



Designation: B 250/B 250M – 01

Standard Specification for General Requirements for Wrought Copper Alloy Wire¹

This standard is issued under the fixed designation B 250/B 250M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This specification establishes requirements common to wrought copper alloy wire and shall apply to Specifications B 16/B 16M, B 99/B 99M, B 134/B 134M, B 159/B 159M, B 197/B 197M, B 206/B 206M, B 272, and B 301/B 301M 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*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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 standard.

2. Referenced Documents

2.1 *ASTM Standards:*

- B 16/B 16M Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines²
- B 99/B 99M Specification for Copper-Silicon Alloy Wire for General Applications²
- B 134/B 134M Specification for Brass Wire²
- B 159/B 159M Specification for Phosphor Bronze Wire²
- B 193 Test Method for Resistivity of Electrical Conductor Materials³
- B 194 Copper-Beryllium Alloy Plate, Strip, Sheet, and Rolled Bar²
- B 197/B 197M Specification for Copper-Beryllium Alloy Wire²
- B 206/B 206M Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) Wire and Copper-Nickel Alloy Wire²
- B 272 Specification for Copper Flat Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)²
- B 301/B 301M Specification for Free-Cutting Copper Rod and Bar²

- B 846 Terminology for Copper and Copper Alloys²
- E 3 Practice for Preparation of Metallographic Specimens⁴
- E 8 Test Methods for Tension Testing of Metallic Materials⁴
- E 8M Test Methods for Tension Testing of Metallic Materials [Metric]⁴
- E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴
- E 18M Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials [Metric]⁴
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵
- E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes⁶
- E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁶
- E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys⁶
- E 112 Test Methods for Determining Average Grain Size⁴
- E 118 Test Methods for Chemical Analysis of Copper-Chromium Alloys⁶
- E 121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys⁶
- E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition⁶
- E 478 Test Methods for Chemical Analysis of Copper Alloys⁷
- E 581 Test Methods for Chemical Analysis of Manganese-Copper Alloys⁷

3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

4. Materials and Manufacture

4.1 *Materials:*

4.1.1 The materials shall conform to the published compositional requirements of the Copper Alloy UNS No. designation specified in the ordering information.

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.

Current edition approved Nov. 10, 2001. Published February 2002. Originally published as B 250 – 51 T. Last previous edition B 250 – 95.

² *Annual Book of ASTM Standards*, Vol 02.01.

³ *Annual Book of ASTM Standards*, Vol 02.03.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

⁶ *Annual Book of ASTM Standards*, Vol 03.05.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

*A Summary of Changes section appears at the end of this standard.

4.1.2 In the event heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Because of 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 produced by either hot- or cold-working operations, or both. It shall be finished, unless otherwise specified, by such cold working and annealing or heat treatment as may be necessary to meet the properties specified.

4.2.2 *Edges*—The edges shall be drawn, extruded, 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 When a product (check) sample is analyzed by the purchaser, the material shall conform to the chemical composition requirements within the permitted analytical variance given in the product specification.

5.2 The chemical compositional limits established for the Copper Alloy UNS No. designation specified in the product specification does not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and the purchaser.

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.

NOTE 2—Blank spaces in the tolerance tables indicate either that the material 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 millimetres. The tolerances shall be that shown in Table 1 and Table 2 for the product specification indicated.

Table 1—Tolerances for diameter or distances between parallel surfaces of wire applicable to Specifications B 16/ B 16M, B 99/ B 99M (Alloy C65100) and B 134/ B 134M.

Table 2—Tolerances for diameter or distances between parallel surfaces of wire applicable to Specifications B 99/ B 99M (Alloy C65500), B 159/ B 159M, B 197/ B 197M, B 206/ B 206M, and B 301/ B 301M.

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

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

(Applicable to Specifications B 16/ B 16M, B 99/ B 99M Copper Alloy UNS No. C65100, B 134/ B 134M, and B 301/ B 301M.)

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]

^AIf 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 B 99/ B 99M Copper Alloy UNS No. C65500, B 159/ B 159M, B 197/ B 197M, and B 206/ B 206M.)

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	[0.020]
Over 0.040–0.050 [1.0–1.2], incl	0.0008	[0.020]	0.003	[0.025]
Over 0.050–0.060 [1.2–1.5], incl	0.0010	[0.025]	0.003	[0.030]
Over 0.060–0.080 [1.5–2.0], incl	0.0015	[0.040]	0.004	[0.040]
Over 0.080–0.150 [2.0–3.8], incl	0.002	[0.050]	0.004	[0.050]
Over 0.150–0.500 [3.8–12], incl	0.002	[0.050]	0.004	[0.075]
Over 0.500–0.750 [12–20], incl	0.003	[0.075]	0.005	[0.10]

tolerances shall be shown in Table 3 and Table 4 for the product specification indicated:

Table 3—Thickness for flat (rectangular and square) wire applicable to Specification B 134/ B 134M.

Table 4—Thickness tolerance for flat (rectangular and square) wire applicable to Specifications B 159/ B 159M, B 197/ B 197M, and B 206/ B 206M.

6.4 *Width*—The method of specifying width shall be in decimal fractions of an inch or in mm. The tolerances shall be that shown in Table 5 and Table 6.

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

(Applicable to Specification B 134/ B 134M.)

