

ASME B16.50-2013

[Revision of ASME B16.50-2001 (R2008)]

Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

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Two Park Avenue • New York, NY • 10016 USA

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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 American National Standards Institute (ASTM) Standard Specifications, B88 (Water and General Plumbing Systems), B280 (Air Conditioning and Refrigeration Service), and B819 (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 new designation ASME B16.50-2001.

In this 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 this Edition, Tables 3 and I-3 now include 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, this Standard was approved as an American National Standard by ANSI on May 28, 2013.

Requests for interpretation or suggestions for revision should be sent to the Secretary, B16 Standards Committee, The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

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As an alternative, inquiries may be submitted via email to: SecretaryB16@asme.org.

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

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The request for 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.
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. 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 this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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ASME B16.50-2013

SUMMARY OF CHANGES

Following approval by the B16 Committee and ASME, and after public review, ASME B16.50-2013 was approved by the American National Standards Institute on May 28, 2013.

ASME B16.50-2013 consists of editorial changes, revisions, and corrections identified by a margin note, **(13)**, placed next to the affected area.

<i>Page</i>	<i>Location</i>	<i>Change</i>
1	1	(1) "General" section moved to section 2, and remaining paragraphs renumbered (2) Paragraph 1.2 deleted
	3	Revised in its entirety
2	Table 1	Title, General Notes, and Note (1) revised
5	9.1	Revised
7	Table 3	Eighth column added
8	12.2	Second paragraph designation revised
10	Table I-1	Title, General Notes, and Note (1) revised
11	Table I-3	Eighth column added
12	Mandatory Appendix II	Updated
13	Nonmandatory Appendix A	Revised

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WROUGHT COPPER AND COPPER ALLOY BRAZE-JOINT PRESSURE FITTINGS

(13) 1 SCOPE

This Standard establishes requirements for wrought copper and wrought copper alloy braze-joint seamless fittings designed for use with seamless copper tube conforming to ASTM Standard Specification, B88 (Water and General Plumbing Systems), B280 (Air Conditioning and Refrigeration Service), and B819 (Medical Gas Systems).

This Standard covers joints assembled with brazing materials conforming to ANSI/AWS A5.8.

This Standard is allied to ASME standards B16.18 and B16.22. It provides requirements for fitting-ends suitable for brazing. 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 Units of Measure

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.

2.2 References

Standards and specifications adopted by reference in this Standard are shown in Mandatory Appendix II, 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 II.

2.3 Quality Systems

Requirements relating to the product manufacturer's Quality System Programs are described in Nonmandatory Appendix B.

3 PRESSURE-TEMPERATURE RATINGS

(13)

3.1 Rating of System

The internal pressure-temperature rating for a braze-joint system is dependent upon 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 (Table I-3), made with typical commercial brazing materials, shall be considered equal to the values given in Table 1 (Table I-1).

The internal pressure-temperature rating of the system shall be the lowest of the values shown in Table 1 (Table I-1) 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 four times the 38°C (100°F) internal pressure rating as shown in Table 1 (Table I-1).

4 TERMINOLOGY

4.1 Size

The size of the fittings shown in Tables 3 and I-3 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 Fig. 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
- FTG* = braze-joint fitting end made to copper tube diameter (male)
- M* = external ANSI standard taper pipe-thread end (male) NPTE

