

**ASME B16.3-2016**  
(Revision of ASME B16.3-2011)

# **Malleable Iron Threaded 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

Two Park Avenue • New York, NY • 10016 USA

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## FOREWORD

In 1921, the American Engineering Standards Committee, later the American Standards Association (ASA) and currently 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).

Threaded fittings were also included in the scope of the B16 Committee, and Subcommittee Number 2 (now Subcommittee B) was made responsible for threaded fittings other than steel. The first edition of a standard covering 150-lb malleable iron fittings was approved as an American Tentative Standard by ASA in December 1927. In 1936, a revision was undertaken to add hydraulic service ratings, material specifications, alignment tolerances, and dimensions for additional sizes. It was approved with the designation American Standard B16c-1939.

Pipe plugs, bushings, and locknuts, included in the first editions, are now covered in a separate standard, B16.14.

A revision begun in 1947 amplified the sections on threading, inspection, and tolerances, and added dimensions for additional sizes of elbows, reducing crosses, reducing tees, straight and reducing couplings, caps, and return bends. It was approved as ASA B16.3-1951.

Meanwhile, MSS, in cooperation with the Association of American Railroads (AAR), developed the first standard for 300-lb malleable iron threaded fittings, published as MSS SP-31 of 1932. The 1950 edition of SP-31, which agreed with AAR Purchase Specification M-404, was submitted to ASA Sectional Committee B16 and assigned to Subcommittee Number 2. After balloting, it was approved as a separate standard, ASA B16.19-1951.

Work was begun to combine the two standards (for 150 lb and 300 lb) into a single document in 1961. The resulting standard was approved as ASA B16.3-1963. Subsequent reviews of the standard, leading to revisions approved as ANSI B16.3-1971 and ANSI B16.3-1977, involved updating referenced standards and the introduction of metric (SI) dimensions and ratings. In the 1977 edition, 150 lb and 300 lb were redesignated as Class 150 and Class 300, respectively.

In 1982, American National Standards Committee B16 became the ASME B16 Standards Committee, operating with the same scope under ASME procedures accredited by ANSI. A further revision of the standard, approved and published as ANSI/ASME B16.3-1985, provided for electrodeposition as an alternative to hot dipping when zinc coating was required.

The 1992 edition of B16.3 omitted metric units, establishing U.S. Customary units as the standard. Clarifications and editorial revisions were made to improve the text. Following approval by the Standards Committee and ASME, the 1992 edition received approval as an American National Standard on December 2, 1992, with the designation ASME B16.3-1992.

In the 1998 edition of ASME B16.3, the References section was updated; a Quality System Program Annex was added; and several editorial revisions were made. Following approval by ASME B16 Subcommittee B and B16 Main Committee, ANSI approved it as an American National Standard on November 20, 1998.

In the 2006 edition, metric dimensions became the primary units and inch dimensions were incorporated into this Standard as secondary units and shown in parentheses. The added metric dimensions constitute an independent but equal standard to the inch units. Following approval by the Standards Committee and the ASME Board, this revision to the 1998 edition of this Standard was approved as an American National Standard by ANSI on November 9, 2006 with the new designation, ASME B16.3-2006.

In the 2011 edition, references to ASME standards were revised to no longer list specific edition years; the latest edition of ASME publications applies unless stated otherwise. Materials manufactured to other editions of the referenced ASTM standards have been permitted to be used to manufacture fittings meeting the requirements of this Standard as long as the fitting

manufacturer verifies the material meets the requirements of the referenced edition. Following approval by the Standards Committee and the ASME Board on PTCS, the 2011 revision was approved as an American National Standard by ANSI on August 9, 2011 with the new designation, ASME B16.3-2011.

In this 2016 Edition, provisions have been made to update verbiage and readings. Following the approval by the ASME B16 Standards Committee, approval as an American National Standard was given by ANSI on September 26, 2016, with the new designation ASME B16.3-2016.



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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](mailto: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.

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 B16.3-2016 SUMMARY OF CHANGES

Following approval by the ASME B16 Committee and ASME, and after public review, ASME B16.3-2016 was approved by the American National Standards Institute on September 26, 2016.

ASME B16.3-2016 includes the following changes identified by a margin note, (16). The Record Numbers listed below are explained in more detail in the "List of Changes in Record Number Order" following this Summary of Changes.

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
2, 3	Section 7.2	Revised in its entirety (11-655)
4	Section 12.1	Metric units added (11-1496)
28	Table I-9	In NPS 2 line, value for Minimum Outside Diameter of Band revised (13-870)





## LIST OF CHANGES IN RECORD NUMBER ORDER

<u>Record Number</u>	<u>Change</u>
11-655	Section 7.2, Reduced Fittings: verbiage revised.
11-1496	Section 12.1, Tolerance readings: metric conversions added.
13-870	Mandatory Appendix I, Table I-9: for NPS 2, value for Minimum Outside Diameter of Band revised.





# MALLEABLE IRON THREADED FITTINGS

## Classes 150 and 300

### 1 SCOPE

This Standard covers malleable iron threaded fittings, Classes 150 and 300. It also contains provisions for using steel for caps and couplings in Class 150 for NPS  $\frac{3}{8}$  and smaller. This Standard includes

- (a) pressure-temperature ratings
- (b) size and method of designating openings of reducing fittings
- (c) marking
- (d) material
- (e) dimensions and tolerances
- (f) threading
- (g) coatings

Mandatory Appendix I provides table values in U.S. Customary units.

### 2 GENERAL

#### 2.1 References

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

#### 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. These systems of units are to be regarded separately as standard. Within the text, the U.S. Customary units are shown in parentheses or in separate tables that appear in Mandatory Appendix I. 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. Combining values from the two systems constitutes nonconformance with the Standard.

#### 2.4 Service Conditions

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: Class 150 and Class 300.

**2.6.2 Size.** NPS, followed by a dimensionless number, is the designation for nominal fitting size. NPS is related to the referenced nominal diameter, DN, used in international standards. The relationship is typically as follows:

NPS	DN
$\frac{1}{4}$	8
$\frac{1}{2}$	15
1	25
$1\frac{1}{4}$	32
$1\frac{1}{2}$	40
2	50
$2\frac{1}{2}$	65
3	80
4	100

GENERAL NOTE: For NPS  $\geq 4$ , the related DN = 25  $\times$  NPS.

## 3 PRESSURE-TEMPERATURE RATINGS

(a) Pressure-temperature ratings for these fittings are shown in Tables 1 and I-1.

(b) All ratings are independent of the contained fluid and are the maximum allowable working gage pressures at the tabulated temperatures. Intermediate ratings may be obtained by linear interpolation between the temperatures shown.

(c) The temperatures shown for the 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.

(d) Class 300 street elbows are not recommended for pressures above 600 psi.

## 4 SIZE

### 4.1 Nominal Pipe Size

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

### 4.2 Reducing Fittings

For reducing tees, crosses, and Y-branches (laterals), the size of the largest run opening shall be given first, followed by the size of the opening at the opposite end of the run. Where the fitting is a tee or Y-branch (lateral), the size of the outlet is given last. Where the fitting is a cross, the largest side-outlet opening is the third dimension given, followed by the opposite opening. The straight-line sketches of Fig. 1 illustrate how the reducing fittings are read.

## 5 MARKING

### 5.1 Class 150 Fittings

Each Class 150 fitting shall be marked for identification with the manufacturer's name or trademark.

### 5.2 Class 300 Fittings

Each Class 300 fitting shall be marked for identification with

- the manufacturer's name or trademark
- the numerals "300"
- the letters "MI" to designate malleable iron
- the size
- other markings as permitted by MSS SP-25

## 6 MATERIAL

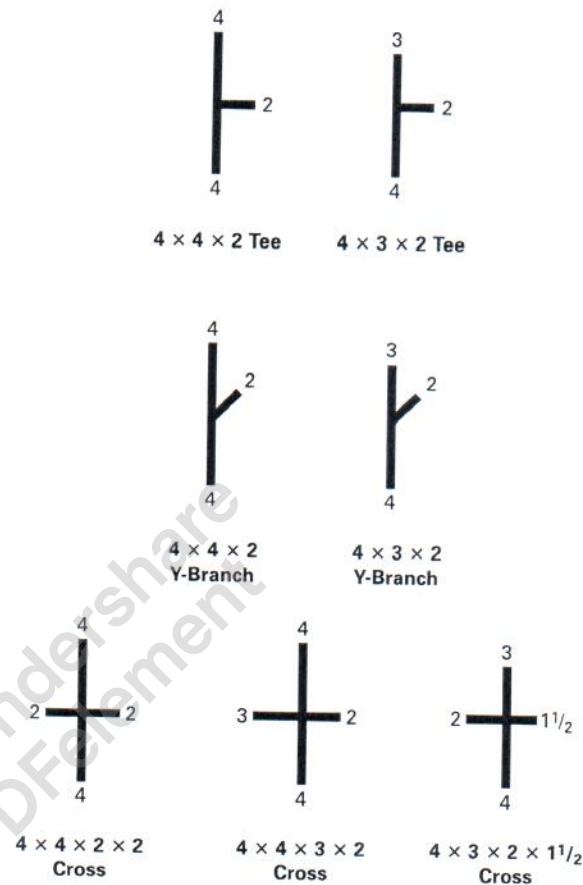
### 6.1 Malleable Iron

The chemical and physical properties of the castings shall be in accordance with ASTM A197. The manufacturer shall be prepared to certify that the product has been so produced.

### 6.2 Steel

Class 150 couplings and caps in NPS  $\frac{1}{8}$ ,  $\frac{1}{4}$ , and  $\frac{3}{8}$  may be made from steel rod or bar with a minimum yield strength of 30 ksi at the manufacturer's option.

Fig. 1 Identification of Reducing Fittings



## 7 DIMENSIONS AND TOLERANCES

### 7.1 General

The tolerances in Tables 2 and I-2 are for center-to-end dimensions of the fittings. Center-to-end dimensions in millimeters are given for both straight and reducing fittings in Tables 3 through 18 (Tables I-3 through I-18 are in U.S. Customary units). The sketches of fittings shown in this Standard are representative and for the purpose of illustration.

### 7.2 Reducing Fittings

**7.2.1** The dimensions of reducing fittings shown in Tables 4, 5, 8, 12, 13, and 15 (Tables I-4, I-5, I-8, I-12, I-13, and I-15) are for use only when making patterns for the specific reducing fitting in question and do not apply when a larger size pattern is reduced (i.e., "bushed") to make the reduction or reductions in the fitting. Reducing pipe fitting patterns shall be designed to produce wall thicknesses, detail, and dimensions as required for the sizes involved.

(16)

**7.2.2** The transition in wall thickness from one end size to another shall be in a manner that minimizes the addition of stress caused by sudden changes in direction or wall thickness.

**7.2.3** Proof of design shall be verified by a hydrostatic pressure test made at ambient temperature in which pressure is applied for a continuous period of no less than 1 min and at a constant minimum pressure of no less than 5 times the pressure rating of the largest size of end connection in the reducing fitting. Testing is considered successful only when no evidence of cracking, fracturing, or leakage is exhibited after holding for at least the minimum time at or above the required pressure.

### 7.3 Tolerances

It is recognized that some variations are absolutely unavoidable in the making of patterns and castings. The following tolerances shall apply.

(a) *Metal Thickness Tolerances.* Metal thickness at no point in the castings shall be less than 90% of the value given in the tables.

(b) *Center-to-End Tolerances.* Permitted tolerances on the center-to-end dimensions of the fittings are shown in Tables 2 and I-2. Tolerances for end-to-end dimensions and lengths of couplings and reducers shall be twice those given. The largest opening in a reducing fitting governs the tolerances to be applied to all openings. These tolerances do not apply to return bends and caps.

## 8 THREADING

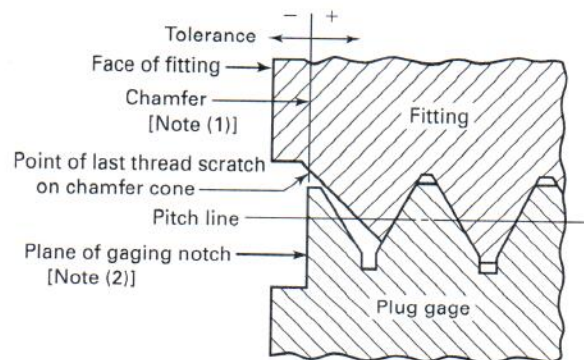
### 8.1 Types of Threads

All fittings shall be threaded according to ANSI/ASME B1.20.1, and shall have taper threads, except wrought couplings (Tables 8 and I-8) and wrought caps (Tables 9 and I-9) in NPS  $\frac{1}{8}$ ,  $\frac{1}{4}$ , and  $\frac{3}{8}$ , which may have straight threads.

### 8.2 Tolerances

Variations in taper threading shall be limited to one turn large or one turn small from the gaging face on ring and gaging notch on plug when using working gages. The variations in straight threading shall be limited to one and one-half turns large or small from the gaging notch on plug when using a taper pipe thread working gage. The reference point for gaging internal fittings threads depends upon the chamfer diameter. When the internal chamfer diameter exceeds the major diameter of the internal thread, the reference point is the last thread scratch on the chamfer cone. When the internal chamfer diameter does not exceed the major diameter of the internal thread, the reference point is the end of the fitting (see Fig. 2).

**Fig. 2 Gaging of Chamfered Internal Threads**



GENERAL NOTE: Enlarged view showing chamfered internal thread of basic size with chamfer exceeding the major diameter.

NOTES:

- (1) The chamfer illustrated is at a 45-deg angle and is approximately  $\frac{3}{8}$  pitch in depth. However, these details are not requirements and are given only for information on the illustration shown.
- (2) Plane of gaging notch should intersect crest of thread on gage.

### 8.3 Countersink or Chamfer

For the purpose of easier entrance in making a joint and for protection of the thread, all internal threads shall be countersunk a distance of not less than one-half the pitch of the thread at an angle of approximately 45 deg with the axis of the thread; all external threads shall be chamfered at an angle of 30 deg to 45 deg with the axis. Countersinking and chamfering shall be concentric with the threads.

