



Designation: B249/B249M – 22

Standard Specification for General Requirements for Wrought Copper and Copper- Alloy Rod, Bar, Shapes and Forgings¹

This standard is issued under the fixed designation B249/B249M; 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 specification² establishes the general requirements common to wrought copper and copper alloy rod, bar, shapes, and forgings which shall apply to Specifications [B16/B16M](#), [B21/B21M](#), [B98/B98M](#), [B124/B124M](#), [B138/B138M](#), [B139/B139M](#), [B140/B140M](#), [B150/B150M](#), [B151/B151M](#), [B187/B187M](#), [B196/B196M](#), [B283/B283M](#), [B301/B301M](#), [B371/B371M](#), [B411/B411M](#), [B441](#), [B453/B453M](#), [B455](#), [B570](#), [B870](#), [B927/B927M](#), [B929](#), [B967/B967M](#), [B974/B974M](#), and [B981/B981M](#) to the extent referenced therein.

1.2 The chemical composition, physical and mechanical properties, and all other requirements not included in this specification are prescribed in the product specification.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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.

1.3.1 Within the text the SI values are given in brackets.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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.*

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.

Current edition approved Oct. 1, 2022. Published October 2022. Originally approved in 1951. Last previous edition approved in 2020 as B249/B249M–20. DOI: 10.1520/B0249_B0249M-22.

² For *ASME Boiler and Pressure Vessel Code* applications see related Specifications SB-249 in Section II of that Code.

2. Referenced Documents

2.1 ASTM Standards:³

- [B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines](#)
- [B21/B21M Specification for Naval Brass Rod, Bar, and Shapes](#)
- [B98/B98M Specification for Copper-Silicon Alloy Rod, Bar and Shapes](#)
- [B124/B124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes](#)
- [B138/B138M Specification for Manganese Bronze Rod, Bar, and Shapes](#)
- [B139/B139M Specification for Phosphor Bronze Rod, Bar, and Shapes](#)
- [B140/B140M Specification for Copper-Zinc-Lead \(Red Brass or Hardware Bronze\) Rod, Bar, and Shapes](#)
- [B150/B150M Specification for Aluminum Bronze Rod, Bar, and Shapes](#)
- [B151/B151M Specification for Copper-Nickel-Zinc Alloy \(Nickel Silver\) and Copper-Nickel Rod and Bar](#)
- [B154 Test Method for Mercurous Nitrate Test for Copper Alloys](#)
- [B187/B187M Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes](#)
- [B193 Test Method for Resistivity of Electrical Conductor Materials](#)
- [B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar](#)
- [B196/B196M Specification for Copper-Beryllium Alloy Rod and Bar](#)
- [B283/B283M Specification for Copper and Copper-Alloy Die Forgings \(Hot-Pressed\)](#)
- [B301/B301M Specification for Free-Cutting Copper Rod, Bar, Wire, and Shapes](#)
- [B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod](#)

³ 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.

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



B411/B411M Specification for Copper-Nickel-Silicon Alloy Rod and Bar

B441 Specification for Copper-Cobalt-Beryllium, Copper-Nickel-Beryllium, and Copper-Nickel-Lead-Beryllium Rod and Bar (UNS Nos. C17500, C17510, and C17465)

B453/B453M Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes

B455 Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes

B570 Specification for Copper-Beryllium Alloy (UNS Nos. C17000 and C17200) Forgings and Extrusions

B577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper

B846 Terminology for Copper and Copper Alloys

B858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys

B870 Specification for Copper-Beryllium Alloy Forgings and Extrusions (UNS Nos. C17500, C17510, and C17540)

B900 Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies

B927/B927M Specification for Brass Rod, Bar, and Shapes

B929 Specification for Copper-Nickel-Tin Spinodal Alloy Rod and Bar

B967/B967M Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire

B974/B974M Specification for Free-Cutting Bismuth Brass Rod, Bar and Wire

B981/B981M Specification for Low-Leaded Brass Rod, Bar, Wire, and Shapes

D4855 Practice for Comparing Test Methods (Withdrawn 2008)⁴

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 (Withdrawn 2022)⁴

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)⁴

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁴

E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)⁴

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)⁴

E112 Test Methods for Determining Average Grain Size

E118 Test Methods for Chemical Analysis of Copper-Chromium Alloys (Withdrawn 2010)⁴

E121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys (Withdrawn 2010)⁴

E255 Practice for Sampling Copper and Copper Alloys for

the Determination of Chemical Composition

E290 Test Methods for Bend Testing of Material for Ductility

E478 Test Methods for Chemical Analysis of Copper Alloys

E581 Test Methods for Chemical Analysis of Manganese-Copper Alloys

2.2 *ASME Code*:⁵

ASME Boiler and Pressure Vessel Code

3. Terminology

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *lengths, mill, n*—straight lengths, including ends, that can be conveniently manufactured in the mill. Full length pieces are usually 10 ft or 12 ft [3000 mm or 3600 mm].