(13) **Table 1 Internal Pressure–Temperature Ratings for Copper Fittings, kPa**

Standard Water Tube Size [Note (1)]	–29°C to 38°C	66°C	93°C	121°C	149°C	177°C	204°C
$\frac{1}{8}$ [Note (2)]	9 690	8 240	7 750	7 750	7 590	6 460	4 840
$\frac{3}{16}$ [Note (3)]	7 630	6 490	6 110	6 110	5 980	5 090	3 810
$\frac{1}{4}$	6 280	5 340	5 020	5 020	4 920	4 190	3 140
$\frac{3}{8}$	5 360	4 560	4 290	4 290	4 200	3 570	2 680
$\frac{1}{2}$	4 970	4 220	3 980	3 980	3 890	3 310	2 480
$\frac{5}{8}$	4 350	3 700	3 480	3 480	3 410	2 900	2 170
$\frac{3}{4}$	4 010	3 410	3 210	3 210	3 140	2 670	2 000
1	3 400	2 890	2 720	2 720	2 660	2 270	1 700
$1\frac{1}{4}$	3 020	2 570	2 420	2 420	2 370	2 010	1 510
$1\frac{1}{2}$	2 810	2 390	2 250	2 250	2 200	1 870	1 400
2	2 500	2 130	2 000	2 000	1 960	1 670	1 250
$2\frac{1}{2}$	2 310	1 960	1 850	1 850	1 810	1 540	1 150
3	2 180	1 850	1 740	1 740	1 710	1 450	1 090
$3\frac{1}{2}$	2 090	1 770	1 670	1 670	1 630	1 390	1 040
4	2 020	1 710	1 610	1 610	1 580	1 340	1 010
5	1 850	1 570	1 480	1 480	1 450	1 230	920
6	1 720	1 460	1 380	1 380	1 350	1 150	860
8	1 860	1 580	1 490	1 490	1 460	1 240	930

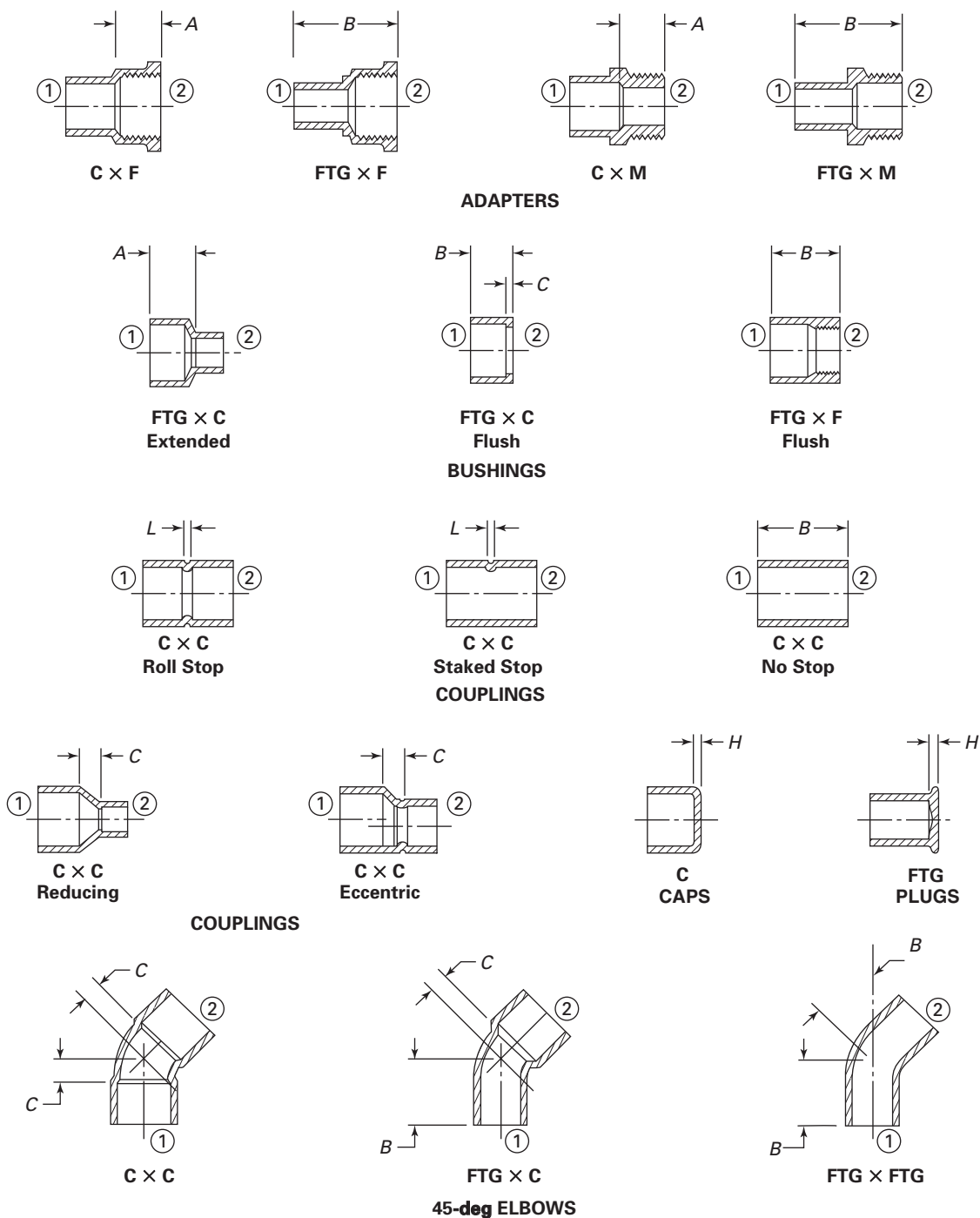
GENERAL NOTES:

- (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.

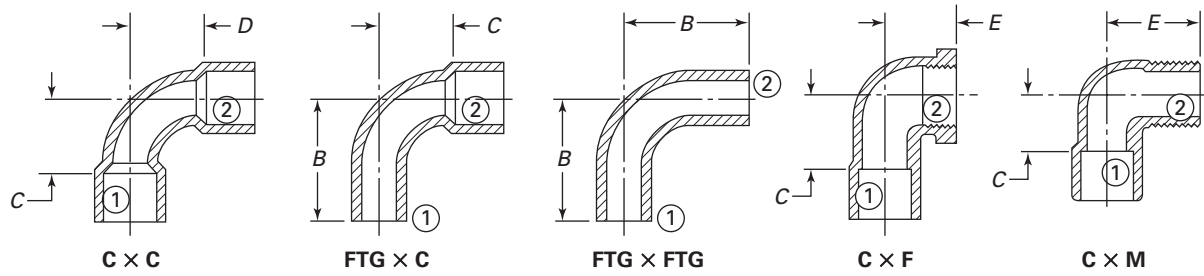
Fig. 1 Method of Designating Laying Lengths of Fittings and Openings of Reducing Fittings



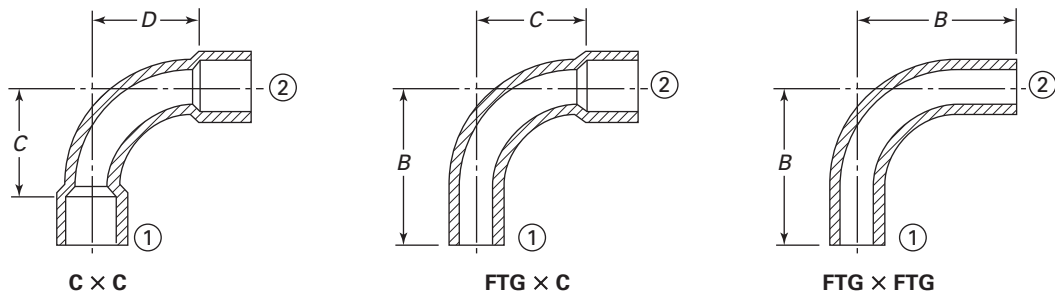
GENERAL NOTES:

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

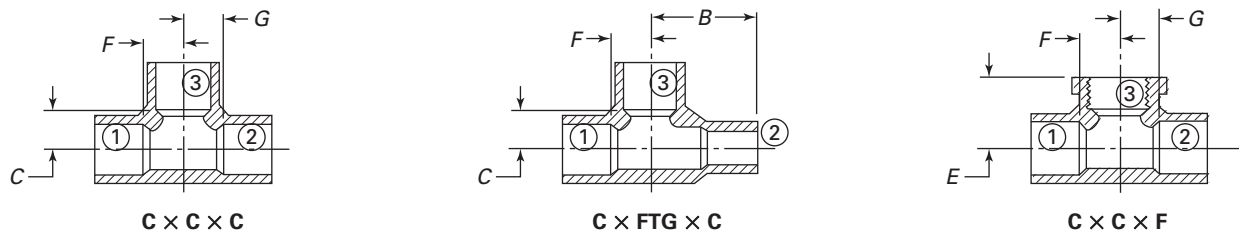
Fig. 1 Method of Designating Laying Lengths of Fittings and Openings of Reducing Fittings (Cont'd)



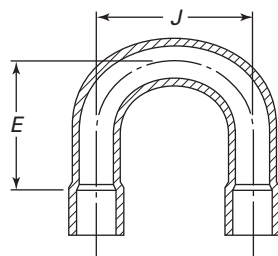
90-deg ELBOWS — SHORT RADIUS



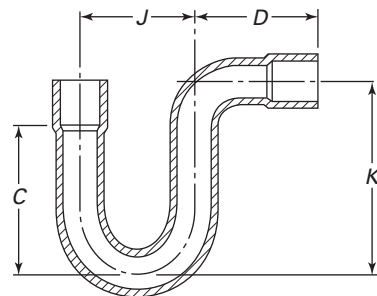
90-deg ELBOWS — LONG RADIUS



TEES



**C × C
RETURN BENDS**



**C × C
SUCTION LINE P-TRAPS**

4.3 Definitions

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

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

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 damages the brazing surfaces is not required.

6 MATERIAL

(a) Fittings shall be made from copper UNS Nos. C10200, C12000, or C12200 or copper alloy UNS C23000, for which allowable stresses are found in ASME B31.1, ASME B31.9, or ASME Boiler and Pressure Vessel Code, Section II, Materials.

(b) Other coppers and copper alloys are permitted provided they meet the chemical requirements of 84% minimum copper and 16% maximum zinc and provided the fittings produced from the copper alloy meets 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 (Table I-3). Examples of various tube stop configurations are shown in Fig. 2.

9 INSPECTION TOLERANCE

(13) 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 2 (Table I-2), 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 2 (Table I-2), except that the minus tolerance applied to dimension *L* (Fig. 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 (Table I-3). 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 (Table I-3). The out-of-roundness condition of the cross-sectional area shall not exceed the value shown in Table 3 (Table I-3).

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 (Table I-3).

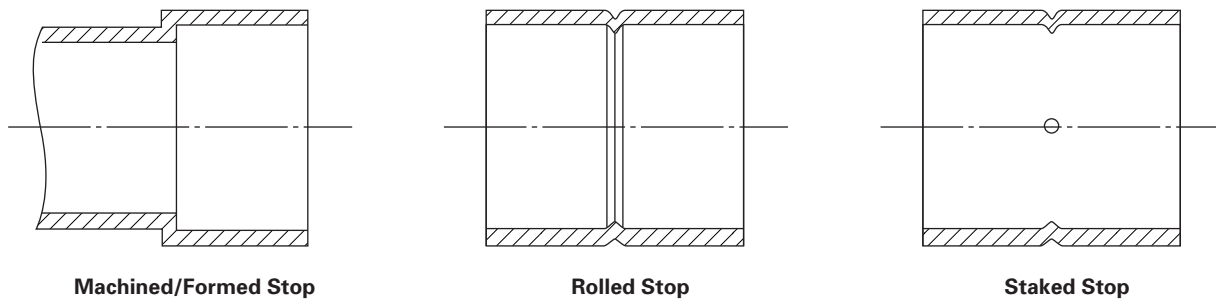
10 THREADED ENDS

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.

