



Standard Specification for Phosphor Bronze Rod, Bar, and Shapes¹

This standard is issued under the fixed designation B 139/B 139M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification establishes the requirements for phosphor bronze rod, bar, and shapes.

1.2 *Units*—The values stated in inch-pound units or SI units are to be regarded separately in the standard. Within the text, the SI values are given in brackets. The values stated in each system are not exact equivalents; each system of units is independent of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:*

B 249/B 249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 8M Test Methods for Tension Testing of Metallic Materials (Metric)³

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁴

E 478 Test Methods for Chemical Analysis of Copper Alloys⁵

3. General Requirements

3.1 The following sections of Specification B 249/B 249M constitute 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.

3.1.12 Mill Test Report.

3.1.13 Packaging and Package Marking.

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 information which supplements that appearing in Specification B 249/B 249M. In case of conflict, this specification shall prevail.

4. Ordering Information

4.1 Include the following when ordering:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper Alloy UNS No. designation (for example, C51000),

4.1.3 Product temper (for example, H04),

4.1.4 Form of product (rod, bar or shape),

4.1.5 Dimensions and permissible variations,

4.1.6 Edge Contours,

4.1.7 Quantity: total weight each copper alloy, temper, form, and size, and

4.1.8 When product is purchased for an agency of the U.S. government.

4.2 The following options are available under this specification and shall be included in the contract or purchase order when required.

4.2.1 Piston finish for rod and shafting,

4.2.2 Certification (Specification B 249/B 249M), and

4.2.3 Mill test report (Specification B 249/B 249M).

5. Material and Manufacture

5.1 *Material:*

5.1.1 The material of manufacture shall be cast rod, bar, or billets of Copper Alloy UNS No. C51000, C52100, C52400, C53400, or C54400 as specified in the ordering information and of such soundness as to be suitable for processing in to the products prescribed herein.

NOTE 1—Copper Alloy UNS Nos. C51000, C52100, and C52400 are suitable for structural applications, pump parts, rods, bolts, gears, and similar applications.

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 Rods, Bars, Wires, Shapes, and Forgings.

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² *Annual Book of ASTM Standards*, Vol 02.01.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.05.

⁵ *Annual Book of ASTM Standards*, Vol 03.06.

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

NOTE 2—Copper Alloys UNS Nos. C53400 and C54400 are free machining and are suitable for screw-machine products.

5.2 Manufacture:

5.2.1 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.

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

6. Chemical Composition

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

6.1.1 These composition limits do not preclude the presence of other elements. When required, limits shall be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser.

6.2 Copper may be taken as the difference between the sum of all elements analyzed and 100 %.

6.3 When all elements specified in Table 1 for the Copper Alloy UNS No. named in the ordering information are determined, the sum of results shall be 99.5 % min.

7. Temper

7.1 Rod and Bar:

7.1.1 The standard tempers for rod and bar produced under this specification are identified in Table 2 or Table 3.

7.2 Shapes:

7.2.1 The temper for shapes is subject to agreement between the manufacturer and the purchaser and the agreement shall be a part of the contract or purchase order.

8. Mechanical Property Requirements

8.1 Tensile Requirements:

8.1.1 Rod and Bar:

8.1.1.1 Rod and bar furnished under this specification shall conform to the tensile requirements prescribed in Table 2 or Table 3 for the specified Copper Alloy UNS No. designation, temper, cross-section, and size when tested in accordance with Test Methods E 8 or E 8M.

8.1.2 Shapes:

8.1.2.1 The tensile requirements for shapes shall be subject to agreement between the manufacturer and the purchaser and the agreement shall be a part of the contract or purchase order.

9. Piston-Finish

9.1 When specified in the contract or purchase order, round rod over 1/2-in. [12-mm] diameter shall be furnished as piston-finished rod or shafting.

10. Purchases for U.S. Government

10.1 When specified in the contract or purchase order, product purchased for agencies of the U.S. government shall conform to the additional requirements prescribed in the Supplementary Requirements section of Specification B 249/ B 249M.

11. Dimensions, Mass, and Permissible Variations

11.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B 249/B 249M with particular reference to the following tables and related paragraphs in that specification:

11.1.1 *Diameter or Distance Between Parallel Surfaces:*

11.1.1.1 *Rod: Round, Hexagonal, Octagonal*—Table 2.

11.1.1.2 *Piston-Finish Rod*—Table 3.

11.1.1.3 *Bar: Rectangular and Square*—Tables 9 and 11.

11.1.2 *Shapes:*

11.1.2.1 The dimensional tolerances for shapes shall be subject to agreement between the manufacturer and the purchaser and the agreement shall be a part of the contract or purchase order.

11.1.3 *Length:*

11.1.3.1 *Rod, Bar, and Shapes*—Tables 13 and 15.

11.1.4 *Straightness:*

11.1.4.1 *Rod and Bar*—Table 16.

11.1.4.2 *Shafting Rod*—Table 17.

11.1.4.3 *Piston-Finish Rod*—The tolerance is subject to agreement between the manufacturer and the purchaser and the agreement shall be a part of the contract or purchase order.

11.1.5 *Edge Contours:*

11.1.5.1 For a description of edge contours, refer to the section titled “Edge Contours” and Figs. 1, 2, and 3 in Specification B 249/B 249M.

12. Test Methods

12.1 *Chemical Analysis:*

12.1.1 Chemical composition, in case of disagreement, shall be determined by the following test methods:

Element	Test Method
Copper	E 478
Iron	E 478
Lead	E 478 (AA)
Zinc <2 %	E 478 (AA)
>2 %	E 478 (titrametric)
Tin	E 478 (titrametric)
Phosphorus	E 62

12.1.2 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 the purchaser.

