Designation: B197/B197M – 07 (Reapproved 2013)

Standard Specification for Copper-Beryllium Alloy Wire[1]

This standard is issued under the fixed designation B197/B197M; 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 copper-beryllium alloy wire in coils, spools, or other than straight lengths, of any uniform cross section. Copper Alloy UNS Nos. C17200 and C17300[2] are included.

1.2 Unless otherwise required, Copper Alloy UNS No. C17200 shall be the alloy furnished whenever Specification B197/B197Mis specified without any alloy designation.

1.3 The values stated in either inch-pounds or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 The following safety hazard caveat pertains only to the test methods described in this specification:

1.4.1 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

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 Test Methods for Tension Testing of Metallic Materials

E8M Test Methods for Tension Testing of Metallic Materials [Metric] (Withdrawn 2008)[4]

E112 Test Methods for Determining Average Grain Size

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. General Requirements

3.1 The following sections of Specification B250/B250M constitute a part of this specification:

3.1.1 Terminology,
3.1.2 Material and Manufacturer,
3.1.3 Chemical Composition,
3.1.4 Dimensions and Permissible Variations,
3.1.5 Workmanship, Finish, and Appearance,
3.1.6 Sampling,
3.1.7 Number of Tests and Retests,
3.1.8 Specimen Preparation,
3.1.9 Test Methods,
3.1.10 Significance of Numerical Limits,
3.1.11 Inspection,
3.1.12 Rejection and Rehearing,
3.1.13 Certification,
3.1.14 Mill Test Report, and
3.1.15 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 requirements which supplement those appearing in Specification B250/B250M.

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology B846.

4.2 *Definitions of Terms Specific to This Standard:*

4.2.1 *grain count*—the number of grains per stock thickness.

[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] The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

[3] 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.

[4] 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**

5. Ordering Information

5.1 Include the following information when placing orders for product under this specification, as applicable:

5.1.1 ASTM specification designation and year of issue,

5.1.2 Copper (Alloy) UNS No. designation,

5.1.3 Temper (Section 7),

5.1.4 Dimensions, diameter, or distance between parallel surfaces, and length if applicable,

5.1.5 Form of material: cross section such as round, hexagonal, octagonal, oval, trapezoidal, and so forth,

5.1.6 How furnished: coils spools, reels, or bucks, and specific lengths with or without ends or stock lengths with or without ends if applicable, and

5.1.7 When material is ordered for agencies of the U.S. Government (see Section 15).

5.2 The following options are available and should be specified in the contract or purchase order when required:

5.2.1 Type of edge: square corners, round edge, full-rounded edge (see the Edge Contours section in the Dimensions and Permissible Variations Section of Specification B250/B250M),

5.2.2 Grain size (Section 9.1),

5.2.3 Grain count (Section 9.2),

5.2.4 Mechanical properties (tensile strength and hardness) (Section 10),

5.2.5 Bend test (after precipitation heat treatment) (11.1),

5.2.6 Heat identification or traceability details,

5.2.7 Special packaging requirements,

5.2.8 Certification, and

5.2.9 Mill test report.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements prescribed in Table 1 for copper alloy UNS No. designation specified in the ordering information.

6.2 These composition limits do not preclude the presence of other elements. Limits for unnamed elements may be established and analysis required by agreement between the manufacturer or supplier and purchaser.

6.3 Copper is customarily given as remainder, but may be taken as the difference between the sum of all elements analyzed and 100 %.

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

TABLE 1 Chemical Requirements

Element	Composition, %	
	Copper Alloy UNS No. C17200	Copper Alloy UNS No. C17300
Beryllium	1.80–2.00	1.80–2.00
Additive elements:		
Nickel + cobalt, min	0.20	0.20
Nickel + cobalt + iron, max	0.6	0.6
Lead	. . .	0.20–0.6
Aluminum, max	0.20	0.20
Silicon, max	0.20	0.20
Copper	remainder	remainder

7. Temper

7.1 The standard tempers available under this specification and as specified in Practice B601 are TB00 (solution heat treated), or with varying degrees of cold work TD00 to TD04 to be precipitation heat treated by the user. Also available are products already precipitation heat-treated by the manufacturer, tempers TF00 (AT), TH01 to TH04. These products meet property requirements in Tables 2 and 3 and generally do not require further heat treatment by the user.

7.2 The pretempered product TL08 shown in Table 4 is prepared by the manufacturer for special applications.

NOTE 1—Special or nonstandard tempers are subject to negotiation between the supplier and the purchaser.

8. Precipitation Heat Treatment

8.1 The precipitation heat treatment is normally performed by the purchaser after forming. The heat treatment specified herein is applicable to mill products. Other treatment times and temperatures may be preferable for end products made from this material.

8.2 Conformance to the TF00 (AT) through TH04 (HT) specification limits shown in Tables 2 and 3 for products supplied in the TB00 (A) through TD04 (H) tempers, shall be determined by testing test specimens heat-treated at a uniform temperature of 600 to 625°F [316 to 329°C] for the times shown in Table 5.

8.3 Special combinations of properties such as increased ductility, electrical conductivity, dimensional accuracy, endurance life, and resistance to elastic drift and hysteresis in springs may be obtained by special precipitation-hardening heat treatments. The mechanical requirements of Tables 2 and 3 do not apply to such special heat treatments.

