



Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes¹

This standard is issued under the fixed designation B 453/B 453M; 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 copper-zinc-lead alloy (leaded-brass) rod, bar, wire, and shapes produced from Copper Alloys UNS Nos. C33500, C34000, C34500, C35000, C35300, and C35600. These alloys have nominal composition given in Table 1.

1.1.1 This product is suitable for applications requiring extensive machining before such cold-forming operations as swaging, flaring, severe knurling, or thread rolling.

1.1.2 Typically, product made to this specification is furnished as straight lengths. Sizes ½ in. [12 mm] and under may be furnished as wire in coils or on reels when requested.

1.2 The values stated in either inch-pound units 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 standard.

NOTE 1—Refer to Specifications B 16/B 16M and B 140/B 140M for copper-zinc-lead (leaded-brass) rod and bar for screw machine applications.

2. Referenced Documents

2.1 ASTM Standards:

2.1.1 The following documents in the current *Book of Standards* form a part of this specification to the extent referenced herein:

B 16/B 16M Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines²

B 140/B 140M Specification for Copper-Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar, and Shapes²

B 249 Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings²

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

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

TABLE 1 Nominal Composition, %

| Copper Alloy UNS No. | Copper | Zinc | Lead |
|----------------------|--------|------|------|
| C33500 | 63.5 | 36.0 | 0.5 |
| C34000 | 63.5 | 35.4 | 1.1 |
| C34500 | 63.5 | 34.5 | 2.0 |
| C35000 | 62.0 | 36.6 | 1.4 |
| C35300 | 62.0 | 36.0 | 2.0 |
| C35600 | 61.5 | 36.0 | 2.5 |

B 250 Specification for General Requirements for Wrought Copper/Alloy Wire²

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

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast²

E 8 Test Methods for Tension Testing of Metallic Materials³

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

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials³

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

3. General Requirements

3.1 The following sections of Specification B 249, B 249M, B 250, and B 250M are a part of this specification:

- 3.1.1 Terminology,
- 3.1.2 Materials and Manufacture,
- 3.1.3 Workmanship, Finish, and Appearance,
- 3.1.4 Sampling,
- 3.1.5 Number of Tests and Retests,
- 3.1.6 Specimen Preparation,
- 3.1.7 Test Methods,
- 3.1.8 Significance of Numerical Limits,
- 3.1.9 Inspection,
- 3.1.10 Rejection and Rehearing,
- 3.1.11 Certification,
- 3.1.12 Test Report,
- 3.1.13 Packaging and Package Marking, and

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.

3.1.14 Supplementary Requirements.

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specifications B 249, B 249M, B 250, or B 250M.

4. Ordering Information

4.1 Include the following information in orders for product:

- 4.1.1 ASTM designation and year of issue (for example, B 453/B 453M – 01),
- 4.1.2 Copper Alloy UNS Number designation,
- 4.1.3 Product (rod, bar, wire, or shape),
- 4.1.4 Cross section (round, hexagonal, square, and so forth),
- 4.1.5 Temper,
- 4.1.6 Dimensions (diameter or distance between parallel surfaces),
- 4.1.7 How furnished: straight lengths, coils, or reels,
- 4.1.8 Length,
- 4.1.9 Total length or number of pieces of each size,
- 4.1.10 Weight: total for each form, and size, and
- 4.1.11 When product is purchased for agencies of the U.S. government.

4.2 The following are options and should be specified in the ordering information when required:

- 4.2.1 Tensile test for product ½ in. [12 mm] and over in diameter or distance between parallel surfaces,
- 4.2.2 Certification, and
- 4.2.3 Mill test report.

5. Chemical Composition

5.1 The material shall conform to the chemical composition requirements in Table 2 for the Copper Alloy UNS No. designation specified in the ordering information.

5.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser. For copper alloys in which zinc is listed as the “remainder,” either copper or zinc may be taken as the difference between the sum of all elements determined and 100 %. When copper is so determined, that difference value shall conform to the requirements given in Table 2.

