



Designation: B250/B250M – 19

Standard Specification for General Requirements for Wrought Copper Alloy Wire¹

This standard is issued under the fixed designation B250/B250M; 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 requirements common to wrought copper and copper alloy wire and shall apply to Specifications B16/B16M, B99/B99M, B134/B134M, B159/B159M, B197/B197M, B206/B206M, B272, B301/B301M, B453/B453M, B967/B967M, B974/B974M, and B981/B981M to the extent referenced therein.

1.2 The chemical composition, physical and mechanical properties, and all other requirements not included in this specification shall be prescribed in the product specification.

1.3 *Units*—Values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system are not necessarily exact equivalents; therefore, each system shall be used independently of the other and values from the two systems shall not be combined.

1.4 The following safety hazard caveat pertains only to the test methods described in this specification. *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 to determine the applicability of regulatory limitations prior to use.*

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

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 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.

- B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B99/B99M Specification for Copper-Silicon Alloy Wire for General Applications
- B134/B134M Specification for Brass Wire
- B159/B159M Specification for Phosphor Bronze Wire
- B193 Test Method for Resistivity of Electrical Conductor Materials
- B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
- B197/B197M Specification for Copper-Beryllium Alloy Wire
- B206/B206M Specification for Copper-Nickel-Zinc (Nickel Silver) Wire and Copper-Nickel Alloy Wire
- B272 Specification for Copper Flat Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)
- B301/B301M Specification for Free-Cutting Copper Rod, Bar, Wire, and Shapes
- B453/B453M Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes
- B846 Terminology for Copper and Copper Alloys
- B900 Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies
- B967/B967M Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire
- B974/B974M Specification for Free-Cutting Bismuth Brass Rod, Bar and Wire
- B981/B981M Specification for Low-Leaded Brass Rod, Bar, Wire, and Shapes
- E3 Guide for Preparation of Metallographic Specimens
- E8/E8M Test Methods for Tension Testing of Metallic Materials
- E18 Test Methods for Rockwell Hardness of Metallic Materials
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)³
- E62 Test Methods for Chemical Analysis of Copper and

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

- Copper Alloys (Photometric Methods) (Withdrawn 2010)³
- E75** Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)³
- E112** Test Methods for Determining Average Grain Size
- E118** Test Methods for Chemical Analysis of Copper-Chromium Alloys (Withdrawn 2010)³
- E121** Test Methods for Chemical Analysis of Copper-Tellurium Alloys (Withdrawn 2010)³
- E255** Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition
- E478** Test Methods for Chemical Analysis of Copper Alloys
- E581** Test Methods for Chemical Analysis of Manganese-Copper Alloys

3. Terminology

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

4. Materials and Manufacture

4.1 Materials:

4.1.1 The materials of manufacture shall be a form (cast bar, billet, rod, etc.) of the copper or copper alloy covered by the product specification, of such purity and soundness as to be suitable for processing into the products required.

4.1.2 When specified in the contract or purchase order, that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify specific casting analysis with a specific quantity of finished material.

4.2 Manufacture:

4.2.1 The material shall be manufactured by such hot working, cold working, and annealing processes as to produce a uniform wrought structure in the finished product.

4.2.2 The product shall be hot or cold worked to the finished size, and subsequently annealed when required, to meet the temper properties specified in the product specification.

4.2.3 *Edges*—The edges shall be drawn or rolled: refer to Dimensions and Permissible Variations section.

5. Chemical Composition

5.1 The material of manufacture shall conform to the chemical composition requirements prescribed in the product specification.

5.1.1 Results of analysis on a product (check) sample shall conform to the composition requirements within the permitted analytical variance specified in the product specification.

5.2 The composition limits established for the Copper Alloy UNS No. designation specified in the product specification do not preclude the presence of other elements. By agreement between the manufacturer and the purchaser, limits may be established and analysis required for unnamed elements.

