



# Standard Specification for Seamless Copper Tube, Bright Annealed<sup>1</sup>

This standard is issued under the fixed designation B 68; 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 Department of Defense.*

## 1. Scope \*

1.1 This specification establishes the requirements for bright annealed seamless copper tube suitable for use in refrigeration, oil lines, gasoline lines, and so forth, where tube with an interior surface essentially free from scale and dirt is required.

1.1.1 Tubes made from any of the following Copper UNS No. designations shall be supplied, unless otherwise specified in the contract or purchase order:

Copper UNS No. <sup>2</sup>	Type of Copper
C10200	Oxygen-free without residual deoxidants
C10300	Oxygen-free, extra low phosphorus
C10800	Oxygen-free, low phosphorus
C12000	Phosphorus deoxidized, low residual phosphorus
C12200	Phosphorus deoxidized, high residual phosphorus

1.2 Values stated in inch-pound units are the standard except for grain size, which is given in SI units.

1.3 This specification is the companion to SI Specification B 68M; therefore, no SI equivalents are presented in this specification.

1.4 The following hazard statement pertains only to the test method described in Sections 20.5 and 21.2.6 of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- B 68M Specification for Seamless Copper Tube, Bright Annealed [Metric]<sup>3</sup>
- B 153 Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing<sup>3</sup>
- B 251 Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube<sup>3</sup>
- B 577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper<sup>3</sup>

<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> Refer to Practice E 527 for explanation of unified numbering system (UNS).

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 02.01.

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast<sup>3</sup>

E 3 Practice for Preparation of Metallographic Specimens<sup>4</sup>

E 8 Test Methods for Tension Testing of Metallic Material<sup>4</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>5</sup>

E 53 Methods for Chemical Analysis of Copper<sup>6</sup>

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)<sup>6</sup>

E 112 Test Methods for Determining the Average Grain Size<sup>4</sup>

E 243 Practice for Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes<sup>7</sup>

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition<sup>6</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>8</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *bright anneal, n*—a thermal treatment carried out in a controlled atmosphere so that surface oxidation is reduced to a minimum and the surface remains relatively bright.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *unaided eye, n*—without visual enhancement; however, corrective spectacles necessary to obtain normal vision shall be permitted.

3.2.2 *capable of*—the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

## 4. Ordering Information

4.1 Include the following information in orders for products.

4.1.1 ASTM designation and year of issue (for example, B 68 – 95),

4.1.2 UNS copper number (for example, C10200),

4.1.3 Temper (Section 8),

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.03.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 01.01.

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

4.1.4 Dimensions, diameter, and wall thickness (Section 16),

4.1.5 How furnished: straight lengths or coils,

4.1.6 Total length, or number of pieces, of each size,

4.1.7 Total weight, each size, and

4.1.8 When product is purchased for agencies of the U.S. Government.

4.2 The following options are available and shall be specified at the time of placing the order, when required:

4.2.1 Electromagnetic (eddy-current) test,

4.2.2 Embrittlement test,

4.2.3 Expansion test,

4.2.4 Flattening test,

4.2.5 Certification, and

4.2.6 Mill test report.

**5. General Requirements**

5.1 The following sections of Specification B 251 are a part of this specification.

5.1.1 Terminology, General,

5.1.2 Material and Manufacture,

5.1.3 Workmanship, Finish, and Appearance,

5.1.4 Significance of Numerical Limits,

5.1.5 Inspection,

5.1.6 Rejection and Rehearing,

5.1.7 Certification,

5.1.8 Test Reports,

5.1.9 Packaging and Package Marking, and

5.1.10 Supplementary Requirements.

5.2 In addition, when a section with an identical title to those referenced in 5.1 appears in this specification, such section may contain requirements which supersede those appearing in Specification B 251. In case of conflict, this specification prevails.

**6. Materials and Manufacture**

6.1 *Materials:*

6.1.1 The material of manufacture shall be billets, bars, or tube of the Copper UNS No. C10200, C10300, C10800, C12000, or C12200 and shall be of such soundness as to be suitable for processing into the tubular products described.

6.2 *Manufacture:*

6.2.1 The tube shall be manufactured by such hot- or cold-working processes as to produce a homogeneous uniform wrought structure in the finished product. The tube shall be cold drawn to the finished size and wall thickness and shall be bright annealed to meet the specified temper.

**7. Chemical Composition**

7.1 The material shall conform to the requirements prescribed in Table 1 for the specified copper.

7.2 These specification limits do not preclude the presence of other elements. It is not prohibited to establish limits for unnamed elements and to require analysis by agreement between the manufacturer or supplier and the purchaser.

**8. Temper**

8.1 The tube shall be furnished in either of two annealed tempers as follows:

Annealed (O)	Temper Designation
O50	(Light annealed)
O60	(Soft annealed)

8.1.1 Tempers are defined in Practice B 601.

**9. Grain Size**

9.1 Tube in the tempers O50 (light annealed) and O60 (soft annealed) shall conform to the requirements of Table 2.

**10. Mechanical Property Requirements**

10.1 *Tensile Strength:*

10.1.1 The tube shall have a minimum tensile strength of 30 ksi when tested in accordance with Test Methods E 8.

10.2 *Elongation:*

10.2.1 The tensile elongation of the tube shall be a minimum 40 % (2-in. gage length) when tested in accordance with Test Methods E 8.

**11. Performance Requirements**

11.1 *Expansion Test:*

11.1.1 When specified in the contract or purchase order, the outside diameter of the tube furnished shall be capable of being expanded as follows when tested in accordance with Test Method B 153.

Outside Diameter, in.	Expansion, %
¾ and under	40
over ¾	30

11.1.1.1 The expanded tube shall show no cracks or ruptures seen through visual inspection without the use of special equipment or enhancement excepting the use of corrective lenses.

11.1.2 A flattening test is an optional alternative to the expansion test for annealed tube over 4 in. in diameter.

11.2 *Flattening Test:*

11.2.1 When specified in the contract or purchase order, the tube shall be capable of being flattened in accordance with the method described in 21.2.6.1 and shall contain no cracks or flaws visible to the unaided eye in the flattened section.

**12. Microscopical Examination**

12.1 Samples of Copper UNS Nos. C10200, C10300, and C12000 shall be free of cuprous oxide as determined by

**TABLE 1 Chemical Composition**

Element	Composition, %				
	Copper UNS No.				
	C10200 <sup>A</sup>	C10300	C10800	C12000	C12200
Copper, <sup>B</sup> min	99.95	...	...	99.90	99.9
Copper <sup>B</sup> + phosphorus, min	...	99.95	99.95	...	...
Phosphorus	...	0.001–0.005	0.005–0.012	0.004–0.012	0.015–0.040

<sup>A</sup> Oxygen in CX10200 shall be 10 ppm max.

<sup>B</sup> Silver counting as copper.