### 8.4 Thread Length

The length of threads specified in all tables shall be measured to include the countersink or chamfer.

### 8.5 Alignment

The maximum allowable variation in the alignment of threads of all openings of threaded fittings shall be 5.0 mm/m (0.06 in./ft) (0.5% slope).

## 9 RIBS

### 9.1 General

The addition of ribs or lugs is permitted on threaded fittings. Where ribs are used, it is recommended that their thickness be the same as specified for metal thickness of the fitting. Right-hand couplings shall have no more than two ribs.

### 9.2 Special Couplings

Right- and left-hand couplings shall have four or more ribs unless the left-hand opening is clearly marked, in which case the use of ribs is optional with the manufacturer.

## 10 PLUGS, BUSHINGS, AND LOCKNUTS

For dimensions of plugs, bushings, and locknuts to be used in connection with Classes 150 and 300 malleable iron threaded fittings, see ASME B16.14.

## 11 FACE BEVEL

A bevel not exceeding 5 deg is permitted on the faces of fitting openings. Center-to-end, end-to-end, and width of band dimensions may include or exclude the bevel.

## 12 COATINGS

### (16) 12.1 Malleable Iron Fittings

When malleable iron fittings are zinc coated, they shall be hot dipped in accordance with ASTM A153 or

have an electrodeposited zinc coating conforming to ASTM B633, Type I, Service Condition 4. Hot-dipped coatings shall be 0.864 mm (0.0034 in.) minimum thickness and applied prior to threading. Electrodeposited zinc shall be 0.025 mm (0.001 in.) minimum thickness and may be applied either before or after threading.

### 12.2 Steel Fittings

Couplings and caps made from steel rod or bar may have electrodeposited zinc coatings conforming to ASTM B633, Type I, Service Condition 4. The electrodeposited coatings may be applied either before or after threading.

### 12.3 Other Coatings

Other coatings specified by the purchaser shall be furnished meeting the agreed requirements.



**Table 1 Pressure–Temperature Ratings**

Temperature, °C	Working Pressure, bar			
	Class 150	Class 300		
		NPS		
		1/4–1	1 1/4–2	2 1/2–3
–29 to 66	20.7	137.9	103.4	69.0
100	17.5	119.6	90.5	61.5
125	15.2	106.4	81.1	56.1
150	12.8	93.1	71.8	50.7
175	10.5 [Note (1)]	79.9	62.5	45.2
200	...	66.6	53.1	39.8
225	...	53.4	43.8	34.3
250	...	40.1	34.5	28.9
275	...	26.9	25.2	23.4
288	...	20.7	20.7	20.7

NOTE:

- (1) Permissible for service temperature up to 186°C, reflecting the temperature of saturated steam at 10.3 bar.

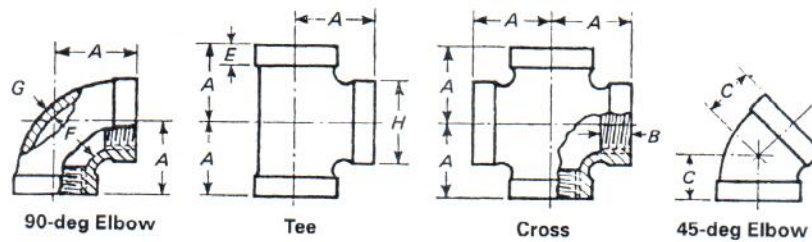
**Table 2 Inspection Tolerances**

NPS	Tolerance, mm
1/8	±0.8
1/4	±1.0
3/8	±1.3
1/2, 3/4	±1.5
1, 1 1/4	±1.8
1 1/2, 2	±2.0
2 1/2, 3, 3 1/2	±2.5
4, 5	±3.0
6	±3.6



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**Table 3 Dimensions of Class 150 90-deg Elbows, Tees, and Crosses, and 45-deg Elbows (Straight Sizes)**

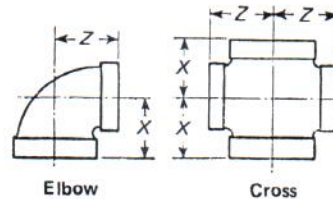


NPS	Center-to-End Elbows, Tees, and Crosses, A [Note (1)]	Center-to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H
					Min.	Max.		
1/8	17.5	...	6.4	5.1	10.3	11.0	2.29	17.6
1/4	20.6	18.5	8.1	5.5	13.7	14.8	2.41	21.4
3/8	24.1	20.3	9.1	5.8	17.1	18.3	2.54	35.8
1/2	28.5	22.4	10.9	6.3	21.3	22.8	2.67	30.4
3/4	33.3	24.9	12.7	6.9	26.7	28.1	3.05	37.0
1	38.1	28.5	14.7	7.7	33.4	35.2	3.40	45.0
1 1/4	44.5	32.8	17.0	8.7	42.2	43.9	3.68	54.7
1 1/2	49.3	36.3	17.8	9.3	48.3	50.0	3.94	61.6
2	57.2	42.7	19.1	10.7	60.3	62.1	4.39	75.3
2 1/2	68.6	49.5	23.4	12.1	73.0	75.6	5.33	91.2
3	78.2	55.1	24.9	13.9	88.9	91.4	5.87	108.8
3 1/2	86.9	60.7	26.2	15.3	101.6	104.1	6.30	123.0
4	96.3	66.3	27.4	16.8	114.4	116.8	6.73	137.2
5	114.3	77.5	30.0	19.8	141.3	143.8	7.62	167.2
6	130.3	87.9	32.5	22.9	168.3	170.8	8.53	197.3

GENERAL NOTE: Dimensions are in millimeters.

NOTE:

(1) Dimensions for reducing elbows and reducing crosses are given in Table 4 and dimensions for reducing tees in Table 5.

**Table 4 Dimensions of Class 150 90-deg Elbows and Crosses (Reducing Sizes)**

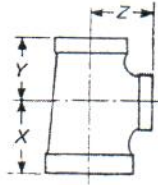
Elbows			Crosses		
NPS	Center-to-End		NPS	Center-to-End	
	X	Z		X	Z
$\frac{1}{4} \times \frac{1}{8}$	18.8	19.3	$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2} \times \frac{1}{2}$	30.5	31.0
$\frac{3}{8} \times \frac{1}{4}$	22.4	22.9	$1 \times 1 \times \frac{3}{4} \times \frac{3}{4}$	34.8	36.8
$\frac{3}{8} \times \frac{3}{8}$	20.5	21.6	$1 \times 1 \times \frac{1}{2} \times \frac{1}{2}$	32.0	35.5
$\frac{1}{2} \times \frac{3}{8}$	26.4	26.2	$1\frac{1}{4} \times 1\frac{1}{4} \times 1 \times 1$	40.1	42.4
$\frac{1}{2} \times \frac{1}{4}$	24.6	24.9	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4} \times \frac{3}{4}$	36.8	41.2
$\frac{3}{4} \times \frac{1}{2}$	30.5	31.0	$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$	46.2	47.8
$\frac{3}{4} \times \frac{3}{8}$	28.5	28.7	$1\frac{1}{2} \times 1\frac{1}{2} \times 1 \times 1$	41.9	45.7
$\frac{3}{4} \times \frac{1}{4}$	26.7	27.4	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4} \times \frac{3}{4}$	38.6	44.5
$1 \times \frac{3}{4}$	34.8	36.8	$2 \times 2 \times 1\frac{1}{2} \times 1\frac{1}{2}$	51.3	54.9
$1 \times \frac{1}{2}$	32.0	35.5	$2 \times 2 \times 1\frac{1}{4} \times 1\frac{1}{4}$	48.3	53.3
$1 \times \frac{3}{8}$	30.0	32.3	$2 \times 2 \times 1 \times 1$	43.9	51.3
$1\frac{1}{4} \times 1$	40.1	42.4	$2 \times 2 \times \frac{3}{4} \times \frac{3}{4}$	40.6	50.0
$1\frac{1}{4} \times \frac{3}{4}$	36.8	41.2	$2\frac{1}{2} \times 2\frac{1}{2} \times 2 \times 2$	60.7	66.0
$1\frac{1}{4} \times \frac{1}{2}$	34.0	38.9	$3 \times 3 \times 2 \times 2$	64.0	73.4
$1\frac{1}{2} \times 1\frac{1}{4}$	46.2	47.8			
$1\frac{1}{2} \times 1$	41.9	45.7			
$1\frac{1}{2} \times \frac{3}{4}$	38.6	44.5			
$2 \times 1\frac{1}{2}$	51.3	54.9			
$2 \times 1\frac{1}{4}$	48.3	53.3			
$2 \times 1$	43.9	51.3			
$2 \times \frac{3}{4}$	40.6	50.0			
$2\frac{1}{2} \times 2$	60.7	66.0			
$2\frac{1}{2} \times 1\frac{1}{2}$	54.9	63.8			
$3 \times 2\frac{1}{2}$	71.9	75.9			
$3 \times 2$	64.0	73.4			
$4 \times 3$	83.8	91.4			

**GENERAL NOTES:**

- Dimensions are in millimeters.
- For dimensions not given, see Table 3.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

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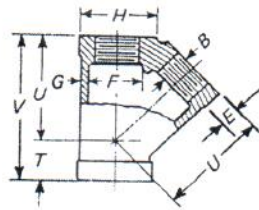
Table 5 Dimensions of Class 150 Tees (Reducing Sizes)



NPS	Center-to-End			NPS	Center-to-End			NPS	Center-to-End		
	X	Y	Z		X	Y	Z		X	Y	Z
1/4 x 1/4 x 1/8	18.8	18.8	19.3	1 1/4 x 1 x 1	40.1	38.1	42.4	2 x 3/4 x 2	57.2	50.0	57.2
1/8 x 1/8 x 1/4	19.3	19.3	18.8	1 1/4 x 1 x 3/4	36.8	34.8	41.2	2 x 1/2 x 2	57.2	47.8	57.2
3/8 x 3/8 x 1/4	22.4	22.4	22.9	1 1/4 x 1 x 1/2	34.0	32.0	38.9	1 1/2 x 1 1/2 x 2	54.9	54.9	51.3
3/8 x 3/8 x 1/8	20.6	20.6	21.6	1 1/4 x 3/4 x 1 1/4	44.5	41.2	44.5	1 1/4 x 1 1/4 x 2	53.3	58.3	48.3
3/8 x 1/4 x 3/8	24.1	22.9	24.1	1 1/4 x 3/4 x 1	40.1	36.8	42.4	1 x 1 x 2	51.3	51.3	48.9
3/8 x 1/4 x 1/4	22.4	20.6	22.9	1 1/4 x 3/4 x 3/4	36.8	33.3	41.2	2 1/2 x 2 1/2 x 2	60.7	60.7	66.0
1/4 x 1/4 x 3/8	22.9	22.9	22.4	1 1/4 x 1/2 x 1 1/4	44.5	38.9	44.5	2 1/2 x 2 1/2 x 1 1/2	54.9	54.9	63.8
1/2 x 1/2 x 3/8	26.4	26.4	26.2	1 1/4 x 1/2 x 1	40.1	34.5	42.4	2 1/2 x 2 1/2 x 1 1/4	51.8	51.8	62.2
1/2 x 1/2 x 1/4	24.6	24.6	24.9	1 x 1 x 1 1/4	42.4	42.4	40.1	2 1/2 x 2 1/2 x 1	47.5	47.5	60.2
1/2 x 3/8 x 1/2	28.5	26.2	28.5	3/4 x 3/4 x 1 1/4	41.2	41.2	36.8	2 1/2 x 2 1/2 x 3/4	44.2	44.2	58.9
1/2 x 3/8 x 3/8	26.4	24.1	26.2	1 1/2 x 1 1/2 x 1 1/4	46.2	46.2	47.8	2 1/2 x 2 x 2 1/2	68.6	66.0	68.6
1/2 x 1/4 x 1/2	28.5	24.9	28.5	1 1/2 x 1 1/2 x 1	41.9	41.9	45.7	2 1/2 x 2 x 2	60.7	57.2	66.0
3/8 x 3/8 x 1/2	26.2	26.2	26.4	1 1/2 x 1 1/2 x 3/4	38.6	38.6	44.5	2 1/2 x 1 1/2 x 2 1/2	68.6	63.8	68.6
3/4 x 3/4 x 1/2	30.5	30.5	31.0	1 1/2 x 1 1/2 x 1/2	35.8	35.8	42.2	2 1/2 x 1 1/2 x 2	60.7	54.9	66.0
3/4 x 3/4 x 3/8	28.5	28.5	28.7	1 1/2 x 1 1/4 x 1 1/2	49.3	47.8	49.3	2 x 2 x 2 1/2	66.0	66.0	60.7
3/4 x 3/4 x 1/4	26.7	26.7	27.4	1 1/2 x 1 1/4 x 1 1/4	46.2	44.5	47.8	3 x 3 x 2 1/2	71.9	71.9	76.0
3/4 x 1/2 x 3/4	33.3	31.0	33.3	1 1/2 x 1 1/4 x 1	41.9	40.1	45.7	3 x 3 x 2	64.0	64.0	73.4
3/4 x 1/2 x 1/2	30.5	28.5	31.0	1 1/2 x 1 1/4 x 3/4	38.6	36.3	44.5	3 x 3 x 1 1/2	58.2	58.2	71.1
3/4 x 1/2 x 3/8	28.5	26.4	28.7	1 1/2 x 1 1/4 x 1/2	35.8	34.0	42.2	3 x 3 x 1 1/4	55.1	55.1	69.6
3/4 x 3/8 x 3/4	33.3	28.7	33.3	1 1/2 x 1 x 1 1/2	49.3	45.7	49.3	3 x 3 x 1	50.8	50.8	67.6
3/4 x 3/8 x 3/8	28.5	24.1	28.7	1 1/2 x 1 x 1 1/4	46.2	42.4	47.8	3 x 3 x 3/4	47.5	47.5	66.3
3/4 x 1/4 x 3/4	33.3	27.4	33.3	1 1/2 x 1 x 1	41.9	38.1	45.7	3 x 2 1/2 x 3	78.2	76.0	78.2
1/2 x 1/2 x 3/4	31.0	31.0	30.5	1 1/2 x 3/4 x 1 1/2	49.3	44.5	49.3	3 x 2 1/2 x 2 1/2	71.9	68.6	76.0
1 x 1 x 3/4	34.8	34.8	36.8	1 1/2 x 1 1/2 x 1 1/2	49.3	42.2	49.3	3 x 2 1/2 x 2	64.0	60.7	73.4
1 x 1 x 1/2	32.0	32.0	35.5	1 1/4 x 1 1/4 x 1 1/2	47.8	47.8	46.2	3 x 2 x 3	78.2	73.4	78.2
1 x 1 x 3/8	30.0	30.0	32.3	1 x 1 x 1 1/2	45.7	45.7	41.9	3 x 2 x 2	64.0	57.2	73.4
1 x 1 x 1/4	28.2	28.2	31.0	2 x 2 x 1 1/2	51.3	51.3	54.9	2 1/2 x 2 1/2 x 3	76.0	76.0	71.9
1 x 3/4 x 1	38.1	36.8	38.1	2 x 2 x 1 1/4	48.3	48.3	53.3	3 1/2 x 3 1/2 x 2 1/2	74.4	74.4	82.3
1 x 3/4 x 3/4	34.8	33.3	36.8	2 x 2 x 1	43.9	43.9	51.3	4 x 4 x 3	83.8	83.8	91.4
1 x 3/4 x 1/2	32.0	30.5	35.5	2 x 2 x 3/4	40.6	40.6	50.0	4 x 4 x 2 1/2	77.5	77.5	89.2
1 x 1/2 x 1	38.1	35.5	38.1	2 x 2 x 1/2	37.9	37.9	47.8	4 x 4 x 2	69.6	69.6	86.6
1 x 1/2 x 3/4	34.8	31.0	36.8	2 x 1 1/2 x 2	57.2	54.8	57.2	4 x 4 x 1 1/2	63.8	63.8	84.3
1 x 1/2 x 1/2	32.0	38.5	35.5	2 x 1 1/2 x 1 1/2	51.3	49.3	54.9	4 x 3 x 4	96.3	91.4	96.3
3/4 x 3/4 x 1	36.8	36.8	34.8	2 x 1 1/2 x 1 1/4	48.3	46.2	53.3	3 x 3 x 4	91.4	91.4	83.8
1/2 x 1/2 x 1	34.6	34.6	32.0	2 x 1 1/2 x 1	43.9	41.9	51.3	5 x 5 x 3	89.2	89.2	107.2
1 1/4 x 1 1/4 x 1	40.1	40.1	42.4	2 x 1 1/4 x 2	57.2	53.3	57.2	6 x 6 x 4	104.9	104.9	125.5
1 1/4 x 1 1/4 x 3/4	36.8	36.8	41.2	2 x 1 1/4 x 1 1/2	51.3	47.8	54.9	6 x 6 x 3	92.5	92.5	120.7
1 1/4 x 1 1/4 x 1/2	34.0	34.0	38.9	2 x 1 1/4 x 1 1/4	48.3	44.5	53.3	6 x 6 x 2 1/2	86.1	86.1	118.4
1 1/4 x 1 1/4 x 3/8	32.0	32.0	36.6	2 x 1 x 2	57.2	51.3	57.2	6 x 6 x 2	78.2	78.2	115.8
1 1/4 x 1 x 1 1/4	44.5	42.4	44.5	2 x 1 x 1 1/2	51.3	45.7	54.9				

