U S A S T A N D A R D

# Steel Pipe Flanges and Flanged Fittings

USAS B16.5 - 1968

150, 300, 400, 600, 900, 1500 and 2500 lb
including Reference to Valves

*Sponsors*

Mechanical Contractors Association of America
Manufacturers Standardization Society of the
Valve and Fittings Industry
The American Society of Mechanical Engineers

*Published by*

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USA STANDARD

This USA Standard is one of nearly 3000 standards approved as American Standards by the American Standards Association. On August 24, 1966, the ASA was reconstituted as the United States of America Standards Institute. Standards approved as American Standards are now designated USA Standards.

# Foreword

IN the Spring of 1920 the American Engineering Standards Committee (later renamed American Standards Association) authorized the organization of a Sectional Committee on the Standardization of Pipe Flanges and Fittings for the purpose of unifying and further developing the flanged and screwed fitting standards in force in this country. The ASA also designated the Heating and Piping Contractors National Association, the Manufacturers' Standardization Society of the Valve and Fittings Industry, and The American Society of Mechanical Engineers as the three joint sponsors.

This sectional committee had not progressed very far with its work when it realized that the standardization of steel flanges and flanged fittings was very greatly needed. An informal conference on this subject which the sponsors held on May 23, 1923, indicated such widespread interest in this subject that it was decided to organize immediately a subcommittee to develop standards for steel flanges to withstand high superheat temperatures and pressures from 250 to 3200 lb per square inch. Accordingly, at an open meeting of this subcommittee held at the Engineering Societies Building, in October, 1923, which was attended by fifty engineers, manufacturers, and users of this product, a comprehensive program for the standardization of steel flanges and flanged fittings was launched.

Subcommittee No. 3 held frequent meetings during the years 1923 to 1926 and in April, 1926, completed its first proposed standard for steel pipe flanges and flanged fittings. This proposal was finally approved by letter ballot vote in December, 1926. The committee presented its report to the three sponsor organizations and they in turn after approval presented it to the American Standards Association for approval and designation as an American Tentative Standard, a status which was granted in June, 1927.

The use of this standard emphasized the need for the hub dimensions of companion flanges and certain changes and additions including the rerating of the 250 and 1350 lb standards and the dimensions for steel base fittings. The Subcommittee continued its work, made an investigation into the factors which determine the stiffness of companion flanges and prepared the revision of 1932.

Prompted by suggestions received from committee members and industry, Subcommittee No. 3 began a revision of the 1932 standard in the Spring of 1936. The work resulted in a new 1939 edition which ASA approved as American Standard January 30, 1939. This edition contained the standard for welding neck flanges completed in March 1937, larger sizes (14 to 24" inclusive) of the 1500 lb standard, standards for 2500 lb pressure class flanges and fittings in sizes 1/2 to 12" inclusive, dimensions for a full line of ring joint flanges originated by The American Petroleum Institute and pressure-temperature ratings for carbon-molybdenum and equivalent alloy steels.

At the request of the War Production Board in August 1942, a special war committee was appointed and, functioning under ASA War Standards Procedure, developed revised pressure-temperature ratings for all pressure classes with the object of conserving essential war materials during the emergency of World War II. These revised ratings were published as American War Standard, B16e5-1943. After the cessation of hostilities in 1945, a special Subgroup of Subcommittees No. 3 and No. 4 on Ratings gave consideration to the pressure-temperature ratings contained in both the war standard B16e5 and the peace time standard B16e-1939. Their work culminated in a report which was finally approved as Supplement No. 1 to B16e-1939 (ASA B16e6-1949). It was approved as American Standard by ASA on April 29, 1949 and replaced all existing American Standards on steel flange and flanged fitting ratings. These pressure-temperature ratings were numerically the same as the war ratings. Material specification references were revised and a table covering metal wall thicknesses for welding end valves was included. This supplement was issued as an expediency to clear the confusion which had been created in industry due to the existence of two sets of ratings.

Subcommittee No. 3 then appointed a special task force to make recommendations for a revision of the whole standard. This task force held frequent meetings through 1949, 1950, and 1951. Their recommendations took the form of a completely new edition. Tables were rearranged for

easier use, Supplement 1 was entirely absorbed, new materials were recognized, welding-end preparations were expanded and new style of presentation was suggested.

*The addition of pressure-temperature ratings for the new materials involved an extensive investigation into the subject of ratings* and the method developed for rating materials was included in an appendix to serve as a record as well as to make it possible to apply proper pressure-temperature ratings to new materials which might be developed. After a study by Subcommittee No. 3 and subsequent approval by the Sectional Committee and Sponsors of this revision, approval was given as American Standard by ASA on October 30, 1953, with the original designation B 16e changed to B16.5.

Owing to subsequent advances in piping installations, Subcommittee No. 3 gave consideration to a further revision of this standard and many meetings were held from 1954 through 1957. This revision deleted the Class B pressure-temperature ratings with a further clarification of the remaining rating class (formerly Class A). An appendix is included defining gasket qualifications (other than ring joint) suitable for pressure-temperature ratings established in the standard. An additional appendix defines the method of calculating lengths for bolts, which now establishes stud-bolt lengths from thread-to-thread and does not include the height of points. Pressure-temperature data was added for several additional materials, the welding end dimensional table expanded, and the temperature used in determining ratings has been redefined.

The Sectional Committee and the Sponsors gave approval to these revisions, and on December 2, 1957, the edition was approved as American Standard by ASA.

During 1959 and 1960 Subcommittee No. 3 studied the standard in light of users' comments. Results of these studies included changes of number of paragraphs to clarify the intent or to make the requirements more practical to administer. The Sectional Committee and the Sponsors gave approval to these revisions, and on August 24, 1961, the edition was approved as American Standard by ASA.

Starting in 1963, Subcommittee No. 3 gathered nearly 100 comments and suggestions for revision and began a study of each. As solutions were developed, a new edition of the standard began to emerge. Most of the changes were of a clarifying nature but permission to have thinner walls than ¼ in. was recognized as feasible. Also added were drilling and facing tolerances.

Following arduous approvals by the Standards Committee and Sponsors, approval of the new edition was granted by the United States of America Standards Institute on July 9, 1968.

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## 1968 REVISIONS

Revisions from the 1961 edition of this standard are noted throughout the document through the use of asterisks (*). In the text, an asterisk at the heading of a paragraph indicates additions to or modifications of the paragraph.

In the tables, an asterisk at the beginning of a line or in a column heading indicates revision of all or a major portion of that line or column. Asterisks beside an individual number or item indicates a change to that item only. An asterisk in the Table title indicates changes to all or a major portion of that table.

USA STANDARD

# Steel Pipe Flanges and Flanged Fittings

150, 300, 400, 600, 900, 1500, and 2500 lb

Including Reference to Valves

## 1 SCOPE

1.1 This standard pertains primarily to cast and forged steel flanges and flanged fittings; but the flange dimensions, bolting, minimum wall thicknesses and certain other requirements herein specified for fittings apply also to cast and forged steel flanged end and butt-welding end valves of corresponding primary service pressure rating and size.

1.2 This standard covers:

(a) Pressure Ratings
(b) Sizes[1] and Methods of designating openings
(c) Marking
(d) Minimum requirements for materials
(e) Dimensions [1]
(f) Tolerances
(g) Tests

*1.3 Standards and specifications adopted by reference in this Standard and the names and addresses of the sponsoring organizations are shown in Appendix G. It is not considered practical to refer to a specific edition of each of the standards and specifications in the individual references. Instead the specific edition references are included in Appendix G.

## *2. PRESSURE-TEMPERATURE RATINGS

2.1 General. Products covered by this standard are classified and designated by their primary service pressure rating: 150, 300, 400, 600, 900, 1500 or 2500 lb. Pressure Ratings for these classes, for various temperatures, are shown in Tables 2 to 8, respectively. These ratings are the maximum allowable non-shock pressures at the temperatures shown, and the allowable pressure may be interpolated between the temperatures. They apply to any product (valve, flange or fitting), but a valve conforming to this standard shall merit these ratings in other respects also.

2.2 Low Temperature Ratings. For a material shown in Table 2 to 8, the pressure rating for service at any temperature below –20F, shall be the same as the rating shown in the Table for –20F. For the "low temperature" materials (ASTM A350 or A352), shown only in Table 1, the pressure rating for below –20F shall be the same as shown for carbon steel (at –20 to 100F) in Tables 2 to 8.

Some of the materials listed in the rating tables undergo a decrease in impact resistance at temperatures lower than –20F to such an extent as to be unable to safely resist shock loadings, sudden changes of stress or high stress concentrations.

2.3 Code Limitations. A product used under the jurisdiction of the ASME Boiler and Vessel Code or of the USAS Code for Pressure Piping, is subject to any limitation of that code. This includes any maximum temperature limitation for a material, or a code rule governing the use of a material at a low temperature.

2.4 Rating Temperature. The temperature shown for the corresponding pressure rating shall be the material temperature of the pressure retaining structure. In view of the various environments in which piping components may be installed (for example, insulated or not, and either heated or cooled externally), in establishing pressure ratings it is assumed that the material temperature of the pressure retaining structure is the temperature of the contained fluid. Use of a pressure rating at a material temperature other than that of the contained fluid is the responsibility of the user, and subject to the requirement of any applicable code.

2.5 Gasket Required. The use of the pressure ratings herein requires that the gasket of a flanged joint conform to the requirements of Par. 6.10. In addition, the user is responsible for selection of gasket dimensions and materials to withstand the required bolt loading without injurious crushing, and also the suitability for the service conditions.

## 3. SIZE

3.1 The size in the Tables is the "nominal"[1] pipe size.

3.2 Reducing fittings shall be designated by the size of the openings in their proper sequence as indicated in the sketches, Fig. 3.

*3.3 Reducing flanges shall be designated by the two nominal pipe sizes. See examples in Footnote 5 of Table 12.

[1] The use of the word "nominal" as a modifier of a dimension or size is intended to indicate that the stated dimension or size is used for purposes of designation. The actual dimension may be the nominal dimension subject to the variation of established tolerances.

## *4 MARKING

4.1 Flanges, Flanged Fittings and Valves. Flanges, flanged fittings and valves, shall be marked as required in MSS Standard Practice SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions. For convenience, the basic requirements of that standard are listed below.

4.1.1 *Name.* The manufacturer's name or trade mark.

4.1.2 *Materials.*

4.1.2.1 All cast carbon steel flanges, flanged fittings and valves shall be marked with the word "STEEL" and may be marked with the melt number or melt identification. All cast alloy steel (except austenitic) flanges, flanged fittings and valves shall be marked with the word "STEEL," the melt number or melt identification and the symbols designated in the ASTM specifications to indicate the grade of steel.

4.1.2.2 All forged carbon and alloy steel flanges, flanged fittings and valves shall be marked with the word "STEEL" and all alloy steel flanges, flanged fittings and valves with symbols designated in the ASTM specifications to indicate the grade of steel. At the option of the manufacturer, the ASTM specification number may be used instead of the word "STEEL."

4.1.2.3 A manufacturer may supplement these mandatory material indications with his trade designation for the grade of steel, but confusion with the symbols herein must be avoided.

4.1.3 *Pressure.* Numerals giving the primary service pressure for which the product is designated.

4.1.4 *Temperature.* No temperature markings are required on flanges and flanged fittings, but if marked, the temperature shall be that permitted by this standard at the primary service pressure.

4.1.5 *Size.* The nominal pipe size in inches shall be given, but may be omitted from reducing flanges and reducing flanged fittings.

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

4.1.7 *Omission of Markings.* On flanges, flanged fittings and valves whose size or shape limit the markings, they may be omitted in the following order:

(a) Size
(b) Temperature
(c) Pressure
(d) Material
(e) Manufacturer's name or trade-mark

## 5 MATERIALS

5.1 General. The products covered by this standard shall be either steel castings or steel forgings and the bolts, nuts, etc., shall be steel,[2] all as listed in the respective ASTM specifications referred to in Table 1.

5.1.1 Where welded construction is used, consideration should be given to the possibility of graphite formation in the following:

Carbon steel above 775F.
Carbon-molybdenum steel above 875F.
Chrome-molybdenum steel (with chromium under 0.60) above 975 F.

5.1.2 Consideration should be given to the possibility of excessive oxidation (scaling) on the following steels:

1 Cr – ½ Mo
1 ¼ Cr – ½ Mo
2 Cr – ½ Mo
2 ¼ Cr – 1 Mo
3 Cr – 1 Mo
} above 1050F

5 Cr – ½ Mo above 1100 F

5.2 Bolting[3]. Alloy steel bolting made of materials given in Table 1 shall be used for all flanges covered by this standard, except bolting for Class 150 and 300 flanges at temperatures of 500F and lower may be made of Grade B of ASTM A307, Specifications for Low Carbon Steel Externally Threaded Standard Fasteners, or better.

*5.3 Gaskets. Ring joint gasket materials shall conform with USAS B16.20. For gaskets for flanges with other than ring joint facing, see Appendix E.

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[2] Bolting materials other than steel may be used provided their strength is adequate for the service conditions.

[3] The bolting prescribed in this standard is based upon bolting steel to steel flanges. Where 150 lb steel flanges are bolted to Class 125 cast-iron flanges, and with flat gaskets extending to the bolt holes, it is recommended the flanges be flat faced and carbon steel bolting equivalent to the requirements of ASTM A307 Grade B, be used. Where flat faced 150 lb steel flanges are bolted to Class 125 cast-iron flanges and with full face gaskets extending to the OD of flange, the bolting as described in this standard may be used. Where 300 lb steel flanges are bolted to Class 250 cast-iron flanges carbon steel bolting equivalent to the requirements of ASTM A307 Grade B, shall be used. Good practice indicates that the flange should be flat faced. When 150 lb and 300 lb steel flanges, either loose or integral are required with flat face, either the full thickness or thickness with raised face removed may be funished unless otherwise specified by the customer.

Users are reminded that removing the raised face will make the center to face dimension non-standard.

## 6. DIMENSIONS

*6.1 Wall Thickness. For inspection purposes the minimum wall thickness of all products except flanges at the time of manufacture shall be those shown in Tables 15, 18, 21, 24, 27, 30 and 33. These thicknesses are all greater than those determined by the following formula:

$$t = 1.5\left[\frac{Pd}{2S - 1.2P}\right]$$

Where

t = Calculated thickness in inches
P = Primary service pressure in psi
d = Inside diameter of fitting or port opening of valve (as taken from tables) in inches.
S = Stress of 7,000 psi.

This formula results in a wall thickness 50 per cent greater than for a simple cylinder designed for a stress of 7,000 psi subjected to an internal pressure equal to the primary service pressure. The actual values in the Tables range from 0.10 to 0.20 in. heavier than those given by the formula. Additional metal thickness needed for assembly stresses, valve closing stresses, shapes other than circular, and stress concentrations must be determined by individual manufacturers since these factors vary widely. In particular 45 deg laterals, tru Ys, crosses, etc. may require additional reinforcement to compensate for inherent weakness in products of these shapes. The welding ends of valves may be reduced below these values by machining the inside and outside surfaces to meet the pipe wall thickness as shown in Figs. 9, 10, 11 and 12. Heavier wall thicknesses for valves for services requiring additional corrosion allowance are provided in API Standard 600, Flanged and Welding End Steel Wedge-Gate and Plug Valves for Refinery Use.

### 6.2 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. The addition of any facing is beyond the outside edge of the flange except for the 1/16-in. raised face in the 150- and 300-lb standards. (See Paragraph 6.3, Facings.)

6.2.2 *Standard Fittings.* Center-to-contact surface, center-to-flange edge and center-to-end (ring-joint) dimensions are shown in Tables 15, 18, 21, 24, 27, 30 and 33.

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

6.2.4 *Side Outlet Fittings.* Side outlet elbows, side outlet tees, and side outlet crosses, shall have all openings on intersecting center lines and the center-to-contact surface dimensions of the side outlet shall be the same as for the largest opening. Long radius elbows with side outlet shall have the side outlet on the radial center line 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 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.

6.2.6 *Other Dimensions.* The face-to-face dimensions of flanged end valves, and end-to-end dimensions of valves with ring-joint, and end-to-end dimensions of welding end valves for the various pressures shall be in accordance with the USA Standard B16.10 Face-to-Face Dimensions for Ferrous Valves. See Note 2 on Page 2 regarding facing and face-to-face dimensions for exceptions when bolting steel flanges to cast iron flanges.

### 6.3 Facings.

6.3.1 *For Other Than Lapped Joints.* Table 9 gives dimensions for facings other than ring-joint. Table 10 gives dimensions for ring-joint facings. Fig. 8 shows application of facings. 150- and 300-lb valves, fittings and companion flanges are regularly furnished with a 1/16-in. raised face which is included in the minimum flange thickness "C", 400-, 600-, 900-, 1500-, and 2500-lb valves, fittings and companion flanges are regularly furnished with 1/4 in. raised face which is additional to the minimum flange thickness "C." Any other facing than the above, when required for any pressure, shall be furnished as follows:

6.3.1.1 No metal shall be cut from the minimum flange thickness specified herein except

on 150- and 300-lb flanges; then the raised face may be removed when bolting to cast iron flanges. See Note 3 on Page 2.

6.3.1.2 In the case of the 1/4 in. raised face, tongue or male face (other than 1/16 in. raised face for 150- and 300-lb), the minimum flange thickness "C" shall be first provided and then the raised face, tongue or male face shall be added thereto.

6.3.1.3 With ring-joint, groove, or female face, the full flange thickness shall be first provided and then sufficient metal added thereto so that the bottom of the ring-joint groove, or the contact face of the groove or female is in the same plane as the flange edge of a full thickness flange.

6.3.2 *For Lapped Joints,* facings shall be furnished as follows:

6.3.2.1 *Raised Face.* Finished height of face shall be no less than pipe wall thickness.

6.3.2.2 *Large Male and Female.* Finished height of male shall be no less than wall thickness of pipe used or 1/4 in., whichever is greater. Thickness of lap remaining after machining female face shall be no less than wall thickness of pipe used.

6.3.2.3 *Tongue and Groove.* Thickness of lap remaining after machining tongue or groove face shall be no less than wall thickness of pipe used.

6.3.2.4 *Ring-Joint.* Thickness of lap remaining after machining ring-groove shall be no less than wall thickness of pipe used.

6.3.2.5 The outside diameters of lap for ring joints are shown in Table 10, dimension K. The outside diameters of laps for large female, large tongue and groove and small tongue and groove are shown in Table 9. Small male and female are not used with lapped joints.

6.3.3 *Blind Flanges* need not be faced in the center if, when this center part is raised, its diameter is at least 1 in. smaller than the inside diameter of the corresponding pressure class fitting, as given in the tables. 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 the tables. Machining of the depressed center is not required.

6.3.4 The finish of facings shall be in accordance with MSS Standard Finishes for Contact Faces of Connecting-end Flanges of Ferrous Valves and Fittings (SP-6).

6.4 **Flange Bolt Holes.** Bolt holes are in multiples of four so that fittings may face in any quarter. Bolt holes shall straddle the center lines.

*6.5 **Spot Facing.** All cast and forged steel flanges, flanged fittings and flanged valves shall have bearing surfaces for bolting which shall be parallel to the flange face within 1 deg. Any back facing or spot facing required to accomplish parallelism shall not reduce the flange thickness "C" below the dimensions given in Tables 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29, 30, 32 and 33. Diameter of spot facing shall be in accordance with MSS Standard Practice, Spot Facing for Bronze, Iron and Steel Flanges (SP-9).

*6.6 **Welding End Preparation, Valves and Flanges.** Welding ends shall be in conformance with USAS B16.25 and for convenience are shown in Figures 9, 10, 11, 12, 13 and 14. The welding groove contour is applicable to welding neck flanges or to valves.

The contour of the outside of the welding neck flanges beyond the welding groove is shown in Figs. 13 and 14. The outside and inside contours for valves are shown in Figs. 9, 10, 11 and 12. Three types of internal machining for welding ends have been standardized and are as shown in Figs. 9, 10, 11 and 12. These types are as follows:

Figs. 9 and 10 – for use without backing rings or with split backing rings.
Fig. 11 – for use with continous taper backing rings.
Fig. 12 – for use with continuous rectangular rings.
Figs. 9 and 10 are regularly furnished unless otherwise specified.

*6.7 **Reducing Flanges.**

6.7.1 *Drilling, OD, Thickness and Facing Dimensions.* Flange drilling, OD, thickness, and facing are the same as those of the standard flange of the size from which the reduction is being made.

6.7.2 *Hub Dimensions.*

6.7.2.1 *Threaded and Slip-On Flanges.* The hub dimensions 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 12.

6.7.2.2 *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.

6.8 Thread of Screwed Flanges. The flanges shall have an USA Standard taper pipe thread conforming to USAS B2.1. The thread shall be concentric with the axis of the flange and variations in alignment shall not exceed 1/16 in. per foot.

6.8.1 150-lb flanges are made without a counterbore and 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 to afford easy entrance in making a joint and to protect the thread. The chamfer shall be concentric with the thread and shall be included in the measurement of the thread length.

6.8.2 300-lb and higher pressure flanges are made with a counterbore and the threads shall be chamfered to the diameter of the counterbore at the back of the flange at an angle of approximately 45 deg with the axis of the threads to afford easy entrance in making a joint. The chamfer shall be concentric with the thread.

6.8.3 The minimum length of effective thread in reducing flanges shall be at least equal to dimension T of the corresponding pressure class screwed flange as shown in the tables but does not necessarily extend to the face of the flange. See Table 12 for reducing screwed flanges.

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

6.8.5 Appendix A to the standard is taken from the USA Standard for Pipe Threads, B2.1 and indicates the amount in inches 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 both parts are assembled by power.

6.9 Stud-Bolts, Bolts and Nuts.

6.9.1 *Alloy-steel* stud-bolts threaded at both ends or full length, or bolts with hexagonal heads, semi-finished and conforming to USA Standard heavy dimensions (USAS B18.2.1) may be used and shall have semi-finished nuts conforming to USA Standard heavy dimensions (USAS B18.2.2).

6.9.2 *Alloy-steel* stud-bolts, with a nut at each end are recommended for high-temperature service. Stud-bolt lengths are specified in Tables 13, 16, 19, 22, 25, 28 and 31 and include the thickness of two nuts. The stud-bolt lengths given in the tables *do not* include the height of any point. A point is that part of a stud-bolt or a bolt beyond the thread and may be chamfered, rounded, or sheared. For method of calculating bolt lengths not given in tables see Appendix F.

These lengths are established as a standard for the convenience of industry to simplify the assembly of these parts on construction work, but consumers may select combinations of these bolt lengths to suit their needs.

6.9.3 *Carbon-steel* bolts may have USA Standard regular square heads or USA Standard heavy hexagonal heads USAS B18.2.1 and shall have USA Standard heavy hexagonal nuts (USAS B18.2.2).

6.9.4 All carbon-steel bolts and stud-bolts, shall have USA Standard, USAS B1.1, Coarse Threads, Class 2A and their nuts, Class 2B.

6.9.5 All alloy steel bolting shall be threaded in accordance with USAS B1.1. Nominal diameters 1 in. and smaller shall be of the coarse thread series; nominal diameters 1 1/8 in. and larger shall be of the 8-thread series. Bolts, studs, and stud-bolts shall have a Class 2A dimensions, and nuts shall have Class 2B dimensions.

6.9.6 The regular end flange bolting is based on a stress not to exceed 7,000 psi assuming the primary service pressure to act upon an area circumscribed by the outside diameter of raised face etc., Column R, Table 9.

6.10 Gaskets.

6.10.1 Ring joint gasket dimensions shall conform to USAS B16.20.

6.10.2 For flanges with raised face, or with large male-and-female face, gaskets shall conform with limiting dimensions of Appendix E.

6.10.3 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 Paragraph 7.2.1 for tolerance applicable to groove.) Solid flat metal gaskets shall have contact width not greater than for Group III gaskets.

6.10.4 For flanges with small male-and-female face, care must be taken to insure that adequate bearing surface is provided for the gaskets. This applies particularly where the joint is made on the end of pipe. See Figure 8.

6.11 Drains.

6.11.1 *Pipe Thread Tapping.* Holes may be tapped in the wall of a fitting or valve if the metal is thick enough to allow the effective thread length specified in Fig. 4. Where thread length is insufficient or the tapped hole needs reinforcement, a boss should be added.

6.11.2 *Welded Connections.*

6.11.2.1 *Sockets.* Sockets (socket welding) may be provided in the wall of a fitting or valve if the metal is thick enough to afford the depth of socket and retaining wall specified in Fig. 5. Where the wall thickness is insufficient, or the size of socket requires opening reinforcement, a boss should be added.

6.11.2.2 *Butt-Weld.* Drain connections may be attached by butt-welding directly to the wall of the fitting. See Fig. 6.

6.11.3 *Bosses.* Where bosses are required the diameters shall be not less than those shown in Fig. 7 and the height shall provide lengths as specified in Fig. 4 or in Fig. 5.

6.11.4 *Drains.* Drain tappings shall be in accordance with MSS Drain Tapping Standard (SP-45). For convenience, pertinent portions of that standard are as follows:

| Size of Fitting or Valve-Inches | 2 to 4 | 5 to 8 | 10 to 24 |
|---|---|---|---|
| Size of Drain Tapping-Inches | 1/2 | 3/4 | 1 |

6.11.5 *Designating Locations.* The means of designating the locations of tapped holes or sockets for drains in fittings is shown in Fig. 1 and for drains in valves in Fig. 2.

Each possible location is designated by a letter so that the desired locations for the various types of fittings or valves may be specified without using further sketches or description.

## 7. TOLERANCES

7.1 Center-to-Contact Surfaces, and Center-to-End (Ring-Joint).

7.1.1 *Center-to-Contact Surfaces* (other than ring-joint).

Sizes 10 in. and smaller ± 1/32 in.
Sizes 12 in. and larger ± 1/16 in.

7.1.2 *Center-to-End* (ring-joint).

Sizes 10 in. and smaller ± 1/32 in.
Sizes 12 in. and larger ± 1/16 in.

7.1.3 *Contact Surface-to-Contact Surface* (other than ring-joint).

Sizes 10 in. and smaller ± 1/16 in.
Sizes 12 in. and larger ± 1/8 in.

7.1.4 *End-to-End* (ring-joint).

Sizes 10 in. and smaller ± 1/16 in.
Sizes 12 in. and larger ± 1/8 in.

7.2 Facings.

7.2.1 Inside and Outside Diameter of large and small tongue and groove and females, ±1/64 in.

7.2.2 Outside Diameter, 1/16 in. raised face, ±1/32 in.

7.2.3 Outside Diameter, 1/4 in. raised face, ± 1/64 in.

7.2.4 Ring-joint Groove Tolerances are shown in Table 10.

*7.3 Flange Thickness.

Sizes 18 in. and smaller + 1/8 in. −zero in.
Sizes 20 in. and larger + 3/16 in. −zero in.

*7.4 Hub Dimensions (Incl. Welding Ends).

7.4.1 Nominal Outside Diameter of Welding End *(Dimension A).*
Figs. 9, 10, 13, and 14.

Valves, (See Table 11) + zero in. − 1/32 in.

Welding Neck Flanges,
Sizes 5 in. and smaller + 3/32 in. − 1/32 in.
Sizes 6 in. and larger + 5/32 in. − 1/32 in.

7.4.2 Nominal Inside Diameter of welding ends of Valves and Welding Neck Flanges *(Dimension B).*
Figs. 9, 10, 13, and 14.
Sizes 10 in. and smaller ±1/32 in.
Sizes 12 in. to 18 in. inclusive ±1/16 in.
Sizes 20 in. and larger + 1/8 in. − 1/16 in.

Fig. 11.
Sizes 10 in. and smaller + zero in. − 1/32 in.
Sizes 12 in. and larger + zero in. − 1/16 in.

7.4.3 Bore for Backing Ring of Valves and Welding Neck Flanges *(Dimension C).* Fig. 11 and 12.

All sizes + 0.010 in. − 0.000 in.

7.4.4 *Thickness of Hub.*

Regardless of tolerances specified for dimensions A and B, the thickness of hub shall never be less than 87 1/2 per cent of the nominal thickness of the pipe to which the flange is to be attached.

7.5 Overall Length of Hub on Welding Neck Flanges.

Sizes 10 in. and smaller ± 1/16 in.
Sizes 12 in. and larger ± 1/8 in.

7.6 Bore of Flanges.

7 6.1 *Lapped, Slip-on and Socket-welding Flanges.*

Sizes 10 in. and smaller + 1/32 in. – zero in.
Sizes 12 in. and larger + 1/16 in. – zero in.

7.6.2 *Counterbore, Screwed and Socket-welding Flanges.*

Sizes 10 in. and smaller + 1/32 in. – zero in.
Sizes 12 in. and larger + 1/16 in. – zero in.

7.7 Drilling and Facing.

7.7.1 Bolt Circle Diameter ± 1/16 in.

7.7.2 Center-to-center of adjacent bolt holes ± 1/32 in.

7.7.3 Eccentricity between bolt circle diameter and machined facing diameters 1/32 in. max.

## 8. TEST

8.1 Valves and Flanged Fittings shall be given a hydrostatic shell test as specified in Par. 8.3.

8.2 Flanges are not required to be hydrostatically tested. Flanges attached to (or integral with) piping, pressure vessels, or other equipment may be hydrostatically tested at higher test pressures than specified in 8.3, in which case testing shall be done at the responsibility of the user. In such cases attention should be given to gasket design to avoid excessive deformation of the flange.

8.3 Except as permitted by Par. 8.2 hydrostatic test pressure shall be as specified in Tables 2 to 8 inclusive, for the material and primary service pressure rating of the item tested. These pressures are 1 1/2 times the 100F rating, rounded-off to next higher 25 psi increment. The test shall be made with water, at a temperature not above 125F, and no visible leakage is permitted.

*Table 1 List of Material Specifications [1]

| General Classification [3,8] | Applicable ASTM Specification | |
|---|---|---|
| | Forgings | Castings |
| Carbon Steel | A105 Grade I<br>A105 Grade II<br>A181 Grade I [5]<br>A181 Grade II [5] | A216 Grade WCB |
| Carbon Steel (low temp.) | A350 Grade LF1 and LF2 [7] | A352 Grade LCB [7] |
| Carbon Moly | A182 Grade F1 | A217 Grade WC1 |
| Carbon Moly (low temp.) | | A352 Grade LC1 [7] |
| 1/2 Cr-1/2 Mo | A335 Grade 82 [6] | A217 Grade WC4 |
| 1 Cr-1/2 Mo | A182 Grade F12 | |
| 1-1/4 Cr-1/2 Mo | A182 Grade F11 | A217 Grade WC6 |
| 2 Cr-1/2 Mo | A335 Grade P36 [6] | |
| 2-1/4 Cr-1 Mo | A182 Grade F22 | A217 Grade WC9 |
| 3 Cr-1 Mo | A335 Grade P21 [6] | |
| 5 Cr-1/2 Mo | A182 Grade F5a | A217 Grade C5 |
| 5 Cr-1/2 Mo-Si | A335 Grade P56 [6] | |
| 9 Cr-1 Mo | A182 Grade F9 | A217 Grade C12 |
| Type 304 | A182 Grade F304 | A351 Grade CF8 |
| Type 304L | A182 Grade 304L | |
| Type 310 | A182 Grade F310 | |
| Type 347 | A182 Grade F347 | A351 Grade CF8c |
| Type 321 | A182 Grade F321 | |
| Type 316 | A182 Grade F316 | A351 Grade CF8M |
| Type 316L | A182 Grade 316L | |
| 2 Ni | | A352 Grade LC2 [7] |
| 3 1/2 Ni | A350 Grade LF3 [7] | A352 Grade LC3 [7] |
| Cr-Cu-Ni-Al Low Alloy | A350 Grade LF4 [7] | |
| 9 Ni | A522 | |

Bolting [2]

| Bolts, Stud-Bolts, Studs | Nuts |
|---|---|
| ASTM A193<br>ASTM A307 Grade B<br>ASTM A320<br>ASTM A354 | ASTM A 194<br>ASTM A307 |

[1] See Par. 5.1

[2] See Par. 5.2 and 6.9.

[3] These classifications are used to group materials for pressure-temperature ratings in Tables 2 to 8 incl.

[4] For method of rating alloy steels not given in Tables 1 to 8 inclusive. See Appendix D.

[5] 150-lb and 300-lb classes only.

[6] ASTM specifications directly covering forged flanges, flanged fittings and valves for these general material specifications do not presently exist. Flanges, flanged fittings and valves of these materials shall be specified to conform to the nearest grade in A182, except chemistry to conform to the ASTM specification listed above.

[7] Primarily intended for low temperature service, below −20F (for pressure rating, see Par. 2.2). Where these materials are also used above −20F, they shall have the same ratings as shown for ferritic steels listed in Tables 2 through 8 for temperatures up to and including 650F.

[8] All steels listed may be used for subzero service at the same pressure rating as for ferritic steels listed in Tables 2 through 8 inclusive at −20F.

## Table 2 – 150-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½ – ½ | Cr-Mo 1 – ½ | Cr-Mo 1¼ – ½ | Cr-Mo 2 – ½ | Cr-Mo 2¼ – 1 | Cr-Mo 3 – 1 | Cr-Mo 5 – ½ | Cr-Mo 5-½-Si | Cr-Mo 9 – 1 | 304 | TYPES 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| −20 to 100[2] | | | | | | | | 275 | | | | | | | | | | −20 to 100 |
| 150 | | | | | | | | 255 | | | | | | | | | | 150 |
| 200 | | | | | | | | 240 | | | | | | | | | | 200 |
| 250 | | | | | | | | 225 | | | | | | | | | | 250 |
| 300 | | | | | | | | 210 | | | | | | | | | | 300 |
| 350 | | | | | | | | 195 | | | | | | | | | | 350 |
| 400 | | | | | | | | 180 | | | | | | | | | | 400 |
| 450 | | | | | | | | 165 | | | | | | | | | | 450 |
| 500 | | | | | | | | 150 | | | | | | | | | | 500 |
| 550 | | | | | | | | 140 | | | | | | | | | | 550 |
| 600 | | | | | | | | 130 | | | | | | | | | | 600 |
| 650 | | | | | | | | 120 | | | | | | | | | | 650 |
| 700 | | | | | | | | 110 | | | | | | | | | | 700 |
| 750 | | | | | | | | 100 | | | | | | | | | | 750 |
| 800 | | | | | | | | 92 | | | | | | | | | | 800 |
| 850 | 82[1] | | | | | | | 82 | | | | | | | | — | 82 | 850 |
| 875 | 75[1] | 75[1] | | | | | | 75 | | | | | | | | — | — | 875 |
| 900 | 70[1] | 70[1] | | | | | | 70 | | | | | | | | — | — | 900 |
| 925 | 60[1] | 60[1] | | | | | | 60 | | | | | | | | — | — | 925 |
| 950 | 55[1] | 55[1] | | | | | | 55 | | | | | | | | — | — | 950 |
| 975 | 50[1] | 50[1] | | | | | | 50 | | | | | | | | — | — | 975 |
| 1000 | 40[1] | 40[1] | | | | | | 40 | | | | | | | | — | — | 1000 |
| Hydrostatic Shell Test Pressure | | | | | | | | 425 | | | | | | | | | | |

* NOTES:

[1] For limitations on code applications, see Par. 2.3.

[2] For low temperature ratings including other materials, see Par. 2.2

## Table 3 – 300-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½–½ | Cr-Mo 1–½ | Cr-Mo 1¼–½ | Cr-Mo 2–½ | Cr-Mo 2¼–1 | Cr-Mo 3–1 | Cr-Mo 5–½ | Cr-Mo 5-½-Si | Cr-Mo 9–1 | TYPES: 304 | 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| –20 to 100[2] | | | | | | 720 | | | | | | 615 | | 720 | | 515 | 515 | –20 to 100 |
| 150 | | | | | | 710 | | | | | | 585 | | 710 | | 510 | 515 | 150 |
| 200 | | | | | | 700 | | | | | | 550 | | 700 | | 505 | 515 | 200 |
| 250 | | | | | | 690 | | | | | | 520 | | 690 | | 465 | 495 | 250 |
| 300 | | | | | | 680 | | | | | | 495 | | 680 | | 430 | 475 | 300 |
| 350 | | | | | | 675 | | | | | | 470 | | 675 | | 395 | 435 | 350 |
| 400 | | | | | | 665 | | | | | | 450 | | 665 | | 360 | 395 | 400 |
| 450 | | | | | | 650 | | | | | | 430 | | 650 | | 340 | 380 | 450 |
| 500 | | | | | | 625 | | | | | | 410 | | 625 | | 320 | 360 | 500 |
| 550 | | | | | | 590 | | | | | | 395 | | 590 | | 310 | 350 | 550 |
| 600 | | | | | | 555 | | | | | | 380 | | 555 | | 300 | 335 | 600 |
| 650 | | | | | | 515 | | | | | | 370 | | 515 | | 290 | 325 | 650 |
| 700 | 470 | 480 | 480 | 485 | 485 | 480 | 485 | 480 | 485 | 480 | 485 | 355 | 495 | | 490 | 280 | 310 | 700 |
| 750 | 425 | 445 | 445 | 450 | 450 | 445 | 450 | 445 | 450 | 445 | 450 | 340 | 470 | | 465 | 275 | 300 | 750 |
| 800 | 365 | 410 | 410 | 415 | 415 | 410 | 415 | 410 | 415 | 410 | 415 | 330 | 450 | | 440 | 265 | 290 | 800 |
| 850 | 300[1] | 370 | 370 | 385 | 385 | 370 | 385 | 370 | 385 | 370 | 385 | 320 | 425 | | 415 | | 280 | 850 |
| 875 | 260[1] | 355[1] | 355 | 365 | 365 | 355 | 365 | 355 | 365 | 355 | 365 | 315 | 415 | | 400 | | | 875 |
| 900 | 225[1] | 335[1] | 335 | 350 | 350 | 335 | 350 | 335 | 350 | 335 | 350 | 310 | 400 | | 390 | | | 900 |
| 925 | 190[1] | 320[1] | 320 | 335 | 335 | 320 | 335 | 320 | 335 | 320 | 335 | 305 | 390 | | 375 | | | 925 |
| 950 | 155[1] | 300[1] | 300 | 315 | 315 | 300 | 315 | 300 | 315 | 300 | 315 | 305 | 380 | | 365 | | | 950 |
| 975 | 120[1] | 280[1] | 280 | 300 | 300 | 280 | 300 | 275 | 300 | 250 | 300 | 300 | 370 | | 350 | | | 975 |
| 1000 | 85[1] | 215[1] | 215 | 255 | 265 | 215 | 265 | 240 | 250 | 190 | 290 | 300 | 355 | | 340 | | | 1000 |
| 1025 | | | | 215 | 230[1] | 180 | 235 | 215 | 215 | 155 | 240 | 295 | 345 | | 325 | | | 1025 |
| 1050 | | | | 170 | 190[1] | 145 | 200 | 190 | 180 | 120 | 190 | 290 | 335 | | 315 | | | 1050 |
| 1075 | | | | 135 | 165[1] | 120 | 170[1] | 165 | 145 | 105 | 150 | 275 | 325 | | 300 | | | 1075 |
| 1100 | | | | 95 | 135[1] | 95 | 145[1] | 135 | 115 | 85 | 115 | 255 | 310 | | 290 | | | 1100 |
| 1125 | | | | 75[1] | 110[1] | 75 | 125[1] | 115 | 95 | 75 | 95 | 225 | 300 | | 270 | | | 1125 |
| 1150 | | | | 55[1] | 85[1] | 60 | 105[1] | 95 | 75 | 60 | 75 | 195 | 260 | 290 | 250 | | | 1150 |
| 1175 | | | | 45[1] | 65[1] | 50 | 85[1] | 70 | 65 | 50 | 65 | 175 | 215 | 260 | 225 | | | 1175 |
| 1200 | | | | 35[1] | 40[1] | 40 | 70[1] | 50 | 50 | 40 | 50 | 155 | 170 | 235 | 205 | | | 1200 |
| 1225 | | | | | | | | | | | | 135 | 140 | 205 | 185 | | | 1225 |
| 1250 | | | | | | | | | | | | 110 | 115 | 180 | 165 | | | 1250 |
| 1275 | | | | | | | | | | | | 100 | 95 | 160 | 140 | | | 1275 |
| 1300 | | | | | | | | | | | | 85 | 75 | 135 | 120 | | | 1300 |
| 1325 | | | | | | | | | | | | 75 | 65 | 115 | 100 | | | 1325 |
| 1350 | | | | | | | | | | | | 60 | 50 | 95 | 80 | | | 1350 |
| 1375 | | | | | | | | | | | | 55 | 45 | 80 | 70 | | | 1375 |
| 1400 | | | | | | | | | | | | 50 | 40 | 70 | 55 | | | 1400 |
| 1425 | | | | | | | | | | | | 40 | 35 | 60 | 45 | | | 1425 |
| 1450 | | | | | | | | | | | | 35 | 30 | 50 | 40 | | | 1450 |
| 1475 | | | | | | | | | | | | 30 | 30 | 45 | 30 | | | 1475 |
| 1500 | | | | | | | | | | | | 25 | 25 | 35 | 25 | | | 1500 |
| Hydrostatic Shell Test Pressure | | | | | | 1100 | | | | | | 925 | | 1100 | | 775 | | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3.

[2] For low temperature ratings including other materials, see Par. 2.2.

## Table 4 – 400-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material | | | | | | | | | | | | | | | | | | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Carbon Steel | Carbon Moly | Cr-Mo ½ – ½ | Cr-Mo 1 – ½ | Cr-Mo 1¼ – ½ | Cr-Mo 2 – ½ | Cr-Mo 2¼ – 1 | Cr-Mo 3 – 1 | Cr-Mo 5 – ½ | Cr-Mo 5-½-Si | Cr-Mo 9* – 1 | TYPES 304 | 347 & 321 | 316 | 310 | 304L | 316L | |
| –20 to 100[2] | | | | | | 960 | | | | | | 825 | | 960 | | 685 | 685 | –20 to 100 |
| 150 | | | | | | 945 | | | | | | 775 | | 945 | | 680 | 685 | 150 |
| 200 | | | | | | 930 | | | | | | 730 | | 930 | | 670 | 685 | 200 |
| 250 | | | | | | 920 | | | | | | 695 | | 920 | | 625 | 660 | 250 |
| 300 | | | | | | 910 | | | | | | 660 | | 910 | | 575 | 635 | 300 |
| 350 | | | | | | 900 | | | | | | 630 | | 900 | | 530 | 580 | 350 |
| 400 | | | | | | 890 | | | | | | 600 | | 890 | | 485 | 525 | 400 |
| 450 | | | | | | 870 | | | | | | 575 | | 870 | | 455 | 505 | 450 |
| 500 | | | | | | 835 | | | | | | 550 | | 835 | | 425 | 485 | 500 |
| 550 | | | | | | 790 | | | | | | 530 | | 790 | | 410 | 465 | 550 |
| 600 | | | | | | 740 | | | | | | 510 | | 740 | | 400 | 445 | 600 |
| 650 | | | | | | 690 | | | | | | 490 | | 690 | | 385 | 430 | 650 |
| 700 | 635 | 640 | 640 | 645 | 645 | 640 | 645 | 640 | 645 | 640 | 645 | 475 | 660 | | 655 | 375 | 415 | 700 |
| 750 | 575 | 590 | 590 | 600 | 600 | 590 | 600 | 590 | 600 | 590 | 600 | 455 | 625 | | 620 | 365 | 400 | 750 |
| 800 | 490 | 545 | 545 | 555 | 555 | 545 | 555 | 545 | 555 | 545 | 555 | 440 | 595 | | 585 | 355 | 385 | 800 |
| 850 | 400[1] | 495 | 495 | 510 | 510 | 495 | 510 | 495 | 510 | 495 | 510 | 425 | 565 | | 550 | | 375 | 850 |
| 875 | 350[1] | 470[1] | 470 | 490 | 490 | 470 | 490 | 470 | 490 | 470 | 490 | 420 | 550 | | 535 | | | 875 |
| 900 | 295[1] | 450[1] | 450 | 465 | 465 | 450 | 465 | 450 | 465 | 450 | 465 | 415 | 535 | | 520 | | | 900 |
| 925 | 250[1] | 425[1] | 425 | 445 | 445 | 425 | 445 | 425 | 445 | 425 | 445 | 410 | 520 | | 500 | | | 925 |
| 950 | 205[1] | 400[1] | 400 | 420 | 420 | 400 | 420 | 400 | 420 | 400 | 420 | 405 | 505 | | 485 | | | 950 |
| 975 | 160[1] | 370[1] | 370 | 400 | 400 | 370 | 400 | 365 | 400 | 330 | 400 | 405 | 490 | | 470 | | | 975 |
| 1000 | 115[1] | 285[1] | 285 | 345 | 355 | 285 | 355 | 320 | 335 | 250 | 390 | 400 | 475 | | 450 | | | 1000 |
| 1025 | | | | 285 | 305[1] | 240 | 310 | 285 | 285 | 205 | 320 | 395 | 460 | | 435 | | | 1025 |
| 1050 | | | | 230 | 250[1] | 190 | 265 | 250 | 240 | 160 | 250 | 390 | 445 | | 415 | | | 1050 |
| 1075 | | | | 180 | 215[1] | 160 | 230[1] | 215 | 195 | 135 | 200 | 365 | 430 | | 400 | | | 1075 |
| 1100 | | | | 130 | 185[1] | 125 | 190[1] | 185 | 150 | 115 | 150 | 345 | 415 | | 390 | | | 1100 |
| 1125 | | | | 100[1] | 150[1] | 105 | 165[1] | 155 | 125 | 100 | 125 | 305 | 400 | | 360 | | | 1125 |
| 1150 | | | | 70[1] | 115[1] | 80 | 135[1] | 125 | 100 | 80 | 100 | 265 | 345 | 390 | 330 | | | 1150 |
| 1175 | | | | 60[1] | 85[1] | 65 | 115[1] | 95 | 85 | 70 | 85 | 235 | 290 | 350 | 305 | | | 1175 |
| 1200 | | | | 45[1] | 55[1] | 55 | 90[1] | 70 | 70 | 55 | 70 | 205 | 230 | 310 | 275 | | | 1200 |
| 1225 | | | | | | | | | | | | 175 | 190 | 275 | 245 | | | 1225 |
| 1250 | | | | | | | | | | | | 150 | 150 | 240 | 215 | | | 1250 |
| 1275 | | | | | | | | | | | | 130 | 125 | 215 | 190 | | | 1275 |
| 1300 | | | | | | | | | | | | 110 | 100 | 185 | 160 | | | 1300 |
| 1325 | | | | | | | | | | | | 95 | 85 | 155 | 135 | | | 1325 |
| 1350 | | | | | | | | | | | | 80 | 70 | 125 | 105 | | | 1350 |
| 1375 | | | | | | | | | | | | 75 | 60 | 105 | 90 | | | 1375 |
| 1400 | | | | | | | | | | | | 65 | 55 | 90 | 75 | | | 1400 |
| 1425 | | | | | | | | | | | | 55 | 50 | 80 | 60 | | | 1425 |
| 1450 | | | | | | | | | | | | 45 | 40 | 70 | 50 | | | 1450 |
| 1475 | | | | | | | | | | | | 40 | 40 | 55 | 40 | | | 1475 |
| 1500 | | | | | | | | | | | | 35 | 35 | 45 | 35 | | | 1500 |
| Hydrostatic Shell Test Pressure | 1450 | | | | | | | | | | | 1250 | 1450 | | | 1025 | | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3

[2] For low temperature ratings including other materials, see Par. 2.2.

