Designation: B974/B974M – 16

Standard Specification for Free-Cutting Bismuth Brass Rod, Bar and Wire[1]

This standard is issued under the fixed designation B974/B974M; 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 free-cutting bismuth brass rod, bar and wire of UNS Alloy No. C49250, C49260, C49265, C49340, and C49345 suitable for high-speed screw machine work, or for general applications.

1.2 Typically, product made to this specification is furnished as straight lengths, or coils when requested.

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 *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

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]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

JIS H 1068:2005 Method for Determination of Bismuth in Copper and Copper Alloys [4]

ISO 5959-1984 Copper and copper alloys – determination of bismuth content – Diethyldithiocarbamate spectrometric method[5]

3. General Requirements

3.1 The following sections of Specification 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 Test Methods,
3.1.7 Inspection,
3.1.8 Certification, and
3.1.9 Test Reports.

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

[5] 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.

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

5. Ordering Information

5.1 Include the following information in orders for products:

5.1.1 ASTM designation and year of issue;

5.1.2 Copper UNS No. designation;

5.1.3 How furnished (rod or bar in straight length, or wire in coils);

5.1.4 Temper;

5.1.5 Cross section (round, hexagonal, square, rectangular);

5.1.6 Dimensions: diameter or distance between parallel surfaces, width and thickness;

5.1.7 How furnished: straight lengths or coils;

5.1.8 Quantity: total weight or total length, or number of pieces of each size; and

5.1.9 If the product is purchased for agencies of the U.S. Government (see the Supplemental Requirements section of Specifications B249/B249M or B250/B250M for additional requirements, if specified).

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

5.2.1 Heat identification or traceability details.

5.2.2 Certification.

5.2.3 Mill Test Report.

5.2.4 Automatic screw machine straightness (see 10.4).

5.2.5 Yield strength test required (see 14.2).

5.2.6 Resistivity test required (see 10.1).

5.2.7 Marking of specification number (see 21.2).

6. Materials and Manufacture

6.1 *Materials:*

6.1.1 The material of manufacture shall be a form of Copper Alloy UNS Nos. C49250, C49260, C49265, C49340, or C49345 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 UNS Number 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. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser.

7.3 For alloys in which zinc is listed as "remainder," zinc 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 the results shall be 99.5 % min.

7.4 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 Rod (round, hexagonal, and octagonal), and bar shall be furnished for general use in O60 temper for maximum formability, and H02 (half-hard) for applications involving moderate cold forming.

9. Mechanical Property Requirements

9.1 The product shall conform to the tensile strength and elongation requirements of Tables 2 and 3 when tested in accordance with Test Methods E8/E8M.

TABLE 1 Chemical Requirements

Element	Composition, % maximum unless shown as a range or minimum Copper or Copper Alloy UNS No.				
	C49250	C49260	C49265	C49340	C49345
Copper	58.0–61.0	58.0–63.0	58.0–62.0[A]	60.0–63.0	60.0–64.0[A]
Zinc	Remainder	Remainder	Remainder	Remainder	Remainder
Bismuth	1.8–2.4	0.50–1.8	0.50–1.3	0.50–2.2	0.50–1.3
Lead	0.09	0.09	0.09–0.25	0.09	0.09–0.25
Iron	0.50	0.50	0.30	0.12	0.30
Tin	0.30	0.50	0.50	0.50–1.5	0.50–1.5
Cadmium	0.001	0.001	0.001	0.001	0.001
Phosphorus	--	0.05–0.15	0.05–0.12	0.05–0.15	0.05–0.12
Silicon	--	0.10	0.10	0.10	0.10

[A] Includes Ag.

TABLE 2 Tensile Requirements, SI

NOTE 1—See Table 3 for inch–pound values.

Temper Designation Standard Name		Diameter or Distance Between Parallel Surfaces, mm		Tensile Strength, Min, MPa	Yield Strength at 0.5 % Extension under Load, min, MPa	Elongation,[A] min, %
Code	Name			Rod and Wire		
O60	soft anneal	25 and under		330	140	15
		over 25 to 50, incl.		305	125	20
		over 50		275	105	25
H02	half-hard	12 and under		395	170	7[B]
		over 12 to 25, incl.		380[C]	170	10
		over 25 to 50, incl.		345	140	15
		over 50 to 100, incl., and		310	105	20
		over 100		275	105	20
				Bar		
		Thickness, mm	Width, mm			
O60	soft anneal	25 and under	150 and under	305	125	20
		over 25	150 and under	275	105	25
H02	half-hard	12 and under	25 and under	345	170	10
		12 and under	over 25 to 150, incl.	310	115	15
		over 12 to 50, incl.	50 and under	310	115	15
		over 12 to 50, incl.	over 50 to 150, incl.	275	105	20
		over 50	over 50 to 100, incl.	275	105	20

[A] In any case, a minimum gage length of 25 mm shall be used. SI elongation values are based on a gage length of 5.65 times the square root of the area for dimensions greater than 2.5 mm.
[B] For product furnished in coils the elongation shall be 4 % min.
[C] If product is specified for thread rolling applications, the minimum tensile strength shall be 350 MPa.