GENERAL NOTES:

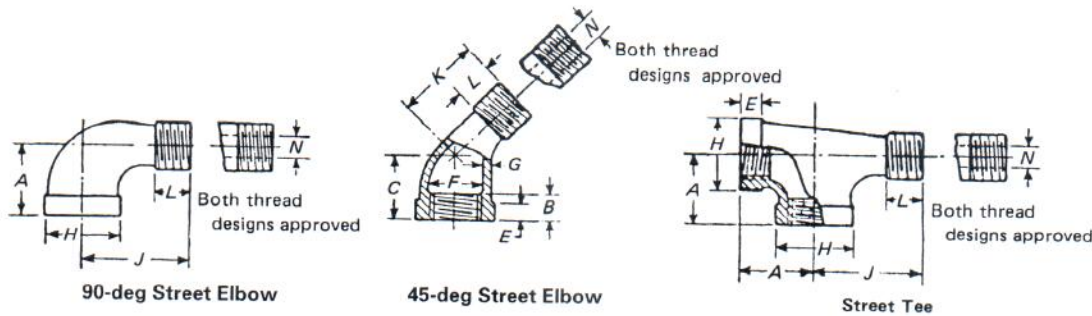
- (a) Dimensions are in millimeters.
- (b) For dimensions not given, see Table 3.
- (c) Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

**Table 6 Dimensions of Class 150 45-deg Y-Branches (Straight Sizes)**

NPS	Minimum Length of Thread, <i>B</i>	Minimum Width of Band, <i>E</i>	Inside Diameter of Fitting, <i>F</i>		Metal Thickness, <i>G</i>	Minimum Outside Diameter of Band, <i>H</i>	Center-to-End Inlet, <i>T</i>	Center-to-End Outlet, <i>U</i>	End-to-End, <i>V</i>
			Min.	Max.					
$\frac{3}{8}$	9.1	5.8	17.1	18.3	2.54	25.8	12.7	36.3	49.0
$\frac{1}{2}$	10.9	6.3	21.3	22.8	2.67	30.4	15.5	43.4	58.9
$\frac{3}{4}$	12.7	6.9	26.7	28.1	3.05	37.0	18.3	52.1	70.4
1	14.7	7.6	33.4	35.2	3.40	45.0	21.6	61.7	83.3
$1\frac{1}{4}$	17.0	8.7	42.2	43.9	3.68	54.7	25.9	74.2	100.1
$1\frac{1}{2}$	17.8	9.3	48.3	50.0	3.94	61.6	27.9	83.3	111.3
2	19.1	10.7	60.3	62.1	4.39	75.3	37.5	99.8	131.3
$2\frac{1}{2}$	23.4	12.1	73.0	75.6	5.33	91.2	38.6	120.1	158.8
3	24.9	13.9	88.9	91.4	5.87	108.8	43.4	141.0	184.4
4	27.4	16.8	114.4	116.8	6.73	137.2	51.1	177.0	228.1

GENERAL NOTE: Dimensions are in millimeters.

Table 7 Dimensions of Class 150 Street Tees and 90-deg and 45-deg Street Elbows



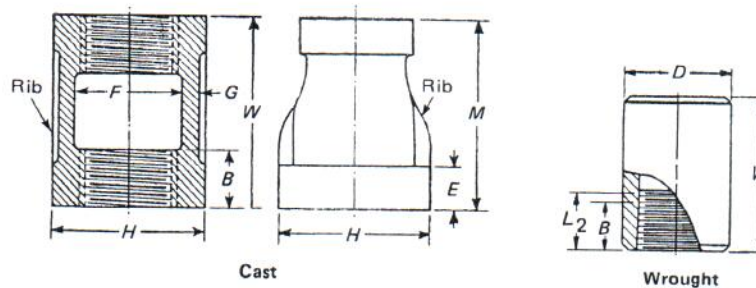
NPS	Center-to-End Elbows and Tees, A	Center-to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Center-to-Male End Elbows and Tees, J	Center-to-Male End 45-deg Elbows, K	Minimum Length of External Thread, L	Maximum Port Diameter Male End, N
	[Note (1)]				Min.	Max.						
1/8	17.5	...	6.4	5.1	10.3	11.0	2.29	17.6	25.4	...	6.70	5.1
1/4	20.6	18.5	8.1	5.5	13.7	14.8	2.41	21.4	[Note (1)]	23.9	10.20	6.6
3/8	24.1	20.3	9.1	5.8	17.1	18.3	2.54	25.8	30.2	26.2	10.36	9.4
1/2	28.5	22.4	10.9	6.3	21.3	22.8	2.67	30.4	41.2	29.2	13.56	13.0
3/4	33.3	24.9	12.7	6.9	26.7	28.1	3.05	37.0	48.0	32.8	13.86	17.5
1	38.1	28.5	14.7	7.7	33.4	35.2	3.40	45.0	54.4	37.3	17.34	23.1
1 1/4	44.5	32.8	17.0	8.7	42.2	43.9	3.68	54.7	62.2	43.4	17.94	30.2
1 1/2	49.3	36.3	17.8	9.3	48.3	50.0	3.94	61.6	68.3	47.8	18.38	35.3
2	57.2	42.7	19.1	10.7	60.3	62.1	4.39	75.3	82.8	56.4	19.22	45.5
2 1/2	68.6	49.5	23.4	12.1	73.0	75.6	5.33	91.2	98.0	65.3	28.96	55.9
[Note (1)]									[Note (1)]			
3	78.2	55.1	24.9	13.9	88.9	91.4	5.87	108.8	114.6	76.2	30.48	70.6
[Note (1)]									[Note (1)]			
4	96.3	66.3	27.4	16.8	114.4	116.8	6.73	137.2	144.5	94.0	33.02	94.0
5	114.3	...	30.0	19.8	141.3	143.8	7.62	167.2	174.2	...	35.72	119.1
[Note (1)]									[Note (1)]			
6	130.3	...	32.5	22.9	168.3	170.8	8.53	197.4	204.0	...	38.42	144.0
[Note (1)]									[Note (1)]			

GENERAL NOTE: Dimensions are in millimeters.

NOTE:

(1) This dimension applies to street elbows only. Street tees are not made in these sizes.

Table 8 Dimensions of Class 150 Couplings (Straight and Reducing Sizes)



NPS	Minimum Length of Thread		Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Thickness of Ribs	Length of Straight Couplings, W	Length of Reducing Concentric Couplings, M [Notes (1) and (2)]	Steel Couplings [Notes (2) and (3)]	
	B	L <sub>2</sub>		Min.	Max.						Length, W	Outside Diameter, D
1/8	6.4	6.7	5.1	10.3	11.0	2.29	17.6	2.29	24.2	...	20.7	14.3
1/4	8.1	10.2	5.5	13.7	14.8	2.41	21.4	2.41	26.9	25.4	30.2	18.3
3/8	9.1	10.4	5.8	17.1	18.3	2.54	25.8	2.54	29.5	28.7	30.2	22.2
1/2	10.9	...	6.3	21.3	22.8	2.67	30.4	2.67	34.0	31.8	...	...
3/4	12.7	...	6.9	26.7	28.1	3.05	37.0	3.05	38.6	36.6	...	...
1	14.7	...	7.7	33.4	35.2	3.40	45.0	3.40	42.4	42.9	...	...
1 1/4	17.0	...	8.7	42.2	43.9	3.68	54.7	3.60	49.0	52.3	...	...
1 1/2	17.8	...	9.3	48.3	50.0	3.94	61.6	3.84	54.6	58.7	...	...
2	19.1	...	10.7	60.3	62.1	4.39	75.3	4.39	64.3	71.4	...	...
2 1/2	23.4	...	12.1	73.0	75.6	5.33	91.2	5.33	73.2	82.6	...	...
3	24.9	...	13.9	88.9	91.4	5.87	108.8	5.87	80.8	93.7	...	...
4	27.4	...	16.8	114.4	116.8	6.73	137.2	6.73	93.7	111.3	...	...

## GENERAL NOTES:

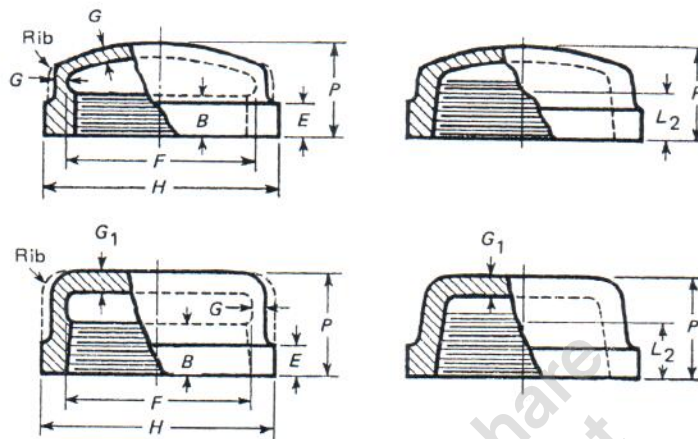
(a) Dimensions are in millimeters.

(b) Right- and left-hand pattern couplings are standard only in sizes up to and including NPS 2.

## NOTES:

- (1) Dimension M for all reduction of reducing couplings (concentric only) shall be the same as shown for the largest opening. Dimension M for eccentric couplings is not standard; such information should be obtained from the manufacturer.
- (2) Couplings NPS 3/8 and smaller may be cast or made from steel rod with a minimum yield strength of 207 MPa at the option of the manufacturer.
- (3) Steel couplings are made without recess. Dimension B for steel couplings is the minimum length of perfect thread, and the length of useful thread (B plus threads with fully formed roots and flat crests) shall be not less than L<sub>2</sub> (effective length of external thread) required by ANSI/ASME B1.20.1. See section 8.