## Table 5 – 600-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½ – ½ | Cr-Mo 1 – ½ | Cr-Mo 1¼ – ½ | Cr-Mo 2 – ½ | Cr-Mo 2¼ – 1 | Cr-Mo 3 – 1 | Cr-Mo 5 – ½ | Cr-Mo 5-½ Si | Cr-Mo 9 – 1 | TYPES 304 | 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| –20 to 100[2] | | | | | | 1440 | | | | | | 1235 | | 1440 | | 1030 | 1030 | –20 to 100 |
| 150 | | | | | | 1420 | | | | | | 1165 | | 1420 | | 1020 | 1030 | 150 |
| 200 | | | | | | 1400 | | | | | | 1095 | | 1400 | | 1005 | 1030 | 200 |
| 250 | | | | | | 1380 | | | | | | 1040 | | 1380 | | 935 | 990 | 250 |
| 300 | | | | | | 1365 | | | | | | 985 | | 1365 | | 860 | 955 | 300 |
| 350 | | | | | | 1350 | | | | | | 945 | | 1350 | | 795 | 870 | 350 |
| 400 | | | | | | 1330 | | | | | | 900 | | 1330 | | 725 | 790 | 400 |
| 450 | | | | | | 1305 | | | | | | 860 | | 1305 | | 680 | 755 | 450 |
| 500 | | | | | | 1250 | | | | | | 825 | | 1250 | | 640 | 725 | 500 |
| 550 | | | | | | 1180 | | | | | | 795 | | 1180 | | 615 | 695 | 550 |
| 600 | | | | | | 1110 | | | | | | 765 | | 1110 | | 600 | 670 | 600 |
| 650 | | | | | | 1030 | | | | | | 735 | | 1030 | | 575 | 645 | 650 |
| 700 | 940 | 960 | 960 | 965 | 965 | 960 | 965 | 960 | 965 | 960 | 965 | 710 | 985 | | 980 | 560 | 620 | 700 |
| 750 | 850 | 890 | 890 | 900 | 900 | 890 | 900 | 890 | 900 | 890 | 900 | 685 | 940 | | 930 | 545 | 600 | 750 |
| 800 | 730 | 815 | 815 | 835 | 835 | 815 | 835 | 815 | 835 | 815 | 835 | 660 | 895 | | 880 | 535 | 580 | 800 |
| 850 | 600[1] | 745 | 745 | 765 | 765 | 745 | 765 | 745 | 765 | 745 | 765 | 640 | 850 | | 830 | | 560 | 850 |
| 875 | 525[1] | 710[1] | 710 | 735 | 735 | 710 | 735 | 710 | 735 | 710 | 735 | 630 | 825 | | 805 | | | 875 |
| 900 | 445[1] | 670[1] | 670 | 700 | 700 | 670 | 700 | 670 | 700 | 670 | 700 | 620 | 805 | | 780 | | | 900 |
| 925 | 375[1] | 635[1] | 635 | 665 | 665 | 635 | 665 | 635 | 665 | 635 | 665 | 615 | 780 | | 755 | | | 925 |
| 950 | 310[1] | 600[1] | 600 | 635 | 635 | 600 | 635 | 600 | 635 | 600 | 635 | 610 | 760 | | 725 | | | 950 |
| 975 | 240[1] | 555[1] | 555 | 600 | 600 | 555 | 600 | 550 | 600 | 495 | 600 | 605 | 735 | | 700 | | | 975 |
| 1000 | 170[1] | 430[1] | 430 | 515 | 535 | 425 | 535 | 480 | 500 | 375 | 585 | 600 | 715 | | 675 | | | 1000 |
| 1025 | | | | 430 | 455[1] | 355 | 465 | 430 | 430 | 310 | 480 | 595 | 690 | | 650 | | | 1025 |
| 1050 | | | | 345 | 375[1] | 290 | 400 | 375 | 355 | 240 | 375 | 585 | 670 | | 625 | | | 1050 |
| 1075 | | | | 265 | 325[1] | 240 | 345[1] | 325 | 290 | 205 | 300 | 550 | 645 | | 600 | | | 1075 |
| 1100 | | | | 190 | 275[1] | 190 | 290[1] | 275 | 225 | 170 | 225 | 515 | 625 | | 585 | | | 1100 |
| 1125 | | | | 150[1] | 225[1] | 155 | 245[1] | 230 | 190 | 145 | 190 | 455 | 600 | | 540 | | | 1125 |
| 1150 | | | | 105[1] | 170[1] | 120 | 205[1] | 185 | 150 | 125 | 150 | 395 | 520 | 585 | 495 | | | 1150 |
| 1175 | | | | 85[1] | 125[1] | 100 | 170[1] | 145 | 125 | 105 | 125 | 350 | 430 | 525 | 455 | | | 1175 |
| 1200 | | | | 70[1] | 80[1] | 80 | 135[1] | 105 | 105 | 80 | 105 | 310 | 345 | 465 | 410 | | | 1200 |
| 1225 | | | | | | | | | | | | 265 | 285 | 415 | 370 | | | 1225 |
| 1250 | | | | | | | | | | | | 225 | 225 | 365 | 325 | | | 1250 |
| 1275 | | | | | | | | | | | | 195 | 190 | 320 | 285 | | | 1275 |
| 1300 | | | | | | | | | | | | 170 | 150 | 275 | 240 | | | 1300 |
| 1325 | | | | | | | | | | | | 145 | 125 | 230 | 200 | | | 1325 |
| 1350 | | | | | | | | | | | | 125 | 105 | 185 | 160 | | | 1350 |
| 1375 | | | | | | | | | | | | 110 | 95 | 160 | 135 | | | 1375 |
| 1400 | | | | | | | | | | | | 95 | 80 | 135 | 110 | | | 1400 |
| 1425 | | | | | | | | | | | | 80 | 70 | 120 | 95 | | | 1425 |
| 1450 | | | | | | | | | | | | 70 | 60 | 105 | 75 | | | 1450 |
| 1475 | | | | | | | | | | | | 60 | 55 | 85 | 65 | | | 1475 |
| 1500 | | | | | | | | | | | | 50 | 50 | 70 | 50 | | | 1500 |
| Hydrostatic Shell Test Pressure | | | | | | 2175 | | | | | | 1875 | 2175 | | | 1550 | | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3

[2] For low temperature ratings including other materials, see Par. 2.2.

## Table 6 – 900-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½–½ | Cr-Mo 1–½ | Cr-Mo 1¼–½ | Cr-Mo 2–½ | Cr-Mo 2¼–1 | Cr-Mo 3–1 | Cr-Mo 5–½ | Cr-Mo 5-½-Si | Cr-Mo 9–1 | TYPES: 304 | 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| −20 to 100[2] | | | | | | 2160 | | | | | | 1850 | | 2160 | | 1545 | 1545 | −20 to 100 |
| 150 | | | | | | 2130 | | | | | | 1750 | | 2130 | | 1525 | 1545 | 150 |
| 200 | | | | | | 2100 | | | | | | 1645 | | 2100 | | 1510 | 1545 | 200 |
| 250 | | | | | | 2070 | | | | | | 1565 | | 2070 | | 1400 | 1490 | 250 |
| 300 | | | | | | 2050 | | | | | | 1480 | | 2050 | | 1295 | 1430 | 300 |
| 350 | | | | | | 2025 | | | | | | 1415 | | 2025 | | 1190 | 1310 | 350 |
| 400 | | | | | | 2000 | | | | | | 1350 | | 2000 | | 1085 | 1185 | 400 |
| 450 | | | | | | 1955 | | | | | | 1290 | | 1955 | | 1020 | 1135 | 450 |
| 500 | | | | | | 1875 | | | | | | 1235 | | 1875 | | 960 | 1085 | 500 |
| 550 | | | | | | 1775 | | | | | | 1190 | | 1775 | | 925 | 1045 | 550 |
| 600 | | | | | | 1660 | | | | | | 1145 | | 1660 | | 900 | 1005 | 600 |
| 650 | | | | | | 1550 | | | | | | 1105 | | 1550 | | 865 | 970 | 650 |
| 700 | 1410 | 1440 | 1440 | 1450 | 1450 | 1440 | 1450 | 1440 | 1450 | 1440 | 1450 | 1065 | | 1480 | 1470 | 840 | 935 | 700 |
| 750 | 1275 | 1330 | 1330 | 1350 | 1350 | 1330 | 1350 | 1330 | 1350 | 1330 | 1350 | 1025 | | 1410 | 1395 | 820 | 900 | 750 |
| 800 | 1100 | 1225 | 1225 | 1250 | 1250 | 1225 | 1250 | 1225 | 1250 | 1225 | 1250 | 985 | | 1345 | 1320 | 800 | 870 | 800 |
| 850 | 900[1] | 1115 | 1115 | 1150 | 1150 | 1115 | 1150 | 1115 | 1150 | 1115 | 1150 | 960 | | 1275 | 1245 | | 840 | 850 |
| 875 | 785[1] | 1060[1] | 1060 | 1100 | 1100 | 1060 | 1100 | 1060 | 1100 | 1060 | 1100 | 945 | | 1240 | 1205 | | | 875 |
| 900 | 670[1] | 1010[1] | 1010 | 1050 | 1050 | 1010 | 1050 | 1010 | 1050 | 1010 | 1050 | 930 | | 1205 | 1165 | | | 900 |
| 925 | 565[1] | 955[1] | 955 | 1000 | 1000 | 955 | 1000 | 955 | 1000 | 955 | 1000 | 920 | | 1175 | 1130 | | | 925 |
| 950 | 465[1] | 900[1] | 900 | 950 | 950 | 900 | 950 | 900 | 950 | 900 | 950 | 915 | | 1140 | 1090 | | | 950 |
| 975 | 360[1] | 835[1] | 835 | 900 | 900 | 835 | 900 | 825 | 900 | 745 | 900 | 905 | | 1105 | 1050 | | | 975 |
| 1000 | 255[1] | 645[1] | 645 | 770 | 800 | 635 | 800 | 720 | 750 | 565 | 875 | 900 | | 1070 | 1015 | | | 1000 |
| 1025 | | | | 645 | 685[1] | 535 | 700 | 645 | 645 | 465 | 720 | 890 | | 1035 | 975 | | | 1025 |
| 1050 | | | | 515 | 565[1] | 430 | 595 | 565 | 535 | 360 | 565 | 875 | | 1000 | 940 | | | 1050 |
| 1075 | | | | 400 | 490[1] | 355 | 515[1] | 490 | 435 | 310 | 455 | 825 | | 970 | 900 | | | 1075 |
| 1100 | | | | 290 | 410[1] | 285 | 430[1] | 410 | 340 | 255 | 340 | 770 | | 935 | 875 | | | 1100 |
| 1125 | | | | 225[1] | 335[1] | 230 | 370[1] | 345 | 285 | 220 | 285 | 680 | | 900 | 810 | | | 1125 |
| 1150 | | | | 160[1] | 255[1] | 180 | 310[1] | 280 | 225 | 185 | 225 | 590 | 780 | 875 | 745 | | | 1150 |
| 1175 | | | | 130[1] | 190[1] | 150 | 255[1] | 215 | 190 | 155 | 190 | 525 | 650 | 785 | 680 | | | 1175 |
| 1200 | | | | 105[1] | 125[1] | 125 | 205[1] | 155 | 155 | 125 | 155 | 465 | 515 | 700 | 615 | | | 1200 |
| 1225 | | | | | | | | | | | | 400 | 425 | 620 | 555 | | | 1225 |
| 1250 | | | | | | | | | | | | 335 | 340 | 545 | 490 | | | 1250 |
| 1275 | | | | | | | | | | | | 295 | 285 | 480 | 425 | | | 1275 |
| 1300 | | | | | | | | | | | | 250 | 225 | 410 | 360 | | | 1300 |
| 1325 | | | | | | | | | | | | 220 | 190 | 345 | 300 | | | 1325 |
| 1350 | | | | | | | | | | | | 185 | 155 | 280 | 240 | | | 1350 |
| 1375 | | | | | | | | | | | | 165 | 140 | 240 | 205 | | | 1375 |
| 1400 | | | | | | | | | | | | 145 | 125 | 205 | 165 | | | 1400 |
| 1425 | | | | | | | | | | | | 125 | 110 | 180 | 140 | | | 1425 |
| 1450 | | | | | | | | | | | | 105 | 95 | 155 | 115 | | | 1450 |
| 1475 | | | | | | | | | | | | 90 | 85 | 130 | 95 | | | 1475 |
| 1500 | | | | | | | | | | | | 75 | 75 | 105 | 75 | | | 1500 |
| Hydrostatic Shell Test Pressure | | | | | | 3250 | | | | | | 2775 | | 3250 | | | 2325 | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3.

[2] For low temperature ratings including other materials, see Par. 2.2.

## Table 7 – 1500-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½–½ | Cr-Mo 1–½ | Cr-Mo 1¼–½ | Cr-Mo 2–½ | Cr-Mo 2¼–1 | Cr-Mo 3–1 | Cr-Mo 5–½ | Cr-Mo 5-½Si | Cr-Mo 9–1 | TYPES: 304 | 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| –20 to 100[2] | | | | | | 3600 | | | | | | 3085 | | 3600 | | 2570 | 2570 | –20 to 100 |
| 150 | | | | | | 3550 | | | | | | 2915 | | 3550 | | 2545 | 2570 | 150 |
| 200 | | | | | | 3500 | | | | | | 2740 | | 3500 | | 2520 | 2570 | 200 |
| 250 | | | | | | 3450 | | | | | | 2605 | | 3450 | | 2335 | 2480 | 250 |
| 300 | | | | | | 3415 | | | | | | 2470 | | 3415 | | 2155 | 2385 | 300 |
| 350 | | | | | | 3375 | | | | | | 2360 | | 3375 | | 1985 | 2180 | 350 |
| 400 | | | | | | 3330 | | | | | | 2245 | | 3330 | | 1810 | 1975 | 400 |
| 450 | | | | | | 3255 | | | | | | 2150 | | 3255 | | 1705 | 1895 | 450 |
| 500 | | | | | | 3125 | | | | | | 2055 | | 3125 | | 1600 | 1810 | 500 |
| 550 | | | | | | 2955 | | | | | | 1985 | | 2955 | | 1540 | 1740 | 550 |
| 600 | | | | | | 2770 | | | | | | 1910 | | 2770 | | 1500 | 1670 | 600 |
| 650 | | | | | | 2580 | | | | | | 1845 | | 2580 | | 1440 | 1615 | 650 |
| 700 | 2350 | 2400 | 2400 | 2415 | 2415 | 2400 | 2415 | 2400 | 2415 | 2400 | 2415 | 1775 | 2465 | | 2455 | 1400 | 1555 | 700 |
| 750 | 2125 | 2220 | 2220 | 2250 | 2250 | 2220 | 2250 | 2220 | 2250 | 2220 | 2250 | 1710 | 2355 | | 2325 | 1365 | 1500 | 750 |
| 800 | 1830 | 2040 | 2040 | 2080 | 2080 | 2040 | 2080 | 2040 | 2080 | 2040 | 2080 | 1645 | 2240 | | 2200 | 1335 | 1450 | 800 |
| 850 | 1500[1] | 1860 | 1860 | 1915 | 1915 | 1860 | 1915 | 1860 | 1915 | 1860 | 1915 | 1595 | 2125 | | 2070 | | 1400 | 850 |
| 875 | 1305[1] | 1770[1] | 1770 | 1830 | 1830 | 1770 | 1830 | 1770 | 1830 | 1770 | 1830 | 1570 | 2070 | | 2010 | | | 875 |
| 900 | 1115[1] | 1680[1] | 1680 | 1750 | 1750 | 1680 | 1750 | 1680 | 1750 | 1680 | 1750 | 1545 | 2010 | | 1945 | | | 900 |
| 925 | 945[1] | 1590[1] | 1590 | 1665 | 1665 | 1590 | 1665 | 1590 | 1665 | 1590 | 1665 | 1535 | 1955 | | 1880 | | | 925 |
| 950 | 770[1] | 1500[1] | 1500 | 1585 | 1585 | 1500 | 1585 | 1500 | 1585 | 1500 | 1585 | 1525 | 1900 | | 1820 | | | 950 |
| 975 | 600[1] | 1395[1] | 1395 | 1500 | 1500 | 1390 | 1500 | 1370 | 1500 | 1245 | 1500 | 1510 | 1840 | | 1755 | | | 975 |
| 1000 | 430[1] | 1070[1] | 1070 | 1285 | 1335 | 1065 | 1335 | 1200 | 1250 | 945 | 1455 | 1500 | 1785 | | 1690 | | | 1000 |
| 1025 | | | | 1070 | 1140[1] | 890 | 1165 | 1070 | 1070 | 770 | 1200 | 1485 | 1725 | | 1625 | | | 1025 |
| 1050 | | | | 855 | 945[1] | 720 | 995 | 945 | 890 | 600 | 945 | 1455 | 1670 | | 1565 | | | 1050 |
| 1075 | | | | 670 | 815[1] | 595 | 855[1] | 815 | 730 | 515 | 755 | 1370 | 1615 | | 1500 | | | 1075 |
| 1100 | | | | 480 | 685[1] | 470 | 720[1] | 685 | 565 | 430 | 565 | 1285 | 1555 | | 1455 | | | 1100 |
| 1125 | | | | 375[1] | 555[1] | 385 | 615[1] | 575 | 470 | 370 | 470 | 1135 | 1500 | | 1350 | | | 1125 |
| 1150 | | | | 265[1] | 430[1] | 300 | 515[1] | 465 | 375 | 310 | 375 | 985 | 1305 | 1455 | 1245 | | | 1150 |
| 1175 | | | | 220[1] | 315[1] | 255 | 430[1] | 360 | 315 | 255 | 315 | 880 | 1080 | 1310 | 1135 | | | 1175 |
| 1200 | | | | 170[1] | 205[1] | 205 | 345[1] | 255 | 255 | 205 | 255 | 770 | 855 | 1165 | 1030 | | | 1200 |
| 1225 | | | | | | | | | | | | 665 | 710 | 1035 | 920 | | | 1225 |
| 1250 | | | | | | | | | | | | 555 | 565 | 910 | 815 | | | 1250 |
| 1275 | | | | | | | | | | | | 490 | 470 | 795 | 705 | | | 1275 |
| 1300 | | | | | | | | | | | | 420 | 375 | 685 | 600 | | | 1300 |
| 1325 | | | | | | | | | | | | 365 | 315 | 575 | 500 | | | 1325 |
| 1350 | | | | | | | | | | | | 310 | 255 | 465 | 405 | | | 1350 |
| 1375 | | | | | | | | | | | | 275 | 230 | 405 | 340 | | | 1375 |
| 1400 | | | | | | | | | | | | 240 | 205 | 345 | 275 | | | 1400 |
| 1425 | | | | | | | | | | | | 205 | 180 | 300 | 230 | | | 1425 |
| 1450 | | | | | | | | | | | | 170 | 155 | 255 | 190 | | | 1450 |
| 1475 | | | | | | | | | | | | 150 | 140 | 215 | 160 | | | 1475 |
| 1500 | | | | | | | | | | | | 130 | 130 | 170 | 130 | | | 1500 |
| Hydrostatic Shell Test Pressure | | | | | | 5400 | | | | | | 4650 | | 5400 | | | 3850 | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3.

[2] For low temperature ratings including other materials, see Par. 2.2.

## Table 8 – 2500-lb Pressure-Temperature Ratings

*NOTE: These ratings are all subject to stipulations in Par. 2 which form a part of this table. All pressures are in pounds per square inch gage (psig).*

| Service Temperature Deg F | Material: Carbon Steel | Carbon Moly | Cr-Mo ½–½ | Cr-Mo 1–½ | Cr-Mo 1¼–½ | Cr-Mo 2–½ | Cr-Mo 2¼–1 | Cr-Mo 3–1 | Cr-Mo 5–½ | Cr-Mo 5-½-Si | Cr-Mo 9–1 | TYPES 304 | 347 & 321 | 316 | 310 | 304L | 316L | Service Temperature Deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| –20 to 100[2] | | | | | | 6000 | | | | | | 5145 | | 6000 | | 4285 | 4285 | –20 to 100 |
| 150 | | | | | | 5915 | | | | | | 4855 | | 5915 | | 4240 | 4285 | 150 |
| 200 | | | | | | 5830 | | | | | | 4565 | | 5830 | | 4200 | 4285 | 200 |
| 250 | | | | | | 5750 | | | | | | 4340 | | 5750 | | 3895 | 4135 | 250 |
| 300 | | | | | | 5690 | | | | | | 4115 | | 5690 | | 3595 | 3980 | 300 |
| 350 | | | | | | 5625 | | | | | | 3930 | | 5625 | | 3305 | 3635 | 350 |
| 400 | | | | | | 5550 | | | | | | 3745 | | 5550 | | 3020 | 3295 | 400 |
| 450 | | | | | | 5430 | | | | | | 3585 | | 5430 | | 2840 | 3155 | 450 |
| 500 | | | | | | 5210 | | | | | | 3430 | | 5210 | | 2660 | 3020 | 500 |
| 550 | | | | | | 4925 | | | | | | 3305 | | 4925 | | 2565 | 2900 | 550 |
| 600 | | | | | | 4620 | | | | | | 3180 | | 4620 | | **2500** | 2785 | 600 |
| 650 | | | | | | 4300 | | | | | | 3070 | | 4300 | | 2400 | 2690 | 650 |
| 700 | 3920 | 4000 | 4000 | 4025 | 4025 | 4000 | 4025 | 4000 | 4025 | 4000 | 4025 | 2960 | 4110 | | 4090 | 2340 | 2595 | 700 |
| 750 | 3550 | 3700 | 3700 | 3745 | 3745 | 3700 | 3745 | 3700 | 3745 | 3700 | 3745 | 2850 | 3920 | | 3875 | 2280 | **2500** | 750 |
| 800 | 3050 | 3400 | 3400 | 3470 | 3470 | 3400 | 3470 | 3400 | 3470 | 3400 | 3470 | 2745 | 3730 | | 3665 | 2225 | 2415 | 800 |
| 850 | **2500**[1] | 3100 | 3100 | 3190 | 3190 | 3100 | 3190 | 3100 | 3190 | 3100 | 3190 | 2660 | 3540 | | 3455 | | 2335 | 850 |
| 875 | 2180[1] | 2950[1] | 2950 | 3055 | 3055 | 2950 | 3055 | 2950 | 3055 | 2950 | 3055 | 2620 | 3445 | | 3345 | | | 875 |
| 900 | 1855[1] | 2800[1] | 2800 | 2915 | 2915 | 2800 | 2915 | 2800 | 2915 | 2800 | 2915 | 2580 | 3350 | | 3240 | | | 900 |
| 925 | 1570[1] | 2650[1] | 2650 | 2775 | 2775 | 2650 | 2775 | 2650 | 2775 | 2650 | 2775 | 2560 | 3260 | | 3135 | | | 925 |
| 950 | 1285[1] | **2500**[1] | **2500** | 2640 | 2640 | **2500** | 2640 | **2500** | 2640 | **2500** | 2640 | 2540 | 3165 | | 3030 | | | 950 |
| 975 | 1000[1] | 2320[1] | 2320 | **2500** | **2500** | 2315 | **2500** | 2285 | **2500** | 2070 | **2500** | 2520 | 3070 | | 2925 | | | 975 |
| 1000 | 715[1] | 1785[1] | 1785 | 2145 | 2230 | 1770 | 2230 | 2000 | 2085 | 1570 | 2430 | **2500** | 2975 | | 2820 | | | 1000 |
| 1025 | | | | 1785 | 1900[1] | 1485 | 1945 | 1785 | 1785 | 1285 | 2000 | 2470 | 2880 | | 2710 | | | 1025 |
| 1050 | | | | 1430 | 1570[1] | 1200 | 1655 | 1570 | 1485 | 1000 | 1570 | 2430 | 2785 | | 2605 | | | 1050 |
| 1075 | | | | 1115 | 1355[1] | 995 | 1430[1] | 1355 | 1215 | 855 | 1255 | 2285 | 2690 | | **2500** | | | 1075 |
| 1100 | | | | 800 | 1145[1] | 785 | 1200[1] | 1145 | 945 | 715 | 945 | 2145 | 2595 | | 2430 | | | 1100 |
| 1125 | | | | 620[1] | 930[1] | 645 | 1030[1] | 955 | 785 | 615 | 785 | 1895 | **2500** | | 2250 | | | 1125 |
| 1150 | | | | 445[1] | 715[1] | 500 | 855[1] | 770 | 630 | 515 | 630 | 1645 | 2170 | 2430 | 2070 | | | 1150 |
| 1175 | | | | 365[1] | 530[1] | 420 | 715[1] | 600 | 530 | 430 | 530 | 1465 | 1800 | 2185 | 1895 | | | 1175 |
| 1200 | | | | 285[1] | 345[1] | 345 | 570[1] | 430 | 430 | 345 | 430 | 1285 | 1430 | 1945 | 1715 | | | 1200 |
| 1225 | | | | | | | | | | | | 1105 | 1185 | 1730 | 1535 | | | 1225 |
| 1250 | | | | | | | | | | | | 930 | 945 | 1515 | 1355 | | | 1250 |
| 1275 | | | | | | | | | | | | 815 | 785 | 1330 | 1180 | | | 1275 |
| 1300 | | | | | | | | | | | | 700 | 630 | 1145 | 1000 | | | 1300 |
| 1325 | | | | | | | | | | | | 605 | 530 | 955 | 835 | | | 1325 |
| 1350 | | | | | | | | | | | | 515 | 430 | 770 | 670 | | | 1350 |
| 1375 | | | | | | | | | | | | 455 | 385 | 670 | 565 | | | 1375 |
| 1400 | | | | | | | | | | | | 400 | 345 | 570 | 455 | | | 1400 |
| 1425 | | | | | | | | | | | | 345 | 300 | 500 | 385 | | | 1425 |
| 1450 | | | | | | | | | | | | 285 | 255 | 430 | 315 | | | 1450 |
| 1475 | | | | | | | | | | | | 250 | 235 | 355 | 265 | | | 1475 |
| 1500 | | | | | | | | | | | | 215 | 215 | 285 | 215 | | | 1500 |
| Hydrostatic Shell Test Pressure | | | | | | 9000 | | | | | | 7725 | | 9000 | | | 6425 | |

*NOTES:

[1] For limitations on code applications, see Par. 2.3.

[2] For low temperature ratings including other materials, see Par. 2.2.

## STEEL FLANGED FITTINGS

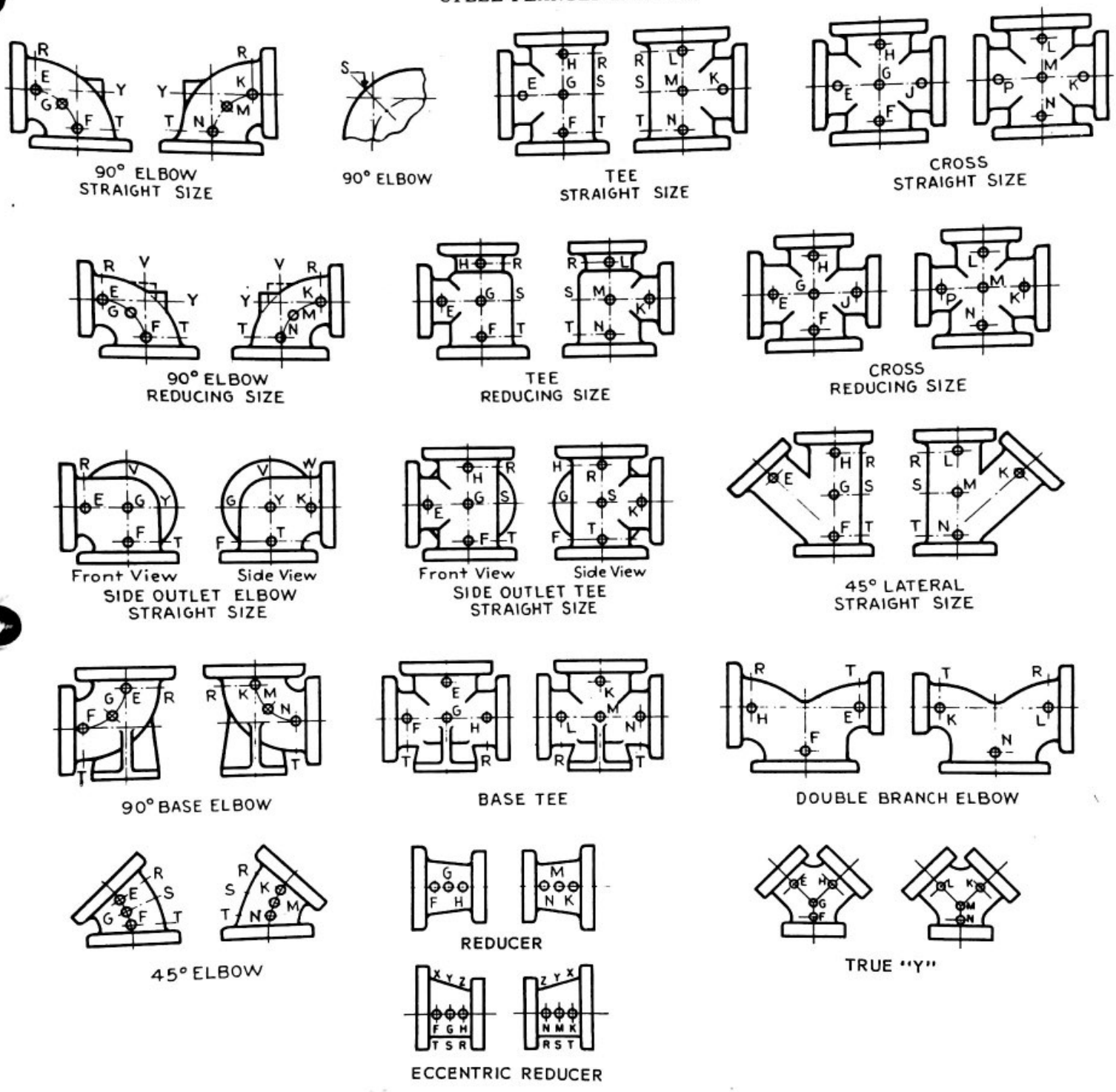



Fig. 1 METHOD OF DESIGNATING LOCATION OF TAPPED HOLES FOR DRAINS WHEN SPECIFIED.

Note: The above sketches show two views of the same fitting and represent fittings with symmetrical shapes, with the exception of the side outlet elbow and the side outlet tee (straight sizes). Sketches are illustrative only and do not infer design.

See Par. 6.11

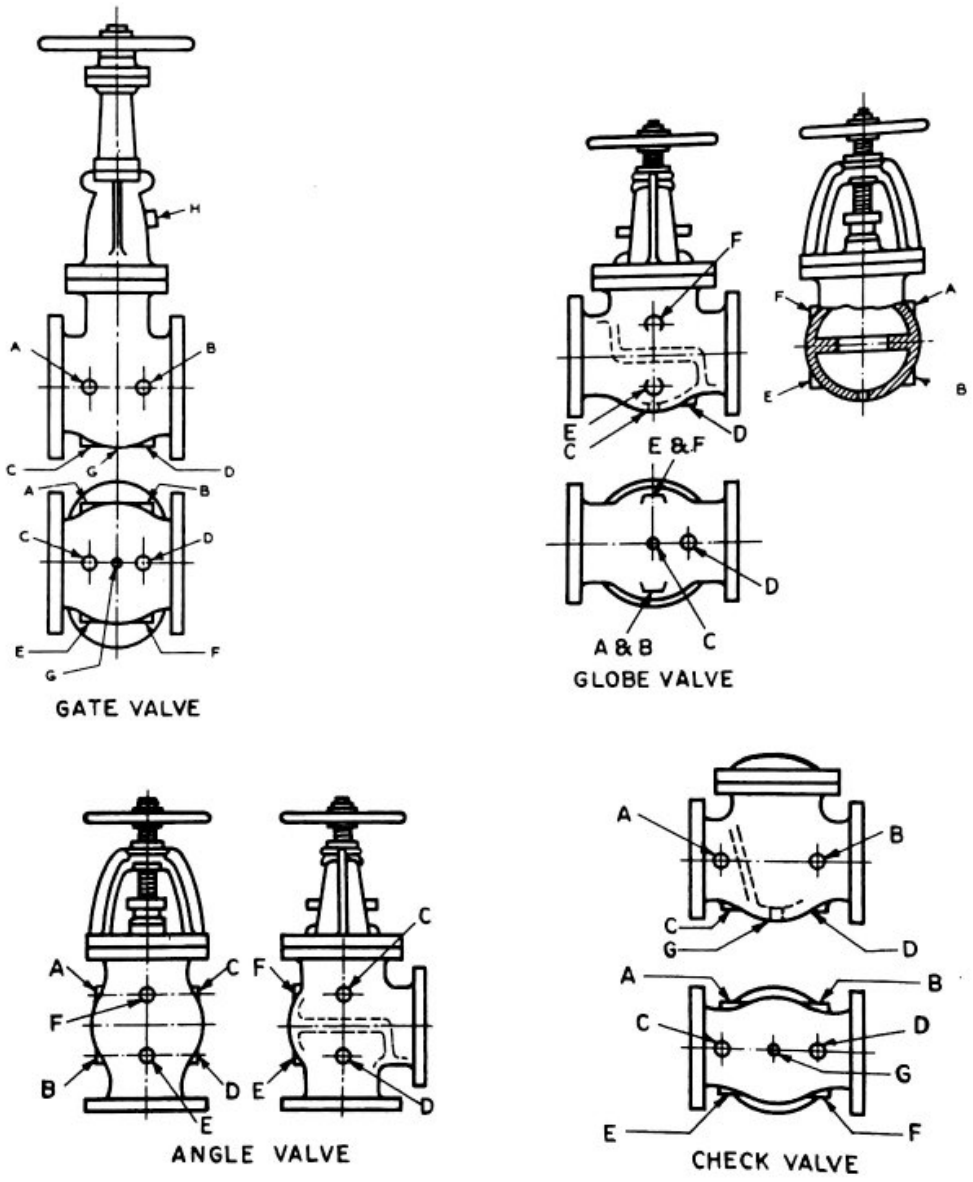



Fig. 2 METHOD OF DESIGNATING LOCATION OF TAPPED HOLES FOR DRAINS WHEN SPECIFIED.

Note: The above sketches represent valves with symmetrical shapes. Sketches are illustrative only and do not infer design.

See Par. 6.11

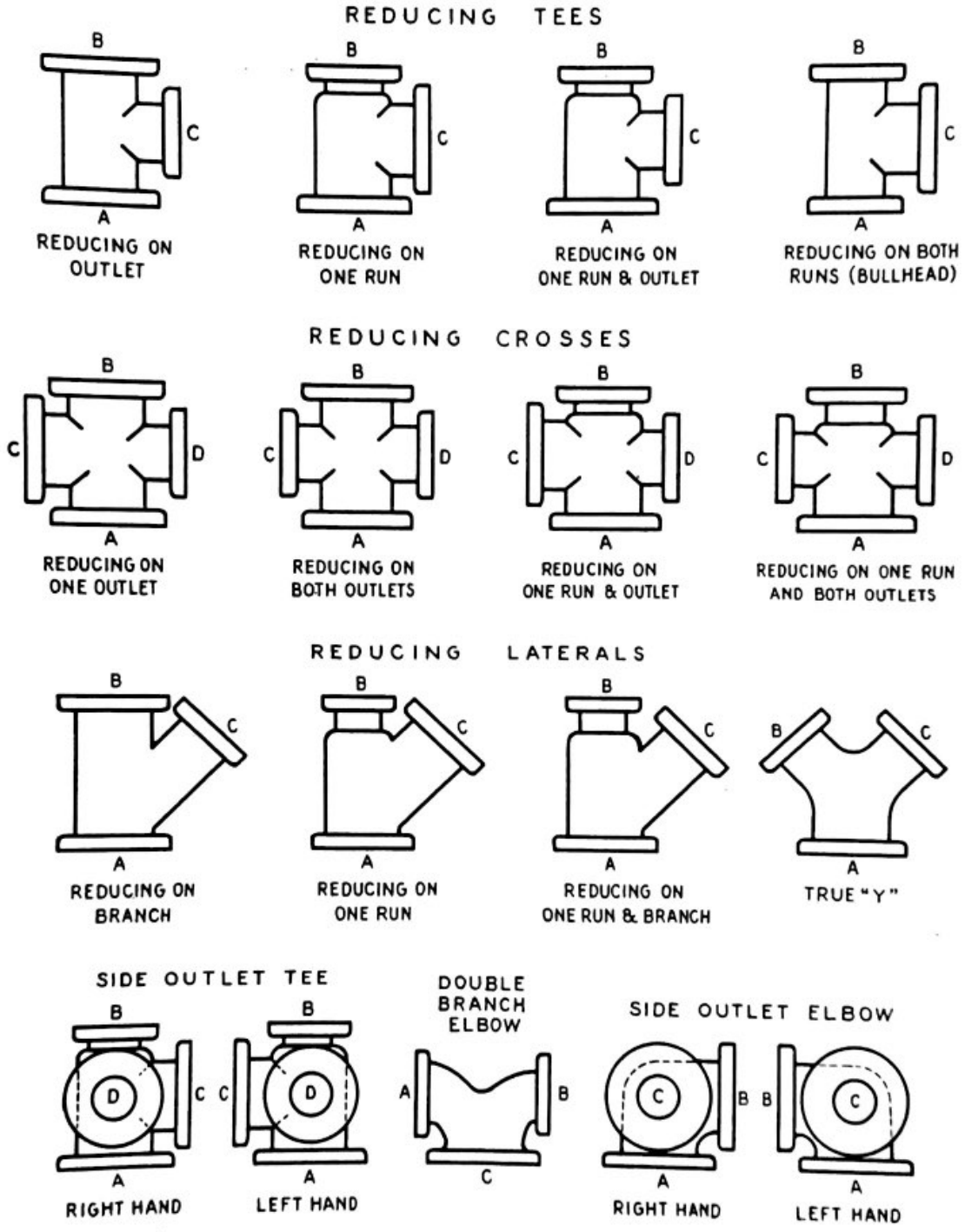



**Fig. 3 METHOD OF DESIGNATING OUTLETS OF REDUCING FITTINGS IN SPECIFICATIONS**

**Note:** The largest opening establishes the basic size of a reducing fitting. The largest opening is named first, except 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 infer design. *See Par. 3.3.

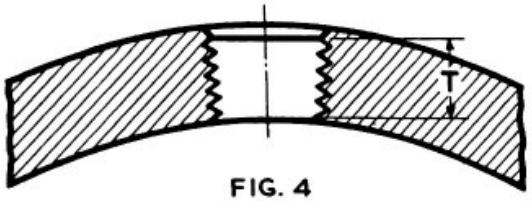



FIG. 4

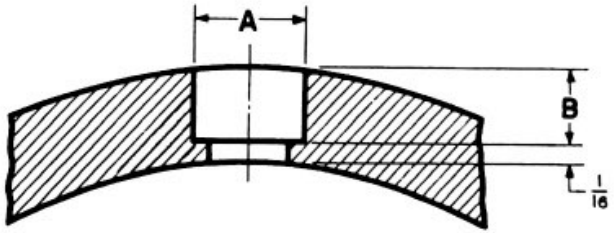



FIG. 5

### Thread Length for Drain Tapping[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Size of Drain | 3/8 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 |
| Length of Thread, T[2] | 0.41 | 0.53 | 0.55 | 0.68 | 0.71 | 0.72 | 0.76 |

All dimensions given in inches.

[1] See Par. 6.11.1, 6.11.3, 6.11.4.

[2] In no case shall the effective length of thread, T be less than that shown in table above. These lengths are equal to the effective thread lenght of USA Standard External Pipe Threads (USAS B2.1).

### Socket Welding for Drains[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Size of Drain | 3/8 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 |
| Minimum Diameter of Socket, A | 0.690 | 0.855 | 1.065 | 1.330 | 1.675 | 1.915 | 2.406 |
| Minimum Depth of Socket, B | 3/16 | 3/16 | 1/4 | 1/4 | 1/4 | 1/4 | 5/16 |

All dimensions given in inches.

[1] See Par. 6.11.2.1, 6.11.3, 6.11.4.

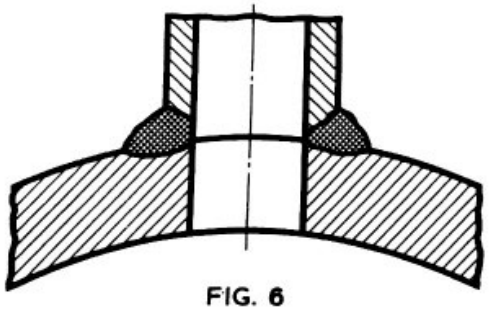


FIG. 6

### Butt Welding for Drains[1]

[1] See Par. 6.11.2.2

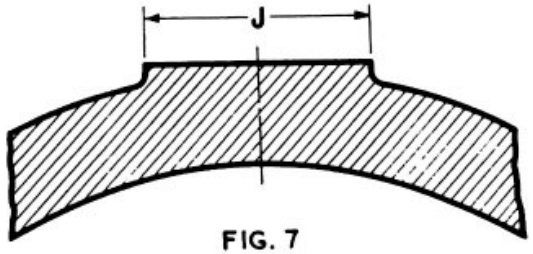



FIG. 7

### Bosses for Drains[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Size of Drain | 3/8 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 |
| Diameter of Boss, J | 1 1/4 | 1 1/2 | 1 3/4 | 2 1/8 | 2 1/2 | 2 3/4 | 3 3/8 |

All dimensions given in inches.

[1] See Par. 6.11.

# *FLANGE FACINGS
150 and 300 lb

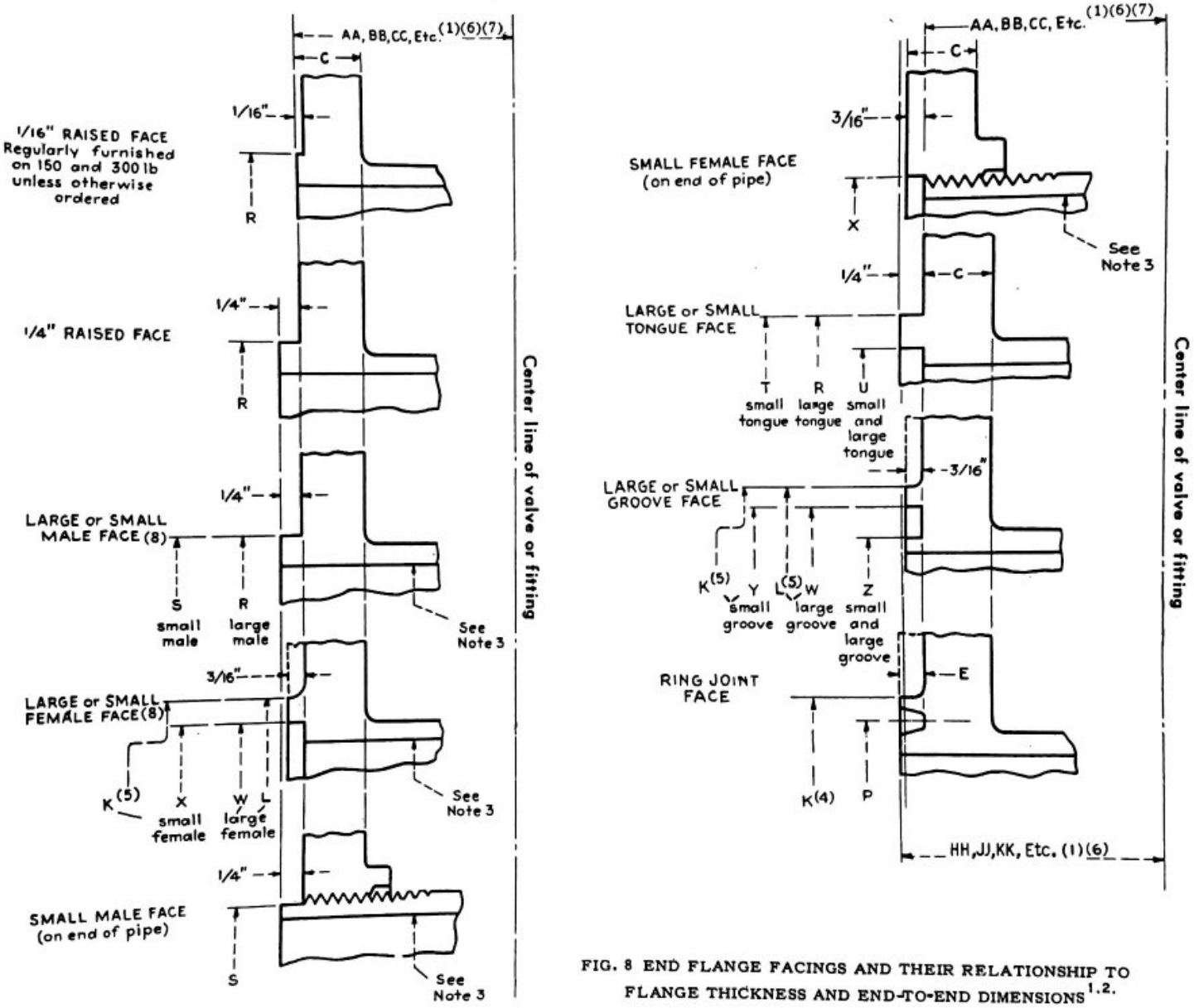



FIG. 8 END FLANGE FACINGS AND THEIR RELATIONSHIP TO FLANGE THICKNESS AND END-TO-END DIMENSIONS [1,2].

