	610	533.4	$1\frac{1}{2}$	20	$1\frac{3}{8}$	255	250	255
14	640	558.8	$1\frac{5}{8}$	20	$1\frac{1}{2}$	275	265	280
16	705	616.0	$1\frac{3}{4}$	20	$1\frac{5}{8}$	285	280	290
18	785	685.8	2	20	$1\frac{7}{8}$	325	320	335
20	855	749.3	$2\frac{1}{8}$	20	2	350	345	360
24	1,040	901.7	$2\frac{5}{8}$	20	$2\frac{1}{2}$	440	430	455

GENERAL NOTES:

- (a) Dimensions of Table 17 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-17](#).
- (b) For other dimensions, see [Tables 18](#) and [19](#).

NOTES:

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

Table 18 Dimensions of Class 900 Flanges

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

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14			
													Length Through Hub	Bore	Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>	Minimum Counterbore Threaded Flange, <i>Q</i>
Nom. Pipe Size, NPS	Outside Diam. of Flange, <i>O</i>	Min. Thickness of Flange, <i>t_f</i>	Diam. of Hub, <i>X</i>	Welding Neck, <i>A_h</i> [Note (2)]	Hub Diam. Beginning of Chamfer			Minimum Thread Length [Note (3)]	Min. Slip- On, <i>B</i>	Min. Lapped, <i>B</i>	Welding Neck, <i>B</i>	Note (5)	13	512.8		
					Threaded/	Slip-On,	Lapped,									
20	855	108.0	622	508.0	159	210	248	93	513.1	514.4						
24	1,040	139.7	749	610.0	203	267	292	102	616.0	616.0	Note (5)	13		614.4		

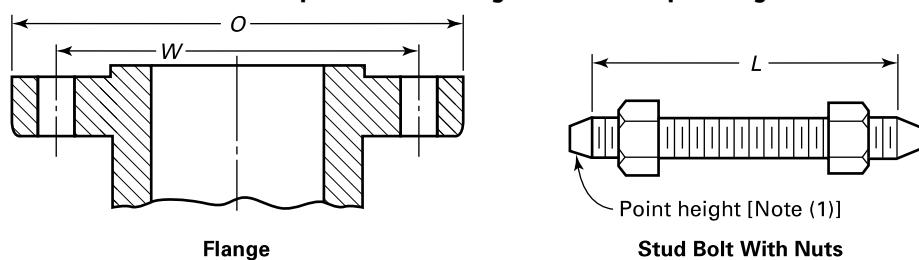
GENERAL NOTES:

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

NOTES:

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

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Table 19 Templates for Drilling Class 1500 Pipe Flanges

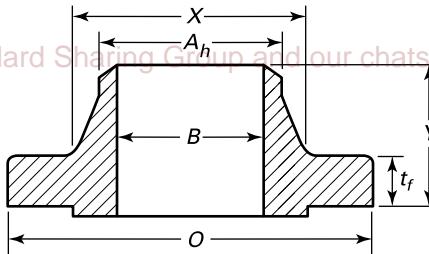
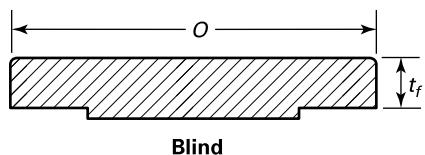
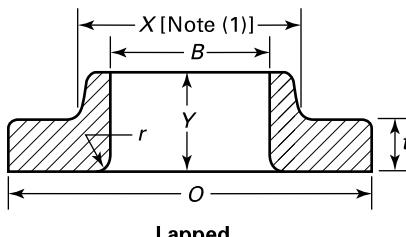
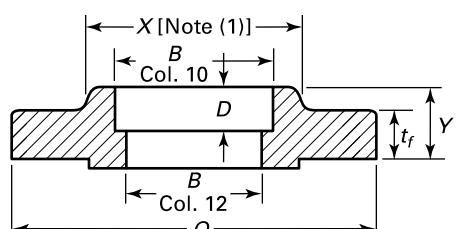
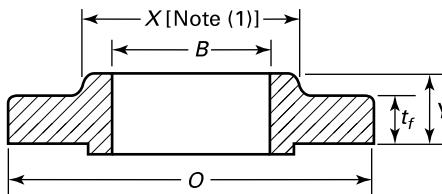
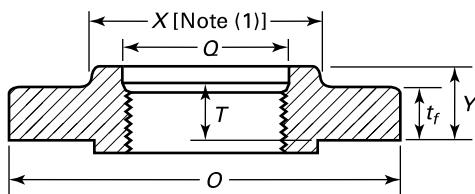
1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, <i>O</i>	3 Diameter of Bolt Circle, <i>W</i>	4 Diameter of Bolt Holes, in.	5 Number of Bolts	6 Diameter of Bolts, in.	7 Length of Bolts, <i>L</i> [Notes (1), (4)]	8 Male and Female/ Tongue and Groove	9 Ring Joint
$\frac{1}{2}$	120	82.6	$\frac{7}{8}$	4	$\frac{3}{4}$	110	100	110
$\frac{3}{4}$	130	88.9	$\frac{7}{8}$	4	$\frac{3}{4}$	115	110	115
1	150	101.6	1	4	$\frac{7}{8}$	125	120	125
$1\frac{1}{4}$	160	111.1	1	4	$\frac{7}{8}$	125	120	125
$1\frac{1}{2}$	180	123.8	$1\frac{1}{8}$	4	1	140	135	140
2	215	165.1	1	8	$\frac{7}{8}$	145	140	145
$2\frac{1}{2}$	245	190.5	$1\frac{1}{8}$	8	1	160	150	160
3	265	203.2	$1\frac{1}{4}$	8	$1\frac{1}{8}$	180	170	180
4	310	241.3	$1\frac{3}{8}$	8	$1\frac{1}{4}$	195	190	195
5	375	292.1	$1\frac{5}{8}$	8	$1\frac{1}{2}$	250	240	250
6	395	317.5	$1\frac{1}{2}$	12	$1\frac{3}{8}$	260	255	265
8	485	393.7	$1\frac{3}{4}$	12	$1\frac{5}{8}$	290	285	300
10	585	482.6	2	12	$1\frac{7}{8}$	335	330	345
12	675	571.5	$2\frac{1}{8}$	16	2	375	370	385
14	750	635.0	$2\frac{3}{8}$	16	$2\frac{1}{4}$	405	400	425
16	825	704.8	$2\frac{5}{8}$	16	$2\frac{1}{2}$	445	440	470
18	915	774.7	$2\frac{7}{8}$	16	$2\frac{3}{4}$	495	490	525
20	985	831.8	$3\frac{1}{8}$	16	3	540	535	565
24	1 170	990.6	$3\frac{5}{8}$	16	$3\frac{1}{2}$	615	610	650

GENERAL NOTES:

- (a) Dimensions of Table 19 are in millimeters, except for the diameters of the bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-19](#).
- (b) For other dimensions, see [Table 20](#).

NOTES:

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

Table 20 Dimensions of Class 1500 Flanges

1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, <i>t_f</i>	4 Diameter of Hub, X	5 Hub Diameter Beginning of Welding Neck, <i>A_h</i> [Note (2)]	Length Through Hub			9 Minimum Thread Length Threaded	Bore			13 Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>	14 Minimum Counterbore Threaded Flange, <i>Q</i>	15 Depth of Socket, <i>D</i>
1/2	120	22.3	38	21.3	32	32	60	23	22.2	22.9	Note (4)	3	23.6	10
3/4	130	25.4	44	26.7	35	35	70	26	27.7	28.2	Note (4)	3	29.0	11
1	150	28.6	52	33.4	41	41	73	29	34.5	34.9	Note (4)	3	35.8	13
1 1/4	160	28.6	64	42.2	41	41	73	31	43.2	43.7	Note (4)	5	44.4	14
1 1/2	180	31.8	70	48.3	44	44	83	32	49.5	50.0	Note (4)	6	50.6	16
2	215	38.1	105	60.3	57	57	102	39	61.9	62.5	Note (4)	8	63.5	17
2 1/2	245	41.3	124	73.0	64	64	105	48	74.6	75.4	Note (4)	8	76.2	19

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

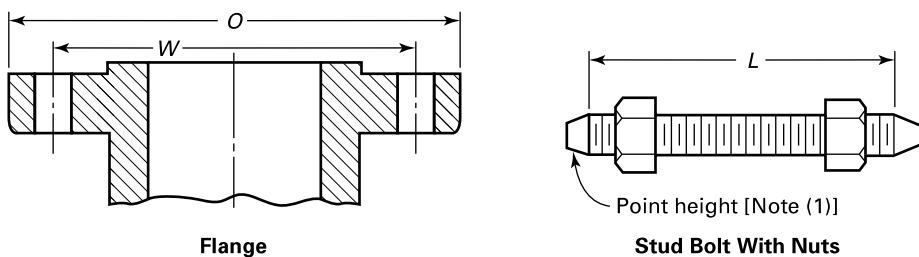
1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f	4 Diameter of Hub, X	5 Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			9 Minimum Thread Length Threaded Flange, T [Note (3)]	Bore			12 Welding Neck/ Socket Welding, B	13 Corner Bore Radius of Lapped Flange and Pipe, r	14 Minimum Counterbore Threaded Flange, Q	15 Depth of Socket, D
3	265	47.7	133	88.9	...	73	117	91.4	Note (4)	10	
4	310	54.0	162	114.3	...	90	124	116.8	Note (4)	11	
5	375	73.1	197	141.3	...	105	156	144.4	Note (4)	11	
6	395	82.6	229	168.3	...	119	171	171.4	Note (4)	13	
8	485	92.1	292	219.1	...	143	213	222.2	Note (4)	13	
10	585	108.0	368	273.0	...	178	254	277.4	Note (4)	13	
12	675	123.9	451	323.8	...	219	283	328.2	Note (4)	13	
14	750	133.4	495	355.6	...	241	298	360.2	Note (4)	13	
16	825	146.1	552	406.4	...	260	311	411.2	Note (4)	13	
18	915	162.0	597	457.0	...	276	327	462.3	Note (4)	13	
20	985	177.8	641	508.0	...	292	356	514.4	Note (4)	13	
24	1 170	203.2	762	610.0	...	330	406	616.0	Note (4)	13	

GENERAL NOTES:

- (a) Dimensions of Table 20 are in millimeters. For dimensions in inch units, refer to [Mandatory Appendix II, Table II-20](#).
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table 19](#).
- (e) For spot facing, see [para 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table 6](#).
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see [para 6.8](#).

NOTES:

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

Table 21 Templates for Drilling Class 2500 Pipe Flanges

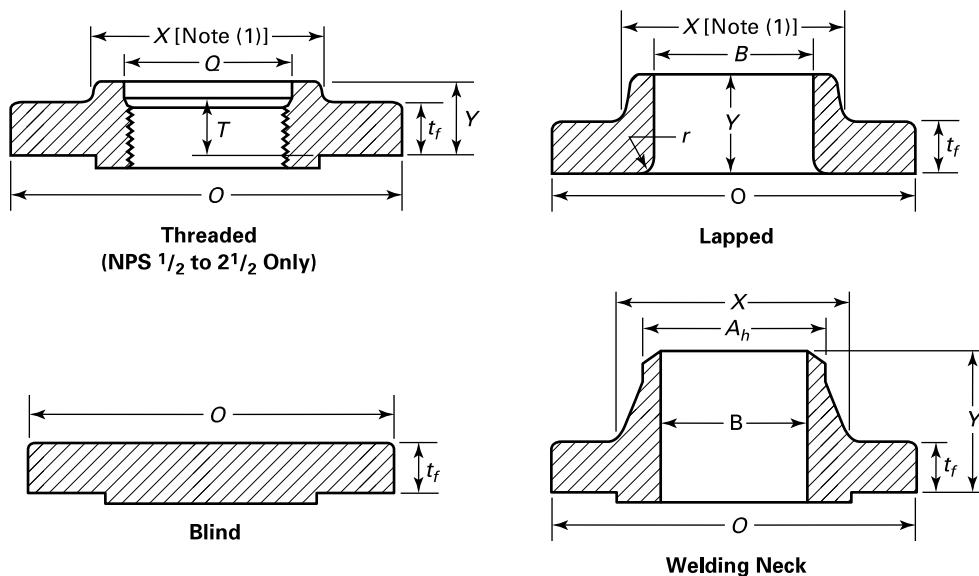
1 Nominal Pipe Size, NPS	2 Outside Diameter of Flange, <i>O</i>	3 Drilling [Notes (2), (3)]				6 Length of Bolts, <i>L</i> [Notes (1), (4)]			7 Male and Female/ Tongue and Groove	8 Ring Joint	9
		3 Diameter of Bolt Circle, <i>W</i>	4 Diameter of Bolt Holes, in.	5 Number of Bolts	6 Diameter of Bolts, in.						
½	135	88.9	7/8	4	3/4	120	115	120			
¾	140	95.2	7/8	4	3/4	125	120	125			
1	160	108.0	1	4	7/8	140	135	140			
1¼	185	130.2	1 1/8	4	1	150	145	150			
1½	205	146.0	1 1/4	4	1 1/8	170	165	170			
2	235	171.4	1 1/8	8	1	180	170	180			
2½	265	196.8	1 1/4	8	1 1/8	195	190	205			
3	305	228.6	1 3/8	8	1 1/4	220	215	230			
4	355	273.0	1 5/8	8	1 1/2	255	250	260			
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5	420	323.8	1 7/8	8	1 3/4	300	290	310			
6	485	368.3	2 1/8	8	2	345	335	355			
8	550	438.2	2 1/8	12	2	380	375	395			
10	675	539.8	2 5/8	12	2 1/2	490	485	510			
12	760	619.1	2 7/8	12	2 3/4	540	535	560			

GENERAL NOTES:

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

NOTES:

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

Table 22 Dimensions of Class 2500 Flanges

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

GENERAL NOTES:

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

NOTES:

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

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

NOTES (Cont'd):

- (2) For welding end bevel, see [para. 6.7](#).
- (3) For thread of threaded flanges, see [para. 6.9](#).
- (4) To be specified by the purchaser.

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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

Classes 150, 300, 400		Class 600			Class 900			Class 1500			Class 2500			
NPS	Number of Turns	Number of Turns	Projection mm	Projection in.										
$\frac{1}{2}$...	(1)	$3\frac{1}{2}$	6.4	0.25	7	12.7	0.50	
$\frac{3}{4}$...	(1)	5	9.5	0.38	7	12.7	0.50	
1	...	(1)	5	11.1	0.44	$7\frac{1}{2}$	16.5	0.65	
$1\frac{1}{4}$...	(1)	5	11.1	0.44	$7\frac{1}{2}$	16.5	0.65	
$1\frac{1}{2}$...	(1)	5	11.1	0.44	$7\frac{1}{2}$	16.5	0.65	
2	...	(1)	11.1	5	11.1	0.44	$7\frac{1}{2}$	16.5	0.65
$2\frac{1}{2}$	5	15.9	0.62	8	25.4	1.00	
3	...	1	3.2	0.12	3	9.5	0.38	
$3\frac{1}{2}$...	1	3.2	0.12	
4	(1)	$1\frac{1}{2}$	4.8	0.19	$3\frac{1}{2}$	11.1	0.44	
5	(1)	$1\frac{1}{2}$	4.8	0.19	$3\frac{1}{2}$	11.1	0.44	
6	(1)	$1\frac{1}{2}$	4.8	0.19	$3\frac{1}{2}$	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

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

The pressure-temperature ratings for the materials listed in [Table 1A](#) and covered by this Standard are as listed in [Tables 2-1.1](#) through [2-3.19](#) and [Tables II-2-1.1](#) through [II-2-3.19](#) of this Appendix.

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

[Tables II-2-1.1](#) through [II-2-3.19](#) of this Appendix have coterminous pressure-temperature ratings using psi units for pressure and degrees Fahrenheit units for temperature.

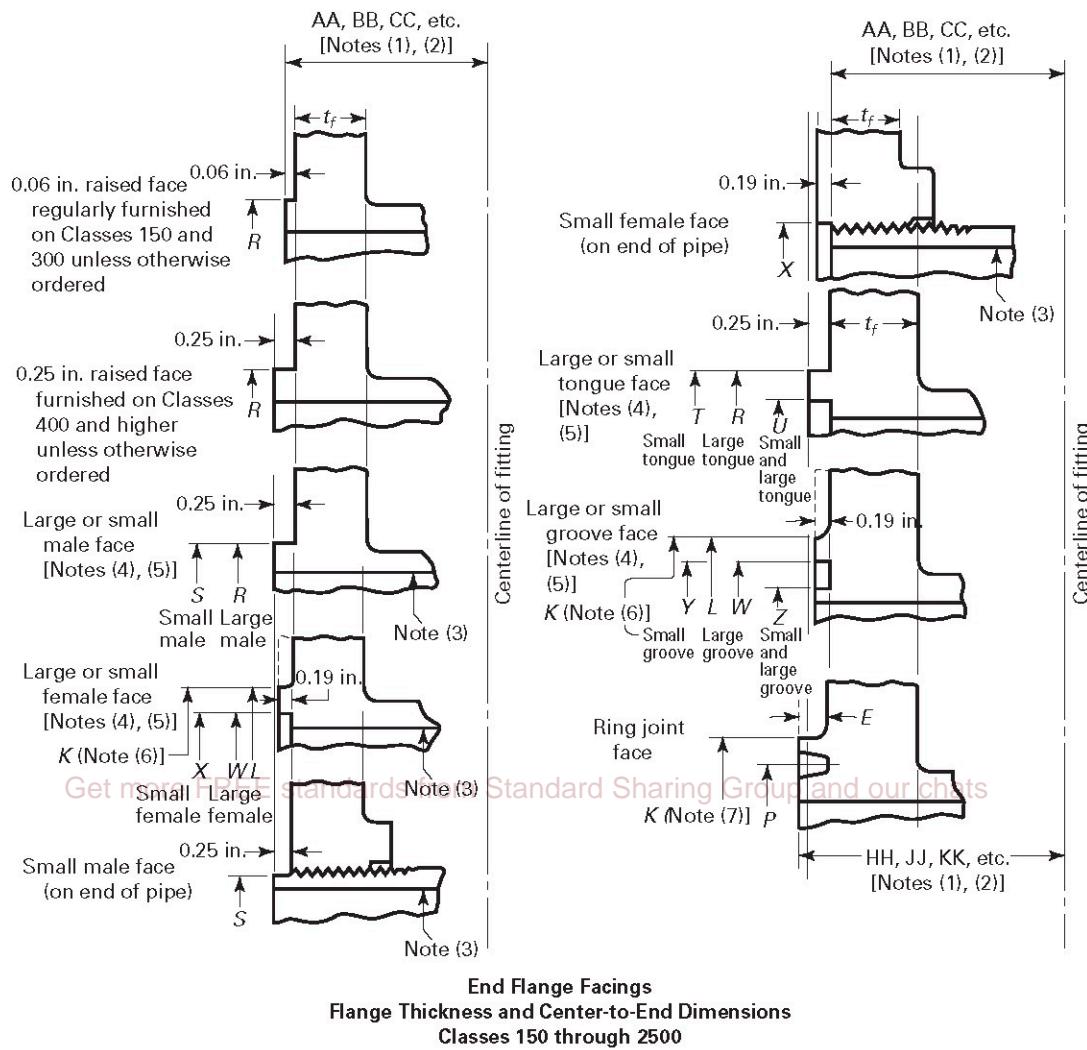
All tabulated pressures are gage pressures. Other tables and figures included in this Appendix provide dimensional data in U.S. Customary units for the following:

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

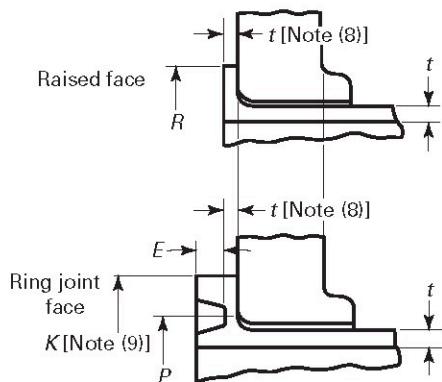
(b) Classes 150 and 300 flanged fittings

[Nonmandatory Appendix E](#) includes dimensional data for Classes 400, 600, 900, 1500, and 2500 flanged fittings for information.

Figure II-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**

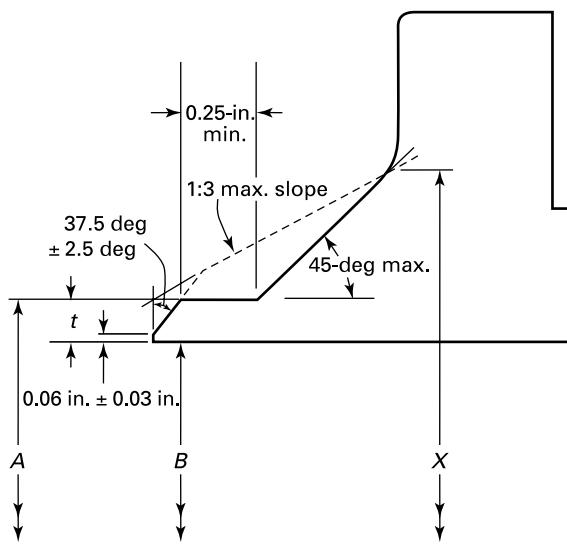
GENERAL NOTE: Dimensions are in inches. For dimensions in millimeters, refer to [Figure 6](#).

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

Figure II-7 Bevel for Wall Thicknesses t From 0.19 in. to 0.88 in. Inclusive



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

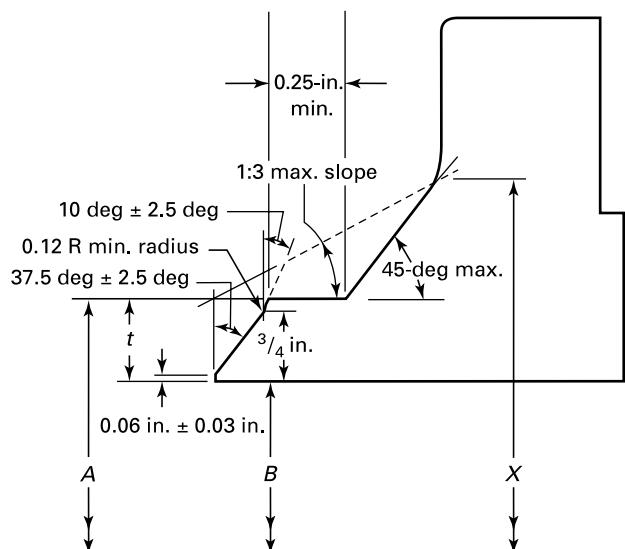
A = nominal outside diameter of pipe

B = nominal inside diameter of pipe

t = nominal wall thickness of pipe

x = diameter of hub (see dimensional tables)

Figure II-8 Bevel for Wall Thicknesses t Greater Than 0.88 in.



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

A = nominal outside diameter of pipe

B = nominal inside diameter of pipe

t = nominal wall thickness of pipe

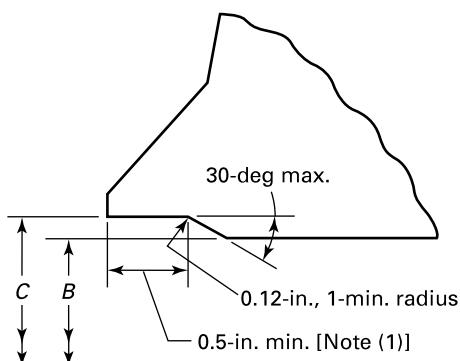
x = diameter of hub (see dimensional tables)

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GENERAL NOTES:

- (a) Dimensions are in inches. For dimensions in millimeters, refer to [Figures 7 and 8](#).
- (b) See [paras. 6.7, 6.8, and 7.4](#) for details and tolerances.
- (c) See [Figures II-9 and II-10](#) for additional details of welding ends.
- (d) When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be used, or, alternatively, the greater outside diameter may be tapered at the same maximum slope or less, from a point on the welding bevel equal to the outside diameter of the mating pipe. Similarly, when the greater thickness is provided on the inside of the flange, it shall be taper-bored from the welding end at a slope not exceeding 1 to 3. When flanges covered by this Standard are intended for services with light wall, higher strength pipe, the thickness of the hub at the bevel may be greater than that of the pipe to which the flange is joined. Under these conditions, a single taper hub may be provided, and the outside diameter of the hub at the base (dimension X) may also be modified. The additional thickness may be provided on either inside or outside or partially on each side, but the total additional thickness shall not exceed one-half times the nominal wall thickness of intended mating pipe (see [Figures 1 through 3](#)).
- (e) The hub transition from the A diameter to the X diameter shall fall within the maximum and minimum envelope outlined by the 1:3 max. slope and solid line.
- (f) For welding end dimensions, refer to ASME B16.25.
- (g) The 0.25-in. min. dimension applies only to the solid line configuration.

GENERAL NOTE: Please see [Figure II-7 General Notes](#).

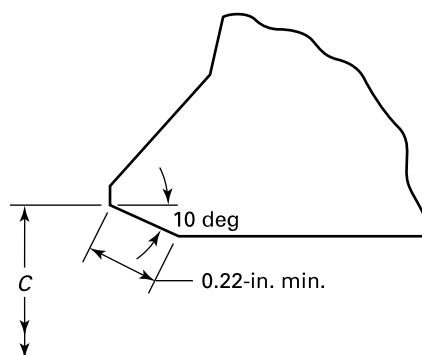
Figure II-9 Inside Contour for Use With Rectangular Backing Ring**Welding Ends
(Welding Neck Flanges)** A = nominal outside diameter of welding end, in. B = nominal inside diameter of pipe ($-A - 2t$), in. $C = A - 0.031 - 1.75t - 0.010$ in. T = nominal wall thickness of pipe

0.031 in. = minus tolerance on outside diameter of pipe to ASTM A106, etc.

 $1.75t = 87\frac{1}{2}\%$ of nominal wall (permitted by ASTM A106, etc.) multiplied by 2 to convert into terms of diameter0.010 in. = plus tolerance on diameter C (see [para. 7.5.3](#))**GENERAL NOTES:**

- (a) Dimensions are in inches. For dimensions in millimeters, refer to [Figures 9 and 10](#).
- (b) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (c) See [Figures II-7 and II-8](#) for welding end details of welding neck flanges.
- (d) For dimensions, see ASME B16.25.

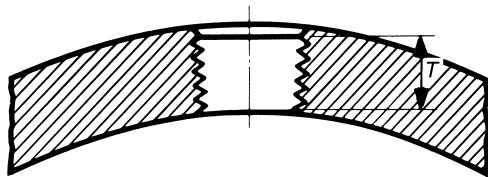
NOTE: (1) 0.5-in. depth based on use of 0.75-in.-wide backing ring.

Figure II-10 Inside Contour for Use With Taper Backing Ring**Welding Ends
(Welding Neck Flanges)** A = nominal outside diameter of welding end, in. B = nominal inside diameter of pipe ($-A - 2t$), in. $C = A - 0.031 - 1.75t - 0.010$ in. T = nominal wall thickness of pipe

0.031 in. = minus tolerance on outside diameter of pipe to ASTM A106, etc.

 $1.75t = 87\frac{1}{2}\%$ of nominal wall (permitted by ASTM A106, etc.) multiplied by 2 to convert into terms of diameter0.010 in. = plus tolerance on diameter C (see [para. 7.5.3](#))**GENERAL NOTES:**

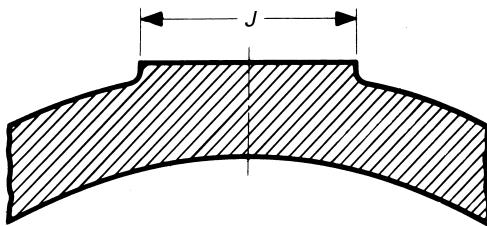
- (a) Dimensions are in inches. For dimensions in millimeters, refer to [Figures 9 and 10](#).
- (b) 0.5-in. depth based on use of 0.75-in.-wide backing ring.
- (c) See [paras. 6.7, 6.8, and 7.5](#) for details and tolerances.
- (d) See [Figures II-7 and II-8](#) for welding end details of welding neck flanges.
- (e) For dimensions, see ASME B16.25.

Figure II-11 Thread Length for Connection Tapping

Connection Size, NPS	Thread Length, T, in.
$\frac{3}{8}$	0.41
$\frac{1}{2}$	0.53
$\frac{3}{4}$	0.55
1	0.68
$1\frac{1}{4}$	0.71
$1\frac{1}{2}$	0.72
2	0.76

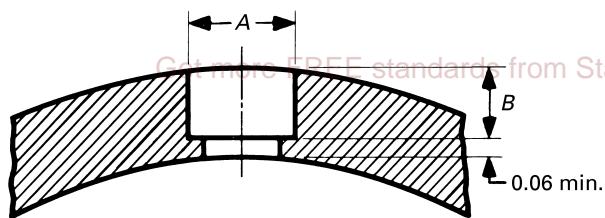
GENERAL NOTE: See paras. 6.12.2, 6.12.5, and 6.12.6.

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 II-13 Bosses for Connections

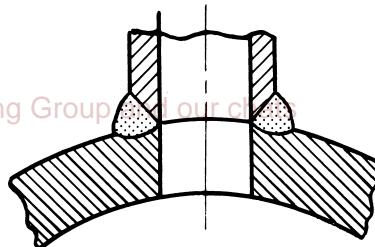
Connection Size, NPS	Minimum Boss Diameter, J, in.
$\frac{3}{8}$	1.25
$\frac{1}{2}$	1.50
$\frac{3}{4}$	1.75
1	2.12
$1\frac{1}{4}$	2.50
$1\frac{1}{2}$	2.75
2	3.38

GENERAL NOTE: See para. 6.12.5.

