



Designation: B159/B159M – 11

Standard Specification for Phosphor Bronze Wire¹

This standard is issued under the fixed designation B159/B159M; 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.

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 0.188 in. [5 mm] thick and 1.250 in. [32 mm] wide.

1.1.2 Round wire from Copper Alloy UNS No. C51000 is generally available in sizes up to 0.500 in. [13 mm] in diameter.

1.2 *Units*—Values stated in either inch-pound units or in SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. 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 specification.

1.3 Additional requirements for these products are established in Specification B250/B250M, see Section 3.

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.*

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 B139/B139M.

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. Referenced Documents

2.1 *ASTM Standards*:²

B139/B139M Specification for Phosphor Bronze Rod, Bar, and Shapes

B250/B250M Specification for General Requirements for Wrought Copper Alloy Wire

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

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)³

E290 Test Methods for Bend Testing of Material for Ductility

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B250/B250M are 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 Reheating,

3.1.11 Certification,

3.1.12 Mill Test Reports,

3.1.13 Packaging and Package Markings, and

3.1.14 Supplementary Requirements.

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 appears in this specification, it

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

contains additional requirements which supplement those appearing in Specification **B250/B250M**.

4. Terminology

4.1 Definitions of Terms Specific to This Standard:

4.1.1 *Cast, n*—The maximum diameter of coiled wire when one complete circumference rests completely on a flat surface as a table, workbench, or floor.

4.1.2 *Camber Offset, n*—The axial component of curvature of wire in an unrestrained state.

NOTE—The camber is measured as the offset in the ends of one turn of freely hanging wire.

4.2 For other definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

5. Ordering Information

5.1 Include the following information when placing orders for product under this specification.

5.1.1 ASTM designation and year of issue (for example, B159/B159M – XX),

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

5.1.3 Temper designation (Section 8),

5.1.4 Dimensions (diameter, distance between parallel surfaces, and so forth),

5.1.5 Type of edge (square corners, rounded corners, and so forth),

5.1.6 How furnished (coil spool, reel, specific lengths, and so forth), and

5.1.7 When product is purchased for agencies of the U.S. government (Section 11).

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

5.2.1 Heat identification or traceability details,

5.2.2 Certification, <https://standards.ohio-state.edu/catalog/standards/sis/cba93f19-6f58-4722-9999-999999999999>

5.2.3 Mill Test Reports,

5.2.4 Special packaging and package markings,

5.2.5 Cast and camber offset requirements if specified.

6. Materials and Manufacture

6.1 Materials:

6.1.1 The material of manufacturer shall be a casting billet of Copper Alloy UNS No. C51000, C52100, or C52400 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.

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.

7. Chemical Composition

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

7.1.1 These composition limits do not preclude the presence of other elements. When required, limits may be established

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

and analysis required for unnamed elements by agreement between the supplier and the purchaser.

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

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

8. Temper

8.1 Tempers, as defined in Classification **B601**, 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).

8.1.1 Tempers not covered by this specification shall be by agreement between purchaser and supplier.

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

9. Mechanical Property Requirements

9.1 Tensile Strength Requirements :

9.1.1 When tested in accordance with Test Methods **E8/E8M**:

9.1.1.1 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**.

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

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

Standard	Temper Name	Tensile Strength, ksi [Mpa] ^A		
		Copper Alloy UNS No.		
		C51000	C52100	C52400
O61	annealed	48.0–63.0	53.0–68.0	60.0–75.0
		[330–435]	[365–470]	[415–515]
H01	quarter-hard	60.0–76.0	74.0–91.0	83.0–102.0
		[415–525]	[510–625]	[570–705]
H02	half-hard	80.0–97.0	95.0–115.0	108.0–129.0
		[550–670]	[655–795]	[745–890]
H03	three-quarter-hard	96.0–115.0	113.0–135.0	125.0–148.0
		[660–795]	[780–930]	[860–1020]
H04	hard	108.0–128.0	125.0–150.0	135.0–160.0
		[745–885]	[860–1035]	[930–1105]
H08	spring	see Table 3

^Aksi = 1000 psi.