Designation: B 16/B 16M – 00

Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines[1]

This standard is issued under the fixed designation B 16/B 16M; 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 the requirements for free-cutting brass rod, bar, wire, and shapes of any specified cross section produced from Copper Alloy UNS No. C36000 suitable for high-speed screw machining applications and moderate thread rolling.

1.2 The values stated in either inch-pound units or in 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 independent of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:*

B 249 Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings[2]

B 249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar Shapes and Forgings [Metric][2]

B 250 Specification for General Requirements for Wrought Copper-Alloy Wire[2]

B 250M Specification for General Requirements for Wrought Copper-Alloy Wire[2]

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast[3]

E 8/E 8M Test Methods for Tension Testing of Metallic Materials[3]

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[3]

E 478 Test Methods for Chemical Analysis of Copper Alloys[4]

3. Ordering Information

3.1 Contracts or purchase orders for product furnished under this specification shall contain the following information:

3.1.1 ASTM specification designation and year of issue (B 16/B 16M-XX).

3.1.2 Copper Alloy UNS No. designation (C36000, see Section 6 and Table 1).

3.1.3 Temper (see Section 7 and Tables 2 and 3).

3.1.4 Product cross section form (for example, round, hexagonal, square, etc.).

3.1.5 Dimensions (see Section 9).

3.1.6 How furnished: straight lengths or coils (see 5.2).

3.1.7 Edge contours (see Section 9).

3.1.8 Quantity; total weight, footage, or number of pieces for each size.

3.1.9 When product is purchased for applications requiring thread rolling (see 1.1, Tables 2 and 3).

3.1.10 When product is purchased for agencies of the U.S. Government (see Section 11).

3.2 The following options are available and shall be specified at the time of placing the order when required:

3.2.1 Tensile test for product ½ in. [12 mm] and over (see 8.2.1).

3.2.2 Certification (refer to Specifications B 249 and B 249M or B 250 and B 250M).

3.2.3 Mill Test Report (refer to Specifications B 249 and B 249M or B 250 and B 250M).

4. General Requirements

4.1 The following sections of Specifications B 249, B 249M (rod, bar, and shapes), B 250, and B 250M (wrought copper alloy wire) constitute a part of this specification.

4.1.1 Terminology,

4.1.2 Materials and Manufacture,

4.1.3 Workmanship, Finish, and Appearance,

4.1.4 Sampling,

4.1.5 Number of Tests and Retest,

4.1.6 Specimen Preparation,

4.1.7 Test Methods,

4.1.8 Significance of Numerical Limits,

[1] 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 Rod, Bar, Shapes, Wire, and Forgings.

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

[3] *Annual Book of ASTM Standards*, Vol 03.01.

[4] *Annual Book of ASTM Standards*, Vol 03.06.

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

TABLE 1 Chemical Requirements
Copper Alloy UNS No. C36000

Element	Composition, %
Copper	60.0 - 63.0
Lead	2.5 - 3.7
Iron, max	0.35
Zinc	remainder

4.1.9 Inspection,
4.1.10 Rejection and Rehearing,
4.1.11 Certification,
4.1.12 Test Report,
4.1.13 Packaging and Package Marking, and
4.1.14 Supplementary Requirements.

4.2 In addition, when a section with a title identical to those referenced in 4.1 appears in this specification, it contains additional requirements that supplement those appearing in Specifications B 249, B 249M, B 250, and B 250M.

5. Materials and Manufacture

5.1 *Material*—The material of manufacture shall be a cast billet of Copper Alloy UNS No. C36000 of such purity and soundness as to be suitable for hot extrusion into rod, bar, wire, and shaped products.

5.2 *Manufacture*—Product produced under this specification shall be in straight lengths; however, it shall be furnished in coils when so specified in the contract or purchase order (see 3.1.6).

6. Chemical Composition

6.1 The product shall conform to the chemical compositional requirements specified in Table 1 for Copper Alloy UNS No. C36000.