Figure II-12 Socket Welding for Connections

Connection Size, NPS	Minimum Diameter of Socket, A, in.	Minimum Depth, B, in.
$\frac{3}{8}$	0.69	0.19
$\frac{1}{2}$	0.86	0.19
$\frac{3}{4}$	1.06	0.25
1	1.33	0.25
$1\frac{1}{4}$	1.68	0.25
$1\frac{1}{2}$	1.92	0.25
2	2.41	0.31

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

Figure II-14 Butt Welding for Connections

GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

Table II-2-1.1 Pressure-Temperature Ratings for Group 1.1 Materials

Nominal Designation	Forgings	Castings	Plates
C-Si	A105 (1)	A216 Gr. WCB (1)	A515 Gr. 70 (1)
C-Mn-Si	A350 Gr. LF2 (1)	...	A516 Gr. 70 (1), (2)
C-Mn-Si	A537 Cl. 1 (3)
C-Mn-Si-V	A350 Gr. LF6 Cl. 1 (4)
3½Ni	A350 Gr. LF3

Temp., °F	Working Pressures by Classes, psig						
	Class						
150	300	400	600	900	1500	2500	
-20 to 100	285	740	985	1,480	2,220	3,705	6,170
200	260	680	905	1,360	2,035	3,395	5,655
300	230	655	870	1,310	1,965	3,270	5,450
400	200	635	845	1,265	1,900	3,170	5,280
500	170	605	805	1,205	1,810	3,015	5,025
600	140	570	755	1,135	1,705	2,840	4,730
650	125	550	730	1,100	1,650	2,745	4,575
700	110	530	710	1,060	1,590	2,655	4,425
750	95	505	675	1,015	1,520	2,535	4,230
800	80	410	550	825	1,235	2,055	3,430
850	65	320	425	640	955	1,595	2,655
900	50	230	305	460	690	1,150	1,915
950	35	135	185	275	410	685	1,145
1,000	20	85	115	170	255	430	715

NOTES:

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

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

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		A203 Gr. B (1)					
3½Ni	...			A352 Gr. LC3 (2)		A203 Gr. E (1)					
Working Pressures by Classes, psig											
Temp., °F		Class									
150	300	400	600	900	1500	2500					
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250				
200	260	750	1,000	1,500	2,250	3,750	6,250				
300	230	730	970	1,455	2,185	3,640	6,070				
400	200	705	940	1,405	2,110	3,520	5,865				
500	170	665	885	1,330	1,995	3,325	5,540				
600	140	605	805	1,210	1,815	3,025	5,040				
650	125	590	785	1,175	1,765	2,940	4,905				
700	110	555	740	1,110	1,665	2,775	4,630				
750	95	505	675	1,015	1,520	2,535	4,230				
800	80	410	550	825	1,235	2,055	3,430				
850	65	320	425	640	955	1,595	2,655				
900	50	225	295	445	670	1,115	1,855				
950	35	135	185	275	410	685	1,145				
1,000	20	85	115	170	255	430	715				

NOTES:

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

(2) Not to be used over 650°F

(3) Not to be used over 500°F.

Table II-2-1.3 Pressure-Temperature Ratings for Group 1.3 Materials

Nominal Designation	Forgings	Castings			Plates								
C-Si	...	A352 Gr. LCB (1)			A515 Gr. 65 (2)								
C-Mn-Si			A516 Gr. 65 (2), (3)								
2½Ni			A203 Gr. A (2)								
3½Ni			A203 Gr. D (2)								
C-½Mo	...	A217 Gr. WC1 (4)-(6)			...								
C-½Mo	...	A352 Gr. LC1 (1)			...								
Working Pressures by Classes, psig													
Temp., °F	Class												
	150	300	400	600	900	1500	2500						
-20 to 100	265	695	930	1,395	2,090	3,480	5,805						
200	255	660	880	1,320	1,980	3,300	5,505						
300	230	640	850	1,275	1,915	3,190	5,315						
400	200	615	820	1,230	1,845	3,075	5,125						
500	170	585	780	1,175	1,760	2,930	4,885						
600	140	550	735	1,105	1,655	2,755	4,595						
650	125	535	710	1,065	1,600	2,665	4,440						
700	110	510	685	1,025	1,535	2,560	4,270						
750	95	475	635	955	1,430	2,385	3,970						
800	80	390	520	780	1,175	1,955	3,255						
850	65	300	400	595	895	1,490	2,485						
900	50	200	270	405	605	1,010	1,685						
950	35	135	185	275	410	685	1,145						
1,000	20	85	115	170	255	430	715						

NOTES:

- (1) Not to be used over 650°F.
- (2) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 800°F.
- (3) Not to be used over 850°F.
- (4) Upon prolonged exposure to temperatures above 875°F, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 875°F.
- (5) Use normalized and tempered material only.
- (6) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

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

Nominal Designation		Forgings		Castings		Plates					
C-Si	A515 Gr. 60 (1)							
C-Mn-Si	A350 Gr. LF1 Cl. 1 (1)		...	A516 Gr. 60 (1), (2)							
Working Pressures by Classes, psig											
Temp., °F		Class									
150		300		400		600					
-20 to 100		235	615	825	1,235	1,850	3,085				
200		215	565	755	1,130	1,695	2,830				
300		210	545	725	1,090	1,635	2,725				
400		200	525	700	1,055	1,580	2,635				
500		170	500	670	1,005	1,505	2,510				
600		140	475	630	945	1,420	2,365				
650		125	455	610	915	1,370	2,285				
700		110	440	590	885	1,325	2,210				
750		95	430	570	855	1,285	2,140				
800		80	370	495	740	1,110	1,850				
850		65	300	400	595	895	1,490				
900		50	170	230	345	515	855				
950		35	135	185	275	410	685				
1,000		20	85	115	170	255	430				

Table II-2-1.5 Pressure-Temperature Ratings for Group 1.5 Materials

Nominal Designation		Forgings		Castings		Plates	
C- $\frac{1}{2}$ Mo	A182 Gr. F1 (1)	A204 Gr. A (1)	A204 Gr. B (1)	
Working Pressures by Classes, psig							
Temp., °F		Class					
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	265	695	930	1,395	2,090	3,480	5,805
200	260	695	930	1,395	2,090	3,480	5,805
300	230	685	915	1,375	2,060	3,435	5,725
400	200	660	885	1,325	1,985	3,310	5,520
500	170	640	855	1,285	1,925	3,210	5,350
600	140	605	805	1,210	1,815	3,025	5,040
650	125	590	785	1,175	1,765	2,940	4,905
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	450	600	900	1,350	2,245	3,745
950	35	280	375	560	845	1,405	2,345
1,000	20	165	220	330	495	825	1,370

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

Table II-2-1.7 Pressure-Temperature Ratings for Group 1.7 Materials

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

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(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.

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

Nominal Designation	Forgings			Castings		Plates	
	1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo	...	A217 Gr. WC6 (1)-(3)	...	A387 Gr. 11 Cl. 2 (4)
1 $\frac{1}{4}$ Cr- $\frac{1}{2}$ Mo-Si	A182 Gr. F11 Cl. 2 (1), (4)
Working Pressures by Classes, psig							
Temp., °F		Class					
150	300	400	600	900	1500	2500	
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250
200	260	750	1,000	1,500	2,250	3,750	6,250
300	230	720	965	1,445	2,165	3,610	6,015
400	200	695	925	1,385	2,080	3,465	5,775
500	170	665	885	1,330	1,995	3,325	5,540
600	140	605	805	1,210	1,815	3,025	5,040
650	125	590	785	1,175	1,765	2,940	4,905
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	450	600	900	1,350	2,245	3,745
950	35	320	425	640	955	1,595	2,655
1,000	20	215	290	430	650	1,080	1,800
1,050	...	145	190	290	430	720	1,200
1,100	...	95	130	190	290	480	800
1,150	...	65	85	130	195	325	545
1,200	...	40	55	80	125	205	345

NOTES:

- (1) Use normalized and tempered material only.
- (2) Not to be used over 1,100°F.
- (3) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.
- (4) Permissible but not recommended for prolonged use above 1,100°F.

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

Nominal Designation	Forgings		Castings		Plates	
	2¹/₄Cr-1Mo	A182 Gr. F22 Cl. 3 (1)	A217 Gr. WC9 (2)-(4)	A387 Gr. 22 Cl. 2 (1)		
	Working Pressures by Classes, psig					
		Class				
Temp., °F	150	300	400	600	900	1500
-20 to 100	290	750	1,000	1,500	2,250	3,750
200	260	750	1,000	1,500	2,250	3,750
300	230	730	970	1,455	2,185	3,640
400	200	705	940	1,410	2,115	3,530
500	170	665	885	1,330	1,995	3,325
600	140	605	805	1,210	1,815	3,025
650	125	590	785	1,175	1,765	2,940
700	110	570	755	1,135	1,705	2,840
750	95	530	710	1,065	1,595	2,660
800	80	510	675	1,015	1,525	2,540
850	65	485	650	975	1,460	2,435
900	50	450	600	900	1,350	2,245
950	35	385	515	775	1,160	1,930
1,000	20	265	355	535	800	1,335
1,050	...	175	235	350	525	875
1,100	...	110	145	220	330	550
1,150	...	70	90	135	205	345
1,200	...	40	55	80	125	205
						345

NOTES:

- (1) Permissible but not recommended for prolonged use above 1,100°F.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 1,100°F.
- (4) The deliberate addition of any element not listed in ASTM A217, Table 1 is prohibited, except that calcium (Ca) and manganese (Mn) may be added for deoxidation.

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

Nominal Designation C- $\frac{1}{2}$ Mo	Forgings		Castings		Plates	
	A204 Gr. C (1)	
Working Pressures by Classes, psig						
		Class				
Temp., °F	150	300	400	600	900	1500
-20 to 100	290	750	1,000	1,500	2,250	3,750
200	260	750	1,000	1,500	2,250	3,750
300	230	730	970	1,455	2,185	3,640
400	200	705	940	1,410	2,115	3,530
500	170	665	885	1,330	1,995	3,325
600	140	605	805	1,210	1,815	3,025
650	125	590	785	1,175	1,765	2,940
700	110	570	755	1,135	1,705	2,840
750	95	530	710	1,065	1,595	2,660
800	80	510	675	1,015	1,525	2,540
850	65	485	650	975	1,460	2,435
900	50	450	600	900	1,345	2,245
950	35	280	375	560	845	1,405
1,000	20	165	220	330	495	825
1,050	...	165	220	330	495	825
1,100	...	110	145	220	330	550
1,150	...	80	110	165	245	410
1,200	...	45	60	90	135	225
						370

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

Table II-2-1.13 Pressure-Temperature Ratings for Group 1.13 Materials

Nominal Designation	Forgings		Castings		Plates	
	5Cr-1/2Mo	A182 Gr. F5a	A217 Gr. C5 (1), (2)			...
Temp., °F	Working Pressures by Classes, psig					
			Class			
150	300	400	600	900	1500	2500
-20 to 100	290	750	1,000	1,500	2,250	3,750
200	260	750	1,000	1,500	2,250	3,750
300	230	730	970	1,455	2,185	3,640
400	200	705	940	1,410	2,115	3,530
500	170	665	885	1,330	1,995	3,325
600	140	605	805	1,210	1,815	3,025
650	125	590	785	1,175	1,765	2,940
700	110	570	755	1,135	1,705	2,840
750	95	530	710	1,065	1,595	2,660
800	80	510	675	1,015	1,525	2,540
850	65	485	650	975	1,460	2,435
900	50	375	500	745	1,120	1,870
950	35	275	365	550	825	1,370
1,000	20	200	265	400	595	995
1,050	...	145	190	290	430	720
1,100	...	100	135	200	300	495
1,150	...	60	80	125	185	310
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.

Table II-2-1.14 Pressure-Temperature Ratings for Group 1.14 Materials

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

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.

Table II-2-1.15 Pressure-Temperature Ratings for Group 1.15 Materials

Nominal Designation	Forgings		Castings		Plates	
	9Cr-1Mo-V	A182 Gr. F91	A217 Gr. C12A (1)	A387 Gr. 91 Cl. 2		
	Working Pressures by Classes, psig					
		Class				
Temp., °F		150	300	400	600	900
-20 to 100	290	750	1,000	1,500	2,250	3,750
200	260	750	1,000	1,500	2,250	3,750
300	230	730	970	1,455	2,185	3,640
400	200	705	940	1,410	2,115	3,530
500	170	665	885	1,330	1,995	3,325
600	140	605	805	1,210	1,815	3,025
650	125	590	785	1,175	1,765	2,940
700	110	570	755	1,135	1,705	2,840
750	95	530	710	1,065	1,595	2,660
800	80	510	675	1,015	1,525	2,540
850	65	485	650	975	1,460	2,435
900	50	450	600	900	1,350	2,245
950	35	385	515	775	1,160	1,930
1,000	20	365	485	725	1,090	1,820
1,050	...	360	480	720	1,080	1,800
1,100	...	300	400	605	905	1,510
1,150	...	225	295	445	670	1,115
1,200	...	145	190	290	430	1,200

NOTE: (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.

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

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	
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250
200	260	735	980	1,470	2,210	3,680	6,135
300	230	700	935	1,400	2,100	3,495	5,830
400	200	670	890	1,335	2,005	3,345	5,570
500	170	645	860	1,290	1,940	3,230	5,385
600	140	605	805	1,210	1,815	3,025	5,040
650	125	590	785	1,175	1,765	2,940	4,905
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	375	500	745	1,120	1,870	3,115
950	35	275	365	550	825	1,370	2,285
1,000	20	200	265	400	595	995	1,655
1,050	...	145	190	290	430	720	1,200
1,100	...	95	130	190	290	480	800
1,150	...	60	80	125	185	310	515
1,200	...	35	45	70	105	170	285

NOTES:

(1) Use normalized and tempered material only.

(2) Permissible but not recommended for prolonged use above 1,100°F.

(17)

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

Nominal Designation	Forgings		Castings		Plates		
	9Cr-2W-V	A182 Gr. F92 (1)	
Temp., °F	Working Pressures by Classes, psig						
	150	300	400	600	900	1500	2500
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250
200	260	750	1,000	1,500	2,250	3,750	6,250
300	230	730	970	1,455	2,185	3,640	6,070
400	200	705	940	1,410	2,115	3,530	5,880
500	170	665	885	1,330	1,995	3,325	5,540
600	140	605	805	1,210	1,815	3,025	5,040
650	125	590	785	1,175	1,765	2,940	4,905
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	450	600	900	1,350	2,245	3,745
950	35	385	515	775	1,160	1,930	3,220
1,000	20	365	485	725	1,090	1,820	3,030
1,050	20	360	480	720	1,080	1,800	3,000
1,100	20	325	430	645	965	1,610	2,685
1,150	20	275	365	550	825	1,370	2,285
1,200	20	190	275	385	575	960	1,600

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

Table II-2-2.1 Pressure-Temperature Ratings for Group 2.1 Materials

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

NOTES:

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

(2) Not to be used over 800°F.

Table II-2-2.2 Pressure-Temperature Ratings for Group 2.2 Materials

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

NOTES:

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

(2) Not to be used over 850°F.

(3) Not to be used over 1,000°F.

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

Nominal Designation	Forgings	Castings			Plates			
18Cr-8Ni	A182 Gr. F304L (1)	...			A240 Gr. 304L (1)			
16Cr-12Ni-2Mo	A182 Gr. F316L	...			A240 Gr. 316L			
18Cr-13Ni-3Mo	A182 Gr. F317L			
Working Pressures by Classes, psig								
		Class						
Temp., °F	150	300	400	600	900	1500		
-20 to 100	230	600	800	1,200	1,800	3,000		
200	195	510	680	1,020	1,535	2,555		
300	175	455	610	910	1,370	2,280		
400	160	420	560	840	1,260	2,100		
500	150	395	525	785	1,180	1,970		
600	140	370	495	745	1,115	1,860		
650	125	365	485	730	1,095	1,825		
700	110	360	480	720	1,080	1,800		
750	95	355	470	705	1,060	1,765		
800	80	345	460	690	1,035	1,730		
850	65	340	450	675	1,015	1,690		
						2,820		

NOTE: (1) Not to be used over 800°F.

Table II-2-2.4 Pressure-Temperature Ratings for Group 2.4 Materials

Nominal Designation		Forgings		Castings		Plates					
18Cr-10Ni-Ti		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		150									
300		300									
400		400									
600		600									
900		900									
1,500		1,500									
2,500		2,500									
-20 to 100		275	720	960	1,440	2,160	3,600				
200		250	650	865	1,295	1,945	3,240				
300		230	595	795	1,190	1,785	2,975				
400		200	550	735	1,105	1,655	2,760				
500		170	515	690	1,030	1,550	2,580				
600		140	485	650	975	1,460	2,435				
650		125	475	635	950	1,425	2,375				
700		110	465	620	930	1,395	2,330				
750		95	460	610	915	1,375	2,290				
800		80	450	600	900	1,355	2,255				
850		65	445	595	895	1,340	2,230				
900		50	440	590	885	1,325	2,210				
950		35	385	515	775	1,160	1,930				
1,000		20	365	485	725	1,090	1,820				
1,050		...	360	480	720	1,080	1,800				
1,100		...	310	415	625	935	1,560				
1,150		...	235	315	475	710	1,185				
1,200		...	185	245	370	555	925				
1,250		...	140	185	280	420	705				
1,300		...	110	145	220	330	550				
1,350		...	85	115	170	255	430				
1,400		...	65	85	130	195	325				
1,450		...	50	70	105	155	255				
1,500		...	40	50	75	115	190				
1,545											

NOTES:

(1) Not to be used over 1,000°F.

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

Table II-2-2.5 Pressure-Temperature Ratings for Group 2.5 Materials

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

NOTES:

(1) Not to be used over 1,000°F.

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

Table II-2-2.6 Pressure-Temperature Ratings for Group 2.6 Materials

Nominal Designation	Forgings		Castings		Plates	
	23Cr-12Ni	A240 Gr. 309H	
Temp., °F	Working Pressures by Classes, psig					
	150	300	400	600	900	1500
-20 to 100	275	720	960	1,440	2,160	3,600
200	240	630	840	1,260	1,895	3,155
300	225	580	775	1,160	1,740	2,905
400	200	545	725	1,090	1,635	2,725
500	170	520	690	1,035	1,555	2,590
600	140	500	665	1,000	1,500	2,495
650	125	490	655	985	1,475	2,460
700	110	485	645	970	1,455	2,425
750	95	480	640	960	1,440	2,400
800	80	475	630	945	1,420	2,365
850	65	465	620	930	1,395	2,330
900	50	450	600	900	1,350	2,245
950	35	385	515	775	1,160	1,930
1,000	20	365	485	725	1,090	1,820
1,050	...	355	470	705	1,060	1,765
1,100	...	260	345	520	780	1,305
1,150	...	190	250	375	565	945
1,200	...	135	185	275	410	685
1,250	...	105	135	205	310	515
1,300	...	75	100	150	225	375
1,350	...	60	80	115	175	290
1,400	...	45	60	90	135	225
1,450	...	35	45	70	105	170
1,500	...	25	35	50	75	130

Table II-2-2.7 Pressure-Temperature Ratings for Group 2.7 Materials

Nominal Designation	Forgings		Castings		Plates	
	25Cr-20Ni	A182 Gr. F310 (1), (2)	...		A240 Gr. 310H	
Working Pressures by Classes, psig						
		Class				
Temp., °F	150	300	400	600	900	1500
-20 to 100	275	720	960	1,440	2,160	3,600
200	245	635	850	1,270	1,910	3,180
300	225	580	775	1,160	1,740	2,905
400	200	540	725	1,085	1,625	2,710
500	170	515	685	1,025	1,540	2,570
600	140	495	660	990	1,485	2,470
650	125	485	645	970	1,455	2,425
700	110	480	635	955	1,435	2,390
750	95	470	625	940	1,410	2,350
800	80	465	620	930	1,395	2,330
850	65	460	610	915	1,375	2,290
900	50	450	600	900	1,350	2,245
950	35	385	515	775	1,160	1,930
1,000	20	365	485	725	1,090	1,820
1,050	...	355	470	705	1,060	1,765
1,100	...	260	345	520	780	1,305
1,150	...	190	250	375	565	945
1,200	...	135	185	275	410	685
1,250	...	105	135	205	310	515
1,300	...	75	100	150	225	375
1,350	...	60	80	115	175	290
1,400	...	45	60	90	135	225
1,450	...	35	45	65	100	165
1,500	...	25	35	50	75	130
						215

NOTES:

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

(2) Service temperatures of 1,050°F and above should be used only when assurance is provided that grain size is not finer than ASTM No. 6.

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Table II-2-2.8 Pressure-Temperature Ratings for Group 2.8 Materials

Nominal Designation	Forgings	Castings	Plates				
20Cr-18Ni-6Mo	A182 Gr. F44	A351 Gr. CK3MCuN	A240 Gr. S31254				
22Cr-5Ni-3Mo-N	A182 Gr. F51 (1)	...	A240 Gr. S31803 (1)				
25Cr-7Ni-4Mo-N	A182 Gr. F53 (1)	...	A240 Gr. S32750 (1)				
24Cr-10Ni-4Mo-V	...	A995 Gr. CE8MN (1)	...				
25Cr-5Ni-2Mo-3Cu-N	...	A995 Gr. CD4MCuN (1)	...				
25Cr-7Ni-3.5Mo-W-Cb	...	A995 Gr. CD3MWCuN (1)	...				
25Cr-7Ni-3.5Mo-N-Cu-W	A182 Gr. F55 (1)	...	A240 Gr. S32760 (1)				
Working Pressures by Classes, psig							
		Class					
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250
200	260	745	990	1,490	2,230	3,720	6,200
300	230	665	890	1,335	2,000	3,335	5,560
400	200	615	820	1,230	1,845	3,070	5,120
500	170	580	775	1,160	1,740	2,905	4,840
600	140	555	740	1,115	1,670	2,785	4,640
650	125	545	730	1,095	1,640	2,735	4,560
700	110	540	725	1,085	1,625	2,710	4,520
750	95	530	710	1,065	1,595	2,660	4,430

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

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

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

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 1,000°F, use only if the material is solution heat treated to the minimum temperature specified in the specification, but not lower than 1,900°F, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 1,050°F and above only when assurance is provided that grain size is not finer than ASTM No. 6.

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

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					
-20 to 100		260		670		895					
200		210		550		735					
300		195		505		675					
400		185		485		645					
500		170		470		625					
600		140		455		610					
650		125		445		595					
700		110		435		580					
750		95		420		565					
800		80		410		545					
850		65		400		530					
900		50		385		510					
950		35		370		495					
1,000		20		340		450					
1,050		...		290		390					
1,100		...		225		295					
1,150		170		230		345					
1,200		...		130		175					
1,250		...		100		135					
1,300		...		80		105					
1,350		...		60		80					
1,400		...		45		60					
1,450		...		30		40					
1,500		...		25		35					

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

Table II-2-2.11 Pressure-Temperature Ratings for Group 2.11 Materials

Nominal Designation	Forgings		Castings		Plates		
	18Cr-10Ni-Cb	...	A351 Gr. CF8C (1)	
	Working Pressures by Classes, psig						
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	275	720	960	1,440	2,160	3,600	6,000
200	255	660	885	1,325	1,985	3,310	5,520
300	230	615	820	1,235	1,850	3,085	5,140
400	200	575	770	1,150	1,730	2,880	4,800
500	170	540	725	1,085	1,625	2,710	4,520
600	140	515	690	1,030	1,550	2,580	4,300
650	125	505	675	1,015	1,520	2,530	4,220
700	110	495	660	995	1,490	2,485	4,140
750	95	490	655	985	1,475	2,460	4,100
800	80	485	650	975	1,460	2,435	4,060
850	65	485	645	970	1,455	2,425	4,040
900	50	450	600	900	1,350	2,245	3,745
950	35	385	515	775	1,160	1,930	3,220
1,000	20	365	485	725	1,090	1,820	3,030
1,050	...	360	480	720	1,080	1,800	3,000
1,100	...	310	415	625	935	1,560	2,600
1,150	...	210	280	420	625	1,045	1,745
1,200	...	150	200	300	455	755	1,255
1,250	...	115	150	225	340	565	945
1,300	...	75	100	150	225	375	630
1,350	...	50	70	105	155	255	430
1,400	...	40	55	80	125	205	345
1,450	...	30	40	60	95	155	255
1,500	...	25	35	55	80	135	230

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

Table II-2-2.12 Pressure-Temperature Ratings for Group 2.12 Materials

Nominal Designation	Forgings			Castings		Plates	
	25Cr-20Ni	A351 Gr. CK20 (1)
	Working Pressures by Classes, psig						
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	260	670	895	1,345	2,015	3,360	5,600
200	210	550	735	1,100	1,650	2,750	4,580
300	195	505	675	1,015	1,520	2,530	4,220
400	185	485	645	970	1,455	2,425	4,040
500	170	470	625	940	1,410	2,350	3,920
600	140	455	610	910	1,370	2,280	3,800
650	125	445	595	895	1,340	2,230	3,720
700	110	435	580	870	1,305	2,170	3,620
750	95	420	565	845	1,265	2,110	3,520
800	80	410	545	820	1,230	2,050	3,420
850	65	400	530	795	1,195	1,990	3,320
900	50	385	510	770	1,150	1,920	3,200
950	35	370	495	740	1,110	1,850	3,080
1,000	20	340	450	675	1,015	1,690	2,820
1,050	...	325	435	650	975	1,630	2,715
1,100	...	290	390	585	875	1,455	2,430
1,150	...	250	335	500	750	1,250	2,085
1,200	...	205	275	410	615	1,030	1,715
1,250	...	165	220	330	495	825	1,370
1,300	...	120	160	240	360	600	1,000
1,350	...	80	110	165	245	410	685
1,400	...	55	75	110	165	275	455
1,450	...	40	50	75	115	190	315
1,500	...	25	35	55	80	135	230

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

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

Nominal Designation		Forgings		Castings		Plates	
35Ni-35Fe-20Cr-Cb		B462 Gr. N08020 (1)		...		B463 Gr. N08020 (1)	
Working Pressures by Classes, psig							
Temp., °F		150	300	400	600	900	1500
-20 to 100		290	750	1,000	1,500	2,250	3,750
200		260	740	990	1,485	2,225	3,710
300		230	710	945	1,420	2,130	3,550
400		200	680	910	1,365	2,045	3,410
500		170	655	875	1,310	1,965	3,275
600		140	605	805	1,210	1,815	3,025
650		125	590	785	1,175	1,765	2,940
700		110	570	755	1,135	1,705	2,840
750		95	530	710	1,065	1,595	2,660
800		80	510	675	1,015	1,525	2,540
							4,230

NOTE: (1) Use annealed material only.

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

Nominal Designation		Forgings		Castings		Plates	
99.0Ni		B564 Gr. N02200 (1)		...		B162 Gr. N02200 (1)	
Working Pressures by Classes, psig							
Temp., °F		150	300	400	600	900	1500
-20 to 100		185	480	640	960	1,440	2,400
200		185	480	640	960	1,440	2,400
300		185	480	640	960	1,440	2,400
400		185	480	640	960	1,440	2,400
500		170	455	605	905	1,360	2,270
600		140	415	550	825	1,240	2,065
							3,440

NOTE: (1) Use annealed material only.

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

Nominal Designation	Forgings			Castings		Plates	
	99.0Ni-Low C	B162 Gr. N02201 (1)		
Working Pressures by Classes, psig							
		Class					
Temp., °F		150	300	400	600	900	1500
-20 to 100		90	240	320	480	720	1,200
	200	90	230	305	460	690	1,150
	300	85	225	300	450	675	1,130
	400	85	225	300	450	675	1,130
	500	85	225	300	450	675	1,130
	600	85	225	300	450	675	1,130
	650	85	225	300	445	670	1,115
	700	85	225	300	445	670	1,115
	750	85	220	295	440	660	1,105
	800	80	215	290	430	650	1,080
	850	65	210	280	420	635	1,055
	900	50	205	275	415	620	1,030
	950	35	195	260	395	590	985
	1,000	20	190	255	380	570	950
	1,050	...	80	110	165	245	410
	1,100	...	70	90	135	205	345
	1,150	...	50	70	105	155	255
	1,200	...	40	55	80	125	205
							345

NOTE: (1) Use annealed material only.

Table II-2-3.4 Pressure-Temperature Ratings for Group 3.4 Materials

Nominal Designation	Forgings			Castings		Plates	
	67Ni-30Cu	B564 Gr. N04400 (1)	B127 Gr. N04400 (1)		
Working Pressures by Classes, psig							
		Class					
Temp., °F		150	300	400	600	900	1500
-20 to 100		230	600	800	1,200	1,800	3,000
	200	200	525	700	1,050	1,575	2,630
	300	190	490	655	980	1,470	2,450
	400	180	475	630	945	1,420	2,365
	500	170	475	630	945	1,420	2,365
	600	140	475	630	945	1,420	2,365
	650	125	475	630	945	1,420	2,365
	700	110	470	625	940	1,410	2,350
	750	95	465	620	930	1,395	2,330
	800	80	460	610	915	1,375	2,290
	850	65	375	505	755	1,130	1,885
	900	50	275	365	550	825	1,370
							2,285

NOTE: (1) Use annealed material only.

