

**ASME B16.50-2021**  
(Revision of ASME B16.50-2018)

# **Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings**

---

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

**ASME B16.50-2021**  
(Revision of ASME B16.50-2018)

# **Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings**

---

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: February 28, 2022

The next edition of this Standard is scheduled for publication in 2026.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME B16 Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at <http://cstools.asme.org/> as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at <http://cstools.asme.org/>. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

ASME is the registered trademark of The American Society of Mechanical Engineers.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Standards Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment that provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

No part of this document may be reproduced in any form,  
in an electronic retrieval system or otherwise,  
without the prior written permission of the publisher.

The American Society of Mechanical Engineers  
Two Park Avenue, New York, NY 10016-5990

Copyright © 2022 by  
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
All rights reserved

# CONTENTS

Foreword .....	iv
Committee Roster .....	v
Correspondence With the B16 Committee .....	vi
Summary of Changes .....	viii
List of Changes in Record Number Order .....	ix
<b>1</b> <b>Scope</b> .....	<b>1</b>
<b>2</b> <b>General</b> .....	<b>1</b>
<b>3</b> <b>Pressure-Temperature Ratings</b> .....	<b>1</b>
<b>4</b> <b>Terminology</b> .....	<b>1</b>
<b>5</b> <b>Marking</b> .....	<b>2</b>
<b>6</b> <b>Material</b> .....	<b>2</b>
<b>7</b> <b>Laying Lengths</b> .....	<b>2</b>
<b>8</b> <b>Tube Stops</b> .....	<b>2</b>
<b>9</b> <b>Inspection Tolerance</b> .....	<b>2</b>
<b>10</b> <b>Threaded Ends</b> .....	<b>2</b>
<b>11</b> <b>Alignment</b> .....	<b>3</b>
<b>12</b> <b>Gaging</b> .....	<b>3</b>
<b>Mandatory Appendix</b>	
I        References .....	10
<b>Nonmandatory Appendices</b>	
A        Fitting Rating .....	11
B        Quality System Program .....	12
<b>Figures</b>	
4.1-1    Method of Designating Laying Lengths of Fittings and Openings of Reducing Fittings .....	7
8-1      Tube Stops .....	9
11-1     Alignment .....	9
<b>Tables</b>	
3.1-1    Dimensions of Braze-Joint Ends .....	4
3.1-2    Internal Pressure-Temperature Ratings for Copper Fittings, kPa (psi) .....	6
9.2-1    Inspection Tolerance .....	9

# FOREWORD

In 1994, the ASME B16 Standards Committee authorized Subcommittee J, Standardization, to develop a standard for wrought copper and copper alloy braze-joint pressure fittings. These fittings are intended for use with seamless copper tube conforming to the standard specifications ASTM B88 (for water and general plumbing systems), ASTM B280 (for air conditioning and refrigeration service), and ASTM B819 (for medical gas systems). Following approval by the Standards Committee and ASME, this Standard was approved as an American National Standard on October 11, 2001, with the designation ASME B16.50-2001.

In the 2013 edition, references to ASME standards were revised to no longer list specific edition years; the latest edition of ASME publication applies, unless stated otherwise. Also in the 2013 edition, Tables 3 and I-3 included a maximum cup length under the column heading shown as “Depth, *G*.” Following approval by the B16 Standards Committee and the ASME supervisory board, and after public review, the 2013 edition of the Standard was approved as an American National Standard by the American National Standards Institute (ANSI) on May 28, 2013.

In the 2018 edition, the U.S. Customary tables formerly in Mandatory Appendix I were merged with the SI tables in the main text; the tables and figures were redesignated, Mandatory Appendix I was deleted, and the cross-references were updated accordingly. In addition, all reference standards in what was formerly Mandatory Appendix II were updated; no additional/technical changes were made to the Standard. Following approval by the ASME B16 Standards Committee, ASME B16.50-2018 was approved as an American National Standard by ANSI on July 27, 2018.

In the 2021 edition, the Scope (section 1) has been revised, and the references in Mandatory Appendix I have been updated. Following approval by the ASME B16 Standards Committee, ASME B16.50-2021 was approved by ANSI on November 15, 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.)

### STANDARDS COMMITTEE OFFICERS

**C. E. Davila**, *Chair*  
**R. M. Bojarczuk**, *Vice Chair*  
**S. J. Rossi**, *Secretary*

### STANDARDS COMMITTEE PERSONNEL

<b>A. Appleton</b> , Alloy Stainless Products Co., Inc.	<b>T. A. McMahon</b> , Emerson Automation Solutions
<b>J. E. Barker</b> , DeZURIK, Inc.	<b>R. C. Merrick</b> , Consultant
<b>R. W. Barnes</b> , ANRIC Enterprises, Inc.	<b>W. H. Patrick</b> , Dow Chemical Co.
<b>D. C. Bayreuther</b> , Neles Corp.	<b>D. W. Raho</b> , CCM 2000
<b>W. B. Bedesem</b> , Consultant	<b>D. F. Reid</b> , VSP Technologies
<b>R. M. Bojarczuk</b> , Retired	<b>S. J. Rossi</b> , The American Society of American Engineers
<b>A. M. Cheta</b> , Shell Global Solutions (U.S.)	<b>R. A. Schmidt</b> , Canadoil
<b>M. A. Clark</b> , NIBCO, Inc.	<b>J. Sekerak</b> , CSA Group
<b>G. A. Cuccio</b> , Capitol Manufacturing Co.	<b>F. R. Volgstadt</b> , Volgstadt and Associates, Inc.
<b>C. E. Davila</b> , Crane Chempharma and Energy	<b>F. Feng</b> , <i>Delegate</i> , China Productivity Center for Machinery
<b>K. S. Felder</b> , Valero Energy	<b>J. D. Grant</b> , <i>Alternate</i> , DeZURIK, Inc.
<b>D. R. Frikken</b> , Becht Engineering Co., Inc.	<b>P. V. Craig</b> , <i>Contributing Member</i> , Jomar Group
<b>J. R. Holstrom</b> , Val-Matic Valve and Manufacturing Corp.	<b>B. G. Fabian</b> , <i>Contributing Member</i> , Pennsylvania Machine Works
<b>D. Hunt, Jr.</b> , Fastenal	<b>A. G. Kireta, Jr.</b> , <i>Contributing Member</i> , Copper Development Association, Inc.
<b>G. A. Jolly</b> , Samshin, Ltd.	
<b>E. J. Lain</b> , Exelon Nuclear	

