ASME B16.42-2021

(Revision of ASME B16.42-2016)

Ductile Iron Pipe Flanges and Flanged Fittings

Classes 150 and 300

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
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FOREWORD

In 1921, the American Engineering Standards Committee, later the American Standards Association (ASA), now the American National Standards Institute (ANSI), authorized the organization of a Sectional Committee on the Standardization of Pipe Flanges and Flanged Fittings, with the following organizations as joint sponsors: Heating, Piping, and Air Conditioning Contractors National Association [later the Mechanical Contractors Association of America (MCAA)], Manufacturers Standardization Society of the Valves and Fittings Industry (MSS), and The American Society of Mechanical Engineers (ASME). Cast iron flanges and flanged fittings are within the scope of Subcommittee No. 1 (now Subcommittee A), with standards approved by ASA as early as 1928.

In 1957, piping components of ductile iron (also called nodular iron and, in Europe, spheroidal graphite iron) first appeared on the market. Controversy immediately developed over proper pressure–temperature ratings, and this was further aggravated by the use of casting patterns for both gray iron and carbon steel for producing the components.

Conflicting philosophies, which emerged from that controversy, thwarted efforts by MSS to develop standard practices in the early 1960s; the conflicts persisted during a study of ratings, starting in 1966 by American National Standards Committee B16 (as the Sectional Committee was called after reorganization of ASA as ANSI). The conflict continued to delay acceptance and approval of this Standard, which ultimately originated with a draft developed by MSS (taking advantage of earlier efforts) and submitted to Subcommittee A in 1977. Combining that draft with the rating basis developed in the B16 Committee, the first edition of this Standard was found acceptable and was approved by the Standards Committee, cosecretariat organizations, and ANSI, and was published with the designation ANSI B16.42-1979.

In 1982, American National Standards Committee B16 was reorganized as an ASME Committee operating under procedures accredited by ANSI. The 1987 edition of the Standard updated the referenced standards and specifications, and established U.S. Customary units as the standard. Following approval by the Standards Committee and ASME, ANSI granted its approval of the edition as an American National Standard on July 13, 1987, with the new designation ASME/ANSI B16.42-1987.

In the 1998 edition of ASME B16.42, reference standards were updated, a quality system program annex was added, and several editorial revisions were made. Following approval by ASME B16 Subcommittee B and the B16 Standards Committee, ANSI approved the American National Standard on November 20, 1998.

Metric units were provided as an independent but parallel alternative standard to the U.S. Customary units in the 2011 edition. Following approval by the Standards Committee and the ASME Board on PTCS, the revision to the 1998 edition of this Standard was approved as an American National Standard by ANSI on August 9, 2011, with the new designation ASME B16.42-2011.

In the 2016 edition, revisions were made to table and appendix references. Following approval by the ASME B16 Standards Committee, ANSI approved ASME B16.42-2016 on November 7, 2016.

In ASME B16.42-2021, the U.S. Customary tables in former Mandatory Appendix I have been merged with the SI tables in the main text. The tables and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendix has been redesignated. Cross-references have been updated accordingly. Also in this edition, Table 3.1-1 (formerly Table 1), Table 3.1-1C (formerly Table I-1), Table 7.1.1-1 (formerly Tables 3 and I-3), Table 7.1.1-2 (formerly Tables 4 and I-4), para. 3.1, and sections 5 and 6 have been revised, and the references in Mandatory Appendix I (formerly Mandatory Appendix II) have been updated. Following approval by the ASME B16 Standards Committee, ASME B16.42-2021 was approved by ANSI on December 10, 2021.

ASME B16 COMMITTEE
Standardization of Valves, Flanges, Fittings, and Gaskets

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

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

Secretary, B16 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

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

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

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

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

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

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may e-mail the request to the Secretary of the B16 Standards Committee at SecretaryB16@asme.org, or mail it to the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

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

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

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

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

Attending Committee Meetings. The B16 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B16 Standards Committee.

ASME B16.42-2021
SUMMARY OF CHANGES

Following approval by the ASME B16 Standards Committee and ASME, and after public review, ASME B16.42-2021 was approved by the American National Standards Institute on December 10, 2021.

In ASME B16.42-2021, the U.S. Customary tables in former Mandatory Appendix I have been merged with the SI tables in the main text. The tables and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendix has been redesignated. Cross-references have been updated accordingly. In addition, this edition includes the following changes identified by a margin note, **(21)**. The Record Numbers listed below are explained in more detail in the "List of Changes in Record Number Order" following this Summary of Changes.

Page	*Location*	*Change (Record Number)*
2	3.1	Revised *(19-922)*
3	5	Subparagraph (b) revised *(19-922)*
3	6.1	Revised *(19-922)*
6	Table 3.1-1	Seventh row and Note (1) added *(19-922)*
6	Table 3.1-1C	Note (1) added *(19-922)*
8	Table 7.1.1-1	(1) 45-deg Lateral, Reducer, Eccentric Reducer, and True Y illustrations revised *(19-920)* (2) Face-to-Face Lateral column added, and subsequent three column heads revised *(19-920)*
10	Table 7.1.1-2	(1) 45-deg Lateral, Reducer, Eccentric Reducer, and True Y illustrations revised *(19-920)* (2) Face-to-Face Lateral column added, and subsequent three column heads revised *(19-920)*
22	Mandatory Appendix I	Former Mandatory Appendix II updated *(21-621)*

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
19-920	Added face-to-face lateral dimensions to Table 7.1.1-1 (former Tables 3 and I-3) and Table 7.1.1-2 (former Tables 4 and I-4).
19-922	Added ductile iron, ASTM A536 Grade 65-45-12 material.
21-621	Updated references in Mandatory Appendix I (former Mandatory Appendix II).

DUCTILE IRON PIPE FLANGES AND FLANGED FITTINGS
Classes 150 and 300

1 SCOPE

This Standard covers minimum requirements for Classes 150 and 300 cast ductile iron pipe flanges and flanged fittings. The requirements covered are as follows:

(a) pressure–temperature ratings
(b) sizes and method of designating openings of reducing fittings
(c) marking
(d) material
(e) dimensions and tolerances
(f) bolts, nuts, and gaskets
(g) tests

2 GENERAL

2.1 References

Standards and specifications adopted by reference in this Standard are shown in Mandatory Appendix I, which is part of this Standard. It is not considered practical to identify in the text the specific edition of each referenced standard and specification. Instead, the specific editions are identified in Mandatory Appendix I.

2.2 Quality Systems

Requirements relating to the product manufacturers' quality system programs are described in Nonmandatory Appendix A.

2.3 Relevant Units

This Standard states values in both SI (metric) and U.S. Customary units. As an exception, diameters of bolts and flange bolt holes are only expressed in inch units. These systems of units are to be regarded separately as standard. In this Standard, the U.S. Customary units are shown in parentheses or in separate tables following the SI tables. The values stated in each system are not exact equivalents; therefore, it is required that each system of units be used independently of the other. Except for the diameters of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard.

2.4 Service

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

2.5 Convention

For determining conformance with this Standard, the convention for fixing significant digits where limits (maximum and minimum values) are specified shall be as defined in ASTM E29. This requires that an observed or calculated value be rounded off to the nearest unit in the last right-hand digit used for expressing the limit. Decimal values and tolerances do not imply a particular method of measurement.

2.6 Denotation

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

(a) Class 150
(b) Class 300

2.6.2 Size. NPS, followed by a dimensionless number, is the designation for nominal flange or flanged fitting size. NPS is related to the referenced nominal diameter, DN, used in metric units. The relationship is typically as follows:

NPS	DN
1	25
1¼	32
1½	40
2	50
2½	65
3	80
3½	90
4	100

For NPS ≥ 4, the related DN = 25 × NPS.

3 PRESSURE–TEMPERATURE RATINGS

(21) 3.1 General

Cast ductile iron pipe flanges and flanged fittings covered by this Standard shall be designated Class 150 or Class 300.

Except as provided in para. 3.5, ratings are maximum allowable working pressures, expressed as gage pressure, at the service temperature from −29°C (−20°F) minimum to 343°C (650°F) maximum for ASTM A395 or 260°C (500°F) maximum for ASTM A536 Grade 65-45-12 (see Tables 3.1-1 and 3.1-1C). These minimum and maximum temperatures may be further limited by referencing regulations, codes, or specifications. For intermediate temperatures, linear interpolation is permitted. The method used for establishing pressure–temperature ratings is shown in Nonmandatory Appendix B.

3.2 Ratings of Flanged Joints

Ratings in this Standard apply to flanged joints that conform to the limitations on bolting in para. 6.2 and on gaskets in para. 7.8, and which are made up in accordance with good practice for alignment and assembly (see also para. 3.4).

Use of the ratings for flanged joints not conforming to these limitations is the sole responsibility of the user. A flanged joint is composed of separate and independent, although interrelated, components: the flanges, the gasket, and the bolting, which are assembled by another influence, the assembler. Proper controls must be exercised in the selection and application for all these elements to attain a joint that has acceptable leak tightness. Special techniques, such as controlled bolt tightening, are described in ASME PCC-1.

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

3.3 Rating Temperature

Temperatures shown for corresponding pressure rating shall be the material temperature of the pressure-retaining structure. It may be assumed that the material temperature is the same as the fluid temperature. 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 requirements of any applicable code or regulation.