Table II-2-3.5 Pressure-Temperature Ratings for Group 3.5 Materials

Nominal Designation	Forgings		Castings		Plates	
	72Ni-15Cr-8Fe	B564 Gr. N06600 (1)	...		B168 Gr. N06600 (1)	
Working Pressures by Classes, psig						
	Class					
Temp., °F	150	300	400	600	900	1500
-20 to 100	290	750	1,000	1,500	2,250	3,750
200	260	750	1,000	1,500	2,250	3,750
300	230	730	970	1,455	2,185	3,640
400	200	705	940	1,410	2,115	3,530
500	170	665	885	1,330	1,995	3,325
600	140	605	805	1,210	1,815	3,025
650	125	590	785	1,175	1,765	2,940
700	110	570	755	1,135	1,705	2,840
750	95	530	710	1,065	1,595	2,660
800	80	510	675	1,015	1,525	2,540
850	65	485	650	975	1,460	2,435
900	50	450	600	900	1,350	2,245
950	35	365	485	725	1,090	1,815
1,000	20	240	320	480	720	1,200
1,050	...	155	205	310	465	770
1,100	...	105	135	205	310	515
1,150	...	75	100	150	225	375
1,200	...	70	90	135	205	345
						570

NOTE: (1) Use annealed material only.

Table II-2-3.6 Pressure-Temperature Ratings for Group 3.6 Materials

Nominal Designation	Forgings			Castings		Plates	
	33Ni-42Fe-21Cr	B564 Gr. N08800 (1)	B409 Gr. N08800 (1)
Working Pressures by Classes, psig							
		Class					
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	275	720	960	1,440	2,160	3,600	6,000
200	255	665	885	1,330	1,995	3,325	5,540
300	230	640	850	1,275	1,915	3,190	5,320
400	200	620	825	1,240	1,860	3,095	5,160
500	170	600	805	1,205	1,805	3,010	5,020
600	140	590	785	1,175	1,765	2,940	4,900
650	125	580	770	1,155	1,735	2,890	4,820
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	450	600	900	1,350	2,245	3,745
950	35	385	515	775	1,160	1,930	3,220
1,000	20	365	485	725	1,090	1,820	3,030
1,050	...	360	480	720	1,080	1,800	3,000
1,100	...	325	430	645	965	1,610	2,685
1,150	...	275	365	550	825	1,370	2,285
1,200	...	205	275	410	620	1,030	1,715
1,250	...	145	190	290	430	720	1,200
1,300	...	70	90	135	205	345	570
1,350	...	55	75	110	165	275	455
1,400	...	40	50	75	115	190	315
1,450	...	35	45	70	105	170	285
1,500	...	25	35	55	80	135	230

NOTE: (1) Use annealed material only.

Table II-2-3.7 Pressure-Temperature Ratings for Group 3.7 Materials

Nominal Designation	Forgings		Castings		Plates					
65Ni-28Mo-2Fe	B462 Gr. N10665 (1)		...		B333 Gr. N10665 (1)					
64Ni-29.5Mo-2Cr-2Fe-Mn-W	B462 Gr. N10675 (1)		...		B333 Gr. N10675 (1)					
Working Pressures by Classes, psig										
Temp., °F		Class								
150		300	400	600	900	1500				
-20 to 100		290	750	1,000	1,500	2,250				
200		260	750	1,000	1,500	2,250				
300		230	730	970	1,455	2,185				
400		200	705	940	1,410	2,115				
500		170	665	885	1,330	1,995				
600		140	605	805	1,210	1,815				
650		125	590	785	1,175	1,765				
700		110	570	755	1,135	1,705				
750		95	530	710	1,065	1,595				
800		80	510	675	1,015	1,525				
		2500								
		6,250								
		6,250								
		6,070								
		5,880								
		5,540								
		5,040								
		4,905								
		4,730								
		4,430								
		4,230								

NOTE: (1) Use solution annealed material only.

Table II-2-3.8 Pressure-Temperature Ratings for Group 3.8 Materials

Nominal Designation	Forgings	Castings	Plates				
54Ni-16Mo-15Cr	B462 Gr. N10276 (1), (2)	...	B575 Gr. N10276 (1), (2)				
60Ni-22Cr-9Mo-3.5Cb	B564 Gr. N06625 (3)-(5)	...	B443 Gr. N06625 (3)-(5)				
62Ni-28Mo-5Fe	B333 Gr. N10001 (1), (6)				
70Ni-16Mo-7Cr-5Fe	B434 Gr. N10003 (3)				
61Ni-16Mo-16Cr	B575 Gr. N06455 (1), (6)				
42Ni-21.5Cr-3Mo-2.3Cu	B564 Gr. N08825 (3), (7)	...	B424 Gr. N08825 (3), (7)				
55Ni-21Cr-13.5Mo	B462 Gr. N06022 (1), (2), (8)	...	B575 Gr. N06022 (1), (2), (8)				
55Ni-23Cr-16Mo-1.6Cu	B462 Gr. N06200 (1), (6)	...	B575 Gr. N06200 (1), (6)				
Working Pressures by Classes, psig							
Class							
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250
200	260	750	1,000	1,500	2,250	3,750	6,250
300	230	730	970	1,455	2,185	3,640	6,070
400	200	700	930	1,395	2,095	3,490	5,820
500	170	665	885	1,330	1,995	3,325	5,540
600	140	605	805	1,210	1,815	3,025	5,040
650	125	590	785	1,175	1,765	2,940	4,905
700	110	570	755	1,135	1,705	2,840	4,730
750	95	530	710	1,065	1,595	2,660	4,430
800	80	510	675	1,015	1,525	2,540	4,230
850	65	485	650	975	1,460	2,435	4,060
900	50	450	600	900	1,350	2,245	3,745
950	35	385	515	775	1,160	1,930	3,220
1,000	20	365	485	725	1,090	1,820	3,030
1,050	...	360	480	720	1,080	1,800	3,000
1,100	...	325	430	645	965	1,610	2,685
1,150	...	275	365	550	825	1,370	2,285
1,200	...	205	275	410	615	1,030	1,715
1,250	...	165	220	330	495	825	1,370
1,300	...	120	160	240	360	600	1,000

NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 1,250°F.
- (3) Use annealed material only.
- (4) Not to be used over 1,200°F. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 1,000°F to 1,400°F.
- (5) Grade 1.
- (6) Not to be used over 800°F.
- (7) Not to be used over 1,000°F.
- (8) Alloy N06022 in the solution annealed condition is subject to severe loss of impact strength at room temperature after exposure to temperatures in the range of 1,000°F to 1,250°F.

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

Nominal Designation		Forgings		Castings		Plates					
47Ni-22Cr-9Mo-18Fe		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											
		Class									
Temp., °F		150	300	400	600	900	1500				
-20 to 100		290	750	1,000	1,500	2,250	3,750				
200		260	750	1,000	1,500	2,250	3,750				
300		230	690	920	1,380	2,075	3,455				
400		200	640	850	1,275	1,915	3,190				
500		170	595	795	1,190	1,785	2,975				
600		140	565	750	1,130	1,690	2,820				
650		125	550	735	1,105	1,655	2,760				
700		110	540	725	1,085	1,625	2,710				
750		95	530	710	1,065	1,595	2,660				
800		80	510	675	1,015	1,525	2,540				
850		65	485	650	975	1,460	2,435				
900		50	450	600	900	1,350	2,245				
950		35	385	515	775	1,160	1,930				
1,000		20	365	485	725	1,090	1,820				
1,050		...	360	480	720	1,080	1,800				
1,100		...	325	430	645	965	1,610				
1,150		...	275	365	550	825	1,370				
1,200		...	205	275	410	620	1,030				
1,250		...	180	245	365	545	910				
1,300		...	140	185	275	410	685				
1,350		...	105	140	205	310	515				
1,400		...	75	100	150	225	380				
1,450		...	60	80	115	175	290				
1,500		...	40	55	85	125	205				
345											

NOTE: (1) Use solution annealed material only.

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

Nominal Designation		Forgings		Castings		Plates					
25Ni-47Fe-21Cr-5Mo			B599 Gr. N08700 (1)					
Working Pressures by Classes, psig											
		Class									
Temp., °F		150	300	400	600	900	1500				
-20 to 100		290	750	1,000	1,500	2,250	3,750				
	200	260	750	1,000	1,500	2,250	3,750				
	300	230	685	910	1,370	2,050	3,420				
	400	200	640	850	1,275	1,915	3,190				
	500	170	615	820	1,235	1,850	3,085				
	600	140	595	790	1,185	1,780	2,965				
	650	125	570	760	1,140	1,715	2,855				
							4,760				

NOTE: (1) Use solution annealed material only.

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

Nominal Designation		Forgings		Castings		Plates					
44Fe-25Ni-21Cr-Mo		A479 Gr. N08904 (1), (2)		...		A240 Gr. N08904 (1)					
Working Pressures by Classes, psig											
		Class									
Temp., °F		150	300	400	600	900	1500				
-20 to 100		285	745	990	1,490	2,230	3,720				
	200	230	600	805	1,205	1,805	3,010				
	300	210	545	725	1,090	1,635	2,725				
	400	190	500	665	1,000	1,500	2,495				
	500	170	455	610	910	1,370	2,280				
	600	140	425	570	855	1,280	2,135				
	650	125	420	555	835	1,255	2,090				
	700	110	410	545	820	1,230	2,050				
							3,420				

NOTES:

(1) Use annealed material only.

(2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B564.

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

Nominal Designation	Forgings		Castings		Plates					
26Ni-43Fe-22Cr-5Mo		B620 Gr. N08320 (1)					
47Ni-22Cr-20Fe-7Mo		B582 Gr. N06985 (1)					
46Fe-24Ni-21Cr-6Mo-Cu-N	B462 Gr. N08367 (1)		A351 Gr. CN3MN (1)		B688 Gr. N08367 (1)					
Working Pressures by Classes, psig										
Temp., °F	Class									
	150	300	400	600	900	1500	2500			
-20 to 100	260	670	895	1,345	2,015	3,360	5,600			
200	240	620	830	1,245	1,865	3,110	5,180			
300	225	585	780	1,165	1,750	2,915	4,860			
400	200	540	715	1,075	1,615	2,690	4,480			
500	170	500	665	1,000	1,500	2,495	4,160			
600	140	475	630	945	1,420	2,365	3,940			
650	125	460	615	920	1,380	2,305	3,840			
700	110	450	600	900	1,355	2,255	3,760			
750	95	440	590	885	1,325	2,210	3,680			
800	80	430	575	865	1,295	2,160	3,600			

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings		Castings		Plates					
49Ni-25Cr-18Fe-6Mo		B582 Gr. N06975 (1)					
Ni-Fe-Cr-Mo-Cu-Low C	B564 Gr. N08031 (2)		...		B625 Gr. N08031 (2)					
Working Pressures by Classes, psig										
Temp., °F	Class									
	150	300	400	600	900	1500	2500			
-20 to 100	290	750	1,000	1,500	2,250	3,750	6,250			
200	260	705	940	1,405	2,110	3,515	5,860			
300	230	665	885	1,330	1,995	3,325	5,540			
400	200	630	840	1,260	1,885	3,145	5,240			
500	170	595	795	1,190	1,785	2,975	4,960			
600	140	560	750	1,125	1,685	2,810	4,680			
650	125	550	735	1,100	1,650	2,750	4,580			
700	110	540	720	1,080	1,620	2,700	4,500			
750	95	530	710	1,065	1,595	2,660	4,430			
800	80	510	675	1,015	1,525	2,540	4,230			

NOTES:

(1) Use solution annealed material only.

(2) Use annealed material only.

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

Nominal Designation		Forgings		Castings		Plates							
47Ni-22Cr-19Fe-6Mo			B582 Gr. N06007 (1)							
40Ni-29Cr-15Fe-5Mo		B462 Gr. N06030 (1), (2)		...		B582 Gr. N06030 (1), (2)							
58Ni-33Cr-8Mo		B462 Gr. N06035 (1), (2)		...		B575 Gr. N06035 (1), (2)							
Working Pressures by Classes, psig													
Class													
Temp., °F	150	300	400	600	900	1500	2500						
-20 to 100	275	720	960	1,440	2,160	3,600	6,000						
200	250	650	865	1,295	1,945	3,240	5,400						
300	230	600	800	1,200	1,800	3,000	5,000						
400	200	565	750	1,130	1,690	2,820	4,700						
500	170	540	715	1,075	1,615	2,690	4,480						
600	140	520	690	1,035	1,555	2,590	4,320						
650	125	510	680	1,020	1,535	2,555	4,260						
700	110	505	675	1,015	1,520	2,530	4,220						
750	95	500	670	1,005	1,505	2,510	4,180						
800	80	500	665	1,000	1,500	2,495	4,160						
850	65	485	650	975	1,460	2,435	4,060						
900	50	450	600	900	1,350	2,245	3,745						
950	35	385	515	775	1,160	1,930	3,220						
1000	20	365	485	725	1,090	1,820	3,030						

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(1) Use solution annealed material only.

(2) Not to be used over 800°F.

Table II-2-3.15 Pressure-Temperature Ratings for Group 3.15 Materials

Nominal Designation	Forgings			Castings		Plates	
	33Ni-42Fe-21Cr	B564 Gr. N08810 (1)	B409 Gr. N08810 (1)
Working Pressures by Classes, psig							
Temp., °F	150	300	400	600	900	1500	2500
-20 to 100	230	600	800	1,200	1,800	3,000	5,000
200	210	550	735	1,105	1,655	2,760	4,600
300	200	520	695	1,040	1,560	2,605	4,340
400	190	490	655	980	1,470	2,450	4,080
500	170	465	620	925	1,390	2,315	3,860
600	140	440	585	880	1,320	2,195	3,660
650	125	430	575	860	1,290	2,150	3,580
700	110	420	555	835	1,255	2,090	3,480
750	95	410	545	820	1,230	2,050	3,420
800	80	400	535	800	1,200	2,005	3,340
850	65	395	525	785	1,180	1,970	3,280
900	50	385	515	775	1,160	1,930	3,220
950	35	380	505	760	1,140	1,895	3,160
1,000	20	365	485	725	1,090	1,820	3,030
1,050	...	350	465	700	1,050	1,750	2,915
1,100	...	325	430	645	965	1,610	2,685
1,150	...	275	365	550	825	1,370	2,285
1,200	...	205	275	410	620	1,030	1,715
1,250	...	180	245	365	545	910	1,515
1,300	...	140	185	275	410	685	1,145
1,350	...	105	140	205	310	515	860
1,400	...	75	100	150	225	380	630
1,450	...	60	80	115	175	290	485
1,500	...	40	55	85	125	205	345

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings			Castings		Plates	
	35Ni-19Cr-1½Si	B511 Gr. N08330	B536 Gr. N08330 (1)
Working Pressures by Classes, psig							
Temp., °F	Class						
	150	300	400	600	900	1500	2500
-20 to 100	275	720	960	1,440	2,160	3,600	6,000
200	245	635	850	1,270	1,910	3,180	5,300
300	225	595	790	1,185	1,780	2,965	4,940
400	200	555	740	1,115	1,670	2,785	4,640
500	170	530	705	1,055	1,585	2,640	4,400
600	140	505	670	1,010	1,510	2,520	4,200
650	125	495	660	990	1,485	2,470	4,120
700	110	480	645	965	1,445	2,410	4,020
750	95	475	630	945	1,420	2,365	3,940
800	80	465	620	925	1,390	2,315	3,860
850	65	455	605	905	1,360	2,270	3,780
900	50	445	590	890	1,330	2,220	3,700
950	35	385	515	775	1,160	1,930	3,220
1,000	20	365	485	725	1,090	1,820	3,030
1,050	...	345	455	685	1,030	1,715	2,855
1,100	...	265	355	535	800	1,335	2,230
1,150	...	205	275	410	615	1,030	1,715
1,200	...	160	215	320	485	805	1,345
1,250	...	130	175	260	390	650	1,085
1,300	...	105	140	215	320	530	885
1,350	...	80	110	165	245	410	685
1,400	...	60	80	125	185	310	515
1,450	...	50	70	105	155	255	430
1,500	...	40	50	75	115	190	315

NOTE: (1) Use solution annealed material only.

Table II-2-3.17 Pressure-Temperature Ratings for Group 3.17 Materials

Nominal Designation	Forgings			Castings		Plates	
	29Ni-20.5Cr-3.5Cu-2.5Mo	...	A351 Gr. CN7M (1)
Working Pressures by Classes, psig							
Temp., °F	Class						
	150	300	400	600	900	1500	2500
-20 to 100	230	600	800	1,200	1,800	3,000	5,000
200	200	520	690	1,035	1,555	2,590	4,320
300	180	465	620	930	1,395	2,330	3,880
400	160	420	565	845	1,265	2,110	3,520
500	150	390	520	780	1,165	1,945	3,240
600	140	360	480	720	1,080	1,800	3,000

NOTE: (1) Use solution annealed material only.

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

Nominal Designation	Forgings		Castings		Plates	
	57Ni-22Cr-14W-2Mo-La	B564 Gr. N06230	...		B435 Gr. N06230	
Working Pressures by Classes, psig						
		Class				
Temp., °F		150	300	400	600	900
-20 to 100		290	750	1,000	1,500	2,250
200		260	750	1,000	1,500	2,250
300		230	730	970	1,455	2,185
400		200	705	940	1,410	2,115
500		170	665	885	1,330	1,995
600		140	605	805	1,210	1,815
650		125	590	785	1,175	1,765
700		110	570	755	1,135	1,705
750		95	530	710	1,065	1,595
800		80	510	675	1,015	1,525
850		65	485	650	975	1,460
900		50	450	600	900	1,350
950		35	385	515	775	1,160
1,000		20	365	485	725	1,090
1,050		20	360	480	720	1,080
1,100		20	325	430	645	965
1,150		20	275	365	550	825
1,200		20	205	275	410	620
1,250		20	180	245	365	545
1,300		20	140	185	275	410
1,350		20	105	140	205	310
1,400		20	75	100	150	225
1,450		20	60	80	115	175
1,500		20	40	55	85	125
						205
						345

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

NPS	Maximum Radial Projection of Imperfections That Are No Deeper Than the Bottom of the Serrations, in.	Maximum Depth and Radial Projection of Imperfections That Are Deeper Than the Bottom of the Serrations, in.
$\frac{1}{2}$	0.12	0.06
$\frac{3}{4}$	0.12	0.06
1	0.12	0.06
$1\frac{1}{4}$	0.12	0.06
$1\frac{1}{2}$	0.12	0.06
2	0.12	0.06
$2\frac{1}{2}$	0.12	0.06
3	0.18	0.06
$3\frac{1}{2}$	0.25	0.12
4	0.25	0.12
5	0.25	0.12
6	0.25	0.12
8	0.31	0.18
10	0.31	0.18
12	0.31	0.18
14	0.31	0.18
16	0.38	0.18
18	0.50	0.25
20	0.50	0.25
22	0.50	0.25
24	0.50	0.25

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Minimum Outside Diameter of Raised Portion [Notes (6), (7)]
Nominal Pipe Size	Outside Diameter				Outside Diameter				Height						
	Raised Face Large Male and Large Tongue, R	Large Male Tongue, S	Small Male, T	Small Tongue, U	Inside Diameter of Large and Small Tongue, W	Inside Diameter of Small Male [Note (1)]	Large Female and Large Groove, X	Small Female, X	Small Groove, Y	Inside Diameter of Large and Small Groove, Z	Raised Face [Notes (2), (3)]	Large and Small Male and Tongue [Notes (2), (4)]	Depth of Groove or Female [Notes (2), (5)]	Small Female and Groove, K	Large Female and Groove, L
½	1.38	0.72	1.38	1.00	...	1.44	0.78	1.44	0.94	1.75	1.81	
¾	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	
1¼	2.50	1.50	2.25	1.88	...	2.56	1.56	2.31	1.81	2.62	2.94	
1½	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	
2½	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	
3½	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 II-6.
- (c) For facing requirements for lapped Joints, see para. 6.4.3 and Figure II-6.
- (d) For facing tolerances, see para. 7.3.

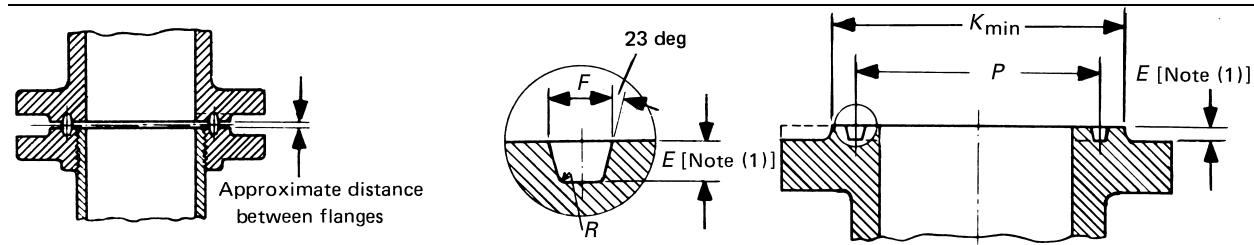
Table II-4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes) (Cont'd)

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 II-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.

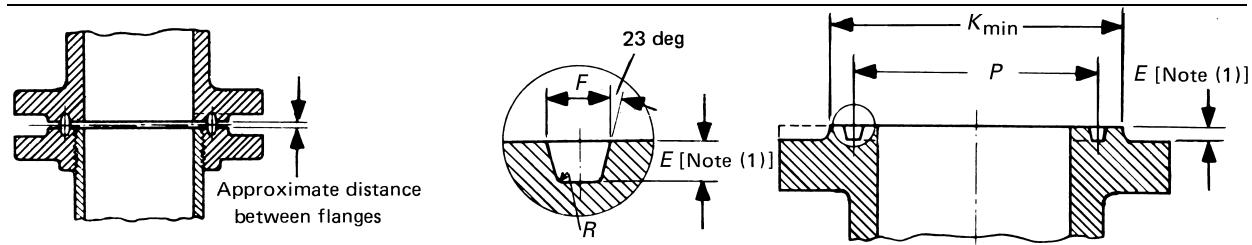
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(17)

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

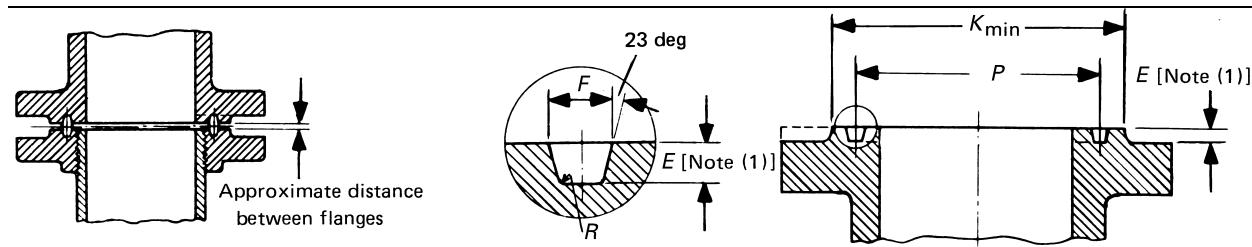
	1	2	3	4	5	6	7	8	9	10	11	12
	Nominal Pipe Size							Groove Dimensions				
Class 150	Class 300 [Note (2)]	Class 400	Class 600 [Note (3)]	Class 900	Class 1500	Class 2500	Groove Number	Pitch Diameter, <i>P</i>	Depth, <i>E</i> [Note (1)]	Width, <i>F</i>	Radius at Bottom, <i>R</i>	
...	1/2	...	1/2	R11	1.344	0.219	0.281	0.03	
...	1/2	...	12	1.562	0.250	0.344	0.03	
...	3/4	...	3/4	1/2	13	1.688	0.250	0.344	0.03	
...	3/4	...	14	1.750	0.250	0.344	0.03	
1	15	1.875	0.250	0.344	0.03	
...	1	...	1	...	1	3/4	16	2.000	0.250	0.344	0.03	
1 1/4	17	2.250	0.250	0.344	0.03	
...	1 1/4	...	1 1/4	...	1 1/4	1	18	2.375	0.250	0.344	0.03	
1 1/2	19	2.562	0.250	0.344	0.03	
...	1 1/2	...	1 1/2	...	1 1/2	...	20	2.688	0.250	0.344	0.03	
...	1 1/4	21	2.844	0.312	0.469	0.03	
2	22	3.250	0.250	0.344	0.03	
...	2	...	2	1 1/2	23	3.250	0.312	0.469	0.03	
...	2	...	24	3.750	0.312	0.469	0.03	
2 1/2	25	4.000	0.250	0.344	0.03	
...	2 1/2	...	2 1/2	2	26	4.000	0.312	0.469	0.03	
...	2 1/2	...	27	4.250	0.312	0.469	0.03	
...	2 1/2	28	4.375	0.375	0.531	0.06	
3	29	4.500	0.250	0.344	0.03	
...	[Note (4)]	...	[Note (4)]	30	4.625	0.312	0.469	0.03	
...	3 [Note (4)]	...	3 [Note (4)]	3	31	4.875	0.312	0.469	0.03	
...	3	32	5.000	0.375	0.531	0.06	
3 1/2	33	5.188	0.250	0.344	0.03	
...	3 1/2	...	3 1/2	34	5.188	0.312	0.469	0.03	
...	3	...	35	5.375	0.312	0.469	0.03	
4	36	5.875	0.250	0.344	0.03	
...	4	4	4	4	37	5.875	0.312	0.469	0.03	
...	4	38	6.188	0.438	0.656	0.06	
...	4	...	39	6.375	0.312	0.469	0.03	
5	40	6.750	0.250	0.344	0.03	

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

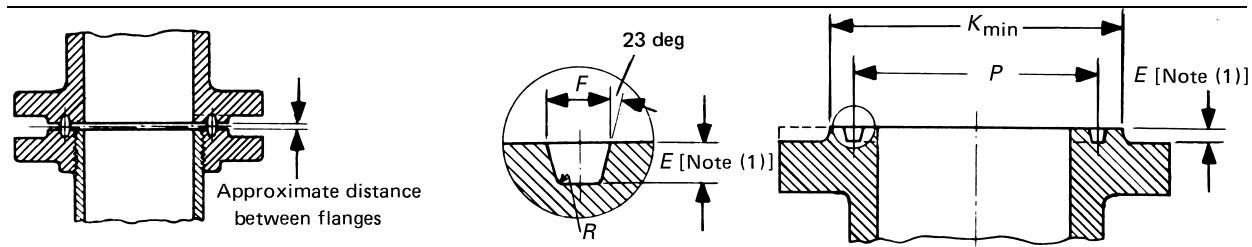
13	14	15	16	17	18	19	20	21	22	23	24	
Diameter of Raised Portion, <i>K</i>					Approximate Distance Between Flanges							
Class 300												
Class 150	Class 400	Class 600	Class 900	Class 1500	Class 2500	Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500
...	2.00	0.12	...	0.12
...	2.38	0.16
...	2.50	2.56	...	0.16	...	0.16	0.16
...	2.62	0.16	...
2.50	0.16
...	2.75	...	2.81	2.88	...	0.16	...	0.16	...	0.16	0.16	0.16
2.88	0.16
...	3.12	...	3.19	3.25	...	0.16	...	0.16	...	0.16	0.16	0.16
3.25	0.16
...	3.56	...	3.62	0.16	...	0.16	...	0.16	0.16	...
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...	4.00	0.12	...
4.00	0.16
...	4.25	4.50	...	0.22	...	0.19	0.12	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	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

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

1	2	3	4	5	6	7	8	9	10	11	12
Nominal Pipe Size							Groove Dimensions				
Class 150	Class 300 [Note (2)]	Class 400	Class 600 [Note (3)]	Class 900	Class 1500	Class 2500	Groove Number	Pitch Diameter, P	Depth, E [Note (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	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	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	16	65	18.500	0.312	0.469	0.03
...	16	66	18.500	0.438	0.656	0.06
...	16	67	18.500	0.688	1.188	0.09
18	68	20.375	0.250	0.344	0.03
...	18	18	18	69	21.000	0.312	0.469	0.03
...	18	70	21.000	0.500	0.781	0.06
...	18	...	71	21.000	0.688	1.188	0.09
20	72	22.000	0.250	0.344	0.03

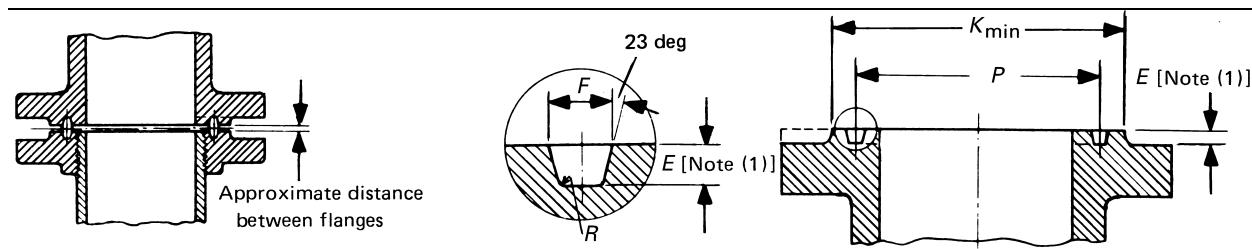
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Table II-5 Dimensions of Ring Joint Facings (All Pressure Rating Classes) (Cont'd)

13	14	15	16	17	18	19	20	21	22	23	24
Diameter of Raised Portion, K					Approximate Distance Between Flanges						
Class 150	Class 300				Class 150	Class 300	Class 400	Class 600	Class 900	Class 1500	Class 2500
	Class 400	Class 600	Class 900	Class 1500							
...	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	...
23.50	0.12

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

1	2	3	4	5	6	7	8	9	10	11	12
Nominal Pipe Size							Groove Dimensions				
Class 150	Class 300 [Note (2)]	Class 400	Class 600 [Note (3)]	Class 900	Class 1500	Class 2500	Groove Number	Pitch Diameter, P	Depth, E [Note (1)]	Width, F	Radius at Bottom, R
...	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	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
...	...	30.38	0.22
...	24	...	79	27.250	0.812	1.438	0.09

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

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

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

GENERAL NOTES:

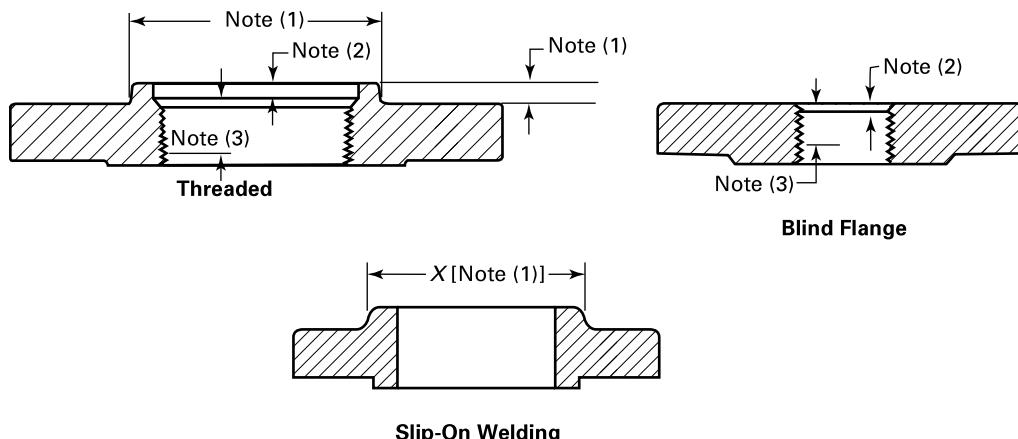
- (a) Dimensions are in inches.
- (b) For facing requirements for flanges and flanged fittings, see [para. 6.4.1](#) and [Figure II-6](#).
- (c) For facing requirements for lapped joints, see [para. 6.4.3](#) and [Figure II-6](#).
- (d) See [para 4.2.7](#) for marking requirements.