### SUBCOMMITTEE J — COPPER AND COPPER ALLOY FLANGES, FLANGED FITTINGS, AND SOLDER-JOINT FITTINGS

<b>A. G. Kireta, Jr.</b> , <i>Chair</i> , Copper Development Association, Inc.	<b>D. Hunt, Jr.</b> , Fastenal
<b>W. E. Chapin</b> , <i>Vice Chair</i> , Professional Code Consulting, LLC	<b>R. Kelsey</b> , NIBCO, Inc.
<b>R. R. Rahaman</b> , <i>Secretary</i> , The American Society of Mechanical Engineers	<b>C. A. Mueller</b> , Mueller Streamline Co.
<b>J. A. Ballanco</b> , JB Engineering and Code Consulting, PC	<b>F. Shingleton</b> , Viega, LLC
<b>D. R. Frikken</b> , Becht Engineering Co., Inc.	<b>J. C. Gast</b> , <i>Alternate</i> , Mueller Fittings
	<b>J. Atkinson</b> , <i>Contributing Member</i> , Consultant

# CORRESPONDENCE WITH THE B16 COMMITTEE

**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](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.

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 B16.50-2021 SUMMARY OF CHANGES

Following approval by the ASME B16 Standards Committee and ASME, and after public review, ASME B16.50-2021 was approved by the American National Standards Institute on November 15, 2021.

ASME B16.50-2021 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.

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
1	Section 1	Revised (19-1235)
1	Section 4	Title editorially revised
2	4.3	Definition for <i>wrought</i> added (18-2111)
2	6	Subpara. (b)(1) revised (18-2111)
10	Mandatory Appendix I	Updated (20-2566)

# LIST OF CHANGES IN RECORD NUMBER ORDER

<u>Record Number</u>	<u>Change</u>
18-2111	Added definition of <i>wrought</i> in para. 4.3, and revised minimum copper requirements in para. 6(b)(1).
19-1235	Revised Section 1, Scope.
20-2566	Updated references in Mandatory Appendix I.

INTENTIONALLY LEFT BLANK

# WROUGHT COPPER AND COPPER ALLOY BRAZE-JOINT PRESSURE FITTINGS

## (21) 1 SCOPE

This Standard establishes requirements for wrought copper and wrought copper alloy seamless pressure fittings designed for use by brazing with seamless copper tube conforming to ASTM B88 (for water and general plumbing systems), ASTM B280 (for air-conditioning and refrigeration service), and ASTM B819 (for medical gas systems).

Fittings made in accordance with this Standard are intended for assembly with brazing materials conforming to AWS A5.8M/A5.8.

This Standard is allied to ASME B16.18 for cast copper alloy pressure fittings and ASME B16.22 for wrought fittings that can be used in soldering or brazing. This Standard provides requirements for fitting ends of suitable depth to only be joined by brazing. Fittings manufactured to this Standard are not suitable for joining by soldering. When soldering is the desired joining method, use fittings manufactured to ASME B16.18 or ASME B16.22. This Standard covers

- (a) pressure-temperature ratings
- (b) abbreviations for end connections
- (c) size and method of designating openings of fittings
- (d) marking
- (e) material
- (f) dimensions and tolerances
- (g) testing

## 2 GENERAL

### 2.1 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. 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.

### 2.2 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 the specific edition of each standard and specification in the individual references. Instead, the specific edition reference is identified in [Mandatory Appendix I](#).

### 2.3 Quality Systems

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

## 3 PRESSURE-TEMPERATURE RATINGS

### 3.1 Rating of System

The internal pressure-temperature rating for a braze joint system is dependent on not only fitting and tube strength but also selection of valves and appurtenances. Pressure-temperature ratings for fittings and braze joints to the dimensions of [Table 3.1-1](#), made with typical commercial brazing materials, shall be considered equal to the values given in [Table 3.1-2](#).

The internal pressure-temperature rating of the system shall be the lowest of the values shown in [Table 3.1-2](#) and those of the tube, valves, or appurtenances.

### 3.2 Fitting Bursting Strength

Fittings manufactured to this Standard shall have an ambient-temperature bursting strength of at least 4 times the 38°C (100°F) internal pressure rating as shown in [Table 3.1-2](#).

## 4 TERMINOLOGY

(21)

### 4.1 Size

The size of the fittings shown in [Table 3.1-1](#) corresponds to standard water tube size as shown in ASTM B88. The size of the threaded ends corresponds to nominal pipe size as shown in ASME B1.20.1. Fittings are designated by the size of the openings in the sequence illustrated in [Figure 4.1-1](#).

### 4.2 Abbreviations

The following symbols are used to designate the type of fitting end:

- C = braze-joint fitting end made to receive copper tube diameter (female)

F = internal ANSI standard taper pipe-thread end (female) NPTI FT

FTG = braze-joint fitting end made to copper tube diameter (male)

M = external ANSI standard taper pipe-thread end (male) NPTE

(21) **4.3 Definitions**

*out-of-roundness*: maximum measured diameter minus the minimum measured diameter.

*ovality*: elliptical condition associated with out-of-roundness.

*wrought*: describing metal that is worked in solid form to form shapes or individual parts including but not limited to tubular shapes, bars, and forgings.

**5 MARKING**

Each fitting shall be permanently marked with the manufacturer's name or trademark in accordance with MSS SP-25 and the letters "BZ" in uppercase. Marking on fittings less than size  $\frac{1}{2}$  or on any fitting where it would damage the brazing surfaces is not required.

(21) **6 MATERIAL**

(a) Fittings shall be made from copper UNS No. C10200, C12000, or C12200 or copper alloy UNS No. C23000, for which allowable stresses are found in ASME B31.1, ASME B31.9, or ASME Boiler and Pressure Vessel Code, Section II, Part D.

(b) Other coppers and copper alloys are permitted, provided

(1) they meet the chemical requirements of 80% minimum copper and 16% maximum zinc

(2) the fittings produced from the copper alloy meet all the mechanical and corrosion-resistant properties for the end purposes of the fittings

The composition of the copper alloys shall contain nothing that will inhibit joining to the tube or to other fittings.

**7 LAYING LENGTHS**

Due to widely varying manufacturing processes, meaningful laying length requirements of fittings cannot be established. Consult the manufacturer for these dimensions.

**8 TUBE STOPS**

Except for repair couplings, fittings shall be manufactured with a tube stop. Repair couplings shall not require a tube stop. The tube stop shall control joint length, even with an external (FTG) end having the minimum outside diameter shown in [Table 3.1-1](#). Examples of various tube stop configurations are shown in [Figure 8-1](#).