[1] See Par. 6.2 and 6.3.1

[2] See Table 9 for dimensions of facings (other than ring-joint) and Table 10 for ring-joint facing.

[3] For small male and female joints care should be taken in the use of these dimensions to insure that the inside diameter of fitting or pipe is small enough to permit sufficient bearing surface to prevent the crushing of the gasket. (See Table 9). This applies particularly on lines where the joint is made on the end of the pipe. Screwed companion flanges for small male and female joints are furnished with plain face and are threaded with USA (American) Standard Locknut Thread (NPSL).

[4] See Table 10

[5] See Table 9

[6] See Tables 15, 18, 21, 24, 27, 30 and 33

[7] For valves, see USAS B16.10 for center-to-face dimensions.

[8] Large male and female faces are not applicable to 150-lb class because of potential dimensional conflicts.

*FLANGE FACINGS
400 lb and higher

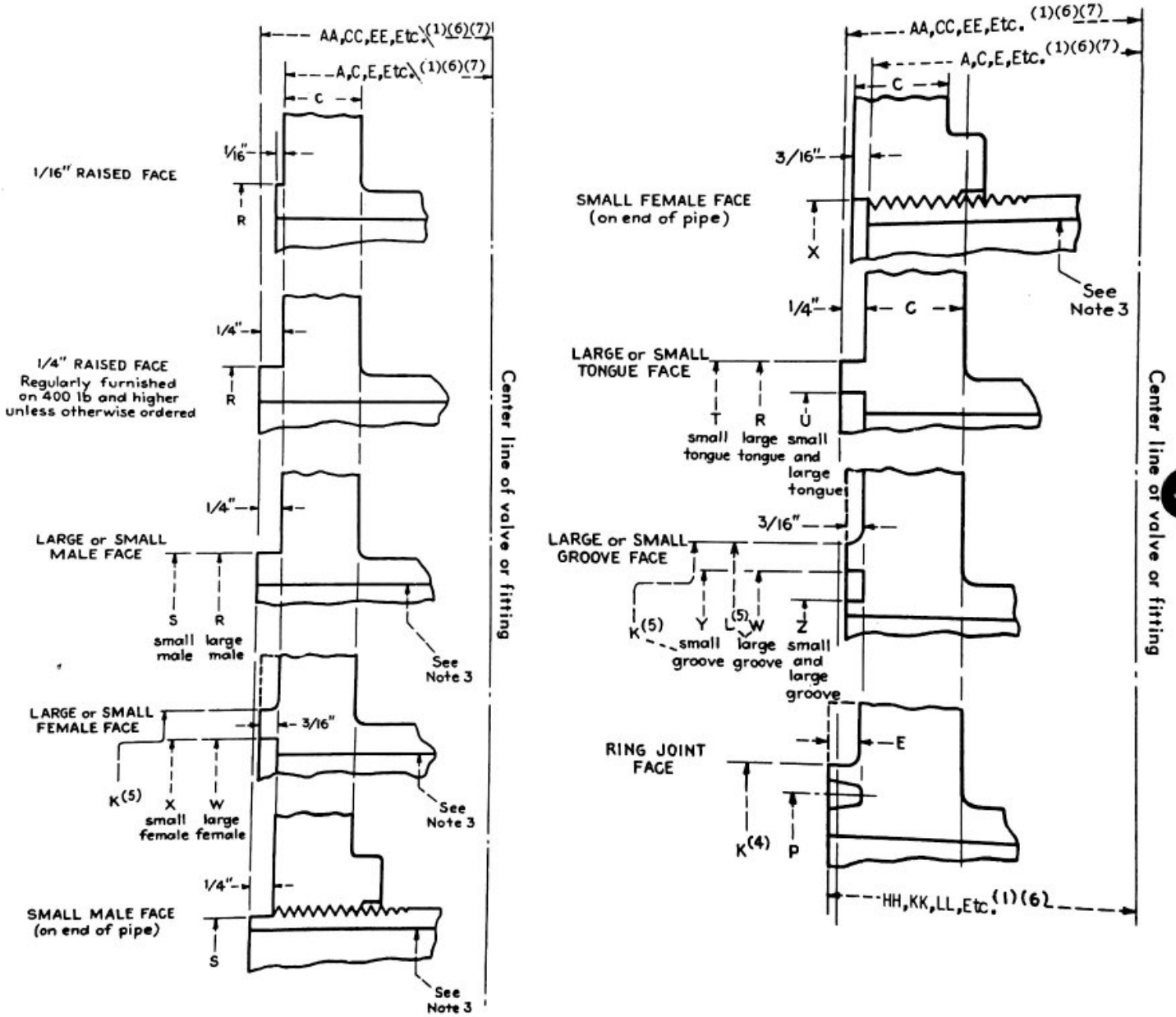



Fig. 8 (continued) END FLANGE FACINGS AND THEIR RELATIONSHIP TO FLANGE THICKNESS AND END-TO-END DIMENSIONS (See page 21 for notes)
(See page 23 for conclusion of Fig. 8)

*FLANGE FACINGS
Lapped Joints

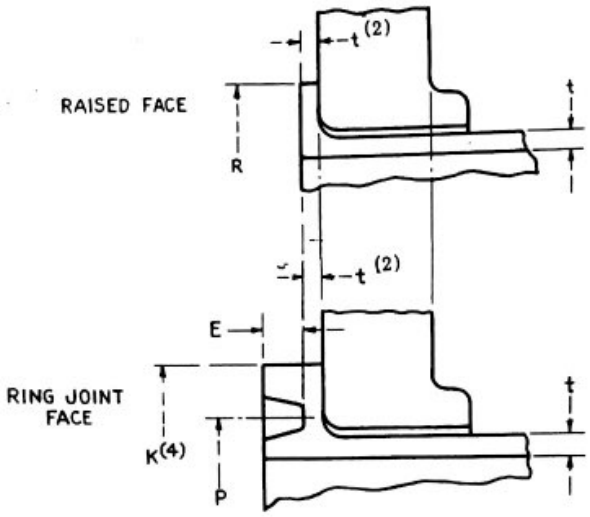



Fig. 8(concluded)END FLANGE FACINGS AND THEIR RELATIONSHIP TO FLANGE THICKNESS AND END-TO-END DIMENSIONS [1]

[1]See Table 9 for dimensions of facings (other than ring-joint) and Table 10 for ring-joint facing.

[2]See Par. 6.3.2.

[3]See Par. 6.3.2.5 and Table 10.

## Table 9 Dimensions of Facings[1,2,3,7] (Other Than Ring Joints) (All Pressures)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Outside Diameter | | | | | Outside Diameter | | | | Height | | | *Minimum[10] Outside Diameter of Raised Portion | | |
| Nominal Pipe Size | Raised Face Large Male and Large Tongue | Small Male[9] | Small Tongue | Inside Diameter of Large and Small Tongue | Inside Diameter of Small Male | Large Female and Large Groove | Small Female[3] | Small Groove | Inside Diameter of Large and Small Groove | Raised Face | Large and Small Male and Tongue | Depth of Groove or Female | Small Female and Groove | Large Female and Groove | Nominal Pipe Size |
| | R | S | T | U | | W | X | Y | Z | | | | K | L | |
| 1/2 | 1 3/8 | 23/32 | 1 3/8 | 1 | | 1 7/16 | 25/32 | 1 7/16 | 15/16 | | | | 1 3/4 | 1 13/16 | 1/2 |
| 3/4 | 1 11/16 | 15/16 | 1 11/16 | 1 5/16 | | 1 3/4 | 1 | 1 3/4 | 1 1/4 | | | | 2 1/16 | 2 1/8 | 3/4 |
| 1 | 2 | 1 3/16 | 1 7/8 | 1 1/2 | | 2 1/16 | 1 1/4 | 1 15/16 | 1 7/16 | | | | 2 1/4 | 2 7/16 | 1 |
| 1 1/4 | 2 1/2 | 1 1/2 | 2 1/4 | 1 7/8 | | 2 9/16 | 1 9/16 | 2 5/16 | 1 13/16 | | | | 2 5/8 | 2 15/16 | 1 1/4 |
| 1 1/2 | 2 7/8 | 1 3/4 | 2 1/2 | 2 1/8 | | 2 15/16 | 1 13/16 | 2 9/16 | 2 1/16 | | | | 2 7/8 | 3 5/16 | 1 1/2 |
| 2 | 3 5/8 | 2 1/4 | 3 1/4 | 2 7/8 | | 3 11/16 | 2 5/16 | 3 5/16 | 2 13/16 | | | | 3 5/8 | 4 1/16 | 2 |
| 2 1/2 | 4 1/8 | 2 11/16 | 3 3/4 | 3 3/8 | | 4 3/16 | 2 3/4 | 3 13/16 | 3 5/16 | | | | 4 1/8 | 4 9/16 | 2 1/2 |
| 3 | 5 | 3 5/16 | 4 5/8 | 4 1/4 | | 5 1/16 | 3 3/8 | 4 11/16 | 4 3/16 | | | | 5 | 5 7/16 | 3 |
| 3 1/2 | 5 1/2 | 3 13/16 | 5 1/8 | 4 3/4 | | 5 9/16 | 3 7/8 | 5 3/16 | 4 11/16 | | | | 5 1/2 | 5 15/16 | 3 1/2 |
| 4 | 6 3/16 | 4 5/16 | 5 11/16 | 5 3/16 | | 6 1/4 | 4 3/8 | 5 3/4 | 5 1/8 | | | | 6 3/16 | 6 5/8 | 4 |
| 5 | 7 5/16 | 5 3/8 | 6 13/16 | 6 5/16 | | 7 3/8 | 5 7/16 | 6 7/8 | 6 1/4 | | | | 7 5/16 | 7 3/4 | 5 |
| 6 | 8 1/2 | 6 3/8 | 8 | 7 1/2 | | 8 9/16 | 6 7/16 | 8 1/16 | 7 7/16 | | | | 8 1/2 | 8 15/16 | 6 |
| 8 | 10 5/8 | 8 3/8 | 10 | 9 3/8 | | 10 11/16 | 8 7/16 | 10 1/16 | 9 5/16 | | | | 10 5/8 | 11 1/16 | 8 |
| 10 | 12 3/4 | 10 1/2 | 12 | 11 1/4 | | 12 13/16 | 10 9/16 | 12 1/16 | 11 3/16 | | | | 12 3/4 | 13 3/16 | 10 |
| 12 | 15 | 12 1/2 | 14 1/4 | 13 1/2 | | 15 1/16 | 12 9/16 | 14 5/16 | 13 7/16 | | | | 15 | 15 7/16 | 12 |
| 14 | 16 1/4 | 13 3/4 | 15 1/2 | 14 3/4 | | 16 5/16 | 13 13/16 | 15 9/16 | 14 11/16 | | | | 16 1/4 | 16 11/16 | 14 |
| 16 | 18 1/2 | 15 3/4 | 17 5/8 | 16 3/4 | | 18 9/16 | 15 13/16 | 17 11/16 | 16 11/16 | | | | 18 1/2 | 18 15/16 | 16 |
| 18 | 21 | 17 3/4 | 20 1/8 | 19 1/4 | | 21 1/16 | 17 13/16 | 20 3/16 | 19 3/16 | | | | 21 | 21 7/16 | 18 |
| 20 | 23 | 19 3/4 | 22 | 21 | | 23 1/16 | 19 13/16 | 22 1/16 | 20 15/16 | | | | 23 | 23 7/16 | 20 |
| 24 | 27 1/4 | 23 3/4 | 26 1/4 | 25 1/4 | | 27 5/16 | 23 13/16 | 26 5/16 | 25 3/16 | | | | 27 1/4 | 27 11/16 | 24 |

See Note 9 (Inside Diameter of Small Male)

See Note 4 & 7 (Height, Raised Face)

See Note 5 & 7 (Height, Large and Small Male and Tongue)

See Note 6 & 7 (Depth of Groove or Female)

All dimensions are given in inches.

[1] For facing requirements for flanges, flanged fittings and valves. (See Par. 6.3.1 and Fig. 8.

[2] For facing requirements for lapped joints — see Par. 6.3.2 and Fig. 8.

[3] For facing tolerances see Par. 7.2

[4] Height of raised face is either 1/16 in. or 1/4 in. — See Par. 6.3.1

[5] Height of large and small male and tongue is 1/4 in.

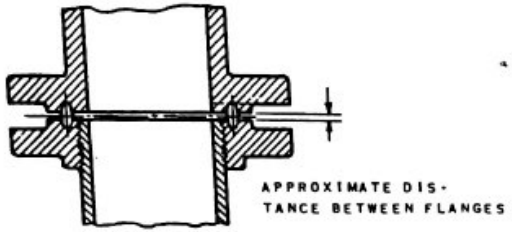
[6] Depth of groove or female is 3/16 in.

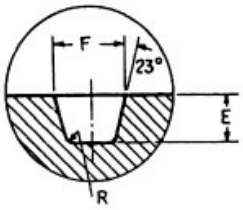
[7] See Par. 6.3.2 and Fig. 8 for thickness and outside diameters of laps.

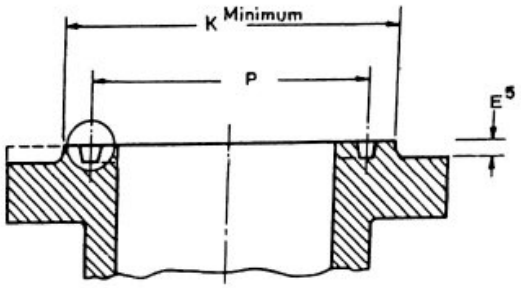
[8] Raised portion of full face may be furnished unless otherwise specified on order.

[9] For small male and female joints care should be taken in the use of these dimensions to insure that the inside diameter of fitting or pipe is small enough to permit sufficient bearing surface to prevent the crushing of the gasket. This applies particularly on lines where the joint is made on the end of the pipe. Inside diameter of fitting should match inside diameter of pipe as specified by purchaser. Screwed companion flanges for small male and female joints are furnished with plain face and are threaded with USA Standard Locknut Thread (NPSL).

[10] Large male and female faces are not applicable to 150-lb class because of potential dimensional conflicts.




## Table 10 Dimensions of Ring-Joint Facings[1,2,6] (All Pressures)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | | | | | | | | Groove Dimensions | | | | Diameter of Raised Portion K | | | | | Approximate Distance Between Flanges | | | | | | |
| 150 Psi | 300 Psi | 400 Psi[3] | 600 Psi | 900 Psi[4] | 1500 Psi | 2500 Psi | Groove Number | Pitch Diameter P | Depth E | Width F | Radius at Bottom R | 150 Psi | 300 400 600 Psi | 900 Psi | 1500 Psi | 2500 Psi | 150 Psi | 300 Psi | 400 Psi | 600 Psi | 900 Psi | 1500 Psi | 2500 Psi |
| ... | 1/2 | ... | 1/2 | ... | ... | ... | R11 | 1 11/32 | 7/32 | 9/32 | 1/32 | ... | 2 | ... | ... | ... | ... | 1/8 | ... | 1/8 | ... | ... | ... |
| ... | ... | ... | ... | ... | 1/2 | ... | 12 | 1 9/16 | 1/4 | 11/32 | 1/32 | ... | ... | ... | 2 3/8 | ... | ... | ... | ... | ... | ... | 5/32 | ... |
| ... | 3/4 | ... | 3/4 | ... | ... | 1/2 | 13 | 1 11/16 | 1/4 | 11/32 | 1/32 | ... | 2 1/2 | ... | ... | 2 9/16 | ... | 5/32 | ... | 5/32 | ... | ... | 5/32 |
| ... | ... | ... | ... | ... | 3/4 | ... | 14 | 1 3/4 | 1/4 | 11/32 | 1/32 | ... | ... | ... | 2 5/8 | ... | ... | ... | ... | ... | ... | 5/32 | ... |
| 1 | ... | ... | ... | ... | ... | ... | 15 | 1 7/8 | 1/4 | 11/32 | 1/32 | 2 1/2 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 1 | ... | 1 | ... | 1 | 3/4 | 16 | 2 | 1/4 | 11/32 | 1/32 | ... | 2 3/4 | ... | 2 13/16 | 2 7/8 | ... | 5/32 | ... | 5/32 | ... | 5/32 | 5/32 |
| 1 1/4 | ... | ... | ... | ... | ... | ... | 17 | 2 1/4 | 1/4 | 11/32 | 1/32 | 2 7/8 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 1 1/4 | ... | 1 1/4 | ... | 1 1/4 | 1 | 18 | 2 3/8 | 1/4 | 11/32 | 1/32 | ... | 3 1/8 | ... | 3 3/16 | 3 1/4 | ... | 5/32 | ... | 5/32 | ... | 5/32 | 5/32 |
| 1 1/2 | ... | ... | ... | ... | ... | ... | 19 | 2 9/16 | 1/4 | 11/32 | 1/32 | 3 1/4 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 1 1/2 | ... | 1 1/2 | ... | 1 1/2 | ... | 20 | 2 11/16 | 1/4 | 11/32 | 1/32 | ... | 3 9/16 | ... | 3 5/8 | ... | ... | 5/32 | ... | 5/32 | ... | 5/32 | ... |
| ... | ... | ... | ... | ... | ... | 1 1/4 | 21 | 2 27/32 | 5/16 | 15/32 | 1/32 | ... | ... | ... | ... | 4 | ... | ... | ... | ... | ... | ... | 1/8 |
| 2 | ... | ... | ... | ... | ... | ... | 22 | 3 1/4 | 1/4 | 11/32 | 1/32 | 4 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 2 | ... | 2 | ... | ... | 1 1/2 | 23 | 3 1/4 | 5/16 | 15/32 | 1/32 | ... | 4 1/4 | ... | ... | 4 1/2 | ... | 7/32 | ... | 3/16 | ... | ... | 1/8 |
| ... | ... | ... | ... | ... | 2 | ... | 24 | 3 3/4 | 5/16 | 15/32 | 1/32 | ... | ... | ... | 4 7/8 | ... | ... | ... | ... | ... | ... | 1/8 | ... |
| 2 1/2 | ... | ... | ... | ... | ... | ... | 25 | 4 | 1/4 | 11/32 | 1/32 | 4 3/4 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 2 1/2 | ... | 2 1/2 | ... | ... | 2 | 26 | 4 | 5/16 | 15/32 | 1/32 | ... | 5 | ... | ... | 5 1/4 | ... | 7/32 | ... | 3/16 | ... | ... | 1/8 |
| ... | ... | ... | ... | ... | 2 1/2 | ... | 27 | 4 1/4 | 5/16 | 15/32 | 1/32 | ... | ... | ... | 5 3/8 | ... | ... | ... | ... | ... | ... | 1/8 | ... |
| ... | ... | ... | ... | ... | ... | 2 1/2 | 28 | 4 3/8 | 3/8 | 17/32 | 1/16 | ... | ... | ... | ... | 5 7/8 | ... | ... | ... | ... | ... | ... | 1/8 |
| 3 | ... | ... | ... | ... | ... | ... | 29 | 4 1/2 | 1/4 | 11/32 | 1/32 | 5 1/4 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | 30 | 4 5/8 | 5/16 | 15/32 | 1/32 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ... | [3] | ... | [3] | 3 | ... | ... | 31 | 4 7/8 | 5/16 | 15/32 | 1/32 | ... | 5 3/4 | 6 1/8 | ... | ... | ... | 7/32 | ... | 3/16 | 5/32 | ... | ... |
| ... | ... | ... | ... | ... | ... | 3 | 32 | 5 | 3/8 | 17/32 | 1/16 | ... | ... | ... | ... | 6 5/8 | ... | ... | ... | ... | ... | ... | 1/8 |
| 3 1/2 | ... | ... | ... | ... | ... | ... | 33 | 5 3/16 | 1/4 | 11/32 | 1/32 | 6 1/16 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 3 1/2 | ... | 3 1/2 | ... | ... | ... | 34 | 5 3/16 | 5/16 | 15/32 | 1/32 | ... | 6 1/4 | ... | ... | ... | ... | 7/32 | ... | 3/16 | ... | ... | ... |
| ... | ... | ... | ... | ... | 3 | ... | 35 | 5 3/8 | 5/16 | 15/32 | 1/32 | ... | ... | ... | 6 5/8 | ... | ... | ... | ... | ... | ... | 1/8 | ... |
| 4 | ... | ... | ... | ... | ... | ... | 36 | 5 7/8 | 1/4 | 11/32 | 1/32 | 6 3/4 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 4 | 4 | 4 | 4 | ... | ... | 37 | 5 7/8 | 5/16 | 15/32 | 1/32 | ... | 6 7/8 | 7 1/8 | ... | ... | ... | 7/32 | 7/32 | 3/16 | 5/32 | ... | ... |
| ... | ... | ... | ... | ... | ... | 4 | 38 | 6 3/16 | 7/16 | 21/32 | 1/16 | ... | ... | ... | ... | 8 | ... | ... | ... | ... | ... | ... | 5/32 |
| ... | ... | ... | ... | ... | 4 | ... | 39 | 6 3/8 | 5/16 | 15/32 | 1/32 | ... | ... | ... | 7 5/8 | ... | ... | ... | ... | ... | ... | 1/8 | ... |
| 5 | ... | ... | ... | ... | ... | ... | 40 | 6 3/4 | 1/4 | 11/32 | 1/32 | 7 5/8 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | 5 | 5 | 5 | 5 | ... | ... | 41 | 7 1/8 | 5/16 | 15/32 | 1/32 | ... | 8 1/4 | 8 1/2 | ... | ... | ... | 7/32 | 7/32 | 3/16 | 5/32 | ... | ... |
| ... | ... | ... | ... | ... | ... | 5 | 42 | 7 1/2 | 1/2 | 25/32 | 1/16 | ... | ... | ... | ... | 9 1/2 | ... | ... | ... | ... | ... | ... | 5/32 |
| 6 | ... | ... | ... | ... | ... | ... | 43 | 7 5/8 | 1/4 | 11/32 | 1/32 | 8 5/8 | ... | ... | ... | ... | 5/32 | ... | ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... | 5 | ... | 44 | 7 5/8 | 5/16 | 15/32 | 1/32 | ... | ... | ... | 9 | ... | ... | ... | ... | ... | ... | 1/8 | ... |
| ... | 6 | 6 | 6 | 6 | ... | ... | 45 | 8 5/16 | 5/16 | 15/32 | 1/32 | ... | 9 1/2 | 9 1/2 | ... | ... | ... | 7/32 | 7/32 | 3/16 | 5/32 | ... | ... |

## Table 10 (Cont'd) Dimensions of Ring-Joint Facings[1,2,6] (All Pressures)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | | | | | | | | Groove Dimensions | | | | Diameter of Raised Portion K | | | | | Approximate Distance Between Flanges | | | | | | |
| 150 Psi | 300 Psi | 400 Psi[3] | 600 Psi | 900 Psi | 1500 Psi | 2500 Psi | Groove Number | Pitch Diameter P | Depth E | Width F | Radius at Bottom R | 150 Psi | 300 400 600 Psi | 900 Psi | 1500 Psi | 2500 Psi | 150 Psi | 300 Psi | 400 Psi | 600 Psi | 900 Psi | 1500 Psi | 2500 Psi |
| | | | | | 6 | | 46 | 8 5/16 | 3/8 | 17/32 | 1/16 | | | | 9 3/4 | | | | | | | 1/8 | |
| | | | | | | 6 | 47 | 9 | 1/2 | 25/32 | 1/16 | | | | | 11 | | | | | | | 5/32 |
| 8 | | | | | | | 48 | 9 3/4 | 1/4 | 11/32 | 1/32 | 10 3/4 | | | | | 5/32 | | | | | | |
| | 8 | 8 | 8 | 8 | | | 49 | 10 5/8 | 5/16 | 15/32 | 1/32 | | 11 7/8 | 12 1/8 | | | | 7/32 | 7/32 | 3/16 | 5/32 | | |
| | | | | | 8 | | 50 | 10 5/8 | 7/16 | 21/32 | 1/16 | | | | 12 1/2 | | | | | | | 5/32 | |
| | | | | | | 8 | 51 | 11 | 9/16 | 29/32 | 1/16 | | | | | 13 3/8 | | | | | | | 3/16 |
| 10 | | | | | | | 52 | 12 | 1/4 | 11/32 | 1/32 | 13 | | | | | 5/32 | | | | | | |
| | 10 | 10 | 10 | 10 | | | 53 | 12 3/4 | 5/16 | 15/32 | 1/32 | | 14 | 14 1/4 | | | | 7/32 | 7/32 | 3/16 | 5/32 | | |
| | | | | | 10 | | 54 | 12 3/4 | 7/16 | 21/32 | 1/16 | | | | 14 5/8 | | | | | | | 5/32 | |
| | | | | | | 10 | 55 | 13 1/2 | 11/16 | 1 3/16 | 3/32 | | | | | 16 3/4 | | | | | | | 1/4 |
| 12 | | | | | | | 56 | 15 | 1/4 | 11/32 | 1/32 | 16 | | | | | 5/32 | | | | | | |
| | 12 | 12 | 12 | 12 | | | 57 | 15 | 5/16 | 15/32 | 1/32 | | 16 1/4 | 16 1/2 | | | | 7/32 | 7/32 | 3/16 | 5/32 | | |
| | | | | | 12 | | 58 | 15 | 9/16 | 29/32 | 1/16 | | | | 17 1/4 | | | | | | | 3/16 | |
| 14 | | | | | | | 59 | 15 5/8 | 1/4 | 11/32 | 1/32 | 16 3/4 | | | | | 1/8 | | | | | | |
| | | | | | | 12 | 60 | 16 | 11/16 | 1 5/16 | 3/32 | | | | | 19 1/2 | | | | | | | 5/16 |
| | 14 | 14 | 14 | | | | 61 | 16 1/2 | 5/16 | 15/32 | 1/32 | | 18 | | | | | 7/32 | 7/32 | 3/16 | | | |
| | | | | 14 | | | 62 | 16 1/2 | 7/16 | 21/32 | 1/16 | | | 18 3/8 | | | | | | | 5/32 | | |
| | | | | | 14 | | 63 | 16 1/2 | 5/8 | 1 1/16 | 3/32 | | | | 19 1/4 | | | | | | | 7/32 | |
| 16 | | | | | | | 64 | 17 7/8 | 1/4 | 11/32 | 1/32 | 19 | | | | | 1/8 | | | | | | |
| | 16 | 16 | 16 | | | | 65 | 18 1/2 | 5/16 | 15/32 | 1/32 | | 20 | | | | | 7/32 | 7/32 | 3/16 | | | |
| | | | | 16 | | | 66 | 18 1/2 | 7/16 | 21/32 | 1/16 | | | 20 5/8 | | | | | | | 5/32 | | |
| | | | | | 16 | | 67 | 18 1/2 | 11/16 | 1 3/16 | 3/32 | | | | 21 1/2 | | | | | | | 5/16 | |
| 18 | | | | | | | 68 | 20 3/8 | 1/4 | 11/32 | 1/32 | 21 1/2 | | | | | 1/8 | | | | | | |
| | 18 | 18 | 18 | | | | 69 | 21 | 5/16 | 15/32 | 1/32 | | 22 5/8 | | | | | 7/32 | 7/32 | 3/16 | | | |
| | | | | 18 | | | 70 | 21 | 1/2 | 25/32 | 1/16 | | | 23 3/8 | | | | | | | 3/16 | | |
| | | | | | 18 | | 71 | 21 | 11/16 | 1 3/16 | 3/32 | | | | 24 1/8 | | | | | | | 5/16 | |
| | | | | | | 18 | 72 | 22 | 1/4 | 11/32 | 1/32 | 23 1/2 | | | | | 1/8 | | | | | | |
| 20 | | | | | | | 73 | 23 | 3/8 | 17/32 | 1/16 | | 25 | | | | | 7/32 | 7/32 | 3/16 | | | |
| | 20 | 20 | 20 | | | | 74 | 23 | 1/2 | 25/32 | 1/16 | | | 25 1/2 | | | | | | | 3/16 | | |
| | | | | 20 | | | 75 | 23 | 11/16 | 1 5/16 | 3/32 | | | | 26 1/2 | | | | | | | 3/8 | |
| | | | | | 20 | | 76 | 26 1/2 | 1/4 | 11/32 | 1/32 | 28 | | | | | 1/8 | | | | | | |
| 24 | | | | | | | 77 | 27 1/4 | 7/16 | 21/32 | 1/16 | | 29 1/2 | | | | | 1/4 | 1/4 | 7/32 | | | |
| | 24 | 24 | 24 | | | | 78 | 27 1/4 | 5/8 | 1 1/16 | 3/32 | | | 30 3/8 | | | | | | | 7/32 | | |
| | | | | 24 | | | 79 | 27 1/4 | 13/16 | 1 7/16 | 3/32 | | | | 31 1/4 | | | | | | | 7/16 | |

TOLERANCES

E (depth) $^{+\ 1/64}_{-\ 0}$
F (width) ± .008
P (pitch diam) ± .005
R (radius at bottom) Max
23° (angle) ±½°

All dimensions given in inches.

† For ring joints with lapped flanges in the 300, and 600 lb standards, ring and groove number R30 are used instead of R31.

‡ For facing requirements for flanges, flanged fittings, and valves see Par. 6.3.1 and Fig. 8.

[2] For facing requirements for lapped joints see Par. 6.3.2 and Fig. 8.

[3] Use 600 lb in sizes ½ to 3½ for 400 lb pressure.

[4] Use 1500 lb in sizes ½ to 2½ for 900 lb pressure.

[5] Height of raised portion is equal to the depth of groove dimensions "E" but is not subject to the tolerance for "E". Former full-face contour may be used.

[6] See Par. 4.1.6 for marking requirements.

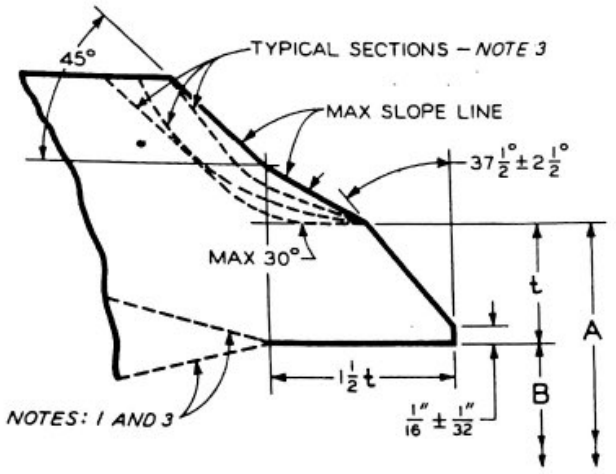



FIG. 9 FOR WALL THICKNESS (t) 3/16 TO 3/4 IN., INCLUSIVE, INSIDE CONTOUR FOR USE WITH SPLIT BACKING RING OR WITHOUT BACKING RING

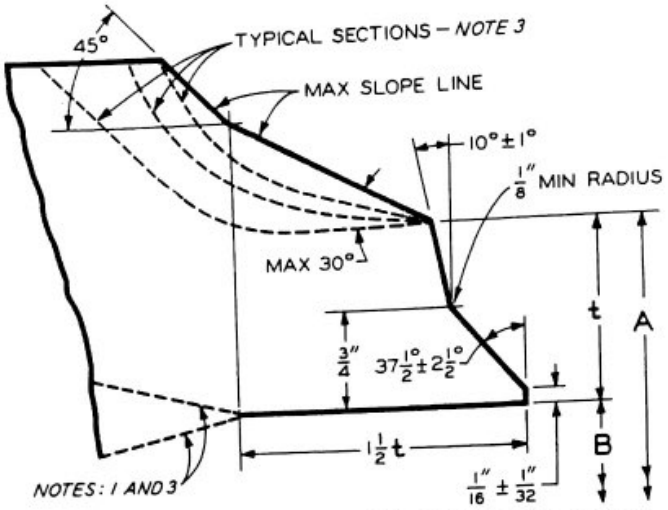



FIG. 10 FOR WALL THICKNESS (t) GREATER THAN 3/4 IN., INSIDE CONTOUR FOR USE WITH SPLIT BACKING RING OR WITHOUT BACKING RING

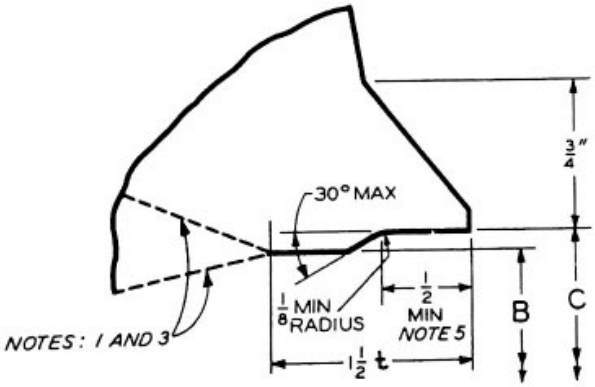



FIG. 11 INSIDE CONTOUR FOR USE WITH RECTANGULAR BACKING RING

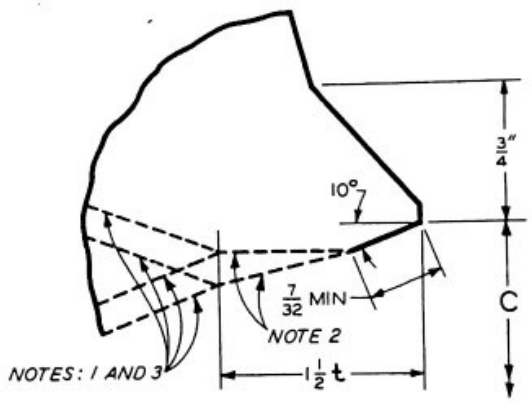



FIG. 12 INSIDE CONTOUR FOR USE WITH TAPER BACKING RING

A = Nominal outside diameter of welding end.
B = Nominal inside diameter of pipe.
C = A - 0.031 - 1.75t - 0.010
t = Nominal wall thickness of pipe.
0.031 = Minus tolerance on OD of pipe to ASTM Specification A106, etc.
1.75 = Minimum Wall of 87 1/2% of nominal wall (permitted by ASTM Specification A106, etc.) multipled by two to convert into terms of diameter.
0.010 = Plus tolerance on diameter C (See Par. 7.4.3)

Note 1 Runout of a machined surface to inside diameter of valve to have no abrupt change in section. Inside diameter of valve may be either larger or smaller than pipe inside diameter.

Note 3 The outside and inside of ends of valves shall be extended back in any manner within the maximum and minimum slope lines indicated. The transition shall be a shape avoiding sharp re-entrant angles and abrupt changes in slope. The profile of the outside contour shall be as furnished by the manufacturer provided above conditions are met.

Note 4 See Par. 6.6 and 7.4 for details and tolerances.

Note 5 ½ in. depth based on use of ¾ in. wide backing ring.

Note 6 See Fig. 13 and 14 for welding end details of welding neck flanges.

Note 7 For dimensions see Table 11.

## WELDING ENDS
(Welding Neck Flanges)

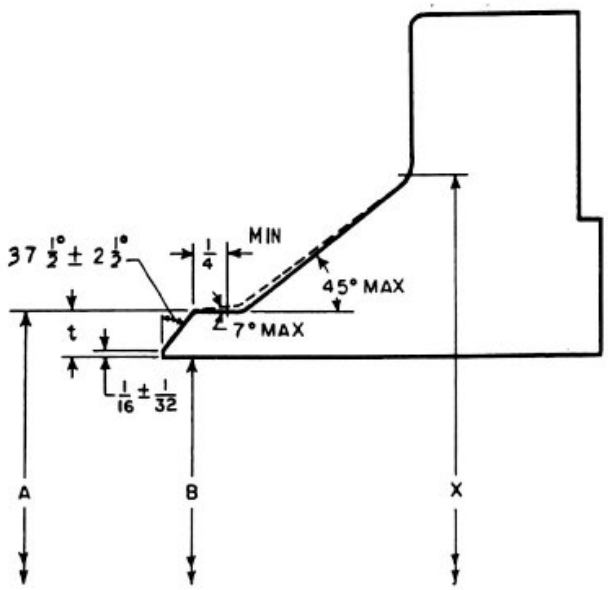



Fig. 13 BEVEL FOR WALL THICKNESSES (t) 3/16 IN. TO 3/4 IN. INCLUSIVE

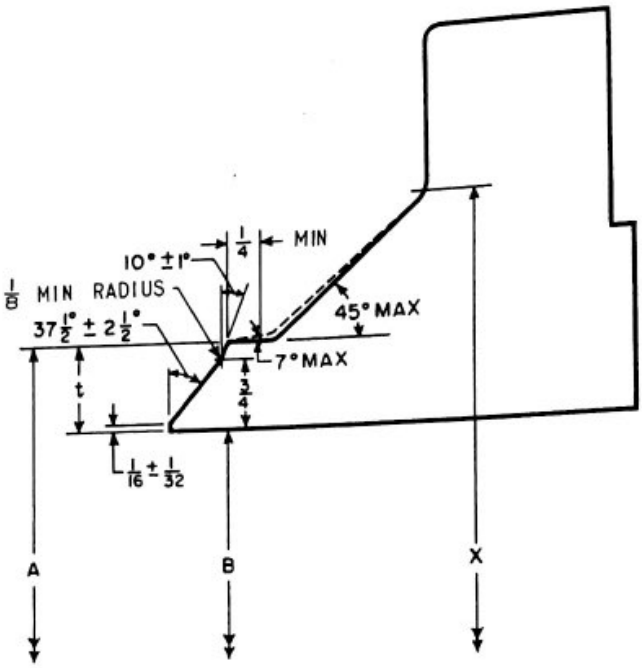



Fig. 14 BEVEL FOR WALL THICKNESSES (t) GREATER THAN 3/4 IN. (Note 2)

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

Note 1 See Par. 6.6, 6.7, and 7.4 for details and tolerances.

Note 2 See Fig. 11 and 12 for additional details of welding ends.

Note 3 When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be employed or alternatively, the greater outside diameter may be tapered, at the same maximum slope or less, from a point on the welding bevel equal to the OD of the mating pipe. Similarly, when the greater thickness is provided on the inside of the valve of 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 service with light wall, high 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 be modified.

Table 11 Dimensions of Welding Ends (See Figures 9 to 14 inclusive)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Nominal Pipe Size | Schedule[1] No. | A | | B[2] | C[2,3] | t[2] |
| | | Welding Neck Flanges[2,4] | Welding End Valves[2,4] | | | |
| 2 1/2 | 40 | 2.875 | | 2.469 | 2.479 | 0.203 |
| | 80 | | | 2.323 | 2.351 | 0.276 |
| | 160 | | | 2.125 | 2.178 | 0.375 |
| | XXS | | | 1.771 | 1.868 | 0.552 |
| 3 | 40 | 3.500 | 3 19/32 | 3.068 | 3.081 | 0.216 |
| | 80 | | | 2.900 | 2.934 | 0.300 |
| | 160 | | | 2.624 | 2.692 | 0.438 |
| | XXS | | | 2.300 | 2.409 | 0.600 |
| 3 1/2 | 40 | 4.000 | | 3.548 | 3.564 | 0.226 |
| | 80 | | | 3.364 | 3.402 | 0.318 |
| 4 | 40 | 4.500 | 4 5/8 | 4.026 | 4.044 | 0.237 |
| | 80 | | | 3.826 | 3.869 | 0.337 |
| | 120 | | | 3.624 | 3.692 | 0.438 |
| | 160 | | | 3.438 | 3.530 | 0.531 |
| | XXS | | | 3.152 | 3.279 | 0.674 |
| 5 | 40 | 5.563 | 5 11/16 | 5.047 | 5.070 | 0.258 |
| | 80 | | | 4.813 | 4.866 | 0.375 |
| | 120 | | | 4.563 | 4.647 | 0.500 |
| | 160 | | | 4.313 | 4.428 | 0.625 |
| | XXS | | | 4.063 | 4.209 | 0.750 |
| 6 | 40 | 6.625 | 6 25/32 | 6.065 | 6.094 | 0.280 |
| | 80 | | | 5.761 | 5.828 | 0.432 |
| | 120 | | | 5.501 | 5.600 | 0.562 |
| | 160 | | | 5.189 | 5.327 | 0.718 |
| | XXS | | | 4.897 | 5.072 | 0.864 |
| 8 | 40 | 8.625 | 8 25/32 | 7.981 | 8.020 | 0.322 |
| | 60 | | | 7.813 | 7.873 | 0.406 |
| | 80 | | | 7.625 | 7.709 | 0.500 |
| | 100 | | | 7.439 | 7.546 | 0.593 |
| | 120 | | | 7.189 | 7.327 | 0.718 |
| | 140 | | | 7.001 | 7.163 | 0.812 |
| | XXS | | | 6.875 | 7.053 | 0.875 |
| | 160 | | | 6.813 | 6.998 | 0.906 |
| 10 | 40 | 10.750 | 10 15/16 | 10.020 | 10.070 | 0.365 |
| | 60 | | | 9.750 | 9.834 | 0.500 |
| | 80 | | | 9.564 | 9.671 | 0.593 |
| | 100 | | | 9.314 | 9.452 | 0.718 |
| | 120 | | | 9.064 | 9.234 | 0.843 |
| | 140 | | | 8.750 | 8.959 | 1.000 |
| | 160 | | | 8.500 | 8.740 | 1.125 |
| 12 | STD | 12.750 | 12 31/32 | 12.000 | 12.053 | 0.375 |
| | 40 | | | 11.938 | 11.999 | 0.406 |
| | XS | | | 11.750 | 11.834 | 0.500 |
| | 60 | | | 11.626 | 11.725 | 0.562 |
| | 80 | | | 11.376 | 11.507 | 0.687 |
| | 100 | | | 11.064 | 11.234 | 0.843 |
| | 120 | | | 10.750 | 10.959 | 1.000 |
| | 140 | | | 10.500 | 10.740 | 1.125 |
| | 160 | | | 10.126 | 10.413 | 1.312 |

Table 11 (Cont'd) Dimensions of Welding Ends (See Figures 9 to 14 inclusive)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Nominal Pipe Size | Schedule[1] No. | A | | B[2] | C[2,3] | t[2] |
| | | Welding Neck Flanges[2,4] | Welding End Valves[2,4] | | | |
| 14 | STD | 14.000 | 14 1/4 | 13.250 | 13.303 | 0.375 |
| | 40 | | | 13.124 | 13.192 | 0.438 |
| | XS | | | 13.000 | 13.084 | 0.500 |
| | 60 | | | 12.814 | 12.921 | 0.593 |
| | 80 | | | 12.500 | 12.646 | 0.750 |
| | 100 | | | 12.126 | 12.319 | 0.937 |
| | 120 | | | 11.814 | 12.046 | 1.093 |
| | 140 | | | 11.500 | 11.771 | 1.250 |
| | 160 | | | 11.188 | 11.498 | 1.406 |
| 16 | STD | 16.000 | 16 1/4 | 15.250 | 15.303 | 0.375 |
| | 40 | | | 15.000 | 15.084 | 0.500 |
| | 60 | | | 14.688 | 14.811 | 0.656 |
| | 80 | | | 14.314 | 14.484 | 0.843 |
| | 100 | | | 13.938 | 14.155 | 1.031 |
| | 120 | | | 13.564 | 13.827 | 1.218 |
| | 140 | | | 13.124 | 13.442 | 1.438 |
| | 160 | | | 12.814 | 13.171 | 1.593 |
| 18 | STD | 18.000 | 18 9/32 | 17.250 | 17.303 | 0.375 |
| | XS | | | 17.000 | 17.084 | 0.500 |
| | 40 | | | 16.876 | 16.975 | 0.562 |
| | 60 | | | 16.500 | 16.646 | 0.750 |
| | 80 | | | 16.126 | 16.319 | 0.937 |
| | 100 | | | 15.688 | 15.936 | 1.156 |
| | 120 | | | 15.250 | 15.553 | 1.375 |
| | 140 | | | 14.876 | 15.225 | 1.562 |
| | 160 | | | 14.438 | 14.842 | 1.781 |
| 20 | STD | 20.000 | 20 5/16 | 19.250 | 19.303 | 0.375 |
| | XS | | | 19.000 | 19.084 | 0.500 |
| | 40 | | | 18.814 | 18.921 | 0.593 |
| | 60 | | | 18.376 | 18.538 | 0.812 |
| | 80 | | | 17.938 | 18.155 | 1.031 |
| | 100 | | | 17.438 | 17.717 | 1.281 |
| | 120 | | | 17.000 | 17.334 | 1.500 |
| | 140 | | | 16.500 | 16.896 | 1.750 |
| | 160 | | | 16.064 | 16.515 | 1.968 |
| 24 | STD | 24.000 | 24 3/8 | 23.250 | 23.303 | 0.375 |
| | XS | | | 23.000 | 23.084 | 0.500 |
| | 30 | | | 22.876 | 22.975 | 0.562 |
| | 40 | | | 22.626 | 22.757 | 0.687 |
| | 60 | | | 22.064 | 22.265 | 0.968 |
| | 80 | | | 21.564 | 21.827 | 1.218 |
| | 100 | | | 20.938 | 21.280 | 1.531 |
| | 120 | | | 20.376 | 20.788 | 1.812 |
| | 140 | | | 19.876 | 20.350 | 2.062 |
| | 160 | | | 19.314 | 19.859 | 2.343 |

All dimensions given in inches.

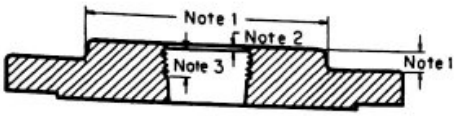
[1] Designations per Appendix B and C and USAS B36.10

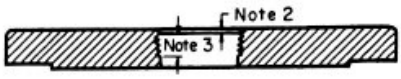
STD = Standard Wall Thickness
XS = Extra Strong Wall Thickness
XXS = Double Extra Strong Wall Thickness

[2] For tolerances see Par. 7.4

[3] It should be recognized that there is no fixed relation between B16.5 pressure classes and pipe schedules. Most pressure classes of valves can be machined to match any one of several schedules of pipe, but not all the schedules that are shown in this tabulation. For unusual cases individual manufacturers must be consulted to determine whether sufficient material is available for all dimensions on the inside of the product.