3.2.2 *lengths, stock, n*—straight lengths that are mill cut and stored in advance of orders. They are usually 10 ft or 12 ft [3000 mm or 3600 mm] and subject to established length tolerances.

4. Materials and Manufacture

4.1 Materials:

4.1.1 The material of manufacture shall be a form of the Copper or Copper Alloy UNS No. designation specified in the ordering information of such purity and soundness as to be suitable for processing into the products described in the product specification.

4.1.2 When specified in the contract or purchase order that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify specific casting analysis with a specific quantity of finished product.

4.2 *Manufacture*—The product shall be manufactured by such hot-working, cold-working, and annealing processes as to produce a uniform wrought structure in the finished product.

4.2.1 The product shall be hot- or cold-worked to the finished size and subsequently annealed or heat treated when required, and straightened to meet the properties specified.

4.2.2 *Edges*—The edge shall be drawn, extruded, or rolled; refer to Edge Contours in Section 6.

5. Chemical Composition

5.1 The material shall conform to the chemical composition requirements prescribed in the product specification.

5.1.1 Results of analysis on a product (check) sample shall conform to the composition requirements within the permitted analytical variance given in the product specification.

5.2 The composition limits established for the Copper or Copper Alloy UNS No. designation specified in the product specification do not preclude the presence of other elements.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

By agreement between the manufacturer or supplier and the purchaser, limits may be established and analysis required for unnamed elements.

5.3 When material composition has been determined during the course of manufacture, analysis of the finished product by the manufacturer is not required.

6. Dimensions, Mass and Permissible Variations

6.1 *General*—For the purpose of determining conformance with the dimensional requirements, any measured value outside the specified limiting values for any dimension may be cause for rejection.

6.1.1 The dimensions and tolerances for products referenced to this specification shall be as noted in the following paragraphs and tables, where the product specification is noted in the table heading.

NOTE 2—Blank spaces in the tolerance tables indicate either that the material generally is not available or that no tolerances are established.

6.2 *Diameter or Distance Between Parallel Surfaces*—The diameter of round sections or the distance between parallel surfaces in the case of other sections, except shapes, shall not vary from that specified by more than the amounts specified in Tables 1-12, included, for the product specification indicated.

Table 1 and Table 2—List the tolerances for diameter or distance between parallel surfaces of cold-drawn rod in round, hexagonal, and octagonal cross sections. Applicable product specifications and alloys are shown in the table titles.

Table 3—Lists the diameter tolerances for piston finish rod applicable to product specifications shown in the table title.

Table 4 and Table 5—List the tolerances for diameter or distance between parallel surfaces of as-extruded rod and bar applicable to the specifications and alloys shown in the table titles. These tolerances are applicable to round, hexagonal, and octagonal rod as well as square and rectangular bar.

Table 6—Lists the diameter tolerances for hot-rolled round rod applicable to the product specification shown in the table title.

TABLE 1 Tolerances for Diameter or Distance Between Parallel Surfaces of Cold-Drawn Rod

(Applicable to Specifications **B16/B16M**, **B21/B21M**, **B98/B98M** (Copper Alloy UNS No. C65100), **B124/B124M** (Copper Alloy UNS Nos. C11000, C14500, C14700, C46400, C46750, C48200, C48500, C48640, C48645, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, and C49360), **B140/B140M**, **B301/B301M**, **B453/B453M**, **B927/B927M**, **B967/B967M**, and **B974/B974M**)

| Diameter or Distance Between Parallel Surfaces, in. [mm] | Tolerances, Plus and Minus, ^A in. [mm] | |
|--|---|---------------------------------------|
| | Round | Hexagonal, Octagonal |
| Up to 0.150 [3.8], incl | 0.0013 [0.035] | 0.0025 [0.06] |
| Over 0.150 to 0.500 [3.8 to 12], incl | 0.0015 [0.04] | 0.003 [0.08] |
| Over 0.500 to 1.00 [12 to 25], incl | 0.002 [0.05] | 0.004 [0.10] |
| Over 1.00 to 2.00 [25 to 50], incl | 0.0025 [0.06] | 0.005 [0.13] |
| Over 2.00 [50] | 0.15 ^B [0.15] ^B | 0.30 ^B [0.30] ^B |

^A When tolerances are specified as all plus or all minus, double the values given.
^B Percent of specified diameter or distance between parallel surfaces expressed to the nearest 0.001 in. [0.01 mm].

