Designation: B929 – 17

Standard Specification for Copper-Nickel-Tin Spinodal Alloy Rod and Bar[1]

This standard is issued under the fixed designation B929; 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-nickel-tin alloy rod and bar. The following alloy is included:

Copper Alloy UNS No.	Nominal Composition, Weight %		
	Copper	Nickel	Tin
C72900	77	15	8

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

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 to 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.*

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

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E23 Test Methods for Notched Bar Impact Testing of Metallic Materials

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

E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)[3]

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B249/B249M constitute a part of this specification:

3.1.1 Dimensions, Mass, and Permissible Variations;
3.1.2 Number of Tests and Retests;
3.1.3 Specimen Preparation;
3.1.4 Significance of Numerical Limits;
3.1.5 Inspection;
3.1.6 Rejection and Rehearing;
3.1.7 Certification;
3.1.8 Packaging and Package Marking; and
3.1.9 Supplementary Requirements.

3.2 In addition, when a section with a title identical to that referenced in 3.1 above appears in this specification, it contains additional requirements which supplement those appearing in Specification B249/B249M.

4. Terminology

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

5. Ordering Information

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

[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

5.1.1 ASTM designation and year of issue;
5.1.2 Copper Alloy UNS No. C72900;
5.1.3 Temper (Section 8);
5.1.4 Dimensions—diameter or distance between parallel surfaces, width, thickness, and length;
5.1.5 How furnished—stock lengths or specific lengths, with or without ends; and
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 Specification B249/B249M for additional requirements, if specified).

5.2 The following options are available but may not be included unless specified at the time of placing of the order, when required:
5.2.1 Type of edge on bar (square corners, rounded corners, rounded edge, full-rounded edge),
5.2.2 Certification (see Specification B249/B249M),
5.2.3 Mill Test Report (see Specification B249/B249M), and
5.2.4 Heat identification or traceability details (see Specification B249/B249M).

6. Materials and Manufacture

6.1 *Materials:*
6.1.1 The material of manufacture shall be a form of Copper Alloy UNS No. C72900, 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, with intermediate heat treatments, when required, and final spinodal hardening 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 No. C72900.
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 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 99.7 % minimum.

8. Temper

8.1 The standard tempers for products described in this specification are given in Table 2. (See Classification B601.)
8.1.1 *TX00, TX02*—Spinodally Hardened (AT). Solution annealed and spinodally hardened to different minimum yield strength levels, respectively.
8.1.2 *TS02, TS04, TS06, TS08*—Suitably cold worked and spinodally hardened to respectively increasing strength levels.

9. Mechanical Property Requirements

9.1 *Tensile Requirements*—Product furnished under this specification shall conform to the tensile requirements prescribed in Table 2, when tested at room temperature in accordance with Test Methods E8/E8M.

9.2 *Rockwell Hardness Requirement*—The Rockwell hardness values given in Table 2 are for general information and assistance in testing and shall not be used as a basis for product rejection.

NOTE 2—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper and tensile strength.

9.3 *Charpy V-Notch (CVN) Impact Requirements:*
9.3.1 When specified by the purchaser, product furnished under this specification shall conform to the minimum average absorbed energy values prescribed in Table 3 when tested at room temperature using averaged results of triplicate full-size Charpy (simple-beam) (Type A) impact specimens tested in accordance with Test Methods E23.
9.3.2 Any tempers not represented in Table 3 may be impact tested when requested by the purchaser; however, the average CVN absorbed energy value shall be for information only.

10. Dimensions, Mass, and Permissible Variation

10.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B249/B249M with particular reference to the following tables and related paragraphs:

TABLE 1 Chemical Composition[A]

		Composition, %							
Copper Alloy UNS No.	Previous Designation	Copper (incl. silver)	Iron, max	Zinc, max	Nickel, incl. Cobalt	Tin	Manganese, max	Niobium, max	Magnesium, max
C72900	Cu-15Ni-8Sn	Remainder	0.50	0.50	14.5 to 15.5	7.5 to 8.5	0.30	0.10	0.15

[A] Lead 0.02 (0.005 maximum for hot rolling).

