



Standard Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire¹

This standard is issued under the fixed designation B967/B967M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification establishes the requirements for copper-zinc-tin-bismuth alloy rod, bar and wire of alloy UNS Nos. C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, and C49360 intended for use in plumbing applications and drinking water systems.

1.2 Typically, rod and bar product made to this specification is furnished as straight lengths. Wire (H04) 0.08 to 0.3 in. [2 to 8 mm inclusive] is furnished in coil form, and H50 shapes.

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 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.

1.4 The following safety hazard caveat pertains only to the test method(s) described in this specification.

1.4.1 *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:²

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

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)³

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)³

E92 Test Methods for Vickers Hardness and Knoop Hardness of Metallic Materials

E478 Test Methods for Chemical Analysis of Copper Alloys

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 Other Standards:

ISO No. 3110 (AA) Copper Alloys – Determination of Aluminum as an Alloying Element – Volumetric⁴ (International Organization of Standardization)

JIS H 1068:2005 Method for Determination of Bismuth in Copper and Copper Alloys⁵ (Japanese Industrial Standards)

3. General Requirements

3.1 The following sections of Specifications **B249/B249M** for rod and bar and **B250/B250M** for wire constitute a part of this specification:

- 3.1.1 Terminology,
- 3.1.2 Materials and Manufacture,
- 3.1.3 Sampling,
- 3.1.4 Number of Tests and Retests,
- 3.1.5 Specimen Preparation,
- 3.1.6 Certification,
- 3.1.7 Test Reports.

3.2 In addition, when a section with a title identical to that referenced in Appendix X1, above, appears in this specification, it contains additional requirements which supplement those appearing in Specifications **B249/B249M** for rod and bar and **B250/B250M** for wire.

4. Terminology

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

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.

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

⁵ Available from Japanese Standards Association (JSA), Mita MT Bldg., 3-13-12 Mita, Minato-ku, Tokyo 108-0073, Japan, http://www.jsa.or.jp.

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

5. Ordering Information

5.1 Include the following information when placing orders for product under this specification, as applicable:

- 5.1.1 ASTM designation and year of issue;
- 5.1.2 Copper Alloy UNS designation;
- 5.1.3 Temper (Section 8);
- 5.1.4 Dimensions, diameter, or distance between parallel surfaces;
- 5.1.5 How furnished: straight lengths or coils;
- 5.1.6 Quantity: total weight or total length or number of pieces of each size;
- 5.1.7 If product is purchased for agencies of the U.S. Government (see the Supplementary Requirements section of Specifications **B249/B249M** or **B250/B250M** for additional requirements, if specified); and
- 5.1.8 *Shapes*—When product is in a shape form, the dimensional tolerances shall be as agreed upon between the manufacturer or supplier and purchaser and shall be specified (see **11.1.7**).

5.2 The following options are available and should be specified at the time of placing of the order when required:

- 5.2.1 Heat identification or traceability details,
- 5.2.2 Certification, and
- 5.2.3 Mill Test Report.

6. Materials and Manufacture

6.1 Materials:

6.1.1 The material of manufacture shall be a form of Copper Alloy UNS Nos. C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, or C49360 of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.1.2 In the event 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 a specific casting analysis with a specific quantity of finished material.

6.2 Manufacture:

6.2.1 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.

6.2.2 The product shall be hot or cold worked to the finished size, and subsequently annealed when required, to meet the temper properties specified.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in **Table 1** for the copper alloy UNS Numbers specified in the ordering information.

7.1.1 Results of analysis on a product (check) sample shall conform to the composition requirements within the permitted analytical variance specified in **Table 1**.

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

7.3 For alloys in which zinc is listed as “remainder,” either copper or zinc may be taken as the difference between the sum of results of all elements determined and 100 %. When all elements in **Table 1** are determined, the sum of results shall be 99.5 % min.

7.4 For alloys in which copper is listed as “remainder,” copper is the difference between the sum of results of all elements determined and 100 %. When all elements in **Table 1** are determined, the sum of results shall be 99.5 % min.

7.5 All chemical composition requirements must be in accordance with the UNS Registered Composition or another internationally recognized system for alloy designation (“other designation”). It is permissible for applications to have tighter (more restrictive) limits, but they must be completely within the registered UNS (or other designation) Composition. When different limits outside the registered limits are desired, a new Registered UNS Composition must be obtained.

NOTE 2—Refer to **E527** Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS) for information on registering a UNS composition.

