



Designation: B159/B159M – 17

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 U.S. Department of Defense.

1. Scope*

1.1 This specification establishes the requirements for round and flat (square and rectangular) 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*—The 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, health, and environmental 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.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

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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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

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

B950 Guide for Editorial Procedures and Form of Product Specifications 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 Rehearing;

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

- 3.1.11 Certification;
- 3.1.12 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 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 such as a table, workbench, or floor.

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

4.1.2.1 *Discussion*—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 specified choices when placing orders for product under this specification, as applicable:

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 Intended application.

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 Heat identification or traceability details;

5.2.2 Certification;

5.2.3 Test Reports;

5.2.4 Special packaging and package markings;

5.2.5 Tolerances for cast and camber offset, if specified;

5.2.6 If product is purchased for agencies of the U.S. Government (see Section 11);

5.2.7 Formability requirements other than bending (see 10.1.2); and

5.2.8 Requirements and method for determining cast and camber offset (12.1.8).

6. Materials and Manufacture

6.1 Materials:

6.1.1 The material of manufacturer shall be a cast 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 When specified in the contract or purchase order that 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 which will meet the temper properties specified.

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 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 the 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**.

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

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