TABLE 2 Mechanical Property Requirements

Temper Designation	Nominal Dimension, in. (mm)	Tensile Strength, min, ksi[A] (MPa)[B]	Yield Strength, (0.2 % Offset), min, ksi[A] (MPa)[B]	Elongation in 4D,[C] min, %	Hardness, min, HRC
TX00	1 to 4.25 (25 to 108), excl 4.25 to 9 (108 to 229), incl	110 (755)	90 (620)	15 12	23[D]
TX02	0.595 to 4.25 (15 to 108), excl 4.25 to 9 (108 to 229), incl	132 (910) 127 (875)	110 (755)	10 6	30[D]
TS02	0.75 to 3.25 (19 to 83), incl Over 3.25 to 6 (83 to 152), incl	106 (730) 105 (720)	95 (655)	18	93 HRB
TS04	0.75 to 3.25 (19 to 83), incl Over 3.25 to 6 (83 to 152), incl	120 (825)	110 (755)	15	24 22
TS06	0.75 to 6 (19 to 152), incl	140 (965)	130 (895)	10	24
TS08	0.25 (6), incl	160 (1100)	150 (1030)	5	32
	Over 0.25 to 0.4 (6 to 10), incl			7	
	Over 0.4 to 0.75 (10 to 19), incl	165 (1135)			36
	Over 0.75 to 1.6 (19 to 41), incl			5	34
	Over 1.6 to 3.25 (41 to 83), incl	160 (1100)		3	
	Over 3.25 to 6 (83 to 152), incl		148 (1020)		32

[A] ksi = 1000 psi.
[B] See Appendix X1.
[C] 4D = Gage length is 4× gage diameter.
[D] May be reported as a conversion of HBW to HRC per Hardness Conversion Tables E140.

TABLE 3 CVN Impact Requirements

Temper	Nominal Dimension, in (mm)	Ave CVN Absorbed Energy, min, ft-lb (J)
TX00	1 to 9 (25 to 229), incl	4 (5)
TX02	0.595 to 9 (15 to 229), incl	4 (5)
TS02	0.75 to 6 (19 to 152), incl	30[A] (40)[A]
TS04	0.75 to 1.6 (19 to 41), excl	15 (20)
	1.6 to 3.25 (41 to 83), incl	12 (16)
	Over 3.25 to 6 (83 to 152), incl	11[B] (15)[B]
TS06	0.75 to 6 (19 to 152), incl	5 (6)

[A] No single value less than 24 ft-lb (32 J).
[B] No single value less than 10 ft-lb (13 J).

10.2 *Diameter or Distance Between Parallel Surfaces:*

10.2.1 *Rod: Hexagonal, Octagonal*—Refer to Table 5.

10.2.2 *Rod: Round–Diameter—Exception to Specification B249/B249M*—Refer to Table 4.

10.3 *Width and Thickness:*

TABLE 4 Diameter Tolerance for Round Rod

Temper	Diameter, in (mm)	Tolerance, Plus and Minus, in (mm)
TX00, TX02	0.595 to 1 (15 to 25), incl	+0.04/-0 (+1.0/-0)
	Over 1 to 2 (25 to 51), incl	+0.06/-0 (+1.5/-0)
	Over 2 to 3 (51 to 76), incl	+0.10/-0 (+2.5/-0)
	Over 3 to 3.5 (76 to 89), incl	+0.14/-0 (+3.6/-0)
	Over 3.5 to 4.25 (89 to 108), excl	+0.24/-0 (+6.1/-0)
	4.25 to 9 (108 to 229), incl	+0.05/-0[A] (+1.3/-0)[A]
TS08	0.25 to 0.4 (6 to 10), excl	±0.002 (±0.05)
	0.4 to 0.75 (10 to 19), excl	+0.005/-0 (+0.13/-0)
TS02, TS04, TS06, TS08	0.75 to 1.6 (19 to 41), incl	+0.02/+0.08 (+0.5/+2.0)
	Over 1.6 to 2.75 (41 to 70), incl	+0.02/+0.10 (+0.5/+2.5)
	Over 2.75 to 3.25 (70 to 83), incl	+0.02/+0.145 (+0.5/+3.7)
	Over 3.25 to 6 (83 to 152), incl	+0.02/+0.187 (+0.5/+4.7)

[A] Rough turned.