TABLE 3 Tensile Requirements, Inch-Pound

NOTE 1—See Table 2 for SI values.

Temper Designation Standard Name		Diameter or Distance Between Parallel Surfaces, in.		Tensile Strength, min, ksi	Yield Strength at 0.5 % Extension under Load, min, ksi	Elongation,[A] min, %
Code	Name			Rod and Wire		
O60	soft anneal	1 and under		48	20	15
		over 1 to 2, incl.		44	18	20
		over 2		40	15	25
H02	half-hard	½ and under		57	25	7[B]
		over ½ to 1, incl.		55[C]	25	10
		over 1 to 2, incl.		50	20	15
		over 2 to 4, incl., and		45	15	20
		over 4		40	15	20
				Bar		
		Thickness, in.	Width, in.			
O60	soft anneal	1 and under	6 and under	44	18	20
		over 1	6 and under	40	15	25
H02	half-hard	½ and under	1 and under	50	25	10
		½ and under	over 1 to 6, incl.	45	17	15
		over ½ to 2, incl.	2 and under	45	17	15
		over ½ to 2, incl.	over 2 to 6, incl.	40	15	20
		over 2	over 2 to 4, incl.	40	15	20

[A] In any case, a minimum gage length of 1 in. shall be used.
[B] For product furnished in coils the elongation shall be 4 % min.
[C] If product is specified for thread rolling applications, the minimum tensile strength shall be 52 ksi.

9.2 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.

10. Dimensions, Mass, and Permissible Variations

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

10.2 *Diameter or Distance Between Parallel Surfaces:*

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

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

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

10.3 *Lengths*—O60 (soft anneal) and H02 (half hard) temper rod and bar, See 6.3 and Tables 13 and 14 of Specification B249/B249M.

10.4 *Straightness*—See 6.4 and Table 16 of Specification B249/B249M.

10.4.1 General use straightness tolerances will apply unless rod is specified for automatic screw machine use at the time of placing the order.

10.5 *Edge Contours*—See 6.5 of Specification B249/B249M.

11. Workmanship, Finish, and Appearance

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

12. Sampling

12.1 Refer to sampling section in Specification B249/B249M for rod and bar, and Specification B250/B250M for wire.

13. Number of Tests and Retests

13.1 *Test:*

13.1.1 *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).

13.2 *Retest:*

13.2.1 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.

13.2.2 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.

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

14. Test Methods

14.1 *Chemical Analysis:*

14.1.1 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	Test Methods
Bismuth	JIS H 1068:2005, ISO 5959
Cadmium	E53
Copper	E478
Iron	E54
Lead	E478
Phosphorus	E62
Silicon	E54
Tin	E478
Zinc	E478

14.1.2 The 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.

14.2 *Other Tests:*

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

Test	Method
Tensile Properties	E8/E8M

14.2.2 *Yield Strength*—The yield strength shall be determined by the 0.5 % extension under load 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.

15. Significance of Numbering Limits

15.1 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 Hardness	Nearest unit in the last right-hand significant digit used in expressing the limiting value
Tensile Strength Yield Strength	Nearest ksi [5 MPa]
Elongation	Nearest 1 %

16. Inspection

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

16.2 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 this 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.

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

17. Rejection and Rehearing

17.1 *Rejection:*

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

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

17.1.3 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.

17.2 *Rehearing:*

17.2.1 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.

18. Certification

18.1 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.

19. Test Report

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

20. Product Identification

20.1 The 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.

21. Packaging and Package Marking

21.1 *Packaging:*

21.1.1 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.

21.2 *Package Marking:*

21.2.1 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.

22. Keywords

22.1 bismuth brass rod and bar; bismuth containing rod and bar; free-cutting brass rod and bar; free-cutting copper rod and bar; lead free brass rod and bar; screw machine stock; UNS Alloy No. C49250; UNS Alloy No. C49260; UNS Alloy No. C49265; UNS Alloy No. C49340; UNS Alloy No. C49345

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B974/B974M – 12a) that may impact the use of this standard. (Approved Oct. 1, 2016.)

(1) Added 7.1.1 and 7.4 to conform to B950-16.
(2) Added UNS Alloy Nos. C49265 and C49345 to 1.1, 6.1.1, Table 1, and Section 22.