**9 INSPECTION TOLERANCE**

**9.1 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.

**9.2 Linear Dimensions**

An inspection tolerance, as shown in [Table 9.2-1](#), shall be allowed on center-to-shoulder, center-to-center, center-to-threaded-end, and shoulder-to-threaded-end dimensions on all fittings having internal (C) braze ends, as well as on center-to-braze-end and braze-end-to-threaded-end dimensions on all fittings having external (FTG) braze ends. Coupling inspection limits for shoulder-to-shoulder and shoulder-to-end dimensions shall be double those shown in [Table 9.2-1](#), except that the minus tolerance applied to dimension *L* ([Figure 4.1-1](#)) shall not result in a dimension less than 1.5 mm (0.06 in.). The largest opening in the fitting shall govern the tolerance to be applied to all openings.

**9.3 Ovality of Fitting End (C or FTG)**

Maximum ovality of the fitting braze-joint end shall not exceed 1% of the maximum diameters shown in [Table 3.1-1](#). The average of the maximum and minimum diameters shall be within the dimensions shown in the table.

**9.4 Inside Diameter of Fitting**

The minimum cross-sectional area of the inside diameter through the fitting body shall not be less than the theoretical minimum area defined by diameter *O* in [Table 3.1-1](#). The out-of-roundness condition of the cross-sectional area shall not exceed the value shown in [Table 3.1-1](#).

For reducer or adapter fittings, the smallest end diameter shall apply, provided that this diameter does not restrict the other outlets.

**9.5 Wall Thickness**

The minimum wall thickness shall not be less than shown in [Table 3.1-1](#).

**10 THREADED ENDS**

Fitting threads shall be right-hand, conforming to ASME B1.20.1. They shall be taper threads (NPT).

### 10.1 Countersink or Chamfer

All internal threads shall be countersunk a distance no 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 from the axis. Countersinking and chamfering shall be concentric with the threads.

The length of threads shall be measured to include the countersink or chamfer.

### 10.2 Threading Tolerances

Tapered pipe threads (NPT) shall be checked by use of plug or ring gages in either standard or limit types. When gaging internal taper threads, the plug gage shall be screwed hand-tight into the fitting. The reference point for gaging internal product threads depends on the chamfer diameter. When the internal chamfer diameter exceeds the major diameter of the internal thread, the reference point shall be the last thread scratch on the chamfer cone. Otherwise, when the internal chamfer diameter does not exceed the major diameter of the internal thread, the reference point shall be the end of the fitting. In gaging external taper threads, the ring gage shall be screwed hand-tight on the external thread. On the external thread, the ring gage shall be flush with the end of the thread.

Tolerance for an internally threaded end having an internal shoulder shall be from the gage reference point (notch) to one turn small. Tolerance for an internally threaded end without a shoulder, and for an externally threaded end, shall be from one turn small to one turn large.

### 10.3 Design of Threaded Ends

The wrenching section of internally threaded ends shall be polygonal, and the wrenching section of externally threaded ends shall be furnished with either polygon or flats, at the manufacturer's option.

## 11 ALIGNMENT

The maximum allowable deviation in the angular alignment of any end from the specified axis position shall be  $\frac{1}{2}$  deg (1 deg total) (see [Figure 11-1](#)).

## 12 GAGING

### 12.1 Preferred Gaging Method of Braze-Joint Ends

The preferred method of gaging the diameter tolerances for external and internal ends shall be by the use of plain plug and ring gages designed to hold the product within the limits established in [Table 3.1-1](#). Gage tolerances shall be Class ZM, as defined in ANSI B4.4M.

### 12.2 Optional Gaging Method of Braze-Joint Ends

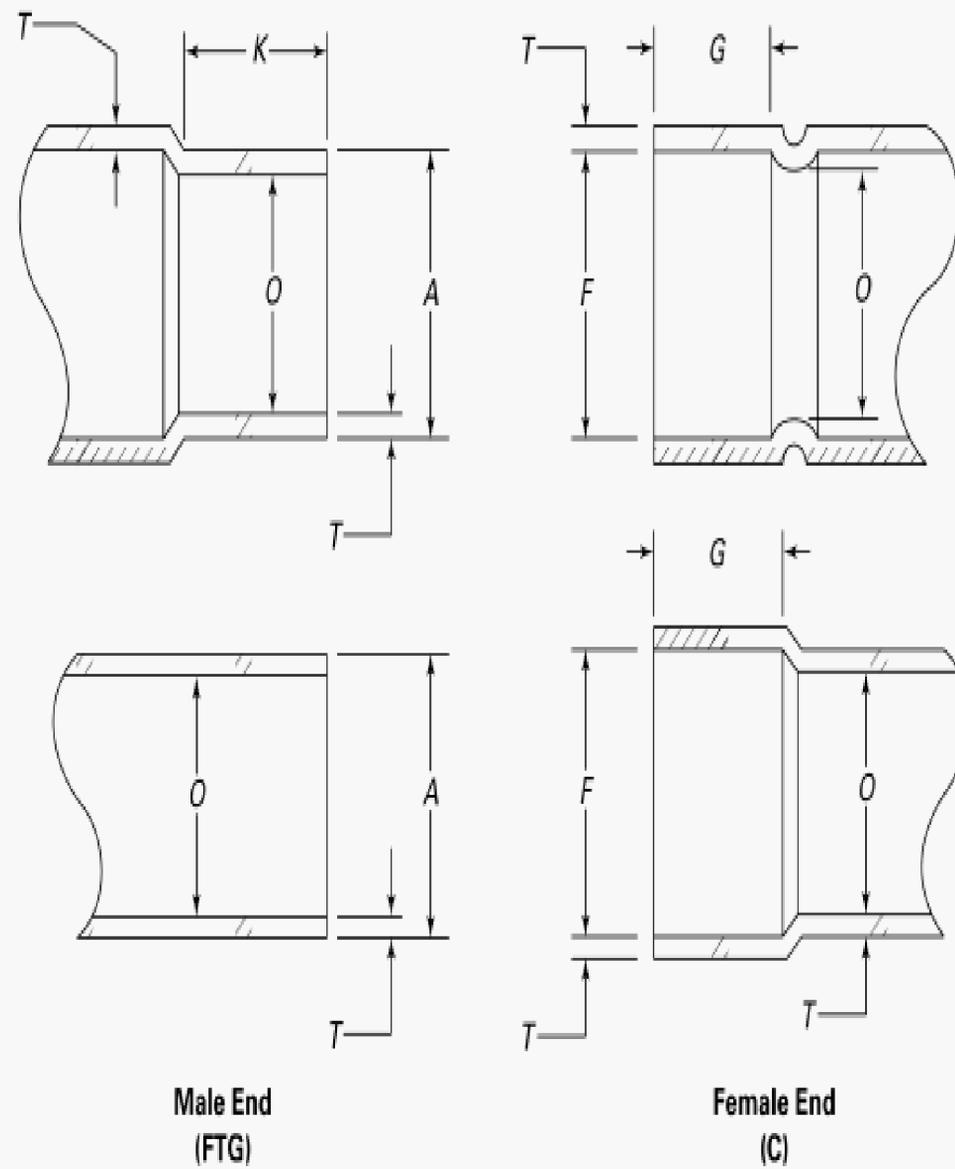
For gaging the diameter tolerance of external and internal ends, the use of direct reading instruments instead of ring and plug gages as specified in [para. 12.1](#) shall be permitted. When gaging the diameters of external and internal ends using direct reading instruments, refer to [para. 9.3](#).

