



Designation: B251/B251M – 17

# Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube<sup>1</sup>

This standard is issued under the fixed designation B251/B251M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification covers a group of general requirements common to several wrought product specifications. Unless otherwise specified in the purchase order, or in an individual specification, these general requirements shall apply to copper and copper-alloy tube supplied under Specifications **B68/B68M**, **B75/B75M**, **B135/B135M**, **B466/B466M**, **B643** and **B743**.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:<sup>2</sup>

**B68/B68M** Specification for Seamless Copper Tube, Bright Annealed

**B75/B75M** Specification for Seamless Copper Tube

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.04 on Pipe and Tube.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- B135/B135M** Specification for Seamless Brass Tube
- B153** Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing
- B154** Test Method for Mercurous Nitrate Test for Copper Alloys
- B170** Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes
- B193** Test Method for Resistivity of Electrical Conductor Materials
- B428** Test Method for Angle of Twist in Rectangular and Square Copper and Copper Alloy Tube
- B466/B466M** Specification for Seamless Copper-Nickel Pipe and Tube
- B643** Specification for Copper-Beryllium Alloy Seamless Tube
- B743** Specification for Seamless Copper Tube in Coils
- B846** Terminology for Copper and Copper Alloys
- E3** Guide for Preparation of Metallographic Specimens
- E8/E8M** Test Methods for Tension Testing of Metallic Materials
- E18** Test Methods for Rockwell Hardness of Metallic Materials
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E53** Test Method for Determination of Copper in Unalloyed Copper by Gravimetry
- E62** Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)<sup>3</sup>
- E112** Test Methods for Determining Average Grain Size
- E255** Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition
- E478** Test Methods for Chemical Analysis of Copper Alloys

## 3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

\*A Summary of Changes section appears at the end of this standard

#### 4. Materials and Manufacture

4.1 The material shall be of such quality and purity that the finished product shall have the properties and characteristics prescribed in the applicable product specification listed in Section 1.

4.2 The material shall be produced by either hot or cold working operations, or both. It shall be finished, unless otherwise specified, by such cold working and annealing or heat treatment as necessary to meet the properties specified.

#### 5. Dimensions and Permissible Variations

##### 5.1 General:

5.1.1 The standard method of specifying wall thickness shall be in decimal fractions of an inch or millimeter.

5.1.2 For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimension shall be cause for rejection.

5.1.3 Tolerances on a given tube shall be specified with respect to any two, but not all three, of the following: outside diameter, inside diameter, wall thickness.

5.1.4 When round tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in Table 1 by more than 50 %.

NOTE 1—Blank spaces in the tolerance tables indicate either that the material is not generally available or that no tolerances have been established.

5.2 *Wall Thickness Tolerances for Copper and Copper-Alloy Tube*—Wall thickness tolerances applicable to Specifications B68/B68M, B75/B75M, B135/B135M, and B743 for round tubes only shall be in accordance with Table 1 or Table 2. Wall thickness tolerances for rectangular including square tube applicable to Specifications B75/B75M and B135/B135M shall be in accordance with Table 3 or Table 4.

5.3 *Diameter or Distance between Parallel Surfaces, Tolerances for Copper and Copper-Alloy Tube*—Diameter tolerances

applicable to Specifications B68/B68M, B75/B75M, B135/B135M, and B743 for round tubes only shall be in accordance with Table 5 or Table 6. Tolerances on distance between parallel surfaces for rectangular including square tube applicable to Specifications B75/B75M and B135/B135M shall be in accordance with Table 7 and Table 8.

5.4 *Roundness (Applicable to Specifications B75/B75M, B135/B135M, and B466/B466M)*—For drawn unannealed tube in straight lengths, the roundness tolerances shall be as follows:

$t/D$ (Ratio of Wall Thickness to Outside Diameter)	Roundness Tolerance as Percent of Outside Diameter (Expressed to the Nearest 0.001 in. [0.025 mm])
0.01 to 0.03, incl	1.5 [1.5]
Over 0.03 to 0.05, incl	1.0 [1.0]
Over 0.05 to 0.10, incl	0.8 or 0.002 in. [mm] whichever is greater
Over 0.10	0.7 or 0.002 in. [mm] whichever is greater

5.4.1 Compliance with the roundness tolerances shall be determined by taking measurements on the outside diameter only, irrespective of the manner in which the tube dimensions are specified. The deviation from roundness is measured as the difference between major and minor diameters as determined at any one cross section of the tube. The major and minor diameters are the diameters of two concentric circles just enclosing the outside surface of the tube at the cross section.