Fig. 2 Tube Stops

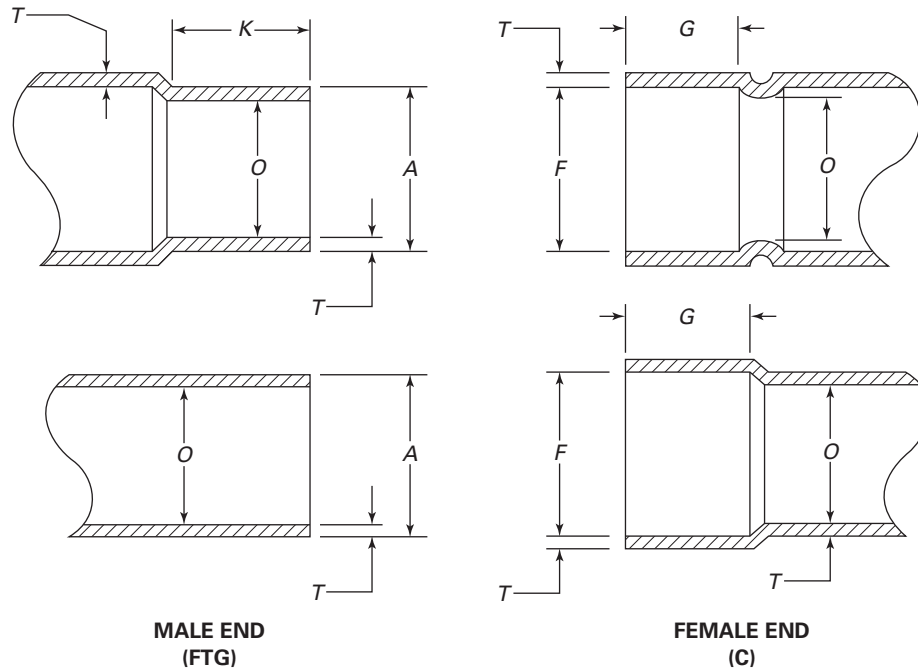
GENERAL NOTE: Figure 2 is for information only; the shape and number of abutments are at the manufacturer's discretion.

Table 2 Inspection Tolerance

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

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.

Table 3 Dimensions of Braze-Joint Ends

Standard Water Tube Size [Note (1)]	External End			Internal End				Wall Thickness, <i>T</i>	Inside Diameter of Fitting, <i>O</i>	
	Outside Diameter, <i>A</i> [Note (2)]		Length, <i>K</i> [Note (3)]	Inside Diameter, <i>F</i> [Note (2)]		Depth, <i>G</i> [Note (4)]			Dia. Min.	Out-of- Round Max.
	Min.	Max.		Min.	Max.	Min.	Max.			
$\frac{1}{8}$ [Note (5)]	6.30	6.38	5.1	6.40	6.50	3.8	5.70	0.48	4.6	0.5
$\frac{3}{16}$ [Note (6)]	7.87	7.95	5.1	8.95	8.08	4.1	6.15	0.58	6.1	0.6
$\frac{1}{4}$	9.47	9.55	5.8	9.58	9.68	4.3	6.45	0.58	7.6	0.8
$\frac{3}{8}$	12.62	12.73	6.6	12.75	12.85	5.1	7.65	0.66	9.9	1.0
$\frac{1}{2}$	15.80	15.90	7.1	15.93	16.03	5.6	8.40	0.74	13.2	1.3
$\frac{5}{8}$	18.97	19.08	7.6	19.10	19.20	6.1	9.15	0.79	16.0	1.6
$\frac{3}{4}$	22.15	22.25	7.9	22.28	22.38	6.4	9.60	0.84	18.8	1.9
1	28.50	28.63	8.6	28.65	28.75	7.1	10.65	1.02	24.9	2.5
$1\frac{1}{4}$	34.85	34.98	9.4	35.00	35.10	7.9	11.85	1.12	31.2	3.1
$1\frac{1}{2}$	41.17	41.33	10.2	41.35	41.48	8.6	12.90	1.30	37.3	3.7
2	53.87	54.03	11.9	54.05	54.18	10.2	15.30	1.50	49.3	4.9
$2\frac{1}{2}$	66.57	66.73	13.5	66.75	66.88	11.9	17.85	1.70	61.5	6.1
3	79.27	79.43	15.0	79.45	79.58	13.5	20.25	1.91	73.4	7.3
$3\frac{1}{2}$	91.97	92.13	16.5	92.15	92.28	14.0	21.00	2.18	85.6	8.6
4	104.67	104.83	18.3	104.85	104.98	16.3	24.45	2.44	97.5	9.8
5	130.07	130.23	20.6	130.25	130.38	18.5	27.75	2.82	119.4	11.9
6	155.47	155.63	23.9	155.65	155.78	21.1	31.65	3.15	145.3	14.5
8	206.22	206.43	32.5	206.45	206.58	29.7	44.55	4.39	191.8	19.2