[4] When the thickness of the welding end of a valve or flange is greater than that of the pipe and the additional thickness increases the outside diameter, a taper weld having a slope not exceeding 3 to 1 may be employed or, alternatively, the greater outside diameter may be tapered, at the same maximum slope or less, from a point on the welding bevel equal to the OD of the mating pipe. Similarly, when the greater thickness is provided on the inside of the valve or flange, it shall be taper-bored from the welding end at a slope not exceeding 3 to 1.




BLIND FLANGE

Table 12 Reducing Threaded and Slip-on Flanges for 150-to 2500-lb Pressures[5]

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

All dimensions given in inches.

*[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 used without hubs.

[2] 150-lb flanges do not have a counterbore. 300-lb and higher pressure flanges will have depth of counterbore (q) of ¼ in. for 2 in. and smaller tapping, and 3/8 in. for 2 ½ in. and larger. The diameter (Q) of counterbore is the same as that given in the tables of threaded flanges for the corresponding tapping.

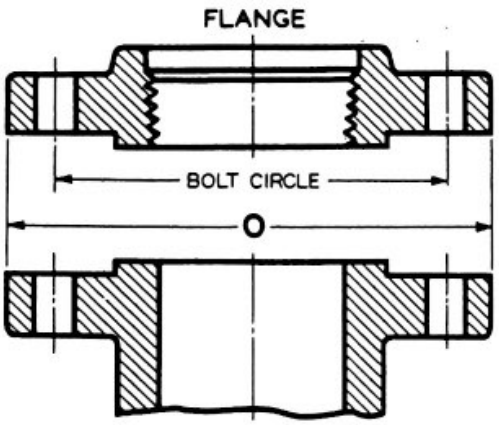
[3] Minimum length of effective threads shall be at least equal to dimension T of the corresponding pressure class screwed flange as shown in tables but does not necessarily extend to the face of the flange. For thread of threaded flanges see Par. 6.8.

[4] For tappings smaller than those given in Columns 2, 4 and 6, blind flanges may be used. See Example 2 below.

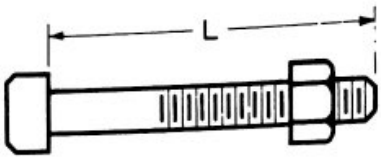
[5] For method of designating reducing threaded flanges, see Par. 3.3. and Examples below.

*Example 1:* 6 × 2 1/2 in. – 300-lb reducing threaded flange.
This flange has the following dimensions:
2 1/2 in. – USA (American) Standard Taper Pipe Thread Tapping
12 1/2 in. – Diameter of regular 6 in. 300-lb threaded flange
1 7/16 in. – Thickness of regular 6 in. 300-lb threaded flange
7 in. – Diameter of hub for regular 5 in. 300-lb threaded flange
5/8 in. – Height of hub for regular 5 in. 300-lb threaded flange
Other dimensions same as for regular 6 in. 300-lb threaded flange, Table 17.

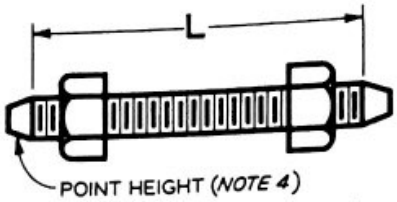
*Example 2:* 6 × 2 in. 300-lb reducing threaded flange.
Use regular 6 in. 300-lb blind flange tapped with 2 in. USA (American) Standard Taper Pipe Thread.




FLANGE FITTING




MACHINE BOLT WITH NUT




STUD BOLT WITH NUTS

Table 13 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Ratings of 150 PSI (Gage)[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| | | | | Drilling[2,3] | | Length of Bolts[5] L | | |
| | | | | | | Stud Bolts[4] | | Machine Bolts |
| Nominal Pipe Size | Outside Diameter of Flange O | Diameter of Bolt Circle | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | 1/16-In. Raised Face | Ring Joint | 1/16-In. Raised Face |
| 1/2 | 3 1/2 | 2 3/8 | 5/8 | 4 | 1/2 | 2 1/4 | . . . . | 1 3/4 |
| 3/4 | 3 7/8 | 2 3/4 | 5/8 | 4 | 1/2 | 2 1/4 | . . . . | 2 |
| 1 | 4 1/4 | 3 1/8 | 5/8 | 4 | 1/2 | 2 1/2 | 3 | 2 |
| 1 1/4 | 4 5/8 | 3 1/2 | 5/8 | 4 | 1/2 | 2 1/2 | 3 | 2 1/4 |
| 1 1/2 | 5 | 3 7/8 | 5/8 | 4 | 1/2 | 2 3/4 | 3 1/4 | 2 1/4 |
| 2 | 6 | 4 3/4 | 3/4 | 4 | 5/8 | 3 | 3 1/2 | 2 3/4 |
| 2 1/2 | 7 | 5 1/2 | 3/4 | 4 | 5/8 | 3 1/4 | 3 3/4 | 3 |
| 3 | 7 1/2 | 6 | 3/4 | 4 | 5/8 | 3 1/2 | 4 | 3 |
| 3 1/2 | 8 1/2 | 7 | 3/4 | 8 | 5/8 | 3 1/2 | 4 | 3 |
| 4 | 9 | 7 1/2 | 3/4 | 8 | 5/8 | 3 1/2 | 4 | 3 |
| 5 | 10 | 8 1/2 | 7/8 | 8 | 3/4 | 3 3/4 | 4 1/4 | 3 1/4 |
| 6 | 11 | 9 1/2 | 7/8 | 8 | 3/4 | 3 3/4 | 4 1/4 | 3 1/4 |
| 8 | 13 1/2 | 11 3/4 | 7/8 | 8 | 3/4 | 4 | 4 1/2 | 3 1/2 |
| 10 | 16 | 14 1/4 | 1 | 12 | 7/8 | 4 1/2 | 5 | 3 3/4 |
| 12 | 19 | 17 | 1 | 12 | 7/8 | 4 1/2 | 5 | 4 |
| 14 | 21 | 18 3/4 | 1 1/8 | 12 | 1 | 5 | 5 1/2 | 4 1/4 |
| 16 | 23 1/2 | 21 1/4 | 1 1/8 | 16 | 1 | 5 1/4 | 5 3/4 | 4 1/2 |
| 18 | 25 | 22 3/4 | 1 1/4 | 16 | 1 1/8 | 5 3/4 | 6 1/4 | 4 3/4 |
| 20 | 27 1/2 | 25 | 1 1/4 | 20 | 1 1/8 | 6 | 6 1/2 | 5 1/4 |
| 24 | 32 | 29 1/2 | 1 3/8 | 20 | 1 1/4 | 6 3/4 | 7 1/4 | 5 3/4 |

All dimensions given in inches.

[1] For other dimensions see Tables 14 and 15.

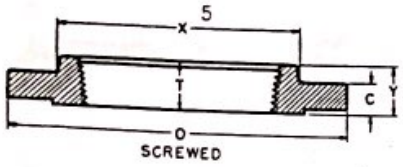
[2] For flange bolt holes see Par. 6.4

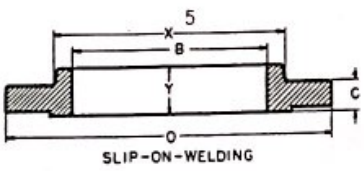
[3] For spot facing see Par. 6.5.

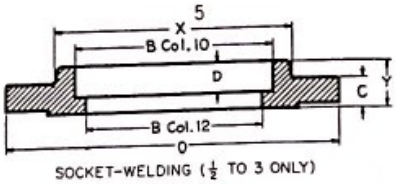
[4] Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

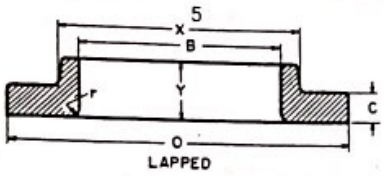
[5] Bolt lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.

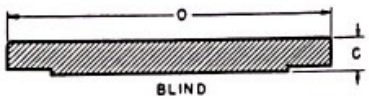
## 150-LB STEEL PIPE FLANGES

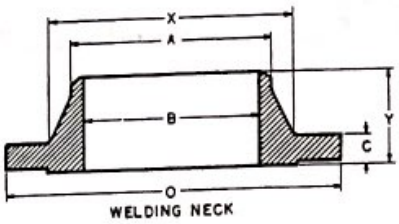



## Table 14 Dimensions of Steel Flanges for Primary Service Pressure Rating of 150 PSI (Gage)[1,2,3,4,6,8,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Thickness of Flange,[12,13] Min C | Diameter of Hub X | Hub Diameter Beginning of Chamfer Welding Neck[9] A | Length Through Hub: Threaded Slip-On Socket Welding Y | Length Through Hub: Lapped Y | Length Through Hub: Welding Neck Y | Thread Length Threaded[7] T | Bore: Slip-On Socket Welding Min B | Bore: Lapped Min B | Bore: 11 Welding Neck Socket Welding B | Corner Radius of Bore of Lapped Flange and Pipe r | Dep of Soc I |
| 1/2 | 3 1/2 | 7/16 | 1 3/16 | 0.84 | 5/8 | 5/8 | 1 7/8 | 5/8 | 0.88 | 0.90 | 0.62 | 1/8 | 3/1 |
| 3/4 | 3 7/8 | 1/2 | 1 1/2 | 1.05 | 5/8 | 5/8 | 2 1/16 | 5/8 | 1.09 | 1.11 | 0.82 | 1/8 | 7/ |
| 1 | 4 1/4 | 9/16 | 1 15/16 | 1.32 | 11/16 | 11/16 | 2 3/16 | 11/16 | 1.36 | 1.38 | 1.05 | 1/8 | 1/ |
| 1 1/4 | 4 5/8 | 5/8 | 2 5/16 | 1.66 | 13/16 | 13/16 | 2 1/4 | 13/16 | 1.70 | 1.72 | 1.38 | 3/16 | 9/ |
| 1 1/2 | 5 | 11/16 | 2 9/16 | 1.90 | 7/8 | 7/8 | 2 7/16 | 7/8 | 1.95 | 1.97 | 1.61 | 1/4 | 5/ |
| 2 | 6 | 3/4 | 3 1/16 | 2.38 | 1 | 1 | 2 1/2 | 1 | 2.44 | 2.46 | 2.07 | 5/16 | 11/ |
| 2 1/2 | 7 | 7/8 | 3 9/16 | 2.88 | 1 1/8 | 1 1/8 | 2 3/4 | 1 1/8 | 2.94 | 2.97 | 2.47 | 5/16 | 3/ |
| 3 | 7 1/2 | 15/16 | 4 1/4 | 3.50 | 1 3/16 | 1 3/16 | 2 3/4 | 1 3/16 | 3.57 | 3.60 | 3.07 | 3/8 | 13/ |
| 3 1/2 | 8 1/2 | 15/16 | 4 13/16 | 4.00 | 1 1/4 | 1 1/4 | 2 13/16 | 1 1/4 | 4.07 | 4.10 | 3.55 | 3/8 | |
| 4 | 9 | 15/16 | 5 5/16 | 4.50 | 1 5/16 | 1 5/16 | 3 | 1 5/16 | 4.57 | 4.60 | 4.03 | 7/16 | |
| 5 | 10 | 15/16 | 6 7/16 | 5.56 | 1 7/16 | 1 7/16 | 3 1/2 | 1 7/16 | 5.66 | 5.69 | 5.05 | 7/16 | |
| 6 | 11 | 1 | 7 9/16 | 6.63 | 1 9/16 | 1 9/16 | 3 1/2 | 1 9/16 | 6.72 | 6.75 | 6.07 | 1/2 | |
| 8 | 13 1/2 | 1 1/8 | 9 11/16 | 8.63 | 1 3/4 | 1 3/4 | 4 | 1 3/4 | 8.72 | 8.75 | 7.98 | 1/2 | |
| 10 | 16 | 1 3/16 | 12 | 10.75 | 1 15/16 | 1 15/16 | 4 | 1 15/16 | 10.88 | 10.92 | 10.02 | 1/2 | |
| 12 | 19 | 1 1/4 | 14 3/8 | 12.75 | 2 3/16 | 2 3/16 | 4 1/2 | 2 3/16 | 12.88 | 12.92 | 12.00 | 1/2 | |
| 14 | 21 | 1 3/8 | 15 3/4 | 14.00 | 2 1/4 | 3 1/8 | 5 | 2 1/4 | 14.14 | 14.18 | To be specified by purchaser | 1/2 | |
| 16 | 23 1/2 | 1 7/16 | 18 | 16.00 | 2 1/2 | 3 7/16 | 5 | 2 1/2 | 16.16 | 16.19 | | 1/2 | |
| 18 | 25 | 1 9/16 | 19 7/8 | 18.00 | 2 11/16 | 3 13/16 | 5 1/2 | 2 11/16 | 18.18 | 18.20 | | 1/2 | |
| 20 | 27 1/2 | 1 11/16 | 22 | 20.00 | 2 7/8 | 4 1/16 | 5 11/16 | 2 7/8 | 20.20 | 20.25 | | 1/2 | |
| 24 | 32 | 1 7/8 | 26 1/8 | 24.00 | 3 1/4 | 4 3/8 | 6 | 3 1/4 | 24.25 | 24.25 | | 1/2 | |

All dimensions given in inches.

For complete pressure-temperature ratings see Table 2

[1] For tolerances see Par. 7

[2] For facing see Par. 6.3

[3] For flange bolt holes see Par. 6.4 and Table 13.

[4] For spot facing see Par. 6.5.

[5] 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.

[6] For reducing threaded flanges see Table 12.

[7] For thread of threaded flanges see Par. 6.8.

[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

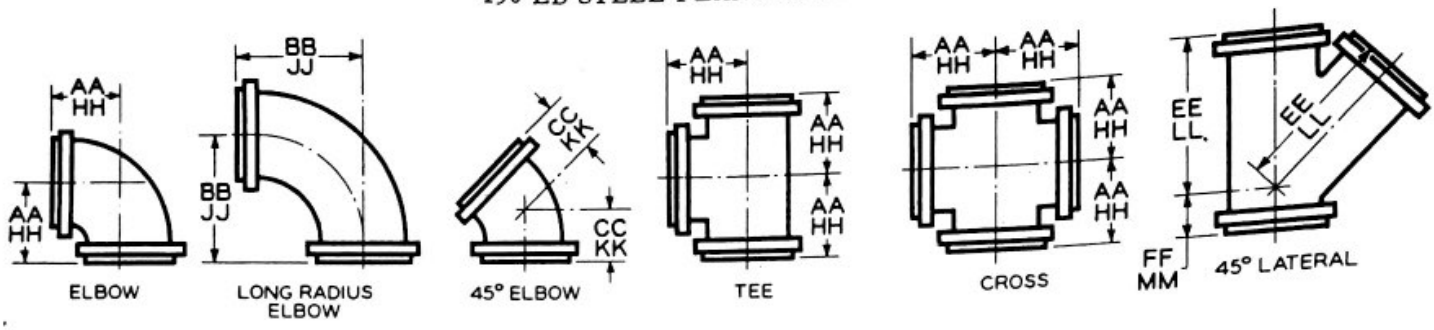
[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.

[11] Dimensions in Column 12 correspond to the inside diameters of pipe as given in USAS B36.10 Standard Wall Pipe, Standard wall dimensions are the same as Schedule 40 sizes 10 inch and smaller. Tolerances in Par. 7.4.2 apply.

[12] The thickness of flange minimum dimensions for these loose flanges, sizes 3½ in. and smaller, are slightly heavier than for the flanges on the fittings, Table 15, which are reinforced by being cast integral with the body of the fitting or valves.

[13] When these flanges are required with flat face, either the full thickness or thickness with raised face removed may be furnished. Users are reminded that removing the raised face will make the length through the hub nonstand




## Table 15 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 150 PSI (Gage)[1,2,3,4,6,8,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1/16 In. Raised Face (Flange Edge)[5] | | | | | | Ring Joint[5] | |
| Nominal Pipe Size | Outside Diameter of Flange O | Thickness of Flange[12,13] Min C | *Wall Thickness of Fitting Min t | Inside Diameter of Fitting d | Center-to-Contact Surface of Raised Face Elbow Tee Cross and True "Y" AA | Center-to-Contact Surface of Raised Face Long Radius Ell BB | Center-to-Contact Surface of Raised Face 45° Ell 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[6] GG | Center-to-End Elbow Tee Cross and True "Y"[11] HH | Center-to-End Long Radius Ell[11] JJ |
| 1 | 4 1/4 | 7/16 | 5/32 | 1 | 3 1/2 | 5 | 1 3/4 | 5 3/4 | 1 3/4 | 4 1/2 | 3 3/4 | 5 1/4 |
| 1 1/4 | 4 5/8 | 1/2 | 3/16 | 1 1/4 | 3 3/4 | 5 1/2 | 2 | 6 1/4 | 1 3/4 | 4 1/2 | 4 | 5 3/4 |
| 1 1/2 | 5 | 9/16 | 3/16 | 1 1/2 | 4 | 6 | 2 1/4 | 7 | 2 | 4 1/2 | 4 1/4 | 6 1/4 |
| 2 | 6 | 5/8 | 7/32 | 2 | 4 1/2 | 6 1/2 | 2 1/2 | 8 | 2 1/2 | 5 | 4 3/4 | 6 3/4 |
| 2 1/2 | 7 | 11/16 | 7/32 | 2 1/2 | 5 | 7 | 3 | 9 1/2 | 2 1/2 | 5 1/2 | 5 1/4 | 7 1/4 |
| 3 | 7 1/2 | 3/4 | 7/32 | 3 | 5 1/2 | 7 3/4 | 3 | 10 | 3 | 6 | 5 3/4 | 8 |
| 3 1/2 | 8 1/2 | 13/16 | 1/4 | 3 1/2 | 6 | 8 1/2 | 3 1/2 | 11 1/2 | 3 | 6 1/2 | 6 1/4 | 8 3/4 |
| 4 | 9 | 15/16 | 1/4 | 4 | 6 1/2 | 9 | 4 | 12 | 3 | 7 | 6 3/4 | 9 1/4 |
| 5 | 10 | 15/16 | 9/32 | 5 | 7 1/2 | 10 1/4 | 4 1/2 | 13 1/2 | 3 1/2 | 8 | 7 3/4 | 10 1/2 |
| 6 | 11 | 1 | 9/32 | 6 | 8 | 11 1/2 | 5 | 14 1/2 | 3 1/2 | 9 | 8 1/4 | 11 3/4 |
| 8 | 13 1/2 | 1 1/8 | 5/16 | 8 | 9 | 14 | 5 1/2 | 17 1/2 | 4 1/2 | 11 | 9 1/4 | 14 1/4 |
| 10 | 16 | 1 3/16 | 11/32 | 10 | 11 | 16 1/2 | 6 1/2 | 20 1/2 | 5 | 12 | 11 1/4 | 16 3/4 |
| 12 | 19 | 1 1/4 | 3/8 | 12 | 12 | 19 | 7 1/2 | 24 1/2 | 5 1/2 | 14 | 12 1/4 | 19 1/4 |
| 14 | 21 | 1 3/8 | 13/32 | 13 1/4 | 14 | 21 1/2 | 7 1/2 | 27 | 6 | 16 | 14 1/4 | 21 3/4 |
| 16 | 23 1/2 | 1 7/16 | 7/16 | 15 1/4 | 15 | 24 | 8 | 30 | 6 1/2 | 18 | 15 1/4 | 24 1/4 |
| 18 | 25 | 1 9/16 | 15/32 | 17 1/4 | 16 1/2 | 26 1/2 | 8 1/2 | 32 | 7 | 19 | 16 3/4 | 26 3/4 |
| 20 | 27 1/2 | 1 11/16 | 1/2 | 19 1/4 | 18 | 29 | 9 1/2 | 35 | 8 | 20 | 18 1/4 | 29 1/4 |
| 24 | 32 | 1 7/8 | 9/16 | 23 1/4 | 22 | 34 | 11 | 40 1/2 | 9 | 24 | 22 1/4 | 34 1/4 |

[1] For tolerance see Section 7.

[2] For tolerances see Section 7.

[3] For flange bolt holes see Par. 6.4 and Table 13.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

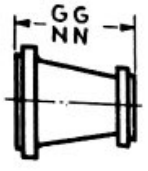
[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings, see Par. 6.2.4.

[8] For center-to-contact surface and center-to-end dimensions of special degree elbows, see Par. 6.2.5.

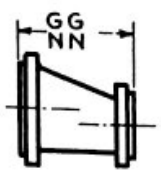
[9] For reinforcement of certain fittings see Par. 6.1.

[10] For drains see Par. 6.11.

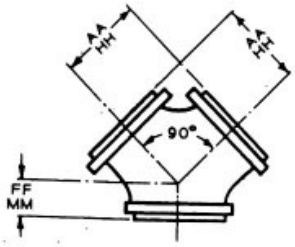
[11] These dimensions apply to straight sizes only. See Par. 6.2.3 and 6.3.1.3. For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers use center-to-contact surface or contact surface-to-contact surface dimensions of 1/16-in. raised face (flange edge) for largest opening and add the proper height to provide for ring-joint groove applying to each flange. See Table 10 for ring-joint facing dimensions.



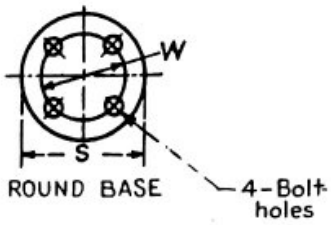
REDUCER



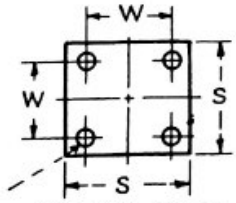
ECCENTRIC REDUCER



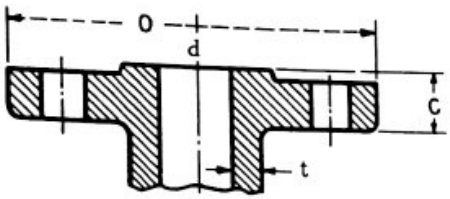
TRUE "Y"

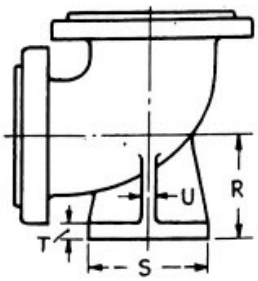


ROUND BASE

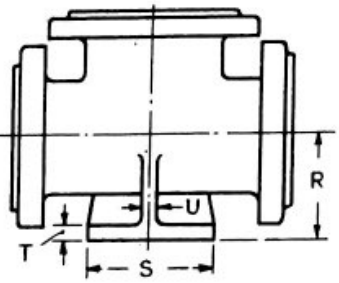


SQUARE BASE



BASE ELBOW



BASE TEE

| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ring Joint[5] | | | | | | | | Base Drilling[16] | | |
| Center-to-End 45° Ell[11] | Long Center-to-End Lateral[11] | Short Center-to-End Lateral and True "Y"[11] | End-to-End Reducer | Center-to-Base[13,14,17] | Diameter of Round Base or Width of Square Base[13] | Thickness of Base[13] | Thickness of Ribs[13] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| KK | LL | MM | NN | R | S | T | U | W | | |
| 2 | 6 | 2 | | | | | | | | 1 |
| 2 1/4 | 6 1/2 | 2 | | | | | | | | 1 1/4 |
| 2 1/2 | 7 1/4 | 2 1/4 | | | | | | | | 1 1/2 |
| 2 3/4 | 8 1/4 | 2 3/4 | | 4 1/8 | 4 5/8 | 1/2 | 1/2 | 3 1/2 | 5/8 | 2 |
| 3 1/4 | 9 3/4 | 2 3/4 | | 4 1/2 | 4 5/8 | 1/2 | 1/2 | 3 1/2 | 5/8 | 2 1/2 |
| 3 1/4 | 10 1/4 | 3 1/4 | | 4 7/8 | 5 | 9/16 | 1/2 | 3 7/8 | 5/8 | 3 |
| 3 3/4 | 11 3/4 | 3 1/4 | | 5 1/4 | 5 | 9/16 | 1/2 | 3 7/8 | 5/8 | 3 1/2 |
| 4 1/4 | 12 1/4 | 3 1/4 | | 5 1/2 | 6 | 5/8 | 1/2 | 4 3/4 | 3/4 | 4 |
| 4 3/4 | 13 3/4 | 3 3/4 | | 6 1/4 | 7 | 11/16 | 5/8 | 5 1/2 | 3/4 | 5 |
| 5 1/4 | 14 3/4 | 3 3/4 | | 7 | 7 | 11/16 | 5/8 | 5 1/2 | 3/4 | 6 |
| 5 3/4 | 17 3/4 | 4 3/4 | | 8 3/8 | 9 | 15/16 | 7/8 | 7 1/2 | 3/4 | 8 |
| 6 3/4 | 20 3/4 | 5 1/4 | | 9 3/4 | 9 | 15/16 | 7/8 | 7 1/2 | 3/4 | 10 |
| 7 3/4 | 24 3/4 | 5 3/4 | | 11 1/4 | 11 | 1 | 1 | 9 1/2 | 7/8 | 12 |
| 7 3/4 | 27 1/4 | 6 1/4 | | 12 1/2 | 11 | 1 | 1 | 9 1/2 | 7/8 | 14 |
| 8 1/4 | 30 1/4 | 6 3/4 | | 13 3/4 | 11 | 1 | 1 | 9 1/2 | 7/8 | 16 |
| 8 3/4 | 32 1/4 | 7 1/4 | | 15 | 13 1/2 | 1 1/8 | 1 1/8 | 11 3/4 | 7/8 | 18 |
| 9 3/4 | 35 1/4 | 8 1/4 | | 16 | 13 1/2 | 1 1/8 | 1 1/8 | 11 3/4 | 7/8 | 20 |
| 11 1/4 | 40 3/4 | 9 1/4 | | 18 1/2 | 13 1/2 | 1 1/8 | 1 1/8 | 11 3/4 | 7/8 | 24 |

See Notes 6 and 11.

[12] The thickness of flange minimum dimensions for loose flanges, Table 14 sizes 3½-in. and smaller, are slightly heavier than for flanges on these fittings which are reinforced by being cast integral with the body of the fitting.

[13] The base dimensions apply to all straight and reducing sizes.

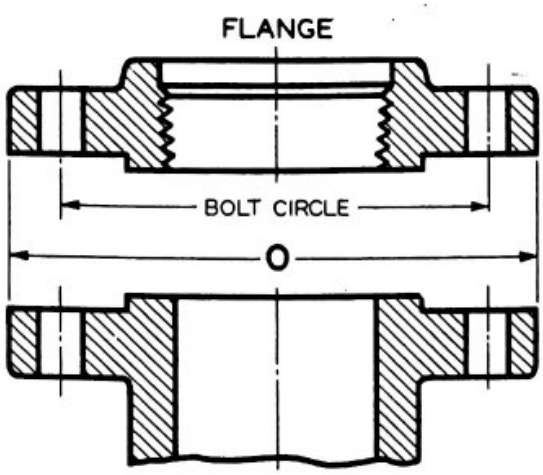
[14] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting.

[15] Bases may be cast integral or attached as weldments at the option of the manufacturer.

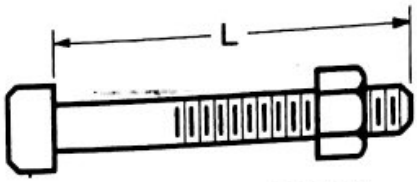
[16] The bolt hole template is the same as for 150-lb flanges, Table 18 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

[17] Bases shall be plain faced unless otherwise specified, and the center to base dimension "R" shall be the finished dimension.

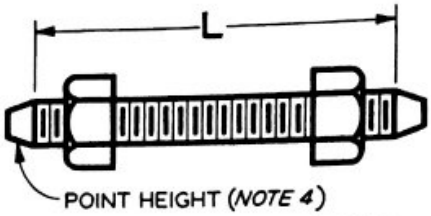
[18] When these fittings are required with flat face flange, either the full thickness or thickness with raised face removed may be furnished. Users are reminded that removing the raised face will make the center-to-face dimension nonstandard.




FLANGE FITTING




MACHINE BOLT WITH NUT




STUD BOLT WITH NUTS

## Table 16 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 300 PSI (Gage) [1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length of Bolts[5] L | | |
| | | Diameter of Bolt Circle | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | Stud Bolts[4] | | Machine Bolts |
| | | | | | | 1/16-In. Raised Face | Ring Joint | 1/16-In. Raised Face |
| 1/2 | 3 3/4 | 2 5/8 | 5/8 | 4 | 1/2 | 2 1/2 | 3 | 2 |
| 3/4 | 4 5/8 | 3 1/4 | 3/4 | 4 | 5/8 | 2 3/4 | 3 1/4 | 2 1/2 |
| 1 | 4 7/8 | 3 1/2 | 3/4 | 4 | 5/8 | 3 | 3 1/2 | 2 1/2 |
| 1 1/4 | 5 1/4 | 3 7/8 | 3/4 | 4 | 5/8 | 3 | 3 1/2 | 2 3/4 |
| 1 1/2 | 6 1/8 | 4 1/2 | 7/8 | 4 | 3/4 | 3 1/2 | 4 | 3 |
| 2 | 6 1/2 | 5 | 3/4 | 8 | 5/8 | 3 1/4 | 4 | 3 |
| 2 1/2 | 7 1/2 | 5 7/8 | 7/8 | 8 | 3/4 | 3 3/4 | 4 1/2 | 3 1/4 |
| 3 | 8 1/4 | 6 5/8 | 7/8 | 8 | 3/4 | 4 | 4 3/4 | 3 1/2 |
| 3 1/2 | 9 | 7 1/4 | 7/8 | 8 | 3/4 | 4 1/4 | 5 | 3 3/4 |
| 4 | 10 | 7 7/8 | 7/8 | 8 | 3/4 | 4 1/4 | 5 | 3 3/4 |
| 5 | 11 | 9 1/4 | 7/8 | 8 | 3/4 | 4 1/2 | 5 1/4 | 4 |
| 6 | 12 1/2 | 10 5/8 | 7/8 | 12 | 3/4 | 4 3/4 | 5 1/2 | 4 1/4 |
| 8 | 15 | 13 | 1 | 12 | 7/8 | 5 1/4 | 6 | 4 3/4 |
| 10 | 17 1/2 | 15 1/4 | 1 1/8 | 16 | 1 | 6 | 6 3/4 | 5 1/4 |
| 12 | 20 1/2 | 17 3/4 | 1 1/4 | 16 | 1 1/8 | 6 1/2 | 7 1/4 | 5 3/4 |
| 14 | 23 | 20 1/4 | 1 1/4 | 20 | 1 1/8 | 6 3/4 | 7 1/2 | 6 |
| 16 | 25 1/2 | 22 1/2 | 1 3/8 | 20 | 1 1/4 | 7 1/4 | 8 | 6 1/2 |
| 18 | 28 | 24 3/4 | 1 3/8 | 24 | 1 1/4 | 7 1/2 | 8 1/4 | 6 3/4 |
| 20 | 30 1/2 | 27 | 1 3/8 | 24 | 1 1/4 | 8 | 8 3/4 | 7 |
| 24 | 36 | 32 | 1 5/8 | 24 | 1 1/2 | 9 | 10 | 7 3/4 |

All dimensions given in inches.

[1] For other dimensions see Tables 17 and 19.

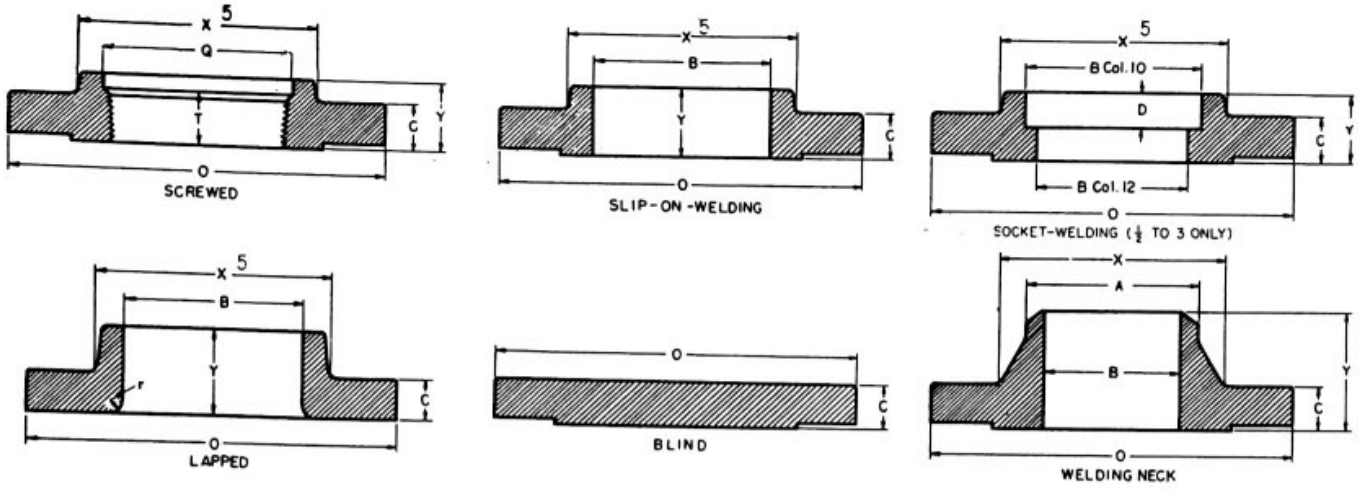
[2] For flange bolt holes see Par. 6.4.

[3] For spot facing see Par. 6.5.

[4] Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

[5] Bolt Lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.

## 300-LB STEEL FLANGED FITTINGS




## Table 17 Dimensions of Steel Flanges for Primary Service Pressure Rating of 300 PSI (Gage)[1·2·3·4·6·8·10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Length Through Hub | | | | Bore | | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange,[12] Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[9] | Threaded Slip-On Socket Welding | Lapped | Welding Neck | Thread Length Threaded[7] | Slip-On Socket Welding Min | Lapped Min | Welding Neck Socket Welding[11] | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange, Min | Depth of Socket |
| | O | C | X | A | Y | Y | Y | T | B | B | B | r | Q | D |
| 1/2 | 3 3/4 | 9/16 | 1 1/2 | 0.84 | 7/8 | 7/8 | 2 1/16 | 5/8 | 0.88 | 0.90 | 0.62 | 1/8 | 0.93 | 3/8 |
| 3/4 | 4 5/8 | 5/8 | 1 7/8 | 1.05 | 1 | 1 | 2 1/4 | 5/8 | 1.09 | 1.11 | 0.82 | 1/8 | 1.14 | 7/16 |
| 1 | 4 7/8 | 11/16 | 2 1/8 | 1.32 | 1 1/16 | 1 1/16 | 2 7/16 | 11/16 | 1.36 | 1.38 | 1.05 | 1/8 | 1.41 | 1/2 |
| 1 1/4 | 5 1/4 | 3/4 | 2 1/2 | 1.66 | 1 1/16 | 1 1/16 | 2 9/16 | 13/16 | 1.70 | 1.72 | 1.38 | 3/16 | 1.75 | 9/16 |
| 1 1/2 | 6 1/8 | 13/16 | 2 3/4 | 1.90 | 1 3/16 | 1 3/16 | 2 11/16 | 7/8 | 1.95 | 1.97 | 1.61 | 1/4 | 1.99 | 5/8 |
| 2 | 6 1/2 | 7/8 | 3 5/16 | 2.38 | 1 5/16 | 1 5/16 | 2 3/4 | 1 1/8 | 2.44 | 2.46 | 2.07 | 5/16 | 2.50 | 11/16 |
| 2 1/2 | 7 1/2 | 1 | 3 15/16 | 2.88 | 1 1/2 | 1 1/2 | 3 | 1 1/4 | 2.94 | 2.97 | 2.47 | 5/16 | 3.00 | 3/4 |
| 3 | 8 1/4 | 1 1/8 | 4 5/8 | 3.50 | 1 11/16 | 1 11/16 | 3 1/8 | 1 1/4 | 3.57 | 3.60 | 3.07 | 3/8 | 3.63 | 13/16 |
| 3 1/2 | 9 | 1 3/16 | 5 1/4 | 4.00 | 1 3/4 | 1 3/4 | 3 3/16 | 1 7/16 | 4.07 | 4.10 | 3.55 | 3/8 | 4.13 | |
| 4 | 10 | 1 1/4 | 5 3/4 | 4.50 | 1 7/8 | 1 7/8 | 3 3/8 | 1 7/16 | 4.57 | 4.60 | 4.03 | 7/16 | 4.63 | |
| 5 | 11 | 1 3/8 | 7 | 5.56 | 2 | 2 | 3 7/8 | 1 11/16 | 5.66 | 5.69 | 5.05 | 7/16 | 5.69 | |
| 6 | 12 1/2 | 1 7/16 | 8 1/8 | 6.63 | 2 1/16 | 2 1/16 | 3 7/8 | 1 13/16 | 6.72 | 6.75 | 6.07 | 1/2 | 6.75 | |
| 8 | 15 | 1 5/8 | 10 1/4 | 8.63 | 2 7/16 | 2 7/16 | 4 3/8 | 2 | 8.72 | 8.75 | 7.98 | 1/2 | 8.75 | |
| 10 | 17 1/2 | 1 7/8 | 12 5/8 | 10.75 | 2 5/8 | 3 3/4 | 4 5/8 | 2 3/16 | 10.88 | 10.92 | 10.02 | 1/2 | 10.88 | |
| 12 | 20 1/2 | 2 | 14 3/4 | 12.75 | 2 7/8 | 4 | 5 1/8 | 2 3/8 | 12.88 | 12.92 | 12.00 | 1/2 | 12.94 | |
| 14 | 23 | 2 1/8 | 16 3/4 | 14.00 | 3 | 4 3/8 | 5 5/8 | 2 1/2 | 14.14 | 14.18 | To be Specified by Purchaser | 1/2 | 14.19 | |
| 16 | 25 1/2 | 2 1/4 | 19 | 16.00 | 3 1/4 | 4 3/4 | 5 3/4 | 2 11/16 | 16.16 | 16.19 | | 1/2 | 16.19 | |
| 18 | 28 | 2 3/8 | 21 | 18.00 | 3 1/2 | 5 1/8 | 6 1/4 | 2 3/4 | 18.18 | 18.20 | | 1/2 | 18.19 | |
| 20 | 30 1/2 | 2 1/2 | 23 1/8 | 20.00 | 3 3/4 | 5 1/2 | 6 3/8 | 2 7/8 | 20.20 | 20.25 | | 1/2 | 20.19 | |
| 24 | 36 | 2 3/4 | 27 5/8 | 24.00 | 4 3/16 | 6 | 6 5/8 | 3 1/4 | 24.25 | 24.25 | | 1/2 | 24.19 | |

All dimensions given in inches.

For complete pressure-temperature ratings see Tables 3.

[1] For tolerances see Par. 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 16

[4] For spot facing see Par. 6.5.

[5] 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.

[6] For reducing threaded flanges see Table 12.

[7] For thread of threaded flanges see Par. 6.8.

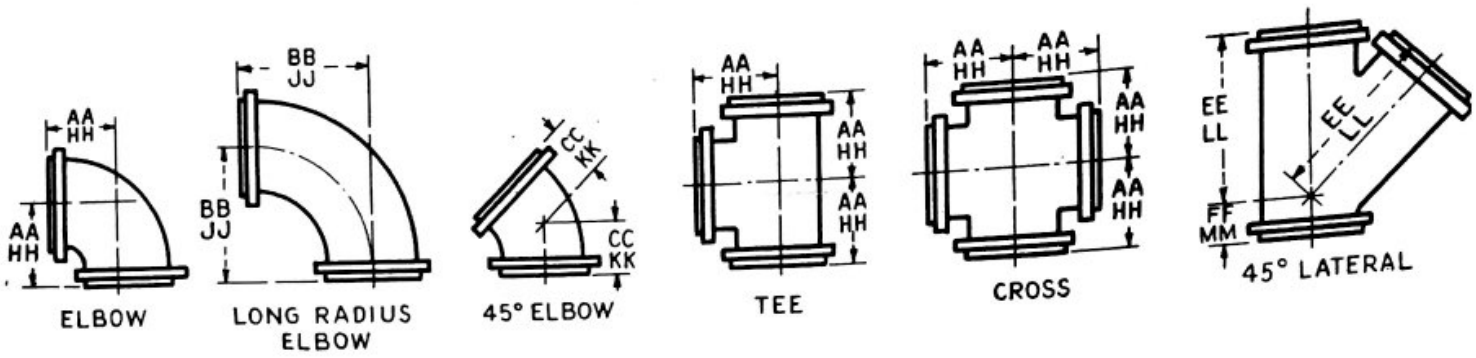
[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.

[11] Dimensions in Column 12 correspond to the inside diameters of pipe as given in USAS B36.10 "Standard Wall Pipe." Standard wall dimensions are the same as Schedule 40 sizes 10 inch and smaller. Tolerances in Par. 7.4.2 apply.

[12] When these flanges are required with flat face, either the full thickness or thickness with raised face removed may be furnished. Users are reminded that removing the raised face will make the length through the hub nonstandard.




## Table 18 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 300 PSI (Gage)[1·2·3·4·7·8·9·10·17]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1/16 In. Raised Face (Flange Edge) | | | | | | Ring Joint[5] |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | *Wall Thickness of Fitting, Min | Inside Diameter of Fitting | Center-to-Contact Surface of Raised Face Elbow Tee Cross and True "Y" | Center-to-Contact Surface of Raised Face Long Radius Ell | Center-to-Contact Surface of Raised Face 45° Ell | 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 of Raised Face Reducer | Center-to-End Elbow Tee Cross and True "Y"[11] |
| | O | C | t | | AA | BB | CC | EE | FF | GG | HH |
| 1 | 4 7/8 | 11/16 | 3/16 | 1 | 4 | 5 | 2 1/4 | 6 1/2 | 2 | 4 1/2 | 4 1/4 |
| 1 1/4 | 5 1/4 | 3/4 | 7/32 | 1 1/4 | 4 1/4 | 5 1/2 | 2 1/2 | 7 1/4 | 2 1/4 | 4 1/2 | 4 1/2 |
| 1 1/2 | 6 1/8 | 13/16 | 7/32 | 1 1/2 | 4 1/2 | 6 | 2 3/4 | 8 1/2 | 2 1/2 | 4 1/2 | 4 3/4 |
| 2 | 6 1/2 | 7/8 | 1/4 | 2 | 5 | 6 1/2 | 3 | 9 | 2 1/2 | 5 | 5 5/16 |
| 2 1/2 | 7 1/2 | 1 | 1/4 | 2 1/2 | 5 1/2 | 7 | 3 1/2 | 10 1/2 | 2 1/2 | 5 1/2 | 5 .13/16 |
| 3 | 8 1/4 | 1 1/8 | 9/32 | 3 | 6 | 7 3/4 | 3 1/2 | 11 | 3 | 6 | 6 5/16 |
| 3 1/2 | 9 | 1 3/16 | 9/32 | 3 1/2 | 6 1/2 | 8 1/2 | 4 | 12 1/2 | 3 | 6 1/2 | 6 13/16 |
| 4 | 10 | 1 1/4 | 5/16 | 4 | 7 | 9 | 4 1/2 | 13 1/2 | 3 | 7 | 7 5/16 |
| 5 | 11 | 1 3/8 | 3/8 | 5 | 8 | 10 1/4 | 5 | 15 | 3 1/2 | 8 | 8 5/16 |
| 6 | 12 1/2 | 1 7/16 | 3/8 | 6 | 8 1/2 | 11 1/2 | 5 1/2 | 17 1/2 | 4 | 9 | 8 13/16 |
| 8 | 15 | 1 5/8 | 7/16 | 8 | 10 | 14 | 6 | 20 1/2 | 5 | 11 | 10 5/16 |
| 10 | 17 1/2 | 1 7/8 | 1/2 | 10 | 11 1/2 | 16 1/2 | 7 | 24 | 5 1/2 | 12 | 11 13/16 |
| 12 | 20 1/2 | 2 | 9/16 | 12 | 13 | 19 | 8 | 27 1/2 | 6 | 14 | 13 5/16 |
| 14 | 23 | 2 1/8 | 5/8 | 13 1/4 | 15 | 21 1/2 | 8 1/2 | 31 | 6 1/2 | 16 | 15 5/16 |
| 16 | 25 1/2 | 2 1/4 | 11/16 | 15 1/4 | 16 1/2 | 24 | 9 1/2 | 34 1/2 | 7 1/2 | 18 | 16 13/16 |
| 18 | 28 | 2 3/8 | 3/4 | 17 | 18 | 26 1/2 | 10 | 37 1/2 | 8 | 19 | 18 5/16 |
| 20 | 30 1/2 | 2 1/2 | 13/16 | 19 | 19 1/2 | 29 | 10 1/2 | 40 1/2 | 8 1/2 | 20 | 19 7/8 |
| 24 | 36 | 2 3/4 | 15/16 | 23 | 22 1/2 | 34 | 12 | 47 1/2 | 10 | 24 | 22 15/16 |

For complete pressure-temperature ratings see Table 3.