8. Temper

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

8.1.1 Hot Extruded and Annealed: O30

TABLE 1 Chemical Composition, %

Copper Alloy UNS No.	Copper	Lead, max	Iron, max	Tin	Zinc	Phosphorus, max	Aluminum, max	Antimony, max	Bismuth	Manganese, max	Nickel, max, incl Co	Selenium, max	Silicon, max
C49250	58.0–61.0 ^A	0.09	0.50	0.30 max	Rem	...	...	...	1.8–2.4	...	...	...	...
C49255	58.0–60.0 ^B	0.01	0.10	0.50 max	Rem	0.10	...	...	1.7–2.9	...	0.10–0.30	0.02–0.07	0.10
C49260	58.0–63.0 ^A	0.09	0.50	0.50 max	Rem	0.05–0.15	...	...	0.50–1.8	...	...	...	0.10
C49265	58.0–62.0 ^{A, C}	0.09–0.25	0.30	0.50	Rem	0.05–0.12	...	...	0.50–1.3	...	...	...	0.10
C49300	58.0–62.0	0.01	0.10	1.0–1.8	Rem	0.20	0.50	0.50	0.50–2.0	0.03	1.5	0.20	0.10
C49340	60.0–63.0 ^A	0.09	0.12	0.50–1.5	Rem	0.05–0.15	...	...	0.50–2.2	...	...	...	0.10
C49345	60.0–64.0 ^{A, C}	0.09–0.25	0.30	0.50–1.5	Rem	0.05–0.12	...	...	0.50–1.3	...	...	...	0.10
C49350	61.0–63.0	0.09	0.12	1.5–3.0	Rem	0.04–0.15	...	0.02–0.10	0.50–2.5	...	...	...	0.30
C49355	63.0–69.0 ^D	0.09	0.10	0.50–2.0	27.0–35.0	...	...	...	0.50–1.5	0.10	...	...	1.0–2.0
C49360	Rem	0.09	...	1.0–2.0	19.0–22.0	...	...	...	0.50–1.5	...	...	...	2.0–3.5

^A Includes Cadmium 0.001 max.

^B Includes Cadmium 0.01 max.

^C Includes Ag.

^D Boron 0.001 max.

TABLE 2 Mechanical Property Requirements – Round and Hexagonal Rod, Bar^A and Wire

Temper		Diameter or Distance Between Parallel Surfaces, in. [mm]	Tensile Strength, ksi [MPa], min	Yield Strength 0.2 offset ksi [MPa], min	Elongation in 4 × dia. % min	Vickers Hardness 5000 gms Typ.
Code	Name					
Copper Alloy UNS Nos. C49250, C49260, C49265, C49300, C49340, and C49345						
M30	As Hot Extruded	1 to 4.375 incl. [25–110] incl.	50 [345]	20 [140]	18	...
O61	Annealed	0.3–1 incl. [8–25] incl.	50 [345]	20 [140]	15	80
		1–2.5 incl. [26–65] incl.	48 [330]	16 [110]	15	80
H02	½ Hard	0.3–1 incl. [8–25] incl.	55 [380]	25 [170]	15	80
		1–2.5 incl. [26–65] incl.	50 [345]	20 [140]	15	80
H04	Hard Wire	0.08–0.3 incl. [2–8] incl.	67 [460]	45 [310]	3	...
H50	Hot extruded and Drawn	All Sizes	50 [345]	20 [140]	...	...
Copper Alloy UNS No C49350						
M30	As Hot extruded	1–4.375 incl. [25–110 incl.]	50 [345]	20 [140]	15	...
O61	Annealed	0.3–2.5 incl. [8–25 incl.]	48 [330]	16 [110]	12	...

^A For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

- 8.1.2 Annealed: O61 for rod and bar
- 8.1.3 As Hot Extruded: M30 for rod and bar
- 8.1.4 Cold drawn half hard temper: H02 for rod and bar
- 8.1.5 Cold drawn hard temper: H04 for wire
- 8.1.6 Hot extruded and drawn: H50 for Shapes in all sizes.

9. Mechanical Property Requirements

9.1 Tensile Strength Requirements:

9.1.1 Product furnished under this specification shall conform to the tensile requirements prescribed in **Table 2**, when tested in accordance with Test Methods **E8/E8M**.

9.1.2 Acceptance or rejection shall be based upon the tensile properties prescribed in **Table 2**, **Table 3**, **Table 4**, or **Table 5**, depending on alloy and product form.

