Designation: ~~B967/B967M – 12a~~ B967/B967M – 16

Standard Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire[1]

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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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) ~~0.08-0.3 in. [2-8~~ 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E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]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 – Volumetric[4] (International Organization of Standardization)

JIS H 1068:2005 Method for Determination of Bismuth in Copper and Copper Alloys[5] (Japanese Industrial Standards)

3. General Requirements

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

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[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 ~~of Standards, http://www.ISO.org/ISO/store.htm~~ for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[5] ~~Japanese Industrial Standard, available through http://www.JIS.or.jp/~~ 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**

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 ~~X.1,~~ Appendix X1, above, appears in this specification, it contains additional requirements which supplement those appearing in Specifications B249/B249M ~~or~~ 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.

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,~~issue;
5.1.2 Copper Alloy UNS ~~designation,~~designation;
5.1.3 Temper (Section 8~~),~~);
5.1.4 Dimensions, diameter, or distance between parallel ~~surfaces,~~surfaces;
5.1.5 How furnished: straight lengths or ~~coils,~~coils;
5.1.6 Quantity: total weight or total length or number of pieces of each ~~size,~~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).~~specified); and
5.1.8 *Shapes*—When product is ~~shapes,~~ 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:~~*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, ~~and~~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:~~*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",~~"remainder," copper is the difference between the sum of results of all elements determined and ~~100%.~~100 %. When all elements in Table 1 are determined, the sum of results shall be ~~99.5%~~99.5 % min.

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
~~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[B]~~	~~58.0–61.0~~	~~0.09~~	~~0.50~~	~~0.30 max~~	~~Rem~~	~~...~~	~~...~~	~~...~~	~~1.8–2.4~~	~~...~~	~~...~~	~~...~~	~~...~~
C49250	58.0–61.0[A]	0.09	0.50	0.30 max	Rem	...	...	...	1.8–2.4	...	...	...	...
~~C49255~~	~~58.0–60.0[A]~~	~~0.01~~	~~0.10~~	~~0.50 max~~	~~Rem~~	~~0.10~~	~~...~~	~~...~~	~~1.7–2.9~~	~~...~~	~~0.10-0.30~~	~~0.02-0.07~~	~~0.10~~
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[B]~~	~~58.0–63.0~~	~~0.09~~	~~0.50~~	~~0.50 max~~	~~Rem~~	~~0.05–0.15~~	~~...~~	~~...~~	~~0.50–1.8~~	~~...~~	~~...~~	~~...~~	~~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~~	~~.50–2.0~~	~~0.03~~	~~1.5~~	~~0.20~~	~~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[B]~~	~~60.0–63.0~~	~~0.09~~	~~0.12~~	~~0.50-1.5~~	~~Rem~~	~~0.05–0.15~~	~~...~~	~~...~~	~~0.50–2.2~~	~~...~~	~~...~~	~~...~~	~~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[C]~~	~~63.0–69.0~~	~~0.09~~	~~0.10~~	~~0.50–2.0~~	~~27.0–35.0~~	~~...~~	~~...~~	~~...~~	~~0.50–1.5~~	~~0.10~~	~~...~~	~~...~~	~~1.0–2.0~~
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 0.01~~Cadmium 0.001 max.
[B] Includes Cadmium ~~0.001~~0.01 max.
[C] Includes Ag.
[D] Boron 0.001 max.

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
8.1.2 Annealed: 061 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:~~*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*—~~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 ~~Specification~~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, SpecificationB249/B249M.

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.
~~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, C49300, and C49340~~				
		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~~	
M30	As Hot Extruded	1 to 4.375 incl. [25–110] incl.	50 [345]	20 [140]	18	...
~~O61~~	~~Annealed~~	~~.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~~
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~~	~~.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~~
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~~	~~.08 – .3 incl. (2 – 8) incl.~~	~~67 (460)~~	~~45 (310)~~	~~3~~	
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)~~		
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~~	
M30	As Hot extruded	1–4.375 incl. [25–110 incl.]	50 [345]	20 [140]	15	...
~~O61~~	~~Annealed~~	~~.3 – 2.5 incl. (8-25 incl.)~~	~~48 (330)~~	~~16 (110)~~	~~12~~	
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.

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 to 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 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

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.