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 16.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

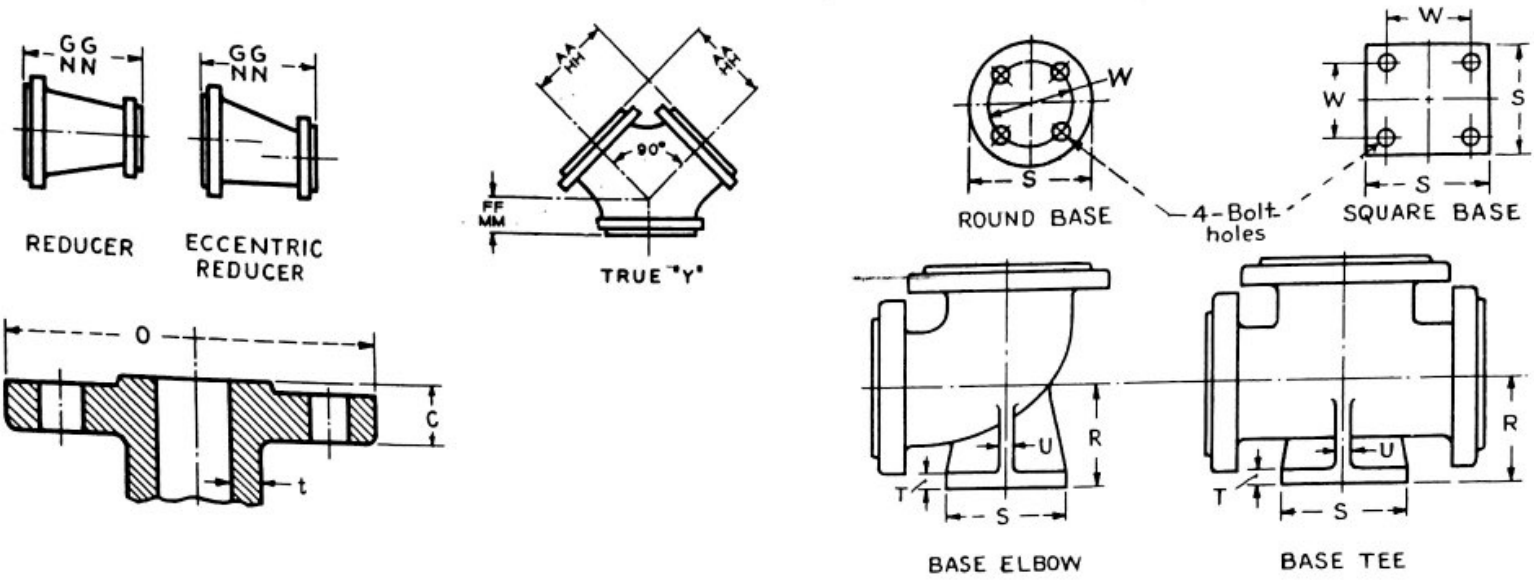
[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings, see Par. 6.2.4.

[8] For center-to-contact surface and center-to-end dimensions of special degree elbows, see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1.

# 300-LB STEEL FLANGED FITTINGS




| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ring Joint[5] | | | | | | | | Base Drilling[15] | | | |
| Center-to-End Long Radius Ell[11] | Center-to-End 45° Ell[11] | Long Center-to-End Lateral[11] | Short Center-to-End Lateral and True "Y"[11] | End-to-End Reducer | Center-to-Base[12,13,16] | Diameter of Round Base or Width of Square Base[12] | Thickness of Base[12] | Thickness of Ribs[12] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| JJ | KK | LL | MM | NN | R | S | T | U | W | | |
| 5 1/4 | 2 1/2 | 6 3/4 | 2 1/4 | | | | | | | | 1 |
| 5 3/4 | 2 3/4 | 7 1/2 | 2 1/2 | | | | | | | | 1 1/4 |
| 6 1/4 | 3 | 8 3/4 | 2 3/4 | | | | | | | | 1 1/2 |
| 6 13/16 | 3 5/16 | 9 5/16 | 2 13/16 | | 4 1/2 | 5 1/4 | 3/4 | 1/2 | 3 7/8 | 3/4 | 2 |
| 7 5/16 | 3 13/16 | 10 13/16 | 2 13/16 | | 4 3/4 | 5 1/4 | 3/4 | 1/2 | 3 7/8 | 3/4 | 2 1/2 |
| 8 1/16 | 3 13/16 | 11 5/16 | 3 5/16 | | 5 1/4 | 6 1/8 | 13/16 | 5/8 | 4 1/2 | 7/8 | 3 |
| 8 13/16 | 4 5/16 | 12 13/16 | 3 5/16 | | 5 5/8 | 6 1/8 | 13/16 | 5/8 | 4 1/2 | 7/8 | 3 1/2 |
| 9 5/16 | 4 13/16 | 13 13/16 | 3 5/16 | See Notes 6 and 11. | 6 | 6 1/2 | 7/8 | 5/8 | 5 | 3/4 | 4 |
| 10 9/16 | 5 5/16 | 15 5/16 | 3 13/16 | | 6 3/4 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 5 |
| 11 13/16 | 5 13/16 | 17 13/16 | 4 5/16 | | 7 1/2 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 6 |
| 14 5/16 | 6 5/16 | 20 13/16 | 5 5/16 | | 9 | 10 | 1 1/4 | 7/8 | 7 7/8 | 7/8 | 8 |
| 16 13/16 | 7 5/16 | 24 5/16 | 5 13/16 | | 10 1/2 | 10 | 1 1/4 | 7/8 | 7 7/8 | 7/8 | 10 |
| 19 5/16 | 8 5/16 | 27 13/16 | 6 5/16 | | 12 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 12 |
| 21 13/16 | 8 13/16 | 31 5/16 | 6 13/16 | | 13 1/2 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 14 |
| 24 5/16 | 9 13/16 | 34 13/16 | 7 13/16 | | 14 3/4 | 12 1/2 | 1 7/16 | 1 1/8 | 10 5/8 | 7/8 | 16 |
| 26 13/16 | 10 5/16 | 37 13/16 | 8 5/16 | | 16 1/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 18 |
| 29 3/8 | 10 7/8 | 40 7/8 | 8 7/8 | | 17 7/8 | 15 | 1 5/8 | 1 1/4 | 13 | 1 | 20 |
| 34 7/16 | 12 7/16 | 47 15/16 | 10 7/16 | | 20 3/4 | 17 1/2 | 1 7/8 | 1 1/4 | 15 1/4 | 1 1/8 | 24 |

[10] For drains see Par. 6.11.

[11] These dimensions apply to straight sizes only. See Par. 6.2.3 and 6.3.1.3. For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers use center-to-contact surface or surface-to-contact surface dimensions of 1/16-in. raised face (flange edge) for largest opening and add the proper height to provide for ring-joint groove applying to each flange. See Table 10 for ring-joint facing dimensions.

[12] The base dimensions apply to all straight and reducing sizes.

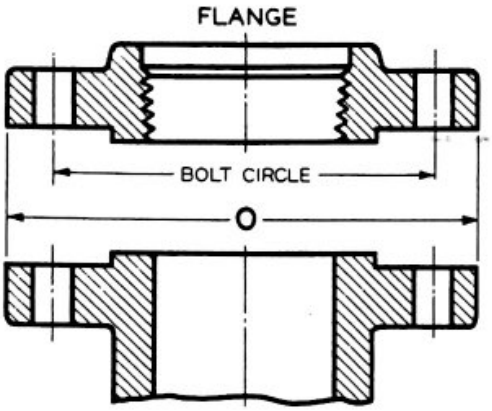
[13] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.

[14] Bases may be cast integral or attached as weldments at the option of the manufacturer.

[15] The bolt hole template for round base is the same as for 300 lb. flanges, Table 16 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. 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.

[16] Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension "R" shall be the finished dimension.

[17] When these fittings are required with flat face flange, either the full thickness or thickness with raised face removed may be furnished. Users are reminded that removing the raised face will make the center-to-face dimension nonstandard.



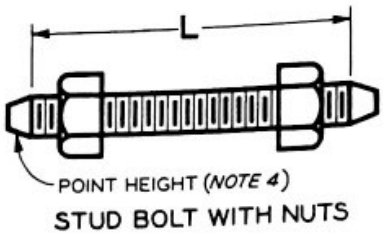




Table 19 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 400 PSI (Gage)[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length[4,5] of Stud Bolts L | | |
| | | Diameter of Bolt Circle | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | 1/4-In. Raised Face | Male & Female also Tongue & Groove | Ring Joint |
| 1/2<br>3/4<br>1<br>1 1/4<br>1 1/2<br>2<br>2 1/2<br>3<br>3 1/2 | Use 600-lb dimensions in these sizes. | | | | | | | |
| 4 | 10 | 7 7/8 | 1 | 8 | 7/8 | 5 1/4 | 5 | 5 1/2 |
| 5 | 11 | 9 1/4 | 1 | 8 | 7/8 | 5 1/2 | 5 1/4 | 5 3/4 |
| 6 | 12 1/2 | 10 5/8 | 1 | 12 | 7/8 | 5 3/4 | 5 1/2 | 6 |
| 8 | 15 | 13 | 1 1/8 | 12 | 1 | 6 1/2 | 6 1/4 | 6 3/4 |
| 10 | 17 1/2 | 15 1/4 | 1 1/4 | 16 | 1 1/8 | 7 1/4 | 7 | 7 1/2 |
| 12 | 20 1/2 | 17 3/4 | 1 3/8 | 16 | 1 1/4 | 7 3/4 | 7 1/2 | 8 |
| 14 | 23 | 20 1/4 | 1 3/8 | 20 | 1 1/4 | 8 | 7 3/4 | 8 1/4 |
| 16 | 25 1/2 | 22 1/2 | 1 1/2 | 20 | 1 3/8 | 8 1/2 | 8 1/4 | 8 3/4 |
| 18 | 28 | 24 3/4 | 1 1/2 | 24 | 1 3/8 | 8 3/4 | 8 1/2 | 9 |
| 20 | 30 1/2 | 27 | 1 5/8 | 24 | 1 1/2 | 9 1/2 | 9 1/4 | 9 3/4 |
| 24 | 36 | 32 | 1 7/8 | 24 | 1 3/4 | 10 1/2 | 10 1/4 | 11 |

All dimensions given in inches.

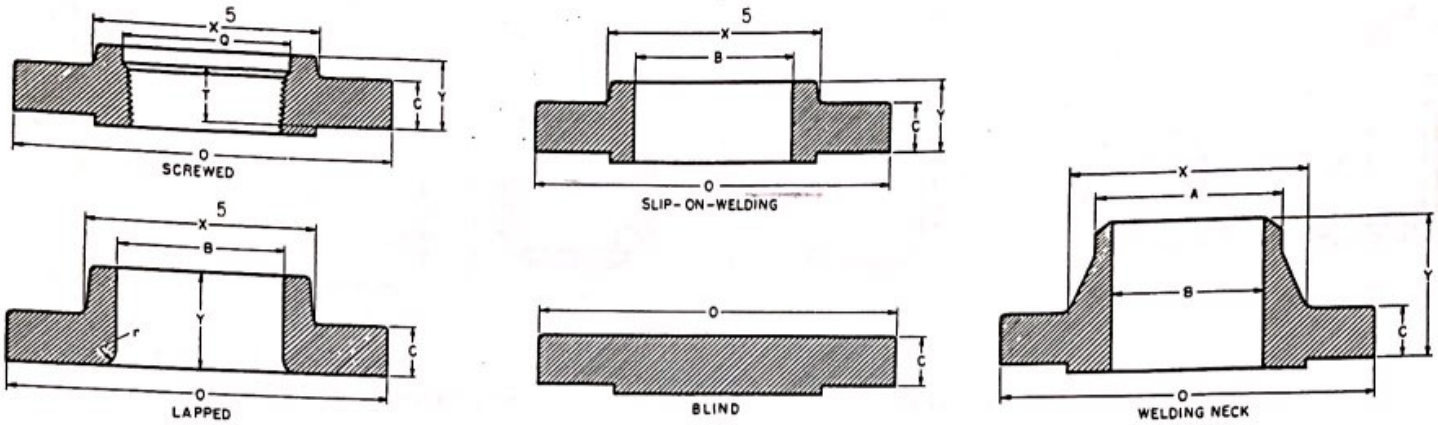
[1]For other dimensions see Tables 20 and 21.

[2]For flange bolt holes see Par. 6.4.

[3]For spot facing see Par. 6.5.

[4]Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

[5]Bolt Lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.




## Table 20 Dimensions of Steel Flanges for Primary Service Pressure Rating of 400 PSI (Gage)[1·2·3·4·6·8·10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[9] | Length Through Hub | | | Thread Length Threaded[7] | Bore | | | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange, Min |
| | | | | | Threaded Slip-on | Lapped | Welding Neck | | Slip-on Min | Lapped Min | Welding Neck | | |
| | O | C | X | A | Y | Y | Y | T | B | B | B | r | Q |
| 1/2 | Use 600-lb dimensions in these sizes. | | | | | | | | | | | | |
| 3/4 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | |
| 1 1/4 | | | | | | | | | | | | | |
| 1 1/2 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 2 1/2 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |
| 3 1/2 | | | | | | | | | | | | | |
| 4 | 10 | 1 3/8 | 5 3/4 | 4.50 | 2 | 2 | 3 1/2 | 1 7/16 | 4.57 | 4.60 | To be specified by purchaser | 7/16 | 4.63 |
| 5 | 11 | 1 1/2 | 7 | 5.56 | 2 1/8 | 2 1/8 | 4 | 1 11/16 | 5.66 | 5.69 | | 7/16 | 5.69 |
| 6 | 12 1/2 | 1 5/8 | 8 1/8 | 6.63 | 2 1/4 | 2 1/4 | 4 1/16 | 1 13/16 | 6.72 | 6.75 | | 1/2 | 6.75 |
| 8 | 15 | 1 7/8 | 10 1/4 | 8.63 | 2 11/16 | 2 11/16 | 4 5/8 | 2 | 8.72 | 8.75 | | 1/2 | 8.75 |
| 10 | 17 1/2 | 2 1/8 | 12 5/8 | 10.75 | 2 7/8 | 4 | 4 7/8 | 2 3/16 | 10.88 | 10.92 | | 1/2 | 10.88 |
| 12 | 20 1/2 | 2 1/4 | 14 3/4 | 12.75 | 3 1/8 | 4 1/4 | 5 3/8 | 2 3/8 | 12.88 | 12.92 | | 1/2 | 12.94 |
| 14 | 23 | 2 3/8 | 16 3/4 | 14.00 | 3 5/16 | 4 5/8 | 5 7/8 | 2 1/2 | 14.14 | 14.18 | | 1/2 | 14.19 |
| 16 | 25 1/2 | 2 1/2 | 19 | 16.00 | 3 11/16 | 5 | 6 | 2 11/16 | 16.16 | 16.19 | | 1/2 | 16.19 |
| 18 | 28 | 2 5/8 | 21 | 18.00 | 3 7/8 | 5 3/8 | 6 1/2 | 2 3/4 | 18.18 | 18.20 | | 1/2 | 18.19 |
| 20 | 30 1/2 | 2 3/4 | 23 1/8 | 20.00 | 4 | 5 3/4 | 6 5/8 | 2 7/8 | 20.20 | 20.25 | | 1/2 | 20.19 |
| 24 | 36 | 3 | 27 5/8 | 24.00 | 4 1/2 | 6 1/4 | 6 7/8 | 3 1/4 | 24.25 | 24.25 | | 1/2 | 24.19 |

All dimensions given in inches.

For complete pressure-temperature ratings see Table 4.

[1] For tolerances see Par. 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 19.

[4] For spot facing see Par. 6.5.

[5] This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on and lapped flanges.

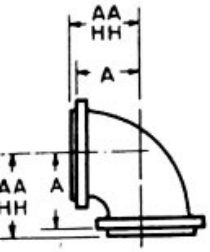
[6] For reducing threaded flanges see Table 12.

[7] For thread of threaded flanges see Par. 6.8.

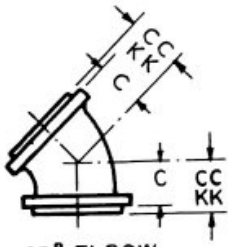
[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

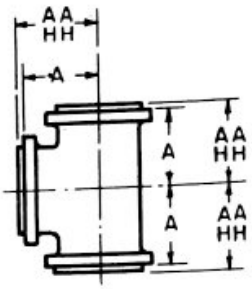
[10] For reducing welding neck flanges see Par. 6.7.



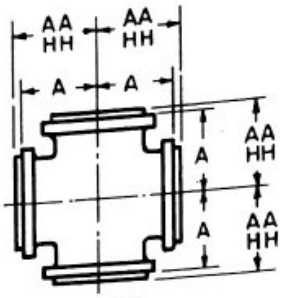
ELBOW



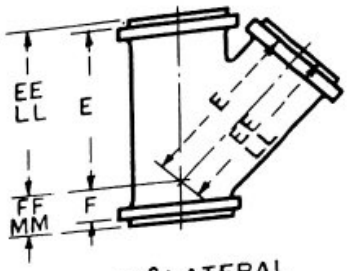
45° ELBOW



TEE



CROSS



45° LATERAL

## Table 21 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 400 PSI (Gage)[1,2,3,4,7,8,9,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flange Edge | | | | | ¼-In. Raised Face[5] | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Wall Thickness of Fitting, Min | Inside Diameter of Fitting | Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y" | Center-to-Flange Edge, 45° Ell | Long Center-to-Flange Edge, Lateral | Short Center-to-Flange Edge, Lateral, and True "Y" | Flange Edge-to-Flange Edge, Reducer | Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y" | Center-to-Contact Surface of Raised Face, 45° Ell | 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 of Raised Face, Reducer[6] |
| | O | C | t | d | A | C | E | F | G | AA | CC | EE | FF | GG |
| 1/2 | | | | | | | | | | | | | | |
| 3/4 | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | |
| 1 1/4 | | | | | | | | | | | | | | |
| 1 1/2 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | |
| 2 1/2 | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | |
| 3 1/2 | | | | | | | | | | | | | | |
| 4 | 10 | 1 3/8 | 3/8 | 4 | 7 3/4 | 5 1/4 | 15 3/4 | 4 1/4 | 7 3/4 | 8 | 5 1/2 | 16 | 4 1/2 | 8 1/4 |
| 5 | 11 | 1 1/2 | 7/16 | 5 | 8 3/4 | 5 3/4 | 16 1/2 | 4 3/4 | 8 3/4 | 9 | 6 | 16 3/4 | 5 | 9 1/4 |
| 6 | 12 1/2 | 1 5/8 | 7/16 | 6 | 9 1/2 | 6 | 18 1/2 | 5 | 9 1/2 | 9 3/4 | 6 1/4 | 18 3/4 | 5 1/4 | 10 |
| 8 | 15 | 1 7/8 | 9/16 | 8 | 11 1/2 | 6 1/2 | 22 | 5 1/2 | 11 1/2 | 11 3/4 | 6 3/4 | 22 1/4 | 5 3/4 | 12 |
| 10 | 17 1/2 | 2 1/8 | 11/16 | 10 | 13 | 7 1/2 | 25 1/2 | 6 | 13 | 13 1/4 | 7 3/4 | 25 3/4 | 6 1/4 | 13 1/2 |
| 12 | 20 1/2 | 2 1/4 | 3/4 | 12 | 14 3/4 | 8 1/2 | 29 1/2 | 6 1/4 | 14 3/4 | 15 | 8 3/4 | 29 3/4 | 6 1/2 | 15 1/4 |
| 14 | 23 | 2 3/8 | 13/16 | 13 1/8 | 16 | 9 | 32 1/2 | 6 3/4 | 16 | 16 1/4 | 9 1/4 | 32 3/4 | 7 | 16 1/2 |
| 16 | 25 1/2 | 2 1/2 | 7/8 | 15 | 17 1/2 | 10 | 36 | 7 3/4 | 18 | 17 3/4 | 10 1/4 | 36 1/4 | 8 | 18 1/2 |
| 18 | 28 | 2 5/8 | 15/16 | 17 | 19 | 10 1/2 | 39 | 8 1/4 | 19 | 19 1/4 | 10 3/4 | 39 1/4 | 8 1/2 | 19 1/2 |
| 20 | 30 1/2 | 2 3/4 | 1 1/16 | 18 7/8 | 20 1/2 | 11 | 42 1/2 | 8 3/4 | 20 1/2 | 20 3/4 | 11 1/4 | 42 3/4 | 9 | 21 |
| 24 | 36 | 3 | 1 3/16 | 22 5/8 | 24 | 12 1/2 | 50 | 10 1/4 | 24 | 24 1/4 | 12 3/4 | 50 1/4 | 10 1/2 | 24 1/2 |

Use 600-lb dimensions in these sizes.

All dimensions given in inches.

For complete pressure-temperature ratings see Table 4.

[1] For tolerances see Par. 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 19.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

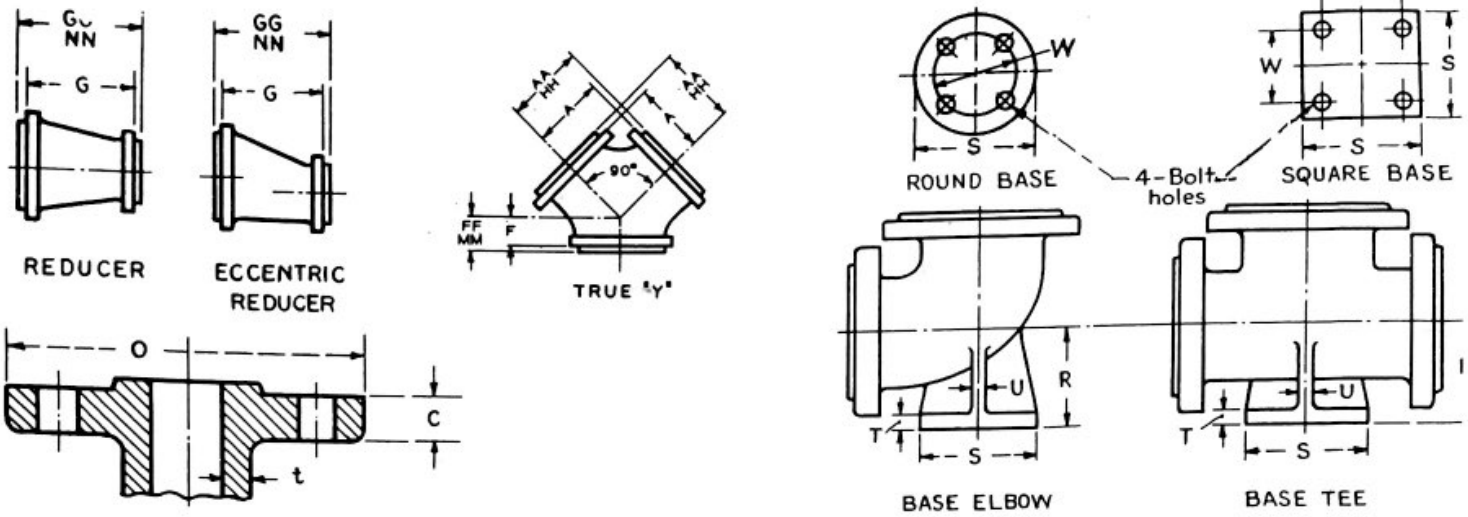
[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

[7] For intersecting centerlines, center-to-contact surface and and center-to-end dimensions of side outlet fittings see Par. 6.2.4.

[8] For center-to-contact surface and center-to-end dimensions of special degree elbows see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1.

## 400-LB STEEL FLANGED FITTINGS




| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ring Joint[5] | | | | | | | | Base Drilling[15] | | |
| Center-to-End Elbow Tee Cross and True "Y"[11] | Center-to-End 45° Ell[11] | Long Center-to-End Lateral[11] | Short Center-to-End Lateral and True "Y"[11] | End-to-End Reducer | Center to Base[12,13,16] | Diameter of Round Base or Width of Square Base[12] | Thickness of Base[12] | Thickness of Ribs[12] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| HH | KK | LL | MM | NN | R | S | T | U | W | | |
| 8 1/16 | 5 9/16 | 16 1/16 | 4 9/16 | See Notes 6 and 11. | 6 | 6 1/2 | 7/8 | 5/8 | 5 | 3/4 | 4 |
| 9 1/16 | 6 1/16 | 16 13/16 | 5 1/16 | | 6 3/4 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 5 |
| 9 13/16 | 6 5/16 | 18 13/16 | 5 5/16 | | 7 1/2 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 6 |
| 11 13/16 | 6 13/16 | 22 5/16 | 5 13/16 | | 9 | 10 | 1 1/4 | 7/8 | 7 7/8 | 7/8 | 8 |
| 13 5/16 | 7 13/16 | 25 13/16 | 6 5/16 | | 10 1/2 | 10 | 1 1/4 | 7/8 | 7 7/8 | 7/8 | 10 |
| 15 1/16 | 8 13/16 | 29 13/16 | 6 9/16 | | 12 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 12 |
| 16 5/16 | 9 5/16 | 32 13/16 | 7 1/16 | | 13 1/2 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 14 |
| 17 13/16 | 10 5/16 | 36 5/16 | 8 1/16 | | 14 3/4 | 12 1/2 | 1 7/16 | 1 1/8 | 10 5/8 | 7/8 | 16 |
| 19 5/16 | 10 13/16 | 39 5/16 | 8 9/16 | | 16 1/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 18 |
| 20 7/8 | 11 3/8 | 42 7/8 | 9 1/8 | | 17 7/8 | 15 | 1 5/8 | 1 1/4 | 13 | 1 | 20 |
| 24 7/16 | 12 15/16 | 50 7/16 | 10 11/16 | | 20 3/4 | 17 1/2 | 1 7/8 | 1 1/4 | 15 1/4 | 1 1/8 | 24 |

Use 600-lb dimensions in these sizes.

[10] For drains see Par. 6.11.

[11] These dimensions apply to straight sizes only. See Par. 6.2.3 and 6.3.1.3. 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 10 for ring-joint facing dimensions.

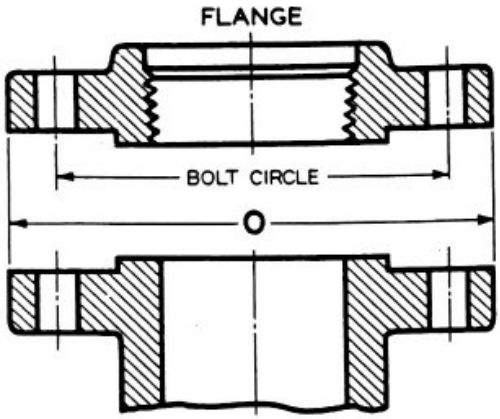
[12] The base dimensions apply to all straight and reducing sizes.

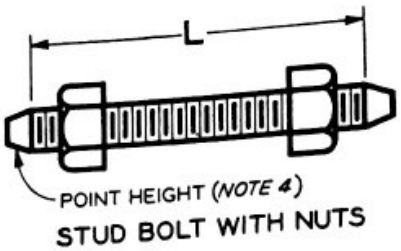
[13] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.

[14] Bases may be cast integral or attached as weldments at the option of the manufacturer.

[15] The bolt hole template for round base is the same as for 300-lb flanges, Table 16 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. 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.

[16] Bases shall be plain faced unless otherwise specified, and the center to base face dimension "R" shall be the finished dimension.




## Table 22 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 600 PSI (Gage)[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length[4,5] of Stud Bolts L | | |
| | | Diameter of Bolt Circle | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | 1/4-In Raised Face | Male & Female also Tongue & Groove | Ring Joint |
| 1/2 | 3 3/4 | 2 5/8 | 5/8 | 4 | 1/2 | 3 | 2 3/4 | 3 |
| 3/4 | 4 5/8 | 3 1/4 | 3/4 | 4 | 5/8 | 3 1/4 | 3 | 3 1/4 |
| 1 | 4 7/8 | 3 1/2 | 3/4 | 4 | 5/8 | 3 1/2 | 3 1/4 | 3 1/2 |
| 1 1/4 | 5 1/4 | 3 7/8 | 3/4 | 4 | 5/8 | 3 3/4 | 3 1/2 | 3 3/4 |
| 1 1/2 | 6 1/8 | 4 1/2 | 7/8 | 4 | 3/4 | 4 | 3 3/4 | 4 |
| 2 | 6 1/2 | 5 | 3/4 | 8 | 5/8 | 4 | 3 3/4 | 4 1/4 |
| 2 1/2 | 7 1/2 | 5 7/8 | 7/8 | 8 | 3/4 | 4 1/2 | 4 1/4 | 4 3/4 |
| 3 | 8 1/4 | 6 5/8 | 7/8 | 8 | 3/4 | 4 3/4 | 4 1/2 | 5 |
| 3 1/2 | 9 | 7 1/4 | 1 | 8 | 7/8 | 5 1/4 | 5 | 5 1/2 |
| 4 | 10 3/4 | 8 1/2 | 1 | 8 | 7/8 | 5 1/2 | 5 1/4 | 5 3/4 |
| 5 | 13 | 10 1/2 | 1 1/8 | 8 | 1 | 6 1/4 | 6 | 6 1/2 |
| 6 | 14 | 11 1/2 | 1 1/8 | 12 | 1 | 6 1/2 | 6 1/4 | 6 3/4 |
| 8 | 16 1/2 | 13 3/4 | 1 1/4 | 12 | 1 1/8 | 7 1/2 | 7 1/4 | 7 3/4 |
| 10 | 20 | 17 | 1 3/8 | 16 | 1 1/4 | 8 1/4 | 8 | 8 1/2 |
| 12 | 22 | 19 1/4 | 1 3/8 | 20 | 1 1/4 | 8 1/2 | 8 1/4 | 8 3/4 |
| 14 | 23 3/4 | 20 3/4 | 1 1/2 | 20 | 1 3/8 | 9 | 8 3/4 | 9 1/4 |
| 16 | 27 | 23 3/4 | 1 5/8 | 20 | 1 1/2 | 9 3/4 | 9 1/2 | 10 |
| 18 | 29 1/4 | 25 3/4 | 1 3/4 | 20 | 1 5/8 | 10 1/2 | 10 1/4 | 10 3/4 |
| 20 | 32 | 28 1/2 | 1 3/4 | 24 | 1 5/8 | 11 1/4 | 11 | 11 1/2 |
| 24 | 37 | 33 | 2 | 24 | 1 7/8 | 12 3/4 | 12 1/2 | 13 1/4 |

All dimensions given in inches.

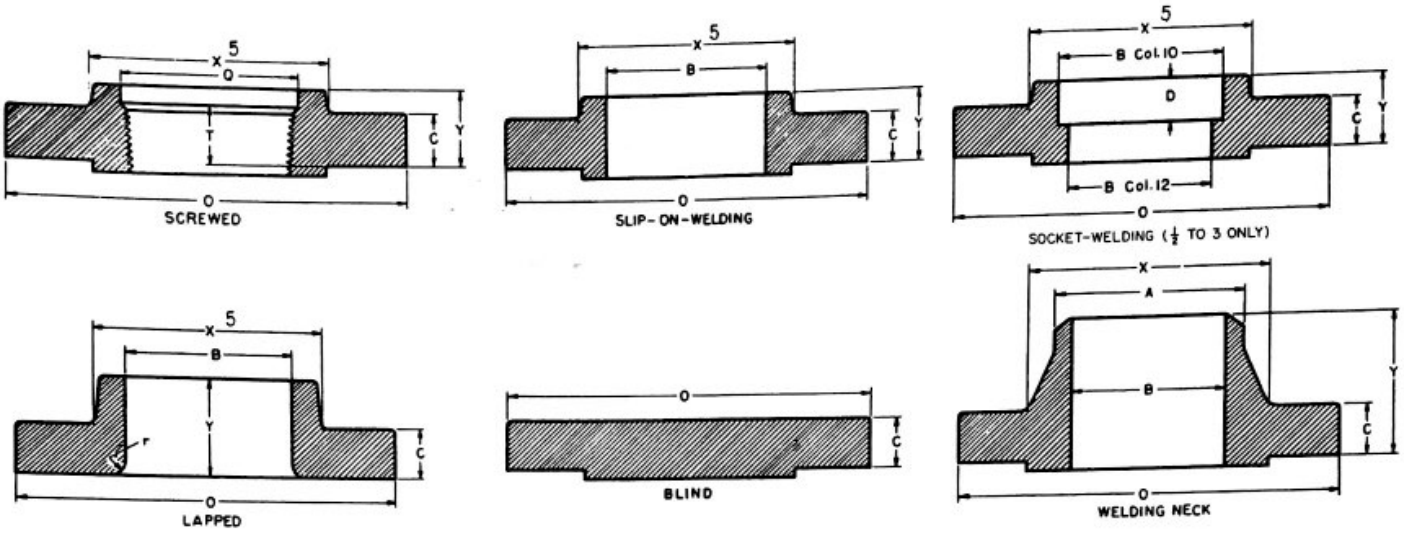
[1] For other dimensions see Tables 23 and 24.

[2] For flange bolt holes see Par. 6.4.

[3] For spot facing see Par. 6.5.

[4] Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

[5] Bolt Lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.




## Table 23 Dimensions of Steel Flanges for Primary Service Pressure Rating of 600 PSI (Gage)[1,2,3,4,6,8,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[5] | Length Through Hub | | | Thread Length Threaded[7] | Bore | | | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange, Min | Depth of Socket |
| | | | | | Threaded Slip-on Socket Welding | Lapped | Welding Neck | | Slip-on Socket-Welding Min | Lapped Min | Welding Neck Socket-Welding | | | |
| | O | C | X | A | Y | Y | Y | T | B | B | B | r | Q | D |
| 1/2 | 3 3/4 | 9/16 | 1 1/2 | 0.84 | 7/8 | 7/8 | 2 1/16 | 5/8 | 0.88 | 0.90 | | 1/8 | 0.93 | 3/8 |
| 3/4 | 4 5/8 | 5/8 | 1 7/8 | 1.05 | 1 | 1 | 2 1/4 | 5/8 | 1.09 | 1.11 | | 1/8 | 1.14 | 7/16 |
| 1 | 4 7/8 | 11/16 | 2 1/8 | 1.32 | 1 1/16 | 1 1/16 | 2 7/16 | 11/16 | 1.36 | 1.38 | | 1/8 | 1.41 | 1/2 |
| 1 1/4 | 5 1/4 | 13/16 | 2 1/2 | 1.66 | 1 1/8 | 1 1/8 | 2 5/8 | 13/16 | 1.70 | 1.72 | | 3/16 | 1.75 | 9/16 |
| 1 1/2 | 6 1/8 | 7/8 | 2 3/4 | 1.90 | 1 1/4 | 1 1/4 | 2 3/4 | 7/8 | 1.95 | 1.97 | | 1/4 | 1.99 | 5/8 |
| 2 | 6 1/2 | 1 | 3 5/16 | 2.38 | 1 7/16 | 1 7/16 | 2 7/8 | 1 1/8 | 2.44 | 2.46 | | 5/16 | 2.50 | 11/16 |
| 2 1/2 | 7 1/2 | 1 1/8 | 3 15/16 | 2.88 | 1 5/8 | 1 5/8 | 3 1/8 | 1 1/4 | 2.94 | 2.97 | | 5/16 | 3.00 | 3/4 |
| 3 | 8 1/4 | 1 1/4 | 4 5/8 | 3.50 | 1 13/16 | 1 13/16 | 3 1/4 | 1 3/8 | 3.57 | 3.60 | | 3/8 | 3.63 | 13/16 |
| 3 1/2 | 9 | 1 3/8 | 5 1/4 | 4.00 | 1 15/16 | 1 15/16 | 3 3/8 | 1 9/16 | 4.07 | 4.10 | | 3/8 | 4.13 | |
| 4 | 10 3/4 | 1 1/2 | 6 | 4.50 | 2 1/8 | 2 1/8 | 4 | 1 5/8 | 4.57 | 4.60 | | 7/16 | 4.63 | |
| 5 | 13 | 1 3/4 | 7 7/16 | 5.56 | 2 3/8 | 2 3/8 | 4 1/2 | 1 7/8 | 5.66 | 5.69 | | 7/16 | 5.69 | |
| 6 | 14 | 1 7/8 | 8 3/4 | 6.63 | 2 5/8 | 2 5/8 | 4 5/8 | 2 | 6.72 | 6.75 | | 1/2 | 6.75 | |
| 8 | 16 1/2 | 2 3/16 | 10 3/4 | 8.63 | 3 | 3 | 5 1/4 | 2 1/4 | 8.72 | 8.75 | | 1/2 | 8.75 | |
| 10 | 20 | 2 1/2 | 13 1/2 | 10.75 | 3 3/8 | 4 3/8 | 6 | 2 9/16 | 10.88 | 10.92 | | 1/2 | 10.88 | |
| 12 | 22 | 2 5/8 | 15 3/4 | 12.75 | 3 5/8 | 4 5/8 | 6 1/8 | 2 3/4 | 12.88 | 12.92 | | 1/2 | 12.94 | |
| 14 | 23 3/4 | 2 3/4 | 17 | 14.00 | 3 11/16 | 5 | 6 1/2 | 2 7/8 | 14.14 | 14.18 | To be specified by purchaser. | 1/2 | 14.19 | |
| 16 | 27 | 3 | 19 1/2 | 16.00 | 4 3/16 | 5 1/2 | 7 | 3 1/16 | 16.16 | 16.19 | | 1/2 | 16.19 | |
| 18 | 29 1/4 | 3 1/4 | 21 1/2 | 18.00 | 4 5/8 | 6 | 7 1/4 | 3 1/8 | 18.18 | 18.20 | | 1/2 | 18.19 | |
| 20 | 32 | 3 1/2 | 24 | 20.00 | 5 | 6 1/2 | 7 1/2 | 3 1/4 | 20.20 | 20.25 | | 1/2 | 20.19 | |
| 24 | 37 | 4 | 28 1/4 | 24.00 | 5 1/2 | 7 1/4 | 8 | 3 5/8 | 24.25 | 24.25 | | 1/2 | 24.19 | |

All dimensions given in inches.
For complete pressure-temperature ratings see Table 5.

[1] For tolerances Par. 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 22.

[4] For spot facing see Par. 6.5.

[5] 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.

[6] For reducing threaded flanges see Table 12.

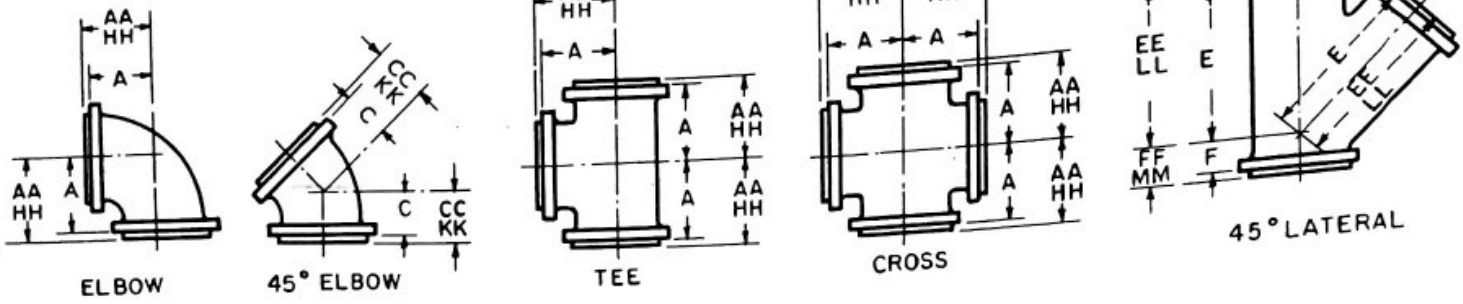
[7] For thread of threaded flanges see Par. 6.8.

[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.

## 600-LB STEEL FLANGED FITTINGS




### Table 24 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 600 PSI (Gage)[1,2,3,4,7,8,9,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flange Edge | | | | | 1/4-In. Raised Face[5] | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | *Wall Thickness of Fitting, Min | Inside Diameter of Fitting | Center-to-Flange Edge Elbow Tee Cross and True "Y" | Center-to-Flange Edge, 45° Ell | Long Center-to-Flange Edge, Lateral | Short Center-to-Flange Edge Lateral and True "Y" | Flange Edge-to-Flange Edge, Reducer | Center-to-Contact Surface of Raised Face Elbow Tee Cross and True "Y" | Center-to-Contact Surface of Raised Face, 45° Ell | 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 of Raised Face, Reduc |
| | O | C | t | | A | C | E | F | G | AA | CC | EE | FF | GG |
| 1/2 | 3 3/4 | 5/32 | 5/32 | 1/2 | 3 | 1 3/4 | 5 1/2 | 1 1/2 | 4 1/2 | 3 1/4 | 2 | 5 3/4 | 1 3/4 | 5 |
| 3/4 | 4 5/8 | 5/32 | 5/32 | 3/4 | 3 1/2 | 2 1/4 | 6 1/2 | 1 3/4 | 4 1/2 | 3 3/4 | 2 1/2 | 6 3/4 | 2 | 5 |
| 1 | 4 7/8 | 3/16 | 3/16 | 1 | 4 | 2 1/4 | 7 | 2 | 4 1/2 | 4 1/4 | 2 1/2 | 7 1/4 | 2 1/4 | 5 |
| 1 1/4 | 5 1/4 | 3/16 | 3/16 | 1 1/4 | 4 1/4 | 2 1/2 | 7 3/4 | 2 1/4 | 4 1/2 | 4 1/2 | 2 3/4 | 8 | 2 1/2 | 5 |
| 1 1/2 | 6 1/8 | 7/32 | 7/32 | 1 1/2 | 4 1/2 | 2 3/4 | 8 3/4 | 2 1/2 | 4 1/2 | 4 3/4 | 3 | 9 | 2 3/4 | 5 |
| 2 | 6 1/2 | 1 | 1/4 | 2 | 5 1/2 | 4 | 10 | 3 1/4 | 5 1/2 | 5 3/4 | 4 1/4 | 10 1/4 | 3 1/2 | 6 |
| 2 1/2 | 7 1/2 | 1 1/8 | 9/32 | 2 1/2 | 6 1/4 | 4 1/4 | 11 1/4 | 3 1/4 | 6 1/4 | 6 1/2 | 4 1/2 | 11 1/2 | 3 1/2 | 6 3/4 |
| 3 | 8 1/4 | 1 1/4 | 5/16 | 3 | 6 3/4 | 4 3/4 | 12 1/2 | 3 3/4 | 6 3/4 | 7 | 5 | 12 3/4 | 4 | 7 1/4 |
| 3 1/2 | 9 | 1 3/8 | 11/32 | 3 1/2 | 7 1/4 | 5 1/4 | 13 3/4 | 4 1/4 | 7 1/4 | 7 1/2 | 5 1/2 | 14 | 4 1/2 | 7 3/4 |
| 4 | 10 3/4 | 1 1/2 | 3/8 | 4 | 8 1/4 | 5 3/4 | 16 1/4 | 4 1/4 | 8 1/4 | 8 1/2 | 6 | 16 1/2 | 4 1/2 | 8 3/4 |
| 5 | 13 | 1 3/4 | 7/16 | 5 | 9 3/4 | 6 3/4 | 19 1/4 | 5 3/4 | 9 3/4 | 10 | 7 | 19 1/2 | 6 | 10 1/4 |
| 6 | 14 | 1 7/8 | 1/2 | 6 | 10 3/4 | 7 1/4 | 20 3/4 | 6 1/4 | 10 3/4 | 11 | 7 1/2 | 21 | 6 1/2 | 11 1/4 |
| 8 | 16 1/2 | 2 3/16 | 5/8 | 7 7/8 | 12 3/4 | 8 1/4 | 24 1/4 | 6 3/4 | 12 3/4 | 13 | 8 1/2 | 24 1/2 | 7 | 13 1/4 |
| 10 | 20 | 2 1/2 | 3/4 | 9 3/4 | 15 1/4 | 9 1/4 | 29 1/4 | 7 3/4 | 15 1/4 | 15 1/2 | 9 1/2 | 29 1/2 | 8 | 15 3/4 |
| 12 | 22 | 2 5/8 | 29/32 | 11 3/4 | 16 1/4 | 9 3/4 | 31 1/4 | 8 1/4 | 16 1/4 | 16 1/2 | 10 | 31 1/2 | 8 1/2 | 16 3/4 |
| 14 | 23 3/4 | 2 3/4 | 31/32 | 12 7/8 | 17 1/4 | 10 1/2 | 34 | 8 3/4 | 17 1/4 | 17 1/2 | 10 3/4 | 34 1/4 | 9 | 17 3/4 |
| 16 | 27 | 3 | 1 3/32 | 14 3/4 | 19 1/4 | 11 1/2 | 38 1/4 | 9 3/4 | 19 1/4 | 19 1/2 | 11 3/4 | 38 1/2 | 10 | 19 3/4 |
| 18 | 29 1/4 | 3 1/4 | 1 7/32 | 16 1/2 | 21 1/4 | 12 | 41 3/4 | 10 1/4 | 21 1/4 | 21 1/2 | 12 1/4 | 42 | 10 1/2 | 21 3/4 |
| 20 | 32 | 3 1/2 | 1 11/32 | 18 1/4 | 23 1/4 | 12 3/4 | 45 1/4 | 10 3/4 | 23 1/4 | 23 1/2 | 13 | 45 1/2 | 11 | 23 3/4 |
| 24 | 37 | 4 | 1 19/32 | 22 | 27 1/4 | 14 1/2 | 52 3/4 | 12 3/4 | 27 1/4 | 27 1/2 | 14 3/4 | 53 | 13 | 27 3/4 |

All dimensions given in inches.

For complete pressure-temperature ratings see Table 5.

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 22.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

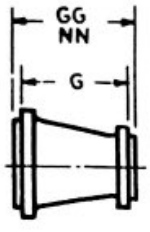
[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings see Par. 6.2.4.

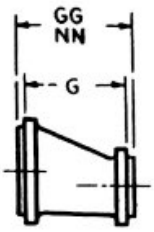
[8] For center-to-contact surface and center-to-end dimensions of special degree elbows see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1.

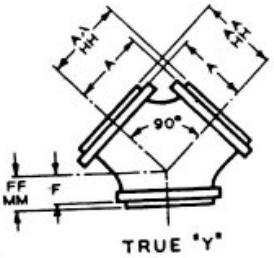
[10] For drains see Par. 6.11.