5.3 When chemical composition has been determined during the course of manufacture, analysis of the finished product by the manufacturer is not required unless specifically stipulated in the contract or purchase order.

6. Dimensions and Permissible Variations

6.1 *General*—For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting value for any dimension may be cause for rejection.

6.1.1 The dimensions and tolerances for products referenced to this specification, shall be as noted in the following paragraphs and tables, where the product specification is noted in the table heading.

NOTE 2—Blank spaces in the tolerance tables indicate either that the product is not generally available or that no tolerances have been established.

6.2 *Diameter or Distance Between Parallel Surfaces*—The method of specifying wire diameter or distances between parallel surfaces shall be in decimal fractions of an inch or in millimeters.

Tables 1 and 2—List the tolerances for diameter or distances between parallel surfaces of wire in round, hexagonal and octagonal cross sections.

6.3 *Thickness*—The method of specifying thickness of wire shall be in decimal fractions of an inch or in millimeters.

Tables 3 and 4—List the thickness tolerances for flat wire in rectangular and square cross sections.

6.4 *Width*—The method of specifying width shall be in decimal fractions of an inch or in millimeter.

Tables 5 and 6—List the width tolerances for flat wire in rectangular and square cross sections.

6.5 Length:

6.5.1 Round, hexagonal, and octagonal wire shall be furnished in coils or reels, consisting of a single length as may be agreed upon between the manufacturer and the purchaser.

6.5.2 Flat (rectangular and square) wire when furnished in straight, specific, or stock lengths shall not exceed the length tolerances in **Table 7**.

6.5.3 Stock lengths with short lengths included as specified in **Table 8** shall be furnished, unless the contract or purchase order specifically states stock or specific lengths are required.

TABLE 1 Tolerances for Diameter or Distance Between Parallel Surfaces of Wire

(Applicable to Specifications **B16/B16M**, **B99/B99M** Copper Alloy UNS No. C65100, **B134/B134M**, **B301/B301M**, **B453/B453M**, **B967/B967M**, **B974/B974M**, and **B981/B981M**)

Diameter or Distance Between Parallel Surfaces, in. [mm]	Tolerances, Plus and Minus ^A			
	Round, in. [mm]		Hexagonal, Octagonal, in. [mm]	
Up to 0.010 [0.25], incl	0.0001	[0.003]	...	...
Over 0.010–0.020 [0.25–0.50], incl	0.0002	[0.005]	...	...
Over 0.020–0.030 [0.50–0.75], incl	0.0003	[0.008]	...	...
Over 0.030–0.040 [0.75–1.0], incl	0.0004	[0.010]	0.0008	[0.020]
Over 0.040–0.050 [1.0–1.2], incl	0.0005	[0.013]	0.0010	[0.025]
Over 0.050–0.060 [1.2–1.5], incl	0.0006	[0.015]	0.0012	[0.030]
Over 0.060–0.080 [1.5–2.0], incl	0.0008	[0.020]	0.0016	[0.040]
Over 0.080–0.150 [2.0–3.8], incl	0.0010	[0.025]	0.002	[0.050]
Over 0.150–0.500 [3.8–12], incl	0.0015	[0.040]	0.003	[0.075]
Over 0.500–0.750 [12–20], incl	0.002	[0.050]	0.004	[0.10]

^A If tolerances are specified as all plus or all minus, double the values given.

TABLE 2 Tolerances for Diameter or Distance Between Parallel Surfaces of Wire

(Applicable to Specifications B99/B99M Copper Alloy UNS No. C65500, B159/B159M, B197/B197M, B206/B206M, and B981/B981M)