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) $+0.016, -0.00$ in.
 F (width) ± 0.008 in.
 P (pitch diameter) ± 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 II-6 Reducing Threaded and Slip-On Flanges for Classes 150 Through 2500 Pipe Flanges

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

NOTES:

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

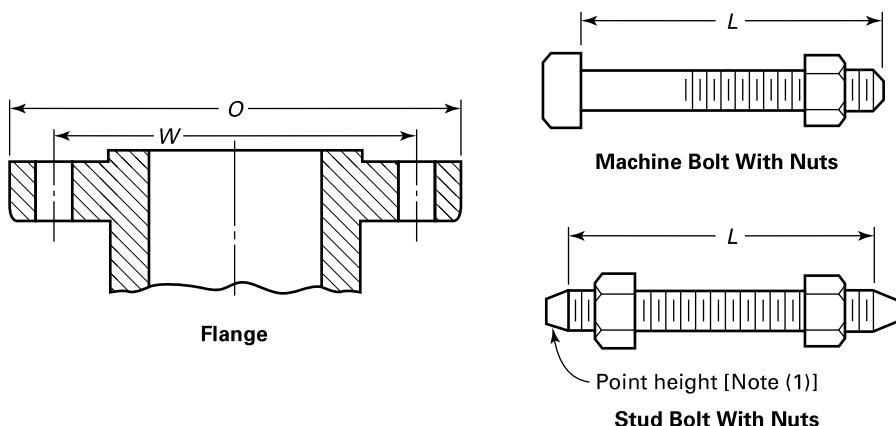
EXAMPLES:

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

Other dimensions the same as for regular NPS 6 Class 300 threaded flange, Table II-12.

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

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

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

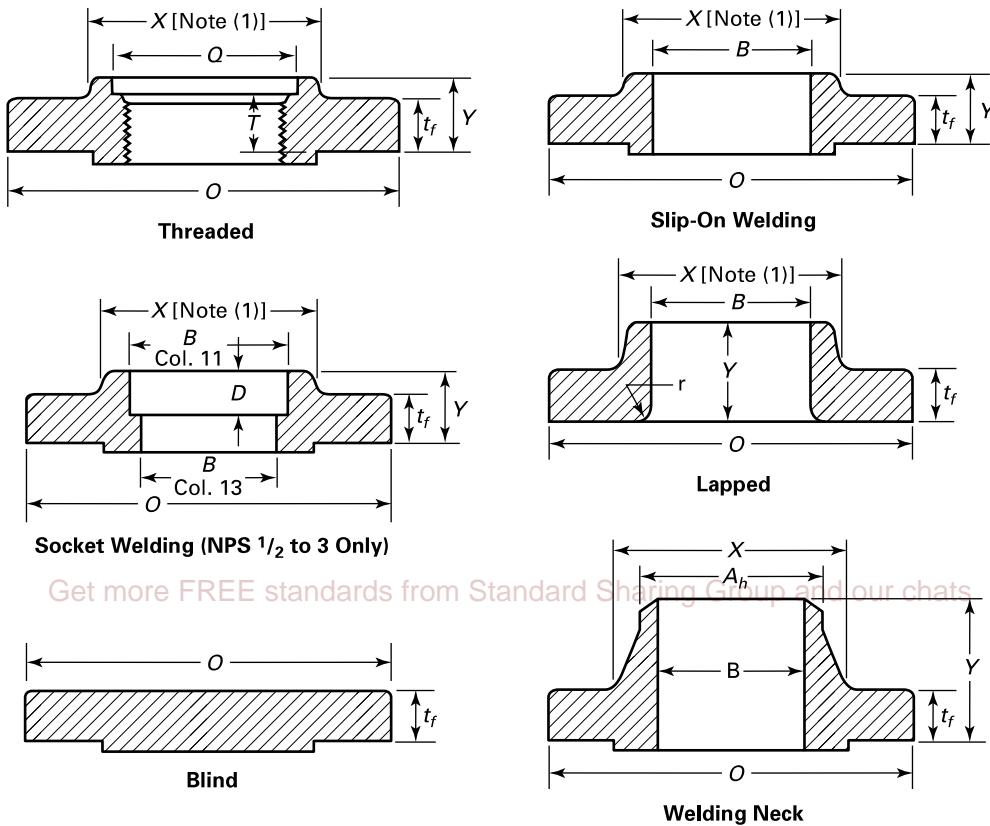
GENERAL NOTES:

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

NOTES:

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

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Table II-8 Dimensions of Class 150 Flanges

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1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f [Notes (2)- (4)]	4 Minimum Thickness Lap Joint	5 Diameter of Hub, X	6 Diameter Beginning of Chamfer Welding Neck, A_h [Note (5)]	7 Length Through Hub	8 Threaded Slip-On Socket Welding, Y	9 Lapped, Y	10 Welding Neck, Y	11 Minimum Thread Length Threaded, T [Note (6)]	12 Minimum Slip-On Socket Welding, B	13 Minimum Lapped, B [Note (7)]	14 Welding Neck/ Socket Welding, B	15 Corner Bore Radius of Lapped Flange and Pipe, r	Depth of Socket, D
$\frac{1}{2}$	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	
$\frac{3}{4}$	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	
$1\frac{1}{4}$	4.62	0.56	0.62	2.31	1.66	0.75	0.81	2.19	0.81	1.70	1.72	1.38	0.19	0.56	
$1\frac{1}{2}$	5.00	0.62	0.69	2.56	1.90	0.81	0.88	2.38	0.88	1.95	1.97	1.61	0.25	0.62	
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	

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

1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f [Notes (2)- (4)]	4 Minimum Thickness of Hub, X	5 Diameter of Hub, X	6 Diameter Beginning of Chamfer Welding Neck, A_h [Note (5)]	7 Threaded Slip-On Socket Welding, Y	8 Lapped, Y	9 Welding Neck, Y	10 Minimum Thread Length Threaded, T [Note (6)]	11 Slip-On Socket Welding, B	12 Minimum Lapped, B [Note (7)]	13 Welding Neck/ Socket Welding, B	14 Corner Bore Radius of Lapped Flange and Pipe, r	15 Depth of Socket, D
2½	7.00	0.81	0.88	3.56	2.88	1.06	1.12	2.69	1.12	2.94	2.97	2.47	0.31	0.75
3	7.50	0.88	0.94	4.25	3.50	1.12	1.19	2.69	1.19	3.57	3.60	3.07	0.38	0.81
3½	8.50	0.88	0.94	4.81	4.00	1.19	1.25	2.75	1.25	4.07	4.10	3.55	0.38	...
4	9.00	0.88	0.94	5.31	4.50	1.25	1.31	2.94	1.31	4.57	4.60	4.03	0.44	...
5	10.00	0.88	0.94	6.44	5.56	1.38	1.44	3.44	1.44	5.66	5.69	5.05	0.44	...
6	11.00	0.94	1.00	7.56	6.63	1.50	1.56	3.44	1.56	6.72	6.75	6.07	0.50	...
8	13.50	1.06	1.12	9.69	8.63	1.69	1.75	3.94	1.75	8.72	8.75	7.98	0.50	...
10	16.00	1.12	1.19	12.00	10.75	1.88	1.94	3.94	1.94	10.88	10.92	10.02	0.50	...
12	19.00	1.19	1.25	14.38	12.75	2.12	2.19	4.44	2.19	12.88	12.92	12.00	0.50	...
14	21.00	1.31	1.38	15.75	14.00	2.19	3.12	4.94	2.25	14.14	14.18	Note (8)	0.50	...
16	23.50	1.38	1.44	18.00	16.00	2.44	3.44	4.94	2.50	16.16	16.19	Note (8)	0.50	...
18	25.00	1.50	1.56	19.88	18.00	2.62	3.81	5.44	2.69	18.18	18.20	Note (8)	0.50	...
20	27.50	1.62	1.69	22.00	20.00	2.81	4.06	5.62	2.88	20.20	20.25	Note (8)	0.50	...
22	29.50	1.75	1.81	24.00	22.00	3.06	4.25	5.82	...	22.22	22.25	Note (8)	0.50	...
24	32.00	1.81	1.88	26.12	24.00	3.19	4.38	5.94	3.25	24.25	24.25	Note (8)	0.50	...

GENERAL NOTES:

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

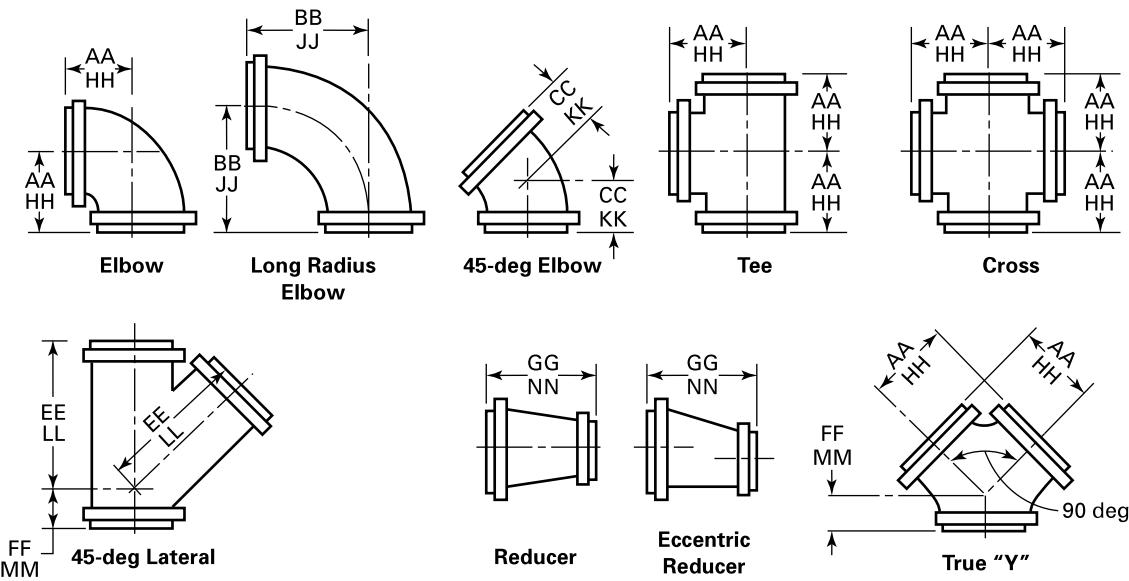
NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) The minimum thickness of these loose flanges, in sizes NPS 3½ and smaller, is slightly greater than the thickness of flanges on fittings, Table II-9, which are reinforced by being cast integral with the body of the fitting.
- (3) When these flanges are required with flat face, the flat face may be either the full t_f dimension thickness plus 0.06 in. or the t_f dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (4) The flange dimensions illustrated are for regularly furnished 0.06-in. raised face (except lapped); for requirements of other facings, see Figure II-6.
- (5) For welding end bevel, see para. 6.7.
- (6) For thread of threaded flanges, see para. 6.9.

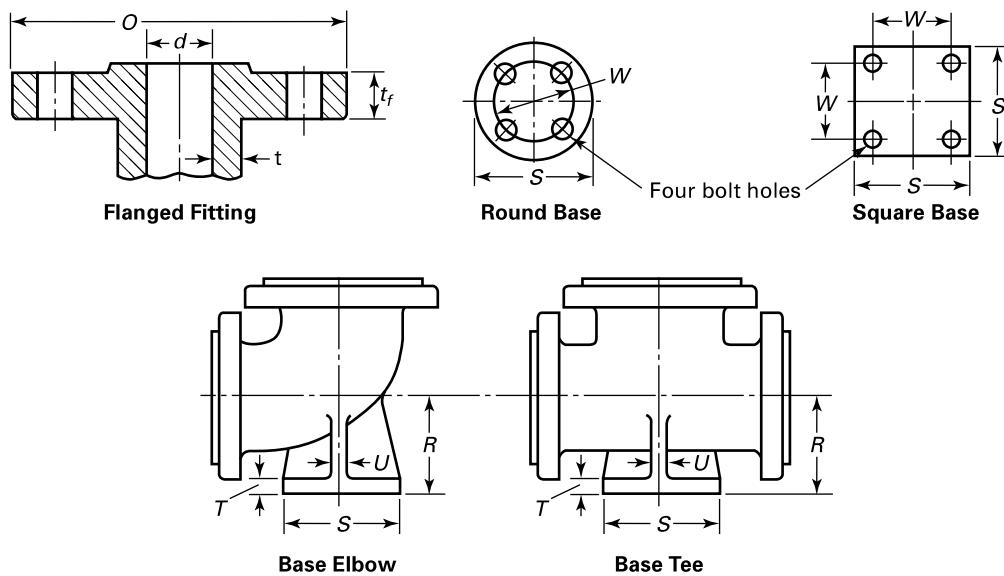
Table II-8 Dimensions of Class 150 Flanges (Cont'd)

NOTES (Cont'd):

- (7) Dimensions in column 13 correspond to the inside diameters of pipe as given in ASME B36.10M for standard wall pipe. The thickness of standard wall is the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in [para. 7.5.2](#) apply. These bore sizes are furnished unless otherwise specified by the purchaser.
- (8) To be specified by the purchaser.

Table II-9 Dimensions of Class 150 Flanged Fittings

Nominal Pipe Size, NPS	Outside Diameter of Flange, [Notes (1)- (3)]	Minimum Thickness of Flange, t_f	Minimum Wall Thickness, t_m	Inside Diamete- r of Fitting, d	0.06-in. Raised Face (Flange Edge) [Note (4)]								Ring Joint [Note (4)]
					Center- to- Contact Surface of Raised Face Elbow,	Center- to- Contact Surface of Raised Face Tee, Cross, and Long Radius Elbow,	Center- to- Contact Surface of Raised Face 45-deg Elbow,	Long Center- to- Contact Surface of Raised Face Lateral,	Short Center- to- Contact Surface of Raised Face Lateral and True "Y,"	Contact Surface- to- Contact Surface Reducer, GG	Center- to- End Elbow Tee, Cross, and True "Y," HH		
					AA	BB	CC	EE	FF	[Note (5)]	[Note (6)]		
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	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	4.50	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	4.50	4.25	
2	6.00	0.56	0.22	2.00	4.50	6.50	2.50	8.00	2.50	5.00	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	5.50	5.25	
3	7.50	0.69	0.22	3.00	5.50	7.75	3.00	10.00	3.00	6.00	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	6.50	6.25	
4	9.00	0.88	0.25	4.00	6.50	9.00	4.00	12.00	3.00	7.00	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	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	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	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	12.00	11.25	
12	19.00	1.19	0.38	12.00	12.00	19.00	7.50	24.50	6.50	14.00	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	16.00	14.25	
16	23.50	1.38	0.44	15.25	15.00	24.00	8.00	30.00	6.50	18.00	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	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	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	24.00	22.25	

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

13	14	15	16	17	18	19	20	21	22	23	1
Ring Joint [Note (4)]						Diameter of Round Base					
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Center-to-End Radius	Center-to-End Elbow,	Long Center-to-End Lateral,	Center-to-End Lateral and True "Y,"	End-to-End Reducer, NN	Center-to-Base, R [Notes (7)-(9)]	Thickness of Square Base, S [Notes (7)- (10)]	Thickness of Base, T [Notes (7)]	Thickness of Ribs, U [Note (7)]	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size, NPS
[Note (6)]	[Note (6)]	[Note (6)]	[Note (6)]	[Notes (5), (6)]							
...	$\frac{1}{2}$
...	$\frac{3}{4}$
5.25	2.00	6.00	2.00	1
5.75	2.25	6.50	2.00	$1\frac{1}{4}$
6.25	2.50	7.25	2.25	$1\frac{1}{2}$
6.75	2.75	8.25	2.75	...	4.12	4.62	0.50	0.50	3.50	$\frac{5}{8}$	2
7.25	3.25	9.75	2.75	...	4.50	4.62	0.50	0.50	3.50	$\frac{5}{8}$	$2\frac{1}{2}$
8.00	3.25	10.25	3.25	...	4.88	5.00	0.56	0.56	3.88	$\frac{5}{8}$	3
8.75	3.75	11.75	3.25	...	5.25	5.00	0.56	0.56	3.88	$\frac{5}{8}$	$3\frac{1}{2}$
9.25	4.25	12.25	3.25	...	5.50	6.00	0.62	0.62	4.75	$\frac{3}{4}$	4
10.50	4.75	13.75	3.75	...	6.25	7.00	0.69	0.65	5.50	$\frac{3}{4}$	5
11.75	5.25	14.75	3.75	...	7.00	7.00	0.69	0.65	5.50	$\frac{3}{4}$	6
14.25	5.75	17.75	4.75	...	8.38	9.00	0.94	0.94	7.50	$\frac{3}{4}$	8
16.75	6.75	20.75	5.25	...	9.75	9.00	0.94	0.94	7.50	$\frac{3}{4}$	10
19.25	7.75	24.75	5.75	...	11.25	11.00	1.00	1.00	9.50	$\frac{7}{8}$	12
21.75	7.75	27.25	6.25	...	12.50	11.00	1.00	1.00	9.50	$\frac{7}{8}$	14
24.25	8.25	30.25	6.75	...	13.75	11.00	1.00	1.00	9.50	$\frac{7}{8}$	16
26.75	8.75	32.25	7.25	...	15.00	13.50	1.12	1.12	11.75	$\frac{7}{8}$	18
29.25	9.75	35.25	8.25	...	16.00	13.50	1.12	1.12	11.75	$\frac{7}{8}$	20
34.25	11.25	40.75	9.25	...	18.50	13.50	1.12	1.12	11.75	$\frac{7}{8}$	24

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

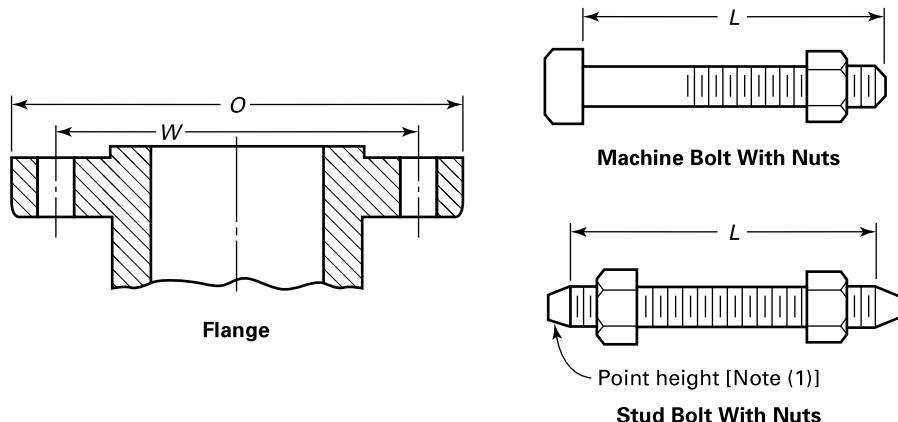
GENERAL NOTE:

- (a) Dimensions of [Table II-9](#) are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-7](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For 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 II-9](#), sizes NPS $3\frac{1}{2}$ and smaller, are slightly heavier than for flanges on these fittings, which are reinforced by being cast integral with the body of 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 II-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 II-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.

(17)

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

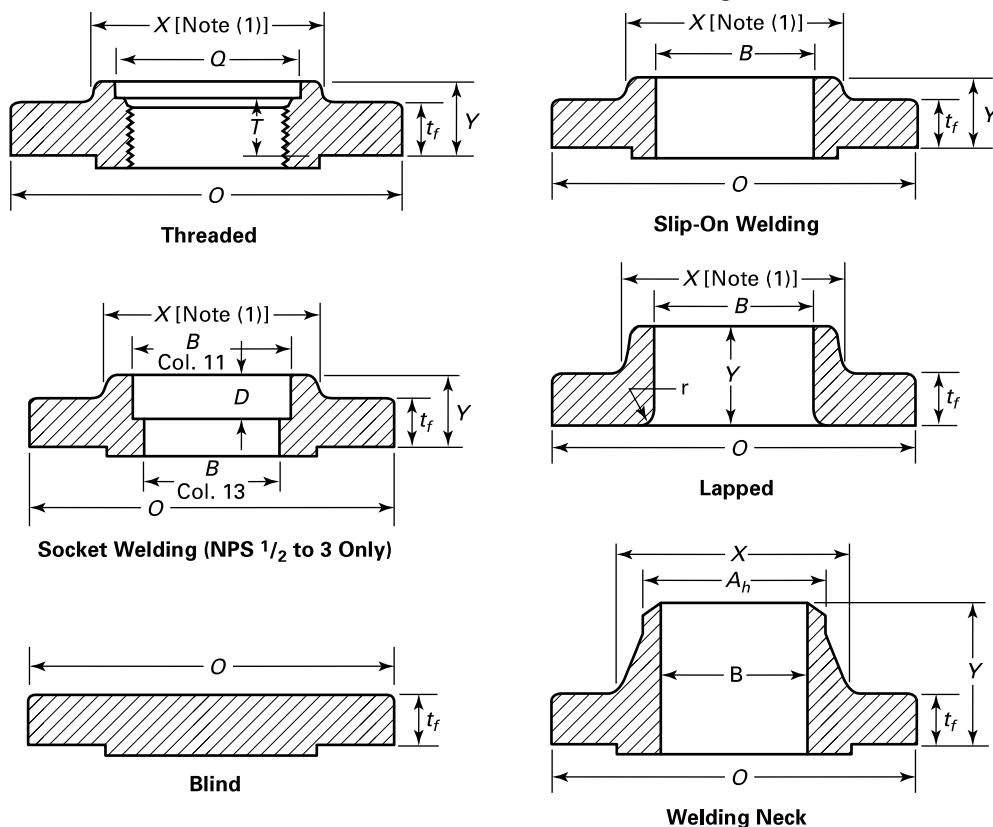
Nominal Pipe Size	Outside Diameter of Flange, <i>O</i>	Drilling [Notes (2), (3)]					Length of Bolts, <i>L</i> [Note (4)]		
		Diameter of Bolt Circle, <i>W</i>	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	Stud Bolts [Note (1)]		Machine Bolts	
						Raised Face 0.06 in.	Ring Joint	Raised Face 0.06 in.	
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 II-11](#) and [II-12](#).

NOTES:

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

Table II-11 Dimensions of Class 300 Flanges

Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)-(4)]	Thickness of Lap Joint, t_f	Diameter of Hub, X Note (4)	Diameter Beginning of Chamfer Neck, A_h Note (4)	Length Through Hub			Minimum Thread Length Threaded, T [Note (5)]	Bore			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		Welded Neck, Y	Welded Neck, Y	Minimum Slip-On Socket Welding, B	Minimum Lapped, B	Welding Neck/Socket Welding, B [Note (6)]	
						Threaded	Slip-On	Socket Welding, Y		Welded Neck, Y	Welded Neck, Y	Minimum Slip-On Socket Welding, B	Minimum Lapped, B	Welding Neck/Socket Welding, B [Note (6)]	
$\frac{1}{2}$	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
$\frac{3}{4}$	4.62	0.56	0.62	1.88	1.05	0.94	1.00	2.19	0.62	1.09	1.11	0.82	0.12	1.14	0.44
1	4.88	0.62	0.69	2.12	1.32	1.00	1.06	2.38	0.69	1.36	1.38	1.05	0.12	1.41	0.50
$1\frac{1}{4}$	5.25	0.69	0.75	2.50	1.66	1.00	1.06	2.50	0.81	1.70	1.72	1.38	0.19	1.75	0.56
$1\frac{1}{2}$	6.12	0.75	0.81	2.75	1.90	1.13	1.19	2.63	0.88	1.95	1.97	1.61	0.25	1.98	0.62
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

(17)

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

Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (2)-(4)]	Thickness of Lap Joint, t_f	Diameter of Hub, X	Diameter Beginning of Chamfer Welding Neck, A_h Note (4)]	Length Through Hub			Minimum Thread Length Threaded, T [Note (5)]	Bore			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	Welding Neck, Y		Minimum Slip-On Socket Welding, B	Minimum Lapped, B	Welding Neck/ Socket Welding, B [Note (6)]			
2½	7.50	0.94	1.00	3.94	2.88	1.44	1.50	2.94	1.25	2.94	2.97	2.47	0.31	3.00	0.75
3	8.25	1.06	1.12	4.62	3.50	1.63	1.69	3.06	1.25	3.57	3.60	3.07	0.38	3.63	0.81
3½	9.00	1.12	1.19	5.25	4.00	1.69	1.75	3.13	1.44	4.07	4.10	3.55	0.38	4.13	...
4	10.00	1.19	1.25	5.75	4.50	1.82	1.88	3.32	1.44	4.57	4.60	4.03	0.44	4.63	...
5	11.00	1.31	1.38	7.00	5.56	1.94	2.00	3.82	1.69	5.66	5.69	5.05	0.44	5.69	...
6	12.50	1.38	1.44	8.12	6.63	2.00	2.06	3.82	1.81	6.72	6.75	6.07	0.50	6.75	...
8	15.00	1.56	1.62	10.25	8.63	2.38	2.44	4.32	2.00	8.72	8.75	7.98	0.50	8.75	...
10	17.50	1.81	1.88	12.62	10.75	2.56	3.75	4.56	2.19	10.88	10.92	10.02	0.50	10.88	...
12	20.50	1.94	2.00	14.75	12.75	2.82	4.00	5.06	2.38	12.88	12.92	12.00	0.50	12.94	...
14	23.00	2.06	2.12	16.75	14.00	2.94	4.38	5.56	2.50	14.14	14.18	Note (7)	0.50	14.19	...
16	25.50	2.19	2.25	19.00	16.00	3.19	4.75	5.69	2.69	16.16	16.19	Note (7)	0.50	16.19	...
18	28.00	2.31	2.38	21.00	18.00	3.44	5.12	6.19	2.75	18.18	18.20	Note (7)	0.50	18.19	...
20	30.50	2.44	2.50	23.12	20.00	3.69	5.50	6.32	2.88	20.20	20.25	Note (7)	0.50	20.19	...
22	33.00	2.56	2.62	25.25	22.00	3.94	5.69	6.44	...	22.22	22.25	Note (7)	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	Note (7)	0.50	24.19	...

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GENERAL NOTES:

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

NOTES:

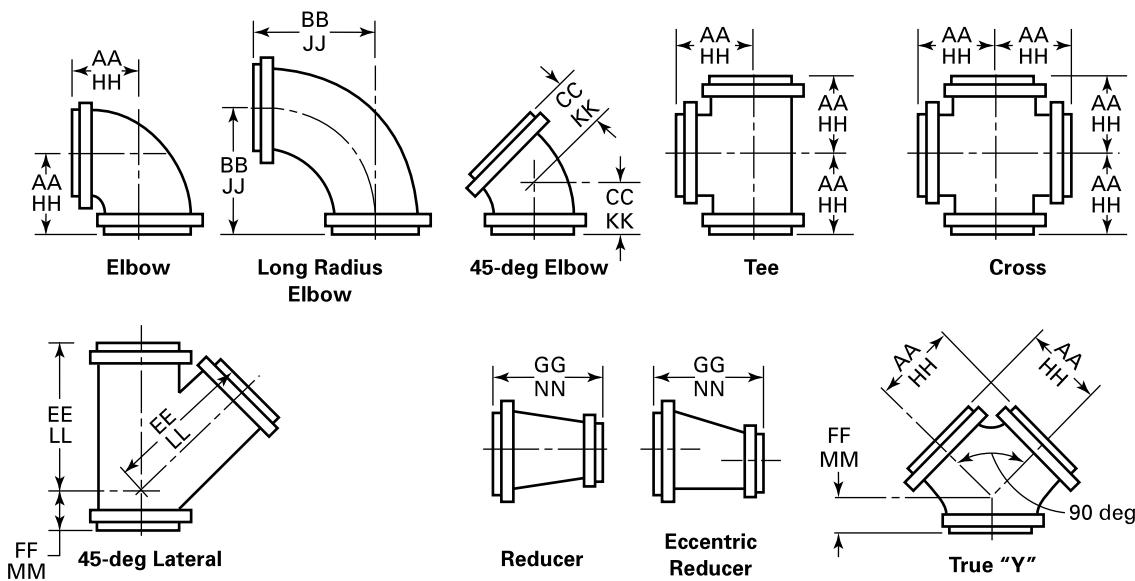
- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and back face of the flange.
- (2) These flanges may be supplied with a flat face. The flat face may be either the full t_f dimension thickness plus 0.06 in. or the t_f dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (3) The flange dimensions illustrated are for regularly furnished 0.06-in. raised face (except lapped); for requirements of other facings, see Figure II-6.
- (4) For welding end bevel, see para. 6.7.