5.4.2 No tolerances have been established for as-extruded tube, redraw tube, annealed tube, any tube furnished in coils or drawn tube whose wall thickness is under 0.016 in. [0.4 mm].

##### 5.5 Length Tolerances:

5.5.1 *Straight Lengths*—Length tolerances, straight lengths, applicable to Specifications B68/B68M, B75/B75M, B135/B135M, and B466/B466M shall be in accordance with Table 9 or Table 10.

5.5.2 *Schedule of Tube Lengths*—Specific and stock lengths of tube with ends, applicable to Specifications B68/B68M, B75/B75M, B135/B135M, and B466/B466M, shall be in accordance with Table 11 or Table 12. Tube in straight lengths shall be furnished in stock lengths with ends, unless the order requires specific lengths or specific lengths with ends.

**TABLE 1 Wall Thickness Tolerances for Copper and Copper-Alloy Tube—Inch-Pound Values**  
(Applicable to Specifications B68/B68M, B75/B75M, B135/B135M, and B743)

NOTE 1—*Maximum Deviation at Any Point*—The following tolerances are plus and minus; if tolerances all plus or all minus are desired, double the values given.

Wall Thickness, in.	Outside Diameter, in. <sup>A</sup>						
	1/32 to 1/8, incl	Over 1/8 to 5/8, incl	Over 5/8 to 1, incl	Over 1 to 2, incl	Over 2 to 4, incl	Over 4 to 7, incl	Over 7 to 10, incl
Up to 0.017, incl	0.002	0.001	0.0015	0.002	...	...	...
Over 0.017 to 0.024, incl	0.003	0.002	0.002	0.0025	...	...	...
Over 0.024 to 0.034, incl	0.003	0.0025	0.0025	0.003	0.004	...	...
Over 0.034 to 0.057, incl	0.003	0.003	0.0035	0.0035	0.005	0.007	...
Over 0.057 to 0.082, incl	...	0.0035	0.004	0.004	0.006	0.008	0.010
Over 0.082 to 0.119, incl	...	0.004	0.005	0.005	0.007	0.009	0.011
Over 0.119 to 0.164, incl	...	0.005	0.006	0.006	0.008	0.010	0.012
Over 0.164 to 0.219, incl	...	0.007	0.009	0.009	0.011	0.012	0.014
Over 0.219 to 0.283, incl	...	...	0.011	0.012	0.014	0.015	0.016
Over 0.283 to 0.379, incl	...	...	0.014	6 <sup>B</sup> %	6 <sup>B</sup> %	7 <sup>B</sup> %	7 <sup>B</sup> %
Over 0.379	...	...	...	6 <sup>B</sup> %	6 <sup>B</sup> %	7 <sup>B</sup> %	7 <sup>B</sup> %

<sup>A</sup> When round tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in the table by more than 50 %.

<sup>B</sup> Percent of specified wall expressed to the nearest 0.001 in.

**TABLE 2 Wall Thickness Tolerances for Copper and Copper-Alloy Tube—SI Values**  
(Applicable to Specifications **B68/B68M**, **B75/B75M**, and **B135/B135M**)

NOTE 1—*Maximum Deviation at Any Point*—The following tolerances are plus and minus; if tolerances all plus or all minus are desired, double the values given.

Wall Thickness, mm	Outside Diameter, mm <sup>A</sup>						
	0.80 to 3.0, incl	Over 3.0 to 16, incl	Over 16 to 25, incl	Over 25 to 50, incl	Over 50 to 100, incl	Over 100 to 180, incl	Over 180 to 250, incl
Up to 0.40, incl	0.05	0.03	0.04	0.05	...	...	...
Over 0.40 to 0.60, incl	0.08	0.05	0.05	0.06	...	...	...
Over 0.60 to 0.90, incl	0.08	0.06	0.06	0.08	0.10	...	...
Over 0.90 to 1.5, incl	0.08	0.08	0.09	0.09	0.12	0.20	...
Over 1.5 to 2.0, incl	...	0.09	0.10	0.10	0.15	0.20	0.25
Over 2.0 to 3.0, incl	...	0.10	0.12	0.12	0.20	0.20	0.28
Over 3.0 to 4.0, incl	...	0.12	0.15	0.15	0.20	0.25	0.30
Over 4.0 to 5.5, incl	...	0.20	0.20	0.20	0.25	0.30	0.35
Over 5.5 to 7.0, incl	...	...	0.25	0.25	0.30	0.35	0.40
Over 7.0 to 10, incl	...	...	0.30	5 <sup>B</sup> %	5 <sup>B</sup> %	6 <sup>B</sup> %	6 <sup>B</sup> %
Over 10	...	...	...	5 <sup>B</sup> %	5 <sup>B</sup> %	6 <sup>B</sup> %	6 <sup>B</sup> %

<sup>A</sup> When round tube is ordered by outside and inside diameters, the maximum plus and minus deviation of the wall thickness from the nominal at any point shall not exceed the values given in the table by more than 50 %.