Table 9 Dimensions of Class 150 Caps



NPS	Minimum Length of Thread		Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness of Side, G	Minimum Outside Diameter of Band, H [Note (1)]	Minimum Height, P [Note (2)]	Thickness of Ribs	Thickness of Flat Top Caps, G <sub>1</sub>
	B	L <sub>2</sub>		Min.	Max.					
1/8	6.4	6.7	5.1	10.3	11.0	2.29	17.6	13.5	...	...
1/4	8.1	10.2	5.5	13.7	14.8	2.41	21.4	16.0	...	...
3/8	9.1	10.4	5.8	17.1	18.3	2.54	25.8	18.8	...	...
1/2	10.9	13.6	6.3	21.3	22.8	2.67	30.4	22.1	3.67	...
3/4	12.7	13.9	6.9	26.7	28.1	3.05	37.0	24.6	3.05	3.30
1	14.7	17.3	7.7	33.4	35.2	3.40	45.0	29.5	3.40	3.81
1 1/4	17.0	18.0	8.7	42.2	43.9	3.68	54.7	32.5	3.68	4.32
1 1/2	17.8	18.4	9.3	48.3	50.0	3.94	61.6	33.8	3.94	4.83
2	19.1	19.2	10.7	60.3	62.1	4.39	75.3	36.8	4.39	5.59
2 1/2	23.4	28.9	12.1	73.0	75.6	5.33	91.3	43.2	5.33	6.35
3	24.9	30.5	13.9	88.9	91.4	5.87	108.8	45.7	5.87	7.37
3 1/2	26.2	31.8	15.3	101.6	104.1	6.30	123.0	48.3	6.30	7.62
4	27.4	33.0	16.9	114.4	116.8	6.73	137.2	52.8	6.73	9.14
5	30.0	35.7	19.8	141.3	143.8	7.62	167.2	58.9	7.62	...
6	32.5	38.4	22.9	168.3	170.8	8.53	197.3	64.8	8.53	...

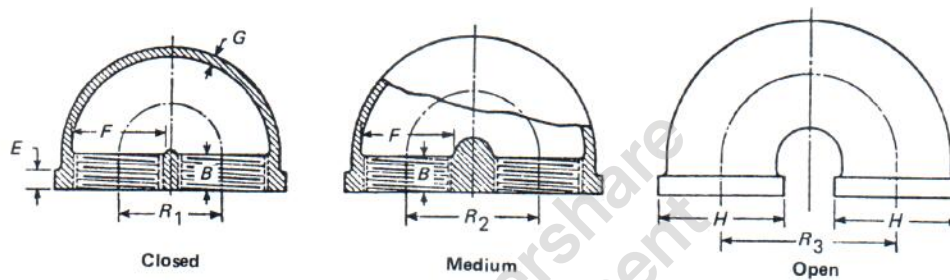
GENERAL NOTE: Dimensions are in millimeters.

## NOTES:

- (1) Caps sizes 1/8, 1/4, and 3/8 may be malleable castings or made from steel rod with a minimum yield strength of 207 MPa at the option of the manufacturer. When made from steel rod, diameters shall be 14.3, 17.4, and 21.4, respectively. Caps made from steel rod have no recess.
- (2) Caps may be made without recess. Caps so made shall be of such height, P, that the length of perfect thread shall be not less than B, and the length of useful thread (B plus threads with fully formed roots and flat crests) shall be not less than L<sub>2</sub> (effective length of external thread) required by ANSI/ASME B1.20.1.

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Table 10 Dimensions of Class 150 Closed-, Medium-, and Open-Pattern Return Bends



NPS	Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fitting, $F$		Metal Thickness, $G$	Minimum Outside Diameter of Band, $H$	Center-to-Center (Closed Pattern), $R_1$	Center-to-Center (Medium Pattern), $R_2$	Center-to-Center (Open Pattern), $R_3$
			Min.	Max.					
$\frac{1}{2}$	10.9	6.3	21.3	22.8	2.95	30.4	25.4	31.8	38.1
$\frac{3}{4}$	12.7	6.9	26.7	28.1	3.38	37.0	31.6	38.1	50.8
1	14.7	7.7	33.3	35.2	3.81	45.0	38.1	47.6	63.5
$1\frac{1}{4}$	17.0	8.7	42.2	43.9	4.19	54.7	44.5	57.2	76.2
$1\frac{1}{2}$	17.8	9.3	48.3	50.0	4.52	61.6	55.6	63.5	88.9
2	19.1	10.7	60.3	62.1	5.11	75.3	66.8	76.2	101.6
$2\frac{1}{2}$	23.4	12.1	73.0	75.8	6.20	91.2	...	...	114.3
3	24.9	13.9	88.9	91.4	6.91	108.8	...	...	127.0
4	27.4	16.8	114.4	116.8	7.87	137.2	...	...	152.4

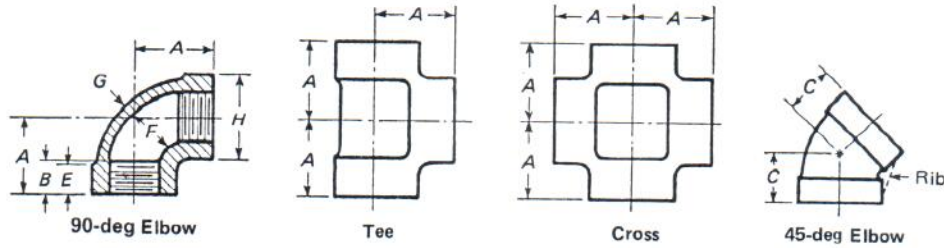
## GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) It is permissible to furnish closed-pattern return bends not banded. Closed-pattern return bends will not make up equally spaced coils, as the distance center-to-center of two adjacent bends is greater than the center-to-center of openings of a single bend.



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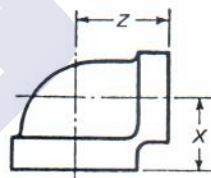
**Table 11 Dimensions of Class 300 90-deg Elbows, Tees, and Crosses, and 45-deg Elbows (Straight Sizes)**



NPS	Center-to-End Elbows, Tees, and Crosses, A	Center-to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H
					Min.	Max.		
1/4	23.9	20.6	10.9	9.7	13.7	14.8	3.6	23.6
3/8	26.9	22.4	11.9	11.2	17.1	18.3	3.8	28.5
1/2	31.8	25.4	14.5	12.7	21.3	22.8	4.1	34.0
3/4	35.6	28.7	16.3	14.2	26.7	28.1	4.6	41.4
1	41.4	33.3	19.1	15.8	33.4	35.2	5.1	49.5
1 1/4	49.3	38.1	21.3	17.5	42.2	43.9	5.6	60.7
1 1/2	54.1	42.9	22.1	19.1	48.3	50.0	6.1	68.1
2	63.5	50.8	25.4	21.3	60.3	62.1	6.6	83.3
2 1/2	74.7	57.2	29.7	23.9	73.0	75.6	7.9	98.0
3	85.9	63.5	31.2	25.4	88.9	91.4	8.9	117.3

GENERAL NOTE: Dimensions are in millimeters.

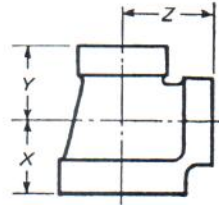
**Table 12 Center-to-End Dimensions of Class 300 90-deg Elbows (Reducing Sizes)**



NPS	Center-to-End	
	X	Z
1/2 x 3/8	30.2	30.2
3/4 x 1/2	33.3	35.1
1 x 3/4	38.1	39.6
1 1/4 x 1	44.5	46.0
1 1/2 x 1 1/4	50.8	52.3
2 x 1 1/2	57.2	60.5
2 1/2 x 2	68.3	69.9
3 x 2 1/2	77.7	84.1

GENERAL NOTES:

- (a) Dimensions are in millimeters.
- (b) For dimensions not given, see Table 11.
- (c) Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

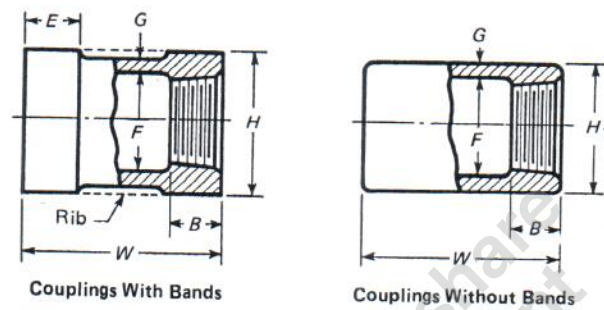
**Table 13 Center-to-End Dimensions of Class 300 Tees (Reducing Sizes)**


NPS	Center-to-End		
	X	Y	Z
$\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$	30.2	30.2	30.2
$\frac{1}{2} \times \frac{3}{8} \times \frac{1}{2}$	31.8	30.2	31.8
$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$	33.3	33.3	35.1
$\frac{3}{4} \times \frac{1}{2} \times \frac{3}{4}$	36.6	35.1	36.6
$1 \times 1 \times \frac{3}{4}$	38.1	38.1	39.6
$1 \times 1 \times \frac{1}{2}$	36.6	36.6	38.1
$1 \times 1 \times \frac{3}{8}$	33.3	33.3	36.6
$1 \times \frac{3}{4} \times 1$	41.4	39.6	41.4
$1\frac{1}{4} \times 1\frac{1}{4} \times 1$	44.5	44.5	46.0
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4}$	41.4	41.4	44.5
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{2}$	38.1	38.1	42.9
$1\frac{1}{4} \times 1 \times 1\frac{1}{4}$	49.3	46.0	49.3
$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4}$	50.8	50.8	52.3
$1\frac{1}{2} \times 1\frac{1}{2} \times 1$	46.0	46.0	50.8
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$	42.9	42.9	47.6
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$	41.4	41.4	46.0
$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{2}$	54.1	52.3	54.1
$2 \times 2 \times 1\frac{1}{2}$	57.2	57.2	60.5
$2 \times 2 \times 1\frac{1}{4}$	54.1	54.1	58.7
$2 \times 2 \times 1$	50.8	50.8	57.2
$2 \times 2 \times \frac{3}{4}$	46.0	46.0	54.1
$2 \times 2 \times \frac{1}{2}$	44.5	44.5	52.3
$2 \times 1\frac{1}{2} \times 2$	63.5	60.5	63.5
$2\frac{1}{2} \times 2\frac{1}{2} \times 2$	68.3	68.3	70.0
$2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$	62.0	62.0	66.8
$2\frac{1}{2} \times 2 \times 2\frac{1}{2}$	74.7	70.0	74.7
$3 \times 3 \times 2\frac{1}{2}$	77.7	77.7	84.1
$3 \times 3 \times 2$	71.4	71.4	79.5
$3 \times 2\frac{1}{2} \times 3$	85.9	84.1	85.9

**GENERAL NOTES:**

- Dimensions are in millimeters.
- For dimensions not given, see Table 11.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

Table 14 Dimensions of Class 300 Couplings



NPS	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Coupling, $H_1$ [Note (1)]	Minimum Outside Diameter of Band, H [Note (2)]	Length of Straight Coupling, W
			Min.	Max.				
1/4	10.9	9.7	13.7	14.8	3.6	20.8	23.6	35.1
3/8	11.9	11.2	17.1	18.3	3.8	24.7	28.5	41.4
1/2	14.5	12.7	21.3	22.8	4.1	29.5	34.0	47.8
3/4	16.3	14.2	26.7	28.2	4.6	35.8	41.4	54.1
1	19.1	15.8	33.4	35.0	5.1	43.7	49.5	60.5
1 1/4	21.3	17.5	42.2	43.9	5.6	53.4	60.7	73.2
1 1/2	22.1	19.1	48.3	50.0	6.1	60.5	68.1	73.2
2	25.4	21.3	60.3	62.0	6.6	73.4	83.3	92.2
2 1/2	29.7	23.9	73.0	75.4	7.9	88.7	98.0	104.9
3	31.2	25.4	88.9	91.4	8.9	106.7	117.3	104.9

GENERAL NOTE: Dimensions are in millimeters.

NOTES:

(1)  $H_1$  diameter is standard for coupling without bands;  $H_1 = F \text{ min.} + 2G$ .

(2) Minimum H is for couplings with bands and is optional with the manufacturer. For information on ribs, see section 9.

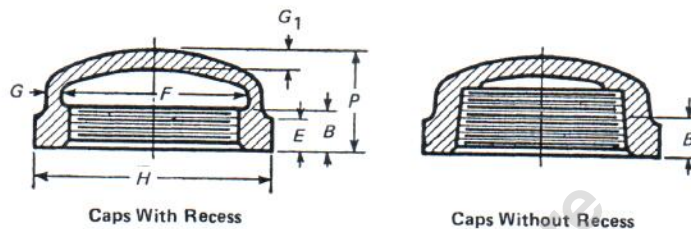
**Table 15 Dimensions of Class 300 Reducing Couplings**


NPS	Length, W
$\frac{3}{8} \times \frac{1}{4}$	36.6
$\frac{1}{2} \times \frac{3}{8}$	42.9
$\frac{1}{2} \times \frac{1}{4}$	42.9
$\frac{3}{4} \times \frac{1}{2}$	44.5
$\frac{3}{4} \times \frac{3}{8}$	44.5
$\frac{3}{4} \times \frac{1}{4}$	44.5
$1 \times \frac{3}{4}$	50.8
$1 \times \frac{1}{2}$	50.8
$1 \times \frac{3}{8}$	50.8
$1 \times \frac{1}{4}$	50.8
$1\frac{1}{4} \times 1$	60.5
$1\frac{1}{4} \times \frac{3}{4}$	60.5
$1\frac{1}{4} \times \frac{1}{2}$	60.5
$1\frac{1}{2} \times 1\frac{1}{4}$	68.3
$1\frac{1}{2} \times 1$	68.3
$1\frac{1}{2} \times \frac{3}{4}$	68.3
$1\frac{1}{2} \times \frac{1}{2}$	68.3
$2 \times 1\frac{1}{2}$	81.0
$2 \times 1\frac{1}{4}$	81.0
$2 \times 1$	81.0
$2 \times \frac{3}{4}$	81.0
$2 \times \frac{1}{2}$	81.0
$2\frac{1}{2} \times 2$	93.7
$2\frac{1}{2} \times 1\frac{1}{2}$	93.7
$3 \times 2\frac{1}{2}$	103.1
$3 \times 2$	103.1
$3 \times 1\frac{1}{2}$	103.1

**GENERAL NOTES:**

- Dimensions are in millimeters.
- For dimensions not given, see Table 11.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

Table 16 Dimensions of Class 300 Caps



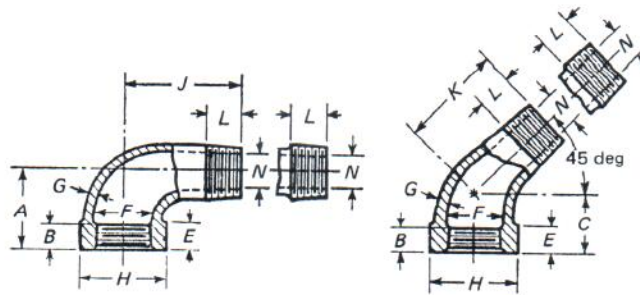
NPS	Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fitting, $F$		Metal Thickness		Minimum Outside Diameter of Band, $H$	Minimum Height, $P$ [Note (2)]
			Min.	Max.	Minimum $G$	Recommended $G_1$ [Note (1)]		
$\frac{1}{4}$	10.9	9.7	13.7	14.8	3.6	4.6	23.6	19.8
$\frac{3}{8}$	11.9	11.2	17.1	18.3	3.8	4.8	28.5	21.1
$\frac{1}{2}$	14.5	12.7	21.3	22.8	4.1	5.1	34.0	24.9
$\frac{3}{4}$	16.3	14.2	26.7	28.2	4.6	5.8	41.4	27.4
1	19.1	15.8	33.4	35.0	5.1	6.4	48.5	32.0
$1\frac{1}{4}$	21.3	17.5	42.2	43.9	5.6	7.1	60.7	35.1
$1\frac{1}{2}$	22.1	19.1	48.3	50.0	6.1	7.6	68.1	36.3
2	25.4	21.3	60.3	62.1	6.6	8.4	83.3	42.7
$2\frac{1}{2}$	29.7	23.9	73.0	75.6	7.9	9.9	98.0	52.3
3	31.2	25.4	88.9	91.4	8.9	11.2	117.3	55.1

GENERAL NOTE: Dimensions are in millimeters.