### 12.3 Standard Gaging Method of Threaded Ends

The standard method of gaging the externally and internally threaded ends shall be in accordance with the requirements of ASME B1.20.1.

NOTE: In gaging pipe threads, it is acceptable and common practice to rap or tap the part to ensure proper seating of the gage. However, it is first necessary to clean both the gage and product threads to ensure that they are free of chips, burrs, abrasives, or other foreign materials.

**Table 3.1-1  
Dimensions of Braze-Joint Ends**



4

ASME B16.50-2021

Standard Water Tube Size [Note (1)]	External End		Internal End				Minimum Wall		Inside Diameter of Fitting, O, mm (in.)	
	Outside Diameter, A, mm (in.) [Note (2)]		Minimum Length, K, mm (in.) [Note (3)]	Inside Diameter, F, mm (in.) [Note (2)]		Depth, G, mm (in.) [Note (4)]		Thickness, T, mm (in.)	Minimum Diameter	Maximum Out-of-Round
	Min.	Max.		Min.	Max.	Min.	Max.			
$\frac{1}{8}$ [Note (5)]	6.30 (0.248)	6.38 (0.251)	5.1 (0.20)	6.40 (0.252)	6.50 (0.256)	3.8 (0.15)	5.70 (0.23)	0.48 (0.019)	4.6 (0.18)	0.5 (0.02)
$\frac{3}{16}$ [Note (6)]	7.87 (0.310)	7.95 (0.313)	5.1 (0.20)	7.98 (0.314)	8.08 (0.318)	4.1 (0.16)	6.15 (0.24)	0.58 (0.023)	6.1 (0.24)	0.6 (0.02)
$\frac{1}{4}$	9.47 (0.373)	9.55 (0.376)	5.8 (0.23)	9.58 (0.377)	9.68 (0.381)	4.3 (0.17)	6.45 (0.26)	0.58 (0.023)	7.6 (0.30)	0.8 (0.03)
$\frac{3}{8}$	12.62 (0.497)	12.73 (0.501)	6.6 (0.26)	12.75 (0.502)	12.85 (0.506)	5.1 (0.20)	7.65 (0.30)	0.66 (0.026)	9.9 (0.39)	1.0 (0.04)
$\frac{1}{2}$	15.80 (0.622)	15.90 (0.626)	7.1 (0.28)	15.93 (0.627)	16.03 (0.631)	5.6 (0.22)	8.40 (0.33)	0.74 (0.029)	13.2 (0.52)	1.3 (0.05)
$\frac{5}{8}$	18.97 (0.747)	19.08 (0.751)	7.6 (0.30)	19.10 (0.752)	19.20 (0.756)	6.1 (0.24)	9.15 (0.36)	0.79 (0.031)	16.0 (0.63)	1.6 (0.06)
$\frac{3}{4}$	22.15 (0.872)	22.25 (0.876)	7.9 (0.31)	22.28 (0.877)	22.38 (0.881)	6.4 (0.25)	9.60 (0.38)	0.84 (0.033)	18.8 (0.74)	1.9 (0.07)

**Table 3.1-1  
Dimensions of Braze-Joint Ends (Cont'd)**

Standard Water Tube Size [Note (1)]	External End			Internal End				Inside Diameter of Fitting, O, mm (in.)		
	Outside Diameter, A, mm (in.) [Note (2)]		Minimum Length, K, mm (in.) [Note (3)]	Inside Diameter, F, mm (in.) [Note (2)]		Depth, G, mm (in.) [Note (4)]				Minimum Wall Thickness, T, mm (in.)
	Min.	Max.		Min.	Max.	Min.	Max.	Minimum Diameter	Maximum Out-of-Round	
1	28.50 (1.122)	28.63 (1.127)	8.6 (0.34)	28.65 (1.128)	28.75 (1.132)	7.1 (0.28)	10.65 (0.42)	1.02 (0.040)	24.9 (0.98)	2.5 (0.10)
1 <sup>1</sup> / <sub>4</sub>	34.85 (1.372)	34.98 (1.377)	9.4 (0.37)	35.00 (1.378)	35.10 (1.382)	7.9 (0.31)	11.85 (0.47)	1.12 (0.044)	31.2 (1.23)	3.1 (0.12)
1 <sup>1</sup> / <sub>2</sub>	41.17 (1.621)	41.33 (1.627)	10.2 (0.40)	41.35 (1.628)	41.48 (1.633)	8.6 (0.34)	12.90 (0.51)	1.30 (0.051)	37.3 (1.47)	3.7 (0.15)
2	53.87 (2.121)	54.03 (2.127)	11.9 (0.47)	54.05 (2.128)	54.18 (2.133)	10.2 (0.40)	15.30 (0.60)	1.50 (0.059)	49.3 (1.94)	4.9 (0.19)
2 <sup>1</sup> / <sub>2</sub>	66.57 (2.621)	66.73 (2.627)	13.5 (0.53)	66.75 (2.628)	66.88 (2.633)	11.9 (0.47)	17.85 (0.71)	1.70 (0.067)	61.5 (2.42)	6.1 (0.24)
3	79.27 (3.121)	79.43 (3.127)	15.0 (0.59)	79.45 (3.128)	79.58 (3.133)	13.5 (0.53)	20.25 (0.80)	1.91 (0.075)	73.4 (2.89)	7.3 (0.29)
3 <sup>1</sup> / <sub>2</sub>	91.97 (3.621)	92.13 (3.627)	16.5 (0.65)	92.15 (3.628)	92.28 (3.633)	14.0 (0.59)	21.00 (0.89)	2.18 (0.086)	85.6 (3.37)	8.6 (0.34)
4	104.67 (4.121)	104.83 (4.127)	18.3 (0.72)	104.85 (4.128)	104.98 (4.133)	16.3 (0.64)	24.45 (0.96)	2.44 (0.096)	97.5 (3.84)	9.8 (0.38)
5	130.07 (5.121)	130.23 (5.127)	20.6 (0.81)	130.25 (5.128)	130.38 (5.133)	18.5 (0.73)	27.75 (1.10)	2.82 (0.111)	119.4 (4.70)	11.9 (0.47)
6	155.47 (6.121)	155.63 (6.127)	23.9 (0.94)	155.65 (6.128)	155.78 (6.133)	21.1 (0.83)	31.65 (1.25)	3.15 (0.124)	145.3 (5.72)	14.5 (0.57)
8	206.22 (8.119)	206.43 (8.127)	32.5 (1.28)	206.45 (8.128)	206.58 (8.133)	29.7 (1.17)	44.55 (1.76)	4.39 (0.173)	191.8 (7.55)	19.2 (0.76)

GENERAL NOTE: Drawings and designs of fittings are illustrative only. Dimensions herein shall govern in all cases.