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

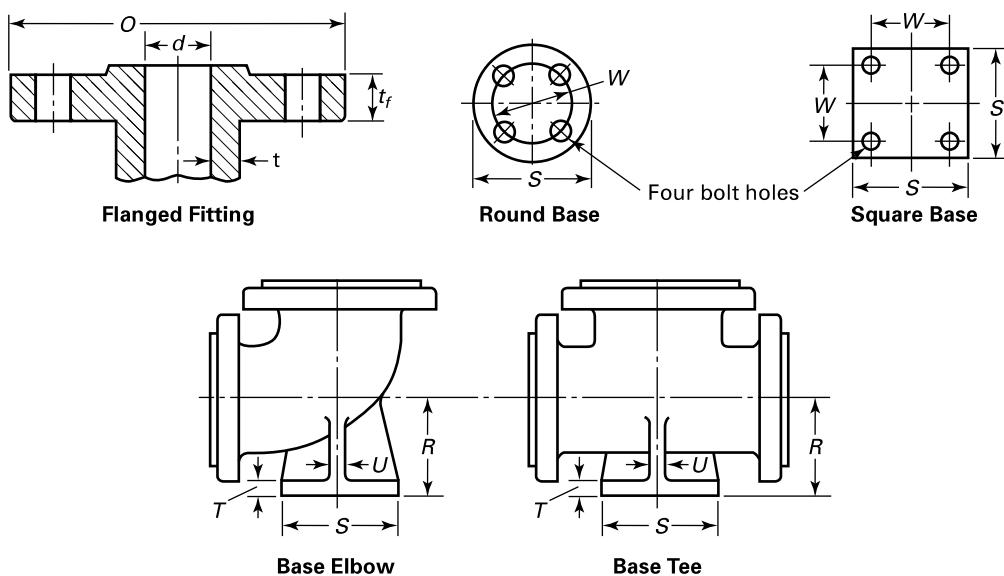
NOTES (Cont'd):

- (5) For thread of threaded flanges, see [para. 6.9](#).
- (6) Dimensions in Column 13 correspond to the inside diameters of pipe as given in ASME B36.10M for standard wall pipe. Standard wall dimensions are the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in [para. 7.5.2](#) apply. These bore sizes are furnished unless otherwise specified by the purchaser.
- (7) To be specified by the purchaser.

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TABLE STARTS ON NEXT PAGE

Table II-12 Dimensions of Class 300 Flanged Fittings

Nominal Pipe Size, NPS	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f [Notes (1)-(4)]	Minimum Wall Thickness of Fitting, t_m	Inside Diameter of Fitting, d	0.06-in. Raised Face (Flange Edge) [Note (4)]							Ring Joint [Note (4)]
					Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA	Center-to-Contact Surface of Raised Face Long Radius Elbow, BB	Center-to-Contact Surface of Raised Face 45-deg Elbow, CC	Long Center-to-Contact Surface of Raised Face Lateral, EE	Short Center-to-Contact Surface of Raised Face Lateral and True "Y," FF	Contact Surface of Raised Face Reducer, GG [Note (5)]	Center-to-End Elbow Tee, Cross, and True "Y," HH [Note (6)]	
1	4.88	0.62	0.19	1.00	4.00	5.00	2.25	6.50	2.00	4.50	4.25	
1½	5.25	0.69	0.19	1.25	4.25	5.50	2.50	7.25	2.25	4.50	4.50	
2	6.12	0.75	0.19	1.50	4.50	6.00	2.75	8.50	2.50	4.50	4.75	
2½	6.50	0.81	0.25	2.00	5.00	6.50	3.00	9.00	2.50	5.00	5.31	
3	7.50	0.94	0.25	2.50	5.50	7.00	3.50	10.50	2.50	5.50	5.81	
3½	8.25	1.06	0.28	3.00	6.00	7.75	3.50	11.00	3.00	6.00	6.31	
4	9.00	1.12	0.29	3.50	6.50	8.50	4.00	12.50	3.00	6.50	6.81	
5	10.00	1.19	0.31	4.00	7.00	9.00	4.50	13.50	3.00	7.00	7.31	
6	11.00	1.31	0.38	5.00	8.00	10.25	5.00	15.00	3.50	8.00	8.31	
8	12.50	1.38	0.38	6.00	8.50	11.50	5.50	17.50	4.00	9.00	8.81	
10	15.00	1.56	0.44	8.00	10.00	14.00	6.00	20.50	5.00	11.00	10.31	
12	17.50	1.81	0.50	10.00	11.50	16.50	7.00	24.00	5.50	12.00	11.81	
14	20.50	1.94	0.56	12.00	13.00	19.00	8.00	27.50	6.00	14.00	13.31	
16	23.00	2.06	0.62	13.25	15.00	21.50	8.50	31.00	6.50	16.00	15.31	
18	25.50	2.19	0.69	15.25	16.50	24.00	9.50	34.50	7.50	18.00	10.81	
20	28.00	2.31	0.75	17.00	18.00	26.50	10.00	37.50	8.00	19.00	18.31	
24	30.50	2.44	0.81	19.00	19.50	29.00	10.50	40.50	8.50	20.00	19.89	
	36.00	2.69	0.94	23.00	22.50	34.00	12.00	47.50	10.00	24.00	22.94	

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

13	14	15	16	17	18	19	20	21	22	23	1
Ring Joint [Note (5)]						Diameter of Round Base or Width Center- to- Base, R [Notes (7)- (9)]					
Get more FREE Standards from Standard Sharing Group and our chats											
Center-to-End Long Radius Elbow, JJ	Center-to-End 45-deg Elbow, KK	Long Center-to-End Lateral, LL	Center-to-End Lateral and True "Y," MM	End-to- Reducer, NN	Center- to- Base, R [Notes (7)- (9)]	Thickness of Square Base, S [Note (7)- (10)]	Thickness of Base, T [Notes (7)- (10)]	Thickness of Ribs, U [Note (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	1½
6.25	3.00	8.75	2.75	1½
6.81	3.31	9.31	2.81	...	4.50	5.25	0.75	0.50	3.88	¾	2
7.31	3.81	10.81	2.81	...	4.75	5.25	0.75	0.50	3.88	¾	2½
8.06	3.81	11.31	3.31	...	5.25	6.12	0.81	0.62	4.50	7/8	3
8.81	4.31	12.81	3.31	...	5.62	6.12	0.81	0.62	4.50	7/8	3½
9.31	4.88	13.81	3.31	...	6.00	6.50	0.88	0.62	5.00	¾	4
10.56	5.31	15.31	3.81	...	6.75	7.50	1.00	0.75	5.88	7/8	5
11.81	5.81	17.81	4.31	...	7.50	7.50	1.00	0.75	5.88	7/8	6
14.31	6.31	20.81	5.31	...	9.00	10.00	1.25	0.88	7.88	7/8	8
16.81	7.31	24.31	5.81	...	10.50	10.00	1.25	0.88	7.88	7/8	10
19.31	8.31	27.81	6.31	...	12.00	12.50	1.44	1.00	10.62	7/8	12
21.81	8.81	31.31	6.81	...	13.50	12.50	1.44	1.00	10.62	7/8	14
24.31	9.81	34.81	7.81	...	14.75	12.50	1.44	1.12	10.62	7/8	16
26.81	10.31	37.81	8.31	...	16.25	15.00	1.62	1.12	13.00	1	18
29.38	10.88	40.88	8.88	...	17.88	15.00	1.62	1.25	13.00	1	20
34.44	12.44	47.94	10.44	...	20.75	17.50	1.88	1.25	15.25	1½	24

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

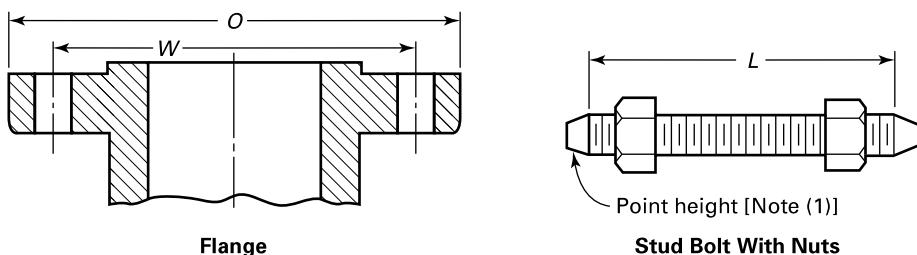
GENERAL NOTES:

- (a) Dimensions of [Table II-12](#) are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-10](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For 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 II-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 II-5](#) 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.

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Table II-13 Templates for Drilling Class 400 Pipe Flanges

1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Diameter of Bolt Circle, W	4 Diameter of Bolt Holes	5 Number of Bolts	6 Diameter of Bolts	7 Raised Face 0.25 in.	8 Length of Bolts, L [Notes (1), (4)]	9 Male and Female/ Tongue and Groove Ring Joint
$\frac{1}{2}$								
$\frac{3}{4}$								
1								
$1\frac{1}{4}$								
$1\frac{1}{2}$								
2								
$2\frac{1}{2}$								
3								
$3\frac{1}{2}$								
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4	10.00	7.88	1	8	$\frac{7}{8}$	5.50	5.25	5.50
5	11.00	9.25	1	8	$\frac{7}{8}$	5.75	5.25	5.75
6	12.50	10.62	1	12	$\frac{7}{8}$	6.00	5.75	6.00
8	15.00	13.00	$1\frac{1}{8}$	12	1	6.75	6.50	6.75
10	17.50	15.25	$1\frac{1}{4}$	16	$1\frac{1}{8}$	7.50	7.25	7.50
12	20.50	17.75	$1\frac{3}{8}$	16	$1\frac{1}{4}$	8.00	7.75	8.00
14	23.00	20.25	$1\frac{3}{8}$	20	$1\frac{1}{4}$	8.25	8.00	8.25
16	25.50	22.50	$1\frac{1}{2}$	20	$1\frac{3}{8}$	8.75	8.50	8.75
18	28.00	24.75	$1\frac{1}{2}$	24	$1\frac{3}{8}$	9.00	8.75	9.00
20	30.50	27.00	$1\frac{5}{8}$	24	$1\frac{1}{2}$	9.50	9.25	9.75
22	33.00	29.25	$1\frac{3}{4}$	24	$1\frac{5}{8}$	10.00	9.75	10.25
24	36.00	32.00	$1\frac{7}{8}$	24	$1\frac{3}{4}$	10.50	10.25	11.00

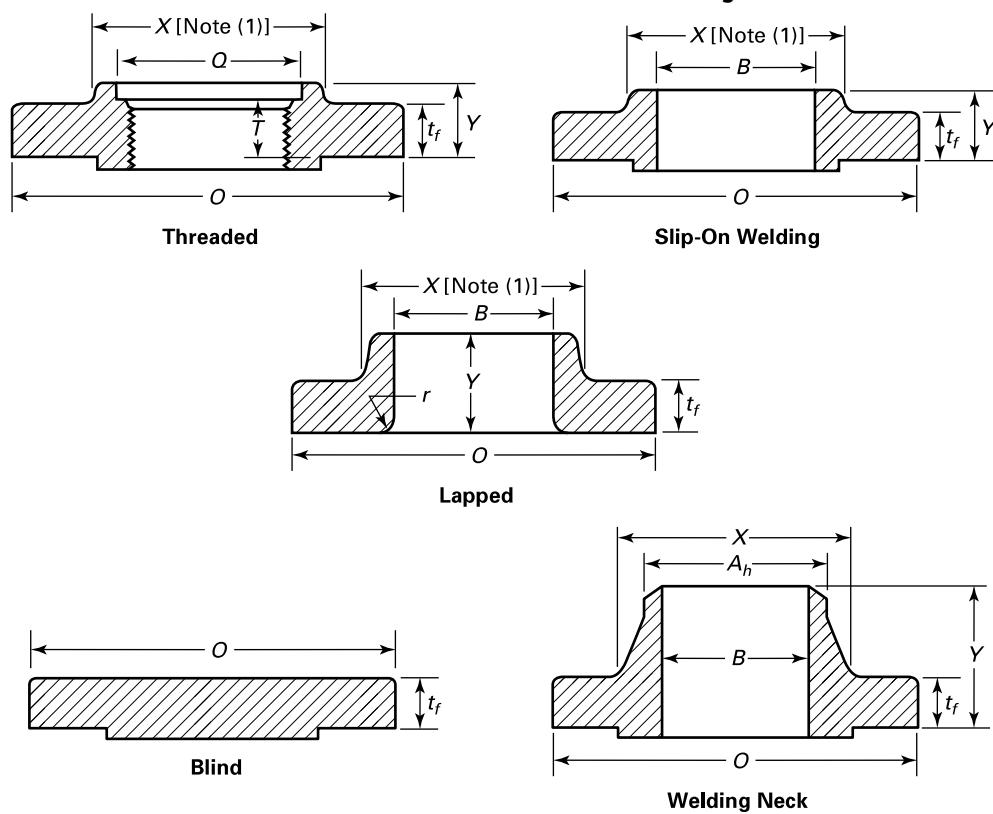
GENERAL NOTES:

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

NOTES:

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

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Table II-14 Dimensions of Class 400 Flanges

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nom.	Outside Diam. of Pipe Size	Min. Thickness of Flange, t_f	Diam. of Hub, X	Hub Diam. Beginning of Chamfer [Note (2)]	Length Through Hub			Minimum Thread Length Threaded [Note (3)]	Bore			Corner Bore Radius of Lapped Flange and Pipe, r	Minimum Counterbore Threaded Flange, Q
$\frac{1}{2}$													
$\frac{3}{4}$													
1													
$1\frac{1}{4}$													
$1\frac{1}{2}$					Use Class 600 dimensions in these sizes [Note (4)]								
2													
$2\frac{1}{2}$													
3													
$3\frac{1}{2}$													
4	10.00	1.38	5.75	4.50	2.00	2.00	3.50	1.44	4.57	4.60	Note (5)	0.44	4.63
5	11.00	1.50	7.00	5.56	2.12	2.12	4.00	1.69	5.66	5.69	Note (5)	0.44	5.69
6	12.50	1.62	8.12	6.63	2.25	2.25	4.06	1.81	6.72	6.75	Note (5)	0.50	6.75
8	15.00	1.88	10.25	8.63	2.69	2.69	4.62	2.00	8.72	8.75	Note (5)	0.50	8.75
10	17.50	2.12	12.62	10.75	2.88	4.00	4.88	2.19	10.88	10.92	Note (5)	0.50	10.88
12	20.50	2.25	14.75	12.75	3.12	4.25	5.38	2.38	12.88	12.92	Note (5)	0.50	12.94
14	23.00	2.38	16.75	14.00	3.31	4.62	5.88	2.50	14.14	14.18	Note (5)	0.50	14.19
16	25.50	2.50	19.00	16.00	3.69	5.00	6.00	2.69	16.16	16.19	Note (5)	0.50	16.19
18	28.00	2.62	21.00	18.00	3.88	5.38	6.50	2.75	18.18	18.20	Note (5)	0.50	18.19
20	30.50	2.75	23.12	20.00	4.00	5.75	6.62	2.88	20.20	20.25	Note (5)	0.50	20.19

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14
					Length Through Hub			Minimum Thread Length			Bore		Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>
Nom. Pipe Size	Outside Diam. <i>O</i>	Min. Thickness <i>t_f</i>	Diam. of Hub, <i>X</i>	Hub Diam. Beginning of Chamfer [Note (2)]	Welding Neck, <i>A_h</i>	Threaded Slip-On, <i>Y</i>	Lapped, <i>Y</i>	Welding Neck, <i>Y</i> [Note (3)]	Threaded Flange, <i>T</i>	Min. Slip- On, <i>B</i>	Min. Lapped, <i>B</i>	Welding Neck, <i>B</i>	Minimum Counterbore Threaded Flange, <i>Q</i>
22	33.00	2.88	25.25	22.00	4.25	6.00	6.75	...	22.22	22.25	Note (5)	0.50	...
24	36.00	3.00	27.62	24.00	4.50	6.25	6.88	3.25	24.25	24.25	Note (5)	0.50	24.19

GENERAL NOTES:

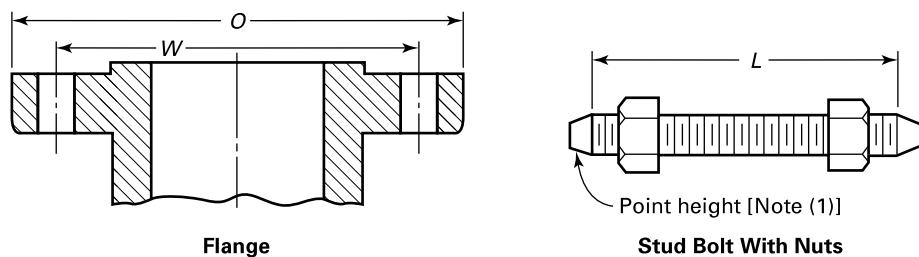
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-13](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table II-6](#).
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see [para. 6.8](#).

NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, and lapped flanges.
- (2) For welding end bevel, see [para. 6.7](#).
- (3) For thread in threaded flanges, see [para. 6.9](#).
- (4) Socket welding flanges may be provided in NPS $\frac{1}{2}$ through $2\frac{1}{2}$ using Class 600 dimensions.
- (5) To be specified by the purchaser.

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

1 Nominal Pipe Size	2	3 Outside Diameter of Flange, <i>O</i>	4 Diameter of Bolt Circle, <i>W</i>	5 Drilling [Notes (2), (3)] Diameter of Bolt Holes	6 Number of Bolts	7 Diameter of Bolts	8 Length of Bolts, <i>L</i> [Notes (1), (4)]	9 Raised Face 0.25 in.	Male and Female/ Tongue and Groove	Ring Joint
$\frac{1}{2}$	3.75	2.62	$\frac{5}{8}$	4	$\frac{1}{2}$	3.00	2.75	3.00		
$\frac{3}{4}$	4.62	3.25	$\frac{3}{4}$	4	$\frac{5}{8}$	3.50	3.25	3.50		
1	4.88	3.50	$\frac{3}{4}$	4	$\frac{5}{8}$	3.50	3.25	3.50		
$1\frac{1}{4}$	5.25	3.88	$\frac{3}{4}$	4	$\frac{5}{8}$	3.75	3.50	3.75		
$1\frac{1}{2}$	6.12	4.50	$\frac{7}{8}$	4	$\frac{3}{4}$	4.25	4.00	4.25		
2	6.50	5.00	$\frac{3}{4}$	8	$\frac{5}{8}$	4.25	4.00	4.25		
$2\frac{1}{2}$	7.50	5.88	$\frac{7}{8}$	8	$\frac{3}{4}$	4.75	4.50	4.75		
3	8.25	6.62	$\frac{7}{8}$	8	$\frac{3}{4}$	5.00	4.75	5.00		
$3\frac{1}{2}$	9.00	7.25	1	8	$\frac{7}{8}$	5.50	5.25	5.50		
4	10.75	8.50	1	8	$\frac{7}{8}$	5.75	5.50	5.75		
5	13.00	10.50	$1\frac{1}{8}$	8	1	6.50	6.25	6.50		
6	14.00	11.50	$1\frac{1}{8}$	12	1	6.75	6.50	6.75		
8	16.50	13.75	$1\frac{1}{4}$	12	$1\frac{1}{8}$	7.50	7.25	7.75		
10	20.00	17.00	$1\frac{3}{8}$	16	$1\frac{1}{4}$	8.50	8.25	8.50		
12	22.00	19.25	$1\frac{3}{8}$	20	$1\frac{1}{4}$	8.75	8.50	8.75		
14	23.75	20.75	$1\frac{1}{2}$	20	$1\frac{3}{8}$	9.25	9.00	9.25		
16	27.00	23.75	$1\frac{5}{8}$	20	$1\frac{1}{2}$	10.00	9.75	10.00		
18	29.25	25.75	$1\frac{3}{4}$	20	$1\frac{5}{8}$	10.75	10.50	10.75		
20	32.00	28.50	$1\frac{3}{4}$	24	$1\frac{5}{8}$	11.25	11.00	11.50		
22	34.25	30.62	$1\frac{7}{8}$	24	$1\frac{3}{4}$	12.00	...	12.25		
24	37.00	33.00	2	24	$1\frac{7}{8}$	13.00	12.75	13.25		

GENERAL NOTES:

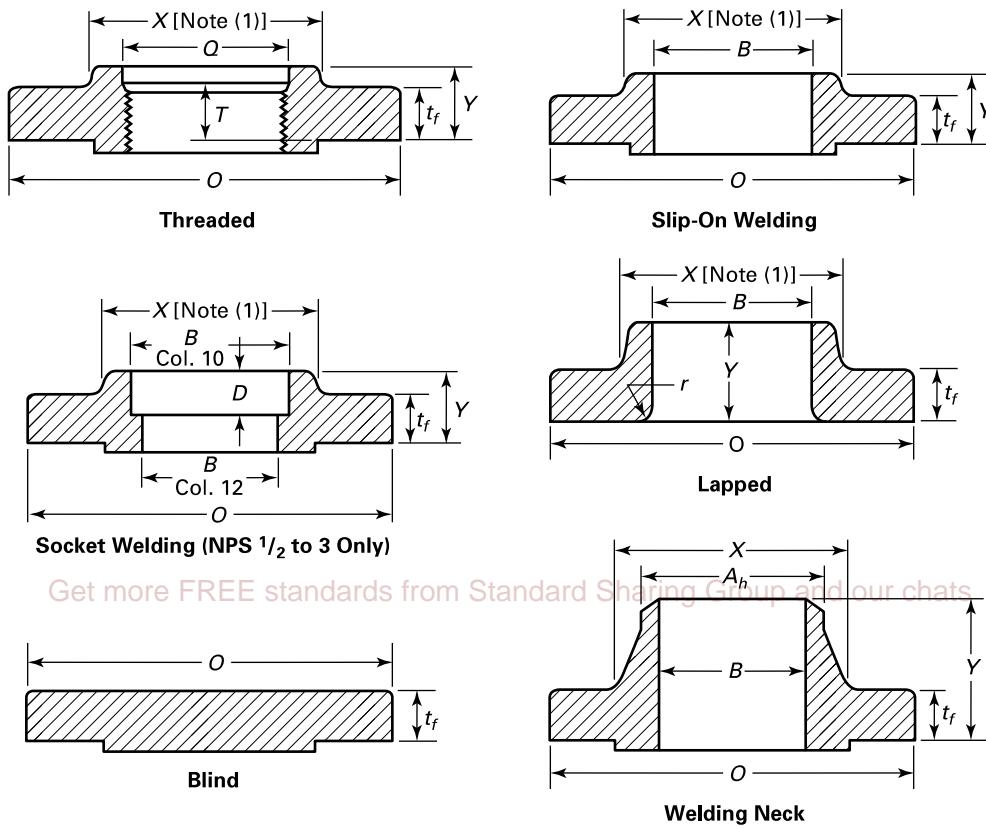
- (a) Dimensions are in inches.
 (b) For other dimensions, see [Table II-16](#).

NOTES:

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

(17)

Table II-16 Dimensions of Class 600 Flanges



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1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f	4 Diameter of Hub, X	5 Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			6 Threaded Slip-On Socket Welding, Y	7 Lapped, Y	8 Welding Neck, Y	9 Minimum Thread Length Threaded Flange, T [Note (3)]	10 Minimum Slip-On/ Socket Welding, B	11 Minimum Lapped, B	12 Welding Neck/ Socket Welding, B	13 Corner Bore Radius of Lapped Flange and Pipe, r	14 Minimum Counter- bore Threaded Flange, Q	15 Depth of Socket, D
$\frac{1}{2}$	3.75	0.56	1.50	0.84	0.88	0.88	2.06	0.62	0.88	0.90	Note (4)	0.12	0.93	0.38			
$\frac{3}{4}$	4.62	0.62	1.88	1.05	1.00	1.00	2.25	0.62	1.09	1.11	Note (4)	0.12	1.14	0.44			
1	4.88	0.69	2.12	1.32	1.06	1.06	2.44	0.69	1.36	1.38	Note (4)	0.12	1.41	0.50			
$1\frac{1}{4}$	5.25	0.81	2.50	1.66	1.12	1.12	2.62	0.81	1.70	1.72	Note (4)	0.19	1.75	0.56			
$1\frac{1}{2}$	6.12	0.88	2.75	1.90	1.25	1.25	2.75	0.88	1.95	1.97	Note (4)	0.25	1.99	0.62			
2	6.50	1.00	3.31	2.38	1.44	1.44	2.88	1.12	2.44	2.46	Note (4)	0.31	2.50	0.69			

(17)

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

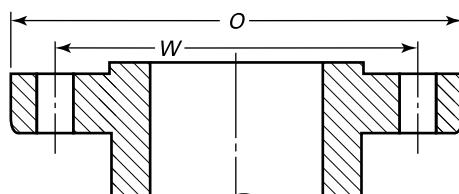
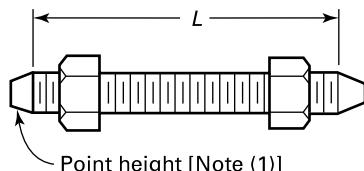
Nominal Pipe Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Minimum Thickness of Hub, X	Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			Minimum Thread Length Threaded Flange, T [Note (3)]	Bore			Welding Neck/Socket Welding, B	Corner 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	Welding Neck, Y		Minimum Slip-On/Socket Welding, B	Minimum Lapped, B					
2½	7.50	1.12	3.94	2.88	1.62	1.62	3.12	1.25	2.94	2.97	Note (4)	0.31	3.00	0.75	
3	8.25	1.25	4.62	3.50	1.81	1.81	3.25	1.38	3.57	3.60	Note (4)	0.38	3.63	0.81	
3½	9.00	1.38	5.25	4.00	1.94	1.94	3.38	1.56	4.07	4.10	Note (4)	0.38	4.13	...	
4	10.75	1.50	6.00	4.50	2.12	2.12	4.00	1.62	4.57	4.60	Note (4)	0.44	4.63	...	
5	13.00	1.75	7.44	5.56	2.38	2.38	4.50	1.88	5.66	5.69	Note (4)	0.44	5.69	...	
6	14.00	1.88	8.75	6.63	2.62	2.62	4.62	2.00	6.72	6.75	Note (4)	0.50	6.75	...	
8	16.50	2.19	10.75	8.63	3.00	3.00	5.25	2.25	8.72	8.75	Note (4)	0.50	8.75	...	
10	20.00	2.50	13.50	10.75	3.38	4.38	6.00	2.56	10.88	10.92	Note (4)	0.50	10.88	...	
12	22.00	2.62	15.75	12.75	3.62	4.62	6.12	2.75	12.88	12.92	Note (4)	0.50	12.94	...	
14	23.75	2.75	17.00	14.00	3.69	5.00	6.50	2.88	14.14	14.18	Note (4)	0.50	14.19	...	
16	27.00	3.00	19.50	16.00	4.19	5.50	7.00	3.06	16.16	16.19	Note (4)	0.50	16.19	...	
18	29.25	3.25	21.50	18.00	4.62	6.00	7.25	3.12	18.18	18.20	Note (4)	0.50	18.19	...	
20	32.00	3.50	24.00	20.00	5.00	6.50	7.50	3.25	20.20	20.25	Note (4)	0.50	20.19	...	
22	34.25	3.75	26.25	22.00	5.25	6.88	7.75	...	22.22	22.25	Note (4)	0.50	
24	37.00	4.00	28.25	24.00	5.50	7.25	8.00	3.62	24.25	24.25	Note (4)	0.50	24.19	...	

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-15](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table II-6](#).
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see [para. 6.8](#).

NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) For welding end bevel, see [para. 6.7](#).
- (3) For threads in threaded flanges, see [para. 6.9](#).
- (4) To be specified by the purchaser.