NOTES:

- (1) Dimension  $G_1$  is recommended but shall in no case be less than dimension  $G$ .
- (2) Dimension  $P$  may be varied to comply with manufacturer's practice, and, for caps without recess, shall be of such height that the length of effective thread shall be not less than  $B$ .

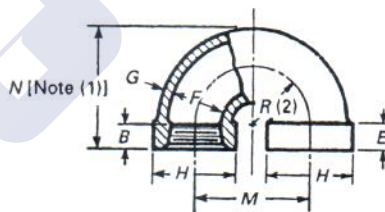
Table 17 Dimensions of Class 300 90-deg and 45-deg Street Elbows



NPS	90-deg Elbows		45-deg Elbows		Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Minimum Length of External Thread, L	Maximum Port Diameter Male End, N
	Center-to-End, A	Center-to-Male End, J	Center-to-End, C	Center-to-Male End, K			Min.	Max.				
1/4	23.9	36.6	...	...	10.9	9.7	13.7	14.8	3.6	23.6	10.2	6.6
3/8	26.9	41.4	...	...	11.9	11.2	17.1	18.3	3.8	28.5	10.4	9.1
1/2	31.8	50.8	25.4	35.1	14.5	12.7	21.3	22.8	4.1	34.0	13.5	12.5
3/4	36.6	55.6	28.7	39.6	16.3	14.2	26.7	28.1	4.6	41.4	14.0	17.0
1	41.4	65.0	33.3	46.0	19.1	15.8	33.4	35.2	5.1	49.5	17.3	22.4
1 1/4	49.3	73.2	38.1	54.1	21.3	17.5	42.2	43.9	5.6	60.7	18.0	29.5
1 1/2	54.1	79.5	42.9	58.7	22.1	19.1	48.3	50.0	6.1	68.1	18.3	34.3
2	63.5	93.7	50.8	68.3	25.4	21.3	60.3	62.1	6.6	83.3	19.3	44.5
2 1/2	74.7	114.3	...	...	29.7	23.9	73.0	75.6	7.9	98.0	29.0	54.9
3	85.9	130.3	...	...	31.2	25.4	88.9	91.4	8.9	117.3	30.5	67.8

GENERAL NOTE: Dimensions are in millimeters.

Table 18 Dimensions of Class 300 Return Bends



NPS	Center-to-Center, M			Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G [Note (3)]	Minimum Outside Diameter of Band, H
	Closed Pattern	Medium Pattern	Open Pattern			Min.	Max.		
1	44.5	63.5	76.2	19.1	15.8	33.4	35.2	5.1	49.5
1 1/4	57.2	63.5	76.2	21.3	17.5	42.2	43.9	5.6	60.7
1 1/2	76.2	88.9	152.4	22.1	18.1	48.3	50.0	6.1	68.1
2	101.6	152.4	203.2	25.4	21.3	60.3	62.1	6.6	83.3

GENERAL NOTE: Dimensions are in millimeters.

NOTES:

- (1) Dimension N may be varied to comply with manufacturer's practice.
- (2) It is recommended that the distance from the end of the fitting to the center of the radius, R, be approximately equal to the dimension B; radius, R, is recommended as being one-half of dimension M.
- (3) It is recommended that G for return bends be increased by 10% or more.

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## MANDATORY APPENDIX I DIMENSIONS OF FITTINGS IN U.S. CUSTOMARY UNITS

This Appendix provides tables of the standard inch dimensions for fittings (Tables I-1 through I-18).

**Table I-1 Pressure-Temperature Ratings**

Temperature, °F	Working Pressure, psi			
	Class 150	Class 300		
		NPS		
		1/4-1	1 1/4-2	2 1/2-3
-20 to 150	300	2,000	1,500	1,000
200	265	1,785	1,350	910
250	225	1,575	1,200	825
300	185	1,360	1,050	735
350	150 [Note (1)]	1,150	900	650
400	...	935	750	560
450	...	725	600	475
500	...	510	450	385
550	...	300	300	300

NOTE:

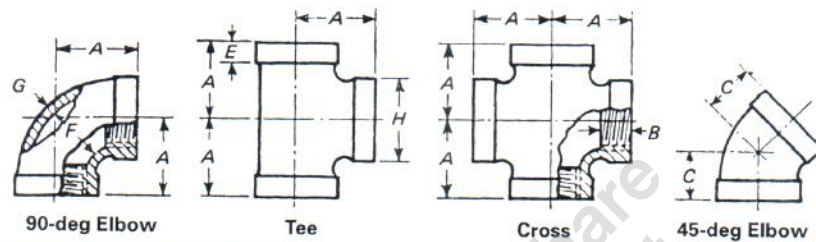
- (1) Permissible for service temperature up to 366°F, reflecting the temperature of saturated steam at 150 psi.

**Table I-2 Inspection Tolerances**

NPS	Tolerance, in.
1/8	±0.03
1/4	±0.04
3/8	±0.05
1/2, 3/4	±0.06
1, 1 1/4	±0.07
1 1/2, 2	±0.08
2 1/2, 3, 3 1/2	±0.10
4, 5	±0.12
6	±0.14



**Table I-3 Dimensions of Class 150 90-deg Elbows, Tees, and Crosses, and 45-deg Elbows (Straight Sizes)**

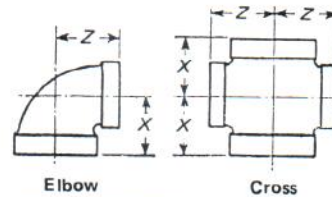


NPS	Center-to-End, Elbows, Tees, and Crosses, A [Note (1)]	Center- to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H
					Min.	Max.		
1/8	0.69	...	0.25	0.20	0.40	0.43	0.09	0.69
1/4	0.81	0.73	0.32	0.21	0.54	0.58	0.09	0.84
3/8	0.95	0.80	0.36	0.23	0.67	0.72	0.10	1.01
1/2	1.12	0.88	0.43	0.25	0.84	0.90	0.10	1.20
3/4	1.31	0.98	0.50	0.27	1.05	1.11	0.12	1.46
1	1.50	1.12	0.58	0.30	1.31	1.38	0.13	1.77
1 1/4	1.75	1.29	0.67	0.34	1.66	1.73	0.14	2.15
1 1/2	1.94	1.43	0.70	0.37	1.90	1.97	0.15	2.43
2	2.25	1.68	0.75	0.42	2.37	2.44	0.17	2.96
2 1/2	2.70	1.95	0.92	0.48	2.87	2.97	0.21	3.59
3	3.08	2.17	0.98	0.55	3.50	3.60	0.23	4.28
3 1/2	3.42	2.39	1.03	0.60	4.00	4.10	0.25	4.84
4	3.79	2.61	1.08	0.66	4.50	4.60	0.26	5.40
5	4.50	3.05	1.18	0.78	5.56	5.66	0.30	6.58
6	5.13	3.46	1.28	0.90	6.62	6.72	0.34	7.77

GENERAL NOTE: Dimensions are in inches.

NOTE:

(1) Dimensions for reducing elbows and reducing crosses are given in Table I-4 and dimensions for reducing tees in Table I-5.

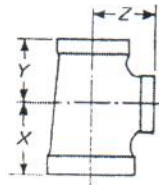
**Table I-4 Dimensions of Class 150 90-deg Elbows and Crosses (Reducing Sizes)**

Elbows			Crosses		
NPS	Center-to-End		NPS	Center-to-End	
	X	Z		X	Z
$\frac{1}{4} \times \frac{1}{8}$	0.74	0.76	$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2} \times \frac{1}{2}$	1.20	1.22
$\frac{3}{8} \times \frac{1}{4}$	0.88	0.90	$1 \times 1 \times \frac{3}{4} \times \frac{3}{4}$	1.37	1.45
$\frac{3}{8} \times \frac{1}{8}$	0.81	0.85	$1 \times 1 \times \frac{1}{2} \times \frac{1}{2}$	1.26	1.36
$\frac{1}{2} \times \frac{3}{8}$	1.04	1.03	$1\frac{1}{4} \times 1\frac{1}{4} \times 1 \times 1$	1.58	1.67
$\frac{1}{2} \times \frac{1}{4}$	0.97	0.98	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4} \times \frac{3}{4}$	1.45	1.62
$\frac{3}{4} \times \frac{1}{2}$	1.20	1.22	$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$	1.82	1.88
$\frac{3}{4} \times \frac{3}{8}$	1.12	1.13	$1\frac{1}{2} \times 1\frac{1}{2} \times 1 \times 1$	1.65	1.80
$\frac{3}{4} \times \frac{1}{4}$	1.05	1.08	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4} \times \frac{3}{4}$	1.52	1.75
$1 \times \frac{3}{4}$	1.37	1.45	$2 \times 2 \times 1\frac{1}{2} \times 1\frac{1}{2}$	2.02	2.16
$1 \times \frac{1}{2}$	1.26	1.36	$2 \times 2 \times 1\frac{1}{4} \times 1\frac{1}{4}$	1.90	2.10
$1 \times \frac{3}{8}$	1.18	1.27	$2 \times 2 \times 1 \times 1$	1.73	2.02
$1\frac{1}{4} \times 1$	1.58	1.67	$2 \times 2 \times \frac{3}{4} \times \frac{3}{4}$	1.60	1.97
$1\frac{1}{4} \times \frac{3}{4}$	1.45	1.62	$2\frac{1}{2} \times 2\frac{1}{2} \times 2 \times 2$	2.39	2.60
$1\frac{1}{4} \times \frac{1}{2}$	1.34	1.53	$3 \times 3 \times 2 \times 2$	2.52	2.89
$1\frac{1}{2} \times 1\frac{1}{4}$	1.82	1.88			
$1\frac{1}{2} \times 1$	1.65	1.80			
$1\frac{1}{2} \times \frac{3}{4}$	1.52	1.75			
$2 \times 1\frac{1}{2}$	2.02	2.16			
$2 \times 1\frac{1}{4}$	1.90	2.10			
$2 \times 1$	1.73	2.02			
$2 \times \frac{3}{4}$	1.60	1.97			
$2\frac{1}{2} \times 2$	2.39	2.60			
$2\frac{1}{2} \times 1\frac{1}{2}$	2.16	2.51			
$3 \times 2\frac{1}{2}$	2.83	2.99			
$3 \times 2$	2.52	2.89			
$4 \times 3$	3.30	3.60			

**GENERAL NOTES:**

- Dimensions are in inches.
- For dimensions not given, see Table I-3.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

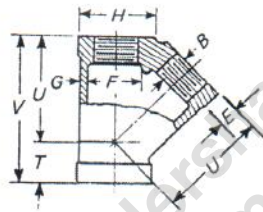
Table I-5 Dimensions of Class 150 Tees (Reducing Sizes)