3.4 Temperature Considerations

Application of the ratings in this Standard to flanged joints at both high and low temperatures shall take into consideration the risk of leakage due to forces and moments developed in the connected piping or equipment. The provisions in paras. 3.4.1 and 3.4.2 are intended to minimize these risks.

3.4.1 Flange Attachment. Threaded flanges are not recommended for service above 260°C (500°F) if severe thermal gradients or thermal cycling is involved.

3.4.2 High-Temperature Service. When used above 205°C (400°F), Class 150 flanged joints may develop leakage unless care is taken to avoid imposing severe external loads and/or severe thermal gradients.

3.5 Variances From Ratings

Except as provided herein, ratings are the maximum allowable working pressure for the corresponding temperature.

3.5.1 Safety or Relief Valve Operation. Under conditions of safety valve, relief valve, or rupture disk operation, the pressure on a flange or flanged fitting may exceed the rated pressure at the pressure-relieving temperature by no more than 10%. Such conditions are necessarily of short duration. Overpressure greater than the aforementioned under pressure-relieving conditions is the responsibility of the user, subject to the requirements of the applicable code or regulation.

3.5.2 Other Variances. Operating variations (transients) that subject a flange or flanged fitting to pressure in excess of the rated pressure at the corresponding temperature are the responsibility of the user, subject to the requirements of the applicable code or regulation.

3.5.3 System Hydrostatic Test. Flanged joints and flanged fittings may be subjected to system hydrostatic tests at a pressure not to exceed the hydrostatic shell test pressure specified in para. 9.3. Testing at any higher pressure is the responsibility of the user.

4 SIZE

4.1 Nominal Size

As applied in this Standard, the use of the phrase “nominal pipe size” or the designation NPS followed by a dimensionless number is for identifying the end connection of piping, flanges, or flanged fittings. The number is not necessarily the same as the inside diameter of the flange or flanged fitting. The diameter of a bolt is its nominal size. Use of nominal indicates that the stated size or dimension is only for designation, not measurement.

4.2 Reducing Fitting Sizes

Reducing fittings shall be designated by the size of the openings in their proper sequence as indicated in the sketches (see Figure 4.2-1).

4.3 Reducing Flange Sizes

Reducing flanges shall be designated by the two nominal pipe sizes. See examples in Table 7.5.2-1, Note (4).

(21) 5 MARKING

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

(a) Name. The manufacturer's name or trademark shall be applied.

(b) Material. The word "DUCTILE," or "DI" where space does not permit "DUCTILE," and the ASTM designation of either "A395" or "A536" shall be applied.

(c) Rating Class. Numerals shall be applied giving the pressure rating class for which the product is designed.

(d) Designation. The designation "B16" shall be applied, preferably located adjacent to the Class designation, to indicate conformance to this Standard.

(e) Temperature. No temperature markings are required on flanges and flanged fittings, but if marked, the temperature shall be shown with its corresponding tabulated pressure rating.

(f) Size. The nominal pipe size shall be applied, but may be omitted from reducing flanges and reducing flanged fittings.

6 MATERIALS

(21) 6.1 Castings

Ductile iron castings covered by this Standard shall conform to ASTM A395 or ASTM A536 Grade 65-45-12. The castings shall not be repaired by plugging, welding, brazing, or impregnation.

6.2 Bolting

Bolting listed in paras. 6.2.1 and 6.2.2 is recommended to be used in flanged joints covered by this Standard. Bolting of other material may be used if permitted by the applicable code or governmental regulation.

6.2.1 High-Strength Bolting. Bolting materials having allowable stresses not less than those for ASTM A193/A193M Grade B7 may be used with any flanged joint at all listed temperatures. The strength of the nut shall be not less than that specified for ASTM A194/A194M Grade 2H.

6.2.2 Low-Strength Bolting. Bolting materials with yield strength equivalent to ASTM A307 Grade B are considered low strength, and may be used for flanged joints at temperatures not greater than 205°C (400°F) and only with gaskets described in para. 7.8.

6.2.3 Bolting to Cast Iron Flanges. When Class 150 ductile iron flanges are bolted to Class 125 cast iron flanges, or Class 300 ductile iron flanges are bolted to Class 250 cast iron flanges, it is recommended that low-strength boltings be used within the limitations in para. 6.2.2. If high-strength bolting is used, it is recommended that the mating flanges be flat faced and that full-faced gaskets (ASME B16.5, Table B-1, Gasket Group Number Ia) extending to the O.D. of the flange be used.

6.3 Gaskets

Materials listed in ASME B16.5, Table B-1 shall be used. The user is responsible for selection of gasket materials that will withstand the expected bolt load without injurious crushing and that are suitable for the service conditions.

For low-strength bolting described in para. 6.2.2, only gaskets listed in Group Ia (ASME B16.5, Table B-1) shall be used.

7 DIMENSIONS

7.1 Center to Contact Surface and Center to End

7.1.1 Standard Fittings. Center-to-contact-surface dimensions are shown in Tables 7.1.1-1 and 7.1.1-2.

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

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

7.1.4 Fittings With Bases. Dimensions of bases for base elbows and base tees are shown in Tables 7.1.4-1 and 7.1.4-2.

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

7.2 Facings

7.2.1 General. Class 150 fittings and companion flanges are regularly furnished flat or with a 1.5 mm (0.06 in.) raised face. Class 300 fittings and companion

flanges are furnished with a 1.5 mm (0.06 in.) raised face. The raised face is included in the minimum flange thickness dimensions, *Q,* as given in the tables.

7.2.2 Facings of Blind Flanges. Blind flanges need not be faced in the center if, when this center part is raised, its diameter is at least 25.4 mm (1 in.) smaller than the inside diameter of the corresponding pressure class fittings, 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.

7.2.3 Flange Facing Finish. Contact faces shall be finished in accordance with MSS SP-6.

7.3 Flange Bolt Holes

Bolt holes are in multiples of four so that fittings may face in any quadrant. Pairs of bolt holes shall straddle the centerlines as described in Tables 7.3-1 and 7.3-2.

7.4 Spot Facing

Spot facing is required on ductile iron flanges and flanges on fittings if the flange thickness at any point does not meet the required minimum thickness, *Q*, as given in Tables 7.1.1-1, 7.1.1-2, 7.4-1, and 7.4-2 by more than the following amounts:

NPS	Maximum Excess Thickness, mm (in.)
2–18	3 (0.12)
20–24	4.8 (0.19)

Flanges and flanged fittings shall have bearing surfaces for bolting that are parallel to the flange face within 1 deg. Any back facing or spot facing shall not reduce the flange thickness below the minimum. Spot facing or back facing shall be in accordance with MSS SP-9.

7.5 Reducing Flanges

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

7.5.2 Threaded Flanges. The hub dimensions shall be at least as large as those of the standard flange of the size from which the reduction is being made. The hub may be larger or may be omitted, as detailed in Table 7.5.2-1.

7.6 Threads for Threaded Flanges

Threaded flanges shall have American National Standard pipe threads, general purpose (inch), conforming to ASME B1.20.1. The thread shall be concentric with the axis of the flange, and variations in alignment shall not exceed 5 mm/m (0.06 in./ft) (0.5%).

7.6.1 Class 150 Flanges. Class 150 flanges are made without a counterbore. The threads shall be chamfered approximately to the major diameter of the thread at the back of the flange at an angle of approximately 45 deg with the axis of the thread, 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.

7.6.2 Class 300 Flanges. Class 300 flanges may be made with a counterbore. 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 counterbore and chamfer shall be concentric with the thread.

7.6.3 Length of Threads. The minimum length of effective thread in reducing flanges shall be at least equal to dimension "Length of Thread" of the corresponding pressure class threaded flange as shown in the tables, but does not necessarily extend to the face of the flange. See Table 7.5.2-1 for reducing threaded flanges.

7.6.4 Threading Tolerances. The gaging notch of the working gage shall come flush with the bottom of the chamfer in all threaded flanges, and shall be considered as 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.

7.7 Stud Bolts, Bolts, and Nuts

7.7.1 Alloy Bolting. Alloy steel stud bolts, threaded at both ends or full length, or heavy hex bolts may be used. Heavy hex nuts shall be used with all alloy steel bolting.

7.7.2 Carbon Steel Bolting

(a) Bolts smaller than $^{3}/_{4}$ diameter shall have square heads or heavy hex heads. Nuts shall be heavy hex.

(b) Bolts $^{3}/_{4}$ diameter and larger shall have square heads or hex heads. Nuts shall be hex or heavy hex.

7.7.3 Bolt Dimensions. Dimensions of all bolts shall conform to ASME B18.2.1.

7.7.4 Nut Dimensions. Dimensions of all nuts shall conform to ASME B18.2.2.

7.7.5 Threading of Bolts

(a) Carbon steel bolting shall be threaded in accordance with ASME B1.1, coarse thread series, Class 2A for bolts and stud bolts, and Class 2B for nuts.

(b) Alloy steel bolting shall be threaded in accordance with ASME 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 Class 2A dimensions; nuts shall have Class 2B dimensions.

7.8 Gaskets

Gaskets for Class 150 flat face flanges shall conform to the dimensions shown in ASME B16.21. For flanges with raised face, gaskets shall conform to ASME B16.5, Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia.

7.9 Drains

7.9.1 Pipe Thread Tapping. Holes may be tapped in the wall of a fitting if the metal is thick enough to allow the effective thread length specified in MSS SP-45. Where thread length is insufficient or the tapped hole needs reinforcement, a boss shall be added.

