



Standard Specification for Copper-Zinc-Silicon Alloy Rod¹

This standard is issued under the fixed designation B371/B371M; 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 specification establishes the requirements for copper-zinc-silicon alloy rod produced in Copper Alloy UNS Nos. C69300, C69400, C69430, C69700, and C69710.

1.1.1 If the purchaser does not specify the alloy to be supplied, product is permitted to be furnished in any of the alloys named in 1.1.

1.2 *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.

1.3 The following safety hazard caveat pertains only to the test methods described in this specification. *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 requirements prior to use.*

1.4 **Warning**—Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney, and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury-containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website (<http://www.epa.gov/mercury/faq.htm>) for additional information. Users should be aware that selling mercury or mercury-containing products, or both, in your state may be prohibited by state law.

2. Referenced Documents

2.1 *ASTM Standards*:²

B154 Test Method for Mercurous Nitrate Test for Copper Alloys

B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

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

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

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

- 3.1.1 Terminology,
- 3.1.2 Materials and Manufacture,
- 3.1.3 Workmanship, Finish, and Appearance,
- 3.1.4 Sampling,
- 3.1.5 Number of Tests and Retests,
- 3.1.6 Specimen Preparation,
- 3.1.7 Test Methods,
- 3.1.8 Significance of Numerical Limits,
- 3.1.9 Inspection,
- 3.1.10 Rejection and Rehearing,
- 3.1.11 Certification,

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.

- 3.1.12 Test Report,
- 3.1.13 Packaging and Package Marking, and
- 3.1.14 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. Ordering Information

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

- 4.1.1 ASTM designation and year of issue,
- 4.1.2 Copper alloy UNS No. designation,
- 4.1.3 *Form*—Cross section such as round, hexagon, and so forth,
- 4.1.4 *Temper*—(Section 7),
- 4.1.5 *Dimensions*—Diameter or distance between parallel surfaces, nominal specific or stock length,
- 4.1.6 *Quantity*—Total weight, footage, or number of pieces, and
- 4.1.7 If product is purchased for agencies of the U.S. government (see Supplementary Requirements section of Specification **B249/B249M**).

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

- 4.2.1 Residual Stress Test (Performance Requirements section, Section 9),
 - 4.2.1.1 Ammonia Vapor Test or Mercurous Nitrate Test,
 - 4.2.1.2 For the Ammonia Vapor Test, pH value other than 10.
- 4.2.2 Certification (Specification **B249/B249M**), and
- 4.2.3 Mill test report (Specification **B249/B249M**).

5. Material and Manufacture

5.1 *Material*—The material of manufacture shall be cast billets, logs, or rods of Copper Alloy UNS Nos. C69300, C69400, C69430, C69700, or C69710 of such purity and soundness to be suitable for processing into the product prescribed herein.

5.2 *Manufacture*—The product shall be manufactured by hot extrusion and finished by such cold working, annealing, straightening, and cutting to length as may be necessary to meet the properties specified.

6. Chemical Composition

6.1 The material shall conform to the chemical compositional requirements specified in **Table 1** for the Copper Alloy UNS No. designation specified in the ordering information.

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

6.2 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 other elements determined and 100 %.

6.3 When all elements in **Table 1** are determined, the sum of results shall be 99.5 % min.

7. Temper

7.1 The standard temper for products under this specification is H02 (Half Hard) for UNS No. C69300 and H04 (Hard) for UNS Nos. C69400, C69430, C69700, and C69710.

8. Mechanical Property Requirements

8.1 *Tensile Strength Requirements*—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. Performance Requirements

9.1 *Residual Stress Test*:

9.1.1 When specified in the contract or purchase order, the product shall be tested for residual stress according to the requirements of Test Method **B154** or Test Method **B858**, and show no signs of cracking. (**Warning**—Mercury is a definite health hazard. With the Mercurous Nitrate Test, equipment for the detection and removal of mercury vapor produced in volatilization and the use of protective gloves is recommended.)