NPS	Center-to-End			NPS	Center-to-End			NPS	Center-to-End		
	X	Y	Z		X	Y	Z		X	Y	Z
1/4 x 1/4 x 1/8	0.74	0.74	0.76	1 1/4 x 1 x 1	1.58	1.50	1.67	2 x 3/4 x 2	2.25	1.97	2.25
1/8 x 1/8 x 1/4	0.76	0.76	0.74	1 1/4 x 1 x 3/4	1.45	1.37	1.62	2 x 1/2 x 2	2.25	1.88	2.25
3/8 x 3/8 x 1/4	0.88	0.88	0.90	1 1/4 x 1 x 1/2	1.34	1.26	1.53	1 1/2 x 1 1/2 x 2	2.16	2.16	2.02
3/8 x 3/8 x 1/8	0.81	0.81	0.85	1 1/4 x 3/4 x 1 1/4	1.75	1.62	1.75	1 1/4 x 1 1/4 x 2	2.10	2.10	1.90
3/8 x 1/4 x 3/8	0.95	0.90	0.95	1 1/4 x 3/4 x 1	1.58	1.45	1.67	1 x 1 x 2	2.02	2.02	1.73
3/8 x 1/4 x 1/4	0.88	0.81	0.90	1 1/4 x 3/4 x 3/4	1.45	1.31	1.62	2 1/2 x 2 1/2 x 2	2.39	2.39	2.60
1/4 x 1/4 x 3/8	0.90	0.90	0.88	1 1/4 x 1/2 x 1 1/4	1.75	1.53	1.75	2 1/2 x 2 1/2 x 1 1/2	2.16	2.16	2.51
1/2 x 1/2 x 3/8	1.04	1.04	1.03	1 1/4 x 1/2 x 1	1.58	1.36	1.67	2 1/2 x 2 1/2 x 1 1/4	2.04	2.04	2.45
1/2 x 1/2 x 1/4	0.97	0.97	0.98	1 x 1 x 1 1/4	1.67	1.67	1.58	2 1/2 x 2 1/2 x 1	1.87	1.87	2.37
1/2 x 3/8 x 1/2	1.12	1.03	1.12	3/4 x 3/4 x 1 1/4	1.62	1.62	1.45	2 1/2 x 2 1/2 x 3/4	1.74	1.74	2.32
1/2 x 3/8 x 3/8	1.04	0.95	1.03	1 1/2 x 1 1/2 x 1 1/4	1.82	1.82	1.88	2 1/2 x 2 x 2 1/2	2.70	2.60	2.70
1/2 x 1/4 x 1/2	1.12	0.98	1.12	1 1/2 x 1 1/2 x 1	1.65	1.65	1.80	2 1/2 x 2 x 2	2.39	2.25	2.60
3/8 x 3/8 x 1/2	1.03	1.03	1.04	1 1/2 x 1 1/2 x 3/4	1.52	1.52	1.75	2 1/2 x 1 1/2 x 2 1/2	2.70	2.51	2.70
3/4 x 3/4 x 1/2	1.20	1.20	1.22	1 1/2 x 1 1/2 x 1/2	1.41	1.41	1.66	2 1/2 x 1 1/2 x 2	2.39	2.16	2.60
3/4 x 3/4 x 3/8	1.12	1.12	1.13	1 1/2 x 1 1/4 x 1 1/2	1.94	1.88	1.94	2 x 2 x 2 1/2	2.60	2.60	2.39
3/4 x 3/4 x 1/4	1.05	1.05	1.08	1 1/2 x 1 1/4 x 1 1/4	1.82	1.75	1.88	3 x 3 x 2 1/2	2.83	2.83	2.99
3/4 x 1/2 x 3/4	1.31	1.22	1.31	1 1/2 x 1 1/4 x 1	1.65	1.58	1.80	3 x 3 x 2	2.52	2.52	2.89
3/4 x 1/2 x 1/2	1.20	1.12	1.22	1 1/2 x 1 1/4 x 3/4	1.52	1.45	1.75	3 x 3 x 1 1/2	2.29	2.29	2.80
3/4 x 1/2 x 3/8	1.12	1.04	1.13	1 1/2 x 1 1/4 x 1/2	1.41	1.34	1.66	3 x 3 x 1 1/4	2.17	2.17	2.74
3/4 x 3/8 x 3/4	1.31	1.13	1.31	1 1/2 x 1 x 1 1/2	1.94	1.80	1.94	3 x 3 x 1	2.00	2.00	2.66
3/4 x 3/8 x 3/8	1.12	0.95	1.13	1 1/2 x 1 x 1 1/4	1.82	1.67	1.88	3 x 3 x 3/4	1.87	1.87	2.61
3/4 x 1/4 x 3/4	1.31	1.08	1.31	1 1/2 x 1 x 1	1.65	1.50	1.80	3 x 2 1/2 x 3	3.08	2.99	3.08
1/2 x 1/2 x 1/4	1.22	1.22	1.20	1 1/2 x 3/4 x 1 1/2	1.94	1.75	1.94	3 x 2 1/2 x 2 1/2	2.83	2.70	2.99
1 x 1 x 3/4	1.37	1.37	1.45	1 1/2 x 1/2 x 1 1/2	1.94	1.66	1.94	3 x 2 1/2 x 2	2.52	2.39	2.89
1 x 1 x 1/2	1.26	1.26	1.36	1 1/4 x 1 1/4 x 1 1/2	1.88	1.88	1.82	3 x 2 x 3	3.08	2.89	3.08
1 x 1 x 3/8	1.18	1.18	1.27	1 x 1 x 1 1/2	1.80	1.80	1.65	3 x 2 x 2	2.52	2.25	2.89
1 x 1 x 1/4	1.11	1.11	1.22	2 x 2 x 1 1/2	2.02	2.02	2.16	2 1/2 x 2 1/2 x 3	2.99	2.99	2.83
1 x 3/4 x 1	1.50	1.45	1.50	2 x 2 x 1 1/4	1.90	1.90	2.10	3 1/2 x 3 1/2 x 2 1/2	2.93	2.93	3.24
1 x 3/4 x 3/4	1.37	1.31	1.45	2 x 2 x 1	1.73	1.73	2.02	4 x 4 x 3	3.30	3.30	3.60
1 x 3/4 x 1/2	1.26	1.20	1.36	2 x 2 x 3/4	1.60	1.60	1.97	4 x 4 x 2 1/2	3.05	3.05	3.51
1 x 1/2 x 1	1.50	1.36	1.50	2 x 2 x 1/2	1.49	1.49	1.88	4 x 4 x 2	2.74	2.74	3.41
1 x 1/2 x 3/4	1.37	1.22	1.45	2 x 1 1/2 x 2	2.25	2.16	2.25	4 x 4 x 1 1/2	2.51	2.51	3.32
1 x 1/2 x 1/2	1.26	1.12	1.36	2 x 1 1/2 x 1 1/2	2.02	1.94	2.16	4 x 3 x 4	3.79	3.60	3.79
3/4 x 3/4 x 1	1.45	1.45	1.37	2 x 1 1/2 x 1 1/4	1.90	1.82	2.10	3 x 3 x 4	3.60	3.60	3.30
1/2 x 1/2 x 1	1.36	1.36	1.26	2 x 1 1/2 x 1	1.73	1.65	2.02	5 x 5 x 3	3.51	3.51	4.22
1 1/4 x 1 1/4 x 1	1.58	1.58	1.67	2 x 1 1/4 x 2	2.25	2.10	2.25	6 x 6 x 4	4.13	4.13	4.94
1 1/4 x 1 1/4 x 3/4	1.45	1.45	1.62	2 x 1 1/4 x 1 1/2	2.02	1.88	2.16	6 x 6 x 3	3.64	3.64	4.75
1 1/4 x 1 1/4 x 1/2	1.34	1.34	1.53	2 x 1 1/4 x 1 1/4	1.90	1.75	2.10	6 x 6 x 2 1/2	3.39	3.39	4.66
1 1/4 x 1 1/4 x 3/8	1.26	1.26	1.44	2 x 1 x 2	2.25	2.02	2.25	6 x 6 x 2	3.08	3.08	4.56
1 1/4 x 1 x 1 1/4	1.75	1.67	1.75	2 x 1 x 1 1/2	2.02	1.80	2.16				

GENERAL NOTES:

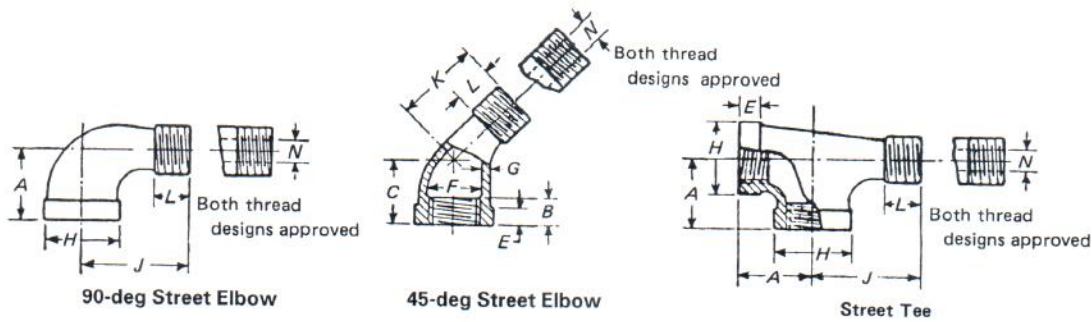
- (a) Dimensions are in inches.
- (b) For dimensions not given, see Table I-3.
- (c) Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

**Table I-6 Dimensions of Class 150 45-deg Y-Branches (Straight Sizes)**

NPS	Minimum Length of Thread, <i>B</i>	Minimum Width of Band, <i>E</i>	Inside Diameter of Fittings, <i>F</i>		Metal Thickness, <i>G</i>	Minimum Outside Diameter of Band, <i>H</i>	Center-to-End Inlet, <i>T</i>	Center-to-End Outlet, <i>U</i>	End-to-End, <i>V</i>
			Min.	Max.					
$\frac{3}{8}$	0.36	0.23	0.67	0.72	0.10	1.01	0.50	1.43	1.93
$\frac{1}{2}$	0.43	0.25	0.84	0.90	0.10	1.20	0.61	1.71	2.32
$\frac{3}{4}$	0.50	0.27	1.05	1.11	0.12	1.46	0.72	2.05	2.77
1	0.58	0.30	1.31	1.38	0.13	1.77	0.85	2.43	3.28
$1\frac{1}{4}$	0.67	0.34	1.66	1.73	0.14	2.15	1.02	2.92	3.94
$1\frac{1}{2}$	0.70	0.37	1.90	1.97	0.15	2.43	1.10	3.28	4.38
2	0.75	0.42	2.37	2.44	0.17	2.96	1.24	3.93	5.17
$2\frac{1}{2}$	0.92	0.48	2.87	2.97	0.21	3.59	1.52	4.73	6.25
3	0.98	0.55	3.50	3.60	0.23	4.28	1.71	5.55	7.26
4	1.08	0.66	4.50	4.60	0.26	5.40	2.01	6.97	8.98

GENERAL NOTE: Dimensions are in inches.

Table I-7 Dimensions of Class 150 Street Tees and 90-deg and 45-deg Street Elbows



NPS	Center-to-End Elbows and Tees, A	Center-to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fittings, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Center-to-Male End Elbows and Tees, J	Center-to-Male End 45-deg Elbows, K	Minimum Length of External Thread, L	Maximum Port Diameter Male End, N
					Min.	Max.						
1/8	0.69 [Note (1)]	...	0.25	0.20	0.40	0.43	0.09	0.69	1.00 [Note (1)]	...	0.26	0.20
1/4	0.81	0.73	0.32	0.21	0.54	0.58	0.09	0.84	1.19	0.94	0.40	0.26
3/8	0.95	0.80	0.36	0.23	0.67	0.72	0.10	1.01	1.44	1.03	0.41	0.37
1/2	1.12	0.88	0.43	0.25	0.84	0.90	0.10	1.20	1.63	1.15	0.53	0.51
3/4	1.31	0.98	0.50	0.27	1.05	1.11	0.12	1.46	1.89	1.29	0.55	0.69
1	1.50	1.12	0.58	0.30	1.31	1.38	0.13	1.77	2.14	1.47	0.68	0.91
1 1/4	1.75	1.29	0.67	0.34	1.66	1.73	0.14	2.15	2.45	1.71	0.71	1.19
1 1/2	1.94	1.43	0.70	0.37	1.90	1.97	0.15	2.43	2.69	1.88	0.72	1.39
2	2.25	1.68	0.75	0.42	2.37	2.44	0.17	2.96	3.26	2.22	0.76	1.79
2 1/2	2.70 [Note (1)]	1.95	0.92	0.48	2.87	2.97	0.21	3.59	3.86 [Note (1)]	2.57	1.14	2.20
3	3.08 [Note (1)]	2.17	0.98	0.55	3.50	3.60	0.23	4.28	4.51 [Note (1)]	3.00	1.20	2.78
4	3.79	2.61	1.08	0.66	4.50	4.60	0.26	5.40	5.69	3.70	1.30	3.70
5	4.50 [Note (1)]	...	1.18	0.78	5.56	5.66	0.30	6.58	6.86 [Note (1)]	...	1.41	4.69
6	5.13 [Note (1)]	...	1.28	0.90	6.62	6.72	0.34	7.77	8.03 [Note (1)]	...	1.51	5.67

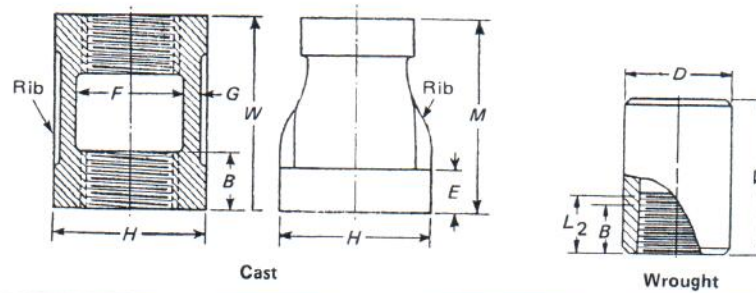
GENERAL NOTE: Dimensions are in inches.

NOTE:

(1) This dimension applies to street elbows only. Street tees are not made in these sizes.

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Table I-8 Dimensions of Class 150 Couplings (Straight and Reducing Sizes)



NPS	Minimum Length of Thread,		Minimum Width of Band, E	Inside Diameter of Fittings, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Thickness of Ribs	Length of Straight Couplings, W	Length of Reducing Concentric Couplings, M [Notes (1) and (2)]	Steel Couplings [Notes (2) and (3)]	
	B	L <sub>2</sub>		Min.	Max.						Length, W	Outside Diameter, D
1/8	0.25	0.2639	0.20	0.40	0.43	0.09	0.69	0.09	0.96	...	0.81	0.56
1/4	0.32	0.4018	0.21	0.54	0.58	0.09	0.84	0.09	1.06	1.00	1.19	0.72
3/8	0.36	0.4078	0.23	0.67	0.72	0.10	1.01	0.10	1.16	1.13	1.19	0.87
1/2	0.43	...	0.25	0.84	0.90	0.10	1.20	0.10	1.34	1.25	...	...
3/4	0.50	...	0.27	1.05	1.11	0.12	1.46	0.12	1.52	1.44	...	...
1	0.58	...	0.30	1.31	1.38	0.13	1.77	0.13	1.67	1.69	...	...
1 1/4	0.67	...	0.34	1.66	1.73	0.14	2.15	0.14	1.93	2.06	...	...
1 1/2	0.70	...	0.37	1.90	1.97	0.15	2.43	0.15	2.15	2.31	...	...
2	0.75	...	0.42	2.37	2.44	0.17	2.96	0.17	2.53	2.81	...	...
2 1/2	0.92	...	0.48	2.87	2.97	0.21	3.59	0.21	2.88	3.25	...	...
3	0.98	...	0.55	3.50	3.60	0.23	4.28	0.23	3.18	3.69	...	...
4	1.08	...	0.66	4.50	4.60	0.26	5.40	0.26	3.69	4.38	...	...