7.9.2 Bosses. Where bosses are required, the diameters shall be as specified in MSS SP-45.

7.9.3 Designating Locations. The means of designating the locations of tapped holes or sockets for drains in fittings is shown in Figure 7.9.3-1.

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

8 TOLERANCES

8.1 Wall Thickness

The wall thickness values for fittings listed in Tables 7.1.1-1 and 7.1.1-2 are minimums. Equipment shall be designed to produce greater nominal wall thickness so that manufacturing variances will not fall below these minimum values. See Nonmandatory Appendix B, para. B-1.2 for the basis used to establish these values.

8.2 Center to Contact Surface and Contact Surface to Contact Surface

8.2.1 Center to Contact Surface

(a) sizes NPS 10 and smaller: ±0.8 mm (±0.03 in.)
(b) sizes NPS 12 and larger: ±1.5 mm (±0.06 in.)

8.2.2 Contact Surface to Contact Surface

(a) sizes NPS 10 and smaller: ±1.5 mm (±0.06 in.)
(b) sizes NPS 12 and larger: ±3 mm (±0.12 in.)

8.3 Facings

Outside diameter, 1.5 mm (0.06 in.) raised face: ±0.8 mm (±0.03 in.)

8.4 Flange Thickness

(a) sizes NPS 18 and smaller: +3 mm, −0 (+0.12 in., −0)
(b) sizes NPS 20 and larger: +4.8 mm, −0 (+0.19 in., −0)

8.5 Bore of Flanges

8.5.1 Lapped Flanges

(a) sizes NPS 10 and smaller: +0.8 mm, −0 (+0.03 in., −0)
(b) sizes NPS 12 and larger: +1.5 mm, −0 (+0.06 in., −0)

8.5.2 Counterbore of Threaded Flanges

(a) sizes NPS 10 and smaller: +0.8 mm, −0 (+0.03 in., −0)
(b) sizes NPS 12 and larger: +1.5 mm, −0 (+0.06 in., −0)

8.6 Drilling and Facing

(a) bolt circle diameter: ±1.5 mm (±0.06 in.)
(b) center to center of adjacent bolt holes: ±0.8 mm (±0.03 in.)
(c) eccentricity between bolt circle diameter and machined facing diameters:
(1) sizes NPS 2½ and smaller: ±0.8 mm (±0.03 in.)
(2) sizes NPS 3 and larger: ±1.5 mm (±0.06 in.)

9 TESTING

9.1 General

Flanged fittings shall be hydrostatically tested in accordance with para. 9.3.

9.2 Flange Testing

Flanges are not required to be hydrostatically tested. Flanges attached to (or integral with) piping, pressure vessels, or other equipment may be subject to system hydrostatic test (see para. 3.5.3). In such cases, attention should be given to gasket selection because of possible excessive deformation of the flange.

9.3 Fitting Shell Tests

The hydrostatic shell test for flanged fittings shall be not less than 1.5 times the 38°C (100°F) rating rounded off to the next higher 1.7 bar (25 psi) increment. The test pressure shall be 27.6 bar (400 psi) for Class 150 and 67.2 bar (975 psi) for Class 300.

(a) The test shall be made with water or with other suitable fluid provided its viscosity is no greater than that of water, at a test fluid temperature not above 52°C (125°F).

(b) The test duration shall be a minimum of 15 s for fittings NPS 2 and smaller, 60 s for fittings NPS 2½ through 8, and 3 min for fittings NPS 10 and larger.

(c) No visible leakage is permitted through the pressure boundary wall.

(21)

Table 3.1-1
Pressure–Temperature Ratings

	Working Pressure, bar	
Temperature, °C	**Class 150**	**Class 300**
−29 to 38	17.2	44
50	17.0	43
100	16.0	41
150	14.8	39
200	13.9	36
250	12.1	35
260 [Note (1)]	12.1	35
300	10.2	33
343	8.6	31

NOTE: (1) The maximum temperature for ASTM A536 Grade 65-45-12 is 260°C.

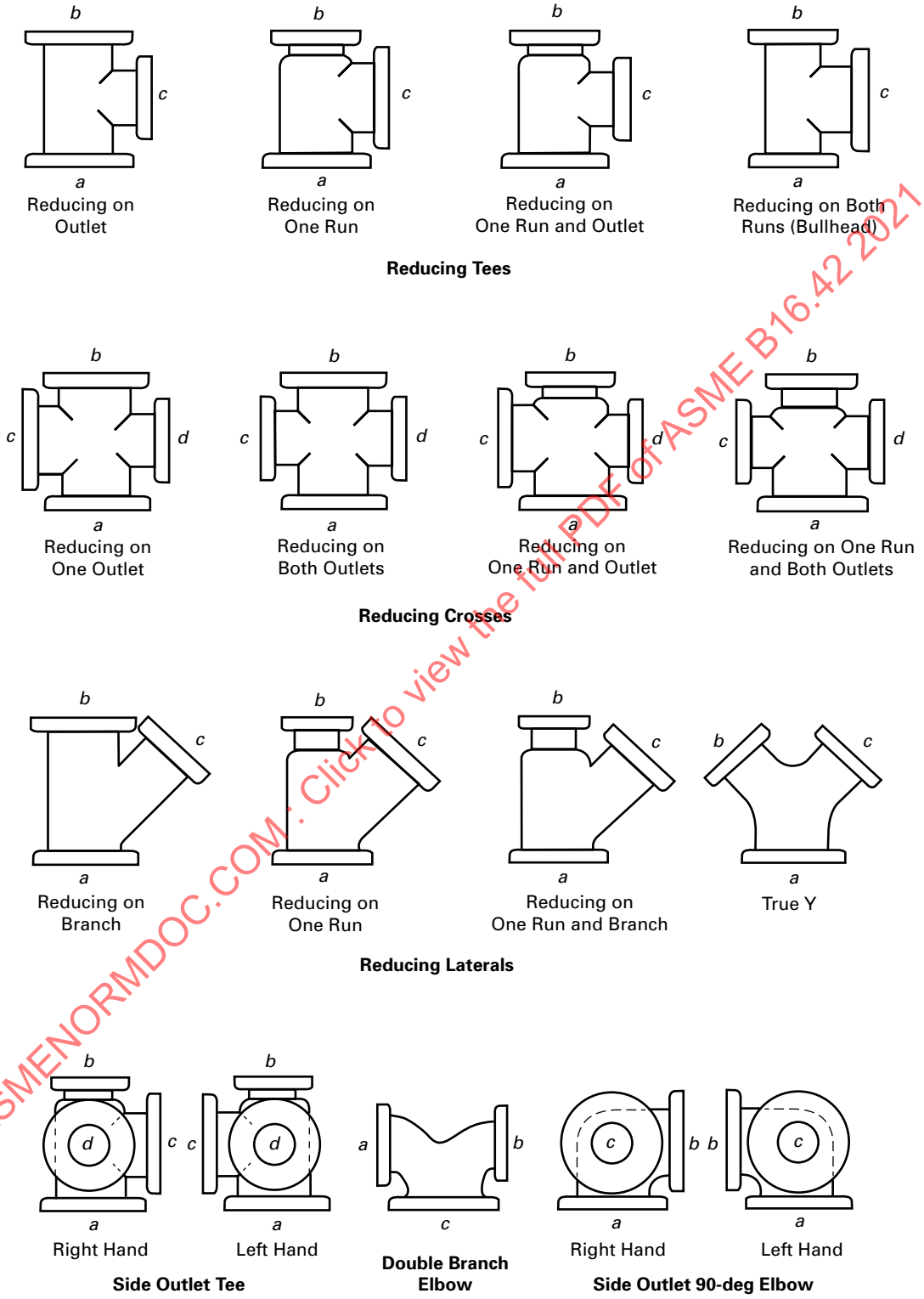
(21)

Table 3.1-1C
Pressure–Temperature Ratings

	Working Pressure, psi	
Temperature, °F	**Class 150**	**Class 300**
−20 to 100	250	640
200	235	600
300	215	565
400	200	525
500 [Note (1)]	170	495
600	140	465
650	125	450