TABLE 1 Chemical Requirements

Element	Composition, %									
	Copper Alloy UNS No.									
	C69300		C69400		C69430		C69700		C69710	
	min	max	min	max	min	max	min	max	min	max
Copper ^A	73.0	77.0	80.0	83.0	80.0	83.0	75.0	80.0	75.0	80.0
Silicon	2.7	3.4	3.5	4.5	3.5	4.5	2.5	3.5	2.5	3.5
Lead	...	0.09	...	0.30	...	0.30	0.50	1.5	0.50	1.5
Iron	...	0.10	...	0.20	...	0.20	...	0.20	...	0.20
Tin	...	0.20	...	...	...	...	...	...	...	...
Nickel	...	0.10	...	...	...	...	...	...	...	...
Manganese	...	0.10	...	...	...	...	...	0.40	...	0.40
Arsenic	...	...	...	...	0.03	0.06	...	...	0.03	0.06
Antimony	...	...	...	...	...	...	...	...	...	...
Phosphorus	0.04	0.15	...	...	...	...	...	...	...	...
Zinc	remainder		remainder		remainder		remainder		remainder	

^A Includes Silver.

TABLE 2 Tensile Requirements

Temper & UNS No.		Tensile Strength, min		Yield Strength at 0.5 % Extension Under Load, min		Elongation in 4× Diameter or Thickness of Specimen, min,% ⁴
Diameter or Distance Between Parallel Surfaces		ksi	MPa	ksi	MPa	
in.	mm					
Temper H02 Half Hard						
Copper Alloy UNS No. C69300						
Up to ½, incl	Up to 12, incl	85	585	45	310	5
Over ½ up to 1, incl	Over 12 to 25, incl	75	515	35	240	10
Over 1 to 2, incl	Over 25 to 50, incl	70	480	30	205	10
Temper H04 Hard						
Copper Alloy UNS Nos. C69400, C69430:						
Up to 1, incl	Up to 25, incl	80	550	40	250	15
Over 1 to 2, incl	Over 25 to 50, incl	75	515	35	240	15
Over 2	Over 50	65	450	35	240	15
Copper Alloy UNS Nos. C69700, C69710:						
Up to 1, incl	Up to 25, incl	65	450	32	220	20
Over 1	Over 25	55	380	28	195	25

^A In any case, a minimum gauge length of 1 in. [25 mm] shall be used.

9.1.2 When the Ammonia Vapor Test is used, the test pH value appropriate for the intended application shall be 10 unless otherwise specified by the purchaser.

NOTE 1—A residual stress test provides information about the adequacy of the stress relief of the material. Bar straightening is a method of mechanical stress relief. Stress relief annealing is a method of thermal stress relief.

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 Specification **B249/B249M**.

11. Dimensions and Permissible Variations

11.1 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:

11.1.1 *Diameter or Distance Between Parallel Surfaces*—Refer to Table 2, Tolerances for Diameter of Cold-Drawn Rod.

11.1.2 *Length*—Refer to Table 13, Length Tolerances for Rod, Bar, and Shapes, and Table 15, Schedule of Lengths with Ends for Rod and Bar.

11.1.3 *Straightness*—Refer to Table 16, Straightness Tolerances for Rod, Bar, and Shapes, For General Use section.

11.1.4 *Edge Contours*—Refer to Edge Contours section.

12. Test Methods

12.1 Chemical composition, in case of disagreement, shall be determined as follows:

Element	ASTM Test Methods
Antimony	E62
Arsenic	E62
Copper	E478
Iron	E478
Lead	E478, atomic absorption
Manganese	E62
Phosphorous	E62
Silicon	E54
Zinc	E478, Titrametric

12.2 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 the purchaser.

13. Keywords

13.1 copper-zinc-silicon rod; UNS No. C69300; UNS No. C69400; UNS No. C69430; UNS No. C69700; UNS No. C69710

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