



## Standard Specification for Phosphor Bronze Wire<sup>1</sup>

This standard is issued under the fixed designation B 159; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by 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.

NOTE 1—A complete metric companion (B 159M) has been developed; therefore no metric equivalents are presented.

1.1.1 Rectangular and square wire of the three alloys are generally available in sizes up to a maximum of 0.188 in. thick and 1.250 in. wide.

1.1.2 Round wire of Alloy UNS No. C51000 is generally available in sizes up to 0.500 in. in diameter.

1.1.3 Round wire of UNS Alloy Nos. C52100 and C52400 is generally available in sizes up to a maximum of 0.250 in. in diameter.

1.2 It should be understood that this specification is general. Since the material is used for many purposes where the requirements of the operations used are too particular to be specified by any of the ordinary physical tests, it is frequently advisable to submit samples or drawings to the manufacturer and secure an adjustment of anneal or temper to suit the actual operations to which the material is to be submitted.

1.3 Material in straight lengths is described by Specification B 139.

### 2. Referenced Documents

2.1 The following documents of the issue in effect on the date of purchase form a part of this specification to the extent referenced herein.

2.1.1 *ASTM Standards*:

B 159M Specification for Phosphor Bronze Wire [Metric]<sup>2</sup>

B 139 Specification for Phosphor Bronze Rod, Bar, and Shapes<sup>2</sup>

B 250 Specification for General Requirements for Wrought Copper-Alloy Wire<sup>2</sup>

B 601 Practice for Temper Designations for Copper and Copper-Alloys—Wrought and Cast<sup>2</sup>

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)<sup>3</sup>

E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>3</sup>

### 3. General Requirements

3.1 Refer to Specification B 250 for the following:

3.1.1 Terminology,

3.1.2 Ordering Information,

3.1.3 Materials and Manufacture,

3.1.4 Workmanship, Finish, and Appearance,

3.1.5 Sampling,

3.1.6 Number of Tests and Retests,

3.1.7 Specimen Preparation,

3.1.8 Test Methods,

3.1.9 Significance of Numerical Limits,

3.1.10 Inspection,

3.1.11 Rejection and Reheating,

3.1.12 Certification,

3.1.13 Mill Test Reports,

3.1.14 Product Marking,

3.1.15 Packaging and Package Marking, and

3.1.16 Supplementary Requirements.

### 4. Chemical Composition

4.1 The material of manufacture shall conform to the requirements of the particular alloy in Table 1.

4.2 The limits of a particular alloy do not preclude the presence of other elements. Limits for unnamed elements may be established and the determination of concentration required may be made by agreement between the manufacturer, or supplier, and the purchaser.

4.2.1 Copper may be specified as the remainder and may be taken as the difference between the sum of results of the specified elements for the particular alloy and 100 %.

4.3 When all elements specified for a given alloy in Table 1 are determined, the sum of results shall be 99.5 % min.

### 5. Temper

5.1 The product shall be available in O61, H01, H02, H03, H04, H06, H08, and H10 tempers as defined by Specification B 601.

### 6. Mechanical Properties

6.1 Round and square wire for general application of UNS Alloy Nos. C51000, C52100 and C52400 shall be capable of conforming to the requirements specified in Table 2.

6.2 Round or square wire of UNS Alloy No. C 51000 in H08 temper shall be capable of conforming to the requirements specified in Table 3.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rods, Bars, Shapes, Forgings, and Nonelectrical Wire.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.05.

TABLE 1 Chemical Requirements

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

6.3 Rectangular wire of UNS Alloy Nos. C51000, C52100 and C52400 shall be capable of conforming to the requirements specified in Table 4.

7. Performance Requirements

7.1 *Bending*—Wire in sizes up to 0.250 in. inclusive of UNS Alloy No. C51000 shall withstand being bent cold through an angle of 120° on a radius equal to the diameter or distance between parallel surfaces of the wire without developing cracks or other flaws visible to the unaided eye for tempers H08 and H10.

NOTE 2—Unaided eye—without enhancement; however, corrective spectacles necessary to obtain normal vision shall be permitted.

8. Dimensions and Permissible Variations

8.1 Refer to Specifications B 250 for the following:

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

8.1.2 *Thickness*—Table 4.

8.1.3 *Width*—Table 6.

8.1.4 *Length*—Tables 7 and 8.

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

Temper Designation <sup>A</sup>		Tensile Strength, ksi <sup>B</sup>		
Standard	Former	Copper Alloy UNS No		
		C51000	C52100	C52400
O61	annealed	43.0-58.0	53.0-68.0	60.0-75.0
H01	quarter-hard	60.0-76.0	74.0-91.0	83.0-102.0
H02	half-hard	80.0-97.0	95.0-115.0	108.0-129.0
H03	three-quarter-hard	96.0-115.0	113.0-135.0	125.0-148.0
H04	hard	108.0-128.0	125.0-150.0	135.0-160.0
H08	spring	See Table 3.		

<sup>A</sup> Standard designation defined in Practice B 601

<sup>B</sup> ksi = 1000 psi.

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

Diameter or distance between parallel surfaces, in.	Tensile Strength, min, ksi <sup>A</sup>	Elongation in 2 in. min, %
0.025 and under	145.0	...
Over 0.025 to 0.0625	135.0	...
Over 0.0625 to 0.125	130.0	...
Over 0.125 to 0.250	125.0	...
Over 0.250 to 0.375	120.0	5.0
Over 0.375 to 0.500, incl	105.0	9.0

<sup>A</sup> ksi = 1000 psi.

8.1.4.1 The length requirement applies to flat wire only.

8.1.5 *Straightness*—Table 9.

8.1.5.1 The straightness requirement applies to flat wire.

8.1.6 *Edge Contour*—Refer to the Section on Edge Contour.

9. Analytical Methods

9.1 Chemical composition shall, in case of dispute, be determined as follows:

Element	ASTM Test Method
Copper	E 478
Phosphorus	E 62
Lead	E 478 (AA)
Iron	E 478
Zinc	E 478 (Titrimetric)
Tin	E 478

10. Keywords

10.1 bronze wire; copper-alloy wire; copper-tin alloy wire; flat wire; general purpose wire; high strength wire; non-electrical wire; phosphor bronze alloy wire; round wire; spring wire; square wire; UNS C51000 Wire; UNS C52100 Wire; UNS C52400 Wire

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

Temper Designation		Tensile Strength, ksi <sup>A</sup>		
Standard	Former	Copper Alloy UNS No.		
		C51000	C52100	C52400
O61	annealed	43-58	53-67	58-73
H02	half-hard	58-73	69-84	76-91
H04	hard	76-91	85-100	94-109
H06	extra hard	88-103	97-112	107-122
H08	spring	95-100	105-119	115-129
H10	extra spring	100-114	116-122	120-133

<sup>A</sup> ksi = 1000 psi.

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