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]

^AIf 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 B 159/B 159M, B 197/B 197M, and B 206/B 206M.)

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]

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

TABLE 5 Width Tolerances for Flat (Rectangular) Wire
(Applicable to Specification B 134/B 134M.)
(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]

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

TABLE 6 Width Tolerances for Flat (Rectangular) Wire
(Applicable to Specifications B 159/B 159M, B 197/B 197M, and B 206/B 206M.)
(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]

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

Table 5—Width tolerances for flat (rectangular and square) wire applicable to Specification B 134/B 134M.

Table 6—Width tolerances for flat (rectangular and square) wire applicable to Specifications B 159/B 159M, B 197/B 197M, and B 206/B 206M.

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 tolerances in Table 7.

Table 7—Length tolerances for straight lengths, specific or stock, of flat (rectangular or square) wire applicable to Specifications B 134/B 134M, B 197/B 197M, and B 206/B 206M.

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 8—Schedule of lengths, specific or stock, with ends, for flat (rectangular or square) wire furnished in straight

TABLE 7 Length Tolerances for Straight Lengths (Specific and Stock) of Flat (Rectangular and Square) Wire
(Applicable to Specifications B 134/B 134M, B 159/B 159M, B 197/B 197M, and B 206/B 206M.)

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

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

^BAs 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 B 134/B 134M, B 159/B 159M, B 197/B 197M, and B 206/B 206M.)

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

^AExpressed to the nearest ½ ft [150 mm].

lengths applicable to Specifications B 134/B 134M, B 197/B 197M, and B 206/B 206M.

6.6 *Straightness*—For flat (rectangular and square) wire, the deviation from straightness shall not exceed the limitations specified in Table 9. 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 ⅓ in. [1 mm] using a straight-edge.

6.7 *Edge Contours*—Flat (rectangular and square) wire applicable to Specifications B 134/B 134M, B 197/B 197M, and B 206/B 206M 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. [0.080

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

(Applicable Specifications B 134/B 134M, B 159/B 159M, B 197/B 197M, and B 206/B 206M.)

Applicable to any longitudinal edge of material supplied in nominally flat straight lengths and in rolls or on bucks.

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, in rolls or on bucks	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 on stagger wound rolls	No straightness tolerances established.

mm] maximum on all sizes of 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, wire over 1/8 to 3/16 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 1/32 in. [1 mm]. The tolerance on the radius shall be ±25%. Wire up to 1/8 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, wire may be finished with edges rounded as shown in Fig. 2, the radius of curvature being 1/4 times the thickness for flat wire with a thickness up to 3/16 in. [5 mm] inclusive. The tolerance on the radius is ±1/2 times the wire thickness.

6.7.4 *Full Rounded Edge*—When specified in the contract or purchase order, wire may be finished with a substantially uniform round edge, the radius of curvature being approximately 1/2 the thickness of the wire, as shown in Fig. 3, but in no case to exceed 1/2 the thickness by more than 25% (see also Fig. 4).

7. Workmanship, Finish, and Appearance

7.1 *Workmanship:*

7.1.1 The product shall not have defects of a nature that interfere with the intended applications. The product shall be free of dirt.

7.2 *Finish:*

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, temper and nominal dimensions, subject to inspection at one time, or shall be the product of one cast bar from a single melt charge whose weight

shall not exceed 20 000 lb [10 000 kg] and that has been continuously processed and subject to inspection at one time.

8.1.2 *Portion Size*—The portion shall be four or more pieces selected so as to be representative of each lot. Should the lot consist of less than five pieces, representative samples shall be taken from each piece.

8.2 *Chemical Analysis:*

8.2.1 The sample for chemical analysis shall be taken in accordance with Practice E 255 for product in the final form from the pieces selected in 8.1.2 and combined into one composite sample. The minimum weight of the composite sample shall be 150 g.

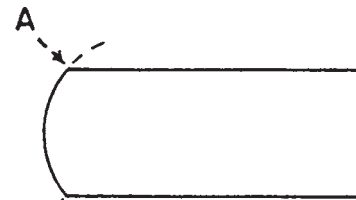
8.2.2 Instead of sampling as directed in 8.2.1, the manufacturer shall have the option of sampling at the time castings are poured or from the semifinished product. When samples are taken during the course of manufacture, sampling of the finished product by the manufacturer is not required. The number of samples taken for the determination of composition shall be as follows:



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.

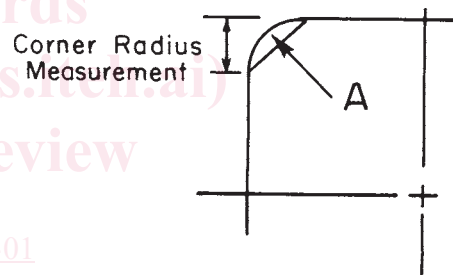
FIG. 2 Full Rounded Edge



Rounded Edge

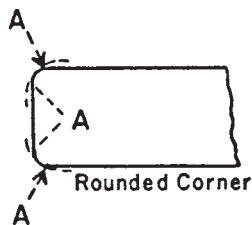
NOTE 1—The arc of the rounded edge shall be substantially symmetrical with the axis of the product. The Corners A will usually be sharp but shall not have rough or projecting edges.

FIG. 3 Rounded Edge



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

FIG. 4 Corner Radius



Rounded Corner

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