Diameter or Distance Between Parallel Surfaces, in. [mm]	Tolerances, Plus and Minus ^A			
	Round, in. [mm]		Hexagonal, Octagonal, in. [mm]	
Up to 0.010 [0.25], incl	0.0002	[0.005]	...	...
Over 0.010–0.020 [0.25–0.50], incl	0.0003	[0.008]	...	...
Over 0.020–0.030 [0.50–0.75], incl	0.0005	[0.013]	...	...
Over 0.030–0.040 [0.75–1.0], incl	0.0007	[0.018]	0.002	[0.050]
Over 0.040–0.050 [1.0–1.2], incl	0.0008	[0.020]	0.003	[0.075]
Over 0.050–0.060 [1.2–1.5], incl	0.0010	[0.025]	0.003	[0.075]
Over 0.060–0.080 [1.5–2.0], incl	0.0015	[0.040]	0.004	[0.10]
Over 0.080–0.150 [2.0–3.8], incl	0.002	[0.050]	0.004	[0.10]
Over 0.150–0.500 [3.8–12], incl	0.002	[0.050]	0.004	[0.10]
Over 0.500–0.750 [12–20], incl	0.003	[0.075]	0.005	[0.13]

^A If tolerances are specified as all plus or all minus, double the values given.

TABLE 3 Thickness Tolerances for Flat (Rectangular and Square) Wire

(Applicable to Specification B134/B134M and Specification B99/B99M (Copper Alloy No. C65100))

Thickness, in. [mm]	Thickness Tolerances, Plus and Minus, ^A in. [mm] for Widths Given in Inches [mm]	
	Up to ½ [12], incl	Over ½ [12] to 1¼ [32], incl
Up to 0.013 [0.33], incl	0.0010 [0.025]	0.0013 [0.033]
Over 0.013–0.050 [0.33–1.25], incl	0.0013 [0.033]	0.0015 [0.040]
Over 0.050–0.090 [1.25–2.30], incl	0.0015 [0.040]	0.002 [0.050]
Over 0.090–0.130 [2.30–3.30], incl	0.002 [0.050]	0.0025 [0.065]
Over 0.130–0.188 [3.30–4.80], incl	0.003 [0.075]	0.0035 [0.090]

^A If tolerances are specified as all plus or all minus, double the values given.

TABLE 4 Thickness Tolerances for Flat (Rectangular and Square) Wire

(Applicable to Specifications B159/B159M, B197/B197M, B206/B206M and B99/B99M (Copper Alloy No. C65500))

Thickness, in. [mm]	Thickness Tolerances, Plus and Minus, ^A in. [mm] for Widths Given in Inches [mm]	
	Up to ½ [12], incl	Over ½ to 1¼ [12 to 32], incl
Up to 0.050 [1.2], incl	0.0015 [0.040]	0.002 [0.050]
Over 0.050–0.090 [1.2–2.3], incl	0.002 [0.050]	0.003 [0.075]
Over 0.090–0.130 [2.3–3.3], incl	0.003 [0.075]	0.004 [0.10]
Over 0.130–0.188 [3.3–4.8], incl	0.004 [0.10]	0.0045 [0.11]

^A If tolerances are specified as all plus or all minus, double the values given.

Table 8—Lists the schedule of lengths, specific or stock, with ends, for flat (rectangular or square) wire furnished in straight lengths.

6.6 Straightness—For flat (rectangular and square) wire furnished in straight lengths in applicable specifications the deviation from straightness shall not exceed the limitations specified in **Table 9**.

6.6.1 To determine compliance with this tolerance, the lengths shall, in case of disagreement, be checked by placing the lengths on a level table so that the arc or departure from straightness is horizontal. Measure the depth of the arc to the nearest ½ in. [1 mm] using a straight edge.

TABLE 5 Width Tolerances for Flat (Rectangular) Wire

(Applicable to Specification B134/B134M and B99/B99M (Copper Alloy No. C65100))

(For Square Wire Use Thickness Tolerances in **Table 3**)

Width, in. [mm]	Tolerances, Plus and Minus, ^A in. [mm]
Up to 0.050 [1.25], incl	0.0013 [0.025]
Over 0.050–0.090 [1.25–2.30], incl	0.0015 [0.040]
Over 0.090–0.130 [2.30–3.30], incl	0.002 [0.050]
Over 0.130–0.188 [3.30–4.80], incl	0.003 [0.075]
Over 0.188–0.500 [4.80–12.5], incl	0.0035 [0.090]
Over 0.500–1.25 [12.5–32.0], incl	0.005 [0.125]

^A If tolerances are specified as all plus or all minus, double the values given.