## GENERAL NOTES:

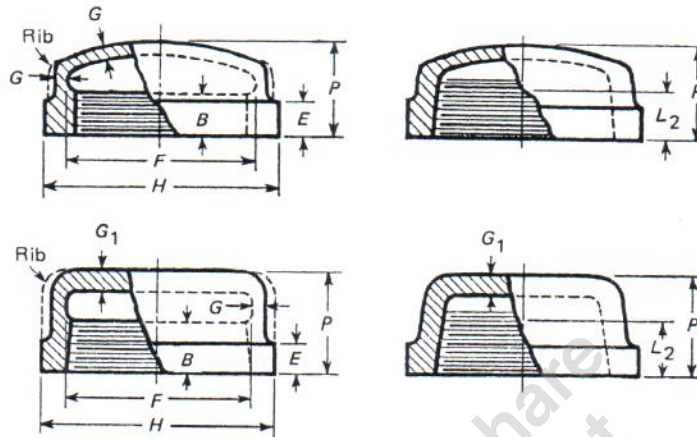
- (a) Dimensions are in inches.  
 (b) Right- and left-hand pattern couplings are standard only in sizes up to and including NPS 2.

## NOTES:

- (1) Dimension M for all reduction of reducing couplings (concentric only) shall be the same as shown for the largest opening. Dimension M for eccentric couplings is not standard; such information should be obtained from the manufacturer.  
 (2) Couplings NPS 3/8 and smaller may be cast or made from steel rod with a minimum yield strength of 30 ksi at the option of the manufacturer.  
 (3) Steel couplings are made without recess. Dimension B for steel couplings is the minimum length of perfect thread, and the length of useful thread (B plus threads with fully formed roots and flat crests) shall be not less than L<sub>2</sub> (effective length of external thread) required by ANSI/ASME B1.20.1. See section 8.

(16)

Table I-9 Dimensions of Class 150 Caps



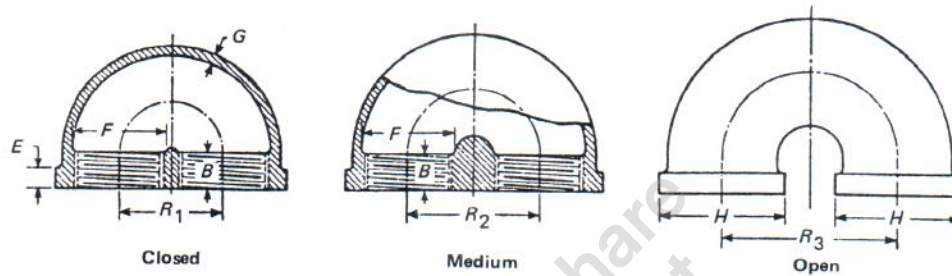
NPS	Minimum Length of Thread		Minimum Width of Band, E	Inside Diameter of Fittings, F		Metal Thickness of Side, G	Minimum Outside Diameter of Band, H [Note (1)]	Minimum Height, P [Note (2)]	Thickness of Ribs	Thickness of Flat Top Caps, G <sub>1</sub>
	B	L <sub>2</sub>		Min.	Max.					
1/8	0.25	0.2639	0.20	0.40	0.43	0.09	0.69	0.53	...	...
1/4	0.32	0.4018	0.21	0.54	0.58	0.09	0.84	0.63	...	...
3/8	0.36	0.4078	0.23	0.67	0.72	0.10	1.01	0.74	...	...
1/2	0.43	0.5337	0.25	0.84	0.90	0.10	1.20	0.87	0.10	...
3/4	0.50	0.5457	0.27	1.05	1.11	0.12	1.46	0.97	0.12	0.13
1	0.58	0.6828	0.30	1.31	1.38	0.13	1.77	1.16	0.13	0.15
1 1/4	0.67	0.7068	0.34	1.66	1.73	0.14	2.15	1.28	0.14	0.17
1 1/2	0.70	0.7235	0.37	1.90	1.97	0.15	2.43	1.33	0.15	0.19
2	0.75	0.7565	0.42	2.37	2.44	0.17	2.96	1.45	0.17	0.22
2 1/2	0.92	1.1375	0.48	2.87	2.97	0.21	3.59	1.70	0.21	0.25
3	0.98	1.2000	0.55	3.50	3.60	0.23	4.28	1.80	0.23	0.29
3 1/2	1.03	1.2500	0.60	4.00	4.10	0.25	4.84	1.90	0.25	0.30
4	1.08	1.3000	0.66	4.50	4.60	0.26	5.40	2.08	0.26	0.36
5	1.18	1.4063	0.78	5.56	5.66	0.30	6.58	2.32	0.30	...
6	1.28	1.5125	0.90	6.62	6.72	0.34	7.77	2.55	0.34	...

GENERAL NOTE: Dimensions are in inches.

NOTES:

- (1) Caps sizes 1/8, 1/4, and 3/8 may be malleable castings or made from steel rod with a minimum yield strength of 30 ksi at the option of the manufacturer. When made from steel rod, diameters shall be 0.50, 0.69, and 0.84, respectively. Caps made from steel rod have no recess.
- (2) Caps may be made without recess. Caps so made shall be of such height, P, that the length of perfect thread shall be not less than B, and the length of useful thread (B plus threads with fully formed roots and flat crests) shall be not less than L<sub>2</sub> (effective length of external thread) required by ANSI/ASME B1.20.1.

Table I-10 Dimensions of Class 150 Closed-, Medium-, and Open-Pattern Return Bends



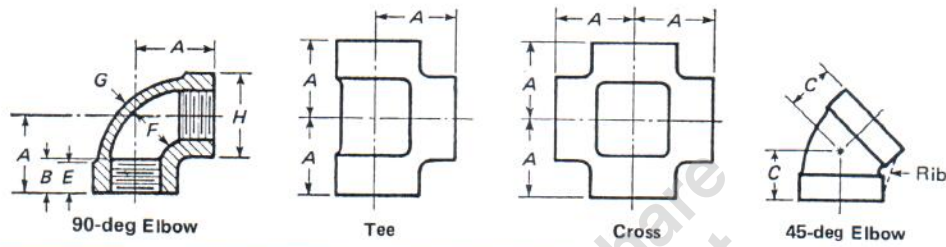
NPS	Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fittings, $F$		Metal Thickness, $G$	Minimum Outside Diameter of Band, $H$	Center-to-Center (Closed Pattern), $R_1$	Center-to-Center (Medium Pattern), $R_2$	Center-to-Center (Open Pattern), $R_3$
			Min.	Max.					
1/2	0.43	0.25	0.84	0.90	0.12	1.20	1.00	1.25	1.50
3/4	0.50	0.27	1.05	1.11	0.13	1.46	1.25	1.50	2.00
1	0.58	0.30	1.31	1.38	0.15	1.77	1.50	1.87	2.50
1 1/4	0.67	0.34	1.66	1.73	0.16	2.15	1.75	2.25	3.00
1 1/2	0.70	0.37	1.90	1.97	0.18	2.43	2.19	2.50	3.50
2	0.75	0.42	2.37	2.44	0.20	2.96	2.62	3.00	4.00
2 1/2	0.92	0.48	2.87	2.97	0.24	3.59	...	...	4.50
3	0.98	0.55	3.50	3.60	0.27	4.28	...	...	5.00
4	1.08	0.66	4.50	4.60	0.31	5.40	...	...	6.00

## GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) It is permissible to furnish closed-pattern return bends not banded. Closed-pattern return bends will not make up equally spaced coils, as the distance center-to-center of two adjacent bends is greater than the center-to-center of openings of a single bend.



**Table I-11 Dimensions of Class 300 90-deg Elbows, Tees, and Crosses, and 45-deg Elbows (Straight Sizes)**

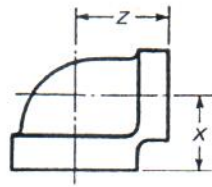


NPS	Center-to-End Elbows, Tees, and Crosses, A	Center-to-End 45-deg Elbows, C	Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H
					Min.	Max.		
1/4	0.94	0.81	0.43	0.38	0.54	0.58	0.14	0.93
3/8	1.06	0.88	0.47	0.44	0.67	0.72	0.15	1.12
1/2	1.25	1.00	0.57	0.50	0.84	0.90	0.16	1.34
3/4	1.44	1.13	0.64	0.56	1.05	1.11	0.18	1.63
1	1.63	1.31	0.75	0.62	1.31	1.38	0.20	1.95
1 1/4	1.94	1.50	0.84	0.69	1.66	1.73	0.22	2.39
1 1/2	2.13	1.69	0.87	0.75	1.90	1.97	0.24	2.68
2	2.50	2.00	1.00	0.84	2.37	2.44	0.26	3.28
2 1/2	2.94	2.25	1.17	0.94	2.87	2.97	0.31	3.86
3	3.38	2.50	1.23	1.00	3.50	3.60	0.35	4.62

GENERAL NOTE: Dimensions are in inches.

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**Table I-12 Center-to-End Dimensions of  
Class 300 90-deg Elbows (Reducing Sizes)**



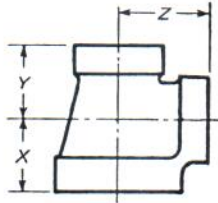
NPS	Center-to-End	
	X	Z
$\frac{1}{2} \times \frac{3}{8}$	1.19	1.19
$\frac{3}{4} \times \frac{1}{2}$	1.31	1.38
$1 \times \frac{3}{4}$	1.50	1.56
$1\frac{1}{4} \times 1$	1.75	1.81
$1\frac{1}{2} \times 1\frac{1}{4}$	2.00	2.06
$2 \times 1\frac{1}{2}$	2.25	2.38
$2\frac{1}{2} \times 2$	2.69	2.75
$3 \times 2\frac{1}{2}$	3.06	3.31

**GENERAL NOTES:**

- (a) Dimensions are in inches.
- (b) For dimensions not given, see Table I-11.
- (c) Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

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**Table I-13 Center-to-End Dimensions of  
Class 300 Tees (Reducing Sizes)**

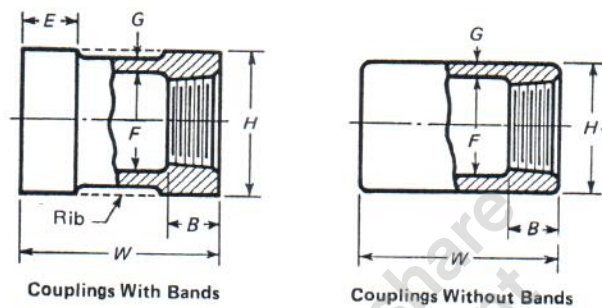


NPS	Center-to-End		
	X	Y	Z
$\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$	1.19	1.19	1.19
$\frac{1}{2} \times \frac{3}{8} \times \frac{1}{2}$	1.25	1.19	1.25
$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$	1.31	1.31	1.38
$\frac{3}{4} \times \frac{1}{2} \times \frac{3}{4}$	1.44	1.38	1.44
$1 \times 1 \times \frac{3}{4}$	1.50	1.50	1.56
$1 \times 1 \times \frac{1}{2}$	1.44	1.44	1.50
$1 \times 1 \times \frac{3}{8}$	1.31	1.31	1.44
$1 \times \frac{3}{4} \times 1$	1.63	1.56	1.63
$1\frac{1}{4} \times 1\frac{1}{4} \times 1$	1.75	1.75	1.81
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4}$	1.63	1.63	1.75
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{2}$	1.50	1.50	1.69
$1\frac{1}{4} \times 1 \times 1\frac{1}{4}$	1.94	1.81	1.94
$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4}$	2.00	2.00	2.06
$1\frac{1}{2} \times 1\frac{1}{2} \times 1$	1.81	1.81	2.00
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$	1.69	1.69	1.88
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$	1.63	1.63	1.81
$1\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{2}$	2.13	2.06	2.13
$2 \times 2 \times 1\frac{1}{2}$	2.25	2.25	2.38
$2 \times 2 \times 1\frac{1}{4}$	2.13	2.13	2.31
$2 \times 2 \times 1$	2.00	2.00	2.25
$2 \times 2 \times \frac{3}{4}$	1.81	1.81	2.13
$2 \times 2 \times \frac{1}{2}$	1.75	1.75	2.06
$2 \times 1\frac{1}{2} \times 2$	2.50	2.38	2.50
$2\frac{1}{2} \times 2\frac{1}{2} \times 2$	2.69	2.69	2.75
$2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$	2.44	2.44	2.63
$2\frac{1}{2} \times 2 \times 2\frac{1}{2}$	2.94	2.75	2.94
$3 \times 3 \times 2\frac{1}{2}$	3.06	3.06	3.31
$3 \times 3 \times 2$	2.81	2.81	3.13
$3 \times 2\frac{1}{2} \times 3$	3.38	3.31	3.38

## GENERAL NOTES:

- Dimensions are in inches.
- For dimensions not given, see Table I-11.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

Table I-14 Dimensions of Class 300 Couplings



NPS	Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fitting, $F$		Metal Thickness, $G$	Minimum Outside Diameter of Coupling, $H_1$ [Note (1)]	Minimum Outside Diameter of Band, $H$ [Note (2)]	Length of Straight Coupling, $W$
			Min.	Max.				
$\frac{1}{4}$	0.43	0.38	0.54	0.58	0.14	0.82	0.93	1.37
$\frac{3}{8}$	0.47	0.44	0.67	0.72	0.15	0.97	1.12	1.62
$\frac{1}{2}$	0.57	0.50	0.84	0.90	0.16	1.16	1.34	1.87
$\frac{3}{4}$	0.64	0.56	1.05	1.11	0.18	1.41	1.63	2.12
1	0.75	0.62	1.31	1.38	0.20	1.71	1.95	2.37
$1\frac{1}{4}$	0.84	0.69	1.66	1.73	0.22	2.10	2.39	2.87
$1\frac{1}{2}$	0.87	0.75	1.90	1.97	0.24	2.38	2.68	2.87
2	1.00	0.84	2.37	2.44	0.26	2.89	3.28	3.62
$2\frac{1}{2}$	1.17	0.94	2.87	2.97	0.31	3.49	3.86	4.12
3	1.23	1.00	3.50	3.60	0.35	4.20	4.62	4.12

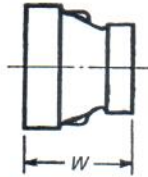
GENERAL NOTE: Dimensions are in inches.