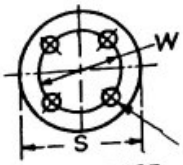

REDUCER




ECCENTRIC REDUCER

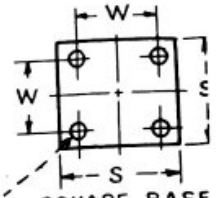



TRUE "Y"

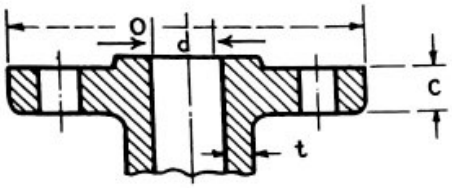


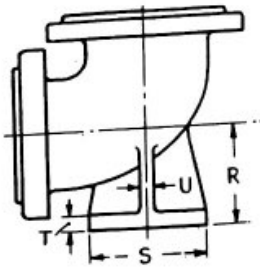

ROUND BASE

4-Bolt holes

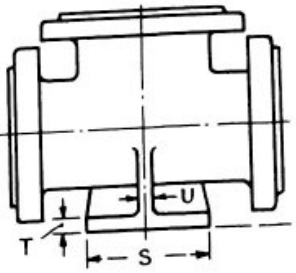



SQUARE BASE




BASE ELBOW




BASE TEE

| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ring Joint [5] | | | | | | | | | Base Drilling [15] | | |
| Center-to-End, Elbow, Tee, Cross, and True "Y" [11] | Center-to-End, 45° Ell [11] | Long Center-to-End, Lateral [11] | Short Center-to-End, Lateral, and True "Y" [11] | End-to-End, Reducer | Center-to-Base [12,13,16] | Diameter of Round Base or Width of Square Base [12] | Thickness of Base [12] | Thickness of Ribs [12] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| HH | KK | LL | MM | NN | R | S | T | U | W | | |
| 3 7/32 | 1 31/32 | 5 23/32 | 1 23/32 | | | | | | | | 1/2 |
| 3 3/4 | 2 1/2 | 6 3/4 | 2 | | | | | | | | 3/4 |
| 4 1/4 | 2 1/2 | 7 1/4 | 2 1/4 | | | | | | | | 1 |
| 4 1/2 | 2 3/4 | 8 | 2 1/2 | | | | | | | | 1 1/4 |
| 4 3/4 | 3 | 9 | 2 3/4 | | | | | | | | 1 1/2 |
| 5 13/16 | 4 5/16 | 10 5/16 | 3 9/16 | | 4 3/4 | 6 1/8 | 13/16 | 5/8 | 4 1/2 | 7/8 | 2 |
| 6 9/16 | 4 9/16 | 11 9/16 | 3 9/16 | | 5 1/4 | 6 1/8 | 13/16 | 5/8 | 4 1/2 | 7/8 | 2 1/2 |
| 7 1/16 | 5 1/16 | 12 13/16 | 4 1/16 | | 5 3/4 | 6 1/2 | 7/8 | 3/4 | 5 | 3/4 | 3 |
| 7 9/16 | 5 9/16 | 14 1/16 | 4 9/16 | | 6 1/2 | 6 1/2 | 7/8 | 3/4 | 5 | 3/4 | 3 1/2 |
| 8 9/16 | 6 1/16 | 16 9/16 | 4 9/16 | | 7 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 4 |
| 10 1/16 | 7 1/16 | 19 9/16 | 6 1/16 | | 8 1/4 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 5 |
| 11 1/16 | 7 9/16 | 21 1/16 | 6 9/16 | | 9 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 6 |
| 13 1/16 | 8 9/16 | 24 9/16 | 7 1/16 | | 11 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 8 |
| 15 9/16 | 9 9/16 | 29 9/16 | 8 1/16 | | 12 1/2 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 10 |
| 16 9/16 | 10 1/16 | 31 9/16 | 8 9/16 | | 13 1/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 12 |
| 17 9/16 | 10 13/16 | 34 5/16 | 9 1/16 | | 14 3/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 14 |
| 19 9/16 | 11 13/16 | 38 9/16 | 10 1/16 | | 16 | 15 | 1 5/8 | 1 1/4 | 13 | 1 | 16 |
| 21 9/16 | 12 5/16 | 42 1/16 | 10 9/16 | | | | | | | | 18 |
| 23 5/8 | 13 1/8 | 45 5/8 | 11 1/8 | | | | | | | | 20 |
| 27 11/16 | 14 15/16 | 53 3/16 | 13 3/16 | | | | | | | | 24 |

See Tables 6 and 11.

[11] These dimensions apply to straight sizes only. See Par. 6.2.3 and 6.3.1.3. For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers use center-to-flange edge dimensions for largest opening and add the proper height to provide for ting joint groove applying to each flange. See Table 10 for ring-joint facing dimensions.

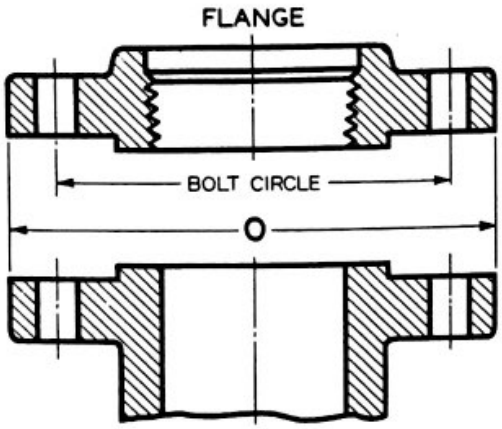
[12] The base dimensions apply to all straight and reducing sizes.

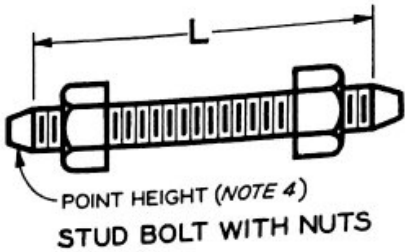
[13] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.

[14] Bases may be cast integral or attached as weldments at the option of the manufacturer.

[15] The bolt hole template for round base is the same as for 300-lb flanges, Table 16 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. 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.

[16] Bases shall be plain faced unless otherwise specified, and the center to base face dimension "R" shall be the finished dimensions.




## Table 25 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 900 PSI (Gage)[1]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length[4,5] of Stud Bolts L | | |
| | | Diameter of Bolt Circle | Diameter of Bolt Holes | Diameter of Bolts | Number of Bolts | 1/4-in. Raised Face | Male & Female also Tongue & Groove | Ring Joint |
| 1/2<br>3/4<br>1<br>1 1/4<br>1 1/2<br>2<br>2 1/2 | Use 1500-lb dimensions in these sizes. | | | | | | | |
| 3 | 9 1/2 | 7 1/2 | 1 | 8 | 7/8 | 5 1/2 | 5 1/4 | 5 3/4 |
| 4 | 11 1/2 | 9 1/4 | 1 1/4 | 8 | 1 1/8 | 6 1/2 | 6 1/4 | 6 3/4 |
| 5 | 13 3/4 | 11 | 1 3/8 | 8 | 1 1/4 | 7 1/4 | 7 | 7 1/2 |
| 6 | 15 | 12 1/2 | 1 1/4 | 12 | 1 1/8 | 7 1/2 | 7 1/4 | 7 1/2 |
| 8 | 18 1/2 | 15 1/2 | 1 1/2 | 12 | 1 3/8 | 8 1/2 | 8 1/4 | 8 3/4 |
| 10 | 21 1/2 | 18 1/2 | 1 1/2 | 16 | 1 3/8 | 9 | 8 3/4 | 9 1/4 |
| 12 | 24 | 21 | 1 1/2 | 20 | 1 3/8 | 9 3/4 | 9 1/2 | 10 |
| 14 | 25 1/4 | 22 | 1 5/8 | 20 | 1 1/2 | 10 1/2 | 10 1/4 | 11 |
| 16 | 27 3/4 | 24 1/4 | 1 3/4 | 20 | 1 5/8 | 11 | 10 3/4 | 11 1/2 |
| 18 | 31 | 27 | 2 | 20 | 1 7/8 | 12 3/4 | 12 1/2 | 13 1/4 |
| 20 | 33 3/4 | 29 1/2 | 2 1/8 | 20 | 2 | 13 1/2 | 13 1/4 | 14 |
| 24 | 41 | 35 1/2 | 2 5/8 | 20 | 2 1/2 | 17 | 16 3/4 | 17 3/4 |

All dimensions given in inches.

[1] All dimensions given in inches.

All dimensions given in inches.

[1] For other dimensions see Tables 26 and 27.

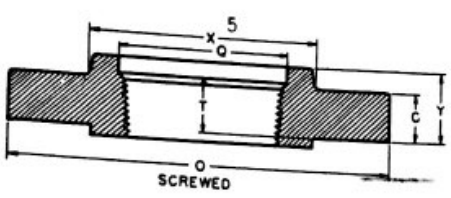
[2] For flange bolt holes see Par. 6.4.

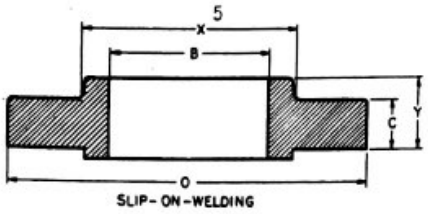
[3] For spot facing see Par. 6.5.

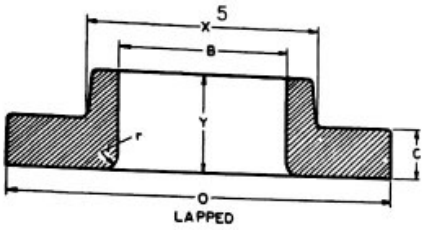
[4] Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

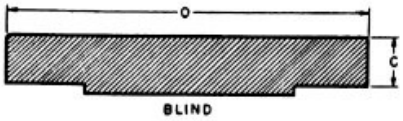
[5] Bolt Length not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.

## 900-LB STEEL PIPE FLANGES



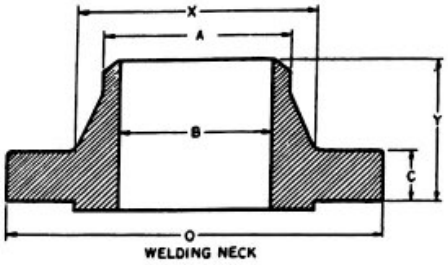




Table 26 Dimensions of Steel Flanges for Primary Service Pressure Rating of 900 Psi (Gage) [1,2,3,4,6,8,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[9] | Length Through Hub | | | Thread Length Threaded[7] | Bore | | | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange, Min |
| | | | | | Threaded Slip-on | Lapped | Welding Neck | | Slip-on Min | Lapped Min | Welding Neck | | |
| | O | C | X | A | Y | Y | Y | T | B | B | B | r | Q |
| 1/2 | Use 1500-lb dimensions in these sizes. | | | | | | | | | | | | |
| 3/4 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | |
| 1 1/4 | | | | | | | | | | | | | |
| 1 1/2 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 2 1/2 | | | | | | | | | | | | | |
| 3 | 9 1/2 | 1 1/2 | 5 | 3.50 | 2 1/8 | 2 1/8 | 4 | 1 5/8 | 3.57 | 3.60 | To be specified by purchaser. | 3/8 | 3.63 |
| 4 | 11 1/2 | 1 3/4 | 6 1/4 | 4.50 | 2 3/4 | 2 3/4 | 4 1/2 | 1 7/8 | 4.57 | 4.60 | | 7/16 | 4.63 |
| 5 | 13 3/4 | 2 | 7 1/2 | 5.56 | 3 1/8 | 3 1/8 | 5 | 2 1/8 | 5.66 | 5.69 | | 7/16 | 5.69 |
| 6 | 15 | 2 3/16 | 9 1/4 | 6.63 | 3 3/8 | 3 3/8 | 5 1/2 | 2 1/4 | 6.72 | 6.75 | | 1/2 | 6.75 |
| 8 | 18 1/2 | 2 1/2 | 11 3/4 | 8.63 | 4 | 4 1/2 | 6 3/8 | 2 1/2 | 8.72 | 8.75 | | 1/2 | 8.75 |
| 10 | 21 1/2 | 2 3/4 | 14 1/2 | 10.75 | 4 1/4 | 5 | 7 1/4 | 2 13/16 | 10.88 | 10.92 | | 1/2 | 10.88 |
| 12 | 24 | 3 1/8 | 16 1/2 | 12.75 | 4 5/8 | 5 5/8 | 7 7/8 | 3 | 12.88 | 12.92 | | 1/2 | 12.94 |
| 14 | 25 1/4 | 3 3/8 | 17 3/4 | 14.00 | 5 1/8 | 6 1/8 | 8 3/8 | 3 1/4 | 14.14 | 14.18 | | 1/2 | 14.19 |
| 16 | 27 3/4 | 3 1/2 | 20 | 16.00 | 5 1/4 | 6 1/2 | 8 1/2 | 3 3/8 | 16.16 | 16.19 | | 1/2 | 16.19 |
| 18 | 31 | 4 | 22 1/4 | 18.00 | 6 | 7 1/2 | 9 | 3 1/2 | 18.18 | 18.20 | | 1/2 | 18.19 |
| 20 | 33 3/4 | 4 1/4 | 24 1/2 | 20.00 | 6 1/4 | 8 1/4 | 9 3/4 | 3 5/8 | 20.20 | 20.25 | | 1/2 | 20.19 |
| 24 | 41 | 5 1/2 | 29 1/2 | 24.00 | 8 | 10 1/2 | 11 1/2 | 4 | 24.25 | 24.25 | | 1/2 | 24.19 |

All dimensions given in inches.

For complete pressure-temperature ratings see Table 6.

[1] For tolerances see Par. 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 25.

[4] For spot facing see Par. 6.5.

[5] This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on and lapped flanges.

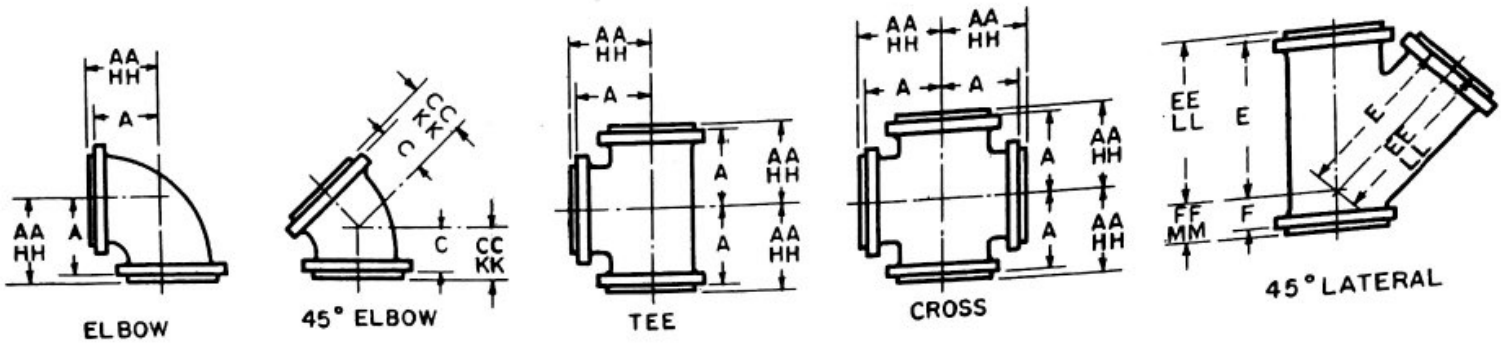
[6] For reducing threaded flanges see Table 12.

[7] For thread of threaded flanges see Par. 6.8.

[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.




## Table 27 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 900 PSI (Gage)[1,2,3,4,7,8,9,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flange Edge | | | | | ¼-In. Raised Face[5] | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange Min | Wall Thickness of Fitting Min | Inside Diameter of Fitting | Center-to-Flange Edge, Elbow Tee, Cross and True "Y" | Center-to-Flange Edge, 45° Ell | Long Center-to-Flange Edge, Lateral | Short Center-to-Flange Edge Lateral and True "Y" | Flange Edge-to-Flange Edge Reducer | Center-to-Contact Surface of Raised Face Elbow Tee Cross and True "Y" | Center-to-Contact Surface of Raised Face 45° Ell | 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 of Raised Face Reducer[6] |
| | O | C | t | d | A | C | E | F | G | AA | CC | EE | FF | GG |
| 1/2 | Use 1500-lb dimensions in these sizes. | | | | | | | | | | | | | |
| 3/4 | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | |
| 1 1/4 | | | | | | | | | | | | | | |
| 1 1/2 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | |
| 2 1/2 | | | | | | | | | | | | | | |
| 3 | 9 1/2 | 1 1/2 | 13/32 | 2 7/8 | 7 1/4 | 5 1/4 | 14 1/4 | 4 1/4 | 7 1/4 | 7 1/2 | 5 1/2 | 14 1/2 | 4 1/2 | 7 3/4 |
| 4 | 11 1/2 | 1 3/4 | 1/2 | 3 7/8 | 8 3/4 | 6 1/4 | 17 1/4 | 5 1/4 | 8 3/4 | 9 | 6 1/2 | 17 1/2 | 5 1/2 | 9 1/4 |
| 5 | 13 3/4 | 2 | 19/32 | 4 3/4 | 10 3/4 | 7 1/4 | 20 3/4 | 6 1/4 | 10 3/4 | 11 | 7 1/2 | 21 | 6 1/2 | 11 1/4 |
| 6 | 15 | 2 3/16 | 23/32 | 5 3/4 | 11 3/4 | 7 3/4 | 22 1/4 | 6 1/4 | 11 3/4 | 12 | 8 | 22 1/2 | 6 1/2 | 12 1/4 |
| 8 | 18 1/2 | 2 1/2 | 7/8 | 7 1/2 | 14 1/4 | 8 3/4 | 27 1/4 | 7 1/4 | 14 1/4 | 14 1/2 | 9 | 27 1/2 | 7 1/2 | 14 3/4 |
| 10 | 21 1/2 | 2 3/4 | 1 1/16 | 9 3/8 | 16 1/4 | 9 3/4 | 31 1/4 | 8 1/4 | 16 1/4 | 16 1/2 | 10 | 31 1/2 | 8 1/2 | 16 3/4 |
| 12 | 24 | 3 1/8 | 1 1/4 | 11 1/8 | 18 3/4 | 10 3/4 | 34 1/4 | 8 3/4 | 17 1/4 | 19 | 11 | 34 1/2 | 9 | 17 3/4 |
| 14 | 25 1/4 | 3 3/8 | 1 3/8 | 12 1/4 | 20 | 11 1/4 | 36 1/4 | 9 1/4 | 18 1/2 | 20 1/4 | 11 1/2 | 36 1/2 | 9 1/2 | 19 |
| 16 | 27 3/4 | 3 1/2 | 1 9/16 | 14 | 22 | 12 1/4 | 40 1/2 | 10 1/4 | 20 1/2 | 22 1/4 | 12 1/2 | 40 3/4 | 10 1/2 | 21 |
| 18 | 31 | 4 | 1 3/4 | 15 3/4 | 23 3/4 | 13 | 45 1/4 | 11 3/4 | 24 | 24 | 13 1/4 | 45 1/2 | 12 | 24 1/2 |
| 20 | 33 3/4 | 4 1/4 | 1 29/32 | 17 1/2 | 25 3/4 | 14 1/4 | 50 | 12 3/4 | 26 | 26 | 14 1/2 | 50 1/4 | 13 | 26 1/2 |
| 24 | 41 | 5 1/2 | 2 9/32 | 21 | 30 1/4 | 17 3/4 | 59 3/4 | 15 1/4 | 30 | 30 1/2 | 18 | 60 | 15 1/2 | 30 1/2 |

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.5.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

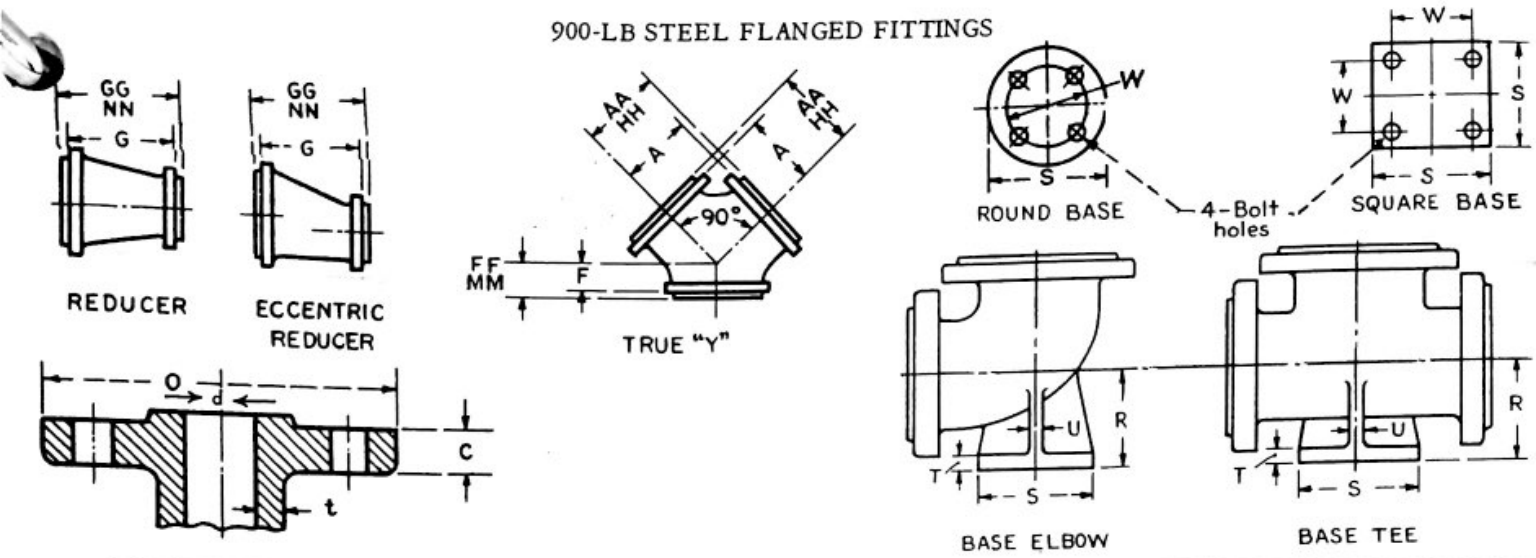
[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings see Par. 6.2.4.

[8] For center-to-contact surface and center-to-end dimensions of special degree elbows see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1

[10] For drains see Par. 6.11.

## 900-LB STEEL FLANGED FITTINGS




| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ring Joint[5] | | | | | | | | | Base Drilling[15] | | |
| Center-to-End Elbow Tee Cross and True "Y"[11] | Center-to-End 45° Ell[11] | Long Center-to-End Lateral[11] | Short Center-to-End Lateral and True "Y"[11] | End-to-End Reducer | Center-to-Base[13,16] | Diameter of Round Base or Width of Square Base[12] | Thickness of Base[12] | Thickness of Ribs[12] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| HH | KK | LL | MM | NN | R | S | T | U | W | | |
| 7 9/16 | 5 9/16 | 14 9/16 | 4 9/16 | See Notes 6 and 11. | 5 3/4 | 6 1/2 | 7/8 | 3/4 | 5 | 3/4 | 3 |
| 9 1/16 | 6 9/16 | 17 9/16 | 5 9/16 | | 7 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 4 |
| 11 1/16 | 7 9/16 | 21 1/16 | 6 9/16 | | 8 1/4 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 5 |
| 12 1/16 | 8 1/16 | 22 9/16 | 6 9/16 | | 9 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 6 |
| 14 9/16 | 9 1/16 | 27 9/16 | 7 9/16 | | 11 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 8 |
| 16 9/16 | 10 1/16 | 31 9/16 | 8 9/16 | | 12 1/2 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 10 |
| 19 1/16 | 11 1/16 | 34 9/16 | 9 1/16 | | 13 1/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 12 |
| 20 7/16 | 11 11/16 | 36 11/16 | 9 11/16 | | 14 3/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 14 |
| 22 7/16 | 12 11/16 | 40 15/16 | 10 11/16 | | 16 | 15 | 1 5/8 | 1 1/4 | 13 | 1 | 16 |
| 24 1/4 | 13 1/2 | 45 3/4 | 12 1/4 | | | | | | | | |
| 26 1/4 | 14 3/4 | 50 1/2 | 13 1/4 | | | | | | | | |
| 30 7/8 | 18 3/8 | 60 3/8 | 15 7/8 | | | | | | | | |

Use 1500-lb dimensions in these sizes.

[11] These dimensions apply to straight sizes only. See Par. 6.2.3 and 6.3.1.3. for the center-to-end dimension of reducing fittings or end-to-end dimensions of reducers use center-to-flange edge or flange edge dimensions for largest opening and add the proper height to provide for ring-joint groove applying to each flange. See Table 10 for ring-joint facing dimension.

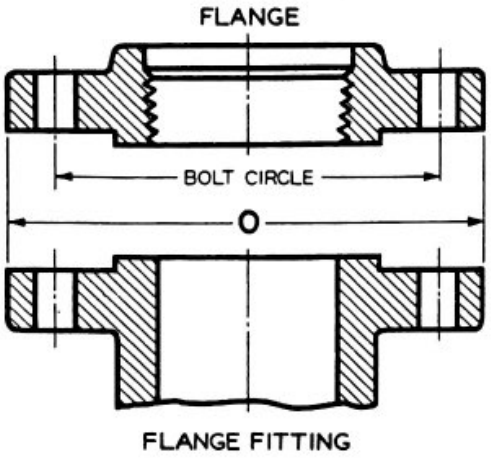
[12] The base dimensions apply to all straight and reducing sizes.

[13] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.

[14] Bases may be case integral or attached as weldments at the option of the manufacturer.

[15] The bolt hole template for round base is the same as for 300-lb flanges. Table 16 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. 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.

[16] Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension "R" shall be the finished dimension.



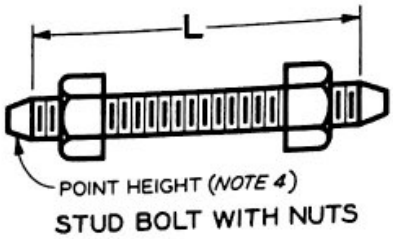




**Table 28 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 1500 PSI (Gage)[1]**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length[4,5] of Stud Bolts L | | |
| | | Diameter of Bolt Circle | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | 1/4-In. Raised Face | Male & Female also Tongue & Groove | Ring Joint |
| 1/2 | 4 3/4 | 3 1/4 | 7/8 | 4 | 3/4 | 4 | 3 3/4 | 4 |
| 3/4 | 5 1/8 | 3 1/2 | 7/8 | 4 | 3/4 | 4 1/4 | 4 | 4 1/4 |
| 1 | 5 7/8 | 4 | 1 | 4 | 7/8 | 4 3/4 | 4 1/2 | 4 3/4 |
| 1 1/4 | 6 1/4 | 4 3/8 | 1 | 4 | 7/8 | 4 3/4 | 4 1/2 | 4 3/4 |
| 1 1/2 | 7 | 4 7/8 | 1 1/8 | 4 | 1 | 5 1/4 | 5 | 5 1/4 |
| 2 | 8 1/2 | 6 1/2 | 1 | 8 | 7/8 | 5 1/2 | 5 1/4 | 5 3/4 |
| 2 1/2 | 9 5/8 | 7 1/2 | 1 1/8 | 8 | 1 | 6 | 5 3/4 | 6 1/4 |
| 3 | 10 1/2 | 8 | 1 1/4 | 8 | 1 1/8 | 6 3/4 | 6 1/2 | 7 |
| 4 | 12 1/4 | 9 1/2 | 1 3/8 | 8 | 1 1/4 | 7 1/2 | 7 1/4 | 7 3/4 |
| 5 | 14 3/4 | 11 1/2 | 1 5/8 | 8 | 1 1/2 | 9 1/2 | 9 1/4 | 9 3/4 |
| 6 | 15 1/2 | 12 1/2 | 1 1/2 | 12 | 1 3/8 | 10 | 9 3/4 | 10 1/4 |
| 8 | 19 | 15 1/2 | 1 3/4 | 12 | 1 5/8 | 11 1/4 | 11 | 11 3/4 |
| 10 | 23 | 19 | 2 | 12 | 1 7/8 | 13 1/4 | 13 | 13 1/2 |
| 12 | 26 1/2 | 22 1/2 | 2 1/8 | 16 | 2 | 14 3/4 | 14 1/2 | 15 1/4 |
| 14 | 29 1/2 | 25 | 2 3/8 | 16 | 2 1/4 | 16 | 15 3/4 | 16 3/4 |
| 16 | 32 1/2 | 27 3/4 | 2 5/8 | 16 | 2 1/2 | 17 1/2 | 17 1/4 | 18 1/2 |
| 18 | 36 | 30 1/2 | 2 7/8 | 16 | 2 3/4 | 19 1/4 | 19 | 20 1/4 |
| 20 | 38 3/4 | 32 3/4 | 3 1/8 | 16 | 3 | 21 | 20 3/4 | 22 1/4 |
| 24 | 46 | 39 | 3 5/8 | 16 | 3 1/2 | 24 | 23 3/4 | 25 1/2 |

All dimensions given in inches.

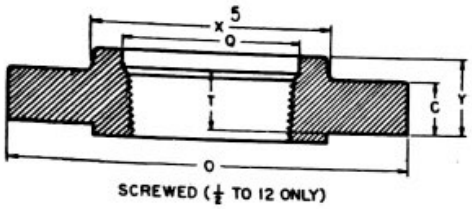
[1] For other dimensions see Tables 32 and 33.

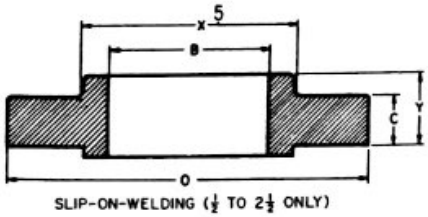
[2] For flange bolt holes see Par. 6.4

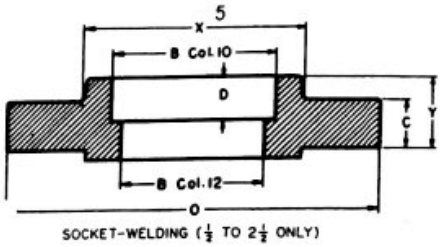
[3] For spot facing see Par. 6.5

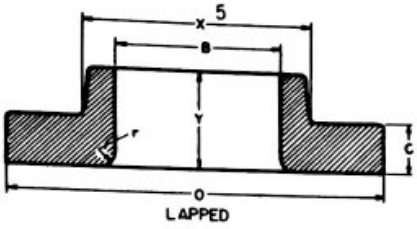
[4] Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

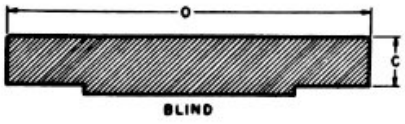
[5] Bolt Lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.

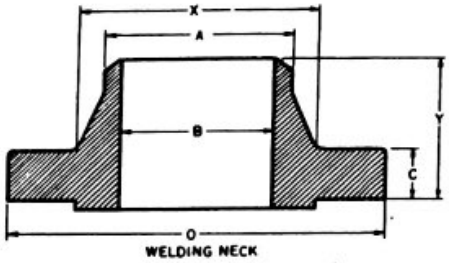



## Table 29 Dimensions of Steel Flanges for Primary Service Pressure Rating of 1500 PSI (Gage)[1,2,3,4,6,8,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[9] | Length Through Hub | | | Thread Length Threaded[7] | Bore | | | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange Min. | Depth of Socket |
| | | | | | Threaded Slip-on Socket Welding | Lapped | Welding Neck | | Slip-On Socket Welding Min | Lapped Min | Welding Neck Socket-Welding | | | |
| | O | C | X | A | Y | Y | Y | T | B | B | B | r | Q | D |
| 1/2 | 4 3/4 | 7/8 | 1 1/2 | 0.84 | 1 1/4 | 1 1/4 | 2 3/8 | 7/8 | 0.88 | 0.90 | | 1/8 | 0.93 | 3/8 |
| 3/4 | 5 1/8 | 1 | 1 3/4 | 1.05 | 1 3/8 | 1 3/8 | 2 3/4 | 1 | 1.09 | 1.11 | | 1/8 | 1.14 | 7/16 |
| 1 | 5 7/8 | 1 1/8 | 2 1/16 | 1.32 | 1 5/8 | 1 5/8 | 2 7/8 | 1 1/8 | 1.36 | 1.38 | | 1/8 | 1.41 | 1/2 |
| 1 1/4 | 6 1/4 | 1 1/8 | 2 1/2 | 1.66 | 1 5/8 | 1 5/8 | 2 7/8 | 1 3/16 | 1.70 | 1.72 | | 3/16 | 1.75 | 9/16 |
| 1 1/2 | 7 | 1 1/4 | 2 3/4 | 1.90 | 1 3/4 | 1 3/4 | 3 1/4 | 1 1/4 | 1.95 | 1.97 | | 1/4 | 1.99 | 5/8 |
| 2 | 8 1/2 | 1 1/2 | 4 1/8 | 2.38 | 2 1/4 | 2 1/4 | 4 | 1 1/2 | 2.44 | 2.46 | | 5/16 | 2.50 | 11/16 |
| 2 1/2 | 9 5/8 | 1 5/8 | 4 7/8 | 2.88 | 2 1/2 | 2 1/2 | 4 1/8 | 1 7/8 | 2.94 | 2.97 | | 5/16 | 3.00 | 3/4 |
| 3 | 10 1/2 | 1 7/8 | 5 1/4 | 3.50 | 2 7/8 | 2 7/8 | 4 5/8 | 2 | | 3.60 | | 3/8 | 3.63 | |
| 4 | 12 1/4 | 2 1/8 | 6 3/8 | 4.50 | 3 9/16 | 3 9/16 | 4 7/8 | 2 1/4 | | 4.60 | | 7/16 | 4.63 | |
| 5 | 14 3/4 | 2 7/8 | 7 3/4 | 5.56 | 4 1/8 | 4 1/8 | 6 1/8 | 2 1/2 | | 5.69 | | 7/16 | 5.69 | |
| 6 | 15 1/2 | 3 1/4 | 9 | 6.63 | 4 11/16 | 4 11/16 | 6 3/4 | 2 3/4 | | 6.75 | | 1/2 | 6.75 | |
| 8 | 19 | 3 5/8 | 11 1/2 | 8.63 | 5 5/8 | 5 5/8 | 8 3/8 | 3 | | 8.75 | | 1/2 | 8.75 | |
| 10 | 23 | 4 1/4 | 14 1/2 | 10.75 | 6 1/4 | 7 | 10 | 3 5/16 | | 10.92 | | 1/2 | 10.88 | |
| 12 | 26 1/2 | 4 7/8 | 17 3/4 | 12.75 | 7 1/8 | 8 5/8 | 11 1/8 | 3 5/8 | | 12.92 | | 1/2 | 12.94 | |
| 14 | 29 1/2 | 5 1/4 | 19 1/2 | 14.00 | ..... | 9 1/2 | 11 3/4 | ..... | | 14.18 | To be specified by purchaser. | 1/2 | 14.19 | |
| 16 | 32 1/2 | 5 3/4 | 21 3/4 | 16.00 | ..... | 10 1/4 | 12 1/4 | ..... | | 16.19 | | 1/2 | 16.19 | |
| 18 | 36 | 6 3/8 | 23 1/2 | 18.00 | ..... | 10 7/8 | 12 7/8 | ..... | | 18.20 | | 1/2 | 18.19 | |
| 20 | 38 3/4 | 7 | 25 1/4 | 20.00 | ..... | 11 1/2 | 14 | ..... | | 20.25 | | 1/2 | 20.19 | |
| 24 | 46 | 8 | 30 | 24.00 | ..... | 13 | 16 | ..... | | 24.25 | | 1/2 | 24.19 | |

All dimensions given in inches.
For complete pressure-temperature ratings see Table 7.

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 31.

[4] For spot facing see Par. 6.5.

[5] This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, and lapped flanges.

[6] For reducing threaded flanges see Table 12.

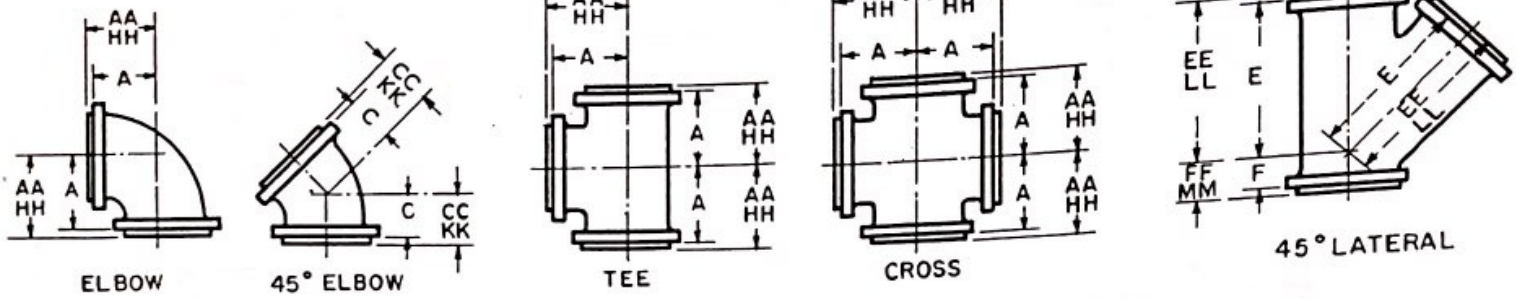
[7] For thread of threaded flanges see Par. 6.8.

[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.

## 1500-LB STEEL FLANGED FITTINGS




### Table 30 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 1500 PSI (Gage)[1,2,3,4,7,8,9,10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flange Edge | | | | | ¼-In. Raised Face[5] | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange Min | *Wall Thickness of Fitting Min | Inside Diameter of Fitting | Center-to-Flange Edge Elbow Tee Cross and True "Y" | Center-to-Flange Edge 45° Ell | Long Center-to-Flange Edge Lateral | Short Center-to-Flange Edge Lateral and True "Y" | Flange Edge-to-Flange Edge Reducer | Center-to-Contact Surface of Raised Face Elbow Tee Cross and True "Y" | Center-to-Contact Surface of Raised Face 45° Ell | 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 of Raised Face Reducer[6] |
| | O | C | t | | A | C | E | F | G | AA | CC | EE | FF | GG |
| 1/2 | 4 3/4 | 7/8 | 3/16 | 1/2 | 4 | 2 3/4 | .... | .... | .... | 4 1/4 | 3 | .... | .... | ..... |
| 3/4 | 5 1/8 | 1 | 7/32 | 11/16 | 4 1/4 | 3 | .... | .... | .... | 4 1/2 | 3 1/4 | .... | .... | ..... |
| 1 | 5 7/8 | 1 1/8 | 1/4 | 7/8 | 4 3/4 | 3 1/4 | 8 3/4 | 2 1/4 | 4 1/2 | 5 | 3 1/2 | 9 | 2 1/2 | 5 |
| 1 1/4 | 6 1/4 | 1 1/8 | 5/16 | 1 1/8 | 5 1/4 | 3 3/4 | 9 3/4 | 2 3/4 | 5 1/4 | 5 1/2 | 4 | 10 | 3 | 5 3/4 |
| 1 1/2 | 7 | 1 1/4 | 3/8 | 1 3/8 | 5 3/4 | 4 | 10 3/4 | 3 1/4 | 5 3/4 | 6 | 4 1/4 | 11 | 3 1/2 | 6 1/4 |
| 2 | 8 1/2 | 1 1/2 | 7/16 | 1 7/8 | 7 | 4 1/2 | 13 | 3 3/4 | 6 3/4 | 7 1/4 | 4 3/4 | 13 1/4 | 4 | 7 1/4 |
| 2 1/2 | 9 5/8 | 1 5/8 | 1/2 | 2 1/4 | 8 | 5 | 15 | 4 1/4 | 7 3/4 | 8 1/4 | 5 1/4 | 15 1/4 | 4 1/2 | 8 1/4 |
| 3 | 10 1/2 | 1 7/8 | 5/8 | 2 3/4 | 9 | 5 1/2 | 17 | 4 3/4 | 8 3/4 | 9 1/4 | 5 3/4 | 17 1/4 | 5 | 9 1/4 |
| 4 | 12 1/4 | 2 1/8 | 3/4 | 3 5/8 | 10 1/2 | 7 | 19 | 5 3/4 | 10 1/4 | 10 3/4 | 7 1/4 | 19 1/4 | 6 | 10 3/4 |
| 5 | 14 3/4 | 2 7/8 | 29/32 | 4 3/8 | 13 | 8 1/2 | 23 | 7 1/4 | 13 1/4 | 13 1/4 | 8 3/4 | 23 1/4 | 7 1/2 | 13 3/4 |
| 6 | 15 1/2 | 3 1/4 | 1 3/32 | 5 3/8 | 13 5/8 | 9 1/8 | 24 5/8 | 7 7/8 | 14 | 13 7/8 | 9 3/8 | 24 7/8 | 8 1/8 | 14 1/2 |
| 8 | 19 | 3 5/8 | 1 13/32 | 7 | 16 1/8 | 10 5/8 | 29 5/8 | 8 7/8 | 16 1/2 | 16 3/8 | 10 7/8 | 29 7/8 | 9 1/8 | 17 |
| 10 | 23 | 4 1/4 | 1 23/32 | 8 3/4 | 19 1/4 | 11 3/4 | 35 3/4 | 10 | 19 3/4 | 19 1/2 | 12 | 36 | 10 1/4 | 20 1/4 |
| 12 | 26 1/2 | 4 7/8 | 2 | 10 3/8 | 22 | 13 | 40 1/2 | 11 3/4 | 22 1/2 | 22 1/4 | 13 1/4 | 40 3/4 | 12 | 23 |
| 14 | 29 1/2 | 5 1/4 | 2 3/16 | 11 3/8 | 24 1/2 | 14 | 43 3/4 | 12 1/4 | 25 1/4 | 24 3/4 | 14 1/4 | 44 | 12 1/2 | 25 3/4 |
| 16 | 32 1/2 | 5 3/4 | 2 1/2 | 13 | 27 | 16 | 48 | 14 1/2 | 27 3/4 | 27 1/4 | 16 1/4 | 48 1/4 | 14 3/4 | 28 1/4 |
| 18 | 36 | 6 3/8 | 2 13/16 | 14 5/8 | 30 | 17 1/2 | 53 | 16 1/4 | 31 | 30 1/4 | 17 3/4 | 53 1/4 | 16 1/2 | 31 1/2 |
| 20 | 38 3/4 | 7 | 3 1/8 | 16 3/8 | 32 1/2 | 18 1/2 | 57 1/2 | 17 1/2 | 33 1/2 | 32 3/4 | 18 3/4 | 57 3/4 | 17 3/4 | 34 |
| 24 | 46 | 8 | 3 23/32 | 19 5/8 | 38 | 20 1/2 | 67 | 20 1/4 | 39 1/4 | 38 1/4 | 20 3/4 | 67 1/4 | 20 1/2 | 39 3/4 |

All dimensions given in inches.

For complete pressure-temperature ratings see Table 7.

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 and Table 28.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

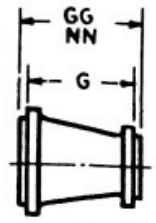
[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.

[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings see Par. 6.2.4.

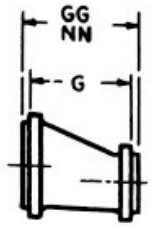
[8] For center-to-contact surface and center-to-end dimensions of special degree elbows see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1.

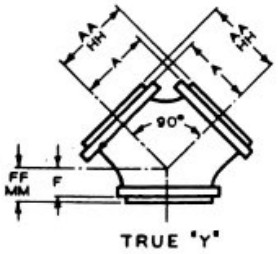
[10] For drains see Par. 11.



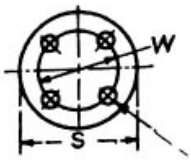

REDUCER




ECCENTRIC REDUCER

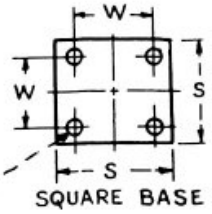



TRUE "Y"

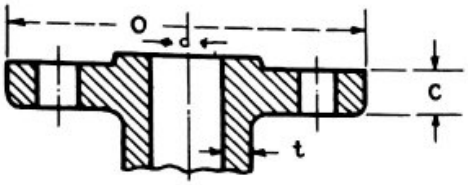


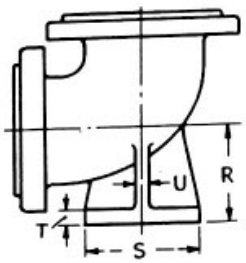

ROUND BASE

4-Bolt holes

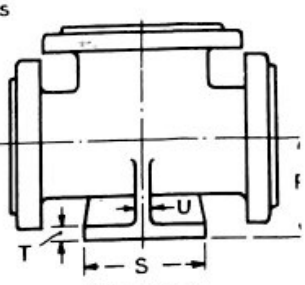



SQUARE BASE




BASE ELBOW




BASE TEE

| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ring Joint[5] | | | | | | | | Base Drilling[15] | | |
| Center-to-End, Elbow Tee Cross and True "Y"[11] | Center-to-End 45° Ell[11] | Long Center-to-End Lateral[11] | Short Center-to-End, Lateral and True "Y"[11] | End-to-End Reducer | Center-to-Base[12,13,16] | Diameter of Round Base or Width of Square Base[12] | Thickness of Base[12] | Thickness of Ribs[12] | Bolt Circle or Bolt Spacing | Diameter of Drilled Holes | Nominal Pipe Size |
| HH | KK | LL | MM | NN | R | S | T | U | W | | |
| 4 1/4 | 3 | . . . . | . . . . | See Notes 6 and 11. | | | | | | | 1/2 |
| 4 1/2 | 3 1/4 | . . . . | . . . . | | | | | | | | 3/4 |
| 5 | 3 1/2 | 9 | 2 1/2 | | | | | | | | 1 |
| 5 1/2 | 4 | 10 | 3 | | | | | | | | 1 1/4 |
| 6 | 4 1/4 | 11 | 3 1/2 | | | | | | | | 1 1/2 |
| 7 5/16 | 4 13/16 | 13 5/16 | 4 1/16 | | 5 1/2 | 6 1/2 | 7/8 | 3/4 | 5 | 3/4 | 2 |
| 8 5/16 | 5 5/16 | 15 5/16 | 4 9/16 | | 6 | 6 1/2 | 7/8 | 3/4 | 5 | 3/4 | 2 1/2 |
| 9 5/16 | 5 13/16 | 17 5/16 | 5 1/16 | | 6 1/2 | 7 1/2 | 1 | 3/4 | 5 7/8 | 7/8 | 3 |
| 10 13/16 | 7 5/16 | 19 5/16 | 6 1/16 | | 7 3/4 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 4 |
| 13 5/16 | 8 13/16 | 23 5/16 | 7 9/16 | | 9 | 10 | 1 1/4 | 3/4 | 7 7/8 | 7/8 | 5 |
| 14 | 9 1/2 | 25 | 8 1/4 | | 9 3/4 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 6 |
| 16 9/16 | 11 1/16 | 30 1/16 | 9 5/16 | | 11 1/2 | 12 1/2 | 1 7/16 | 1 | 10 5/8 | 7/8 | 8 |
| 19 11/16 | 12 3/16 | 36 3/16 | 10 7/16 | | 13 3/4 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 10 |
| 22 9/16 | 13 9/16 | 41 1/16 | 12 5/16 | | 15 1/2 | 15 | 1 5/8 | 1 1/8 | 13 | 1 | 12 |
| 25 1/8 | 14 5/8 | 44 3/8 | 12 7/8 | | 17 1/4 | 17 1/2 | 1 7/8 | 1 1/4 | 15 1/4 | 1 1/8 | 14 |
| 27 11/16 | 16 11/16 | 48 11/16 | 15 3/16 | | 18 3/4 | 17 1/2 | 1 7/8 | 1 1/4 | 15 1/4 | 1 1/8 | 16 |
| 30 11/16 | 18 3/16 | 53 11/16 | 16 15/16 | | | | | | | | 18 |
| 33 3/16 | 19 3/16 | 58 3/16 | 18 3/16 | | | | | | | | 20 |
| 38 13/16 | 21 5/16 | 67 13/16 | 21 1/16 | | | | | | | | 24 |

[11] These dimensions apply to straight sizes only. See Par. 6.2.5 and 6.3.1.3. For the center-to-end dimensions or reducing fittings or end-to-end dimensions of reducers use center-to-flange edge dimensions for largest opening and add the proper height to provide for ring-joint groove applying to each flange. See Table 10 for ring-joint dimensions.