Table II-17 Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings**Flange****Stud Bolt With Nuts**

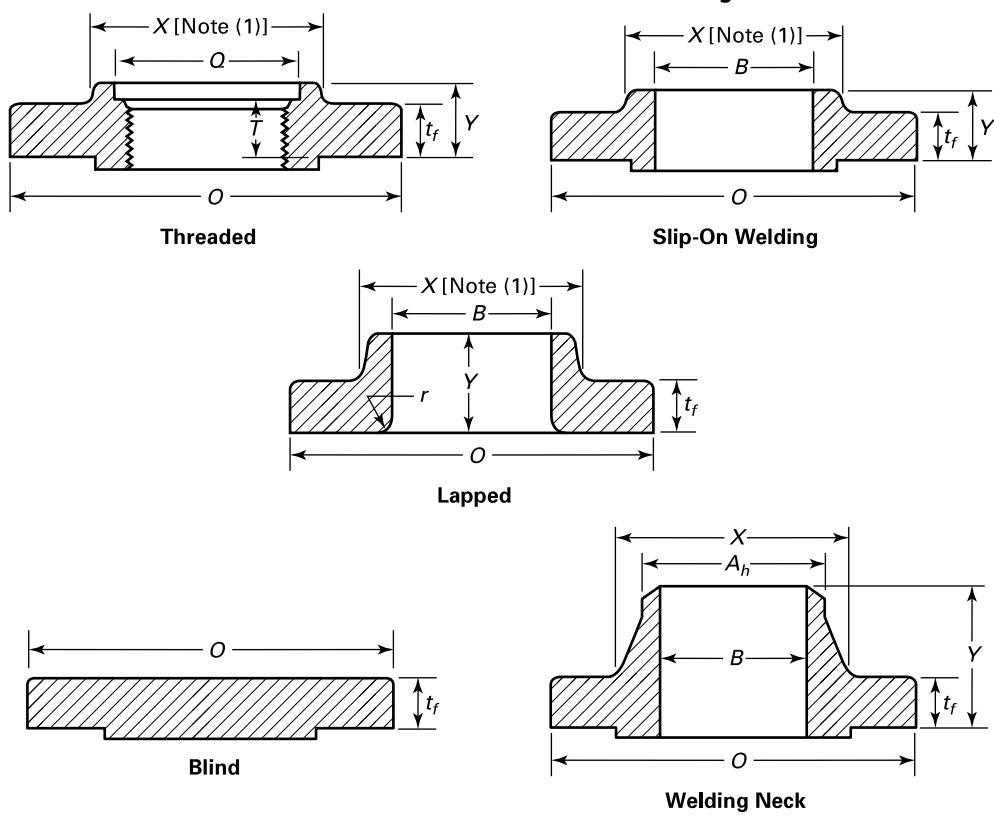
1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Diameter of Bolt Circle, W	4 Diameter of Bolt Holes	5 Number of Bolts	6 Diameter of Bolts	7 Raised Face 0.25 in.	8 Length of Bolts, L [Notes (1), (4)]	9 Male and Female/ Tongue and Groove Ring Joint
$\frac{1}{2}$								
$\frac{3}{4}$								
1							Use Class 1500 dimensions in these sizes	
$1\frac{1}{4}$								
$1\frac{1}{2}$								
2								
$2\frac{1}{2}$								
3	9.50	7.50	1	8	$\frac{7}{8}$	5.75	5.50	5.75
4	11.50	9.25	$1\frac{1}{4}$	8	$1\frac{1}{8}$	6.75	6.50	6.75
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5	13.75	11.00	$1\frac{3}{8}$	8	$1\frac{1}{4}$	7.50	7.25	7.50
6	15.00	12.50	$1\frac{1}{4}$	12	$1\frac{1}{8}$	7.50	7.25	7.75
8	18.50	15.50	$1\frac{1}{2}$	12	$1\frac{3}{8}$	8.75	8.50	8.75
10	21.50	18.50	$1\frac{1}{2}$	16	$1\frac{3}{8}$	9.25	9.00	9.25
12	24.00	21.00	$1\frac{1}{2}$	20	$1\frac{3}{8}$	10.00	9.75	10.00
14	25.25	22.00	$1\frac{5}{8}$	20	$1\frac{1}{2}$	10.75	10.50	11.00
16	27.75	24.25	$1\frac{3}{4}$	20	$1\frac{5}{8}$	11.25	11.00	11.50
18	31.00	27.00	2	20	$1\frac{7}{8}$	12.75	12.50	13.25
20	33.75	29.50	$2\frac{1}{8}$	20	2	13.75	13.50	14.25
24	41.00	35.50	$2\frac{5}{8}$	20	$2\frac{1}{2}$	17.25	17.00	18.00

GENERAL NOTES:

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

NOTES:

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

Table II-18 Dimensions of Class 900 Flanges

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

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal Pipe Size	Outside Diameter of Flange, <i>O</i>	Minimum Thickness of Flange, <i>t_f</i>	Diameter of Hub, <i>X</i>	Hub Diameter Beginning of Chamfer Welding Neck, <i>A_h</i> [Note (2)]	Length Through Hub				Bore			Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>	Minimum Counterbore Threaded Flange, <i>Q</i>
					Threaded	Slip-On,	Lapped,	Welding Flange, <i>T</i> [Note (3)]	Minimum Slip-On, <i>B</i>	Minimum Lapped, <i>B</i>	Welding Neck, <i>B</i>		
					<i>Y</i>	<i>Y</i>	<i>Y</i>						
20	33.75	4.25	24.50	20.00	6.25	8.25	9.75	3.62	20.20	20.25	Note (5)	0.50	20.19
24	41.00	5.50	29.50	24.00	8.00	10.50	11.50	4.00	24.25	24.25	Note (5)	0.50	24.19

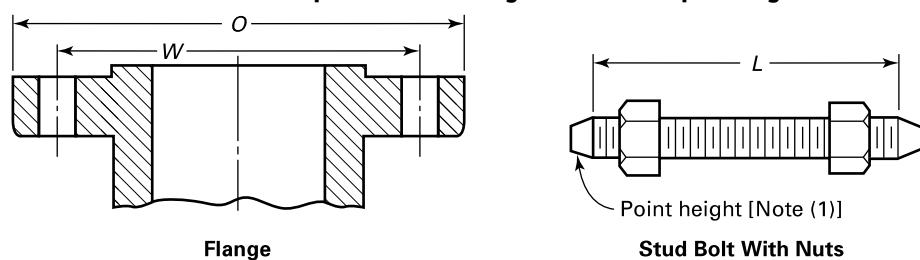
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-17](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table II-6](#).
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see [para. 6.8](#).

NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) For welding end bevel, see [para. 6.7](#).
- (3) For threads in threaded flanges, see [para. 6.9](#).
- (4) Socket welding flanges may be provided in NPS 1/2 through 2 1/2 using Class 1500 dimensions.
- (5) To be specified by the purchaser.

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Table II-19 Templates for Drilling Class 1500 Pipe Flanges

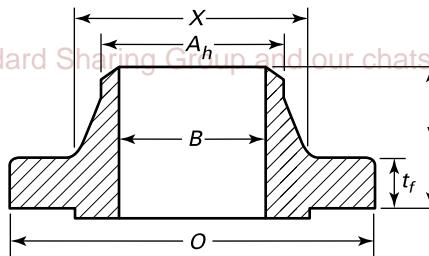
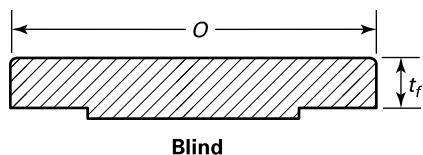
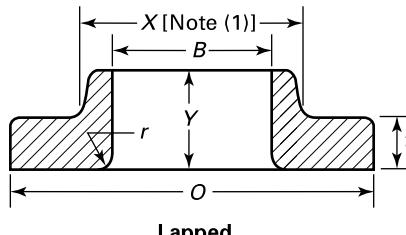
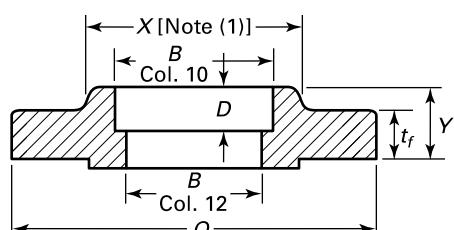
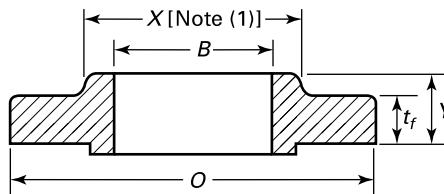
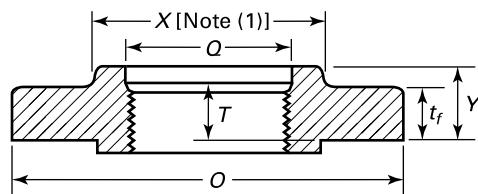
1 Nominal Pipe Size	2	3 Outside Diameter of Flange, <i>O</i>	4 Diameter of Bolt Circle, <i>W</i>	5 Diameter of Bolt Holes	6 Number of Bolts	7 Diameter of Bolts	8 Length of Bolts, <i>L</i> [Notes (1), (4)]	9 Raised Face 0.25 in. Male and Female/ Tongue and Groove Ring Joint
$\frac{1}{2}$	4.75	3.25	$\frac{7}{8}$	4	$\frac{3}{4}$	4.25	4.00	4.25
$\frac{3}{4}$	5.12	3.50	$\frac{7}{8}$	4	$\frac{3}{4}$	4.50	4.25	4.50
1	5.88	4.00	1	4	$\frac{7}{8}$	5.00	4.75	5.00
$1\frac{1}{4}$	6.25	4.38	1	4	$\frac{7}{8}$	5.00	4.75	5.00
$1\frac{1}{2}$	7.00	4.88	$1\frac{1}{8}$	4	1	5.50	5.25	5.50
2	8.50	6.50	1	8	$\frac{7}{8}$	5.75	5.50	5.75
$2\frac{1}{2}$	9.62	7.50	$1\frac{1}{8}$	8	1	6.25	6.00	6.25
3	10.50	8.00	$1\frac{1}{4}$	8	$1\frac{1}{8}$	7.00	6.75	7.00
4	12.25	9.50	$1\frac{3}{8}$	8	$1\frac{1}{4}$	7.75	7.50	7.75
5	14.75	11.50	$1\frac{5}{8}$	8	$1\frac{1}{2}$	9.75	9.50	9.75
6	15.50	12.50	$1\frac{1}{2}$	12	$1\frac{3}{8}$	10.25	10.00	10.50
8	19.00	15.50	$1\frac{3}{4}$	12	$1\frac{5}{8}$	11.50	11.25	11.75
10	23.00	19.00	2	12	$1\frac{7}{8}$	13.25	13.00	13.50
12	26.50	22.50	$2\frac{1}{8}$	16	2	14.75	14.50	15.25
14	29.50	25.00	$2\frac{3}{8}$	16	$2\frac{1}{4}$	16.00	15.75	16.75
16	32.50	27.75	$2\frac{5}{8}$	16	$2\frac{1}{2}$	17.50	17.25	18.50
18	36.00	30.50	$2\frac{7}{8}$	16	$2\frac{3}{4}$	19.50	19.25	20.75
20	38.75	32.75	$3\frac{1}{8}$	16	3	21.25	21.00	22.25
24	46.00	39.00	$3\frac{5}{8}$	16	$3\frac{1}{2}$	24.25	24.00	25.50

GENERAL NOTES:

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

NOTES:

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

Table II-20 Dimensions of Class 1500 Flanges

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1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f	4 Diameter of Hub, X	5 Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	6 Length Through Hub Threaded Slip-On Socket Welding, Y	7 Welding Neck, Y	8 Length Through Hub Welded Lapped Y	9 Minimum Thread Length Threaded Flange, T [Note (3)]	10 Minimum Slip-On Socket Welding, B	11 Minimum Lapped, B	12 Bore Welding Neck/ Socket Welding, B	13 Corner Bore Radius of Lapped Flange and Pipe, r	14 Minimum Counterbore Threaded Flange, Q	15 Depth of Socket, D
1/2	4.75	0.88	1.50	0.84	1.25	1.25	2.38	0.88	0.88	0.90	Note (4)	0.12	0.93	0.38
3/4	5.12	1.00	1.75	1.05	1.38	1.38	2.75	1.00	1.09	1.11	Note (4)	0.12	1.14	0.44
1	5.88	1.12	2.06	1.32	1.62	1.62	2.88	1.12	1.36	1.38	Note (4)	0.12	1.41	0.50
1 1/4	6.25	1.12	2.50	1.66	1.62	1.62	2.88	1.19	1.70	1.72	Note (4)	0.19	1.75	0.56
1 1/2	7.00	1.25	2.75	1.90	1.75	1.75	3.25	1.25	1.95	1.97	Note (4)	0.25	1.99	0.62
2	8.50	1.50	4.12	2.38	2.25	2.25	4.00	1.50	2.44	2.46	Note (4)	0.31	2.50	0.69
2 1/2	9.62	1.62	4.88	2.88	2.50	2.50	4.12	1.88	2.94	2.97	Note (4)	0.31	3.00	0.75

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

1 Nominal Pipe Size	2 Outside Diameter of Flange, O	3 Minimum Thickness of Flange, t_f	4 Diameter of Hub, X	5 Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)]	Length Through Hub			9 Minimum Thread Length Threaded Slip-On Socket Welding, Y	10 Bore	11 Corner Bore Radius of Lapped Flange and Pipe, r	12 Welding Neck/ Socket Welding, B	13 Minimum Counterbore Threaded Flange, Q	14 Depth of Socket, D	15
3	10.50	1.88	5.25	3.50	...	2.88	4.62	3.60	Note (4)	0.38
4	12.25	2.12	6.38	4.50	...	3.56	4.88	4.60	Note (4)	0.44
5	14.75	2.88	7.75	5.56	...	4.12	6.12	5.69	Note (4)	0.44
6	15.50	3.25	9.00	6.63	...	4.69	6.75	6.75	Note (4)	0.50
8	19.00	3.62	11.50	8.63	...	5.62	8.38	8.75	Note (4)	0.50
10	23.00	4.25	14.50	10.75	...	7.00	10.00	10.92	Note (4)	0.50
12	26.50	4.88	17.75	12.75	...	8.62	11.12	12.92	Note (4)	0.50
14	29.50	5.25	19.50	14.00	...	9.50	11.75	14.18	Note (4)	0.50
16	32.50	5.75	21.75	16.00	...	10.25	12.25	16.19	Note (4)	0.50
18	36.00	6.38	23.50	18.00	...	10.88	12.88	18.20	Note (4)	0.50
20	38.75	7.00	25.25	20.00	...	11.50	14.00	20.25	Note (4)	0.50
24	46.00	8.00	30.00	24.00	...	13.00	16.00	24.25	Note (4)	0.50

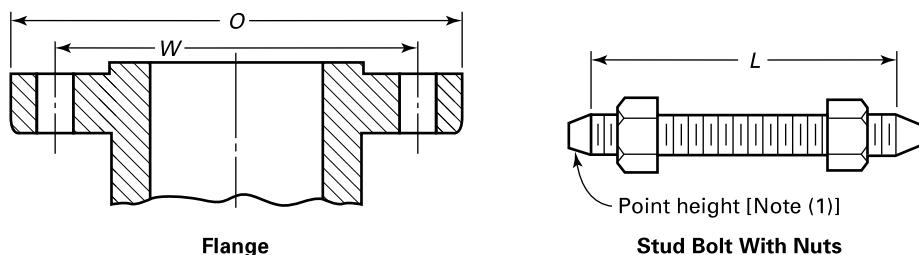
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GENERAL NOTES:

- (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 II-19](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For reducing threaded and slip-on flanges, see [Table II-6](#).
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see [para. 6.8](#).

NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) For welding end bevel, see [para. 6.7](#).
- (3) For threads in threaded flanges, see [para. 6.9](#).
- (4) To be specified by the purchaser.

Table II-21 Templates for Drilling Class 2500 Pipe Flanges

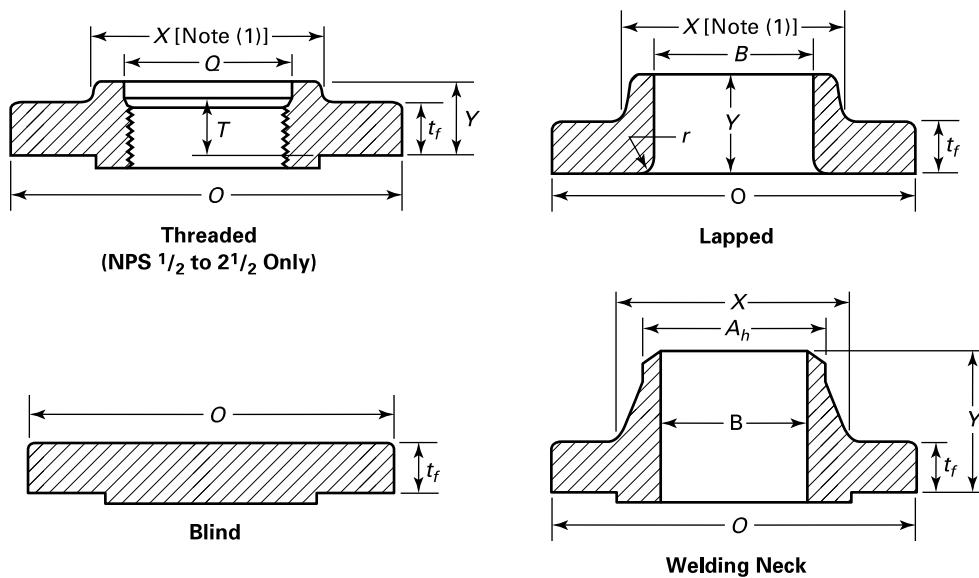
1	2	3	4	5	6	7	8	9
Nominal Pipe Size	Outside Diameter of Flange, O	Drilling [Notes (2), (3)]				Length of Bolts, L [Notes (1), (4)]		
		Diameter of Bolt Circle, W	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	Raised Face 0.25 in.	Male and Female/Tongue and Groove	Ring Joint
$\frac{1}{2}$	5.25	3.50	$\frac{7}{8}$	4	$\frac{3}{4}$	4.75	4.50	4.75
$\frac{3}{4}$	5.50	3.75	$\frac{7}{8}$	4	$\frac{3}{4}$	5.00	4.75	5.00
1	6.25	4.25	1	4	$\frac{7}{8}$	5.50	5.25	5.50
$1\frac{1}{4}$	7.25	5.12	$1\frac{1}{8}$	4	1	6.00	5.75	6.00
$1\frac{1}{2}$	8.00	5.75	$1\frac{1}{4}$	4	$1\frac{1}{8}$	6.75	6.50	6.75
2	9.25	6.75	$1\frac{1}{8}$	8	1	7.00	6.75	7.00
$2\frac{1}{2}$	10.50	7.75	$1\frac{1}{4}$	8	$1\frac{1}{8}$	7.75	7.50	8.00
3	12.00	9.00	$1\frac{3}{8}$	8	$1\frac{1}{4}$	8.75	8.50	9.00
4	14.00	10.75	$1\frac{5}{8}$	8	$1\frac{1}{2}$	10.00	9.75	10.25
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5	16.50	12.75	$1\frac{7}{8}$	8	$1\frac{3}{4}$	11.75	11.50	12.25
6	19.00	14.50	$2\frac{1}{8}$	8	2	13.50	13.25	14.00
8	21.75	17.25	$2\frac{1}{8}$	12	2	15.00	14.75	15.50
10	26.50	21.25	$2\frac{5}{8}$	12	$2\frac{1}{2}$	19.25	19.00	20.00
12	30.00	24.38	$2\frac{7}{8}$	12	$2\frac{3}{4}$	21.25	21.00	22.00

GENERAL NOTES:

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

NOTES:

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

Table II-22 Dimensions of Class 2500 Flanges

Nominal Pipe Size	1 Outside Diameter of Flange, <i>O</i>	2 Minimum Thickness of Flange, <i>t_f</i>	3 Diameter of Hub, <i>X</i>	4 Hub Diameter Beginning of Chamfer Welding Neck, <i>A_h</i> [Note (2)]	Length Through Hub			Bore			Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>		13 Minimum Counterbore Threaded Flange, <i>Q</i>	
					Length Through Hub			Bore			Corner Bore Radius of Lapped Flange and Pipe, <i>r</i>			
					6 Welding Neck Threaded, <i>Y</i>	7 Lapped, <i>Y</i>	8 Welding Neck <i>T</i> [Note (3)]	9 Minimum Thread Length Threaded	10 Minimum Lapped, <i>B</i>	11 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	Note (4)	0.12	0.93		
3/4	5.50	1.25	2.00	1.05	1.69	1.69	3.12	1.25	1.11	Note (4)	0.12	1.14		
1	6.25	1.38	2.25	1.32	1.88	1.88	3.50	1.38	1.38	Note (4)	0.12	1.41		
1 1/4	7.25	1.50	2.88	1.66	2.06	2.06	3.75	1.50	1.72	Note (4)	0.19	1.75		
1 1/2	8.00	1.75	3.12	1.90	2.38	2.38	4.38	1.75	1.97	Note (4)	0.25	1.99		
2	9.25	2.00	3.75	2.38	2.75	2.75	5.00	2.00	2.46	Note (4)	0.31	2.50		
2 1/2	10.50	2.25	4.50	2.88	3.12	3.12	5.62	2.25	2.97	Note (4)	0.31	3.00		
3	12.00	2.62	5.25	3.50	...	3.62	6.62	...	3.60	Note (4)	0.38	...		
4	14.00	3.00	6.50	4.50	...	4.25	7.50	...	4.60	Note (4)	0.44	...		
5	16.50	3.62	8.00	5.56	...	5.12	9.00	...	5.69	Note (4)	0.44	...		
6	19.00	4.25	9.25	6.63	...	6.00	10.75	...	6.75	Note (4)	0.50	...		
8	21.75	5.00	12.00	8.63	...	7.00	12.50	...	8.75	Note (4)	0.50	...		
10	26.50	6.50	14.75	10.75	...	9.00	16.50	...	10.92	Note (4)	0.50	...		
12	30.00	7.25	17.38	12.75	...	10.00	18.25	...	12.92	Note (4)	0.50	...		

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table II-21.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table II-6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

NOTES:

- (1) This dimension is for the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded and lapped flanges.
- (2) For welding end bevel, see para. 6.7.
- (3) For threads in threaded flanges, see para. 6.9.
- (4) To be specified by the purchaser.

MANDATORY APPENDIX III REFERENCES

(17)

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 and UNR Thread Form)
- ASME B1.20.1, Pipe Threads, General Purpose (Inch)
- ASME B16.20, ~~Other FREEBIE from Standard Sharing Group and GURU~~ Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
- ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
- ASME B16.25, Butt welding Ends
- ASME B16.34, Valves — Flanged, Threaded, and Welding End
- ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series)
- ASME B18.2.2, Square and Hex Nuts (Inch Series)
- ASME B18.31.2, Continuous Thread Stud, Double-End Stud, and Flange Bolting Stud (Stud Bolt) (Inch Series)
- ASME B36.10M, Welded and Seamless Wrought Steel Pipe
- ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay)
- ASME PCC-1, Guidelines for Pressure Boundary Bolted Flange Joint Assembly
- Section I, Power Boilers
- Section II, Materials
- Section III, Rules for Construction of Nuclear Facility Components
- Section VIII, Div. 1 and 2, Pressure Vessels
- Section IX, Welding, Brazing, and Fusing Qualifications
- Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (<http://www.asme.org>)
- ASTM A105-2005, Carbon Steel forgings for Piping Applications

- ASTM A106-2006a, Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A182-2007, Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service
- ASTM A193-2007, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
- ASTM A194-2007a, Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both
- ASTM A203-1997, Pressure Vessel Plates, Alloy Steel, Nickel
- ASTM A204-2003, Pressure Vessel Plates, Alloy Steel, Molybdenum
- ASTM A216-2007, Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- ASTM A217-2007, Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service
- ASTM A240-2007, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- ASTM A307-2004e1, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- ASTM A320-2007, Alloy/Steel Bolting Materials for Low-Temperature Service
- ASTM A350-2004a, Carbon and Low-Alloy Steel forgings, Requiring Notch Toughness Testing for Piping Components
- ASTM A351-2006, Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts
- ASTM A352-2006, Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
- ASTM A354-2004e1, Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- ASTM A387-2006a, Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
- ASTM A449-2004be1, Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
- ASTM A453-2004e1, High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels

- ASTM A515-2003, Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
- ASTM A516-2006, Pressure Vessel Plates, Carbon Steel, For Moderated- and Lower-Temperature Service
- ASTM A537-2006, Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon-Steel
- ASTM A540-2006, Alloy-Steel Bolting Materials for Special Applications
- ASTM B127-2005, Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
- ASTM B160-2005, Nickel Rod and Bar
- ASTM B162-1999 (R2005), Nickel Plate, Sheet, and Strip
- ASTM B164-2003, Nickel-Copper Alloy Rod, Bar, and Wire
- ASTM B166-2006, Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire
- ASTM B168-2006, Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Plate, Sheet, and Strip
- ASTM B333-2003, Nickel-Molybdenum Alloy Plate, Sheet, and Strip
- ASTM B335-2003, Nickel-Molybdenum Alloy Rod
- ASTM B408-2006, Nickel-Iron-Chromium Alloy Rod and Bar
- ASTM B409-2006, Nickel-Iron-Chromium Alloy, Plate, Sheet, and Strip
- ASTM B424-2005, Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and N08821) Plate, Sheet, and Strip
- ASTM B425-1999 (R2005), Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221) Rod and Bar
- ASTM B434-2006, Nickel-Molybdenum-Chromium-Iron Alloys (UNS N10003, UNS N10242) Plate, Sheet, and Strip
- ASTM B435-2006, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Plate, Sheet, and Strip
- ASTM B443-2000 (R2005), Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip
- ASTM B446-2003, Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar
- ASTM B462-2006, Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service
- ASTM B463-2004, UNS N08020, UNS N08024, and UNS N08026 Alloy Plate, Sheet, and Strip
- ASTM B473-2007, UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire
- ASTM B511-2001 (R2005), Nickel-Iron-Chromium-Silicon Alloy Bars and Shapes
- ASTM B536-2007, Nickel-Iron-Chromium-Silicon Alloy (UNS N08330 and N08332) Plate, Sheet, and Strip
- ASTM B564-2006a, Nickel Alloy Forgings
- ASTM B572-2006, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Rod
- ASTM B573-2006, Nickel-Molybdenum-Chromium-Iron Alloy (UNS N10003, N10242) Rod
- ASTM B574-2006e1, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel Molybdenum-Chromium-Tantalum, Low-Carbon Nickel Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
- ASTM B575-2006, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Plate, Sheet, and Strip
- ASTM B581-2002, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod
- ASTM B582-2002, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip
- ASTM B599-1992 (R2003), Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Plate, Sheet, and Strip
- ASTM B620-2003, Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Plate, Sheet, and Strip
- ASTM B621-2002 (R2006), Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Rod
- ASTM B625-2005, UNS N08925, UNS N08031, UNS N08932, UNS N08926, UNS N08354, and UNS R20033 Plate, Sheet, and Strip
- ASTM B649-2006, Ni-Fe Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, UNS N08354, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire, and Ni-Cr-Fe-Mo-N Alloy (UNS N08936) Wire
- ASTM B672-2002, Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Bar and Wire
- ASTM B688-1996 (R2004), Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip
- ASTM E29-2006b, Using Significant Digits in Test Data to Determine Conformance with Specifications
- Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O.Box C700, West Conshohocken, PA 19428-2959 (<http://www.astm.org>)

ISO 9000-1:1994, Quality management and quality assurance standards — Part 1: Guidelines for selection and use
 ISO 9000-2:1997, Quality management and quality assurance standard — Part 2: Generic guidelines for the application of ISO 9001, ISO 9002m, and ISO 9003
 ISO 9000-3:1997, Quality management and quality assurance standards — Part 3: Guidelines for the application of ISO 9001 to the development, supply, and maintenance of software
 ISO 9001:2000, Quality management systems — Requirements
 ISO 9002:1994, Quality system — Model for quality assurance in production and servicing
 ISO 9003:1994, Quality systems — Model for quality assurance in final inspection and test

Publisher:¹ International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (<http://www.iso.org>)

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

MSS SP-9-2001, Spot Facing for Bronze, Iron, and Steel Flanges

MSS SP-25-1998, Standard Marking System for Valves, Fittings, Flanges, and Unions

MSS SP-44-2006, Steel Pipeline Flanges

MSS SP-45-2003, Bypass and Drain Connections

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

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

Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180 (<http://www.msshq.org>)

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

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.¹ Other considerations affecting or limiting ratings include

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

A-1.2 Bolt Cross-Sectional Area

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

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

where

- A_b = total effective bolt tensile stress area
- A_g = an area whose circumference is defined by a diameter equal to the raised face dimension R in [Table 4](#)
- P_c = pressure rating class designation or number (e.g., for Class 150, $P_c = 150$; for Class 300, $P_c = 300$)

A-1.3 Flanged Fitting Wall Thickness

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

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

where

- d = inside diameter of the fitting
- P_c = pressure rating class designation or number (e.g., for Class 150, $P_c = 150$; for Class 300, $P_c = 300$)
- S_F = stress base constant equal to 7000
- t = calculated thickness

The resultant units for t will be the same as those used to express d . [Equation \(2\)](#) results in a fitting wall thickness 50% greater than that for a simple cylinder designed for a stress of 48.28 MPa (7,000 psi) when subjected to an internal pressure equal to the pressure rating class designation P_c . The actual values in the dimension tables referred to in [para. 6.1](#) are approximately 2.5 mm (0.1 in.) larger than those given by the equation.

A-1.4 Material Properties

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

A-1.5 Material Groups

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

¹This method is appropriate for materials listed in [Table 1A](#). 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 1A](#), were established by the equation

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

where

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

p_c = ceiling pressure, bar (psi), at temperature T as specified in [section A-3](#)

P_r = pressure rating class index. For all designations Class 300 and above, P_r is equal to the class designation (e.g., for Class 300, $P_r = 300$). (For Class 150, see [para. A-2.4](#) of this Nonmandatory Appendix.)

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

S_1 = selected stress, MPa (psi) for the specified material at temperature T . The value of S_1 shall be established as described in [paras. A-2.2, A-2.3, and A-2.4](#).

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A-2.2 Ratings for Group No. 1 Materials

The selected stress for Group No. 1 materials in [Table 1A](#) is determined as follows:

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

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

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

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

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

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

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

(e) When the allowable stresses listed for the reference ASME Boiler and Pressure Vessel Code Section show a higher and lower value for allowable stress and the higher value is noted to the effect that these stress values exceed two-thirds of the yield strength at temperature, then the lower value shall be used. If lower allowable

stress values do not appear and it is noted in the allowable stress table that the allowable stress values exceed two-thirds of the yield strength at temperature, then the allowable stress values used shall be determined as two-thirds of the tabulated yield strength at temperature.

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

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

A-2.3 Method for Groups 2 and 3 Materials

Pressure-temperature ratings for Class 300 and higher, of materials corresponding to those in Materials Groups 2 and 3 of [Table 1A](#), are established by the method of [paras. A-2.1 and A-2.2](#), except that in [paras. A-2.2\(a\)\(1\) and A-2.2\(a\)\(2\)](#), the 60% factor shall be changed to 70%. For Group 2 materials, the creep range is considered to be at temperatures in excess of 510°C (950°F) unless the material properties indicate lower temperatures should be used. For Group 3 materials, the creep range onset temperature shall be determined on an individual basis.