GENERAL NOTES:

- (a) Dimensions are in millimeters.
 (b) 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 in Column *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 in Column *G*.
 (5) $\frac{1}{8}$ nominal size is $\frac{1}{4}$ O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.
 (6) $\frac{3}{16}$ nominal size is $\frac{5}{16}$ O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.

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 handtight 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 handtight 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

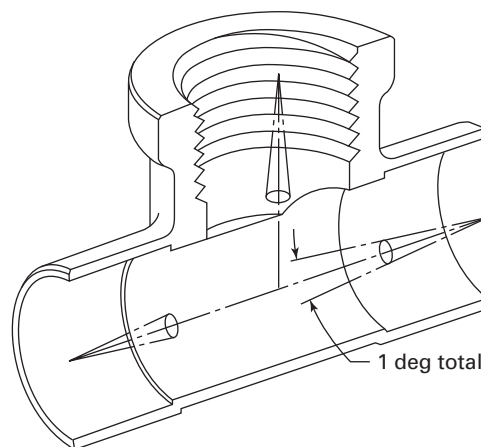
The maximum-allowable deviation in the angular alignment of any end from the specified axis position shall be $\frac{1}{2}$ deg (1 deg total) (see Fig. 3).

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

Fig. 3 Alignment



GENERAL NOTE: Figure 3 is for illustration only.

plain plug and ring gages designed to hold the product within the limits established in Table 3 (Table I-3). Gage tolerances shall be Class ZM, as defined in ASME B4.4M.

12.2 Optional Gaging Method of Braze-Joint Ends (13)

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.

MANDATORY APPENDIX I U.S. CUSTOMARY EQUIVALENTS

See Tables I-1 through I-3.

(13) **Table I-1 Internal Pressure–Temperature Ratings for Copper Fittings, psi**

Standard Water Tube Size [Note (1)]	–20°F to 100°F	150°F	200°F	250°F	300°F	350°F	400°F
$\frac{1}{8}$ [Note (2)]	1,405	1,195	1,125	1,125	1,100	935	700
$\frac{3}{16}$ [Note (3)]	1,105	940	885	885	865	735	550
$\frac{1}{4}$	910	770	725	725	710	605	455
$\frac{3}{8}$	775	660	620	620	610	515	385
$\frac{1}{2}$	720	610	575	575	565	480	360
$\frac{5}{8}$	630	535	505	505	490	420	315
$\frac{3}{4}$	580	490	465	465	455	385	290
1	490	420	395	395	385	325	245
$1\frac{1}{4}$	435	370	350	350	340	290	215
$1\frac{1}{2}$	405	345	325	325	315	270	200
2	360	305	290	290	280	240	180
$2\frac{1}{2}$	335	285	265	265	260	220	165
3	315	265	250	250	245	210	155
$3\frac{1}{2}$	300	255	240	240	235	200	150
4	290	245	230	230	225	195	145
5	265	225	215	215	210	175	130
6	250	210	200	200	195	165	125
8	270	225	215	215	210	180	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 5.

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.