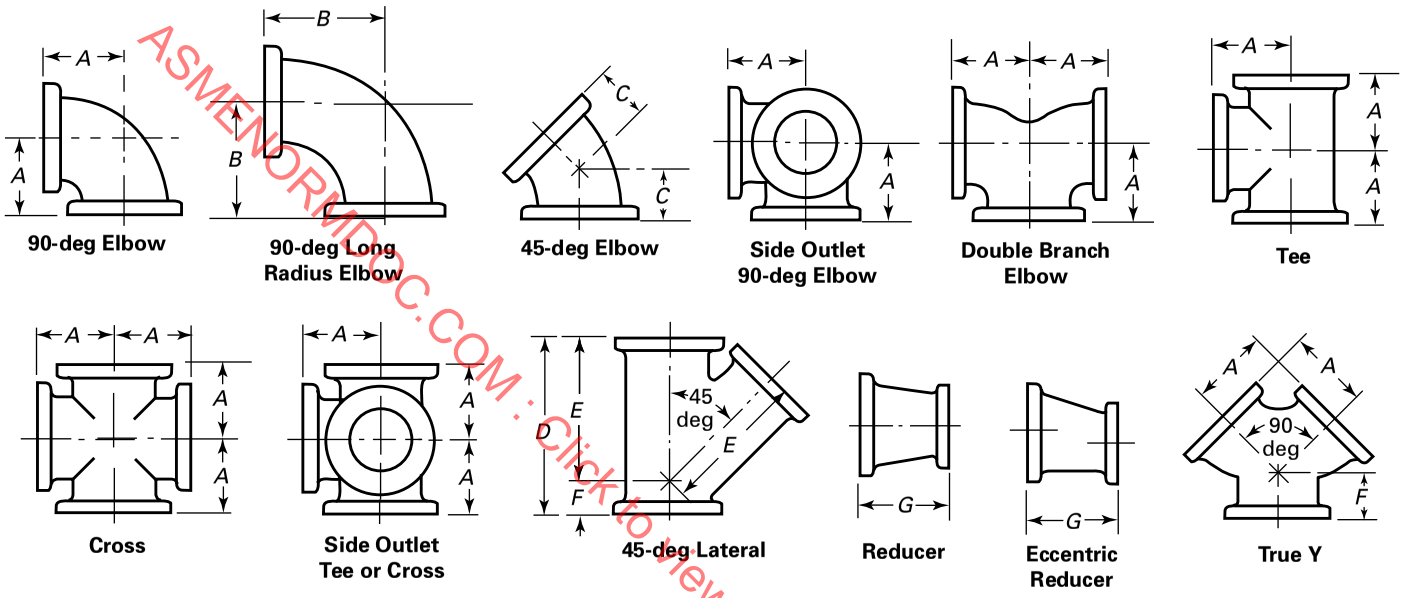
NOTE: (1) The maximum temperature for ASTM A536 Grade 65-45-12 is 500°F.

Figure 4.2-1
Method of Designating Outlets of Reducing Fittings



(21)

Table 7.1.1-1
Dimensions of Class 150 Elbows, Double Branch Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers



NPS	Inside Diameter of Fittings	Center-to-Face 90-deg Elbows, Tees, Crosses, True Y, and Double Branch Elbow, *A*	Center-to-Face 90-deg Long Radius Elbow, *B*	Center-to-Face 45-deg Elbow, *C*	Face-to- Face Lateral, *D*	Center-to-Face Lateral, *E*	Short Center-to-Face True Y and Lateral, *F*	Face-to-Face Reducer, *G*	Diameter of Flange	Minimum Thickness of Flange, *Q*	Minimum Body Wall Thickness
1	25 (1.00)	89 (3.50)	127 (5.00)	45 (1.75)	191 (7.50)	146 (5.75)	45 (1.75)	114 (4.50)	106 (4.25)	11.1 (0.44)	4.0 (0.16)
1¼	32 (1.25)	95 (3.75)	140 (5.50)	51 (2.00)	204 (8.00)	159 (6.25)	45 (1.75)	114 (4.50)	118 (4.62)	12.7 (0.50)	4.8 (0.19)
1½	38 (1.50)	102 (4.00)	152 (6.00)	57 (2.25)	229 (9.00)	178 (7.00)	51 (2.00)	114 (4.50)	127 (5.00)	14.3 (0.56)	4.8 (0.19)
2	51 (2.00)	114 (4.50)	165 (6.50)	64 (2.50)	267 (10.50)	203 (8.00)	64 (2.50)	127 (5.00)	152 (6.00)	15.9 (0.62)	5.6 (0.22)
2½	64 (2.50)	127 (5.00)	178 (7.00)	76 (3.00)	305 (12.00)	241 (9.50)	64 (2.50)	140 (5.50)	178 (7.00)	17.5 (0.69)	5.6 (0.22)
3	76 (3.00)	140 (5.50)	197 (7.75)	76 (3.00)	330 (13.00)	254 (10.00)	76 (3.00)	152 (6.00)	191 (7.50)	19.0 (0.75)	5.6 (0.22)
3½	89 (3.50)	152 (6.00)	216 (8.50)	89 (3.50)	368 (14.50)	292 (11.50)	76 (3.00)	165 (6.50)	216 (8.50)	20.6 (0.81)	6.3 (0.25)
4	102 (4.00)	165 (6.50)	229 (9.00)	102 (4.00)	381 (15.00)	305 (12.00)	76 (3.00)	178 (7.00)	229 (9.00)	23.8 (0.94)	6.3 (0.25)
5	127 (5.00)	191 (7.50)	260 (10.25)	114 (4.50)	432 (17.00)	343 (13.50)	89 (3.50)	203 (8.00)	254 (10.00)	23.8 (0.94)	7.1 (0.28)
6	152 (6.00)	203 (8.00)	292 (11.50)	127 (5.00)	457 (18.00)	368 (14.50)	89 (3.50)	229 (9.00)	279 (11.00)	25.4 (1.00)	7.1 (0.28)
8	203 (8.00)	229 (9.00)	356 (14.00)	140 (5.50)	559 (22.00)	445 (17.50)	114 (4.50)	279 (11.00)	343 (13.50)	28.6 (1.12)	7.9 (0.31)
10	254 (10.00)	279 (11.00)	419 (16.50)	165 (6.50)	648 (25.50)	521 (20.50)	127 (5.00)	305 (12.00)	406 (16.00)	30.2 (1.19)	8.6 (0.34)

Table 7.1.1-1
Dimensions of Class 150 Elbows, Double Branch Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers (Cont'd)

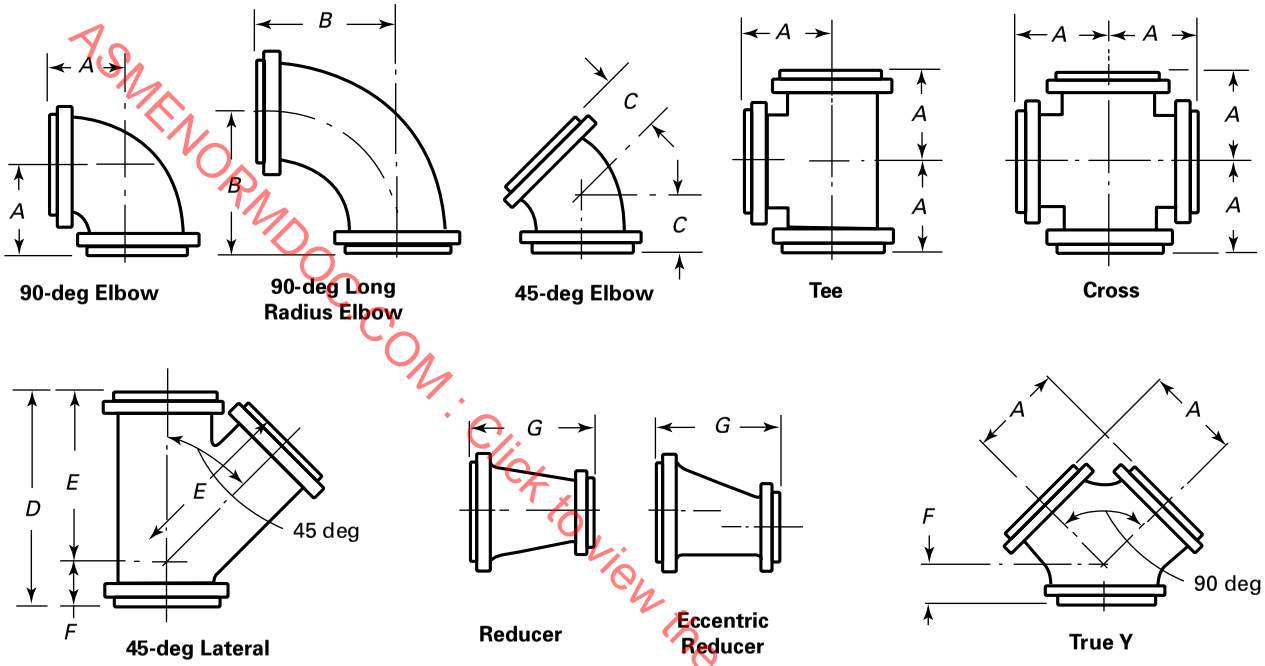
NPS	Inside Diameter of Fittings	Center-to-Face 90-deg Elbows, Tees, Crosses, True Y, and Double Branch Elbow, *A*	Center-to-Face 90-deg Long Radius Elbow, *B*	Center-to-Face 45-deg Elbow, *C*	Face-to- Face Lateral, *D*	Center-to-Face Lateral, *E*	Short Center-to-Face True Y and Lateral, *F*	Face-to-Face Reducer, *G*	Diameter of Flange	Minimum Thickness of Flange, *Q*	Minimum Body Wall Thickness
12	305 (12.00)	305 (12.00)	483 (19.00)	191 (7.50)	762 (30.00)	622 (24.50)	140 (5.50)	356 (14.00)	483 (19.00)	31.8 (1.25)	9.5 (0.38)
14	356 (13.25)	356 (14.00)	546 (21.50)	191 (7.50)	838 (33.00)	686 (27.00)	152 (6.00)	406 (16.00)	533 (21.00)	34.9 (1.38)	10.3 (0.41)
16	406 (15.25)	381 (15.00)	610 (24.00)	203 (8.00)	927 (36.50)	762 (30.00)	165 (6.50)	457 (18.00)	597 (23.50)	36.5 (1.44)	11.1 (0.44)
18	457 (17.25)	419 (16.50)	673 (26.50)	216 (8.50)	991 (39.00)	813 (32.00)	178 (7.00)	483 (19.00)	635 (25.00)	39.7 (1.56)	11.9 (0.47)
20	508 (19.25)	457 (18.00)	737 (29.00)	241 (9.50)	1 092 (43.00)	889 (35.00)	203 (8.00)	508 (20.00)	699 (27.50)	42.9 (1.69)	12.7 (0.50)
24	610 (23.25)	559 (22.00)	864 (34.00)	279 (11.00)	1 258 (49.50)	1 029 (40.50)	229 (9.00)	610 (24.00)	813 (32.00)	47.6 (1.88)	14.3 (0.57)