A-2.4 Method for Class 150 — All Materials

Pressure-temperature ratings for Class 150 rating designation are established by the method given for the related materials in [paras. A-2.1, A-2.2, and A-2.3](#) subject to the following exceptions:

(a) The value of P_r , the pressure class rating index in [eq. \(3\)](#) 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_o , 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

$$C_2 = 21.41$$

$C_3 = 0.03724$ with T expressed in °C, the resultant p_t will be in bar units ($C_2 = 320$ and $C_3 = 0.3$, with T expressed in °F, the resultant p_t will be in psi units)

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

The value of T in [eq. \(4\)](#) shall not exceed 538°C (1,000°F). For values of T less than 38°C (100°F), use T equal to 38°C (100°F) in [eq. \(4\)](#).

A-3 MAXIMUM RATINGS

The rules for establishing pressure-temperature ratings include consideration of ceiling pressures p_c that effectively set limits on the selected stress. The ceiling pressure-temperature values set an upper

bound for high-strength materials and are imposed to limit deflection. Ceiling pressure values are listed in [Tables A-1](#) and [A-2](#). Ratings in excess of these ceiling values are not permitted under this Standard.

Table A-1 Rating Ceiling Pressure — p_c , bar

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

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

Table A-2 Rating Ceiling Pressure — p_{cr} , psi

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

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

NONMANDATORY APPENDIX B

LIMITING DIMENSIONS OF GASKETS

OTHER THAN RING JOINT GASKETS

B-1 GASKET MATERIALS AND CONSTRUCTION

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

B-2 GASKET DIMENSIONS

Reference to a dimensional standard for gaskets (e.g., ASME B16.21) is recommended. In any event, selected dimensions should be based on the type of gasket and

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

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Table B-1 Gasket Groups and Typical Materials

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

NONMANDATORY APPENDIX C

METHOD FOR CALCULATING BOLT LENGTHS¹

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

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

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

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

(a) For ring joint groove facing

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

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

(b) For other than ring joint facing

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

L_{CMB} = B - F + (Table C-1 thickness) + n Get more FREE standards from Standard Sharing Group and our chats

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 II-5 of Mandatory Appendix II)

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

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

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

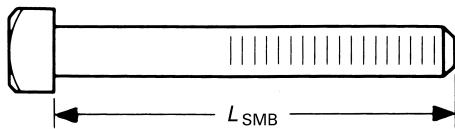
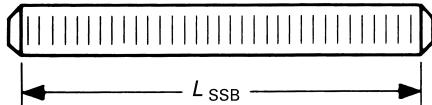
n = negative tolerance on bolt length (see Table C-3)

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)

¹ The equations used in this Nonmandatory Appendix are for calculated bolt lengths established to ensure full thread engagement of heavy hexagon nuts when worst case tolerances occur on all relevant dimensions of the flanged joint. The use of shorter bolt lengths is acceptable provided that full thread engagement is obtained at assembly (see para. 6.10.2).

Figure C-1 Specified Machine Bolt Length**Figure C-2 Specified Stud Bolt Length****Table C-1 Thickness for Lapped Joints**

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

Table C-2 F Values

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

Table C-3 n Values

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

NONMANDATORY APPENDIX D QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.¹ A determination of the need for registration and/or certification of the product 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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¹ 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 III.

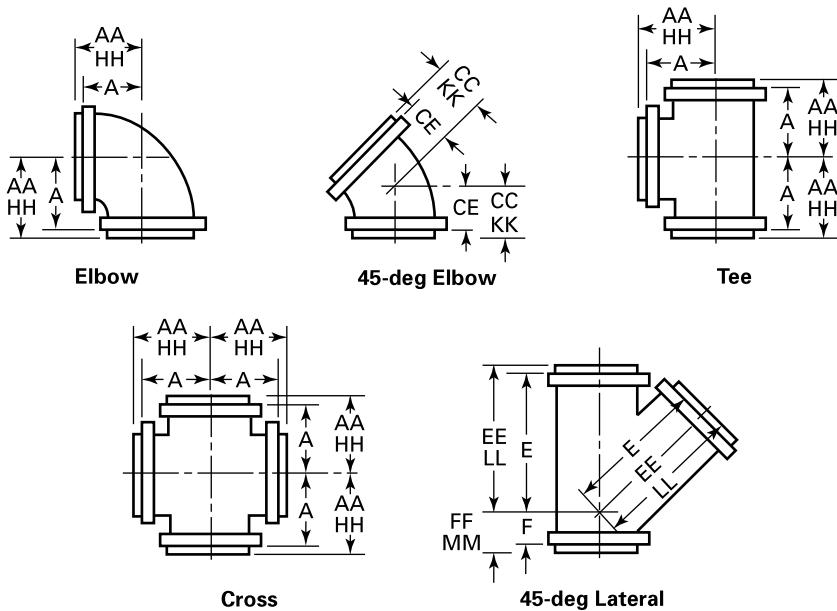
NONMANDATORY APPENDIX E

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](#).

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TABLE STARTS ON NEXT PAGE

Table E-1 Dimensions of Class 400 Flanged Fittings

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flange Edge										Raised Face 0.25 in. [Note (1)]			
Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y," Elbow, Lateral, 45-deg Edge, "Y," Reducer,										Center-to-Contact Surface of Raised Face, Contact of Elbow, Surface of Cross, and True "Y," Elbow, Lateral, 45-deg Edge, "Y," Reducer,			
Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Minimum Wall Thickness of Fitting, t_m	Inside Diamete- r of Fitting, d	A	C	E	F	G	AA	CC	EE	FF
$\frac{1}{2}$													
$\frac{3}{4}$													
1													
$1\frac{1}{4}$													
$1\frac{1}{2}$													
2													
$2\frac{1}{2}$													
3													
$3\frac{1}{2}$													
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

Use Class 600 dimensions in these sizes

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

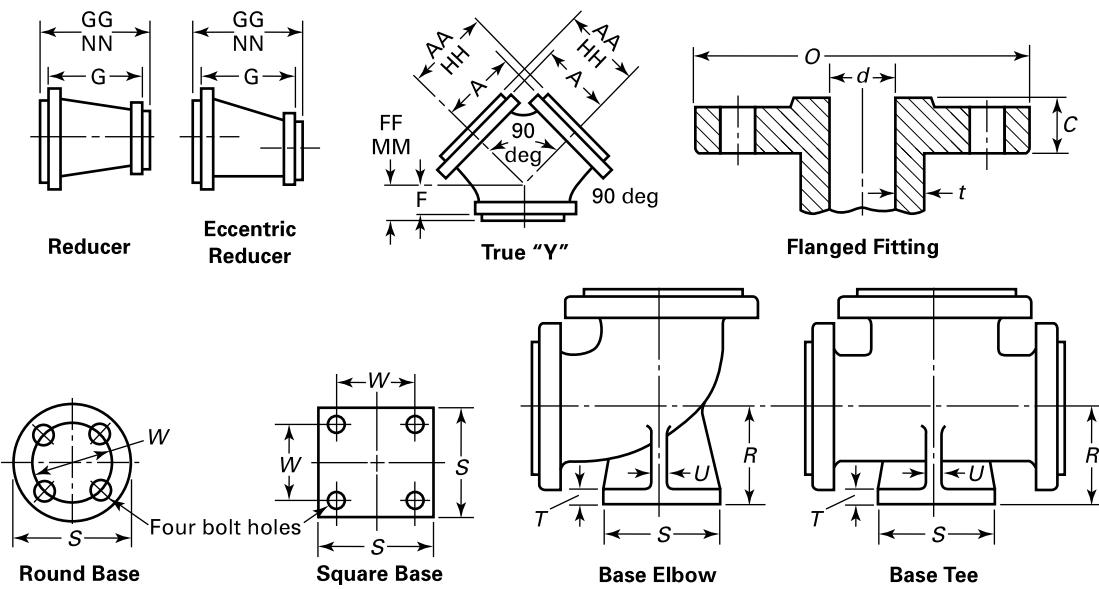
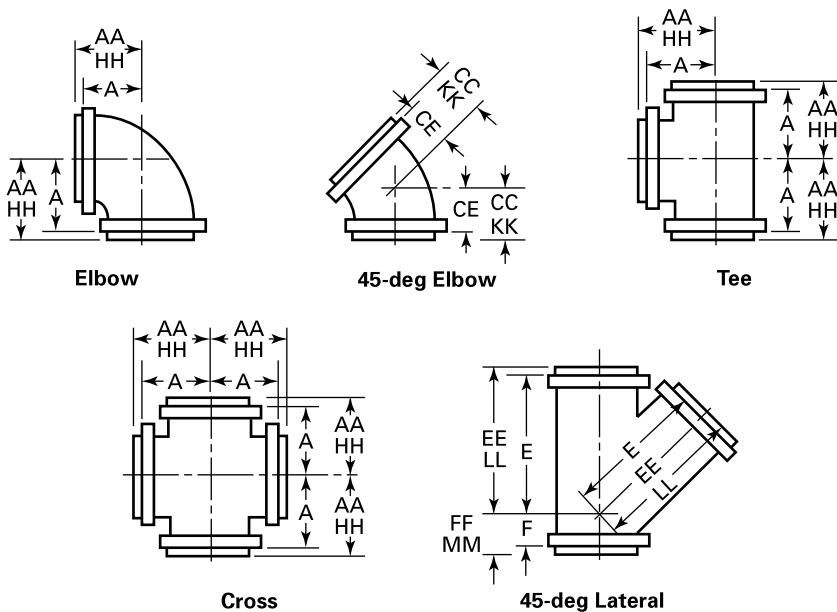
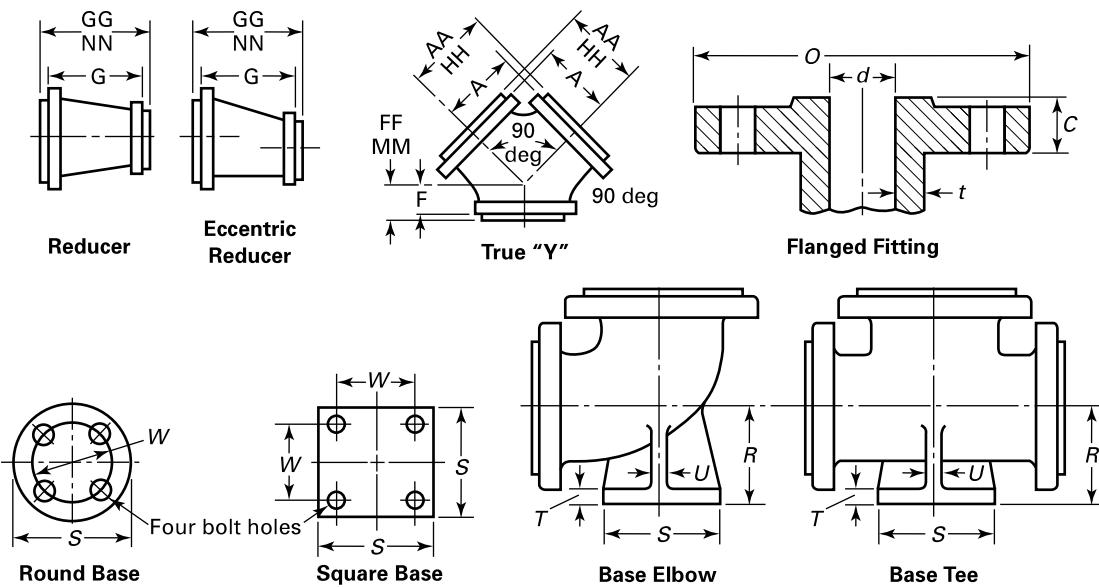


Table E-1 Dimensions of Class 400 Flanged Fittings (Cont'd)

Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Minimum Wall Thickness of Fitting, t_m	Inside Diameter of Fitting, d	Flange Edge					Raised Face 0.25 in. [Note (1)]				
					Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y," A	Center-to-Flange Edge, 45-deg Elbow, C	Center-to-Flange Edge, Lateral, E	Long Flange Edge, Flange Edge, and True "Y," F	Short Flange Edge, Lateral, and Flange Edge, Reducer, G	Center-to-Contact Surface of Raised Face, Center Contact Face, and True "Y," AA	Center-to-Contact Surface of Raised Face, Center Contact Face, and 45-deg Elbow, CC	Long Flange Edge, Center Contact Face, and Lateral, EE	Center-to-Contact Surface of Raised Face, Center Contact Face, and Flange Edge, FF	Short Center-to-Contact Surface of Raised Face, Long Flange Edge, and Center Contact Face, and Lateral, FF
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
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]											Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Get more FREE standards from Standard Sharing Group and our chats											
Center-to-End Elbow, Tee, Cross, and True "Y," Elbow, KK [Note (3)]	Center-to-End, 45-deg End, Lateral, "Y," Elbow, LL [Note (3)]	Long Center-to-End, Lateral, "Y," Elbow, MM [Note (3)]	Center-to-End, and True "Y," Reducer, NN [Note (3)]	Short Center-to-End, and True "Y," Reducer, NN [Note (3)]	Center-to-End, Lateral	Diameter of Round Base or Width Center-to-Base, R	Thickness of Square Base, S	Thickness of Base, T	Thickness of Ribs, U	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size
15.25	15.06	8.81	29.81	6.56	Notes (2), (3)	12.00	12.50	1.44	1.00	10.62	0.88	12
16.50	16.31	9.31	32.81	7.06	Notes (2), (3)	13.50	12.50	1.44	1.00	10.62	0.88	14
18.50	17.81	10.31	36.31	8.06	Notes (2), (3)	14.75	12.50	1.44	1.12	10.62	0.88	16
19.50	19.31	10.81	39.31	8.56	Notes (2), (3)	16.25	15.00	1.62	1.12	13.00	1.00	18
21.00	20.88	11.38	42.88	9.12	Notes (2), (3)	17.88	15.00	1.62	1.25	13.00	1.00	20
24.50	24.44	12.94	50.44	10.69	Notes (2), (3)	20.75	17.50	1.88	1.25	15.25	1.12	24

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

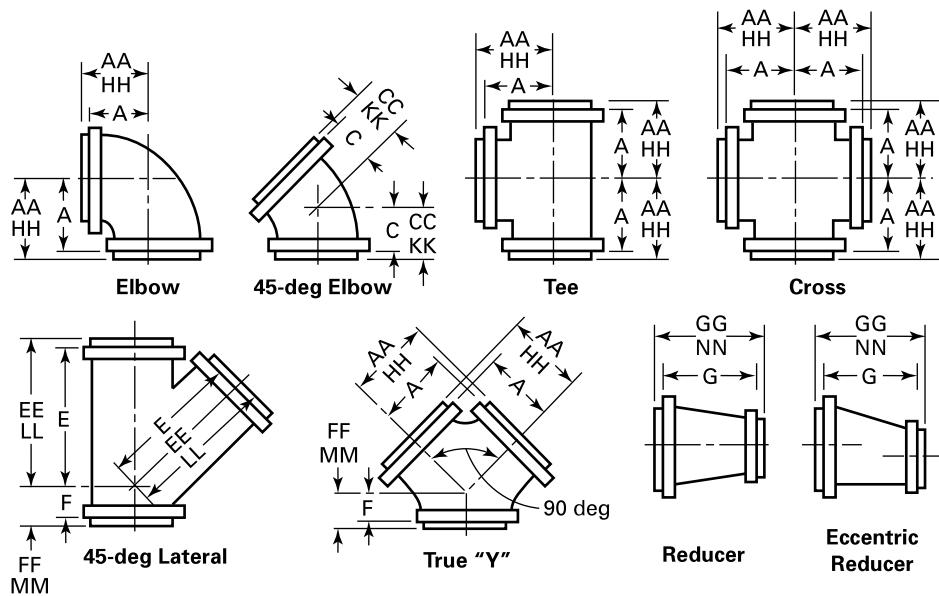
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-13](#) of [Mandatory Appendix II](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see [para. 6.2.4](#).
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see [para. 6.2.5](#).
- (h) For reinforcement of certain fittings, see [para. 6.1](#).
- (i) For drains, see [para. 6.12](#).

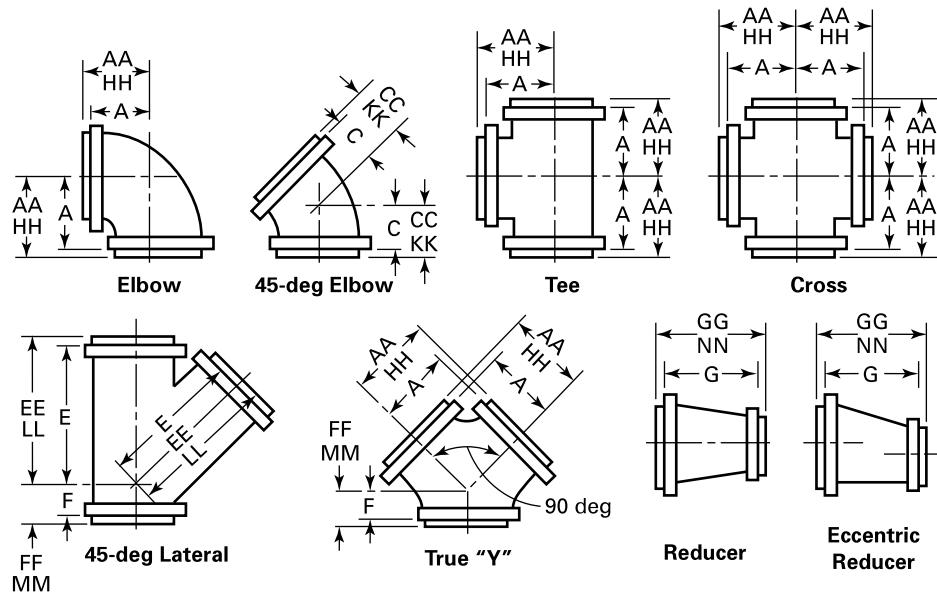
NOTES:

- (1) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (2) These dimensions apply to straight sizes only (see [paras. 6.2.3](#) and [6.4.2.2](#)). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See [Table II-5](#) of [Mandatory Appendix II](#) for ring joint facing dimensions.
- (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.

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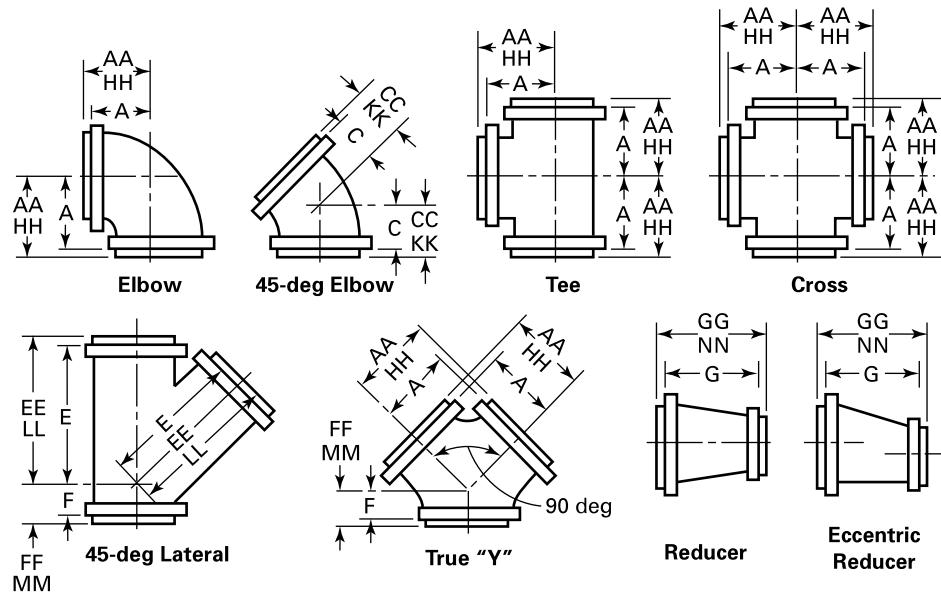
Table E-2 Dimensions of Class 600 Flanged Fittings

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

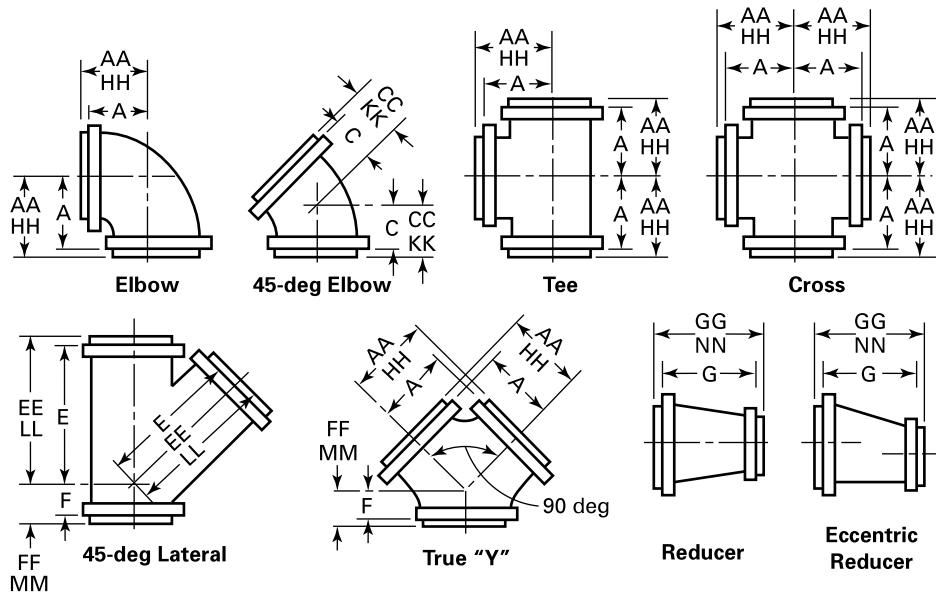
Table E-2 Dimensions of Class 600 Flanged Fittings (Cont'd)

15	16	17	18	19	20	21	22	23	24	25	26	1
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]											Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Center-to-End Elbow, Tee, Cross, and True "Y," HH [Note (3)]	Center-to-End, Long Center-to-End, and 45-deg Elbow, KK [Note (3)]	Center-to-End, Lateral, and Lateral, LL [Note (3)]	Center-to-End, and True "Y," MM [Note (3)]	Long Lateral, and End-to-End Reducer, NN [Note (3)]	Diameter of Round Base or Center-to-Base, R [Notes (4)-(6)]	Width of Square Base, S [Note (4)]	Thickness of Base, T [Notes (4), (7)]	Thickness of Ribs, U [Note (4)]	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size
5.00	3.22	1.97	5.72	1.72	Notes (2), (3)	1/2
5.00	3.75	2.50	6.75	2.00	Notes (2), (3)	3/4
5.00	4.25	2.50	7.25	2.25	Notes (2), (3)	1
5.00	4.50	2.75	8.00	2.50	Notes (2), (3)	1 1/4
5.00	4.75	3.00	9.00	2.75	Notes (2), (3)	1 1/2
6.00	5.81	4.31	10.31	3.56	Notes (2), (3)	4.75	6.12	0.81	0.62	4.50	0.88	2
6.75	6.56	4.56	11.56	3.56	Notes (2), (3)	5.25	6.12	0.81	0.62	4.50	0.88	2 1/2
7.25	7.06	5.06	12.81	4.06	Notes (2), (3)	5.75	6.50	0.88	0.75	5.00	0.75	3
7.75	7.56	5.56	14.06	4.56	Notes (2), (3)	6.50	6.50	0.88	0.75	5.00	0.75	3 1/2
8.75	8.56	6.06	16.56	4.56	Notes (2), (3)	7.00	7.50	1.00	0.75	5.88	0.88	4
10.25	10.06	7.06	19.56	6.06	Notes (2), (3)	8.25	10.00	1.25	0.75	7.88	0.88	5
11.25	11.06	7.56	21.06	6.56	Notes (2), (3)	9.00	10.00	1.25	0.75	7.88	0.88	6
13.25	13.06	8.56	24.56	7.06	Notes (2), (3)	11.00	12.50	1.44	1.00	10.62	0.88	8
15.75	15.56	9.56	29.56	8.06	Notes (2), (3)	12.50	12.50	1.44	1.00	10.62	0.88	10
16.75	16.56	10.06	31.56	8.56	Notes (2), (3)	13.25	15.00	1.62	1.12	13.00	1.00	12
17.75	17.56	10.81	34.31	9.06	Notes (2), (3)	14.75	15.00	1.62	1.12	13.00	1.00	14

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. [Note (1)]			
Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y," A										Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," AA	Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," CC	Short Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," EE	Short Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," FF
Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_m	Minimum Wall Thickness of Fitting, t_m	Inside Diameter of Fitting, d	Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y," A	Center-to-Flange Edge, 45-deg Elbow, C	Long Center-to-Flange Edge, Flange Edge, 45-deg Elbow, Lateral, E	Short Center-to-Flange Edge, Lateral, and True "Y," F	Flange Edge, Reducer, G	Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," AA	Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," CC	Long Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," EE	Contact-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y," FF
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
Raised Face 0.25 in. [Note (1)]												Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Center-to-End Elbow, Tee, Cross, and True "Y," Elbow, HH [Note (3)]	Center-to-End, Long Center-to-End, 45-deg Elbow, KK [Note (3)]	Center-to-End, Center-to-End, Lateral, Lateral, LL [Note (3)]	Short Center-to-End, and True "Y," "Y," MM [Note (3)]	Lateral, and End-to-End Reducer, NN [Note (3)]	Diameter of Round Base or Width of Square Center-to-Base, R [Notes (4)-(6)]	Thickness of Base, S [Note (4)]	Thickness of Base, T [Notes (4), (7)]	Thickness of Ribs, U [Note (4)]	Bolt Circle or Bolt Spacing, W [Note (4)]	Diameter of Drilled Holes [Note (4)]	Nominal Pipe Size
Get more FREE standards from Standard Sharing Group and our chats												
19.75	19.56	11.81	38.56	10.06	Notes (2), (3)	16.00	15.00	1.62	1.25	13.00	1.00	16
21.75	21.56	12.31	42.06	10.56	Notes (2), (3)	18
23.75	23.62	13.12	45.62	11.12	Notes (2), (3)	20
27.75	27.69	14.94	53.19	13.19	Notes (2), (3)	24

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

GENERAL NOTES:

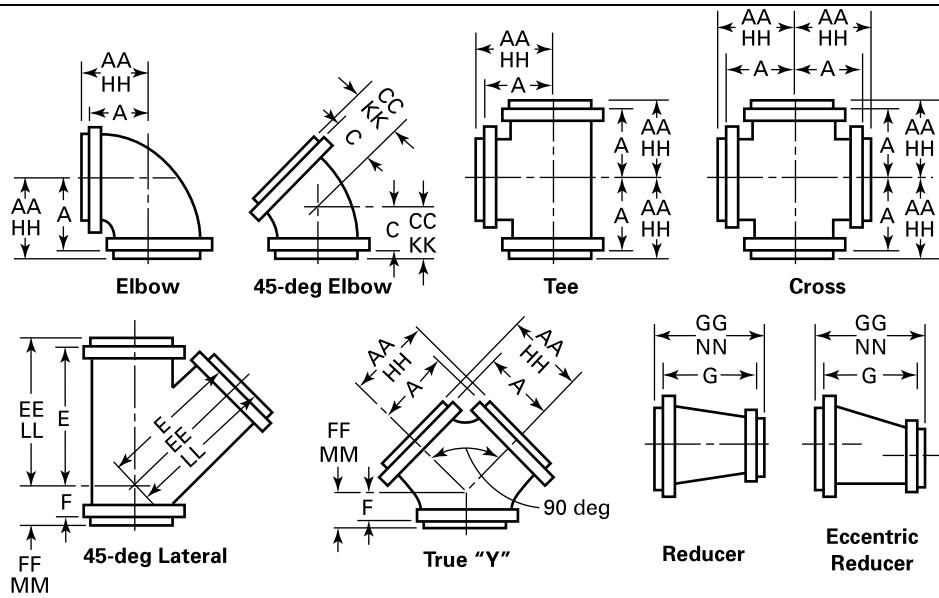
- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-15](#) of [Mandatory Appendix II](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see [para. 6.2.4](#).
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see [para. 6.2.5](#).
- (h) For reinforcement of certain fittings, see [para. 6.1](#).
- (i) For drains, see [para. 6.12](#).

NOTES:

- (1) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (2) For contact surface-to-contact surface and 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 II-5](#) of [Mandatory Appendix II](#) 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.