[12] The base dimensions apply to all straight and reducing sizes.

[13] For reducing fittings the size and center-to-face dimension of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.

[14] Bases may be cast integral or attached as weldments at the option of the manufacturer.

[15] The bolt hole template for round base is the same as for 300-lb flanges. Table 10 of corresponding outside diameter, except using only four holes in all cases so placed as to straddle center lines. The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension of shear.

[16] Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension "R" shall be the finished dimension.

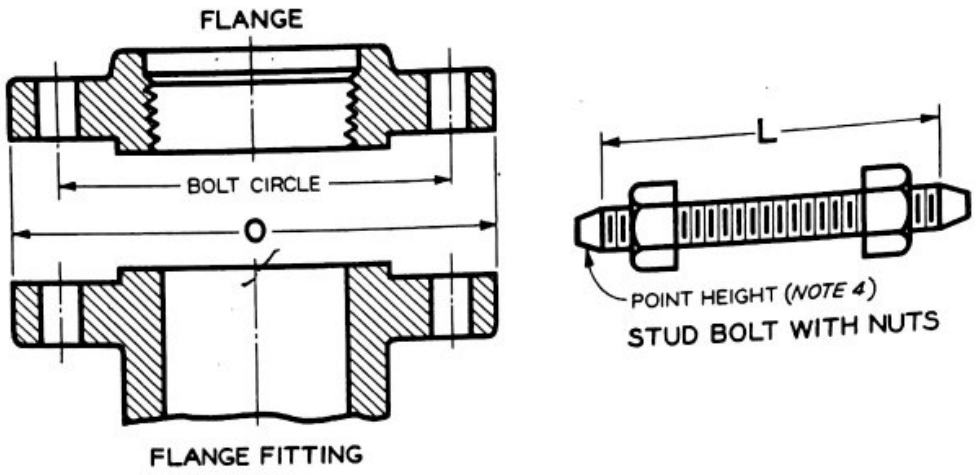



**Table 31 Templates for Drilling Steel Flanges and Flanged Fittings for Primary Service Pressure Rating of 2500 PSI (Gage)[1]**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange O | Drilling[2,3] | | | | Length[4,5] of Stud Bolts L | | |
| | | Diameter of Bolt Circle | Number of Bolts | Diameter of Bolts | Diameter of Bolt Holes | 1/4-In. Raised Face | Male & Female also Tongue & Groove | Ring Joint |
| 1/2 | 5 1/4 | 3 1/2 | 4 | 3/4 | 7/8 | 4 3/4 | 4 1/2 | 4 3/4 |
| 3/4 | 5 1/2 | 3 3/4 | 4 | 3/4 | 7/8 | 4 3/4 | 4 1/2 | 4 3/4 |
| 1 | 6 1/4 | 4 1/4 | 4 | 7/8 | 1 | 5 1/4 | 5 | 5 1/4 |
| 1 1/4 | 7 1/4 | 5 1/8 | 4 | 1 | 1 1/8 | 5 3/4 | 5 1/2 | 6 |
| 1 1/2 | 8 | 5 3/4 | 4 | 1 1/8 | 1 1/4 | 6 1/2 | 6 1/4 | 6 3/4 |
| 2 | 9 1/4 | 6 3/4 | 8 | 1 | 1 1/8 | 6 3/4 | 6 1/2 | 7 |
| 2 1/2 | 10 1/2 | 7 3/4 | 8 | 1 1/8 | 1 1/4 | 7 1/2 | 7 1/4 | 7 3/4 |
| 3 | 12 | 9 | 8 | 1 1/4 | 1 3/8 | 8 1/2 | 8 1/4 | 8 3/4 |
| 4 | 14 | 10 3/4 | 8 | 1 1/2 | 1 5/8 | 9 3/4 | 9 1/2 | 10 1/4 |
| 5 | 16 1/2 | 12 3/4 | 8 | 1 3/4 | 1 7/8 | 11 1/2 | 11 1/4 | 12 1/4 |
| 6 | 19 | 14 1/2 | 8 | 2 | 2 1/8 | 13 1/2 | 13 1/4 | 14 |
| 8 | 21 3/4 | 17 1/4 | 12 | 2 | 2 1/8 | 15 | 14 3/4 | 15 1/2 |
| 10 | 26 1/2 | 21 1/4 | 12 | 2 1/2 | 2 5/8 | 19 | 18 3/4 | 20 |
| 12 | 30 | 24 3/8 | 12 | 2 3/4 | 2 7/8 | 21 | 20 3/4 | 22 |

All dimensions given in inches.

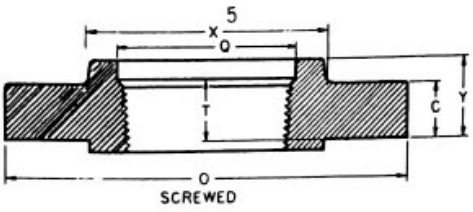
[1]For other dimensions see Tables 29 and 30.

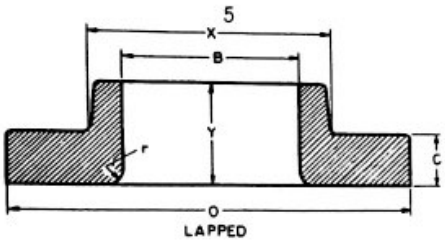
[2]For flange bolt holes see Par. 6.4.

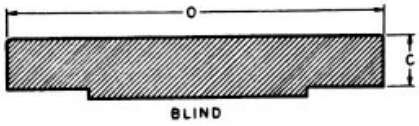
[3]For spot facing see Par. 6.5.

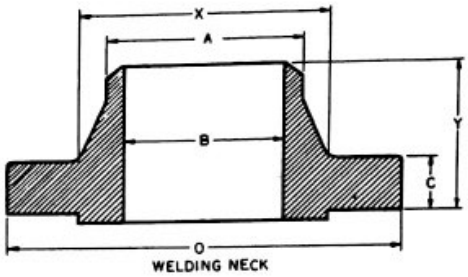
[4]Length of stud-bolts do not include the height of the points. See Par. 6.9.2.

[5]Bolt lengths not shown in table are determined in accordance with Appendix F. See Par. 6.9.2.




## Table 32 Dimensions of Steel Flanges for Primary Service Pressure Rating of 2500 PSI (Gage)[1·2·3·4·7·8·9·10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Diameter of Hub | Hub Diameter Beginning of Chamfer Welding Neck[9] | Length Through Hub | | | Thread Length Threaded[7] | Bore | | Corner Radius of Bore of Lapped Flange and Pipe | Counterbore Screwed Flange, Min |
| | | | | | Threaded | Lapped | Welding Neck | | Lapped Min | Welding Neck | | |
| | O | C | X | A | Y | Y | Y | T | B | B | r | Q |
| 1/2 | 5 1/4 | 1 3/16 | 1 11/16 | 0.84 | 1 9/16 | 1 9/16 | 2 7/8 | 1 1/8 | 0.90 | To be specified by purchaser | 1/8 | 0.93 |
| 3/4 | 5 1/2 | 1 1/4 | 2 | 1.05 | 1 11/16 | 1 11/16 | 3 1/8 | 1 1/4 | 1.11 | | 1/8 | 1.14 |
| 1 | 6 1/4 | 1 3/8 | 2 1/4 | 1.32 | 1 7/8 | 1 7/8 | 3 1/2 | 1 3/8 | 1.38 | | 1/8 | 1.41 |
| 1 1/4 | 7 1/4 | 1 1/2 | 2 7/8 | 1.66 | 2 1/16 | 2 1/16 | 3 3/4 | 1 1/2 | 1.72 | | 3/16 | 1.75 |
| 1 1/2 | 8 | 1 3/4 | 3 1/8 | 1.90 | 2 3/8 | 2 3/8 | 4 3/8 | 1 3/4 | 1.97 | | 1/4 | 1.99 |
| 2 | 9 1/4 | 2 | 3 3/4 | 2.38 | 2 3/4 | 2 3/4 | 5 | 2 | 2.46 | | 5/16 | 2.50 |
| 2 1/2 | 10 1/2 | 2 1/4 | 4 1/2 | 2.88 | 3 1/8 | 3 1/8 | 5 5/8 | 2 1/4 | 2.97 | | 5/16 | 3.00 |
| 3 | 12 | 2 5/8 | 5 1/4 | 3.50 | 3 5/8 | 3 5/8 | 6 5/8 | 2 1/2 | 3.60 | | 3/8 | 3.63 |
| 4 | 14 | 3 | 6 1/2 | 4.50 | 4 1/4 | 4 1/4 | 7 1/2 | 2 3/4 | 4.60 | | 7/16 | 4.63 |
| 5 | 16 1/2 | 3 5/8 | 8 | 5.56 | 5 1/8 | 5 1/8 | 9 | 3 | 5.69 | | 7/16 | 5.69 |
| 6 | 19 | 4 1/4 | 9 1/4 | 6.63 | 6 | 6 | 10 3/4 | 3 1/4 | 6.75 | | 1/2 | 6.75 |
| 8 | 21 3/4 | 5 | 12 | 8.63 | 7 | 7 | 12 1/2 | 3 3/4 | 8.75 | | 1/2 | 8.75 |
| 10 | 26 1/2 | 6 1/2 | 14 3/4 | 10.75 | 9 | 9 | 16 1/2 | 4 1/4 | 10.92 | | 1/2 | 10.88 |
| 12 | 30 | 7 1/4 | 17 3/8 | 12.75 | 10 | 10 | 18 1/4 | 4 3/4 | 12.92 | | 1/2 | 12.94 |

All dimensions given in inches.
For complete pressure-temperature ratings see Table 7.

[1] For tolerances see Section 7.

[2] For facing see Par. 6.3

[3] For flange bolt holes see Par. 6.4 and Table 28.

[4] For spot facing see Par. 6.5

[5] This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, socket welding and lapped flanges.

[6] For reducing threaded flanges see Table 12.

[7] For thread of threaded flanges see Par. 6.8.

[8] Blind flanges may be made with or without hubs at the option of the manufacturer.

[9] For welding end and bevel see Par. 6.6.

[10] For reducing welding neck flanges see Par. 6.7.

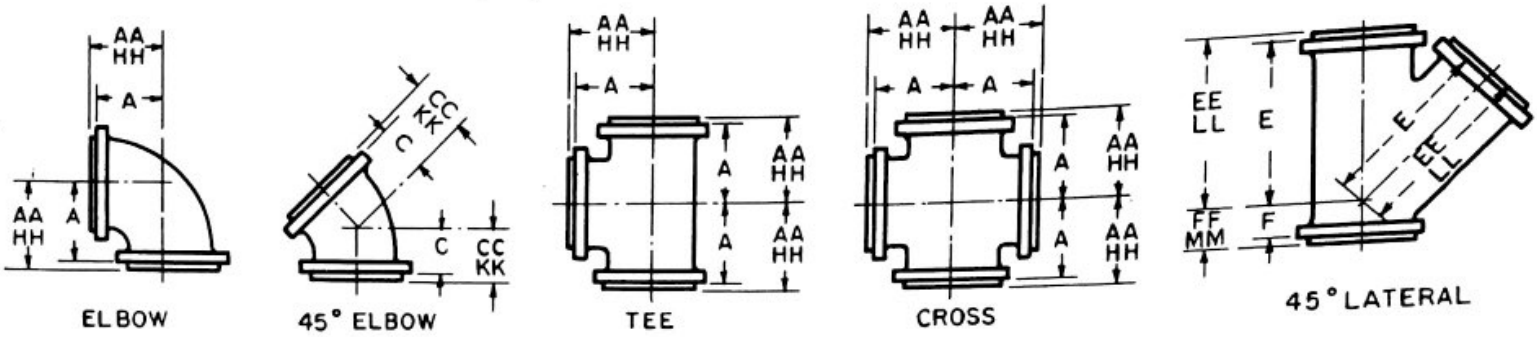



Table 33 Dimensions of Steel Flanged Fittings for Primary Service Pressure Rating of 2500 PSI (Gage)[1-2-3-4-7-8-9-10]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flange Edge | | | | |
| Nominal Pipe Size | Outside Diameter of Flange | Thickness of Flange, Min | Wall Thickness of Fitting, Min | Inside Diameter of Fitting | Center-to-Flange Edge, Elbow, Tee, Cross, and True "Y" | Center-to-Flange Edge, 45° Ell | Long Center-to-Flange Edge, Lateral | Short Center-to-Flange Edge, Lateral, and True "Y" | Flange Edge-to-Flange Edge, Reducer |
| | O | C | t | | A | C | E | F | G |
| 1/2 | 5 1/4 | 1 3/16 | 1/4 | 7/16 | 4 15/16 | ..... | ..... | ..... | ..... |
| 3/4 | 5 1/2 | 1 1/4 | 9/32 | 9/16 | 5 1/8 | ..... | ..... | ..... | ..... |
| 1 | 6 1/4 | 1 3/8 | 11/32 | 3/4 | 5 13/16 | 3 3/4 | ..... | ..... | ..... |
| 1 1/4 | 7 1/4 | 1 1/2 | 7/16 | 1 | 6 5/8 | 4 | ..... | ..... | ..... |
| 1 1/2 | 8 | 1 3/4 | 1/2 | 1 1/8 | 7 5/16 | 4 1/2 | ..... | ..... | ..... |
| 2 | 9 1/4 | 2 | 5/8 | 1 1/2 | 8 5/8 | 5 1/2 | 15 | 5 | 9 |
| 2 1/2 | 10 1/2 | 2 1/4 | 3/4 | 1 7/8 | 9 3/4 | 6 | 17 | 5 1/2 | 10 |
| 3 | 12 | 2 5/8 | 7/8 | 2 1/4 | 11 1/8 | 7 | 19 1/2 | 6 1/2 | 11 1/4 |
| 4 | 14 | 3 | 1 3/32 | 2 7/8 | 13 | 8 1/4 | 22 3/4 | 7 1/2 | 13 |
| 5 | 16 1/2 | 3 5/8 | 1 11/32 | 3 5/8 | 15 3/8 | 9 3/4 | 27 | 9 | 15 1/4 |
| 6 | 19 | 4 1/4 | 1 19/32 | 4 3/8 | 17 3/4 | 11 1/4 | 31 | 10 1/4 | 17 1/2 |
| 8 | 21 3/4 | 5 | 2 1/16 | 5 3/4 | 19 7/8 | 12 1/2 | 35 | 11 1/2 | 20 |
| 10 | 26 1/2 | 6 1/2 | 2 19/32 | 7 1/4 | 24 3/4 | 15 3/4 | 43 | 14 1/2 | 25 |
| 12 | 30 | 7 1/4 | 3 1/32 | 8 5/8 | 27 3/4 | 17 1/2 | 49 | 16 | 28 1/2 |

For dimensions given in inches.

For complete pressure-temperature ratings see Table 8.

[1] For tolerances see Par. 7.

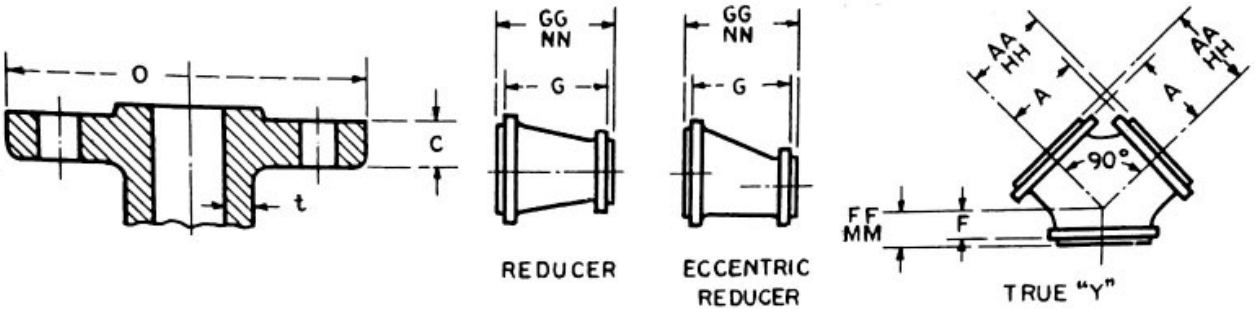
[2] For facing see Par. 6.3.

[3] For flange bolt holes see Par. 6.4 Table 31.

[4] For spot facing see Par. 6.5.

[5] For center-to-contact surface and center-to-end dimensions of reducing fittings see Par. 6.2.3.

[6] For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers see Par. 6.2.3.




| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| ¼-In. Raised Face[5] | | | | | Ring Joint[5] | | | | | |
| Center-to-Contact Surface of Raised Face, Elbow, Tee, Cross, and True "Y" | Center-to-Contact Surface of Raised Face, 45° Ell | 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 of Raised Face, Reducer[6] | Center-to-End, Elbow, Tee, Cross, and True "Y"[11] | Center-to-End, 45° Ell[11] | Long Center-to-End, Lateral[11] | Short Center-to-End, Lateral, and True "Y"[11] | End-to-End, Reducer | Nominal Pipe Size |
| AA | CC | EE | FF | GG | HH | KK | LL | MM | NN | |
| 5 3/16 | ..... | ..... | ..... | ..... | 5 3/16 | ..... | ..... | ..... | See Notes 6 and 11 | 1/2 |
| 5 3/8 | ..... | ..... | ..... | ..... | 5 3/8 | ..... | ..... | ..... | | 3/4 |
| 6 1/16 | 4 | ..... | ..... | ..... | 6 1/16 | 4 | ..... | ..... | | 1 |
| 6 7/8 | 4 1/4 | ..... | ..... | ..... | 6 15/16 | 4 5/16 | ..... | ..... | | 1 1/4 |
| 7 9/16 | 4 3/4 | ..... | ..... | ..... | 7 5/8 | 4 13/16 | ..... | ..... | | 1 1/2 |
| 8 7/8 | 5 3/4 | 15 1/4 | 5 1/4 | 9 1/2 | 8 15/16 | 5 13/16 | 15 5/16 | 5 5/16 | | 2 |
| 10 | 6 1/4 | 17 1/4 | 5 3/4 | 10 1/2 | 10 1/8 | 6 3/8 | 17 3/8 | 5 7/8 | | 2 1/2 |
| 11 3/8 | 7 1/4 | 19 3/4 | 6 3/4 | 11 3/4 | 11 1/2 | 7 3/8 | 19 7/8 | 6 7/8 | | 3 |
| 13 1/4 | 8 1/2 | 23 | 7 3/4 | 13 1/2 | 13 7/16 | 8 11/16 | 23 3/16 | 7 15/16 | | 4 |
| 15 5/8 | 10 | 27 1/4 | 9 1/4 | 15 3/4 | 15 7/8 | 10 1/4 | 27 1/2 | 9 1/2 | | 5 |
| 18 | 11 1/2 | 31 1/4 | 10 1/2 | 18 | 18 1/4 | 11 3/4 | 31 1/2 | 10 3/4 | | 6 |
| 20 1/8 | 12 3/4 | 35 1/4 | 11 3/4 | 20 1/2 | 20 7/16 | 13 1/16 | 35 9/16 | 12 1/16 | | 8 |
| 25 | 16 | 43 1/4 | 14 3/4 | 25 1/2 | 25 7/16 | 16 7/16 | 43 11/16 | 15 3/16 | | 10 |
| 28 | 17 3/4 | 49 1/4 | 16 1/4 | 29 | 28 7/16 | 18 3/16 | 49 11/16 | 16 11/16 | | 12 |

[7] For intersecting centerlines, center-to-contact surface and center-to-end dimensions of side outlet fittings see Par. 6.2.4.

[8] For center-to-contact surface and center-to-end dimensions of special degree elbows see Par. 6.2.5.

[9] For reinforcement of certain fittings see Par. 6.1.

[10] For drains see Par. 6.11.

[11] These dimensions apply to straight sizes only. Par. 6.2.3 and 6.3.1.3. 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 10 for ring-joint facing dimensions.

# APPENDIX A

## THREADING OF PIPE FOR USA STANDARD THREADED STEEL FLANGES

The length of the effective external taper thread of the USA (American) Standard Pipe Thread provides a sufficient number of threads on the pipe to insure a satisfactory joint with the ordinary weight of fitting or flange. The USA Standard Steel Flanges for high pressure-temperature service (USAS B16.5) calls for thread lengths in the flanges in proportion to the thickness of the flange. This means that the thread lengths in the flanges intended for higher pressures in a given size are longer than the thread lengths in the flanges intended for the lower pressures.

The following table provides for a length of effective thread on pipe for sizes and weights of flanges where the regular USA (American) Standard length of effective thread is too short to bring the end of the pipe reasonably close to the face of the flange when both parts are assembled by power. As the thread in all flanges as well as on the pipe are gaged with a tolerance of one thread large and one thread small there will naturally be some difference in distance between the end of the pipe and face of the flange in the various assemblies for the different sizes and weights of flanges.

In the following table the additional number of threads are added to the small end of the standard pipe thread and the pitch diameter at the end of the external thread ($E_o$) is, therefore, smaller than that of the regular standard pipe. In other words, the small end of the ring gage will pass over the end of the pipe the number of turns or the length in inches equal to the values given in the following table:

### PROJECTION OF THREADED END THROUGH RING GAGE

| Nominal Pipe Size | 150, 300 lb | 400 lb | 600 lb | | 900 lb | | 1500 lb | | 2500 lb | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Turns | Number of Turns | Number of Turns | Inches | Number of Turns | Inches | Number of Turns | Inches | Number of Turns | Inches |
| 1/2 | * | ... | * | * | ... | ... | 3 1/2 | 0.250 | 7 | 0.500 |
| 3/4 | * | ... | * | * | ... | ... | 5 | 0.360 | 7 | 0.500 |
| 1 | * | ... | * | * | ... | ... | 5 | 0.435 | 7 1/2 | 0.650 |
| 1 1/4 | * | ... | * | * | ... | ... | 5 | 0.435 | 7 1/2 | 0.650 |
| 1 1/2 | * | ... | * | * | ... | ... | 5 | 0.435 | 7 1/2 | 0.650 |
| 2 | * | ... | * | * | ... | ... | 5 | 0.435 | 7 1/2 | 0.650 |
| 2 1/2 | * | ... | * | * | ... | ... | 5 | 0.625 | 8 | 1.000 |
| 3 | * | ... | 1 | 0.125 | 3 | 0.375 | 6 | 0.750 | 10 | 1.250 |
| 3 1/2 | * | ... | 1 | 0.125 | ... | ... | ... | ... | ... | ... |
| 4 | * | * | 1 1/2 | 0.187 | 3 1/2 | 0.437 | 6 1/2 | 0.812 | 10 1/2 | 1.312 |
| 5 | * | * | 1 1/2 | 0.187 | 3 1/2 | 0.437 | 6 1/2 | 0.812 | 10 1/2 | 1.312 |
| 6 | * | * | 1 1/2 | 0.187 | 3 1/2 | 0.437 | 7 1/2 | 0.937 | 11 1/2 | 1.437 |
| 8 | * | * | 2 | 0.250 | 4 | 0.500 | 8 | 1.000 | 14 | 1.750 |
| 10 | * | * | 3 | 0.375 | 5 | 0.625 | 9 | 1.125 | 16 | 2.000 |
| 12 | * | * | 3 | 0.375 | 5 | 0.625 | 10 | 1.250 | 19 | 2.375 |
| 14 | * | * | 3 | 0.375 | 6 | 0.750 | ... | ... | ... | ... |
| 16 | * | * | 3 | 0.375 | 6 | 0.750 | ... | ... | ... | ... |
| 18 | * | * | 3 | 0.375 | 6 | 0.750 | ... | ... | ... | ... |
| 20 | * | * | 3 | 0.375 | 6 | 0.750 | ... | ... | ... | ... |
| 24 | * | * | 3 | 0.375 | 6 | 0.750 | ... | ... | ... | ... |

*Regular USA Standard pipe thread is used for this size.
Data taken from USAS B2.1.

# APPENDIX B

## DIMENSIONS OF WELDED AND SEAMLESS STEEL PIPE (USAS B36.10)

(Listed as Standard Wall, Extra Strong Wall and Double Extra Strong Wall)

| Nominal Pipe Size | Outside Diameter | Wall Thickness | | |
|---|---|---|---|---|
| | | Standard Wall | Extra Strong Wall | Double Extra Strong Wall |
| 1/8 | 0.405 | **0.068** | **0.095** | . . . |
| 1/4 | 0.540 | **0.088** | **0.119** | . . . |
| 3/8 | 0.675 | **0.091** | **0.126** | . . . |
| 1/2 | 0.840 | **0.109** | **0.147** | 0.294 |
| 3/4 | 1.050 | **0.113** | **0.154** | 0.308 |
| 1 | 1.315 | **0.133** | **0.179** | 0.358 |
| 1 1/4 | 1.660 | **0.140** | **0.191** | 0.382 |
| 1 1/2 | 1.900 | **0.145** | **0.200** | 0.400 |
| 2 | 2.375 | **0.154** | **0.218** | 0.436 |
| 2 1/2 | 2.875 | **0.203** | **0.276** | 0.552 |
| 3 | 3.500 | **0.216** | **0.300** | 0.600 |
| 3 1/2 | 4.000 | **0.226** | **0.318** | . . . |
| 4 | 4.500 | **0.237** | **0.337** | 0.674 |
| 5 | 5.563 | **0.258** | **0.375** | 0.750 |
| 6 | 6.625 | **0.280** | **0.432** | 0.864 |
| 8 | 8.625 | **0.322** | **0.500** | 0.875 |
| 10 | 10.750 | **0.365** | **0.500** | . . . |
| 12 | 12.750 | 0.375 | 0.500 | . . . |
| 14 | 14.000 | 0.375 | 0.500 | . . . |
| 16 | 16.000 | 0.375 | 0.500 | . . . |
| 18 | 18.000 | 0.375 | 0.500 | . . . |
| 20 | 20.000 | 0.375 | 0.500 | . . . |
| 24 | 24.000 | 0.375 | 0.500 | . . . |

All dimensions given in inches.

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specifications.

Thicknesses shown in bold face type for Standard Wall are identical with corresponding thicknesses shown in bold face type for Schedule 40 in Appendix C. Those shown in bold face type for Extra Strong Wall are identical with corresponding thicknesses shown in bold face type in Schedules 60 and 80 in Appendix C.

Double Extra Strong Wall has no corresponding schedule numbers.

# APPENDIX C

## DIMENSIONS OF WELDED AND SEAMLESS STEEL PIPE (USAS B36.10)

(Listed by Schedule Numbers)

| Nominal Pipe Size | Outside Diameter | Nominal Wall Thickness | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sched 10 | Sched 20 | Sched 30 | Sched 40 | Sched 60 | Sched 80 | Sched 100 | Sched 120 | Sched 140 | Sched 160 |
| 1/8 | 0.405 | . . . | . . . | . . . | **0.068** | . . . | **0.095** | . . . | . . . | . . . | . . . |
| 1/4 | 0.540 | . . . | . . . | . . . | **0.088** | . . . | **0.119** | . . . | . . . | . . . | . . . |
| 3/8 | 0.675 | . . . | . . . | . . . | **0.091** | . . . | **0.126** | . . . | . . . | . . . | . . . |
| 1/2 | 0.840 | . . . | . . . | . . . | **0.109** | . . . | **0.147** | . . . | . . . | . . . | 0.187 |
| 3/4 | 1.050 | . . . | . . . | . . . | **0.113** | . . . | **0.154** | . . . | . . . | . . . | 0.218 |
| 1 | 1.315 | . . . | . . . | . . . | **0.133** | . . . | **0.179** | . . . | . . . | . . . | 0.250 |
| 1 1/4 | 1.660 | . . . | . . . | . . . | **0.140** | . . . | **0.191** | . . . | . . . | . . . | 0.250 |
| 1 1/2 | 1.900 | . . . | . . . | . . . | **0.145** | . . . | **0.200** | . . . | . . . | . . . | 0.281 |
| 2 | 2.375 | . . . | . . . | . . . | **0.154** | . . . | **0.218** | . . . | . . . | . . . | 0.343 |
| 2 1/2 | 2.875 | . . . | . . . | . . . | **0.203** | . . . | **0.276** | . . . | . . . | . . . | 0.375 |
| 3 | 3.500 | . . . | . . . | . . . | **0.216** | . . . | **0.300** | . . . | . . . | . . . | 0.438 |
| 3 1/2 | 4.000 | . . . | . . . | . . . | **0.226** | . . . | **0.318** | . . . | . . . | . . . | . . . |
| 4 | 4.500 | . . . | . . . | . . . | **0.237** | . . . | **0.337** | . . . | 0.438 | . . . | 0.531 |
| 5 | 5.563 | . . . | . . . | . . . | **0.258** | . . . | **0.375** | . . . | 0.500 | . . . | 0.625 |
| 6 | 6.625 | . . . | . . . | . . . | **0.280** | . . . | **0.432** | . . . | 0.562 | . . . | 0.718 |
| 8 | 8.625 | . . . | 0.250 | 0.277 | **0.322** | 0.406 | **0.500** | 0.593 | 0.718 | 0.812 | 0.906 |
| 10 | 10.750 | . . . | 0.250 | 0.307 | **0.365** | **0.500** | 0.593 | 0.718 | 0.843 | 1.000 | 1.125 |
| 12 | 12.750 | . . . | 0.250 | 0.330 | 0.406 | 0.562 | 0.687 | 0.843 | 1.000 | 1.125 | 1.312 |
| 14 | 14.000 | 0.250 | 0.312 | 0.375 | 0.438 | 0.593 | 0.750 | 0.937 | 1.093 | 1.250 | 1.406 |
| 16 | 16.000 | 0.250 | 0.312 | 0.375 | 0.500 | 0.656 | 0.843 | 1.031 | 1.218 | 1.438 | 1.593 |
| 18 | 18.000 | 0.250 | 0.312 | 0.438 | 0.562 | 0.750 | 0.937 | 1.156 | 1.375 | 1.562 | 1.781 |
| 20 | 20.000 | 0.250 | 0.375 | 0.500 | 0.593 | 0.812 | 1.031 | 1.281 | 1.500 | 1.750 | 1.968 |
| 24 | 24.000 | 0.250 | 0.375 | 0.562 | 0.687 | 0.968 | 1.218 | 1.531 | 1.812 | 2.062 | 2.343 |
| 30 | 30.000 | 0.312 | 0.500 | 0.625 | . . . | . . . | . . . | . . . | . . . | . . . | . . . |

All dimensions given in inches.

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specifications.

Thicknesses shown in bold face type for Schedule 40 are identical with thicknesses shown in bold face type for Standard Wall pipe in Appendix B. Those in bold face type in Schedules 60 and 80 are identical with thicknesses in bold face type for Extra Strong Wall pipe in Appendix B.

Some of the larger, heavier wall sections are beyond the capabilities of seamless mill production and must be obtained from turned-and-bored billets or other sources.

# APPENDIX D

## METHOD OF RATING ALLOY STEELS NOT GIVEN IN TABLES 1 to 8 INCLUSIVE

Ratings of 150-lb pressure class flanges and flanged fittings for all alloy steels shall be taken to be the same as 150-lb pressure class ratings for carbon steel.

Ratings of 300-lb and higher pressure class flanges or flanged fittings made of alloy steels with allowable stresses given in Table PG 23.1 of the ASME Boiler and Pressure Vessel Code other than those in Tables 1 to 8 inclusive may be obtained by the following procedure:

### 1 DEFINITION OF SYMBOLS

$P$ = pressure ratings (psi) at desired temperature
$S_c$ = Table PG 23.1 allowable stress (psi) at that temperature
$S_y$ = yield strength (psi) at that temperature
$P_p$ = primary rating pressure (psi)

### 2 RATINGS

a Primary Ratings Temperature. Plot allowable stresses given in ASME Boiler and Pressure Vessel Code, Table PG 23.1, for the alloy steel[1] against temperature. The temperature at which the curve intersects the 8,750 psi stress line is the primary rating temperature. This temperature should be rounded to an even 25F by adding not more than 5 deg, otherwise dropping to the next lower 25 deg, interval.

b Pressure-Temperature Ratings.

| Temperature | Pressure Ratings[2] |
|---|---|
| Up to 650 F | Ratings same as carbon steel ratings |
| 650 F to primary rating temperature | Ratings obtained by linear interpolation between pressure rating at 650 F and primary rating pressure at primary rating temperature |
| Above primary rating temperature | Ratings determined from formula $P = \frac{S_c}{8750} P_p$ |
| All | Except: [3]Ratings shall not exceed those determined from formula: $P = \frac{0.6 S_y}{8750} P_p$ |

[1]The same ratings shall be used for cast and forged material. Where ASME Code gives different allowable stresses for the two forms of the same material, use the lower.

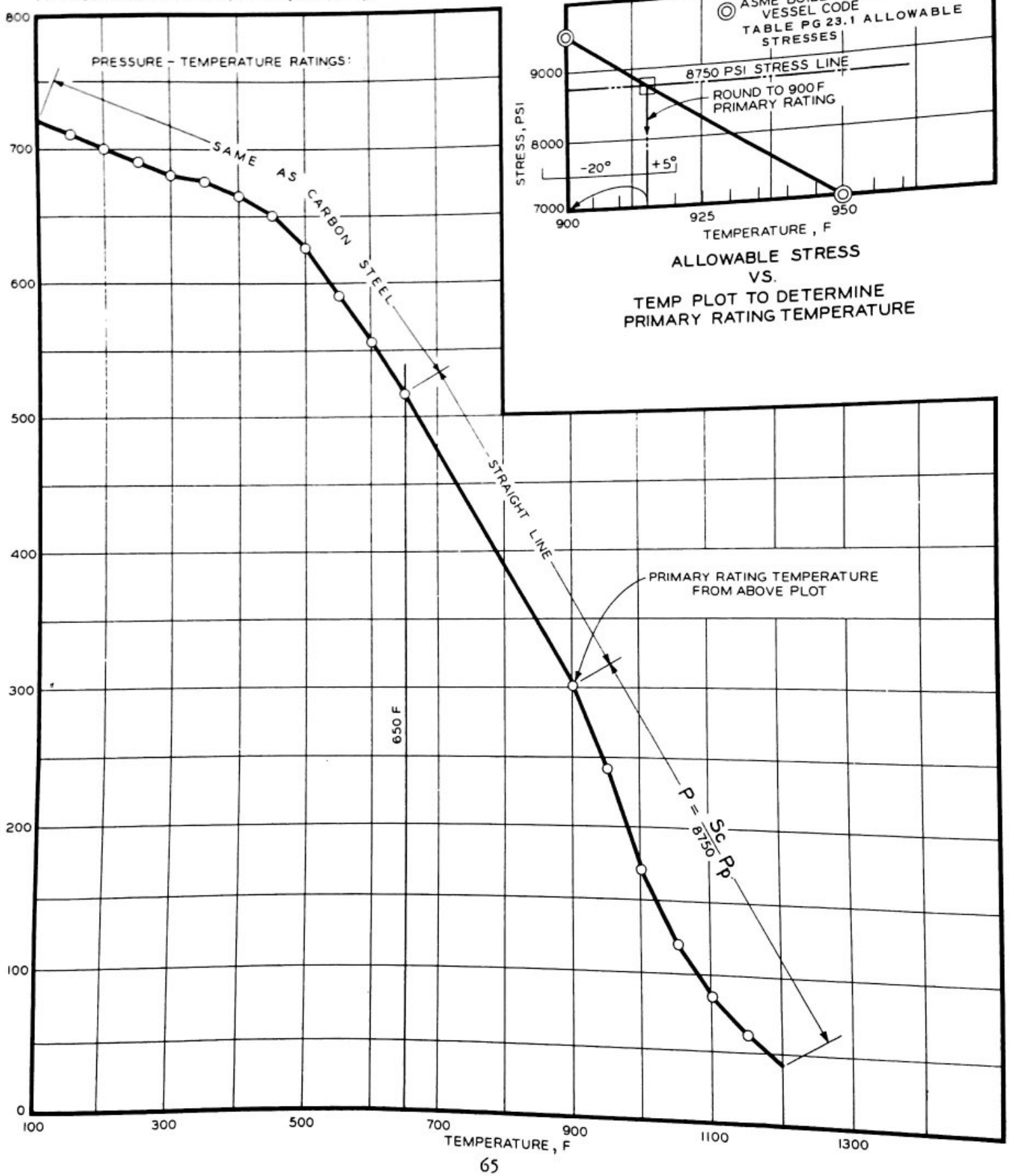
[2]Calculated ratings may be rounded to nearest 5 psi.

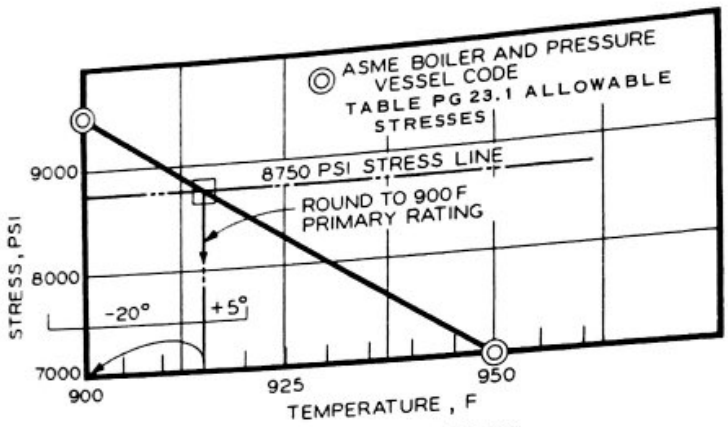
[3]This exception applies to materials with comparatively low yield strength at atmospheric and moderate temperatures, such as Type 304 austenitic stainless steel.

# METHOD OF RATING ALLOY STEELS NOT GIVEN IN TABLES 1 TO 8 INCLUSIVE

*EXAMPLE –*

TO OBTAIN RATINGS OF 300 LB USAS B16.5 FLANGES AND FLANGED FITTINGS MADE OF SA-335, GR P7 (7Cr-1/2Mo):




ALLOWABLE STRESS
VS.
TEMP PLOT TO DETERMINE
PRIMARY RATING TEMPERATURE

# APPENDIX E

## LIMITING DIMENSIONS OF GASKETS

(Other than Ring Joint)

### 1. Scope

This appendix gives limiting dimensions of gaskets (other than ring joint) suitable for the pressure temperature ratings established in USAS B16.5.

### 2. Gasket Materials and Construction

Classification of gasket materials and types are shown in Figure 1. Other gaskets, which result in no increase in bolt loads or flange moment over those resulting from the gaskets included in the respective Groups in this Appendix, may be used and warrant the ratings of this standard with the limiting dimensions of the applicable group.

### 3. Gasket Dimensions

(a) The actual dimensions to be used for a gasket must be established by the user, possibly by reference to a dimensional standard for gaskets (such as USAS B16.21 or API 601), based on the type of gasket and its characteristics. These characteristics include its density, flexibility, resistance to the fluid and its temperature, and the necessity for satisfactorily compressing the gasket either on its ID, OD, or both. Also to be considered is the question of allowing a "pocket" at the gasket ID (between the flange facings) or of allowing any intrusion of the gasket into the flange bore, depending on the service fluid as well as on the possibility of damaging attendant equipment by partially disintegrated gaskets.

(b) Limiting gasket dimensions are given in Tables I, II and III. These dimensions represent approximately the maximum combinations of widths and diameters of the different types of gaskets covered which meet rating requirements. Variations which tend to reduce bolt loads and flange moments (e.g. reducing the gasket width) may be made; however, in departing from the tabulated dimensions, consideration should be given to the stability of the gasket under high bolt loads. As a general rule, the area of unconfined nonmetallic gaskets should not be less than the bolt area.

(c) Gaskets are divided into three groups based on their gasket loading factors as shown in the ASME Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels.

| Group | Factor "m" | Factor "y" |
|---|---|---|
| I | 0 to 3.00 | 0 to 4,500 |
| II | over 3.00 to 4.25 | over 4,500 to 10,100 |
| III | over 4.25 | over 10,100 |

(d) Gasket contact widths are as follows:
Group I USAS B16.5 slip-on flange raised face width.
Group II USAS B16.5 large tongue width.
Group III USAS B16.5 small tongue width minus 1/32 in., but not less than 3/16 in.

(e) Gaskets of Group I have inside diameters equal to the outside diameter of the corresponding pipe, which follows the principle established in USAS B16.21, nonmetallic gaskets for pipe flanges. In order to avoid pocketing of fluid handled, Group I gaskets may be extended to the inside diameter of valves, pipe or the bore of integral, welding neck or socket weld type flanges. Group I gaskets have outside contact diameter equal to the outside diameter of the raised face.

(f) Gaskets of IIa and IIIa also have inside diameters equal to the outside diameter of the corresponding pipe. It may be desirable under some conditions to make the inside diameter of these gaskets equal to the inside diameter of valves, pipe or the bore of integral, welding neck or socket weld type flanges, and this is permissible provided the gasket contact width does not exceed that shown. This provision affects gaskets shown in Figures 4, 5, 8, and 9 and requires a reduction in gasket outside diameters as well as inside diameters.

Additional provisions for varying gasket widths in contact with raised face are covered in Par. 3a. Groups IIb and IIIb have outside contact diameters equal to the outside diameter of the raised face.

(g) The outside diameter of gaskets or centering rings extending beyond the raised face is equal to the bolt circle minus one bolt diameter. This type gasket is designed to be aligned by the flange bolts.

(h) Groups IIa and IIIa gaskets are designed for those users who prefer that narrow gaskets be located close to the bore, thereby keeping the pressure area to a minimum and giving maximum flexibility to the flanged joint. See Par. 3(e). Groups IIb and IIIb gaskets are designed for those users who prefer narrow gaskets to be located at the outside of the raised face for ease in aligning the gaskets without a centering ring.

(i) Group I gaskets with edges extending to the bolts (Figure 3) are dimensionally the same as the corresponding flat ring gaskets given in USA Standard B16.21 Nonmetallic Gaskets for Pipe Flanges. See Par. 3(d).

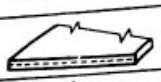
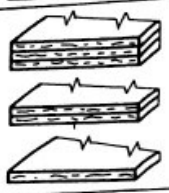
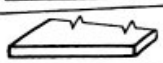
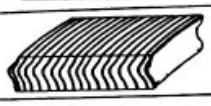
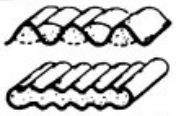
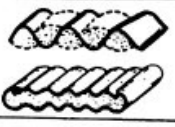
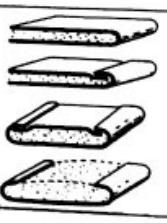
### 4. Tolerances

Gasket contact widths for Groups II and III shall not exceed specified contact width by more than 10 per cent.