10. Other Requirements

10.1 *Purchases for the U.S. Government*—Product purchased for agencies of the U.S. Government shall conform to the additional requirements prescribed in the Supplementary Requirements section of Specifications **B249/B249M** or **B250/B250M**.

11. Dimensions, Mass, and Permissible Variation

11.1 The dimensions and tolerances for product described by this specification shall be as specified in Specifications **B249/B249M** or **B250/B250M** for wire as noted, with particular reference to the following Tables and related paragraphs:

11.1.1 Diameter or Distance Between Parallel Surfaces

11.1.1.1 Rod, Cold-Drawn, H02, H04 Table 1, Specification **B249/B249M**.

11.1.1.2 Hot Extruded and Annealed, O30 Table 4, Specification **B249/B249M**.

11.1.1.3 Rod and Bar, As Extruded, O61 Table 4, Specification **B249/B249M**.

11.1.1.4 Wire Cold Drawn Hard, H04 Table 1, Specification **B250/B250M**.

11.1.2 Thickness Tolerance for Rectangular and Square Bar, Table 8, Specification **B249/B249M**.

11.1.3 Width Tolerance for Rectangular Bar, Table 10, Specification **B249/B249M**.

11.1.4 Length: Table 13, Full Length Tolerances for Rod, Bar, and Table 15, Schedule of Lengths with Ends for Rod and Bar, Specification **B249/B249M**.

11.1.5 Straightness: Table 16, Straightness Tolerances for Rod, Bar, For General Use section, Specification **B249/B249M**.

11.1.6 Edge Contour: Refer to Edge Contours section in Specifications **B249/B249M** or **B250/B250M**.

11.1.7 Shapes: The dimensional tolerances for shapes shall be agreed upon between the manufacturer or supplier and the purchaser and shall be specified in the order or purchase contract.

12. Workmanship, Finish, and Appearance

12.1 The product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.

13. Sampling

13.1 Refer to sampling section in Specifications **B249/B249M** or **B250/B250M**.

14. Number of Tests and Retests

14.1 Test:

14.1.1 *Chemical Analysis*—Chemical composition shall be determined in accordance with the element mean of the results from at least two replicate analyses of the sample(s).

14.2 Retest:

TABLE 3 Mechanical Property Requirements UNS Alloy No. C49255 Rod

Temper		Diameter or Distance Between Parallel Surfaces, in. [mm]	Tensile Strength, ksi [MPa], min	Yield Strength 0.2 offset ksi [MPa], min	Elongation in 4 × dia. % min	Vickers Hardness 5000 gms Typ.
Code	Name					
M30	As Hot Extruded	1–4.375 incl. [25–110] incl.	46 [315]	...	15	...
O30	Hot Extruded and Annealed	0.3–3 incl. [8–75] incl.	49 [335]	...	...	80

TABLE 4 Mechanical Property Requirements UNS Alloy No. C49355 Round and Hexagonal Rod and Bar^A

Code	Temper Name	Diameter or Distance Between Parallel Surfaces, in. [mm]	Tensile Strength ksi [MPa] min	Yield Strength 0.2 offset ksi [MPa] min	Elongation in 4 × dia. % min
M30	As Hot extruded	0.3–2.5 incl. [8–65 incl.]	50 [345]	20 [140]	15
O60	Soft Annealed	0.3–2.5 incl. [8–65 incl.]	50 [345]	20 [140]	15

^A For rectangular bar, the distance between parallel surfaces refers to thickness.

TABLE 5 Mechanical Property Requirements UNS Alloy No. C49360 Round and Hexagonal Rod and Bar^A

Code	Temper Name	Diameter or Distance Between Parallel Surfaces, in. [mm]	Tensile Strength, ksi [MPa], min	Yield Strength 0.2 offset ksi [MPa], min	Elongation in 4 × dia. % min	Vickers Hardness 5000 gms Typ.
M30	As Hot Extruded	1 to 3.15 incl. [26–80] incl.	50 [345]	22 [150]	15	...
O61	Annealed	0.4–1 incl. [10–25] incl.	50 [345]	22 [150]	12	...

^A For rectangular bar, the distance between parallel surfaces refers to thickness.

14.2.1 When requested by the manufacturer or supplier, a retest shall be permitted when results of tests obtained by the purchaser fail to conform to the requirements of the product specification.

14.2.2 The retest shall be as directed in the product specification for the initial test, except the number of test specimens shall be twice that normally required for the specified test.