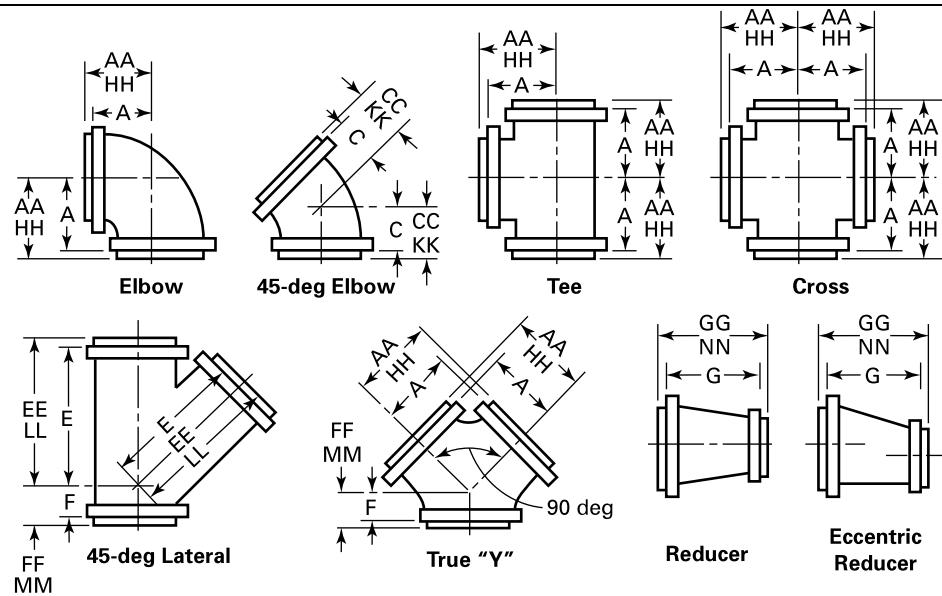
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TABLE STARTS ON NEXT PAGE

Table E-3 Dimensions of Class 900 Flanged Fittings

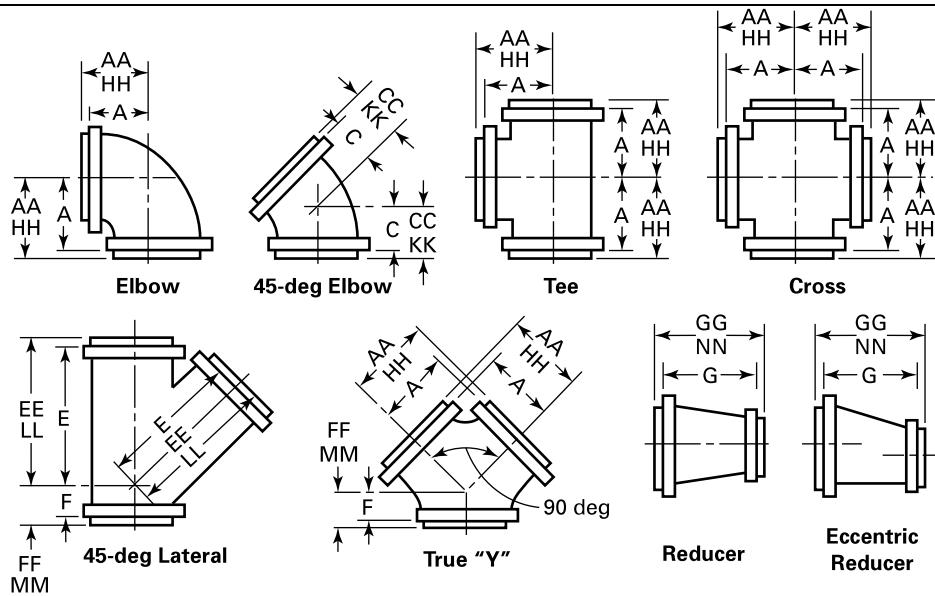


	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	C	E	F	G	AA	CC	EE	FF						
$\frac{1}{2}$	4.75	0.88	0.16	0.50										
$\frac{3}{4}$	5.12	1.00	0.19	0.69										
1	5.88	1.12	0.22	0.88										
$1\frac{1}{4}$	6.25	1.12	0.25	1.12										
$1\frac{1}{2}$	7.00	1.25	0.28	1.38										
Use Class 1500 dimensions in these sizes														
2	8.50	1.50	0.31	1.88										
$2\frac{1}{2}$	9.62	1.62	0.34	2.25										
3	9.50	1.50	0.41	2.88	7.25	5.25	14.25	4.25	7.25	7.50	5.50	14.50	4.50	
4	11.50	1.75	0.50	3.88	8.75	6.25	17.25	5.25	8.75	9.00	6.50	17.50	5.50	
5	13.75	2.00	0.59	4.75	10.75	7.25	20.75	6.25	10.75	11.00	7.50	21.00	6.50	
6	15.00	2.19	0.72	5.75	11.75	7.75	22.25	6.25	11.75	12.00	8.00	22.50	6.50	
8	18.50	2.50	0.88	7.50	14.25	8.75	27.25	7.25	14.25	14.50	9.00	27.50	7.50	
10	21.50	2.75	1.06	9.38	16.25	9.75	31.25	8.25	16.25	16.50	10.00	31.50	8.50	
12	24.00	3.12	1.25	11.12	18.75	10.75	34.25	8.75	17.25	19.00	11.00	34.50	9.00	
14	25.25	3.38	1.38	12.25	20.00	11.25	36.25	9.25	18.50	20.25	11.50	36.50	9.50	

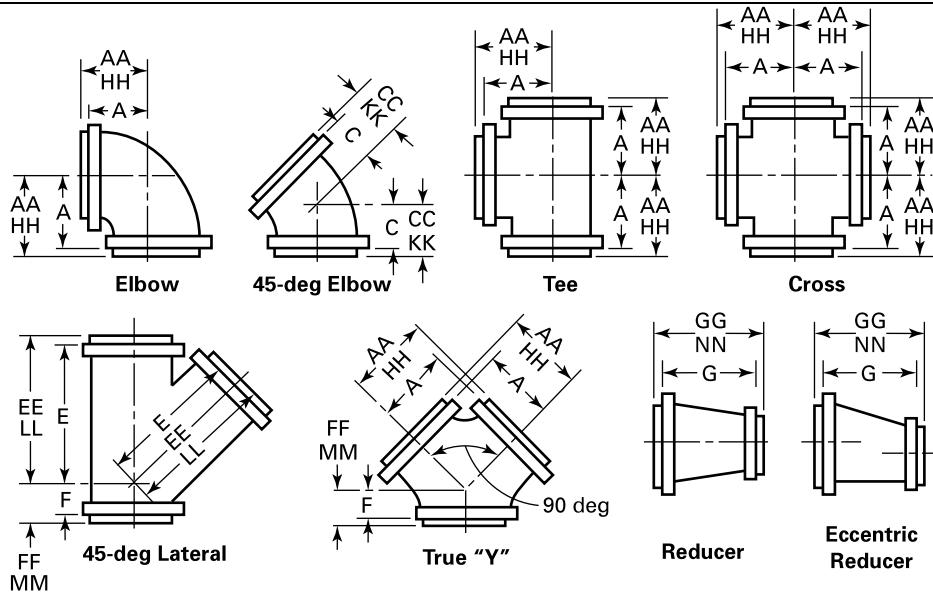
Table E-3 Dimensions of Class 900 Flanged Fittings (Cont'd)



15	16	17	18	19	20	21	22	23	24	25	26	1
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]											Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Get more FREE standards from Standard Sharing Group and our chats											
Center-to-End Elbow, Tee, Cross, True "Y," HH	Center-to-End, Elbow, Lateral, 45-deg Elbow,	Long Center-to-End, Lateral, 45-deg Elbow,	Short Center-to-End, and True "Y,"	Center-Lateral, and True "Y,"	End-to-End Reducer, NN	Center-to-Base, S [Notes (4), (5)]	Diameter of Round Base or Square Base, S [Note (6)]	Width of Base, T [Notes (6), (7)]	Thickness of Base, U [Note (6)]	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size
7.75	7.56	5.56	14.56	4.56	Notes (2), (3)	5.75	6.50	0.88	0.75	5.00	0.75	2
9.25	9.06	6.56	17.56	5.56	Notes (2), (3)	7.00	7.50	1.00	0.75	5.88	0.88	2 1/2
11.25	11.06	7.56	21.06	6.56	Notes (2), (3)	8.25	10.00	1.25	0.75	7.88	0.88	3
12.25	12.06	8.06	22.56	6.56	Notes (2), (3)	9.00	10.00	1.25	0.75	7.88	0.88	4
14.75	14.56	9.06	27.56	7.56	Notes (2), (3)	11.00	12.50	1.44	1.00	10.62	0.88	8
16.75	16.56	10.06	31.56	8.56	Notes (2), (3)	12.50	12.50	1.44	1.00	10.62	0.88	10
17.75	19.06	11.06	34.56	9.06	Notes (2), (3)	13.25	15.00	1.62	1.12	13.00	1.00	12
19.00	20.44	11.69	36.69	9.69	Notes (2), (3)	14.75	15.00	1.62	1.12	13.00	1.00	14

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
Flange Edge										Raised Face 0.25 in. [Note (1)]			
Nominal Pipe Size	Outside Diameter <i>O</i>	Minimum Thickness of Flange, <i>t_f</i>	Minimum Wall Thickness of Fitting, <i>t_m</i>	Inside Diamete- r of Fitting, <i>d</i>	Center- to- Flange Edge, Elbow,	Center- to- Tee,	Long Center- to- Cross,	Short Center- to- Flange Edge, Tee,	Long Flange Edge,	Short Center- to- Flange Edge, Tee,	Center- to- Cross,	Long Center- to- Flange Edge, Tee,	Short Center- to- Flange Edge, Tee,
					<i>A</i>	<i>C</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>AA</i>	<i>CC</i>	<i>EE</i>	<i>FF</i>
16	27.75	3.50	1.56	14.00	22.00	12.25	40.50	10.25	20.50	22.25	12.50	40.75	10.25
18	31.00	4.00	1.75	15.75	23.75	13.00	45.25	11.75	24.00	24.00	13.25	45.50	12.00
20	33.75	4.25	1.91	17.50	25.75	14.25	50.00	12.75	26.00	26.00	14.50	50.25	13.00
24	41.00	5.50	2.28	21.00	30.25	17.75	59.75	15.25	30.00	30.50	18.00	60.00	15.50

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

15	16	17	18	19	20	21	22	23	24	25	26	1
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]						Base Drilling [Note (8)]					
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Center-to-End Elbow, Tee, Cross, and True "Y," HH [Note (3)]	Center-to-End, Long Center-to-End, 45-deg Elbow, KK [Note (3)]	Center-to-End, Lateral, Lateral, Lateral, LL [Note (3)]	Short Center-to-End, and True "Y," MM [Note (3)]	Center-to-End, and End-to-End Reducer, NN [Note (3)]	Diameter of Round Base or Width of Center-to-Base, S [Notes (4), (5)]	Diameter of Square Base, S [Note (6)]	Thickness of Base, T [Notes (6), (7)]	Thickness of Ribs, U [Note (6)]	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size
21.00	22.44	12.69	40.94	10.69	Notes (2), (3)	16.00	15.00	1.62	1.25	13.00	1.00	16
24.50	24.25	13.50	45.75	12.25	Notes (2), (3)	18
26.50	26.25	14.75	50.50	13.25	Notes (2), (3)	20
30.50	30.88	18.38	60.38	15.88	Notes (2), (3)	24

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

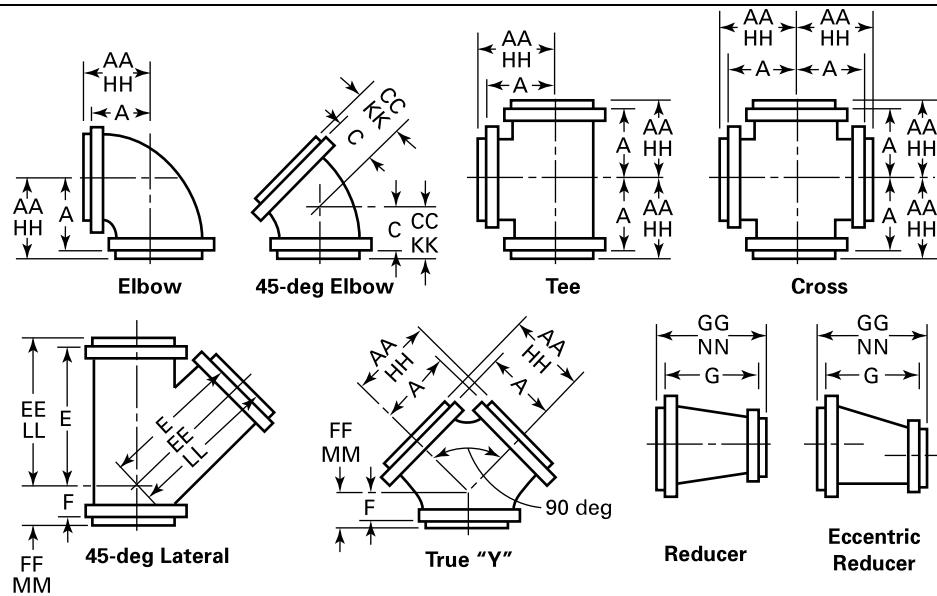
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-17](#) of [Mandatory Appendix II](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see [para. 6.2.4](#).
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see [para. 6.2.5](#).
- (h) For reinforcement of certain fittings, see [para. 6.1](#).
- (i) For drains, see [para. 6.12](#).

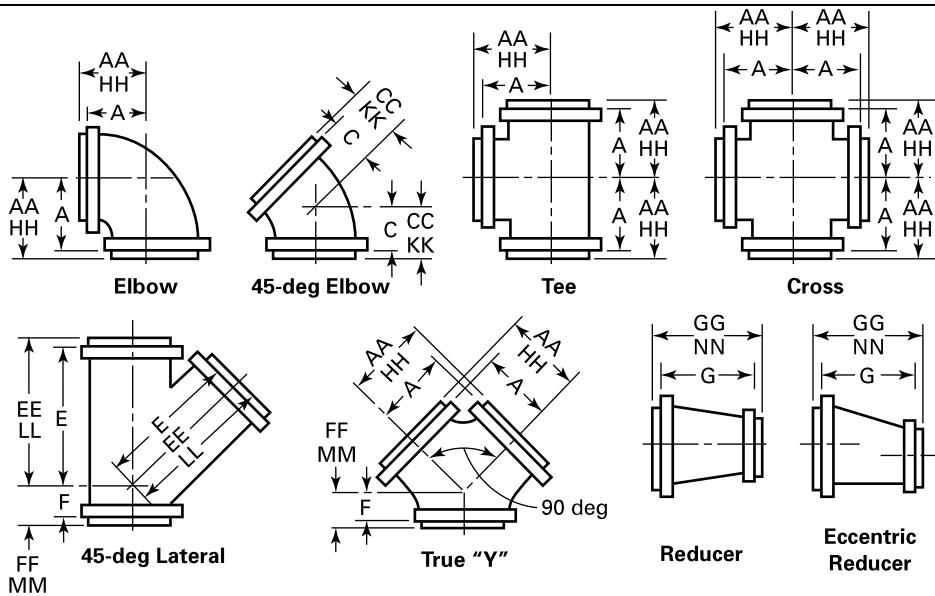
NOTES:

- (1) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (2) For contact surface-to-contact surface and center-to-end dimensions of reducers and eccentric reducers, see [para. 6.2.3](#).
- (3) These dimensions apply to straight sizes only (see [paras. 6.2.3](#) and [6.4.2.2](#)). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See [Table II-5](#) of [Mandatory Appendix II](#) for ring joint facing dimensions.
- (4) For reducing fittings, the size and center-to-face dimensions of the base are determined by the size of the largest opening fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- (5) Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension R shall be the finished dimension.
- (6) The base dimensions apply to all straight and reducing sizes.
- (7) Bases may be cast integral or attached as weldments at the option of the manufacturer.
- (8) The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

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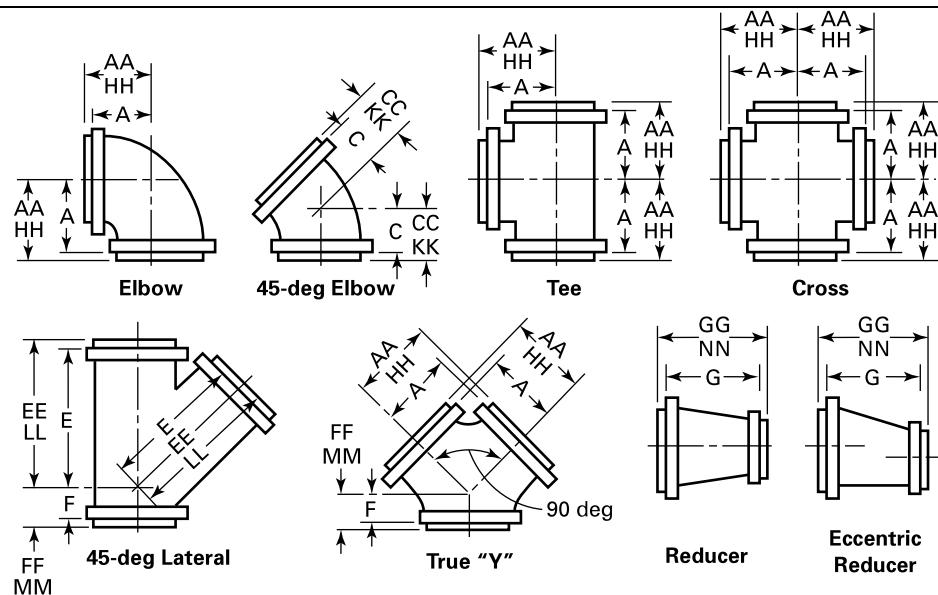
Table E-4 Dimensions of Class 1500 Flanged Fittings

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flange Edge										Raised Face 0.25 in. [Note (1)]			
Nominal Pipe Size	Outside Diameter of Flange, <i>O</i>	Minimum Thickness of Flange, <i>t_f</i>	Minimum Wall Thickness of Fitting, <i>t_m</i>	Inside Diamete- r of Fitting, <i>d</i>	Center- to- Flange Edge, Elbow, Tee, Cross, and True "Y," A	Center- to- Flange Edge, 45-deg Elbow, Lateral, E	Short Center- to- Flange Edge, Lateral, True "Y," F	Flange Edge, Reducer, G	Center- of Raised Face, Tee, Cross, and True "Y," AA	Center- to- Contact Surface of Raised Face, Cross, and True "Y," CC	Long Center- to- Contact Surface of Raised Face, Lateral, EE	Center- to- Contact Surface of Raised Face, True "Y," FF	
$\frac{1}{2}$	4.75	0.88	0.19	0.50	4.00	2.75	4.25	3.00
$\frac{3}{4}$	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
$1\frac{1}{4}$	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
$1\frac{1}{2}$	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
$2\frac{1}{2}$	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
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

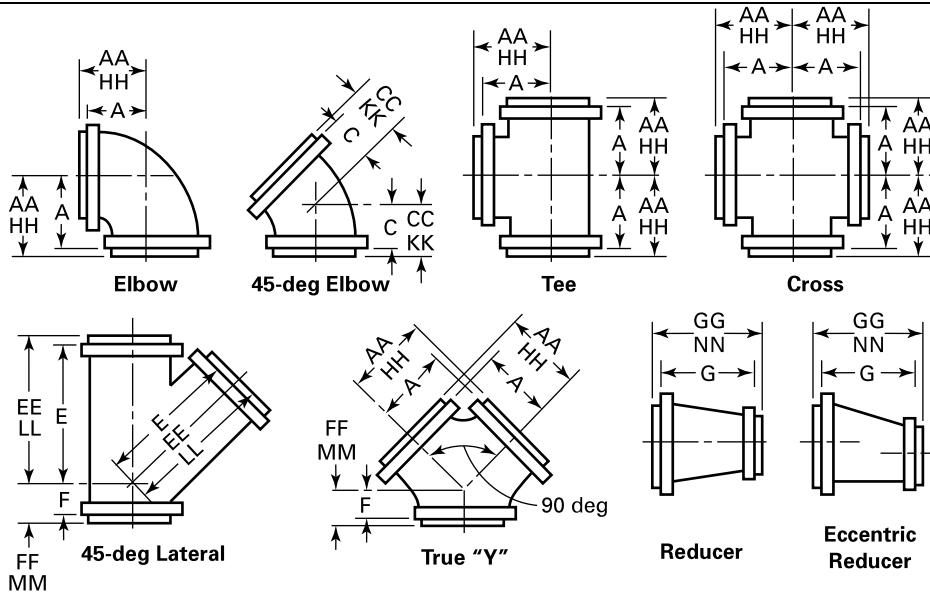
Table E-4 Dimensions of Class 1500 Flanged Fittings (Cont'd)

15	16	17	18	19	20	21	22	23	24	25	26	1
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]											Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Center-to-End Elbow, Tee, Center-to-End, Long Center-to-End, and True "Y," Elbow, KK	Center-to-End, Lateral, LL	Center-to-End, Lateral, MM	Long Center-to-End, and True "Y," Lateral, LL	Center-to-End, Lateral, and True "Y," Reducer, NN	Diameter of Round Base or Width	Thickness of Base, T	Thickness of Ribs, U	Bolt Circle or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size	
...	4.25	3.00	Notes (2), (3)	1/2
...	4.50	3.25	Notes (2), (3)	3/4
5.00	5.00	3.50	9.00	2.50	Notes (2), (3)	1
5.75	5.50	4.00	10.00	3.00	Notes (2), (3)	1 1/4
6.25	6.00	4.25	11.00	3.50	Notes (2), (3)	1 1/2
7.25	7.31	4.81	13.31	4.06	Notes (2), (3)	5.50	6.50	0.88	0.75	5.00	0.75	2
8.25	8.31	5.31	15.31	4.56	Notes (2), (3)	6.00	6.50	0.88	0.75	5.00	0.75	2 1/2
9.25	9.31	5.81	17.31	5.06	Notes (2), (3)	6.50	7.50	1.00	0.75	5.88	0.88	3
10.75	10.81	7.31	19.31	6.06	Notes (2), (3)	7.75	10.00	1.25	0.75	7.88	0.88	4
13.75	13.31	8.81	23.31	7.56	Notes (2), (3)	9.00	10.00	1.25	0.75	7.88	0.88	5
14.50	14.00	9.50	25.00	8.25	Notes (2), (3)	9.75	12.50	1.44	1.00	10.62	0.88	6
17.00	16.56	11.06	30.06	9.31	Notes (2), (3)	11.50	12.50	1.44	1.00	10.62	0.88	8
20.25	19.69	12.19	36.19	10.44	Notes (2), (3)	13.75	15.00	1.62	1.12	13.00	1.00	10
23.00	22.56	13.56	41.06	12.31	Notes (2), (3)	15.50	15.00	1.62	1.12	13.00	1.00	12
25.75	25.12	14.62	44.38	12.88	Notes (2), (3)	17.25	17.50	1.88	1.25	15.25	1.12	14
28.25	27.69	16.69	48.69	15.19	Notes (2), (3)	18.75	17.50	1.88	1.25	15.25	1.12	16

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



1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flange Edge										Raised Face 0.25 in. [Note (1)]			
Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"										Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Short Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Short Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"
Nominal Pipe Size	Outside Diameter of Flange, O	Minimum Thickness of Flange, t_f	Minimum Wall Thickness of Fitting, t_m	Diameter of Fitting, d	Inside Flange, A	Center-to-Flange Edge, C	Long Center-to-Flange Edge, E	Short Center-to-Flange Edge, F	Long Center-to-Flange Edge, G	Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"	Center-to-Contact Surface of Elbow, Tee, Cross, and True "Y,"
18	36.00	6.38	2.81	14.62	30.00	17.50	53.00	16.25	31.00	30.25	17.75	53.25	16.50
20	38.75	7.00	3.12	16.38	32.50	18.50	57.50	17.50	33.50	32.75	18.75	57.75	17.75
24	46.00	8.00	3.72	19.62	38.00	20.50	67.00	20.25	39.25	38.75	20.75	67.25	20.50

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

15	16	17	18	19	20	21	22	23	24	25	26	1
Raised Face 0.25 in. [Note (1)]	Ring Joint [Note (1)]											Base Drilling [Note (8)]
Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)]	Get more FREE standards from Standard Sharing Group and our chats											
Center-to-End Elbow, Tee, Center-to-Cross, and True "Y," Elbow, 45-deg Elbow, KK	Center-to-End Long Lateral, Center-to-End, Lateral, and End, Lateral, 45-deg Lateral, LL	Short Center-to-End, Lateral, and True "Y," Lateral, MM	Center-to-End, Reducer, NN	Center-to-Base, R	Diameter of Round Base or Width	Thickness of Square Base, S	Thickness of Base, T	Thickness of Ribs, U	Bolt Circle Diameter or Bolt Spacing, W	Diameter of Drilled Holes	Nominal Pipe Size	
31.50 [Note (3)]	30.69 [Note (3)]	18.19 [Note (3)]	53.69 [Note (3)]	16.94 [Notes (2), (3)]	... [Notes (4)-(6)]	... [Note (4)]	... [Notes (4), (7)]	... [Note (4)]	... [Note (4)]	... [Note (4)]	18	
34.00 [Note (3)]	33.19 [Note (3)]	19.19 [Note (3)]	58.19 [Note (3)]	18.19 [Notes (2), (3)]	... [Notes (2), (3)]	... [Note (2)]	... [Notes (2), (3)]	... [Note (2)]	... [Note (2)]	... [Note (2)]	20	
39.75 [Note (3)]	38.81 [Note (3)]	21.31 [Note (3)]	67.81 [Note (3)]	21.06 [Notes (2), (3)]	... [Notes (2), (3)]	... [Note (2)]	... [Notes (2), (3)]	... [Note (2)]	... [Note (2)]	... [Note (2)]	24	

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

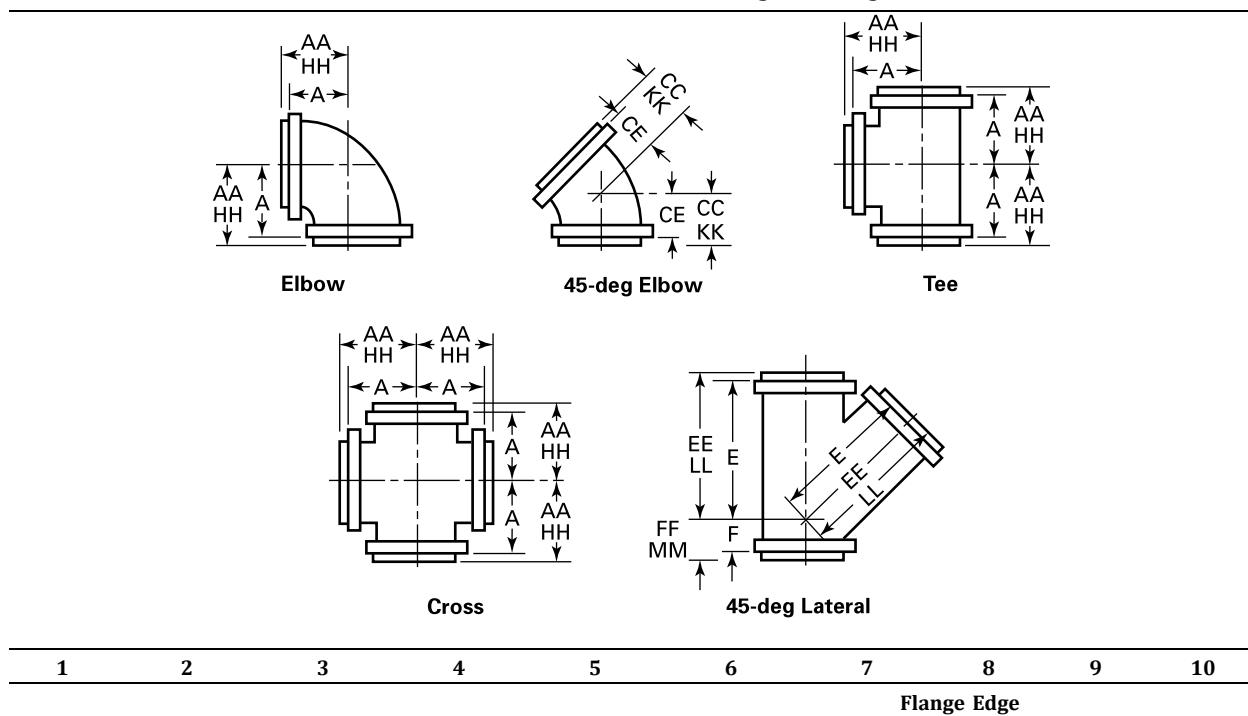
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-19](#) of [Mandatory Appendix II](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see [para. 6.2.4](#).
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see [para. 6.2.5](#).
- (h) For reinforcement of certain fittings, see [para. 6.1](#).
- (i) For drains, see [para. 6.12](#).

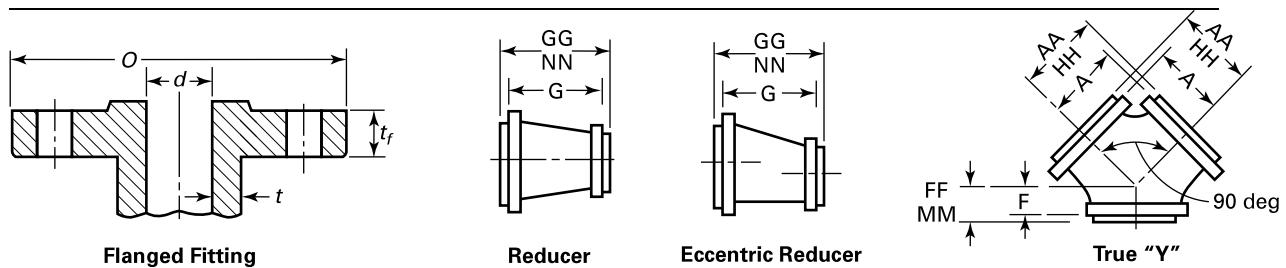
NOTES:

- (1) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (2) For contact surface-to-contact surface and 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 II-5](#) of [Mandatory Appendix II](#) 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.

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TABLE STARTS ON NEXT PAGE

Table E-5 Dimensions of Class 2500 Flanged Fittings

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

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

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

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see [section 7](#).
- (c) For facings, see [para. 6.4](#).
- (d) For flange bolt holes, see [para. 6.5](#) and [Table II-21](#) of [Mandatory Appendix II](#).
- (e) For spot facing, see [para. 6.6](#).
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see [para. 6.2.4](#).
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see [para. 6.2.5](#).
- (h) For reinforcement of certain fittings, see [para. 6.1](#).
- (i) For drains, see [para. 6.12](#).

NOTES:

- (1) For center-to-contact surface and center-to-end dimensions of reducing fittings, see [para. 6.2.3](#).
- (2) For contact surface-to-contact surface and 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 II-5](#) of [Mandatory Appendix II](#) for ring joint facing dimensions.

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