NOTES:

(1)  $H_1$  diameter is standard for couplings without bands;  $H_1 = F \text{ min.} + 2G$ .

(2) Minimum  $H$  is for couplings with bands and is optional with the manufacturer. For information on ribs, see section 9.

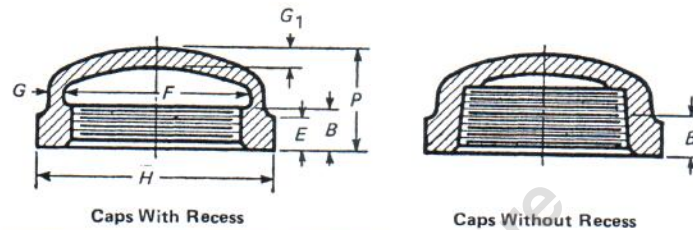
**Table I-15 Dimensions of Class 300 Reducing Couplings**



NPS	Length, W
$\frac{3}{8} \times \frac{1}{4}$	1.44
$\frac{1}{2} \times \frac{3}{8}$	1.69
$\frac{1}{2} \times \frac{1}{4}$	1.69
$\frac{3}{4} \times \frac{1}{2}$	1.75
$\frac{3}{4} \times \frac{3}{8}$	1.75
$\frac{3}{4} \times \frac{1}{4}$	1.75
$1 \times \frac{3}{4}$	2.00
$1 \times \frac{1}{2}$	2.00
$1 \times \frac{3}{8}$	2.00
$1 \times \frac{1}{4}$	2.00
$1\frac{1}{4} \times 1$	2.38
$1\frac{1}{4} \times \frac{3}{4}$	2.38
$1\frac{1}{4} \times \frac{1}{2}$	2.38
$1\frac{1}{2} \times 1\frac{1}{4}$	2.69
$1\frac{1}{2} \times 1$	2.69
$1\frac{1}{2} \times \frac{3}{4}$	2.69
$1\frac{1}{2} \times \frac{1}{2}$	2.69
$2 \times 1\frac{1}{2}$	3.19
$2 \times 1\frac{1}{4}$	3.19
$2 \times 1$	3.19
$2 \times \frac{3}{4}$	3.19
$2 \times \frac{1}{2}$	3.19
$2\frac{1}{2} \times 2$	3.69
$2\frac{1}{2} \times 1\frac{1}{2}$	3.69
$3 \times 2\frac{1}{2}$	4.06
$3 \times 2$	4.06
$3 \times 1\frac{1}{2}$	4.06

**GENERAL NOTES:**

- Dimensions are in inches.
- For dimensions not given, see Table I-11.
- Reducing sizes of fittings for which dimensions are not given in tables may be produced from regular patterns for listed sizes by sand bushing.

**Table I-16 Dimensions of Class 300 Caps**

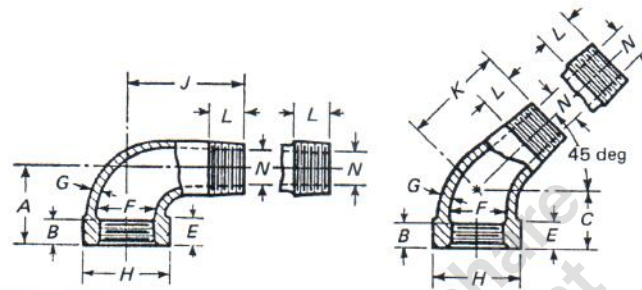
NPS	Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fitting, $F$		Metal Thickness		Minimum Outside Diameter of Band, $H$	Minimum Height, $P$ [Note (2)]
			Min.	Max.	Minimum $G$	Recommended $G_1$ [Note (1)]		
$\frac{1}{4}$	0.43	0.38	0.54	0.58	0.14	0.18	0.93	0.78
$\frac{3}{8}$	0.47	0.44	0.67	0.72	0.15	0.19	1.12	0.83
$\frac{1}{2}$	0.57	0.50	0.84	0.90	0.16	0.20	1.34	0.98
$\frac{3}{4}$	0.64	0.56	1.05	1.11	0.18	0.23	1.63	1.08
1	0.75	0.62	1.31	1.38	0.20	0.25	1.95	1.26
$1\frac{1}{4}$	0.84	0.69	1.66	1.73	0.22	0.28	2.39	1.38
$1\frac{1}{2}$	0.87	0.75	1.90	1.97	0.24	0.30	2.68	1.43
2	1.00	0.84	2.37	2.44	0.26	0.33	3.28	1.68
$2\frac{1}{2}$	1.17	0.94	2.87	2.97	0.31	0.39	3.86	2.06
3	1.23	1.00	3.50	3.60	0.35	0.44	4.62	2.17

GENERAL NOTE: Dimensions are in inches.

NOTES:

- (1) Dimension  $G_1$  is recommended but shall in no case be less than dimension  $G$ .
- (2) Dimension  $P$  may be varied to comply with manufacturer's practice, and, for caps without recess, shall be of such height that the length of effective thread shall be not less than  $B$ .

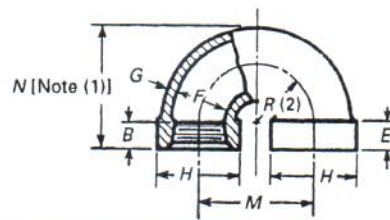
Table I-17 Dimensions of Class 300 90-deg and 45-deg Street Elbows



NPS	90-deg Elbows		45-deg Elbows		Minimum Length of Thread, B	Minimum Width of Band, E	Inside Diameter of Fitting, F		Metal Thickness, G	Minimum Outside Diameter of Band, H	Minimum Length of External Thread, L	Maximum Port Diameter Male End, N
	Center-to-End, A	Center-to-Male End, J	Center-to-End, C	Center-to-Male End, K			Min.	Max.				
1/4	0.94	1.44	...	...	0.43	0.38	0.54	0.58	0.14	0.93	0.40	0.26
3/8	1.06	1.63	...	...	0.47	0.44	0.67	0.72	0.15	1.12	0.41	0.36
1/2	1.25	2.00	1.00	1.38	0.57	0.50	0.84	0.90	0.16	1.34	0.53	0.49
3/4	1.44	2.19	1.13	1.56	0.64	0.56	1.05	1.11	0.18	1.63	0.55	0.67
1	1.63	2.56	1.31	1.81	0.75	0.62	1.31	1.38	0.20	1.95	0.68	0.88
1 1/4	1.94	2.88	1.50	2.13	0.84	0.69	1.66	1.73	0.22	2.39	0.71	1.16
1 1/2	2.13	3.13	1.69	2.31	0.87	0.75	1.90	1.97	0.24	2.68	0.72	1.35
2	2.50	3.69	2.00	2.69	1.00	0.84	2.37	2.44	0.26	3.28	0.76	1.75
2 1/2	2.94	4.50	...	...	1.17	0.94	2.87	2.97	0.31	3.86	1.14	2.16
3	3.38	5.13	...	...	1.23	1.00	3.50	3.60	0.35	4.62	1.20	2.67

GENERAL NOTE: Dimensions are in inches.

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**Table I-18 Dimensions of Class 300 Return Bends**

NPS	Center-to-Center, $M$			Minimum Length of Thread, $B$	Minimum Width of Band, $E$	Inside Diameter of Fitting, $F$		Metal Thickness, $G$ [Note (3)]	Minimum Outside Diameter of Band, $H$
	Closed Pattern	Medium Pattern	Open Pattern			Min.	Max.		
1	1.75	2.50	3.00	0.75	0.62	1.31	1.38	0.20	1.95
1 $\frac{1}{4}$	2.25	2.50	3.00	0.84	0.69	1.66	1.73	0.22	2.39
1 $\frac{1}{2}$	3.00	3.50	6.00	0.87	0.75	1.90	1.97	0.24	2.68
2	4.00	6.00	8.00	1.00	0.84	2.37	2.44	0.26	3.28

GENERAL NOTE: Dimensions are in inches.

NOTES:

- (1) Dimension  $N$  may be varied to comply with manufacturer's practice.
- (2) It is recommended that the distance from the end of the fitting to the center of the radius,  $R$ , be approximately equal to the dimension  $B$ ; radius,  $R$ , is recommended as being one-half of dimension  $M$ .
- (3) It is recommended that  $G$  for return bends be increased by 10% or more.



## MANDATORY APPENDIX II REFERENCES

The following is a list of publications referenced in this Standard. Unless otherwise stated, the latest edition of ASME publications shall apply. Materials manufactured to other editions of the referenced ASTM standards shall be permitted to be used to manufacture fittings meeting the requirements of this Standard as long as the fitting manufacturer verifies the material meets the requirements of the referenced edition.

ASME B1.20.1, Pipe Threads, General Purpose (Inch)  
 ASME B16.14, Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads  
 Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 ([www.asme.org](http://www.asme.org))  
 ASTM A153/A153M-09, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware  
 ASTM A197/A197M-00 (2006), Specification for Cupola Malleable Iron  
 ASTM B633-98<sup>1</sup>, Specification for Electrodeposited Coatings of Zinc on Iron and Steel  
 ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance With Specifications

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 ([www.astm.org](http://www.astm.org))

ISO 9000:2005, Quality management systems — Fundamentals and vocabulary<sup>1</sup>

ISO 9001:2008, Quality management systems — Requirements<sup>1</sup>

ISO 9004:2009, Managing for the sustained success of an organization — A quality management approach<sup>1</sup>

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

MSS SP-25-2008, Standard Practice Marking System for Valves, Fittings, Flanges, and Unions

Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180 ([www.mss-hq.org](http://www.mss-hq.org))

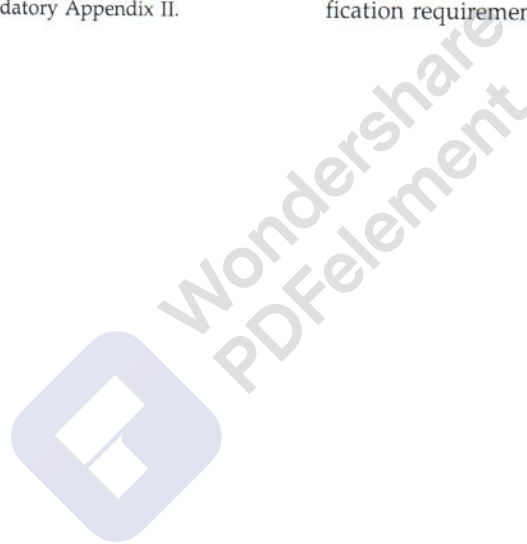
<sup>1</sup> May also be obtained from the American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036.

## NONMANDATORY APPENDIX A QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of the ISO 9000 series.<sup>1</sup> A determination of the need for registration and/or

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

certification of the product manufacturer's quality system program by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demonstrating program compliance shall be available to the purchaser at the manufacturer's facility. A written summary description of the program utilized by the product manufacturer shall be available to the purchaser upon request. The product manufacturer is defined as the entity whose name or trademark appears on the product in accordance with the marking or identification requirements of this Standard.



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Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250) .....	B16.1-2015
Malleable Iron Threaded Fittings: Classes 150 and 300 .....	B16.3-2016
Gray Iron Threaded Fittings: Classes 125 and 250 .....	B16.4-2016
Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard .....	B16.5-2013
Factory-Made Wrought Butt Welding Fittings .....	B16.9-2012
Face-to-Face and End-to-End Dimensions of Valves .....	B16.10-2009
Forged Fittings, Socket-Welding and Threaded .....	B16.11-2011
Cast Iron Threaded Drainage Fittings .....	B16.12-2009 (R2014)
Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads .....	B16.14-2013
Cast Copper Alloy Threaded Fittings .....	B16.15-2013
Cast Copper Alloy Solder Joint Pressure Fittings .....	B16.18-2012
Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed .....	B16.20-2012
Nonmetallic Flat Gaskets for Pipe Flanges .....	B16.21-2011
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings .....	B16.22-2013
Cast Copper Alloy Solder Joint Drainage Fittings: DWV .....	B16.23-2011
Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 .....	B16.24-2016
Butt Welding Ends .....	B16.25-2012
Cast Copper Alloy Fittings for Flared Copper Tubes .....	B16.26-2013
Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings — DWV .....	B16.29-2012
Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi (Sizes NPS 1/2 Through NPS 2) .....	B16.33-2012
Valves — Flanged, Threaded, and Welding End .....	B16.34-2013
Orifice Flanges .....	B16.36-2015
Large Metallic Valves for Gas Distribution: Manually Operated, NPS 2 1/2 (DN 65) to NPS 12 (DN 300), 125 psig (8.6 bar) Maximum .....	B16.38-2012
Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300 .....	B16.39-2014
Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems .....	B16.40-2013
Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300 .....	B16.42-2016
Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems Up to 5 psi .....	B16.44-2012
Large Diameter Steel Flanges NPS 26 Through NPS 60 Metric/Inch Standard .....	B16.47-2011
Line Blanks .....	B16.48-2015
Factory-Made Wrought Steel Butt Welding Induction Bends for Transportation and Distribution Systems .....	B16.49-2012
Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings .....	B16.50-2013
Copper and Copper Alloy Press-Connect Pressure Fittings .....	B16.51-2013

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