GENERAL NOTES:

(a) Dimensions are in millimeters (inches).
(b) For tolerances, see section 8.
(c) For facings, see para. 7.2.
(d) For flange bolt holes, see para. 7.3 and Table 7.3-1.
(e) For spot facing, see para. 7.4.
(f) For center-to-contact-surface and center-to-end dimensions of reducing fittings, see para. 7.1.
(g) For contact-surface-to-contact-surface and end-to-end dimensions of reducers and eccentric reducers, see para. 7.1.
(h) For intersecting centerlines, and center-to-contact-surface and center-to-end dimensions of side-outlet fittings, see para. 7.1.
(i) For center-to-contact-surface and center-to-end dimensions of special-degree elbows, see para. 7.1.
(j) For drains, see para. 7.9.

(21)

Table 7.1.1-2
Dimensions of Class 300 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers



NPS	Minimum Inside Diameter of Fittings	Center-to-Face 90-deg Elbows, Tees, Crosses, and True Y, *A*	Center-to-Face 90-deg Long Radius Elbow, *C*	Center-to-Face 45-deg Elbow, *C*	Face-to-Face Lateral, *D*	Center-to-Face Lateral, *E*	Short Center-to-Face True Y and Lateral, *F*	Face-to-Face Reducer, *G*	Diameter of Flange	Minimum Thickness of Flange, *Q*	Minimum Body Wall Thickness
1	25 (1.00)	102 (4.00)	127 (5.00)	58 (2.25)	216 (8.50)	165 (6.50)	51 (2.00)	114 (4.50)	124 (4.88)	17.5 (0.69)	4.8 (0.19)
1¼	32 (1.25)	108 (4.25)	140 (5.50)	64 (2.50)	241 (9.50)	184 (7.25)	57 (2.25)	114 (4.50)	133 (5.25)	19.1 (0.75)	4.8 (0.19)
1½	38 (1.50)	114 (4.50)	152 (6.00)	70 (2.75)	280 (11.00)	216 (8.50)	64 (2.50)	114 (4.50)	156 (6.12)	20.6 (0.81)	4.8 (0.19)
2	51 (2.00)	127 (5.00)	165 (6.50)	76 (3.00)	293 (11.50)	229 (9.00)	64 (2.50)	127 (5.00)	165 (6.50)	22.3 (0.88)	6.4 (0.25)
2½	64 (2.50)	140 (5.50)	178 (7.00)	89 (3.50)	331 (13.00)	267 (10.50)	64 (2.50)	140 (5.50)	191 (7.50)	25.4 (1.00)	6.4 (0.25)
3	78 (3.00)	152 (6.00)	197 (7.75)	89 (3.50)	355 (14.00)	279 (11.00)	76 (3.00)	152 (6.00)	210 (8.25)	28.4 (1.12)	7.1 (0.28)
3½	89 (3.50)	165 (6.50)	216 (8.50)	102 (4.00)	394 (15.50)	318 (12.50)	76 (3.00)	165 (6.50)	229 (9.00)	30.2 (1.19)	7.4 (0.29)
4	102 (4.00)	178 (7.00)	229 (9.00)	114 (4.50)	419 (16.50)	343 (13.50)	76 (3.00)	178 (7.00)	254 (10.00)	31.8 (1.25)	7.9 (0.31)
5	127 (5.00)	203 (8.00)	260 (10.25)	127 (5.00)	470 (18.50)	381 (15.00)	89 (3.50)	203 (8.00)	279 (11.00)	35.0 (1.38)	9.6 (0.38)
6	152 (6.00)	216 (8.50)	292 (11.50)	140 (5.50)	547 (21.50)	445 (17.50)	102 (4.00)	229 (9.00)	318 (12.50)	38.6 (1.44)	9.6 (0.38)

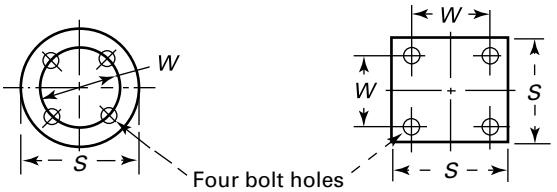
Table 7.1.1-2
Dimensions of Class 300 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers (Cont'd)

NPS	Minimum Inside Diameter of Fittings	Center-to-Face 90-deg Elbows, Tees, Crosses, and True Y, *A*	Center-to-Face 90-deg Long Radius Elbow, *C*	Center-to-Face 45-deg Elbow, *C*	Face-to-Face Lateral, *D*	Center-to-Face Lateral, *E*	Short Center- to-Face True Y and Lateral, *F*	Face-to-Face Reducer, *G*	Diameter of Flange	Minimum Thickness of Flange, *Q*	Minimum Body Wall Thickness
8	203 (8.00)	254 (10.00)	356 (14.00)	152 (6.00)	648 (25.50)	521 (20.50)	127 (5.00)	279 (11.00)	381 (15.00)	41.1 (1.62)	11.2 (0.44)
10	254 (10.00)	292 (11.50)	419 (16.50)	178 (7.00)	750 (29.50)	610 (24.00)	140 (5.50)	305 (12.00)	444 (17.50)	47.8 (1.88)	12.7 (0.50)
12	305 (12.00)	330 (13.00)	483 (19.00)	203 (8.00)	851 (33.50)	699 (27.50)	152 (6.00)	356 (14.00)	521 (20.50)	50.8 (2.00)	14.2 (0.56)
14	337 (13.25)	381 (15.00)	546 (21.50)	216 (8.50)	946 (37.50)	787 (31.00)	159 (6.50)	406 (16.00)	584 (23.00)	53.8 (2.12)	15.7 (0.62)
16	387 (15.25)	419 (16.50)	609 (24.00)	241 (9.50)	1067 (42.00)	876 (34.50)	191 (7.50)	457 (18.00)	648 (25.50)	57.2 (2.25)	17.5 (0.69)
18	432 (17.00)	457 (18.00)	673 (26.50)	254 (10.00)	1156 (45.50)	953 (37.50)	203 (8.00)	483 (19.00)	711 (28.00)	60.4 (2.38)	19.1 (0.75)
20	483 (19.00)	495 (19.50)	737 (29.00)	267 (10.50)	1245 (49.00)	1029 (40.50)	216 (8.50)	503 (20.00)	775 (30.50)	63.5 (2.50)	20.6 (0.81)
24	584 (23.00)	572 (22.50)	864 (34.00)	305 (12.00)	1461 (57.50)	1207 (47.50)	254 (10.00)	610 (24.00)	914 (36.00)	69.8 (2.75)	23.9 (0.94)

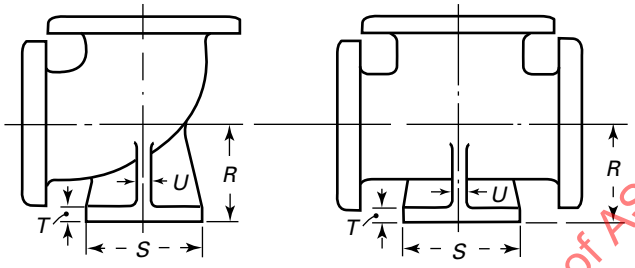
GENERAL NOTES:

(a) Dimensions are in millimeters (inches).
(b) For tolerances, see section 8.
(c) For facings, see para. 7.2.
(d) For flange bolt holes, see para. 7.3 and Table 7.3-2.
(e) For spot facing, see para. 7.4.
(f) For center-to-contact-surface and center-to-end dimensions of reducing fittings, see para. 7.1.
(g) For contact-surface-to-contact-surface and end-to-end dimensions of reducers and eccentric reducers, see para. 7.1.
(h) For intersecting centerlines, and center-to-contact-surface and center-to-end dimensions of side-outlet fittings, see para. 7.1.
(i) For center-to-contact-surface and center-to-end dimensions of special-degree elbows, see para. 7.1.
(j) For drains, see para. 7.9.