TABLE 1 Chemical Requirements

Element, %	Copper Alloy UNS No.				
	C51000	C52100	C52400	C53400	C54400
Tin	4.2–5.8	7.0–9.0	9.0–11.0	3.5–5.8	3.5–4.5
Phosphorus	0.03–0.35	0.03–0.35	0.03–0.35	0.03–0.35	0.01–0.50
Iron, max	0.10	0.10	0.10	0.10	0.10
Lead	0.05 max	0.05 max	0.05 max	0.8–1.2	3.5–4.5
Zinc	0.30 max	0.20 max	0.20 max	0.30 max	1.5–4.5
Copper	remainder	remainder	remainder	remainder	remainder

TABLE 2 Tensile Requirements for Rod and Bar, in./lb

Temper		Diameter or Distance Between Parallel Surfaces, ^A in.	Tensile Strength, ksi		Elongation in 4× Diameter or Thickness of Specimen, min, % ^B
Standard	Name		min	max	
Copper Alloy UNS No. C51000					
O60	soft anneal	rod: round under ¼	40	58	...
H04	hard	rod: round under ¼	80	128	...
		rod and hexagonal:			
		¼ to ½, incl	70	...	13
		over ½ to 1, incl	60	...	15
		over 1	55	...	18
		bar: square and rectangular:			
		¼ to ⅜, incl	60	...	10
		over ⅜	55	...	15
H08	spring	rod: round:			
		0.026 to ¼, incl	115
		over ¼ to ⅙, incl	110
		over ⅙ to ¼, incl	105	...	3.5
		over ¼ to ⅜, incl	100	...	5.0
		over ⅜ to ½, incl	90	...	9.0
Copper Alloy UNS No. C52100					
O60	soft anneal	rod: round under ¼	53	68	...
H04	hard	rod: round under ¼	105	150	...
		rod and hexagonal:			
		¼ to ½, incl	85	...	12
		over ½ to 1, incl	75	...	15
		over 1	60	...	20
		bar: square and rectangular:			
		¼ to ⅜, incl	68	...	10
		over ⅜	60	...	15
Copper Alloy UNS No. C52400					
O60	soft anneal	rod: round under ¼	60	75	...
H04	hard	rod: round under ¼	105	160	...
		rod and hexagonal:			
		¼ to ½, incl	95	...	10
		over ½ to 1, incl	85	...	12
		over 1	70	...	15
		bar: square and rectangular:			
		¼ to ⅜, incl	76	...	10
		over ⅜	70	...	15
Copper Alloy UNS Nos. C53400 and C54400					
H04	hard	rod: round and hexagonal:			
		¼ to ½, incl	65	...	8
		over ¼ to ⅙, incl	60	...	10
		over ⅙ to ¼, incl	55	...	12
		over ¼ to ⅜, incl	50	...	15
		bar: square and rectangular:			
		¼ to ⅜, incl	55	...	10
		over ⅜	50	...	15

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

^BIn any case, a minimum gage length of 1 in. shall be used.

13. Keywords

13.1 C51000; C52100; C52400; C53400; C54400; phosphor bronze bar; phosphor bronze rod; phosphor bronze shapes

TABLE 3 Tensile Requirements for Rod and Bar, SI

Temper		Diameter or Distance Between Parallel Surfaces, ^A mm	Tensile Strength, MPa		Elongation in 4× Diameter or Thickness of Specimen, min, % ^B
Standard	Name		min	max	
Copper Alloy UNS No. C51000					
O60	soft anneal	rod: round under 6	275	400	...
H04	hard	rod: round under 6	550	880	...
		round and hexagonal:			
		6 to 12 incl	485	...	13
		12 to 25 incl	415	...	15
		over 25	380	...	18
		bar: square and rectangular:			
		6 to 9 incl	415	...	10
		over 9	380	...	15
H08	spring	rod: round:			
		0.065 to 1.6 incl	790
		over 1.6 to 3 incl	760
		over 3 to 6 incl	725	...	3.5
		over 6 to 9 incl	690	...	5.0
		over 9 to 12 incl	620	...	9.0
Copper Alloy UNS No. C52100					
O60	soft anneal	rod: round under 6	365	470	...
H04	hard	rod: round under 6	720	1030	...
		round and hexagonal:			
		6 to 12 incl	585	...	12
		over 12 to 25 incl	515	...	15
		over 25	415	...	20
		bar: square and rectangular:			
		6 to 9 incl	470	...	10
		over 9	415	...	15
Copper Alloy UNS No. C52400					
O60	soft anneal	rod: round under 6	415	515	...
H04	hard	rod: round under 6	725	1100	...
		round and hexagonal:			
		6 to 12 incl	655	...	10
		over 12 to 25 incl	585	...	12
		over 25	480	...	15
		bar: square and rectangular:			
		6 to 9 incl	525	...	10
		over 9	480	...	15
Copper Alloy UNS Nos. C53400 and C54400					
H04	hard	rod: round and hexagonal:			
		1.6 to 6 incl	450	...	8
		over 6 to 12 incl	415	...	10
		over 12 to 25 incl	380	...	12
		over 25	345	...	15
		bar: square and rectangular:			
		6 to 9 incl	380	...	10
		over 9	345	...	15

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

^B In any case, a minimum gage length of 25mm shall be used.

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (1995) that may impact the use of this standard.

(1) Added Manufacture section.

(2) All sections editorially changed to clarify intent.

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