5.2 When all the named elements in Table 2 for the specified alloy are determined, the sum of results shall be as follows:

| Copper Alloy UNS No. | Percent, min |
|--------------------------------|--------------|
| C33500, C34000, C34500, C35000 | 99.6 |
| C35300, C35600 | 99.5 |

6. Temper

6.1 The standard tempers for products described in this

TABLE 2 Chemical Requirements

| Copper Alloy UNS No. | Composition, % | | | |
|----------------------|----------------|----------|----------|-----------|
| | Copper | Lead | Iron | Zinc |
| C33500 | 62.0–65.0 | 0.25–0.7 | 0.15 max | remainder |
| C34000 | 62.0–65.0 | 0.8–1.5 | 0.15 max | remainder |
| C34500 | 62.0–65.0 | 1.5–2.5 | 0.15 max | remainder |
| C35000 | 61.0–63.0 | 0.8–2.0 | 0.15 max | remainder |
| C35300 | 61.0–63.0 | 1.5–2.5 | 0.15 max | remainder |
| C35600 | 60.0–63.0 | 2.0–3.0 | 0.15 max | remainder |

specification are given in Tables 3 and 4.

- 6.1.1 O60 (soft annealed),
- 6.1.2 H01 (¼ hard), and
- 6.1.3 H02 (½ hard).

6.2 Other tempers, and temper for other products including shapes, shall be subject to agreement between the manufacturer and the purchaser.

7. Mechanical Property Requirement

7.1 Rockwell Hardness Requirements:

7.1.1 Product with a diameter or distance between parallel surfaces of ½ in. [12 mm] and over shall conform to the requirements of Table 3 when tested in accordance with Test Methods E 18.

7.1.1.1 Rockwell hardness test results shall be the basis for product acceptance for mechanical properties except when tensile test is so specified in the ordering information (4.2.1).

7.2 Tensile Strength Requirements:

7.2.1 Product with diameter or distance between parallel surfaces under ½ in. [12 mm] shall conform to the requirements of Table 4 when tested in accordance with Test Methods E 8 or E 8M.

7.2.2 When specified in the contract or purchase order, product with diameter or distance between parallel surfaces of ½ in. [12 mm] and over shall conform to the tensile requirements prescribed in Table 4 for the specified temper and size when tested in accordance with Test Methods E 8 or E 8M.

TABLE 3 Hardness Requirements^A

| Code | Temper Name | Diameter or Distance Between Parallel Surfaces, in. [mm] | Rockwell B Hardness |
|------------------|-------------|---|---|
| | | | Determined on the Cross Section Midway Between Surface and Center |
| Rod and Wire | | | |
| O60 | soft anneal | ½ [12] and over | 45 max |
| H01 | ¼ hard | ½ [12] to 1, both incl over 1 [25] to 2 [50], incl over 2 [50] | 50–75 40–70 35–65 |
| H02 | ½ hard | ½ [25] to 1 [50], both incl over 1 [25] to 2 [50], incl over 2 [50] | 60–80 55–75 40–70 |
| Bar ^B | | | |
| O60 | soft anneal | ½ [12] and over | 35 max |
| H01 | ¼ hard | ½ [12] to 1, both incl over 1 [25] to 2 [50], incl over 2 [50] | 45–75 35–70 35–65 |
| H02 | ½ hard | ½ [25] to 1 [50], both incl over 1 [25] to 2 [50], incl over 2 [50] | 45–85 40–80 35–70 |

^ARockwell hardness requirements are not established for diameters less than ½ in. [12 mm].

^BFor rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

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TABLE 4 Tensile Requirements

