



Designation: B 159M – 96a^{ε1}
METRIC

Standard Specification for Phosphor Bronze Wire [Metric]¹

This standard is issued under the fixed designation B 159M; 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 Department of Defense.

^{ε1} NOTE—The definition of unaided eye was deleted in Section 3.

1. Scope *

1.1 This specification establishes the requirements for round, square, and flat phosphor bronze wire of UNS Alloy Nos. C51000, C52100, and C52400 for general and spring applications.

1.1.1 Rectangular and square wire of the three alloys are generally available in sizes up to a maximum of 5 mm thick and 32 mm wide.

1.1.2 Round wire from Copper Alloy UNS No. C51000 is generally available in sizes up to 13 mm in diameter.

1.1.3 This specification is the SI companion to Specification B 159.

NOTE 1—It is to be understood that this specification is general. Since the product is used for many applications where the requirements of the operations used are too particular to be specified by any of the ordinary mechanical tests, it is frequently advisable to submit samples or drawings to the manufacturer and secure an adjustment of temper to suit the actual application for which the product is intended.

NOTE 2—Product in rod, bar, and shape form is produced to Specification B 139M.

2. Referenced Documents

2.1 ASTM Standards:

2.1.1 The following documents in the current issue of the Book of Standards form a part of this specification.

B 139M Specification for Phosphorus Bronze Rod, Bar, and Shapes [Metric]²

B 250M Specification for General Requirements for Wrought Copper-Alloy Wire [Metric]²

B 601 Practice for Temper Designation for Copper and Copper Alloys—Wrought and Cast²

B 846 Terminology for Copper and Copper Alloys²

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 Method)⁴

E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials³

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

3. Terminology

3.1 For definition of terms related to copper and copper alloys, refer to Terminology B 846.

4. Ordering Information

4.1 Contract or purchase orders for product under this specification shall include the following information:

4.1.1 ASTM designation and year of issue (for example, B159M – 96a),

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

4.1.3 Temper designation (Section 5),

4.1.4 Dimensions (diameter, distance between parallel faces, etc.),

4.1.5 Type of edge (square corners, rounded corners, etc.),

4.1.6 How furnished (coil spool, reel, specific lengths, etc.), and

4.1.7 When product is purchased for agencies of the U.S. Government (Section 8).

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

4.2.1 Heat identification or traceability details,

4.2.2 Certification.

4.2.3 Mill Test Reports, and

4.2.4 Special packaging and package markings.

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 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.

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

5. Chemical Composition

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

5.1.1 These compositional limits do not preclude the presence of other elements. When required, limits may be established and analysis required for unnamed elements by agreement between the supplier and the purchaser.

5.2 Copper listed as the “Remainder” is the difference between the sum of results for all elements determined and 100 %.

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

6. Temper

6.1 Tempers, as defined in Practice B 601, available under this specification are O61 (annealed), H01 (¼ hard), H02 (½ hard), H03 (¾ hard), H04 (hard), H06 (extra hard), H08 (spring), and H10 (extra spring).

NOTE 3—The purchaser shall confer with the supplier for availability of product in specific alloy, temper, form and size.

7. Mechanical Property Requirements

7.1 Tensile Requirements:

7.1.1 Tested in accordance with Test Methods E 8M:

7.1.1.1 Round and square wire for general application produced from Copper Alloy UNS Nos. C51000, C52100, and C52400 shall conform to the requirements prescribed in Table 2.

7.1.1.2 Round or square wire produced from Copper Alloy UNS No. C51000 in H08 (spring) temper shall conform to the requirements prescribed in Table 3.

7.1.1.3 Rectangular wire produced from Copper Alloy UNS Nos. C51000, C52100, and C52400 shall conform to the requirements prescribed in Table 4.

8. Performance Requirements

8.1 Bending Requirements:

8.1.1 Wire in sizes up to 6 mm inclusive produced from Copper Alloy UNS No. C51000 shall withstand being bent cold (room temperature) through an angle of 120° on a radius equal to the diameter or distance between parallel surfaces in accordance with Test Method E 290. When so bent, tempers H08 and H10 shall not develop cracks or other flaws visible to the unaided eye on the outside surface of the bend.

9. Purchases for U.S. Government

9.1 Product purchased for agencies of the U.S. Government

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	C51000	C52100	C52400
	Composition, %		
Copper, incl silver	remainder	remainder	remainder
Lead, max	0.05	0.05	0.05
Iron, max	0.10	0.10	0.10
Tin	4.2–5.8	7.0–9.0	9.0–11.0
Zinc, max	0.30	0.20	0.20
Phosphorus	0.03–0.35	0.03–0.35	0.03–0.35

TABLE 2 Mechanical Requirements for Round or Square Wire for General Purposes

Temper Designation ^A		Tensile Strength, MPa		
Standard	Former	Copper Alloy UNS No.		
		C51000	C52100	C52400
O61	annealed	295–400	365–470	415–515
H01	quarter hard	415–525	510–625	570–705
H02	half hard	550–670	655–795	745–890
H03	three-quarter hard	660–795	780–930	860–1020
H04	hard	745–880	860–1035	930–1100
H08	spring	(see Table 3)		

^AStandard designation defined in Practice B 601.

TABLE 3 Mechanical Requirements for H08 (Spring Temper) UNS No. C51000 Round or Square Wire

Diameter or Distance Between Parallel Surfaces, mm	Tensile Strength, min, MPa	Elongation in 50 mm, min
0.60 and under	1000	...
Over 0.60 to 1.6	930	...
Over 1.6 to 3.0	890	...
Over 3.0 to 6.0	850	...
Over 6.0 to 10	830	5.0
Over 10 to 16	720	9.0

TABLE 4 Mechanical Strength Requirements for Flat Wire (Other than Square Wire)

Temper Designation		Tensile Strength, MPa		
Standard	Former	Copper Alloy UNS No.		
		C51000	C52100	C52400
O61	annealed	295–400	365–460	400–505
H02	half hard	400–505	475–580	525–625
H04	hard	525–625	585–690	650–750
H06	extra hard	605–710	670–770	735–840
H08	spring	655–760	725–820	795–890
H10	extra spring	690–785	800–840	825–920

shall conform to the additional requirements prescribed in the Supplementary Requirements Section of Specification B 250M (see 4.1.7).

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances for product produced to this specification shall be as specified in the following tables and related paragraphs or specified titles found in Specification B 250M:

10.1.1 *Diameter or Distance Between Parallel Surfaces*—Table 2.

10.1.1.1 *Thickness*—Table 4.

10.1.1.2 *Width*—Table 6.

10.1.1.3 *Length (Flat Wire Product)*—Table 7.

10.1.1.4 *Straightness (Flat Wire Product)*—Table 9.

10.1.1.5 *Edge Contours*—Edge Contour section.

11. Test Methods

11.1 Chemical Analysis:

11.1.1 Product composition shall, in case of dispute, be determined as follows:



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