TABLE 2 Tolerances for Diameter or Distance Between Parallel Surfaces of Cold-Drawn Rod

(Applicable to Specifications **B98/B98M** (Copper Alloy UNS Nos. C65500 and C66100), **B124/B124M** (Copper Alloy UNS Nos. C27450, C27453, C28500, C36300, C36500, C37000, C37700, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C65680, C67500, C67600, C69240, C69300, C69410, C69850, C70620, C71520, and C77400), **B138/B138M**, **B139/B139M**, **B150/B150M**, **B151/B151M**, **B196/B196M**, **B371/B371M**, **B411/B411M**, **B441**, and **B981/B981M**)

| Diameter or Distance Between Parallel Surfaces, in. [mm] | Tolerances, Plus and Minus, ^A in. [mm] | |
|--|---|---------------------------------------|
| | Round | Hexagonal, Octagonal |
| Up to 0.150 [3.8], incl | 0.002 [0.050] | ... |
| Over 0.150 to 0.500 [3.8 to 12], incl | 0.002 [0.050] | 0.004 [0.10] |
| Over 0.500 to 1.00 [12 to 25], incl | 0.003 [0.08] | 0.005 [0.13] |
| Over 1.00 to 2.00 [25 to 50], incl | 0.004 [0.10] | 0.006 [0.15] |
| Over 2.00 [50] | 0.20 ^B [0.20] ^B | 0.40 ^B [0.40] ^B |

^A When tolerances are specified as all plus or all minus, double the values given.
^B Percent of specified diameter or distance between parallel surfaces expressed to the nearest 0.001 in. [0.01 mm].

TABLE 3 Diameter Tolerances for Piston-Finish Rod
 (Applicable to Specifications **B21/B21M**, **B138/B138M**, **B139/B139M**, and **B150/B150M**)

| Diameter, in. [mm] | Tolerances, Plus and Minus, ^A in. [mm] |
|-------------------------------------|---|
| Over 0.500 to 1.00 [12 to 25], incl | 0.0013 [0.35] |
| Over 1.00 to 2.00 [25 to 50], incl | 0.0015 [0.04] |
| Over 2.00 [50] | 0.10 ^B [0.10] ^B |

^A When tolerances are specified as all plus or all minus, double the values given.
^B Percent of specified diameter expressed to the nearest 0.0005 in. [0.01 mm].

TABLE 4 Tolerances for Diameter or Distance Between Parallel Surfaces of As-Extruded Rod and Bar

(Applicable to Specifications **B21/B21M**, **B124/B124M** (Copper Alloy UNS Nos. C27450, C27453, C28500, C36300, C36500, C37000, C37700, C46400, C46750, C48200, C48500, C48640, C48645, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, C49360, C61900, C62300, C63000, C63200, C64200, C64210, C67500, C67600, C69240, C69300, C69410, C69850, C70620, and C71520), **B138/B138M** (Copper Alloy UNS Nos. C67500 and C67600), **B150/B150M**, **B967/B967M**, and **B981/B981M**)

| Diameter or Distance Between Parallel Surfaces, in. [mm] | Tolerances, Plus and Minus, ^A in. [mm] |
|--|--|
| | Rod (Round, Hexagonal, and Octagonal) Bar (Rectangular and Square) |
| Up to 1.00 [25], incl | 0.010 [0.25] |
| Over 1.00 to 2.00 [25 to 50], incl | 0.015 [0.38] |
| Over 2.00 to 3.00 [50 to 75], incl | 0.025 [0.65] |
| Over 3.00 to 3.50 [75 to 90], incl | 0.035 [0.90] |
| Over 3.50 to 4.00 [90 to 100], incl | 0.060 [1.5] |

^A When tolerances are specified as all plus or all minus, double the values given.

Table 7, Table 8 and Table 9—List the thickness tolerances for rectangular and square bar applicable to the product specifications and alloys shown in the table titles.

Table 10 and Table 11—List the width tolerances for rectangular bar applicable to the product specifications and alloys shown in the table titles.