Table 7.1.4-1
Dimensions of Class 150 Base Elbows and Base Tees



Round Base | Square Base



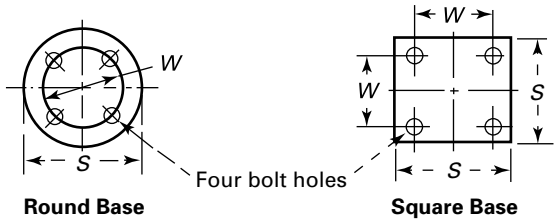
Base Elbow | Base Tee

NPS	Center-to-Base, *R* [Note (1)]	Diameter of Round Base or Width of Square Base, *S* [Note (2)]	Thickness of Base, *T*	Thickness of Ribs, *U*	Nominal Size of Supporting Pipe for Base	Base Drilling [Note (3)]	
						Bolt Circle or Bolt Spacing, *W*	Diameter of Drilled Holes
2	105 (4.12)	118 (4.62)	13 (0.50)	13 (0.50)	1¼	89 (3.50)	15.9 (0.62)
2½	114 (4.50)	118 (4.62)	13 (0.50)	13 (0.50)	1¼	89 (3.50)	15.9 (0.62)
3	124 (4.88)	127 (5.00)	14 (0.56)	13 (0.50)	1½	98 (3.88)	15.9 (0.62)
3½	133 (5.25)	127 (5.00)	14 (0.56)	13 (0.50)	1½	98 (3.88)	15.9 (0.62)
4	140 (5.50)	152 (6.00)	16 (0.62)	13 (0.50)	2	121 (4.75)	19.0 (0.75)
5	159 (6.25)	178 (7.00)	18 (0.69)	16 (0.62)	2½	140 (5.50)	19.0 (0.75)
6	178 (7.00)	178 (7.00)	18 (0.69)	16 (0.62)	2½	140 (5.50)	19.0 (0.75)
8	213 (8.38)	229 (9.00)	24 (0.94)	22 (0.88)	4	191 (7.50)	19.0 (0.75)
10	248 (9.75)	229 (9.00)	24 (0.94)	22 (0.88)	4	191 (7.50)	19.0 (0.75)
12	286 (11.25)	279 (11.00)	25 (1.00)	25 (1.00)	6	241 (9.50)	22.2 (0.88)
14	318 (12.50)	279 (11.00)	25 (1.00)	25 (1.00)	6	241 (9.50)	22.2 (0.88)
16	349 (13.75)	279 (11.00)	25 (1.00)	25 (1.00)	6	241 (9.50)	22.2 (0.88)
18	381 (15.00)	343 (13.50)	29 (1.12)	29 (1.12)	8	298 (11.75)	22.2 (0.88)
20	406 (16.00)	343 (13.50)	29 (1.12)	29 (1.12)	8	298 (11.75)	22.2 (0.88)
24	470 (18.50)	343 (13.50)	29 (1.12)	29 (1.12)	8	298 (11.75)	22.2 (0.88)

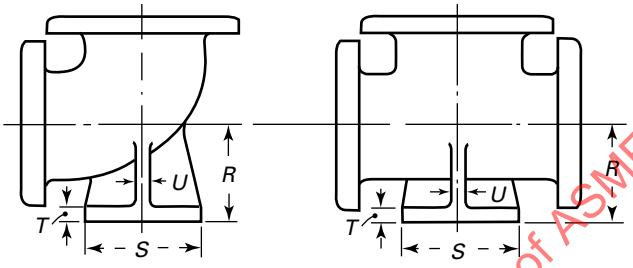
GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) Bases are not finished unless so ordered.

NOTES:
(1) For reducing fittings, the size and center-to-face dimensions of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
(2) The base dimensions apply to all straight and reducing sizes.
(3) Bolt-hole template shown for round base is the same as for the flange of the supporting pipe size, except using only four holes in all cases, so placed as to straddle centerlines. The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

Table 7.1.4-2
Dimensions of Class 300 Base Elbows and Base Tees



Round Base | Square Base



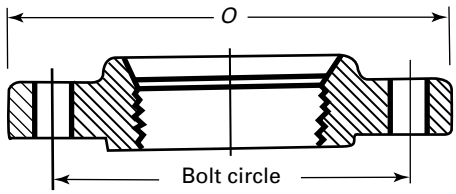
Base Elbow | Base Tee

NPS	Center-to-Base, *R* [Note (1)]	Diameter of Round Base or Width of Square Base, *S* [Note (2)]	Thickness of Base, *T*	Thickness of Ribs, *U*	Nominal Size of Supporting Pipe for Base	Base Drilling [Note (3)]	
						Bolt Circle or Bolt Spacing, *W*	Diameter of Drilled Holes
2	114 (4.50)	133 (5.25)	19 (0.75)	13 (0.50)	1¼	98 (3.88)	19.1 (0.75)
2½	121 (4.75)	133 (5.25)	19 (0.75)	13 (0.50)	1¼	98 (3.88)	19.1 (0.75)
3	133 (5.25)	156 (6.12)	21 (0.81)	16 (0.62)	1½	114 (4.50)	22.3 (0.88)
3½	143 (5.62)	156 (6.12)	21 (0.81)	16 (0.62)	1½	114 (4.50)	22.3 (0.88)
4	152 (6.00)	165 (6.50)	22 (0.88)	16 (0.62)	2	127 (5.00)	19.1 (0.75)
5	171 (6.75)	191 (7.50)	25 (1.00)	19 (0.75)	2½	149 (5.88)	22.3 (0.88)
6	191 (7.50)	191 (7.50)	25 (1.00)	19 (0.75)	2½	149 (5.88)	22.3 (0.88)
8	229 (9.00)	254 (10.00)	32 (1.25)	22 (0.88)	4	200 (7.88)	22.3 (0.88)
10	267 (10.50)	254 (10.00)	32 (1.25)	22 (0.88)	4	200 (7.88)	22.3 (0.88)
12	305 (12.00)	318 (12.50)	36 (1.44)	25 (1.00)	6	270 (10.62)	22.3 (0.88)
14	343 (13.50)	318 (12.50)	36 (1.44)	25 (1.00)	6	270 (10.62)	22.3 (0.88)
16	375 (14.75)	318 (12.50)	36 (1.44)	28 (1.12)	6	270 (10.62)	22.3 (0.88)
18	413 (16.25)	381 (15.00)	41 (1.62)	28 (1.12)	8	330 (13.00)	25.4 (1.00)
20	454 (17.88)	381 (15.00)	41 (1.62)	32 (1.25)	8	330 (13.00)	25.4 (1.00)
24	527 (20.75)	445 (17.50)	48 (1.88)	32 (1.25)	10	387 (15.25)	28.4 (1.12)

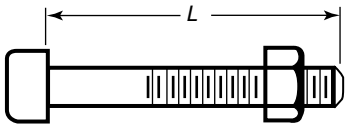
GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) Bases are not finished unless so ordered.

NOTES:
(1) 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.
(2) The base dimensions apply to all straight and reducing sizes.
(3) Bolt-hole template shown for round base is the same as for the flange of the supporting pipe size, except using only four holes in all cases, so placed as to straddle centerlines. The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

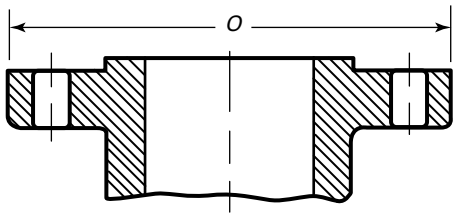
Table 7.3-1
Templates for Drilling Class 150 Ductile Iron Flanges



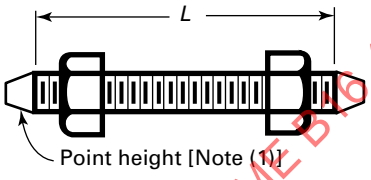
Flange



Machine Bolt With Nut



Flanged Fitting



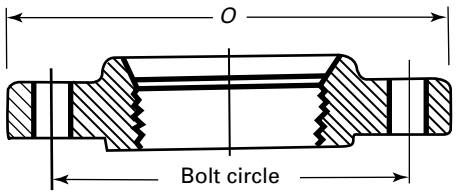
Stud Bolt With Nuts

		Drilling [Notes (2) and (3)]				Length of Bolts, *L*	
NPS	Outside Diameter of Flange, *O*	Diameter of Bolt Circle	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	Stud Bolts [Note (1)]	Machine Bolts
1	110 (4.25)	79.4 (3.12)	5/8	4	1/2	75 (2.75)	55 (2.25)
1 1/4	115 (4.62)	88.9 (3.50)	5/8	4	1/2	85 (2.75)	55 (2.50)
1 1/2	125 (5.00)	98.4 (3.88)	5/8	4	1/2	85 (3.00)	65 (2.50)
2	150 (6.00)	120.7 (4.75)	3/4	4	5/8	95 (3.25)	70 (2.75)
2 1/2	180 (7.00)	139.7 (5.50)	3/4	4	5/8	100 (3.50)	75 (3.00)
3	190 (7.50)	152.4 (6.00)	3/4	4	5/8	100 (3.75)	75 (3.25)
3 1/2	215 (8.50)	177.8 (7.00)	3/4	8	5/8	100 (3.75)	75 (3.25)
4	230 (9.00)	190.5 (7.50)	3/4	8	5/8	100 (3.75)	75 (3.25)
5	255 (10.00)	215.9 (8.50)	7/8	8	3/4	110 (4.00)	85 (3.25)
6	280 (11.00)	241.3 (9.50)	7/8	8	3/4	115 (4.00)	85 (3.50)
8	345 (13.50)	298.5 (11.75)	7/8	8	3/4	120 (4.25)	90 (3.75)
10	405 (16.00)	362.0 (14.25)	1	12	7/8	125 (4.75)	100 (4.00)
12	485 (19.00)	431.8 (17.00)	1	12	7/8	135 (4.75)	100 (4.25)
14	535 (21.00)	476.3 (18.75)	1 1/8	12	1	145 (5.25)	115 (4.50)
16	595 (23.50)	539.8 (21.25)	1 1/8	16	1	145 (5.50)	115 (4.75)
18	635 (25.00)	577.9 (22.75)	1 1/4	16	1 1/8	160 (6.00)	125 (5.00)
20	700 (27.50)	635.0 (25.00)	1 1/4	20	1 1/8	170 (6.25)	140 (5.50)
24	815 (32.00)	749.3 (29.50)	1 3/8	20	1 1/4	185 (7.00)	150 (6.00)

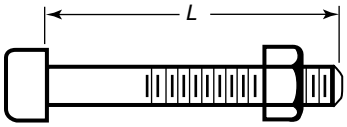
GENERAL NOTES:
(a) Dimensions are in millimeters (inches) except for diameters of bolts and bolt holes, which are in inches.
(b) For other dimensions, see Tables 7.1.1-1 and 7.4-1.