# APPENDIX E

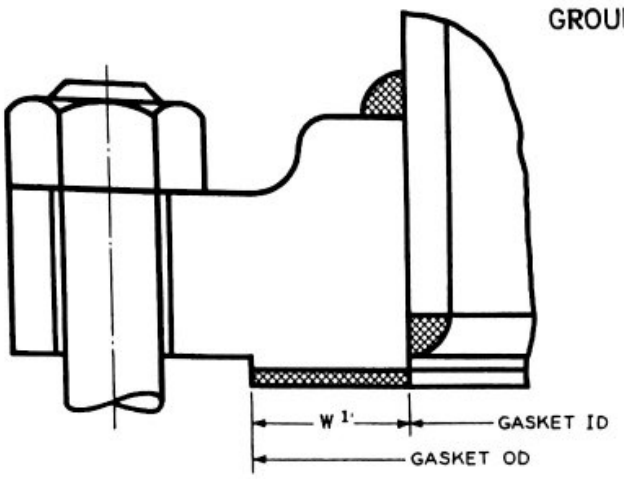
## * FIGURE 1 – GASKET MATERIALS AND CONSTRUCTION

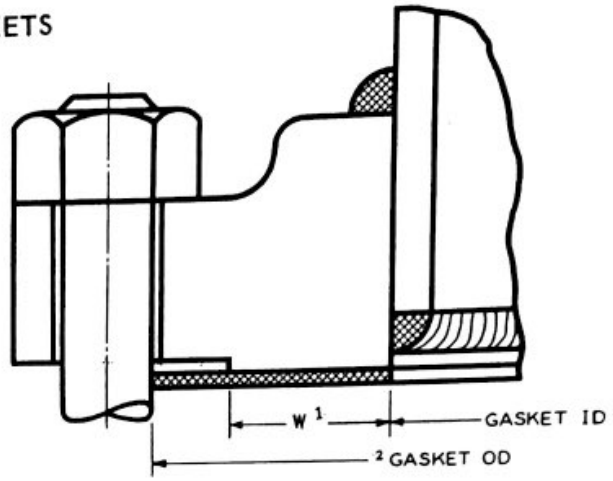
(Based upon Table UA-49.1 of the ASME Unfired Pressure Vessels Code.
The design values and other details given in this table are suggested only and are not mandatory.)

| GASKET GROUP NUMBER | GASKET MATERIAL | | GASKET † FACTOR *m* | MINIMUM DESIGN SEATING STRESS † *y* | SKETCHES |
|---|---|---|---|---|---|
| I | Elastomer without Fabric or a High Percentage of Asbestos Fiber: Below 75 Shore Durometer | | 0.50 | 0 |  |
| | 75 or Higher Shore Durometer | | 1.00 | 200 | |
| | Asbestos with a Suitable Binder for the Operating Conditions | 1/8" Thick | 2.00 | 1600 |  |
| | | 1/16" Thick | 2.75 | 3700 | |
| | Elastomer with Cotton Fabric Insertion | | 1.25 | 400 |  |
| | Elastomer with Asbestos Fabric Insertion, with or without Wire Reinforcement | 3-Ply | 2.25 | 2200 |  |
| | | 2-Ply | 2.50 | 2900 | |
| | | 1-Ply | 2.75 | 3700 | |
| | Vegetable Fiber | | 1.75 | 1100 |  |
| | Spiral-Wound Metal, with Asbestos or other Nonmetallic Filler | Carbon Steel | 2.50 | 2900 |  |
| | | Stainless Steel or Monel | 3.00 | 4500 | |
| | Corrugated Metal, Asbestos Inserted — or Corrugated Metal Double Jacketed Asbestos Filled | Soft Aluminum | 2.50 | 2900 |  |
| | | Soft Copper or Brass | 2.75 | 3700 | |
| | | Iron or Soft Steel | 3.00 | 4500 | |
| | Corrugated Metal | Soft Aluminum | 2.75 | 3700 |  |
| | | Soft Copper or Brass | 3.00 | 4500 | |
| II a & II b | Asbestos with a Suitable Binder for the operating conditions | 1/32" Thick | 3.50 | 6500 |  |
| | Corrugated Metal, Asbestos Inserted —or Corrugated Metal Double Jacketed Asbestos Filled | Monel or 4-6% Chrome | 3.25 | 5500 |  |
| | | Stainless Steels | 3.50 | 6500 | |
| | Corrugated Metal | Iron or Soft Steel | 3.25 | 5500 |  |
| | | Monel or 4-6% Chrome | 3.50 | 6500 | |
| | | Stainless Steels | 3.75 | 7600 | |
| | Flat Metal Jacketed Asbestos Filled | Soft Aluminum | 3.25 | 5500 |  |
| | | Soft Copper or Brass | 3.50 | 6500 | |
| | | Iron or Soft Steel | 3.75 | 7600 | |
| | | Monel | 3.50 | 8000 | |
| | | 4-6% Chrome | 3.75 | 9000 | |
| | | Stainless Steels | 3.75 | 9000 | |
| | Grooved Metal | Soft Aluminum | 3.25 | 5500 |  |
| | | Soft Copper or Brass | 3.50 | 6500 | |
| | | Iron or Soft Steel | 3.75 | 7600 | |
| | | Monel or 4-6% Chrome | 3.75 | 9000 | |
| | | Stainless Steels | 4.25 | 10100 | |
| | Solid Flat Metal | Soft Aluminum | 4.00 | 8800 |  |
| III a & III b | Solid Flat Metal | Soft Copper or Brass | 4.75 | 13000 | |
| | | Iron or Soft Steel | 5.50 | 18000 | |
| | | Monel or 4-6% Chrome | 6.00 | 21800 | |
| | | Stainless Steels | 6.50 | 26000 | |

# APPENDIX E

## TABLE I
## GROUP I GASKETS




| Nominal Size | W[1] Gasket Contact Width | FIGURE 2 | | FIGURE 3 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Inside Diameter | Outside Diameter | Inside Diameter | OUTSIDE DIAMETER[2] | | | | | |
| | | | | | 150 lb | 300 lb | 400 lb | 600 lb | 900 lb | 1500 lb | 2500 lb |
| 1/2 | 17/64 | 27/32 | 1 3/8 | 27/32 | 1 7/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/2 | 2 1/2 | 2 3/4 |
| 3/4 | 5/16 | 1 1/16 | 1 11/16 | 1 1/16 | 2 1/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 3/4 | 3 |
| 1 | 11/32 | 1 5/16 | 2 | 1 5/16 | 2 5/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/8 | 3 3/8 |
| 1 1/4 | 27/64 | 1 21/32 | 2 1/2 | 1 21/32 | 3 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/2 | 3 1/2 | 4 1/8 |
| 1 1/2 | 31/64 | 1 29/32 | 2 7/8 | 1 29/32 | 3 3/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 3 7/8 | 4 5/8 |
| 2 | 5/8 | 2 3/8 | 3 5/8 | 2 3/8 | 4 1/8 | 4 3/8 | 4 3/8 | 4 3/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 2 1/2 | 5/8 | 2 7/8 | 4 1/8 | 2 7/8 | 4 7/8 | 5 1/8 | 5 1/8 | 5 1/8 | 6 1/2 | 6 1/2 | 6 5/8 |
| 3 | 3/4 | 3 1/2 | 5 | 3 1/2 | 5 3/8 | 5 7/8 | 5 7/8 | 5 7/8 | 6 5/8 | 6 7/8 | 7 3/4 |
| 3 1/2 | 3/4 | 4 | 5 1/2 | 4 | 6 3/8 | 6 1/2 | 6 3/8 | 6 3/8 | . . . | . . . | . . . |
| 4 | 27/32 | 4 1/2 | 6 3/16 | 4 1/2 | 6 7/8 | 7 1/8 | 7 | 7 5/8 | 8 1/8 | 8 1/4 | 9 1/4 |
| 5 | 7/8 | 5 9/16 | 7 5/16 | 5 9/16 | 7 3/4 | 8 1/2 | 8 3/8 | 9 1/2 | 9 3/4 | 10 | 11 |
| 6 | 15/16 | 6 5/8 | 8 1/2 | 6 5/8 | 8 3/4 | 9 7/8 | 9 3/4 | 10 1/2 | 11 3/8 | 11 1/8 | 12 1/2 |
| 8 | 1 | 8 5/8 | 10 5/8 | 8 5/8 | 11 | 12 1/8 | 12 | 12 5/8 | 14 1/8 | 13 7/8 | 15 1/4 |
| 10 | 1 | 10 3/4 | 12 3/4 | 10 3/4 | 13 3/8 | 14 1/4 | 14 1/8 | 15 3/4 | 17 1/8 | 17 1/8 | 18 3/4 |
| 12 | 1 1/8 | 12 3/4 | 15 | 12 3/4 | 16 1/8 | 16 5/8 | 16 1/2 | 18 | 19 5/8 | 20 1/2 | 21 5/8 |
| 14 | 1 1/8 | 14 | 16 1/4 | 14 | 17 3/4 | 19 1/8 | 19 | 19 3/8 | 20 1/2 | 22 3/4 | . . . |
| 16 | 1 1/4 | 16 | 18 1/2 | 16 | 20 1/4 | 21 1/4 | 21 1/8 | 22 1/4 | 22 5/8 | 25 1/4 | . . . |
| 18 | 1 1/2 | 18 | 21 | 18 | 21 5/8 | 23 1/2 | 23 3/8 | 24 1/8 | 25 1/8 | 27 3/4 | . . . |
| 20 | 1 1/2 | 20 | 23 | 20 | 23 7/8 | 25 3/4 | 25 1/2 | 26 7/8 | 27 1/2 | 29 3/4 | . . . |
| 24 | 1 5/8 | 24 | 27 1/4 | 24 | 28 1/4 | 30 1/2 | 30 1/4 | 31 1/8 | 33 | 35 1/2 | . . . |

[1] Applies to both Figure 2 & Figure 3. Gasket diameters may be varied. In no case, however, should the area of unconfined nonmetallic gaskets be less than that of the bolts. See Par. 3(c).

[2] Gasket OD may be extended, or an attached centering device may be used. The OD of extended metallic gaskets or of any centering ring may be 1/8" less than specified.

[3] Slip-on type flange shown for illustration purposes only. Gaskets may be used with other types of flange. See Paragraph 3(d).

# APPENDIX E

## TABLE IIA
## GROUP IIa GASKETS

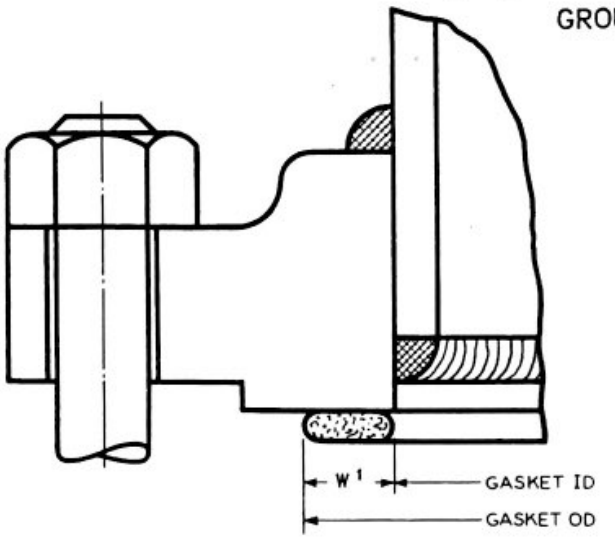



FIGURE 4 [3]

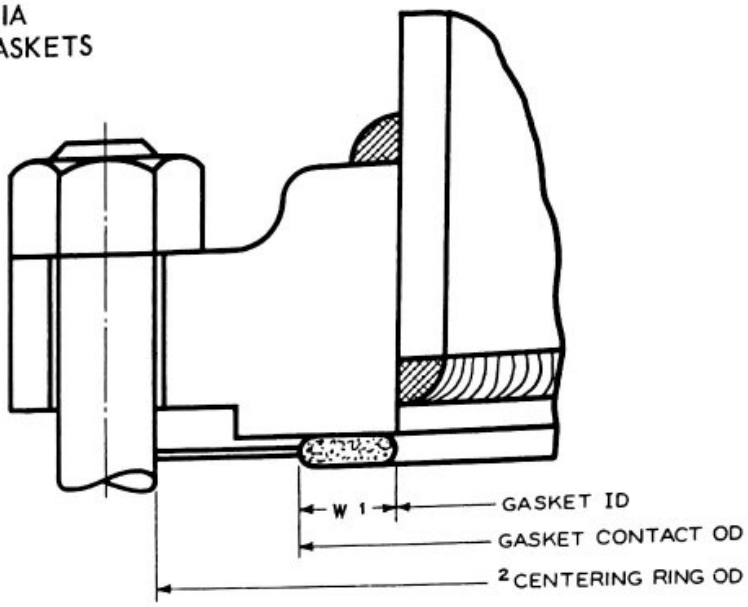



FIGURE 5 [3]

| Nominal Size | W [1] Gasket Contact Width | FIGURE 4 | | FIGURE 5 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | In-side Diam-eter | Out-side Diam-eter | In-side Diam-eter | Gasket Contact Out-side Diam-eter | CENTERING RING OUTSIDE DIAMETER [2] | | | | | |
| | | | | | | 150 lb | 300 lb | 400 lb | 600 lb | 900 lb | 1500 lb | 2500 lb |
| 1/2 | 3/16 | 27/32 | 1 7/32 | 27/32 | 1 7/32 | 1 7/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/2 | 2 1/2 | 2 3/4 |
| 3/4 | 3/16 | 1 1/16 | 1 7/16 | 1 1/16 | 1 7/16 | 2 1/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 3/4 | 3 |
| 1 | 1/4 | 1 5/16 | 1 13/16 | 1 5/16 | 1 13/16 | 2 5/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/8 | 3 3/8 |
| 1 1/4 | 5/16 | 1 21/32 | 2 9/32 | 1 21/32 | 2 9/32 | 3 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/2 | 3 1/2 | 4 1/8 |
| 1 1/2 | 3/8 | 1 29/32 | 2 21/32 | 1 29/32 | 2 21/32 | 3 3/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 3 7/8 | 4 5/8 |
| 2 | 3/8 | 2 3/8 | 3 1/8 | 2 3/8 | 3 1/8 | 4 1/8 | 4 3/8 | 4 3/8 | 4 3/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 2 1/2 | 3/8 | 2 7/8 | 3 5/8 | 2 7/8 | 3 5/8 | 4 7/8 | 5 1/8 | 5 1/8 | 5 1/8 | 6 1/2 | 6 1/2 | 6 5/8 |
| 3 | 3/8 | 3 1/2 | 4 1/4 | 3 1/2 | 4 1/4 | 5 3/8 | 5 7/8 | 5 7/8 | 5 7/8 | 6 5/8 | 6 7/8 | 7 3/4 |
| 3 1/2 | 3/8 | 4 | 4 3/4 | 4 | 4 3/4 | 6 3/8 | 6 1/2 | 6 3/8 | 6 3/8 | . . . | . . . | . . . |
| 4 | 1/2 | 4 1/2 | 5 1/2 | 4 1/2 | 5 1/2 | 6 7/8 | 7 1/8 | 7 | 7 5/8 | 8 1/8 | 8 1/4 | 9 1/4 |
| 5 | 1/2 | 5 9/16 | 6 9/16 | 5 9/16 | 6 9/16 | 7 3/4 | 8 1/2 | 8 3/8 | 9 1/2 | 9 3/4 | 10 | 11 |
| 6 | 1/2 | 6 5/8 | 7 5/8 | 6 5/8 | 7 5/8 | 8 3/4 | 9 7/8 | 9 3/4 | 10 1/2 | 11 3/8 | 11 1/8 | 12 1/2 |
| 8 | 5/8 | 8 5/8 | 9 7/8 | 8 5/8 | 9 7/8 | 11 | 12 1/8 | 12 | 12 5/8 | 14 1/8 | 13 7/8 | 15 1/4 |
| 10 | 3/4 | 10 3/4 | 12 1/4 | 10 3/4 | 12 1/4 | 13 3/8 | 14 1/4 | 14 1/8 | 15 3/4 | 17 1/8 | 17 1/8 | 18 3/4 |
| 12 | 3/4 | 12 3/4 | 14 1/4 | 12 3/4 | 14 1/4 | 16 1/8 | 16 5/8 | 16 1/2 | 18 | 19 5/8 | 20 1/2 | 21 5/8 |
| 14 | 3/4 | 14 | 15 1/2 | 14 | 15 1/2 | 17 3/4 | 19 1/8 | 19 | 19 3/8 | 20 1/2 | 22 3/4 | . . . |
| 16 | 7/8 | 16 | 17 3/4 | 16 | 17 3/4 | 20 1/4 | 21 1/4 | 21 1/8 | 22 1/4 | 22 5/8 | 25 1/4 | . . . |
| 18 | 7/8 | 18 | 19 3/4 | 18 | 19 3/4 | 21 5/8 | 23 1/2 | 23 3/8 | 24 1/8 | 25 1/8 | 27 3/4 | . . . |
| 20 | 1 | 20 | 22 | 20 | 22 | 23 7/8 | 25 3/4 | 25 1/2 | 26 7/8 | 27 1/2 | 29 3/4 | . . . |
| 24 | 1 | 24 | 26 | 24 | 26 | 28 1/4 | 30 1/2 | 30 1/4 | 31 1/8 | 33 | 35 1/2 | . . . |

[1] Applies to both Figure 4 and Figure 5. Gasket diameters may be varied, provided the gasket contact width does not exceed that shown, subject to tolerances in Par. 4. See Par. 3(c).

[2] Metallic gaskets may have attached centering device. The OD of any centering ring may be 1/8" less than specified.

[3] Slip-on type flange shown for illustration purposes only. Gaskets may be used with other types of flange. See Paragraph 3(e).

# APPENDIX E

## TABLE IIB
## GROUP IIb GASKETS

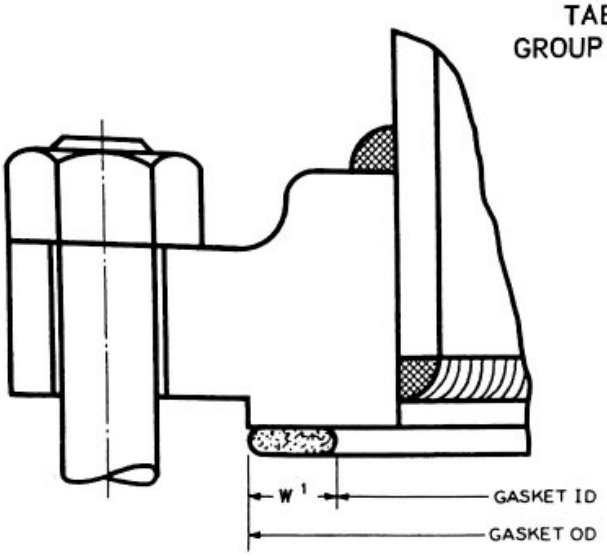



FIGURE 6 [3]

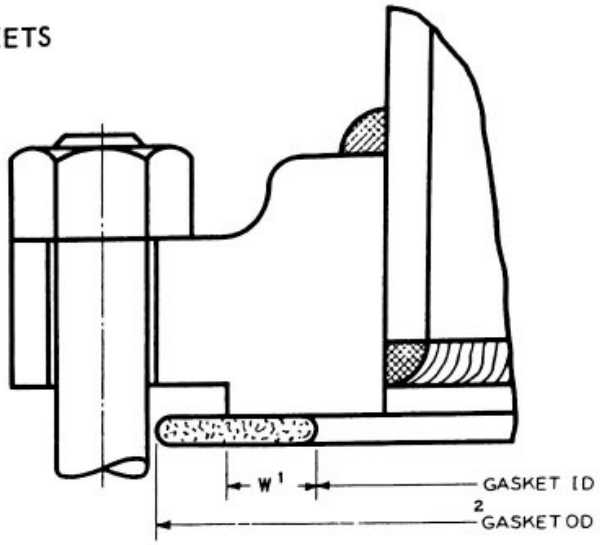



FIGURE 7 [3]

| Nominal Size | FIGURE 6 | | | FIGURE 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | W [1] Gasket Contact Width | Inside Diameter | Outside Diameter | Inside Diameter | OUTSIDE DIAMETER [2] | | | | | | |
| | | | | | 150 lb | 300 lb | 400 lb | 600 lb | 900 lb | 1500 lb | 2500 lb |
| 1/2 | 3/16 | 1 | 1 3/8 | 1 | 1 7/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/2 | 2 1/2 | 2 3/4 |
| 3/4 | 3/16 | 1 5/16 | 1 11/16 | 1 5/16 | 2 1/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 3/4 | 3 |
| 1 | 1/4 | 1 1/2 | 2 | 1 1/2 | 2 5/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/8 | 3 3/8 |
| 1 1/4 | 5/16 | 1 7/8 | 2 1/2 | 1 7/8 | 3 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/2 | 3 1/2 | 4 1/8 |
| 1 1/2 | 3/8 | 2 1/8 | 2 7/8 | 2 1/8 | 3 3/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 3 7/8 | 4 5/8 |
| 2 | 3/8 | 2 7/8 | 3 5/8 | 2 7/8 | 4 1/8 | 4 3/8 | 4 3/8 | 4 3/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 2 1/2 | 3/8 | 3 3/8 | 4 1/8 | 3 3/8 | 4 7/8 | 5 1/8 | 5 1/8 | 5 1/8 | 6 1/2 | 6 1/2 | 6 5/8 |
| 3 | 3/8 | 4 1/4 | 5 | 4 1/4 | 5 3/8 | 5 7/8 | 5 7/8 | 5 7/8 | 6 5/8 | 6 7/8 | 7 3/4 |
| 3 1/2 | 3/8 | 4 3/4 | 5 1/2 | 4 3/4 | 6 3/8 | 6 1/2 | 6 3/8 | 6 3/8 | . . . | . . . | . . . |
| 4 | 1/2 | 5 3/16 | 6 3/16 | 5 3/16 | 6 7/8 | 7 1/8 | 7 | 7 5/8 | 8 1/8 | 8 1/4 | 9 1/4 |
| 5 | 1/2 | 6 5/16 | 7 5/16 | 6 5/16 | 7 3/4 | 8 1/2 | 8 3/8 | 9 1/2 | 9 3/4 | 10 | 11 |
| 6 | 1/2 | 7 1/2 | 8 1/2 | 7 1/2 | 8 3/4 | 9 7/8 | 9 3/4 | 10 1/2 | 11 3/8 | 11 1/8 | 12 1/2 |
| 8 | 5/8 | 9 3/8 | 10 5/8 | 9 3/8 | 11 | 12 1/8 | 12 | 12 5/8 | 14 1/8 | 13 7/8 | 15 1/4 |
| 10 | 3/4 | 11 1/4 | 12 3/4 | 11 1/4 | 13 3/8 | 14 1/4 | 14 1/8 | 15 3/4 | 17 1/8 | 17 1/8 | 18 3/4 |
| 12 | 3/4 | 13 1/2 | 15 | 13 1/2 | 16 1/8 | 16 5/8 | 16 1/2 | 18 | 19 5/8 | 20 1/2 | 21 5/8 |
| 14 | 3/4 | 14 3/4 | 16 1/4 | 14 3/4 | 17 3/4 | 19 1/8 | 19 | 19 3/8 | 20 1/2 | 22 3/4 | . . . |
| 16 | 7/8 | 16 3/4 | 18 1/2 | 16 3/4 | 20 1/4 | 21 1/4 | 21 1/8 | 22 1/4 | 22 5/8 | 25 1/4 | . . . |
| 18 | 7/8 | 19 1/4 | 21 | 19 1/4 | 21 5/8 | 23 1/2 | 23 3/8 | 24 1/8 | 25 1/8 | 27 3/4 | . . . |
| 20 | 1 | 21 | 23 | 21 | 23 7/8 | 25 3/4 | 25 1/2 | 26 7/8 | 27 1/2 | 29 3/4 | . . . |
| 24 | 1 | 25 1/4 | 27 1/4 | 25 1/4 | 28 1/4 | 30 1/2 | 30 1/4 | 31 1/8 | 33 | 35 1/2 | . . . |

1 Applies to both Figure 6 and Figure 7. Gasket diameters may be varied, provided the gasket contact width does not exceed that shown, subject to tolerances in Par. 4. See Par. 3(c).

2 Gasket OD may be extended, or an attached centering device may be used. The OD of extended metallic gasket or of any centering ring may be 1/8" less than specified.

3 Slip-on type flanges shown for illustration purposes only. Gaskets may be used with other types of flange. See Paragraph 3(e).

# APPENDIX E

## TABLE IIIA
## GROUP IIIa GASKETS

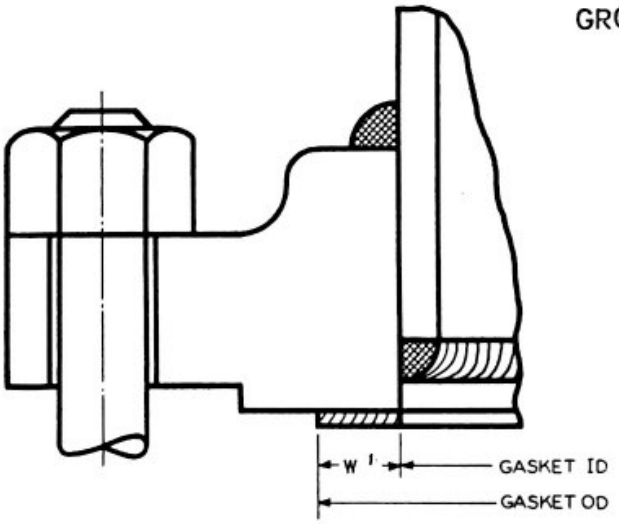



FIGURE 8 [3]

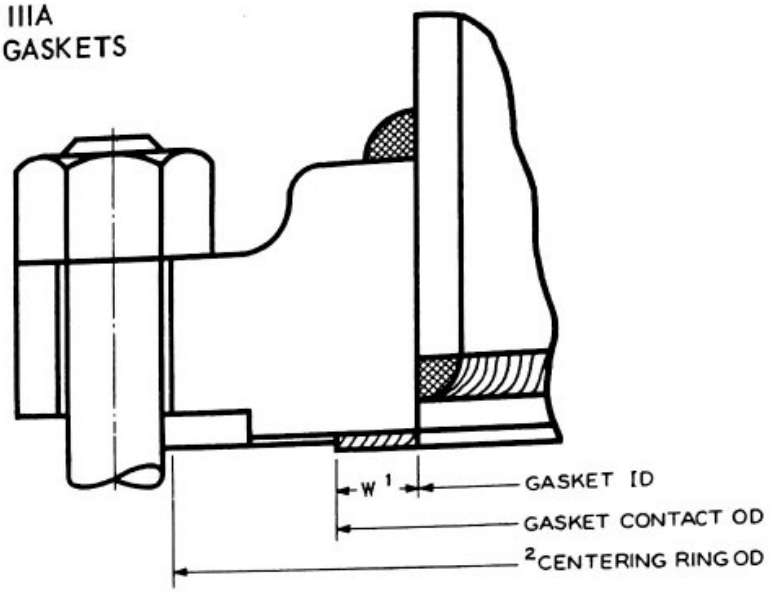



FIGURE 9 [3]

| Nominal Size | W Gasket Contact Width | FIGURE 8 | | FIGURE 9 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Inside Diameter | Outside Diameter | Inside Diameter | Gasket Contact Outside Diameter | CENTERING RING OUTSIDE DIAMETER[2] | | | | | | |
| | | | | | | 150 lb | 300 lb | 400 lb | 600 lb | 900 lb | 1500 lb | 2500 lb |
| 1/2 | 3/16 | 27/32 | 1 7/32 | 27/32 | 1 7/32 | 1 7/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/2 | 2 1/2 | 2 3/4 |
| 3/4 | 3/16 | 1 1/16 | 1 7/16 | 1 1/16 | 1 7/16 | 2 1/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 3/4 | 3 |
| 1 | 3/16 | 1 5/16 | 1 11/16 | 1 5/16 | 1 11/16 | 2 5/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/8 | 3 3/8 |
| 1 1/4 | 3/16 | 1 21/32 | 2 1/32 | 1 21/32 | 2 1/32 | 3 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/2 | 3 1/2 | 4 1/8 |
| 1 1/2 | 3/16 | 1 29/32 | 2 9/32 | 1 29/32 | 2 9/32 | 3 3/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 3 7/8 | 4 5/8 |
| 2 | 3/16 | 2 3/8 | 2 3/4 | 2 3/8 | 2 3/4 | 4 1/8 | 4 3/8 | 4 3/8 | 4 3/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 2 1/2 | 3/16 | 2 7/8 | 3 1/4 | 2 7/8 | 3 1/4 | 4 7/8 | 5 1/8 | 5 1/8 | 5 1/8 | 6 1/2 | 6 1/2 | 6 5/8 |
| 3 | 3/16 | 3 1/2 | 3 7/8 | 3 1/2 | 3 7/8 | 5 3/8 | 5 7/8 | 5 7/8 | 5 7/8 | 6 5/8 | 6 7/8 | 7 3/4 |
| 3 1/2 | 3/16 | 4 | 4 3/8 | 4 | 4 3/8 | 6 3/8 | 6 1/2 | 6 3/8 | 6 3/8 | - - - | - - - | - - - |
| 4 | 7/32 | 4 1/2 | 4 15/16 | 4 1/2 | 4 15/16 | 6 7/8 | 7 1/8 | 7 | 7 5/8 | 8 1/8 | 8 1/4 | 9 1/4 |
| 5 | 7/32 | 5 9/16 | 6 | 5 9/16 | 6 | 7 3/4 | 8 1/2 | 8 3/8 | 9 1/2 | 9 3/4 | 10 | 11 |
| 6 | 7/32 | 6 5/8 | 7 1/16 | 6 5/8 | 7 1/16 | 8 3/4 | 9 7/8 | 9 3/4 | 10 1/2 | 11 3/8 | 11 1/8 | 12 1/2 |
| 8 | 9/32 | 8 5/8 | 9 3/16 | 8 5/8 | 9 3/16 | 11 | 12 1/8 | 12 | 12 5/8 | 14 1/8 | 13 7/8 | 15 1/4 |
| 10 | 11/32 | 10 3/4 | 11 7/16 | 10 3/4 | 11 7/16 | 13 3/8 | 14 1/4 | 14 1/8 | 15 3/4 | 17 1/8 | 17 1/8 | 18 3/4 |
| 12 | 11/32 | 12 3/4 | 13 7/16 | 12 3/4 | 13 7/16 | 16 1/8 | 16 5/8 | 16 1/2 | 18 | 19 5/8 | 20 1/2 | 21 5/8 |
| 14 | 11/32 | 14 | 14 11/16 | 14 | 14 11/16 | 17 3/4 | 19 1/8 | 19 | 19 3/8 | 20 1/2 | 22 3/4 | - - - |
| 16 | 13/32 | 16 | 16 13/16 | 16 | 16 13/16 | 20 1/4 | 21 1/4 | 21 1/8 | 22 1/4 | 22 5/8 | 25 1/4 | - - - |
| 18 | 13/32 | 18 | 18 13/16 | 18 | 18 13/16 | 21 5/8 | 23 1/2 | 23 3/8 | 24 1/8 | 25 1/8 | 27 3/4 | - - - |
| 20 | 15/32 | 20 | 20 15/16 | 20 | 20 15/16 | 23 7/8 | 25 3/4 | 25 1/2 | 26 7/8 | 27 1/2 | 29 3/4 | - - - |
| 24 | 15/32 | 24 | 24 15/16 | 24 | 24 15/16 | 28 1/4 | 30 1/2 | 30 1/4 | 31 1/8 | 33 | 35 1/2 | - - - |

[1] Applies to both Figure 8 and Figure 9. Gasket diameters may be varied, provided the gasket contact width does not exceed that shown, subject to tolerances in Par. 4. See Par. 3(c).

[2] Metallic gaskets may have attached centering device. The OD of any centering ring may be 1/8" less than specified.

[3] Slip-on type flanges shown for illustration purposes only. Gaskets may be used with other type of flange. See Paragraph 3(e).

# APPENDIX E

## TABLE IIIB
## GROUP IIIb GASKETS

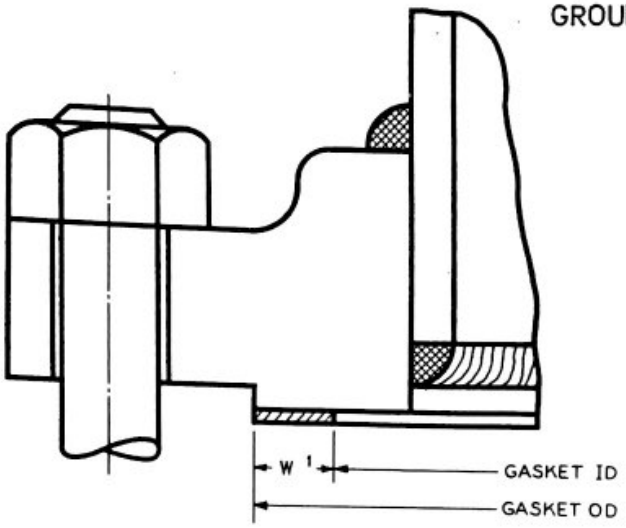



FIGURE 10[3]

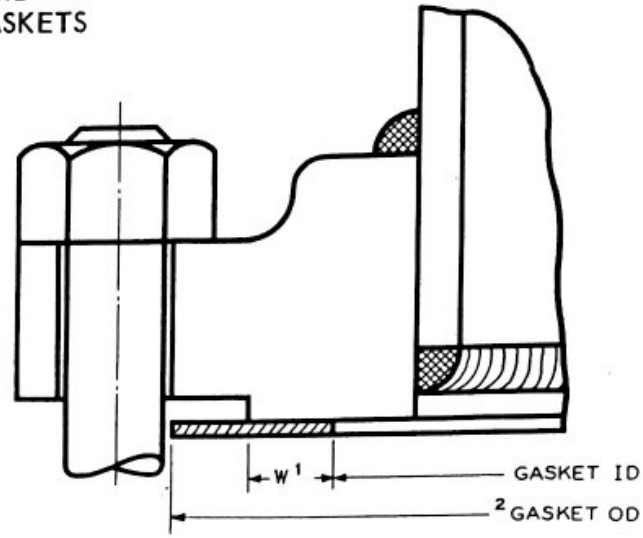



FIGURE 11[3]

| Nominal Size | W[1] Gasket Contact Width $\phi$ | FIGURE 10 | | FIGURE 11 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Inside Diameter | Outside Diameter | Inside Diameter | OUTSIDE DIAMETER[2] 150 lb | 300 lb | 400 lb | 600 lb | 900 lb | 1500 lb | 2500 lb |
| 1/2 | 3/16 | 1 | 1 3/8 | 1 | 1 7/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/2 | 2 1/2 | 2 3/4 |
| 3/4 | 3/16 | 1 5/16 | 1 11/16 | 1 5/16 | 2 1/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 3/4 | 2 3/4 | 3 |
| 1 | 3/16 | 1 5/8 | 2 | 1 5/8 | 2 5/8 | 2 7/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/8 | 3 3/8 |
| 1 1/4 | 3/16 | 2 1/8 | 2 1/2 | 2 1/8 | 3 | 3 1/4 | 3 1/4 | 3 1/4 | 3 1/2 | 3 1/2 | 4.1/8 |
| 1 1/2 | 3/16 | 2 1/2 | 2 7/8 | 2 1/2 | 3 3/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 7/8 | 3 7/8 | 4 5/8 |
| 2 | 3/16 | 3 1/4 | 3 5/8 | 3 1/4 | 4 1/8 | 4 3/8 | 4 3/8 | 4 3/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 2 1/2 | 3/16 | 3 3/4 | 4 1/8 | 3 3/4 | 4 7/8 | 5 1/8 | 5 1/8 | 5 1/8 | 6 1/2 | 6 1/2 | 6 5/8 |
| 3 | 3/16 | 4 5/8 | 5 | 4 5/8 | 5 3/8 | 5 7/8 | 5 7/8 | 5 7/8 | 6 5/8 | 6 7/8 | 7 3/4 |
| 3 1/2 | 3/16 | 5 1/8 | 5 1/2 | 5 1/8 | 6 3/8 | 6 1/2 | 6 3/8 | 6 3/8 | - - - | - - - | - - - |
| 4 | 7/32 | 5 3/4 | 6 3/16 | 5 3/4 | 6 7/8 | 7 1/8 | 7 | 7 5/8 | 8 1/8 | 8 1/4 | 9 1/4 |
| 5 | 7/32 | 6 7/8 | 7 5/16 | 6 7/8 | 7 3/4 | 8 1/2 | 8 3/8 | 9 1/2 | 9 3/4 | 10 | 11 |
| 6 | 7/32 | 8 1/16 | 8 1/2 | 8 1/16 | 8 3/4 | 9 7/8 | 9 3/4 | 10 1/2 | 11 3/8 | 11 1/8 | 12 1/2 |
| 8 | 9/32 | 10 1/16 | 10 5/8 | 10 1/16 | 11 | 12 1/8 | 12 | 12 5/8 | 14 1/8 | 13 7/8 | 15 1/4 |
| 10 | 11/32 | 12 1/16 | 12 3/4 | 12 1/16 | 13 3/8 | 14 1/4 | 14 1/8 | 15 3/4 | 17 1/8 | 17 1/8 | 18 3/4 |
| 12 | 11/32 | 14 5/16 | 15 | 14 5/16 | 16 1/8 | 16 5/8 | 16 1/2 | 18 | 19 5/8 | 20 1/2 | 21 5/8 |
| 14 | 11/32 | 15 9/16 | 16 1/4 | 15 9/16 | 17 3/4 | 19 1/8 | 19 | 19 3/8 | 20 1/2 | 22 3/4 | - - - |
| 16 | 13/32 | 17 11/16 | 18 1/2 | 17 11/16 | 20 1/4 | 21 1/4 | 21 1/8 | 22 1/4 | 22 5/8 | 25 1/4 | - - - |
| 18 | 13/32 | 20 3/16 | 21 | 20 3/16 | 21 5/8 | 23 1/2 | 23 3/8 | 24 1/8 | 25 1/8 | 27 3/4 | - - - |
| 20 | 15/32 | 22 1/16 | 23 | 22 1/16 | 23 7/8 | 25 3/4 | 25 1/2 | 26 7/8 | 27 1/2 | 29 3/4 | - - - |
| 24 | 15/32 | 26 5/16 | 27 1/4 | 26 5/16 | 28 1/4 | 30 1/2 | 30 1/4 | 31 1/8 | 33 | 35 1/2 | - - - |

1 Applies to both Figure 10 and Figure 11. Gasket diameters may be varied, provided the gasket contact width does not exceed that shown, subject to tolerances in Par. 4. See Par. 3(c).

2 Gasket OD may be extended, or an attached centering device may be used. The OD of extended metallic gasket or of any centering ring may be 1/8" less than specified.

3 Slip-on type flanges shown for illustration purposes only. Gaskets may be used with other types of flanges. See Par. 3(e).

# APPENDIX F

## METHOD FOR CALCULATING BOLT LENGTHS

The following formulas were used in establishing Dimension L in Tables 13, 16, 19, 22, 25, 28 and 31 and are included in this Appendix for the convenience of Industry use in determining lengths not given in the tables.

$L_{CSB}$ (See Note 1) = A + n
$L_{CMB}$ (See Note 1) = B + n

Where: $L_{CSB}$ = Calculated stud-bolt length (effective thread length, excluding end points).

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

$A = 2(T + .50t + d) + G + F - C$, (i.e. stud-bolt length exclusive of negative length tolerance "n").

$B = 2(T + .50t) + d + G + F + p - C$, (i.e. machine bolt length exclusive of negative length tolerance "n".

$T$ = minimum flange thickness (See Tables 14, 17, 20, 23, 26, 29, & 32, USAS B16.5 and Note 2 below).

$t$ = plus tolerance for flange thickness (See Par. 7.3, USAS B16.5).

$d$ = heavy nut thickness (equals nominal bolt diameter, see USAS B18.2).

$G$ = 1/8" gasket thickness for raised face, M&F and T&G flanges; also approximate distance between ring-joint flanges listed in Table 10, USAS B16.5.

$F$ = Total height of facings or depth of ring-joint groove for both flanges, see Table A.

$C$ = Zero; except where the small female face is on the end of pipe, C = 3/16".

$p$ = Allowance for height of point of machine bolt (= 1 1/2 times thread pitch).

$n$ = Negative tolerance on bolt length, see Table B.

$L_{SSB}$ = Specified stud-bolt length (effective thread length, excluding end points) which is $L_{CSB}$ rounded-off to the nearest commercially available length; see Note 3 and Fig.1.

$L_{SMB}$ = Specified machine bolt length (from underhead to end, including end point) which is $L_{CMB}$ rounded-off to the nearest commercially available length; see Note 3 and Fig. 2.

**Notes:**

(1) For lapped joints calculate stud-bolt and machine bolt lengths as follows:

For ring-joint groove facing:
$L_{CSB}$ = [A + (pipe thickness for each lap)] + n
$L_{CMB}$ = [B + (pipe thickness for each lap)] + n

For other than ring-joint facing:
$L_{CSB}$ = [A − F + (Table C Thicknesses)] + n
$L_{CMB}$ = [B − F + (Table C Thicknesses )] + n

(2) Raised face (1/16") is included in minimum flange thickness for 150 & 300 pound flanges.

(3) Rounding-off Procedure (stud-bolts and machine bolts, all diameters): If $L_{CSB}$ or $L_{CMB}$ is 0.10" (or more) greater than any 1/4" increment, round-off upward to next 1/4" increment; if less than 0.10", round-off downward to the next 1/4" increment.

# APPENDIX F

## Table A, "F" Values

| Flanged Joint Primary Rating | Total Height of Facings or Depth of Ring-Joint Groove for Both Flanges F | | | |
|---|---|---|---|---|
| | Type of Flange Facing[1] | | | |
| | 1/16" Raised | 1/4" Raised | M&F or T&G | Ring-Joint |
| 150 & 300–lb | Zero[2] | 1/2" | 1/4" | 2 x groove depth |
| 400 to 2500–lb | 1/8" | 1/2" | 1/4" | 2 x groove depth |

[1] See Fig. 8 and Tables 9 & 10, USAS B16.5.
[2] See Note 2 on Page 77.

## Table B, "n" Values

| | Length | Negative Tolerance on Bolt Lengths "n" |
|---|---|---|
| Stud-Bolt | A<br>or<br>[A + (pipe thickness for each lap)]<br>or<br>[A – F + (Table C Thicknesses)] | 1/16", for lengths up to 12" incl.,<br>1/8", for lengths over 12" to 18" incl.,<br>1/4", for lengths over 18". |
| Machine Bolt | B<br>or<br>[B + (pipe thickness for each lap)]<br>or<br>[B – F + (Table C Thicknesses)] | For "n" values,<br>Use negative length tolerances<br>per USAS B18.2.1. |

## Table C, Thicknesses for Lapped Joints

| Lap Combination | 150 & 300–lb Flanges | 400 to 2500–lb Flanges, Incl. |
|---|---|---|
| For Lapped to 1/16" Raised Face | One Lap | . . . . . |
| For Lapped to Lapped | Both Laps | Both Laps |
| For Lapped to 1/4" Male Face on Flange | . . . . . | One Lap and 1/4" |
| For Lapped to Female Face on Flange | . . . . . | One Lap not less than 1/4" |
| For Male in Lap to Female in Lap | . . . . . | 2 x pipe wall with Lap for Male not less than 1/4" |

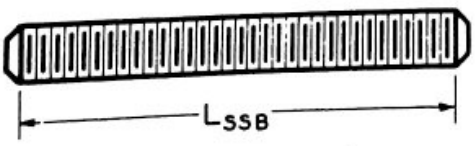



FIGURE 1

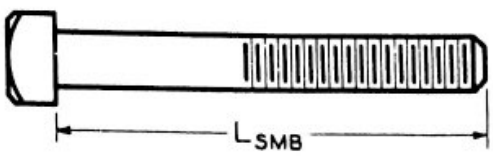



FIGURE 2

# APPENDIX G

List of standards and specifications approved for use under this Standard showing year dates.

ASTM Specifications

A–105–65
A–106–65
A–181–65
A–182–65
A–193–65
A–194–65
A–216–65
A–217–65
A–307–65
A–320–65
A–335–65
A–350–65
A–351–65
A–352–65
A–354–65
A–522–65

MSS Standard Practices

SP–6–1963
SP–9–1964
SP–25–1964
SP–45–1953

USA Standards

B1.1–1960
B2.1–1960
B16.10–1957
B16.20–1963
B16.25–1964
B18.2.1–1965
B18.2.2–1965
B36.10–1959

API Standards

600, Fifth Edition, December, 1961

ASME Code

Unfired Pressure Vessel Code, Section VIII, 1966

Specifications and standards of the following organizations appear in the above list:

API American Petroleum Institute
1271 Avenue of the Americas, New York, N.Y. 11120

ASTM The American Society for Testing and Materials
1916 Race Street, Philadelphia, Pennsylvania 19103

MSS Manufacturers Standardization Society of the Valve and Fittings Industry
420 Lexington Avenue, New York, N.Y. 10017

USASI United States of America Standards Institute
10 East 40th Street, New York, N. Y. 10016

ASME The American Society of Mechanical Engineers
345 East 47th Street, New York, N. Y. 10017

# INDEX

# USA Standards for Piping, Pipe Flanges and Fittings

| TITLE OF STANDARD | |
|---|---|
| Cast-Iron Soil Pipe and Fittings | A40.1–1935 |
| Pipe Threads (Except Dryseal) | B2.1–1960 |
| Dryseal Pipe Threads | B2.2–1960 |
| Cast-Iron Pipe Flanges & Flanged Fittings (25, 125, 250, 800 lb) | B16.1–1967 |
| Malleable-Iron Screwed Fittings, 150 and 300 lb | B16.3–1963 |
| Cast-Iron Screwed Fittings, 125 and 250 lb | B16.4–1963 |
| Steel Pipe Flanges and Flanged Fittings (150, 300, 400, 600, 900, 1500, and 2500 lb) with Appendices | B16.5–1968 |
| Steel Buttwelding Fittings | B16.9–1964 |
| Face-to-Face and End-to-End Dimensions of Ferrous Valves | B16.10–1957 |
| Forged-Steel Fittings, Socket Welding and Threaded | B16.11–1966 |
| Cast-Iron Threaded Drainage Fittings | B16.12–1965 |
| Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads | B16.14–1965 |
| Cast-Bronze Screwed Fittings, 125 and 250 lb | B16.15–1964 |
| Cast-Bronze Solder-Joint Pressure Fittings | B16.18–1963 with 1967 Addendum |
| Ring-Joint Gaskets and Grooves for Steel Pipe Flanges | B16.20–1963 |
| Nonmetallic Gaskets for Pipe Flanges | B16.21–1962 |
| Wrought-Copper and Wrought-Bronze Solder-Joint Pressure Fittings | B16.22–1963 |
| Cast-Bronze Solder-Joint Drainage Fittings | B16.23–1960 |
| Bronze Flanges & Flanged Fittings 150 and 300 lb | B16.24–1962 |
| Buttwelding Ends | B16.25–1964 |
| Cast-Bronze Fittings for Flared Copper Tubes | B16.26–1967 |
| Plastic Insert Fittings for Flexible Polyethylene Pipe | B16.27–1962 |
| Wrought-Steel Buttwelding Short Radius Elbows and Returns | B16.28–1964 |
| Wrought-Copper and Wrought-Copper Alloy Solder-Joint Drainage Fittings | B16.29–1966 |
| Code for Pressure Piping | B31.1–1955 |
| Power Piping | B31.1.0–1967 |
| Petroleum Refinery Piping | B31.3–1966 |
| Liquid Petroleum Transportation Piping | B31.4–1966 with 1966 Addendum |
| Refrigeration Piping | B31.5–1966 with 1966 Addendum |
| Gas Transmission and Distribution Piping Systems | B31.8–1968 |
| Wrought-Steel and Wrought-Iron Pipe | B36.10–1959 |
| Stainless Steel Pipe | B36.19–1965 |

Binders for holding standards are available.

A complete list of USA Standards published by The American Society of Mechanical Engineers obtainable upon request.