14.2.3 All test specimens shall conform to the product specification requirement(s) in retest. Failure to conform shall be cause for rejection.

15. Test Methods

15.1 Chemical Analyses:

15.1.1 In cases of disagreement, the resolution of the dispute shall be subject to agreement between the manufacturer or supplier and purchaser. The following methods may be used:

Element	Method
Copper	E478
Aluminum	ISO No. 3110 (AA)
Phosphorus	E62
Nickel	E478
Tin	E478
Zinc	E478
Bismuth	JIS H 1068: 2005
Lead	E478
Iron	E478
Silicon	E54
Antimony	E62
Manganese	E62

15.1.2 Test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and purchaser.

15.2 Other Tests:

15.2.1 The product furnished shall conform to specified requirements when subjected to test in accordance with the following table:

Test	Method
Tensile Properties	E8/E8M
Hardness, Vickers	E92

15.2.2 *Yield Strength*—The yield strength shall be determined by the 0.2 % offset method of Test Methods E8/E8M. When test results are obtained from both full-size and machined specimens, and they differ, the test results from the full-size specimens shall prevail.

16. Significance of Numerical Limits

16.1 For the purpose of determining compliance with the specified limits for requirements of the properties listed in the following table and for dimensional tolerances, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Test Method E92:

Property	Rounded Unit for Observed or Calculated Value
Chemical Composition	Nearest unit in the last right-hand significant digit used in expressing the limiting value
Hardness	
Tensile Strength	Nearest ksi [5 MPa]
Yield Strength	
Elongation	Nearest 1 %

17. Inspection

17.1 The manufacturer, or supplier, shall inspect and make tests necessary to verify that the furnished product conforms to specification requirements.

17.2 Source inspection of the product by the purchaser may be agreed upon between the manufacturer, or supplier, and the purchaser as part of the purchase order. In such case, the nature of the facilities needed to satisfy the inspector, representing the purchaser, that the product is being furnished in accordance with the specification shall be included in the agreement. All testing and inspection shall be conducted so as not to interfere unnecessarily with the operation of the works.

17.3 When mutually agreed upon, the manufacturer, or supplier, and the purchaser shall conduct the final inspection simultaneously.



18. Rejection and Rehearing

18.1 Rejection:

18.1.1 Product that fails to conform to the specification requirements when tested by the purchaser or purchaser's agent shall be subject to rejection.

18.1.2 Rejection shall be reported to the manufacturer or supplier promptly. In addition, a written notification of rejection shall follow.

18.1.3 In case of dissatisfaction with results of the test upon which rejection is based, the manufacturer, or supplier, shall have the option to make claim for a rehearing.

18.2 Rehearing:

18.2.1 As a result of product rejection, the manufacturer, or supplier, shall have the option to make claim for a retest to be conducted by the manufacturer, or supplier, and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and subjected to test by both parties using the test method(s) specified in the product specification, or alternately, upon agreement of both parties, an independent laboratory may be selected for the test(s) using the test method(s) specified in the product specification.

19. Certification

19.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and requirements have been met.

20. Test Report

20.1 When specified in the contract or purchase order, a report of test results shall be furnished.

21. Product Identification

21.1 Type and frequency of product identification requirements shall be specified in the ordering information and shall be subject to agreement between the purchaser and manufacturer or supplier.

22. Packaging and Package Marking

22.1 Packaging:

22.1.1 The product shall be separated by size, composition, and temper, and prepared for shipment by common carrier, in such a manner as to afford protection from the normal hazards of transportation.

22.2 Package Marking:

22.2.1 Each shipping unit shall be legibly marked with the purchase order number, metal or alloy designation, temper, size, shape, gross and net weight, and name of supplier. The specification number shall be shown when specified.

23. Keywords

23.1 bar; copper-zinc-tin-bismuth alloy; drinking water; hexagonal rod; plumbing; rectangular bar; round rod; shapes; UNS Alloy Nos. C49250; C49255; C49260; C49265; C49300; C49340; C49345; C49350; C49360; wire; wrought copper alloys

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B967/B967M – 12a) that may impact the use of this standard. (Approved Oct. 1, 2016.)

- (1) Added 7.1.1, 7.4, and 7.5 to conform to B950-16.
- (2) Added UNS Alloy No. C49265 and UNS Alloy No. C49345 to 1.1, 6.1.1, Table 1, Table 2, and Section 23.

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