NOTES:
(1) Length of stud bolts does not include the height of the points.
(2) For flange bolt holes, see para. 7.3.
(3) For spot facing, see para. 7.4.

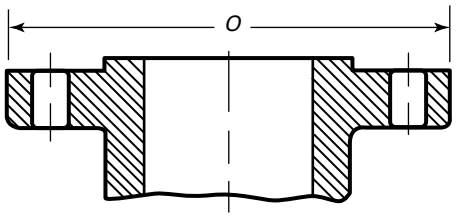
Table 7.3-2
Templates for Drilling Class 300 Ductile Iron Flanges



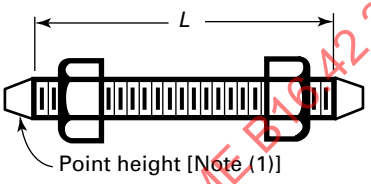
Flange



Machine Bolt With Nut



Flanged Fitting



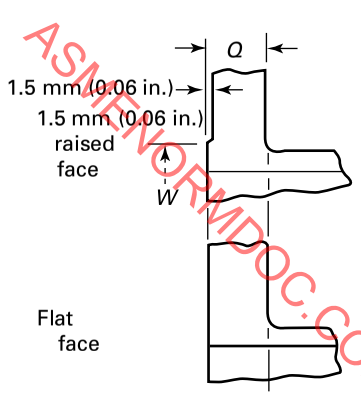
Stud Bolt With Nuts

		Drilling [Notes (2) and (3)]				Length of Bolts, *L*	
NPS	Outside Diameter of Flange, *O*	Diameter of Bolt Circle	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	Stud Bolts [Note (1)]	Machine Bolts
1	125 (4.88)	88.9 (3.50)	3/4	4	5/8	75 (3.00)	65 (2.50)
1 1/4	135 (5.25)	98.4 (3.88)	3/4	4	5/8	85 (3.25)	70 (2.75)
1 1/2	155 (6.12)	114.3 (4.50)	7/8	4	3/4	90 (3.50)	75 (3.00)
2	165 (6.50)	127.0 (5.00)	3/4	8	5/8	90 (3.50)	75 (3.00)
2 1/2	190 (7.50)	149.2 (5.88)	7/8	8	3/4	100 (4.00)	85 (3.25)
3	210 (8.25)	168.3 (6.62)	7/8	8	3/4	110 (4.25)	90 (3.50)
3 1/2	230 (9.00)	184.2 (7.25)	7/8	8	3/4	110 (4.25)	95 (3.75)
4	255 (10.00)	200.0 (7.88)	7/8	8	3/4	115 (4.50)	95 (3.75)
5	280 (11.00)	235.0 (9.25)	7/8	8	3/4	120 (4.75)	110 (4.25)
6	320 (12.50)	269.9 (10.62)	7/8	12	3/4	120 (4.75)	110 (4.25)
8	380 (15.00)	330.2 (13.00)	1	12	7/8	140 (5.50)	120 (4.75)
10	445 (17.50)	387.4 (15.25)	1 1/8	16	1	160 (6.25)	140 (5.50)
12	520 (20.50)	450.8 (17.75)	1 1/4	16	1 1/8	170 (6.75)	145 (5.75)
14	585 (23.00)	514.4 (20.25)	1 1/4	20	1 1/8	180 (7.00)	160 (6.25)
16	650 (25.50)	571.5 (22.50)	1 3/8	20	1 1/4	190 (7.50)	165 (6.50)
18	710 (28.00)	628.6 (24.75)	1 3/8	24	1 1/4	195 (7.75)	170 (6.75)
20	775 (30.50)	685.8 (27.00)	1 3/8	24	1 1/4	205 (8.00)	185 (7.25)
24	915 (36.00)	812.8 (32.00)	1 1/2	24	1 1/2	230 (9.00)	205 (8.00)

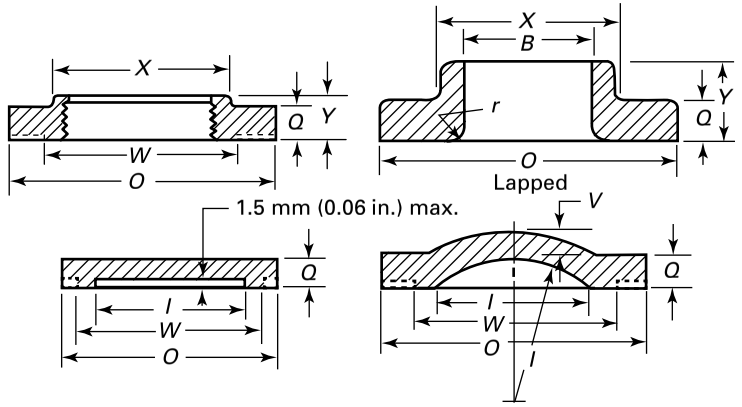
GENERAL NOTES:
(a) Dimensions are in millimeters (inches) except for diameters of bolts and bolt holes, which are in inches.
(b) For other dimensions, see Tables 7.1.1-2 and 7.4-2.

NOTES:
(1) Length of stud bolts does not include the height of the points.
(2) For flange bolt holes, see para. 7.3.
(3) For spot facing, see para. 7.4.

Table 7.4-1
Dimensions of Class 150 Ductile Iron Flanges



End Flange Facings and Their Relationship to Flange Thickness



NPS 12 and Larger Optional Design

NPS	Diameter of Port, *I*	Diameter of Flange, *O*	Minimum Thickness of Flange, *Q*	Minimum Diameter of Hub, *X* [Note (1)]	Minimum Length of Hub and Threads, *Y* [Note (2)]	Minimum Domed Wall Thickness, *V*	Diameter of Raised Face, *W*	Minimum Bore Lapped, *B*	Corner Radius of Bore of Lapped Flange, *r*	Hub Length Lapped, *Y*
1	25 (1.00)	110 (4.25)	14.2 (0.56)	49 (1.94)	18 (0.69)	...	51 (2.00)	35 (1.38)	4 (0.12)	17 (0.69)
1¼	32 (1.25)	115 (4.62)	15.7 (0.62)	59 (2.31)	21 (0.81)	...	64 (2.50)	44 (1.72)	5 (0.19)	21 (0.81)
1½	38 (1.50)	125 (5.00)	17.5 (0.69)	65 (2.56)	22 (0.88)	...	73 (2.88)	50 (1.97)	6 (0.25)	22 (0.88)
2	51 (2.00)	150 (6.00)	19.0 (0.75)	78 (3.06)	25 (1.00)	...	92 (3.62)	62 (2.46)	8 (0.31)	25 (1.00)
2½	64 (2.50)	180 (7.00)	22.3 (0.88)	91 (3.56)	29 (1.12)	...	105 (4.12)	75 (2.97)	8 (0.31)	29 (1.12)
3	76 (3.00)	190 (7.50)	23.8 (0.94)	108 (4.25)	30 (1.19)	...	127 (5.00)	91 (3.60)	10 (0.38)	30 (1.19)
3½	89 (3.50)	215 (8.50)	23.8 (0.94)	122 (4.81)	32 (1.25)	...	140 (5.50)	104 (4.10)	10 (0.38)	32 (1.25)
4	102 (4.00)	230 (9.00)	23.8 (0.94)	135 (5.31)	33 (1.31)	...	157 (6.19)	117 (4.60)	11 (0.44)	33 (1.31)
5	127 (5.00)	255 (10.00)	23.8 (0.94)	164 (6.44)	37 (1.44)	...	186 (7.31)	144 (5.69)	11 (0.44)	36 (1.44)
6	152 (6.00)	280 (11.00)	25.4 (1.00)	192 (7.56)	40 (1.56)	...	216 (8.50)	172 (6.75)	13 (0.50)	40 (1.56)
8	203 (8.00)	345 (13.50)	28.6 (1.12)	246 (9.69)	44 (1.75)	...	270 (10.62)	222 (8.75)	13 (0.50)	44 (1.75)
10	254 (10.00)	405 (16.00)	30.2 (1.19)	303 (12.00)	49 (1.94)	...	324 (12.75)	277 (10.92)	13 (0.50)	49 (1.94)
12	305 (12.00)	485 (19.00)	31.8 (1.25)	357 (14.38)	56 (2.19)	20.6 (0.81)	381 (15.00)	328 (12.92)	13 (0.50)	56 (2.19)
14	356 (14.00)	535 (21.00)	35.0 (1.38)	391 (15.75)	57 (2.25)	22.2 (0.88)	413 (16.25)	360 (14.18)	13 (0.50)	79 (3.12)
16	406 (16.00)	595 (23.50)	36.5 (1.44)	445 (18.00)	64 (2.50)	25.4 (1.00)	470 (18.50)	419 (16.19)	13 (0.50)	87 (3.44)
18	457 (18.00)	635 (25.00)	39.7 (1.56)	499 (19.88)	68 (2.69)	27.0 (1.06)	533 (21.00)	462 (18.20)	13 (0.50)	97 (3.81)