| Temper | | Diameter or Distance Between Parallel Surfaces, in. [mm] | Tensile Strength, ksi [Mpa] | | Yield Strength at 0.5 % Elongation Under Load, min | Elongation ^A in 4× Diameter or 4× Thickness, min, % |
|------------------|-------------|--|-----------------------------|----------|--|--|
| Code | Name | | min | max | ksi | |
| Rod and Wire | | | | | | |
| O60 | soft anneal | under ½ [12] | 46 [315] | | 16 [110] | 20 |
| | | ½ [12] to 1 [25], both incl | 44 [305] | | 15 [105] | 25 |
| | | over 1 [25] | 40 [275] | | 15 [105] | 30 |
| H01 | ¼ hard | under ½ [12] | 52 [360] | 65 [450] | 25 [170] | 10 ^B |
| | | ½ [12] to 1 [25], both incl | 50 [345] | 62 [425] | 20 [140] | 15 |
| | | over 1 [25] | 42 [290] | 62 [425] | 15 [105] | 20 |
| H02 | ½ hard | under ½ [12] | 57 [395] | 80 [555] | 25 [170] | 7 ^C |
| | | ½ [12] to 1 [25], both incl | 55 [380] | 70 [485] | 25 [170] | 10 |
| | | over 1 [25] | 50 [345] | 62 [425] | 20 [140] | 15 |
| Bar ^D | | | | | | |
| O60 | soft anneal | under ½ [12] | 46 [315] | | 16 [110] | 20 |
| | | ½ [12] to 1 [25], both incl | 44 [305] | | 15 [105] | 25 |
| | | over 1 [25] | 40 [275] | | 15 [105] | 25 |
| H01 | ¼ hard | under ½ [12] | 48 [330] | | 25 [170] | 10 |
| | | ½ [12] to 1 [25], both incl | 45 [310] | | 20 [140] | 15 |
| | | over 1 [25] | 40 [275] | | 15 [105] | 20 |
| H02 | ½ hard | under ½ [12] | 50 [345] | | 25 [170] | 10 |
| | | ½ [12] to 1 [25], both incl | 45 [310] | | 17 [115] | 15 |
| | | over 1 [25] | 40 [275] | | 15 [105] | 20 |

^AIn any case, a minimum gage length of 1 in. [25 mm] shall be used.

^BFor product furnished as wire, the elongation shall be 7 % min.

^CFor product furnished as wire, the elongation shall be 4 % min.

^DFor rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

8. Purchases for U.S. Government

8.1 When specified in the contract or purchase order, product purchased for agencies of the U.S. government shall conform to the special government requirements stipulated in the Supplementary Requirements section.

9. Dimensions and Permissible Variations

9.1 The dimensions and tolerances for rod, bar, and shapes in accordance with this specification shall be as specified in Specification B 249 or B 249M with particular reference to the following tables in that specification:

9.1.1 *Diameter or Distance Between Parallel Surfaces:*

9.1.1.1 *Rod*—Table 1.

9.1.1.2 *Bar*—Tables 8 and 10.

9.1.2 *Shapes*—Dimensional tolerances shall be subject to agreement between the manufacturer and the purchaser.

9.1.3 *Length*—Tables 13 and 14.

9.1.4 *Straightness*—Table 16.

9.1.5 *Angles*—All regular polygonal sections shall have substantially exact angles and, unless otherwise specified, sharp corners.

9.2 The dimensions and tolerances for wire product de-

scribed by this specification shall be as specified in Table 1 of Specification B 250 or B 250M.

10. Test Methods

10.1 *Chemical Analysis:*

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

| Element | Method |
|---------|---------------------|
| Copper | E 478 |
| Iron | E 478 |
| Lead | E 478 (AA) |
| Zinc | E 478 (titrimetric) |

10.1.2 Test method(s) to be used for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and the purchaser.

11. Keywords

11.1 copper-zinc-lead alloy bar; copper-zinc-lead alloy rod; copper-zinc-lead alloy wire; leaded-brass bar; leaded-brass rod; leaded-brass wire

APPENDIX

(Nonmandatory Information)

X1. ADDITIONAL INFORMATION

X1.1 Selection of the alloy and temper best suited for the particular application involves a compromise between desired hardness of the finished part, machinability, and ductility or malleability. The following guide may be used:

X1.1.1 In general, the higher the lead content, the better the machinability and lower the ductility and malleability.

X1.1.2 In general, increasing the copper content improves ductility and malleability.

X1.1.3 In general, the softer tempers have improved ductility and malleability but are less able to withstand unbalanced tool pressures.

SUMMARY OF CHANGES

This section identifies the location of selected changes to this specification that have been incorporated since the 1996 issue as follows:

- (1) This specification has been completely revised and a number of required sections previously missing are now included by reference to the General Requirements Specifications B 249, B 249M, B 250, and B 250M.
- (2) Combined customary inch-pound and SI unit specifications into a single document.
- (3) Scope revised and bar, wire, and shape products added.
- (4) Mechanical property requirements added for bar and wire products in Tables 3 and 4.
- (5) Bar and wire tolerances added.
- (6) Alloy C35340 removed from Table 2.

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