NOTES:

- (1) For size designation of fittings, see para. 4.1.
- (2) For ovality, see para. 9.3.
- (3) The distance from the point of tangency, at the gage I.D. to the gage line, shall be equal to the dimension shown under "Length, K."
- (4) The distance from the point of tangency, at the gage O.D. to the gage line, shall be equal to the dimension shown under "Depth, G."
- (5) <sup>1</sup>/<sub>8</sub> nominal size is <sup>1</sup>/<sub>4</sub> O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.
- (6) <sup>3</sup>/<sub>16</sub> nominal size is <sup>5</sup>/<sub>16</sub> O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.

**Table 3.1-2**  
**Internal Pressure–Temperature Ratings for Copper Fittings, kPa (psi)**

Standard Water Tube Size [Note (1)]	–29°C to 38°C (–20°F to 100°F)	66°C (150°F)	93°C (200°F)	121°C (250°F)	149°C (300°F)	177°C (350°F)	204°C (400°F)
$\frac{1}{8}$ [Note (2)]	9 690 (1,405)	8 240 (1,195)	7 750 (1,125)	7 750 (1,125)	7 590 (1,100)	6 460 (935)	4 840 (700)
$\frac{3}{16}$ [Note (3)]	7 630 (1,105)	6 490 (940)	6 110 (885)	6 110 (885)	5 980 (865)	5 090 (735)	3 810 (550)
$\frac{1}{4}$	6 280 (910)	5 340 (770)	5 020 (725)	5 020 (725)	4 920 (710)	4 190 (605)	3 140 (455)
$\frac{3}{8}$	5 360 (775)	4 560 (660)	4 290 (620)	4 290 (620)	4 200 (610)	3 570 (515)	2 680 (385)
$\frac{1}{2}$	4 970 (720)	4 220 (610)	3 980 (575)	3 980 (575)	3 890 (565)	3 310 (480)	2 480 (360)
$\frac{5}{8}$	4 350 (630)	3 700 (535)	3 480 (505)	3 480 (505)	3 410 (490)	2 900 (420)	2 170 (315)
$\frac{3}{4}$	4 010 (580)	3 410 (490)	3 210 (465)	3 210 (465)	3 140 (455)	2 670 (385)	2 000 (290)
1	3 400 (490)	2 890 (420)	2 720 (395)	2 720 (395)	2 660 (385)	2 270 (325)	1 700 (245)
$1\frac{1}{4}$	3 020 (435)	2 570 (370)	2 420 (350)	2 420 (350)	2 370 (340)	2 010 (290)	1 510 (215)
$1\frac{1}{2}$	2 810 (405)	2 390 (345)	2 250 (325)	2 250 (325)	2 200 (315)	1 870 (270)	1 400 (200)
2	2 500 (360)	2 130 (305)	2 000 (290)	2 000 (290)	1 960 (280)	1 670 (240)	1 250 (180)
$2\frac{1}{2}$	2 310 (335)	1 960 (285)	1 850 (265)	1 850 (265)	1 810 (260)	1 540 (220)	1 150 (165)
3	2 180 (315)	1 850 (265)	1 740 (250)	1 740 (250)	1 710 (245)	1 450 (210)	1 090 (155)
$3\frac{1}{2}$	2 090 (300)	1 770 (255)	1 670 (240)	1 670 (240)	1 630 (235)	1 390 (200)	1 040 (150)
4	2 020 (290)	1 710 (245)	1 610 (230)	1 610 (230)	1 580 (225)	1 340 (195)	1 010 (145)
5	1 850 (265)	1 570 (225)	1 480 (215)	1 480 (215)	1 450 (210)	1 230 (175)	920 (130)
6	1 720 (250)	1 460 (210)	1 380 (200)	1 380 (200)	1 350 (195)	1 150 (165)	860 (125)
8	1 860 (270)	1 580 (225)	1 490 (215)	1 490 (215)	1 460 (210)	1 240 (180)	930 (135)

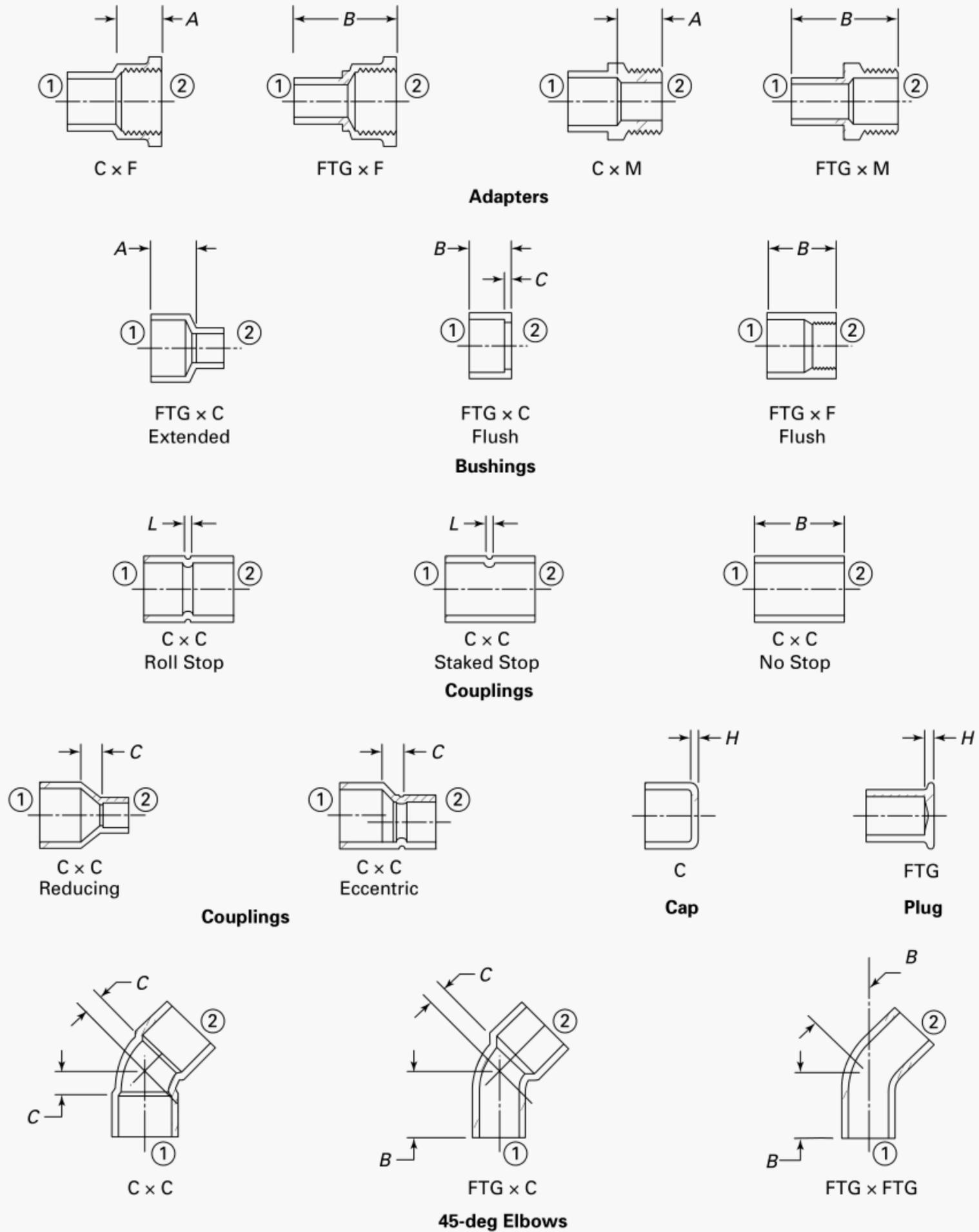
## GENERAL NOTES:

- (a) The fitting pressure–temperature rating applies to the largest opening of the fitting.  
 (b) The fitting pressure–temperature rating is calculated, as shown in [Nonmandatory Appendix A](#), then rounded down to the nearest unit of 10.

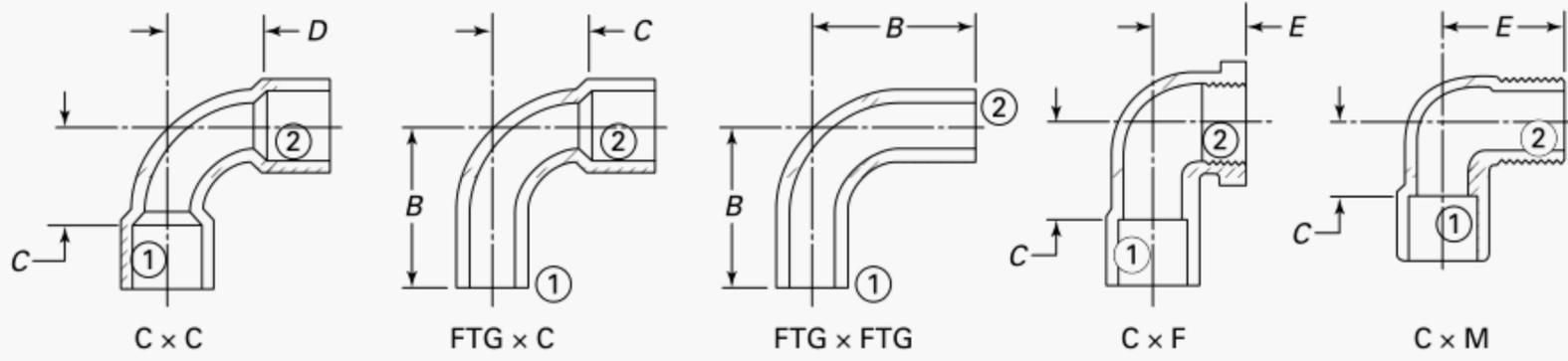
## NOTES:

- (1) For size designation of fittings, see [para. 4.1](#).  
 (2)  $\frac{1}{8}$  nominal size is  $\frac{1}{4}$  O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.  
 (3)  $\frac{3}{16}$  nominal size is  $\frac{5}{16}$  O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.

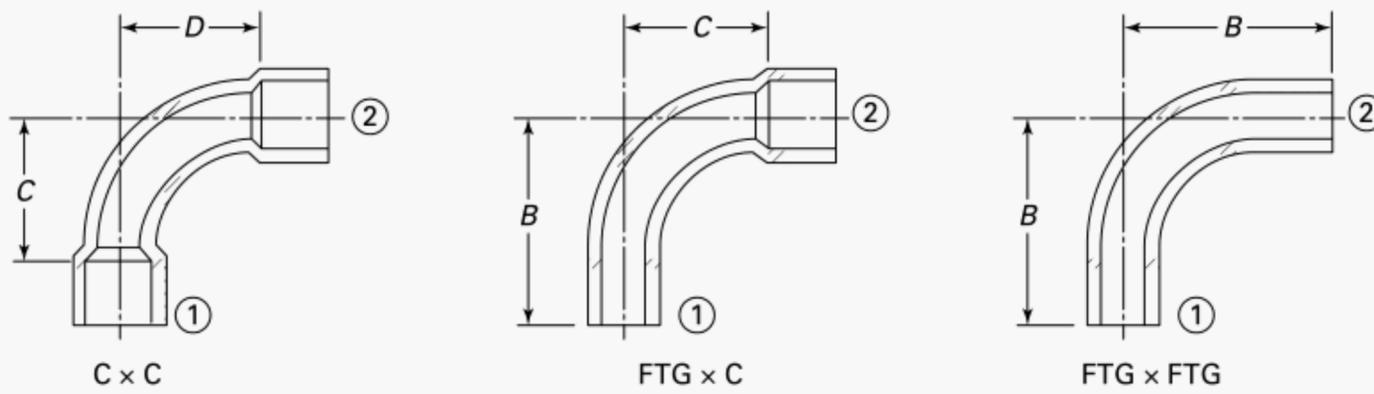
**Figure 4.1-1**  
**Method of Designating Laying Lengths of Fittings and Openings of Reducing Fittings**