Table 7.4-1
Dimensions of Class 150 Ductile Iron Flanges (Cont'd)

NPS	Diameter of Port, *I*	Diameter of Flange, *O*	Minimum Thickness of Flange, *Q*	Minimum Diameter of Hub, *X* [Note (1)]	Minimum Length of Hub and Threads, *Y* [Note (2)]	Minimum Domed Wall Thickness, *V*	Diameter of Raised Face, *W*	Minimum Bore Lapped, *B*	Corner Radius of Bore of Lapped Flange, *r*	Hub Length Lapped, *Y*
20	508 (20.00)	700 (27.50)	42.9 (1.69)	553 (22.00)	73 (2.88)	28.6 (1.12)	584 (23.00)	514 (20.25)	13 (0.50)	103 (4.06)
24	610 (24.00)	815 (32.00)	47.6 (1.88)	660 (26.12)	83 (3.25)	31.8 (1.25)	692 (27.25)	616 (24.25)	13 (0.50)	111 (4.38)

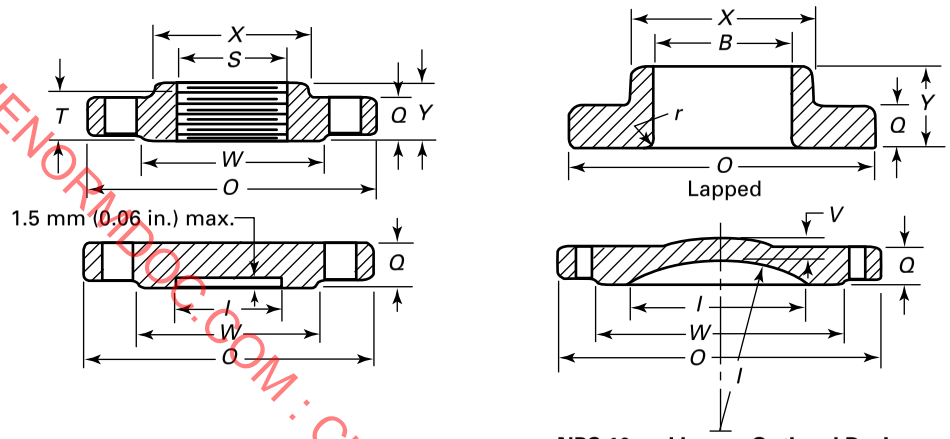
GENERAL NOTES:

(a) Dimensions are in millimeters (inches).
(b) For tolerances, see section 8.
(c) For facings, see para. 7.2.
(d) For flange bolt holes, see para. 7.3 and Table 7.3-1.
(e) For spot facing, see para. 7.4.
(f) For reducing threaded flanges, see Table 7.5.2-1.
(g) Blind flanges may be made with or without hubs at the option of the manufacturer.

NOTES:

(1) This dimension is for large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded and lapped flanges.
(2) For threads of threaded flanges, see para. 7.6.

Table 7.4-2
Dimensions of Class 300 Ductile Iron Flanges



NPS 10 and Larger Optional Design

NPS	Diameter of Port, *I*	Diameter of Flange, *O*	Minimum Thickness of Flange, *Q*	Minimum Diameter of Hub, *X* [Note (1)]	Minimum Length of Hub, *Y*	Hub Lapped, *Y*	Minimum Domed Wall Thickness, *V*	Minimum Length of Threads, *T* [Note (2)]	Minimum Bore Lapped, *B*	Corner Radius of Bore of Lapped Flange, *r*	Diameter of Raised Face, *W*	Diameter of Counterbore, *S*
1	25 (1.00)	125 (4.88)	17.5 (0.69)	52 (2.06)	27 (1.06)	27 (1.06)	...	18 (0.69)	35 (1.38)	3 (0.12)	51 (2.00)	36 (1.41)
1¼	32 (1.25)	135 (5.25)	19.1 (0.75)	64 (2.50)	27 (1.06)	27 (1.06)	...	21 (0.81)	44 (1.72)	5 (0.19)	64 (2.50)	44 (1.75)
1½	38 (1.50)	155 (6.12)	20.6 (0.81)	70 (2.75)	30 (1.19)	30 (1.19)	...	22 (0.88)	51 (1.97)	6 (0.25)	73 (2.88)	51 (1.99)
2	51 (2.00)	165 (6.50)	22.3 (0.88)	84 (3.31)	33 (1.31)	33 (1.31)	...	29 (1.12)	62 (2.46)	8 (0.31)	92 (3.62)	64 (2.50)
2½	64 (2.50)	190 (7.50)	25.4 (1.00)	100 (3.94)	38 (1.50)	38 (1.50)	...	32 (1.25)	75 (2.97)	8 (0.31)	105 (4.12)	76 (3.00)
3	76 (3.00)	210 (8.25)	28.4 (1.12)	117 (4.62)	43 (1.69)	43 (1.69)	...	32 (1.25)	91 (3.60)	10 (0.38)	127 (5.00)	92 (3.63)
3½	89 (3.50)	230 (9.00)	30.2 (1.19)	133 (5.25)	44 (1.75)	44 (1.75)	...	36 (1.44)	104 (4.10)	10 (0.38)	140 (5.50)	105 (4.13)
4	102 (4.00)	255 (10.00)	31.8 (1.25)	146 (5.75)	48 (1.88)	48 (1.88)	...	36 (1.44)	117 (4.60)	11 (0.44)	157 (6.19)	118 (4.63)
5	127 (5.00)	280 (11.00)	35.0 (1.38)	178 (7.00)	51 (2.00)	51 (2.00)	...	43 (1.69)	144 (5.69)	11 (0.44)	186 (7.31)	144 (5.69)
6	152 (6.00)	320 (12.50)	36.6 (1.44)	206 (8.12)	52 (2.06)	52 (2.06)	...	46 (1.81)	172 (6.75)	13 (0.50)	216 (8.50)	172 (6.75)
8	203 (8.00)	380 (15.00)	41.1 (1.62)	260 (10.25)	62 (2.44)	62 (2.44)	...	51 (2.00)	222 (8.75)	13 (0.50)	270 (10.62)	222 (8.75)
10	254 (10.00)	445 (17.50)	47.8 (1.88)	321 (12.62)	67 (2.62)	95 (3.75)	23.9 (0.94)	56 (2.19)	277 (10.92)	13 (0.50)	324 (12.75)	276 (10.88)
12	305 (12.00)	520 (20.50)	50.8 (2.00)	375 (14.75)	73 (2.88)	102 (4.00)	25.4 (1.00)	60 (2.38)	328 (12.92)	13 (0.50)	381 (15.00)	329 (12.94)
14	337 (13.25)	585 (23.00)	53.8 (2.12)	425 (16.75)	76 (3.00)	111 (4.38)	28.6 (1.12)	64 (2.50)	360 (14.18)	13 (0.50)	413 (16.25)	360 (14.19)
16	387 (15.25)	650 (25.50)	57.2 (2.25)	467 (19.00)	83 (3.25)	121 (4.75)	31.8 (1.25)	68 (2.69)	411 (16.19)	13 (0.50)	470 (18.50)	411 (16.19)
18	432 (17.00)	710 (28.00)	60.4 (2.38)	533 (21.00)	89 (3.50)	130 (5.12)	34.9 (1.38)	70 (2.75)	462 (18.20)	13 (0.50)	533 (21.00)	462 (18.19)

Table 7.4-2
Dimensions of Class 300 Ductile Iron Flanges (Cont'd)

NPS	Diameter of Port, *I*	Diameter of Flange, *O*	Minimum Thickness of Flange, *Q*	Minimum Diameter of Hub, *X* [Note (1)]	Minimum Length of Hub, *Y*	Hub Lapped, *Y*	Minimum Domed Wall Thickness, *V*	Minimum Length of Threads, *T* [Note (2)]	Minimum Bore Lapped, *B*	Corner Radius of Bore of Lapped Flange, *r*	Diameter of Raised Face, *W*	Diameter of Counterbore, *S*
20	438 (19.00)	775 (30.50)	63.5 (2.50)	587 (23.12)	95 (3.75)	140 (5.50)	38.1 (1.50)	73 (2.88)	514 (20.25)	13 (0.50)	584 (23.00)	513 (20.19)
24	584 (23.00)	915 (36.00)	69.8 (2.75)	702 (27.62)	106 (4.19)	152 (6.00)	41.3 (1.62)	83 (3.25)	616 (24.25)	13 (0.50)	692 (27.25)	614 (24.19)

GENERAL NOTES:

(a) Dimensions are in millimeters (inches).
(b) For tolerances, see section 8.
(c) For facings, see para. 7.2.
(d) For flange bolt holes, see para. 7.3 and Table 7.3-2.
(e) For spot facing, see para. 7.4.
(f) For reducing threaded flanges, see Table 7.5.2-1.
(g) Blind flanges may be made with or without hub at the option of the manufacturer.

NOTES:

(1) 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.
(2) For threads of threaded flanges, see para. 7.6.