Designation: B 250M – 95
METRIC

Standard Specification for General Requirements for Wrought Copper Alloy Wire [Metric][1]

This standard is issued under the fixed designation 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 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 Department of Defense.

1. Scope *

1.1 This specification establishes a group of requirements common to wrought copper alloy wire and shall apply to Specifications B 16M, B 99M, B 159M, B 197M, and B 206M 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 This specification is the SI companion to Specification B 250.

1.4 SI units are the measurement standard.

2. Referenced Documents

2.1 *ASTM Standards:*

B 16M Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines [Metric][2]

B 99M Specification for Copper-Silicon Alloy Wire for General Purposes [Metric][2]

B 159M Specification for Phosphor Bronze Wire [Metric][2]

B 193 Test Method for Resistivity of Electrical Conductor Material[3]

B 194 Copper-Beryllium Alloy Plate, Strip, Sheet, and Rolled Bar[2]

B 197M Specification for Copper-Beryllium Alloy Wire [Metric][2]

B 206M Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) Wire and Copper-Nickel Alloy Wire [Metric][2]

B 250 General requirements for Wrought Copper Alloy Wire[2]

E 3M Methods of Preparation of Metallographic Specimens [Metric][4]

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 Materials[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[5]

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes[6]

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)[6]

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys[6]

E 112 Test Methods for Determining Average Grain Size[4]

E 118 Test Methods for Chemical Analysis of Copper-Chromium Alloys[6]

E 121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys[6]

E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition[6]

E 478 Test Methods for Chemical Analysis of Copper Alloys[6]

E 581 Test Methods for Chemical Analysis of Manganese-Copper Alloys[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *capable of*—possessing the required properties or characteristics, or both, necessary to conform to specification requirement(s) when subjected to specified test(s).

3.1.2 *coil*—a length of the product wound into a series of connected turns. The unqualified term as applied to flat wire usually refers to a product which is spirally wound with the successive layers on top of one another; sometimes called a roll. The unqualified term as applied to other than flat wire usually refers to a bunched coil.

3.1.2.1 *coil, bunched*—a length of the product wound into a series of connected turns and grouped such that the cross section of the grouped turns is approximately circular.

3.1.2.2 *coil, level or transverse wound*—a coil in which the turns are wound into layers parallel to the axis of the coil such that successive turns in a given layer are next to one another; sometimes called a helical coil.

3.1.2.3 *coil, level or transverse wound on a reel or spool*—a

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[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.

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

coil in which the turns are positioned into layers on a reel or spool parallel to the axis of the reel or spool such that successive turns in a given layer are next to one another.

3.1.2.4 *coil, stagger wound*—a coil in which the turns are positioned in layers approximately parallel to the axis of the coil, but not necessarily with a fixed regularity of a level or transverse wound coil.

3.1.3 *corner radius on square or rectangular wire*—any configuration on the corner between a chamfer and a full radius.

3.1.3.1 The measurement of a corner radius is the distance from the blend point of one surface to the extension of the other surface.

3.1.4 *length*—straight piece of the product.

3.1.4.1 *length, end*—straight piece, shorter than the nominal stock length, left over after cutting the product into mill length, stock length, or specific length. They are subject to minimum length and maximum weight requirements.

3.1.4.2 *length, mill*—straight length, including end, that can be conveniently manufactured in the mills. A full-length piece is usually 300 cm or 400 cm and subject to established length tolerance.

3.1.4.3 *length, multiple*—straight length of integral multiples of a base length, with a suitable allowance for cutting, if and when specified.

3.1.4.4 *length, specific*—straight length that is uniform in length, as specified, and subject to established length tolerances.

3.1.4.5 *length, specific with ends*—specific length, including ends.

3.1.4.6 *lengths, stock*—straight lengths that are mill cut and stored in advance of orders. They are usually 10 or 12 ft and subject to established length tolerances.

3.1.4.7 *lengths, stock with ends*—stock lengths, including ends.

3.1.5 *reel or spool*—a cylindrical device that has a rim at each end and an axial hoe for a shaft or spindle, and on which the product is wound to facilitate handling and shipping.

3.1.6 *unaided eye*—without visual enhancement; however, corrective spectacles necessary to obtain normal vision shall be permitted.