TABLE 6 Width Tolerances for Flat (Rectangular) Wire

(Applicable to Specifications B159/B159M, B197/B197M, B206/B206M and B99/B99M (Copper Alloy No. C65500))

(For Square Wire Use Thickness Tolerances in **Table 4**)

Width, in. [mm]	Tolerances, Plus and Minus, ^A in. [mm]
Up to 0.050 [1.2], incl	0.0015 [0.040]
Over 0.050–0.090 [1.2–2.3], incl	0.002 [0.050]
Over 0.090–0.130 [2.3–3.3], incl	0.003 [0.075]
Over 0.130–0.188 [3.3–4.8], incl	0.004 [0.10]
Over 0.188–0.500 [4.8–12], incl	0.005 [0.13]
Over 0.500–1.25 [12–32], incl	0.007 [0.18]

^A If tolerances are specified as all plus or all minus, double the values given.

TABLE 7 Length Tolerances for Straight Lengths (Specific and Stock) of Flat (Rectangular and Square) Wire

(Applicable to Specifications B134/B134M, B159/B159M, B197/B197M, B206/B206M, and B981/B981M)

Lengths	Length Tolerances Applicable Only to Full Length Pieces ^A in. [mm]
Specific lengths	⅜ [10]
Specific lengths with ends	1 [25]
Stock lengths with or without ends	1 [25] ^B

^A Tolerances are all plus; if all minus tolerances are desired, use the same values; if tolerances plus and minus are desired, halve the values given.

^B As stock lengths are cut and placed in stock in advance of orders, departure from this tolerance is not practicable.

TABLE 8 Schedule of Lengths (Specific and Stock) With Ends for Flat (Rectangular and Square) Wire Furnished in Straight Lengths

(Applicable to Specifications B134/B134M, B159/B159M, B197/B197M, B206/B206M, and B981/B981M)

Nominal Length, ft [mm]	Shortest Permissible Length ^A (in % of Nominal Length)	Maximum Permissible Weight of Ends (in % of Lot Weight)
6–14 [2000–4500], incl	75	20

^A Expressed to the nearest ½ ft [150 mm].

6.7 Edge Contours—Flat (rectangular and square) wire applicable to listed specifications shall, unless otherwise specified in the contract or purchase order, be finished with commercially square corners with a maximum permissible radius of ⅓ in. [0.3 mm] for wire ⅓ to ⅓ in. [1 to 1.5 mm] inclusive in thickness, and of ⅓ in. [0.4 mm] for wire over ⅓ to ⅓ in. [1.5 to 5 mm] inclusive in thickness.

6.7.1 Sharp Corners—When specified in the contract or purchaser order, the corner radius shall be 0.003 in.

TABLE 9 Straightness Tolerances for Flat (Rectangular and Square) Wires

(Applicable Specifications B134/B134M, B159/B159M, B197/B197M, B206/B206M, and B981/B981M)

Applicable to any longitudinal edge of material supplied in flat straight lengths and on reels or coils.

For material having a cross-sectional area of 0.010 in. ² [6.5 mm ²] and over and a thickness of 0.010 in. [0.25 mm] and over, furnished in straight lengths, on reels or coils	½ in. [12 mm] maximum edgewise curvature (depth of arc) in any 6-ft [2000 mm] portion of the total length
For material having a cross-sectional area of less than 0.010 in. ² [6.5 mm ²], or a thickness of less than 0.010 in. [0.25 mm], and all material furnished on reels or coils	No straightness tolerances established.

[0.080 mm] maximum on all sizes of flat wire up to and including 0.188 in. [5 mm] between flats.