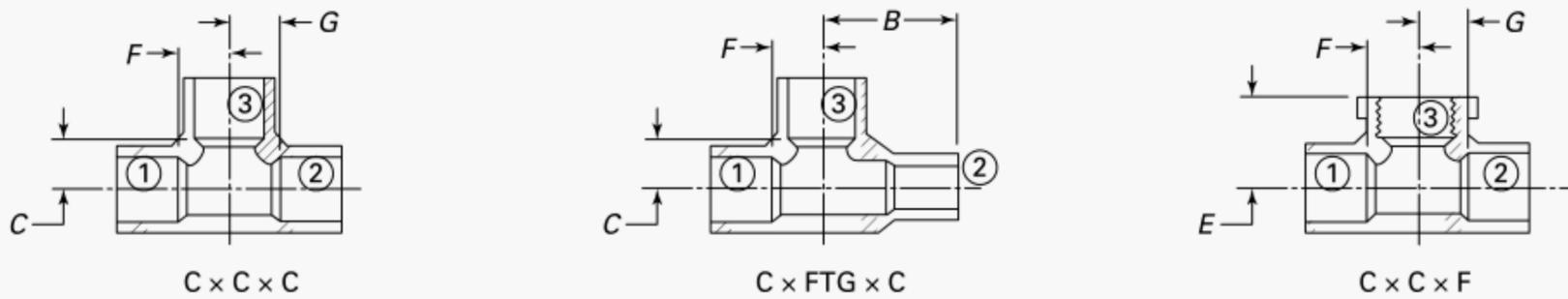
**Figure 4.1-1**  
**Method of Designating Laying Lengths of Fittings and Openings of Reducing Fittings (Cont'd)**



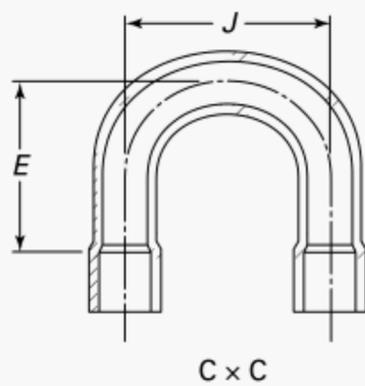
**90-deg Elbows — Short Radius**



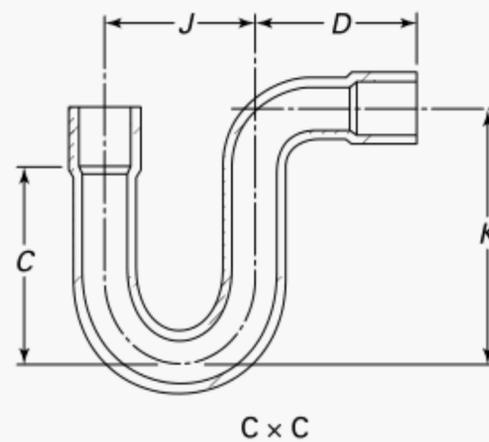
**90-deg Elbows — Long Radius**



**Tees**



**Return Bend**

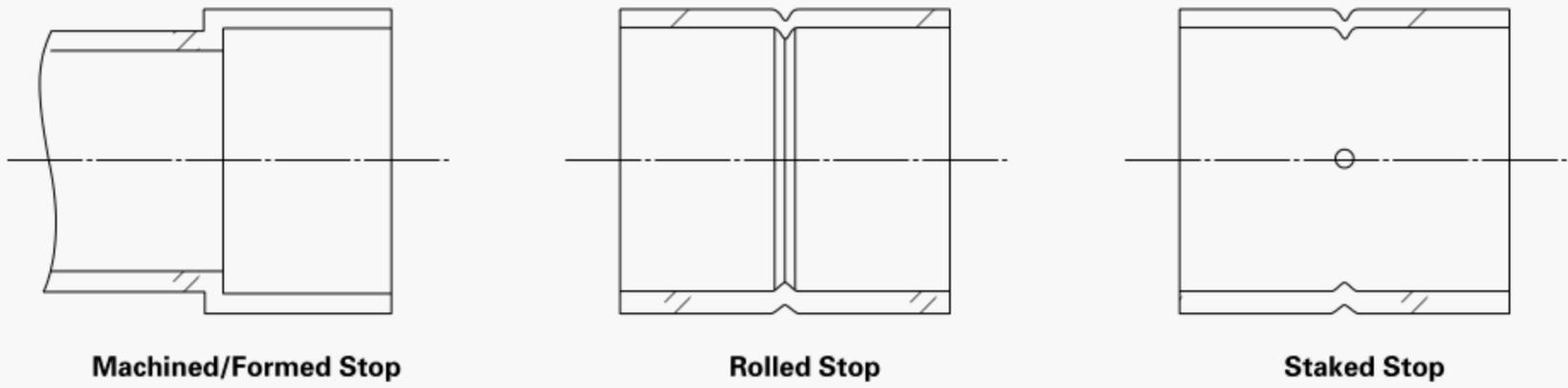


**Suction Line P-Trap**

**GENERAL NOTES:**

- (a) Fittings are designated by size in the order: 1 x 2 x 3.
- (b) Fitting designs and drawings are illustrative only.

**Figure 8-1  
Tube Stops**



GENERAL NOTES: This figure is for information only; the shape and number of abutments are at the manufacturer's discretion.

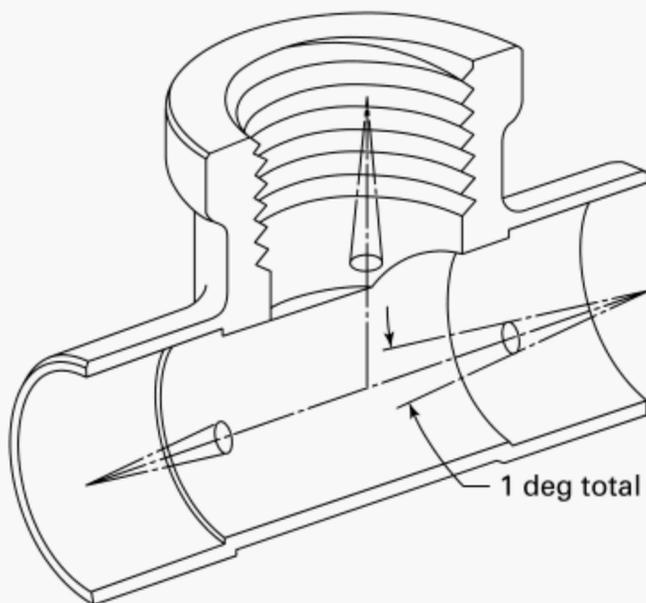
**Table 9.2-1  
Inspection Tolerance**

Standard Water Tube and Pipe Thread Sizes	Tolerance, Plus or Minus, mm (in.)
$\frac{1}{8}$ [Note (1)], $\frac{3}{16}$ [Note (2)], $\frac{1}{4}$ , $\frac{3}{8}$	1.3 (0.05)
$\frac{1}{2}$ , $\frac{5}{8}$ , $\frac{3}{4}$	1.5 (0.06)
1, $1\frac{1}{4}$ , $1\frac{1}{2}$ , 2	2.0 (0.08)
$2\frac{1}{2}$ , 3, $3\frac{1}{2}$	2.8 (0.11)
4 and 5	3.0 (0.12)
6 and 8	4.1 (0.16)

NOTES:

- (1)  $\frac{1}{8}$  nominal size is  $\frac{1}{4}$  O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.
- (2)  $\frac{3}{16}$  nominal size is  $\frac{5}{16}$  O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.