9. Physical Property Requirements

9.1 *Grain Size*—The average grain size of each of two samples of rectangular other than square wire, in thicknesses

TABLE 2 Tensile Strength Requirements for Round, Hexagonal, Octagonal, and Square Wire After Precipitation Heat Treatment (See 11.2)

Temper Designation		Tensile Strength,[A]	
Standard	Former	ksi[B]	MPa
TF00	Precipitation hardened (AT)	160–200[C]	[1105–1380]
TH01	¼ hard and precipitation heat treated (¼ HT)	175–210[C]	[1205–1450]
TH02	½ hard and precipitation heat treated (½ HT)	185–215	[1275–1480]
TH03	¾ hard and precipitation heat treated (¾ HT)[D]	190–230	[1310–1585]
TH04	Hard and precipitation heat treated (HT)	195–230	[1345–1585]

[A]These values apply to mill products (see 11.2).
[B]ksi = 1000 psi.
[C]Corrected editorially.
[D]TH03 (¾ HT) condition is generally available up to 0.080 in. [2.0 mm], inclusive, in diameter or distance between parallel surfaces.

TABLE 3 Mechanical Property Requirements[A] for Rectangular Other Than Square Wire After Precipitation Heat Treatment (See 11.2)

NOTE 1—Rockwell hardness values apply only to direct determinations, not converted values.

Temper Designation		Tensile Strength[A]		Rockwell hardness[B]		
Standard	Former	ksi[C]	MPa	C Scale, min	30N Scale, min	15N Scale, min
TF00	Precipitation hardened (AT)	165–190	[1140–1310]	36	56	78
TH01	¼ hard and precipitation heat treated (¼ H)	175–200	[1210–1380]	38	58	79
TH02	½ hard and precipitation heat treated (½ HT)	185–210	[1280–1450]	39	59	79.5
TH04	Hard and precipitation heat treated (HT)	190–215	[1310–1480]	40	60	80

[A]The upper limit in the tensile strength column applies to material thicker than 0.020 in. [0.50 mm].
[B]The thickness of material that may be tested in the case of the Rockwell hardness scales is as follows:

C Scale	0.032 in. and over	[0.80 mm and over]
30N	0.020 to 0.032 in., excl	[0.50 to 0.80 mm, excl]
15N Scale	0.015 to 0.020 in., excl	[0.38 to 0.50 mm, excl]

[C]ksi = 1000 psi.

TABLE 4 Tensile Strength Requirements for Round, Hexagonal, Octagonal, and Square Wire After Mill Hardening (Pretempered TL08-Former Designation XHT)

Diameter or Distance Between Parallel Surfaces, in.	Tensile Strength, ksi[A]	Diameter or Distance Between Parallel Surfaces, mm	Tensile Strength, MPa
Over 0.050 to 0.075, excl	140–165	[Over 1.2 to 1.9, excl]	[965–1140]
0.075 to 0.100, excl	120–140	[1.9 to 2.5, excl]	[830–965]
0.100 to 0.114, incl	115–130	[2.5 to 2.9, excl]	[795–895]

[A]ksi = 1000 psi.

TABLE 5 Standard Precipitation Heat Treatment Time for Acceptance Test

Temper Designation Before Hardening		Time at 600 to 625°F, h [316–329°C]	
Standard	Former	Round, Hexagonal, Octagonal, and Square Wire	Rectangular Other Than Square Wire
TB00	Solution heat treated (annealed)	3	3
TD01	Quarter-hard	2	2½
TD02	Half-hard	1½	2
TD03	Three-quarter hard	1	2
TD04	Hard	1	2

over 0.010 in. [0.25 mm] taken after precipitation heat treatment (see 8.2), shall not exceed the limits specified in Table 6 when determined in accordance with Test Methods E112 and taken on a plane perpendicular to the direction of rolling or drawing.

9.2 *Grain Count:*

9.2.1 The grain count of each of two samples of rectangular other than square wire, in thicknesses over 0.004 to 0.010 in. [0.10 to 0.25 mm] inclusive, taken after precipitation heat treatment (see 8.2), shall not be less than the limits specified in Table 7 when tested in accordance with 9.2.2.

9.2.2 Grain count is the number of grains per stock thickness, averaged for five locations one stock thickness apart. Grain count shall be determined in a plane perpendicular to the direction of rolling or drawing.

10. Property Requirements

10.1 The property requirement basis for acceptance or rejection for product in all forms and tempers is listed in the Tables as follows:

10.1.1 For round, hexagonal, octagonal, and square wire:

10.1.1.1 In the solution heat-treated, and solution heat-treated and cold worked conditioning—Table 8,

10.1.1.2 After precipitation heat-treatment—Table 2,

10.1.1.3 In the pretempered (mill-hardened) condition—Table 4.

10.1.2 For rectangle other than square wire:

10.1.2.1 Rockwell hardness shall be the basis of acceptance or rejection for wire 0.015 in. (0.040 mm) thick or over unless otherwise specified—Table 9.

10.1.2.2 For wire less than 0.015 in. (0.40 mm), or when agreement on hardness tests cannot be reached, the tensile strength requirements shall apply.

TABLE 6 Grain Size Requirements for Rectangular Other Than Square Wire

Thickness, in.	Maximum Average Grain Size, mm	Thickness, mm
Over 0.010 to 0.030, incl	0.035	[Over 0.25 to 0.75, incl]
Over 0.030 to 0.090, incl	0.045	[Over 0.75 to 2.30, incl]
Over 0.090 to 0.188, incl	0.060	[Over 2.3 to 4.8, incl]

TABLE 7 Grain Count Requirements for Rectangular Other Than Square Wire

Thickness, in.	Minimum Number of Grains	Thickness, mm
Over 0.004 to 0.006, incl	6	[Over 0.10 to 0.15, incl]
Over 0.006 to 0.008, incl	7	[Over 0.15 to 0.20, incl]
Over 0.008 to 0.010, incl	8	[Over 0.20 to 0.25, incl]