6.2 The UNS designated composition limits do not preclude the possible presence of other unnamed elements; however, analysis shall be made regularly only for the minor elements listed in Table 1, plus either copper or zinc, or plus all major elements except one. The major element that is not analyzed shall be determine by difference between the sum of those elements analyzed and 100 %. By agreement between producer or supplier and purchaser, analysis may be required and limits established for the elements not cited. Percentage content of elements shown as "remainder" (rem.) is calculated by difference.

6.3 When all elements in Table 1 are analyzed, their sum shall be 99.5 % min.

7. Temper

7.1 Tempers, as defined in Practice B 601, identified in Tables 2 and 3 for product produced under this specification, are as follows:

7.1.1 O60 (soft annealed).
7.1.2 H02 (half hard).
7.1.3 H04 (hard).

7.2 Rod and bar shall be furnished in the H02 (half hard) temper, unless otherwise specified in the ordering information (see 3.1.3).

8. Mechanical Property Requirements

8.1 *Rockwell Hardness*:

8.1.1 Product ½ in. [12 mm], and over in diameter or distance between parallel surfaces, shall conform with the requirements given in Table 3 for temper, size, and form when tested in accordance with Test Methods E 18.

8.1.1.1 Rockwell hardness shall be the acceptance criterion for sizes ½ in. [12 mm], or greater, based upon mechanical properties, except when tensile requirements are specified as the acceptance criteria in the ordering information.

8.2 *Tensile Requirements*:

8.2.1 When tensile requirements are specified, the product shall conform to the requirements given in Table 2 for temper, size, and form.

8.2.1.1 Tensile requirements shall be the acceptance criteria of mechanical properties for product under ½ in. [12 mm] in diameter or distance between parallel surfaces when tested in accordance with Test Methods E 8/E 8M.

8.2.1.2 When specified in the ordering information, tensile requirements shall be the acceptance criteria based upon mechanical properties for product ½ in. [12 mm], or greater in diameter or distance between parallel planes when tested in accordance with Test Methods E 8/E 8M.

8.3 *Shapes*—Mechanical property requirements for shapes shall be subject to agreement between the manufacturer and the purchaser and the agreement shall be part of that contract or purchase order.

9. Dimensions, Mass, and Permissible Variations

9.1 The dimensions and tolerances for bar, rod and shapes produced under this specification shall be as specified in the following tables and paragraphs in Specifications B 249 and B 249M.

9.1.1 *Diameter or Distance Between Parallel Surfaces*:
9.1.1.1 *Rod in Length*—See Table 1.
9.1.1.2 *Bar, Rectangular and Square*—See Tables 8 and 10.

9.1.2 *Shapes*—Dimensional tolerances shall be subject to agreement between the manufacturer and the purchaser and the agreement shall be part of the contract or purchase order.

9.1.3 *Length*:
9.1.3.1 *Rod, Bar, and Shapes*—See Tables 13 and 14.

9.1.4 *Edge Contours*—Refer to the subsection titled "Edge Contours" and Figs. 1, 2, and 3.

9.2 The dimensions and tolerances for wire product under this specification shall be as specified in Table 1 and the related section in Specifications B 250 and B 250M.

9.2.1 *Wire, Coiled, Round*—See Table 1.

10. Test Methods

10.1 *Chemical Analysis*:

10.1.1 Chemical composition shall, in case of disagreement, be determined as follows:

Element	Test Method
Copper	E 478
Lead	E 478 atomic absorption
Iron	E 478
Zinc	E 478 titrimetric

10.2 Test method(s) to be followed for the determination of other element(s) resulting from contractual or purchaser order agreement shall be as agreed upon between the manufacturer and the purchaser.