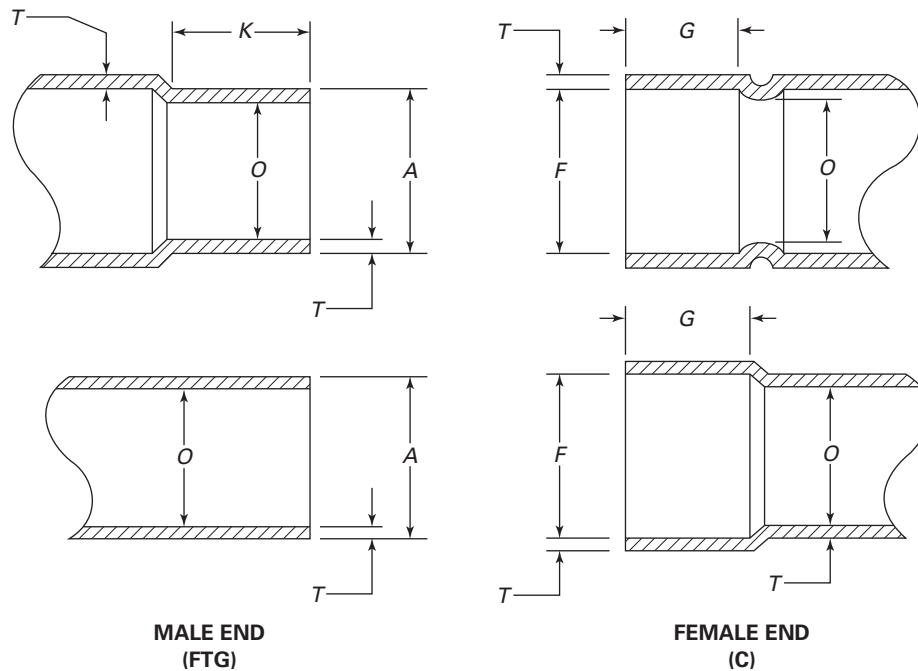
Table I-2 Inspection Tolerance

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

Table I-3 Dimensions of Braze-Joint Ends



Standard Water Tube Size [Note (1)]	External End			Internal End				Wall Thickness, <i>T</i> Min.	Inside Diameter of Fitting, <i>O</i>	
	Outside Diameter, <i>A</i> [Note (2)]		Length, <i>K</i> [Note (3)] Min.	Inside Diameter, <i>F</i> [Note (2)]		Depth, <i>G</i> [Note (4)]			Dia. Min.	Out-of- Round Max.
	Min.	Max.		Min.	Max.	Min.	Max.			
$\frac{1}{8}$ [Note (5)]	0.248	0.251	0.20	0.252	0.256	0.15	0.23	0.019	0.18	0.02
$\frac{3}{16}$ [Note (6)]	0.310	0.313	0.20	0.314	0.318	0.16	0.24	0.023	0.24	0.02
$\frac{1}{4}$	0.373	0.376	0.23	0.377	0.381	0.17	0.26	0.023	0.30	0.03
$\frac{3}{8}$	0.497	0.501	0.26	0.502	0.506	0.20	0.30	0.026	0.39	0.04
$\frac{1}{2}$	0.622	0.626	0.28	0.627	0.631	0.22	0.33	0.029	0.52	0.05
$\frac{5}{8}$	0.747	0.751	0.30	0.752	0.756	0.24	0.36	0.031	0.63	0.06
$\frac{3}{4}$	0.872	0.876	0.31	0.877	0.881	0.25	0.38	0.033	0.74	0.07
1	1.122	1.127	0.34	1.128	1.132	0.28	0.42	0.040	0.98	0.10
$1\frac{1}{4}$	1.372	1.377	0.37	1.378	1.382	0.31	0.47	0.044	1.23	0.12
$1\frac{1}{2}$	1.621	1.627	0.40	1.628	1.633	0.34	0.51	0.051	1.47	0.15
2	2.121	2.127	0.47	2.128	2.133	0.40	0.60	0.059	1.94	0.19
$2\frac{1}{2}$	2.621	2.627	0.53	2.628	2.633	0.47	0.71	0.067	2.42	0.24
3	3.121	3.127	0.59	3.128	3.133	0.53	0.80	0.075	2.89	0.29
$3\frac{1}{2}$	3.621	3.627	0.65	3.628	3.633	0.59	0.89	0.086	3.37	0.34
4	4.121	4.127	0.72	4.128	4.133	0.64	0.96	0.096	3.84	0.38
5	5.121	5.127	0.81	5.128	5.133	0.73	1.10	0.111	4.70	0.47
6	6.121	6.127	0.94	6.128	6.133	0.83	1.25	0.124	5.72	0.57
8	8.119	8.127	1.28	8.128	8.133	1.17	1.76	0.173	7.55	0.76

GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) 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 in Column *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 in Column *G*.
 (5) $\frac{1}{8}$ nominal size is $\frac{1}{4}$ O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.
 (6) $\frac{3}{16}$ nominal size is $\frac{5}{16}$ O.D. seamless copper tube for refrigeration service, etc., as listed in ASTM B280.

(13)

MANDATORY APPENDIX II

REFERENCES

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest issue shall apply.

ASME B1.20.1, Pipe Threads, General Purpose (Inch)
 ASME B4.4M, Inspection of Workpieces
 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings
 ASME B31.1, Power Piping
 ASME B31.9, Building Services Piping
 ASME Boiler & Pressure Vessel Code, Section II, Materials, Part B — Nonferrous Material Specifications
 Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 (www.asme.org)
 ASTM B88-09, Seamless Copper Water Tube
 ASTM B280-08, Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
 ASTM B819, Seamless Copper Tube for Medical Gas Systems
 ASTM E29-08, Practice for Using Significant Digits in Test Data to Determine Conformance with Specification
 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 A5.8-04, Filler Metals for Brazing and Braze Welding

Publisher: American Welding Society (AWS), 8669 Doral Boulevard, Doral, FL 33166 (www.aws.org)

ISO 9000:2005, Quality management systems — Fundamentals and vocabulary¹

ISO 9001:2008, COR 1 2009, Quality management systems — Requirements¹

ISO 9004:2009, Quality management systems — Guidelines for performance improvements¹

Publisher: International Organization for Standardization (ISO), Central Secretariat, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Genève 20, Switzerland/Suisse (www.iso.org)

MSS SP-25-1998, 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.mss-hq.org)

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

NONMANDATORY APPENDIX A FITTING RATING

(13)

The pressure–temperature ratings of the fitting are shown in Table 1 (Table I-1). 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 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.), from annealed temper ASTM B88 for Type L 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.¹ A determination of the need for registration or certification of the product manufacturer's quality system program by an independent

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

organization, or both, 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 summarized 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.

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

Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250)	B16.1-2010
Malleable Iron Threaded Fittings: Classes 150 and 300.	B16.3-2011
Gray Iron Threaded Fittings: Classes 125 and 250	B16.4-2011
Pipe Flanges and Flanged Fittings NPS ½ 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
Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads	B16.14-2010
Cast Copper Alloy Threaded Fittings.....	B16.15-2011
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.....	B16.22-2012
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	B16.24-2011
Butt welding Ends.	B16.25-2012
Cast Copper Alloy Fittings for Flared Copper Tubes.....	B16.26-2011
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 ½ Through NPS 2)	B16.33-2012
Valves — Flanged, Threaded, and Welding End.....	B16.34-2013
Orifice Flanges.....	B16.36-2009
Large Metallic Valves for Gas Distribution: Manually Operated, NPS 2½ (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.....	B16.39-2009
Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems.....	B16.40-2008
Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300	B16.42-2011
Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems Up to 5 psi	B16.44-2012
Cast Iron Fittings for Sovent® Drainage Systems.....	B16.45-1998 (R2006)
Large Diameter Steel Flanges NPS 26 Through NPS 60 Metric/Inch Standard	B16.47-2011
Line Blanks	B16.48-2010
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	B16.51-2011

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