<sup>B</sup> Percent of specified wall expressed to the nearest 0.025 mm.

**TABLE 3 Wall Thickness Tolerances for Copper and Copper-Alloy Rectangular and Square Tube—Inch-Pound Values**  
(Applicable to Specifications **B75/B75M**, **B135/B135M**, and **B743**)

NOTE 1—*Maximum Deviation at Any Point*—The following tolerances are plus and minus; if tolerances all plus or all minus are desired, double the values given.

Wall Thickness, in.	Distance Between Outside Parallel Surface, in. <sup>A</sup>						
	1/32 to 1/8, incl	Over 1/8 to 5/16, incl	Over 5/16 to 1, incl	Over 1 to 2, incl	Over 2 to 4, incl	Over 4 to 7, incl	Over 7 to 10, incl
Up to 0.017, incl	0.002	0.002	0.0025	0.003	...	...	...
Over 0.017 to 0.024, incl	0.003	0.0025	0.003	0.0035	...	...	...
Over 0.024 to 0.034, incl	0.0035	0.0035	0.0035	0.004	0.006	...	...
Over 0.034 to 0.057, incl	0.004	0.004	0.0045	0.005	0.007	0.009	...
Over 0.057 to 0.082, incl	...	0.005	0.006	0.007	0.008	0.010	0.012
Over 0.082 to 0.119, incl	...	0.007	0.008	0.009	0.010	0.012	0.014
Over 0.119 to 0.164, incl	...	0.009	0.010	0.011	0.012	0.014	0.016
Over 0.164 to 0.219, incl	...	0.011	0.012	0.013	0.015	0.017	0.019
Over 0.219 to 0.283, incl	...	...	0.015	0.016	0.018	0.020	0.022

<sup>A</sup> In the case of rectangular tube the major dimension determines the thickness tolerance applicable to all walls.

**TABLE 4 Wall Thickness Tolerances for Copper and Copper-Alloy Rectangular and Square Tube—SI Values**  
(Applicable to Specifications **B75/B75M** and **B135/B135M**)

NOTE 1—*Maximum Deviation at Any Point*—The following tolerances are plus and minus; if tolerances all plus or all minus are desired, double the values given.

Wall Thickness, mm	Distance Between Outside Parallel Surface, mm <sup>A</sup>						
	0.80 to 3.0, incl	3.0 to 16, incl	16 to 25, incl	25 to 50, incl	50 to 100, incl	100 to 180, incl	180 to 250, incl
Up to 0.40, incl	0.05	0.05	0.06	0.08	...	...	...
Over 0.40 to 0.60, incl	0.08	0.06	0.08	0.09	...	...	...
Over 0.60 to 0.90, incl	0.09	0.09	0.09	0.10	0.15	...	...
Over 0.90 to 1.5, incl	0.10	0.10	0.12	0.12	0.20	0.25	...
Over 1.5 to 2.0, incl	...	0.12	0.15	0.20	0.20	0.25	0.30
Over 2.0 to 3.0, incl	...	0.20	0.20	0.25	0.25	0.30	0.35
Over 3.0 to 4.0, incl	...	0.25	0.25	0.28	0.30	0.36	0.40
Over 4.0 to 5.5, incl	...	0.28	0.30	0.33	0.38	0.45	0.50
Over 5.5 to 7.0, incl	...	...	0.38	0.40	0.45	0.50	0.55

<sup>A</sup> In the case of rectangular tube, the major dimension determines the thickness tolerance applicable to all walls.

5.6 *Squareness of Cut* (Applicable to Specifications **B68/B68M**, **B75/B75M**, **B135/B135M**, and **B466/B466M**)—For tube in straight lengths, the departure from squareness of the end of any tube shall not exceed the following:

5.6.1 *Round Tube:*

Specified Outside Diameter, in. [mm]	Tolerance
Up to 5/8 [16], incl	0.010 in. [0.25 mm]
Over 5/8 [16]	0.016 in./in. [mm/mm] of diameter