TABLE 2 Tensile Requirements

Temper Designation Standard Name		Diameter or Distance Between Parallel Surfaces, in. [mm]	Tensile Strength min, ksi [MPa]	Yield Strength at 0.5 % Extension under Load min, ksi [MPa]	Elongation,[A] min, %
		Rod and Wire			
O60	soft	1 [25] and under	48 [330]	20 [140]	15
		over 1 [25] to 2 [50]	44 [305]	18 [125]	20
		over 2 [50]	40 [275]	15 [105]	25
H02	half-hard	½ [12] and under	57 [395]	25 [170]	7[B]
		over ½ [12] to 1 [25]	55 [380][C]	25 [170]	10
		over 1 [25] to 2 [50]	50 [345]	20 [140]	15
		over 2 [50] to 4 [100], and	45 [310]	15 [105]	20
		over 4 [100]	40 [275]	15 [105]	20
H04	hard	1/16 [1.6] to 3/16 [4], incl.	80 [550]	45 [310]	
		over 3/16 [4] to ½ [12], incl.	70 [480]	35 [240]	4
		over ½ [12] to ¾ [18], incl.	65 [450]	30 [205]	6
		Bar			
Standard Name		Thickness, in. [mm]	Width, in. [mm]		
O60	soft anneal	1 [25] and under	6 [150] and under	44 [305]	18 [125]	20
		over 1 [25]	6 [150] and under	40 [275]	15 [105]	25
H02	half-hard	½ [12] and under	1 [25] and under	50 [345]	25 [170]	10
		½ [12] and under	over 1 [25] to 6 [150]	45 [310]	17 [115]	15
		over ½ [12] to 2 [50]	2 [50] and under	45 [310]	17 [115]	15
		over ½ [12] to 2 [50]	over 2 [50] to 6 [150]	40 [275]	15 [105]	20
		over 2 [50]	over 2 [50] to 4 [100]	40 [275]	15 [105]	20

[A] In any case, a minimum gage length of 1 in. [25 mm] shall be used. SI elongation values are based on a gage length of 5.65 times the square root of the area for dimensions greater than 2.5 mm.
[B] For product furnished in coils the elongation shall be 4 % min.
[C] If product is specified for thread rolling applications, the minimum tensile strength shall be 52 ksi [350 MPa].

TABLE 3 Rockwell Hardness Requirements

NOTE 1—Rockwell hardness requirements are not established for diameters less than ½ in. [12 mm].

Temper Designation		Diameter of Distance Between Parallel Surfaces, in. [mm]	Rockwell B Hardness Determined on the Cross Section Midway Between Surface and Center	
		Rod and Wire		
Standard Name			Round	Hexagonal and Octagonal
O60	soft anneal	½ [12] and over	10 - 45	10 - 45
H02	half-hard	½ [12] to 1 [25] incl.	60 - 80[A]	55 - 80
		over 1 [25] to 2 [50] incl.	55 - 75	45 - 80
		over 2 [50] to 3 [75], incl.	45 - 70	40 - 65
		over 3 [75] to 4 [100], incl.	40 - 65	35 - 60
		over 4 [100]	25 min	25 min
		Bar		
		Thickness, in. [mm]	Width, in. [mm]	
O60	soft anneal	½ [12] and over	½ [12] and over	10 - 35
H02	half-hard	½ [12] and under	1 [25] and under	45 - 85
		½ [12] and under	over 1 [25] to 6 [150]	35 - 70
		over ½ [12] to 2 [50], incl.	2 [50] and under	40 - 80
			over 2 [50] to 6 [150]	35 - 70
		over 2 [50]	over 2 [50] to 4 [100]	35 - 70

[A] If product is specified for thread rolling application, the Rockwell B hardness shall be 55–75.

11. Purchases for U.S. Government Agencies

11.1 Product purchased for agencies of the U.S. Government, when specified in the contract or purchase order, shall conform to the special Supplementary Requirements section in Specifications B 249, B 249M (rod, bar, and shapes) and B 250 and B 250M (wire).

12. Keywords

12.1 free-cutting brass bar; free-cutting brass rod; free-cutting brass wire; screw machine rod

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B 16–92) that may impact its use.

(*1*) Scope—Revised to better state intent of specification.
(*2*) Specification B 16M is combined with B 16.
(*3*) General Requirements—Expanded to identify sections in the general requirement specification, which constitute a part of this specification.
(*4*) Ordering Information—Revised to eliminate reference to the general requirements specification.
(*5*) Mechanical Property Requirements—Significantly revised for better clarity of intent.
(*6*) Dimensions, Mass, and Permissible Variations—Revised to identify more clearly the tables in Specifications B 249, B 249M, B 250, and B 250M that apply to this specification.