



Designation: B301/B301M – 13 (Reapproved 2020)

Standard Specification for Free-Cutting Copper Rod, Bar, Wire, and Shapes¹

This standard is issued under the fixed designation B301/B301M; 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 (ϵ) 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 establishes the requirements for free-cutting copper rod, bar, wire, and shapes of UNS Alloy Nos. C14500, C14510, C14520, C14700, and C18700, suitable for high-speed screw machine work or for general applications.

1.2 Typically, product made to this specification is furnished as straight lengths. Sizes $\frac{1}{2}$ in. [12 mm] and under may be furnished in coils when requested.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4 *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 ASTM Standards:²

[B193 Test Method for Resistivity of Electrical Conductor Materials](#)

[B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings](#)

[B250/B250M Specification for General Requirements for Wrought Copper Alloy Wire](#)

[B950 Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys \(Withdrawn 2010\)³](#)

[E478 Test Methods for Chemical Analysis of Copper Alloys](#)

3. General Requirements

3.1 The following sections of Specification [B249/B249M](#) or [B250/B250M](#) constitute a part of this specification:

- 3.1.1 Terminology;
- 3.1.2 Materials and Manufacture;
- 3.1.3 Dimensions and Permissible Variations;
- 3.1.4 Workmanship, Finish, and Appearance;
- 3.1.5 Sampling;
- 3.1.6 Number of Tests and Retests;
- 3.1.7 Specimen Preparation;
- 3.1.8 Test Methods;
- 3.1.9 Inspection;
- 3.1.10 Significance of Numerical Limits;
- 3.1.11 Rejection and Reheating;
- 3.1.12 Certification;
- 3.1.13 Test Reports;
- 3.1.14 Packaging and Package Marking; and
- 3.1.15 Supplementary Requirements.

3.2 In addition, when a section with a title identical to that referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specification [B249/B249M](#) or [B250/B250M](#).

4. Ordering Information

4.1 Include the following specified choices when placing orders for products under this specification, as applicable:

- 4.1.1 ASTM designation and year of issue;
- 4.1.2 Copper UNS No. designation;
- 4.1.3 Product (rod, bar, wire, or shape);
- 4.1.4 Cross section (round, hexagonal, square, and so forth);
- 4.1.5 Temper (Section 6);

¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rod, Bar, Wire, Shapes and Forgings.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

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

- 4.1.6 Dimensions, diameter or distance between parallel surfaces; width and thickness;
- 4.1.7 How furnished: straight lengths, coils, or reels;
- 4.1.8 Length (Section 9.3);
- 4.1.9 Total length, or number of pieces of each size;
- 4.1.10 Total weight of each size; and
- 4.1.11 Intended application.

4.2 The following options are available but may not be included unless specified at the time of placing of the order when required:

- 4.2.1 Certification (Specification B249/B249M or B250/B250M),
- 4.2.2 Mill Test Reports (Specification B249/B249M or B250/B250M),
- 4.2.3 Yield strength tests (Section 8),
- 4.2.4 Resistivity tests (Section 7),
- 4.2.5 Automatic screw machine use (9.4), and
- 4.2.6 When product is purchased for agencies of the U.S. Government (Specification B249/B249M or B250/B250M).

5. Chemical Composition

5.1 The material shall conform to the chemical composition requirements in Table 1 for the UNS No. designation specified in the ordering information.

5.2 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser.

6. Temper

6.1 The standard tempers for products described in this specification are given in Table 2.

6.1.1 Rod (round, hexagonal, and octagonal) shall be furnished in H02 (half-hard) temper for general use and applications involving moderate cold forming and in H04 (hard) temper (round only) for applications that require maximum strength and resistance to bending under cutting-tool pressure.

6.1.2 Bar shall be furnished in H04 (hard) temper only.

6.1.3 Wire shall be furnished in H02 (half-hard) or H04 (hard) temper.

6.2 Other tempers, and temper for other products including shapes, shall be subject to agreement between the manufacturer and the purchaser.

7. Physical Property Requirements

7.1 Electrical Requirements:

7.1.1 The product produced from Copper UNS Nos. C14500, C14520, C14700, and C18700 shall conform to the following electrical requirements, when tested in accordance with Test Method B193, at a temperature of 68 °F [20 °C].

UNS No.	Resistivity, max, Ω , g/m ²	Conductivity, min, % IACS ^A
C14500	0.180 33	85.0
C14520	0.204 37	75.0
C14700	0.170 30	90.0
C18700	0.170 30	90.0

^A International Annealed Copper Standard.

7.1.2 Copper UNS No. C14510 is not intended for electrical applications. This alloy, therefore, has no electrical requirements.

7.1.3 Electrical resistivity tests need not be made except when indicated by the purchaser at the time of placing the order. The electrical resistivity tests shall be made on annealed test specimens.

8. Mechanical Property Requirements

8.1 The product shall conform to the tensile strength and elongation requirements of Table 2 when tested in accordance with Test Methods E8/E8M.

8.2 When specified in the contract or purchase order, the yield strength shall be determined and conform with the yield strength requirements of Table 2 when tested in accordance with Test Methods E8/E8M.

9. Dimensions, Mass, and Permissible Variations

9.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B249/B249M or B250/B250M with particular reference to the following tables and related paragraphs in those specifications.

9.2 Diameter or Distance Between Parallel Surfaces:

9.2.1 Rod (Round, Hexagonal, and Octagonal)—See 6.2 and Table 1 of Specification B249/B249M.

9.2.2 Bar (Rectangular and Square)—See 6.2 and Tables 7 and 10 of Specification B249/B249M.

9.2.3 Wire—See 6.2 and Table 1 of Specification B250/B250M.

TABLE 1 Chemical Requirements

Element	Composition, %				
	Copper or Copper Alloy UNS No.				
	C14500 ^A	C14510	C14520	C14700 ^A	C18700
Tellurium	0.40–0.7	0.30–0.7	0.40–0.7
Sulfur	0.20–0.50	...
Lead	...	0.05 max	0.8–1.5
Phosphorus	0.004–0.012	0.010–0.030	0.004–0.020	0.002–0.005	...
Copper (incl silver)	99.90 min ^B	99.85 min ^B	99.90 min ^B	99.90 min ^C	99.5 min ^D

^A Includes oxygen-free or deoxidized grades with deoxidizers (such as phosphorus, boron, lithium, or other) in an amount agreed upon.

^B Includes tellurium and phosphorus.

^C Includes sulfur and phosphorus.

^D Includes lead.