10.3.1 *Bar*—Rectangular and Square—Refer to Tables 9 and 11.

10.4 *Length*—Rod and Bar—Refer to Tables 13 and 15.

10.5 *Straightness*—Rod and Bar—Refer to Table 16, General Use section.

10.6 *Edge Contours*—Refer to 6.5, Edge Contours.

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 Sampling shall be in accordance with Specification B249/B249M, except that the heat size may be up to 100 000 lb (45 360 kg) or fraction thereof.

12.2 Sample pieces shall be taken from a heat and lot of material processed simultaneously in the same equipment.

13. Number of Tests and Retests

13.1 Section 9 of Specification B249/B249M constitutes a part of this specification.

13.2 If any lot of material fails to conform to the requirement of this specification following heat treatment, the product may be subjected to additional heat treatment, and new samples of material may be resubmitted for testing. Only two such reheat treatments shall be permitted.

14. Specimen Preparation

14.1 Section 10 of Specification B249/B249M constitutes a part of this specification.

14.2 Tension test specimens shall be prepared in a full cross-section area if practicable and in the direction of final working unless otherwise specified. Full cross-section or machined specimens shall be as specified in Test Methods E8/E8M.

14.3 When specified by the purchaser, triplicate, full size, Charpy (simple beam) (Type A) impact specimens shall be taken from the Test Methods E8/E8M designated testing location, or a location specified by the purchaser, and shall be prepared according to Test Methods E23. The axis of impact specimens shall be machined from the center of product 1.500 in. (38.1 mm) in diameter or less, in the L-R orientation. The axis of impact specimens shall be machined from a location midway from the center to the surface of product over 1.500 in. (38.1 mm) in diameter, in the L-C orientation.

15. Test Methods

15.1 *Chemical Analyses:*

15.1.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. The following table is a list of published methods, some of which may no longer be viable, which along with others not listed, may be used subject to agreement:

Element	Method
Copper	E53
Iron	E53
Zinc	E478
Nickel	E478
Tin	E478
Manganese	E75

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

Test	Method
Tensile	E8/E8M
Hardness	E18, E10, E140
Charpy V-Notch Impact	E23

16. Significance of Numerical Limits

16.1 See Specification B249/B249M for this part of this specification.

17. Inspection

17.1 See Specification B249/B249M for this part of this specification.

18. Rejection and Rehearing

18.1 See Specification B249/B249M for this part of this specification.

19. Certification

19.1 See Specification B249/B249M for this part of this specification.

20. Test Report

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

21. Packaging and Package Marking

21.1 See Specification B249/B249M for this part of this specification.

22. Keywords

22.1 bar; Copper Alloy UNS No. C72900; rod

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown in accordance with the International System of Units (SI). The derived SI unit of force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second square ($N=kg{\cdot}m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa, the metric equivalents are expressed as megapascal (MPa) which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the 2011 issue, as follows:

(1) Revised to comply with the B950-15, Standard Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys.
(2) Added new tempers TX02, TS02, TS04, TS06, and TS08 to Section 8, and updated Table 2 Mechanical Property Requirements to include new tempers.
(3) Deleted 9.1.2, eliminating tensile strength as the sole mechanical property used for product acceptance or rejection decisions.
(4) Added Charpy V-notch impact testing to Sections 2, 9, 14, and 15, and added Table 3 CVN Impact Requirements.
(5) Identified diameter tolerances for round rod in Section 10 as an exception to Specification B249/B249M, and added Table 4 Diameter Tolerance for Round Rod.
(6) Modified 13.2 to allow additional reheat treatments and new samples for testing.
(7) Provided conversions to SI units.
(8) Revised 15.1.1.