3.1.7 *wire*—a solid section, other than strip, furnished in coils or on reels (spools), or bucks.

3.1.7.1 *wire, flat*—a product up to and including 4.8 mm in thickness and up to and including 31.8 mm in width, with all surfaces rolled or drawn, without having been slit, sheared, or sawed. This product may also be furnished in straight lengths.

4. Materials and Manufacture

4.1 *Materials*:

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

4.1.2 In the event 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 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 6.7.

5. Chemical Composition

5.1 The material of manufacture shall conform to the 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 composition requirements within the permitted analytical variance given in the product specification.

5.2 The 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 material composition has been determined during the course of manufacture, analysis of the finished product by the manufacturer is not required.

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 a millimeter. 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 16M and B 99M (Alloy C65100).

TABLE 1 Tolerances for Diameter or Distance Between Parallel Surfaces of Wire
(Applicable to Specifications B 16M, B 99M (Alloy UNS No. C65100)

Diameter or Distance Between Parallel Surfaces, mm	Tolerances, Plus and Minus,[A] mm	
	Round	Hexagonal, Octagonal
Up to 0.25, incl	0.003	...
Over 0.25–0.50, incl	0.005	...
Over 0.50–0.75, incl	0.008	...
Over 0.75–1.0, incl	0.010	0.020
Over 1.0–1.2, incl	0.013	0.025
Over 1.2–1.5, incl	0.015	0.030
Over 1.5–2.0, incl	0.020	0.040
Over 2.0–3.8, incl	0.025	0.050
Over 3.8–12, incl	0.040	0.075
Over 12–20, incl	0.050	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 B 99M (Alloy UNS No. C65500), B 159M, B 197M, and B 206M)

Diameter or Distance Between Parallel Surfaces, mm	Tolerances, Plus and Minus,[A] mm	
	Round	Hexagonal, Octagonal
Up to 0.25, incl	0.005	...
Over 0.25–0.50, incl	0.008	...
Over 0.50–0.75, incl	0.013	...
Over 0.75–1.0, incl	0.018	0.050
Over 1.0–1.2, incl	0.020	0.075
Over 1.2–1.5, incl	0.025	0.075
Over 1.5–2.0, incl	0.040	0.10
Over 2.0–3.8, incl	0.050	0.10
Over 3.8–12, incl	0.050	0.10
Over 12–20, incl	0.075	0.13

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

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

6.3 *Thickness*—The method of specifying thickness of wire shall be in decimal fractions of a millimeter. The 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 159M, B 197M and B 206M.

6.4 *Width*—The method of specifying width shall be in decimal fractions of a millimeter. The tolerances shall be that shown in Table 4.

Table 4—Width tolerance for flat (rectangular and square) wire applicable to Specifications B 159M, B 197M, and 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 5 and Table 6 as applicable.

6.6 *Straightness*—For flat (rectangular and square) wire, the deviation from straightness shall not exceed the limitations specified in Table 7. 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 millimeter using a straight-edge.

6.7 *Edge Contours*—Flat (rectangular and square) wire applicable to Specifications B 197M and B 206M shall, unless otherwise specified in the contract or purchase order, be finished with commercially square corners with a maximum permissible radius of 0.3 mm for wire 0.8 to 1.5 mm inclusive in thickness, and of 0.4 mm for wire over 1.5 to 5 mm inclusive in thickness.

6.7.1 *Sharp Corners*—When specified in the contract or purchase order, the corner radius shall be 0.080 mm maximum on all sizes of wire up to and including 5 mm between flats.

6.7.2 *Rounded Corners*—When specified in the contract or purchase order, wire over 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 mm. The tolerance on the radius shall

TABLE 3 Thickness Tolerances for Flat (Rectangular and Square) Wire
(Applicable to Specifications B 159M, B 197M, and B 206M)

Thickness, mm	Thickness Tolerances, Plus and Minus,[A] mm for Widths Given in Millimetres	
	Up to 12, incl	Over 12 to 32, incl
Up to 1.2, incl	0.040	0.050
Over 1.2–2.3, incl	0.050	0.075
Over 2.3–3.3, incl	0.075	0.10
Over 3.3–4.8, incl	0.10	0.11