**Figure 11-1  
Alignment**



GENERAL NOTE: This figure is for illustration only.

## MANDATORY APPENDIX I REFERENCES

(21)

The following is a list of publications referenced in this Standard. Unless otherwise specified, 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.

ANSI B4.4M, Inspection of Workpieces

Publisher: American National Standards Institute (ANSI),  
25 West 43rd Street, New York, NY 10036  
(www.ansi.org)

ASME B1.20.1, Pipe Threads, General Purpose (Inch)

ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

ASME B31.1, Power Piping

ASME B31.9, Building Services Piping

ASME Boiler and Pressure Vessel Code, Section II, Materials, Part D — Properties

Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990  
(www.asme.org)

ASTM B88-20, Standard Specification for Seamless Copper Water Tube

ASTM B280-20, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM B819-19, Standard Specification for Seamless Copper Tube for Medical Gas Systems

ASTM E29-13(R2019), 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)

AWS A5.8M/A5.8:2019, Specification for Filler Metals for Brazing and Braze Welding

Publisher: American Welding Society (AWS), 8669 NW 36 Street, No. 130, Miami, FL 33166 (www.aws.org)

ISO 9000:2015, Quality management systems — Fundamentals and vocabulary<sup>1</sup>

ISO 9001:2015, Quality management systems — Requirements<sup>1</sup>

ISO 9004:2018, Quality management — Quality of an organization — Guidance to achieve sustained success<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)

MSS SP-25-2018, Standard 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.msshq.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 FITTING RATING

The pressure-temperature ratings of the fitting are shown in [Table 3.1-2](#). These values are the same as those calculated for annealed temper ASTM B88 Type L copper water tube. The rated internal working pressures for annealed temper ASTM B88 Type L copper water tube are calculated as follows:

$$p = \frac{2St}{D - 0.8t}$$

where

$D$  = maximum outside diameter, mm (in.), from annealed temper ASTM B88 for Type L copper water tube

$p$  = rated pressure at temperature, kPa (psi)

$S$  = allowable stress at temperature, kPa (psi), from ASME B31.1 or ASME B31.9 for annealed temper ASTM B88 Type L copper water tube

$t$  = minimum wall thickness, mm (in.), for annealed temper ASTM B88 for Type L copper water tube

## NONMANDATORY APPENDIX B QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.<sup>1</sup> A determination of the need for registration or certification of the product manufacturer's quality system program by an independent organization, or both, shall be the responsibility of the manufacturer. The detailed documentation demon-

strating program compliance shall be available to the purchaser at the manufacturer's facility. A written summarized description of the program used 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.

---

<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 I](#).

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

B16.1-2020	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
B16.3-2021	Malleable Iron Threaded Fittings: Classes 150 and 300
B16.4-2021	Gray Iron Threaded Fittings: Classes 125 and 250
B16.5-2020	Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard
B16.9-2018	Factory-Made Wrought Butt welding Fittings
B16.10-2017	Face-to-Face and End-to-End Dimensions of Valves
B16.11-2016	Forged Fittings, Socket-Welding and Threaded
B16.12-2019	Cast Iron Threaded Drainage Fittings
B16.14-2018	Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads
B16.15-2018	Cast Copper Alloy Threaded Fittings
B16.18-2021	Cast Copper Alloy Solder Joint Pressure Fittings
B16.20-2017	Metallic Gaskets for Pipe Flanges
B16.21-2021	Nonmetallic Flat Gaskets for Pipe Flanges
B16.22-2021	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.23-2021	Cast Copper Alloy Solder Joint Drainage Fittings: DWV
B16.24-2016	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500
B16.25-2017	Butt welding Ends
B16.26-2018	Cast Copper Alloy Fittings for Flared Copper Tubes
B16.29-2017	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings — DWV
B16.33-2012 (R2017)	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 175 psi (Sizes NPS ½ Through NPS 2)
B16.34-2020	Valves — Flanged, Threaded, and Welding End
B16.36-2020	Orifice Flanges
B16.38-2012 (R2017)	Large Metallic Valves for Gas Distribution: Manually Operated, NPS 2½ (DN 65) to NPS 12 (DN 300), 125 psig (8.6 bar) Maximum
B16.39-2019	Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
B16.40-2019	Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
B16.42-2021	Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300
B16.44-2012 (R2017)	Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems Up to 5 psi
B16.47-2020	Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard
B16.48-2020	Line Blanks
B16.49-2017	Factory-Made, Wrought Steel, Butt welding Induction Bends for Transportation and Distribution Systems
B16.50-2021	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
B16.51-2021	Copper and Copper Alloy Press-Connect Pressure Fittings
B16.52-2018	Forged Nonferrous Fittings, Socket-Welding and Threaded (Titanium, Titanium Alloys, Aluminum, and Aluminum Alloys)

The ASME Publications Catalog shows a complete list of all the Standards published by the Society. For a complimentary catalog, or the latest information about our publications, call 1-800-THE-ASME (1-800-843-2763).

# ASME Services

ASME is committed to developing and delivering technical information. At ASME's Customer Care, we make every effort to answer your questions and expedite your orders. Our representatives are ready to assist you in the following areas:

ASME Press	Member Services & Benefits	Public Information
<i>Codes &amp; Standards</i>	Other ASME Programs	Self-Study Courses
Credit Card Orders	Payment Inquiries	Shipping Information
IMEchE Publications	Professional Development	Subscriptions/Journals/Magazines
Meetings & Conferences	Short Courses	Symposia Volumes
Member Dues Status	Publications	Technical Papers

## How can you reach us? It's easier than ever!

There are four options for making inquiries\* or placing orders. Simply mail, phone, fax, or E-mail us and a Customer Care representative will handle your request.

<i>Mail</i>	<i>Call Toll Free</i>	<i>Fax—24 hours</i>	<i>E-Mail—24 hours</i>
<b>ASME</b>	<b>US &amp; Canada:</b> 800-THE-ASME	973-882-1717	customer-care@asme.org
150 Clove Road, 6th Floor	(800-843-2763)	973-882-5155	
Little Falls, New Jersey	<b>Mexico:</b> 95-800-THE-ASME		
07424-2139	(95-800-843-2763)		

\*Customer Care staff are not permitted to answer inquiries about the technical content of this code or standard. Information as to whether or not technical inquiries are issued to this code or standard is shown on the copyright page. All technical inquiries must be submitted in writing to the staff secretary. Additional procedures for inquiries may be listed within.

# ASME B16.50-2021

ISBN 978-0-7918-7494-3



9 780791 874943



J 1 6 3 2 Q