6.7.2 Rounded Corners—When specified in the contract or purchase order, flat wire over ⅛ to ⅜ in. [3 to 5 mm], inclusive in thickness may be finished with corners rounded as shown in Fig. 1 to a quarter of a radius of ⅓ in. [1 mm]. The tolerance on the radius shall be ±25 %. Wire up to ⅛ in. [3 mm] inclusive in thickness, may be finished with a full rounded edge as described in 6.7.4.

6.7.3 Round Edge—When specified in the contract or purchase order, flat wire may be finished with edges rounded as shown in Fig. 2, the radius of curvature being 1¼ times the thickness for flat wire with a thickness up to ⅜ in. [5 mm] inclusive. The tolerance on the radius is ±½ times the wire thickness.

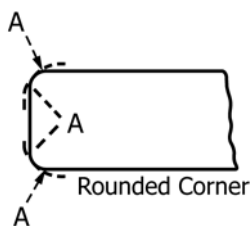
6.7.4 Full Rounded Edge—When specified in the contract or purchase order, flat wire may be finished with a substantially uniform round edge, the radius of curvature being approximately ½ the thickness of the wire, as shown in Fig. 3, but in no case to exceed ½ the thickness by more than 25 % (see also Fig. 4).

7. Workmanship, Finish, and Appearance

7.1 Workmanship:

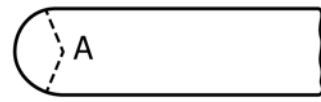
7.1.1 The product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable. The product shall be free of dirt.

7.2 Finish:



NOTE 1—The arc of the rounded corner shall not necessarily be tangent at Points A, but the product shall be commercially free from sharp, rough, or projecting edges.

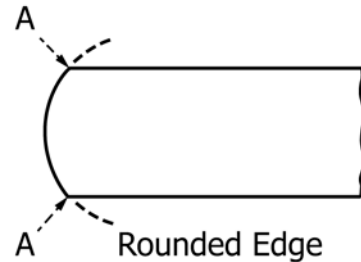
FIG. 1 Rounded Corners



Full Rounded Edge

NOTE 1—The arc of the rounded edge shall not necessarily be tangent at Points A, but shall be substantially symmetrical with the axis of the product, and the product shall be commercially free from sharp, rough, or projecting edges.

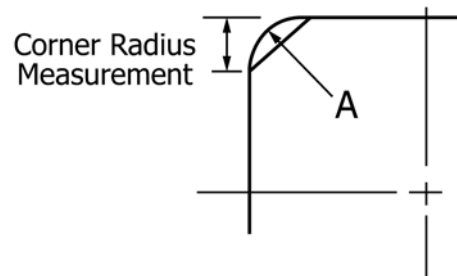
FIG. 2 Full Rounded Edge



Rounded Edge

NOTE 1—The arc of the rounded edge shall be substantially symmetrical with the axis of the product. The Corners A will usually be sharp but shall not have rough or projecting edges.

FIG. 3 Rounded Edge



NOTE 1—Any configuration within A is a corner radius.

FIG. 4 Corner Radius

7.2.1 Necessary joints in the wire shall be made prior to final drawing and in accordance with current practice.

7.3 Appearance:

7.3.1 The surface finish and appearance shall be the normal quality for product ordered.

7.3.2 When application information is provided with the contract or purchase order, the surface condition shall be suitable for the application.

7.3.3 Superficial films of discoloration, such as lubricants or tarnish inhibitors, are permissible unless otherwise specified.

8. Sampling

8.1 The lot size, portion size, and selection of sample pieces shall be as follows:

8.1.1 Lot Size—An inspection lot shall be 10 000 lb [5000 kg] or less, of the same mill form, alloy, temper and nominal dimensions, subject to inspection at one time. Alternatively, a lot shall be the product of one cast bar from a single melt charge, or one continuous casting run whose weight does not exceed 20 000 lb [10 000 kg] that has been continuously processed and subject to inspection at one time.