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

TABLE 4 Width Tolerances for Flat (Rectangular) Wire
(Applicable to Specifications B 159M, B 197M, and B 206M)
(For Square Wire Use Thickness Tolerances in Table 4)

Width, mm	Tolerances, Plus and Minus,[A] mm
Up to 1.2, incl	0.040
Over 1.2–2.3, incl	0.050
Over 2.3–3.3, incl	0.075
Over 3.3–4.8, incl	0.10
Over 4.8–12, incl	0.13
Over 12–32, incl	0.18

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

TABLE 5 Length Tolerances for Straight Lengths (Specific and Stock) of Flat (Rectangular and Square Wire)
(Applicable to Specifications B 159M, B 197M, and B 206M)

Lengths	Length Tolerances Applicable Only to Full Length Pieces,[A] mm
Specific lengths	10
Specific lengths with ends	25
Stock lengths with or without ends	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.

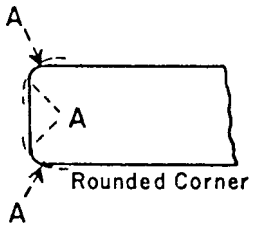
TABLE 6 Schedule of Lengths (Specific and Stock) With Ends for Flat (Rectangular and Square) Wire Furnished in Straight Lengths
(Applicable to Specifications B 159M, B 197M, and B 206M)

Nominal Length, mm	Shortest Permissible Length[A] (in Percent of Nominal Length)	Maximum Permissible Weight of Ends (in Percent of Lot Weight)
2000–4500, incl	75	20

[A] Expressed to the nearest 150 mm.

TABLE 7 Straightness Tolerances for Flat (Rectangular and Square) Wires
(Applicable to Specifications B 159M, B 197M, and 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 6.5 mm^2 and over and a thickness of 0.25 mm and over, furnished in straight lengths, in rolls, or on bucks	12-mm maximum edgewise curvature (depth of arc) in any 2000-mm portion of the total length
For material having a cross-sectional area of less than 6.5 mm^2, or a thickness of less than 0.25 mm, and all material furnished on reels or on stagger-wound rolls	No straightness tolerances established



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

be ± 25 %. Wire up to 3 mm inclusive in thickness, may be finished with a full rounded edge as described in 6.7.5.

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 one and one-fourth times the thickness for flat wire with a thickness up to 5 mm inclusive. The tolerance on the radius is plus and minus one-half 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 one-half the thickness of the wire, as shown in Fig. 3, but in no case to exceed one-half the thickness by more than 25 %.

7. Workmanship, Finish, and Appearance

7.1 *Workmanship*:

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

7.2 *Finish*:

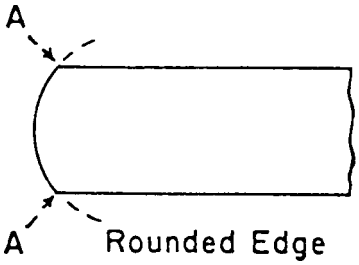
7.2.1 Necessary joints in the wire shall be made prior to final drawing and in accordance with current practice.

7.3 *Appearance*:

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

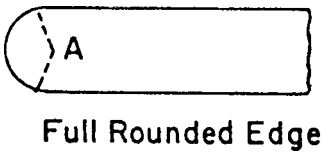
7.3.2 When application information is provided with the contract or purchase order, the surface shall be that normally produced for the application.

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



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. 2 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. 3 Full Rounded Edge

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 5 000 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 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:

8.2.2.1 When samples are taken at the time the castings are poured, at least one sample shall be taken for each group of casting poured from the same source of molten metal.

8.2.2.2 When samples are taken from semifinished product, a sample shall be taken to represent each 5 000 kg, or fraction thereof, except that not more than one sample shall be required per piece.

8.2.2.3 Only one sample need be taken from the semifinished product of one cast bar from a single melt charge continuously processed.

8.3 *Samples for All Other Tests*—Samples for all other tests shall be taken from the sample portions selected in 8.1.2 and be of a convenient size to accommodate the test and comply with the requirements of the appropriate product specification and test method.

9. Number of Tests and Retests

9.1 *Tests*:

9.1.1 *Chemical Analysis*—Chemical composition shall be determined as the per element mean of results from at least two replicate analysis of the sample(s) and the results of each