



# Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes<sup>1</sup>

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 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 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, C35330, 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.

NOTE 1—Refer to [Appendix X1](#) for additional applications information.

1.1.2 Typically, product made to this specification is furnished as straight lengths. Sizes 1/2 in. [12 mm] and under may be furnished as wire in coils or on reels when requested.

1.2 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.

NOTE 2—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:<sup>2</sup>

[B 16/B 16M](#) Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

[B 140/B 140M](#) Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes

[B 249/B 249M](#) Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

<sup>1</sup> 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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<sup>2</sup> 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.

TABLE 1 Nominal Composition, %

Copper Alloy UNS No.	Copper	Zinc	Lead
C33500	63.5	36.0	0.5
C34000	63.5	35.3	1.2
C34500	63.5	34.5	2.0
C35000	61.5	37.1	1.4
C35300	61.5	36.5	2.0
C35330	61.8	35.7	2.5
C35600	61.5	36.0	2.5

[B 250/B 250M](#) Specification for General Requirements for Wrought Copper Alloy Wire

[B 601](#) Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

[E 8](#) Test Methods for Tension Testing of Metallic Materials

[E 8M](#) Test Methods for Tension Testing of Metallic Materials [Metric]<sup>3</sup>

[E 18](#) Test Methods for Rockwell Hardness of Metallic Materials

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

[E 478](#) Test Methods for Chemical Analysis of Copper Alloys

## 3. General Requirements

3.1 The following sections of Specification [B 249/B 249M](#) and [B 250/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 Reheating,
- 3.1.11 Certification,

<sup>3</sup> Withdrawn. 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.

- 3.1.12 Mill Test Report,
- 3.1.13 Packaging and Package Marking, and
- 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** and **B 250/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 – 05),
  - 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 (See Section 6),
  - 4.1.6 Dimensions (diameter or distance between parallel surfaces, width, thickness),
  - 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,
  - 4.2.3 Mill test report, and
  - 4.2.4 Automatic screw machine use (9.1.4).

#### 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:

**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
C35330 <sup>A</sup>	59.5–64.0	1.5–3.5 <sup>B</sup>	–	remainder
C35600	60.0–63.0	2.0–3.0	0.15 max	remainder

<sup>A</sup>.02 – .25 As

<sup>B</sup>Pb may be reduced to 1.0 % by agreement.

Copper Alloy UNS No.	Percent, min
C33500, C34000, C34500, C35000	99.6
C35300, C35330, C35600	99.5

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

NOTE 3—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify a specific casting analysis with a specific quantity of finished material.

#### 6. Temper

6.1 The standard tempers, as defined in Classification **B 601**, for products described in this specification are given in **Tables 3-6**.

- 6.1.1 O60 (soft anneal),
- 6.1.2 H01 (¼ hard),
- 6.1.3 HR01 (¼ hard and Stress Relieved), and
- 6.1.4 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** and **Table 4** when tested in accordance with Test Methods **E 18**.

**TABLE 3 Rockwell Hardness Requirements, Inch-Pound<sup>A</sup>**

NOTE—SI values are stated in **Table 4**.

Temper Designation	Diameter or Distance Between Parallel Surfaces, in.	Rockwell B Hardness Determined on the Cross Section Midway Between Surface and Center
Rod and Wire		
O60	soft anneal ½ and over	45 max
H01	¼ hard ½ to 1, both incl over 1 to 2, incl over 2	50–75 40–70 35–65
HR01	¼ hard and Stress Relieved ½ to 1, both incl over 1 to 2, incl over 2	50–75 40–70 35–65
H02	½ hard ½ to 1, both incl over 1 to 2, incl over 2	60–80 55–75 40–70
Bar <sup>B</sup>		
O60	soft anneal ½ and over	35 max
H01	¼ hard ½ to 1, both incl over 1 to 2, incl over 2	45–75 35–70 35–65
H02	½ hard ½ to 1, both incl over 1 to 2, incl over 2	45–85 40–80 35–70

<sup>A</sup> Rockwell hardness requirements are not established for diameters less than ½ in.

<sup>B</sup> For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

**TABLE 4 Rockwell Hardness Requirements, SI<sup>A</sup>**

NOTE—Inch-pound values are stated in Table 3.

Temper Designation		Diameter or Distance Between Parallel Surfaces, mm	Rockwell B Hardness Determined on the Cross Section Midway Between Surface and Center
Code	Name		
Rod and Wire			
O60	soft anneal	12 and over	45 max
H01	¼ hard	12 to 25, both incl over 25 to 50, incl over 50	50–75 40–70 35–65
HR01	¼ hard and Stress Relieved	12 to 25, both incl over 25 to 50, incl over 50	50–75 40–70 35–65
H02	½ hard	25 to 50, both incl over 25 to 50, incl over 50	60–80 55–75 40–70
Bar <sup>B</sup>			
O60	soft anneal	12 and over	35 max
H01	¼ hard	12 to 25, both incl over 25 to 50, incl over 50	45–75 35–70 35–65
H02	½ hard	25 to 50, both incl over 25 to 50, incl over 50	45–85 40–80 35–70

<sup>A</sup> Rockwell hardness requirements are not established for diameters less than 12 mm.

<sup>B</sup> For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

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).

7.1.1.2 Product that fails to conform to the hardness requirements shall be acceptable if tensile strength requirements are in conformance.

### 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 Tables 3-6 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 Tables 3-6 for the specified temper and size when tested in accordance with Test Methods E 8 or E 8M.

## 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 of Specifications B 249/B 249M and B 250/B 250M.

## 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/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.

9.1.4.1 General use straightness tolerances will apply unless rod is specified for automatic screw machine use at the time of placing an order.

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 described by this specification shall be as specified in Table 1 of Specification B 250/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)
Arsenic	E 62

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; UNS No. C33500; UNS No. C34000; UNS No. C34500; UNS No. C35000; UNS No. C35300; UNS No. C35330; UNS No. C35600

**TABLE 5 Tensile Requirements, Inch-Pound**

 NOTE—SI values are stated in [Table 6](#).

Temper Designation		Diameter or Distance Between Parallel Surfaces, in.	Tensile Strength, ksi		Yield Strength at 0.5 % Extension Under Load, min	Elongation <sup>A</sup> in 4× Diameter or 4× Thickness, min, %
Code	Name		min	max	ksi	
Rod and Wire						
O60	soft anneal	under 1/2	46		16	20
		1/2 to 1, both incl	44		15	25
		over 1	40		15	30
H01	1/4 hard	under 1/2	52	65	25	10 <sup>B</sup>
		1/2 to 1, both incl	50	62	20	15
		over 1	42	62	15	20
HR01	1/4 hard and Stress Relieved	under 1/2	52	65	25	10 <sup>B</sup>
		1/2 to 1, both incl	50	62	20	15
		over 1	42	62	15	20
H02	1/2 hard	under 1/2	57	80	25	7 <sup>C</sup>
		1/2 to 1, both incl	55	70	25	10
		over 1	50	62	20	15
Bar <sup>D</sup>						
O60	soft anneal	under 1/2	46		16	20
		1/2 to 1, both incl	44		15	25
		over 1	40		15	25
H01	1/4 hard	under 1/2	48		25	10
		1/2 to 1, both incl	45		20	15
		over 1	40		15	20
H02	1/2 hard	under 1/2	50		25	10
		1/2 to 1, both incl	45		17	15
		over 1	40		15	20

<sup>A</sup> In any case, a minimum gage length of 1 in. shall be used.

<sup>B</sup> For product furnished as wire, the elongation shall be 7 % min.

<sup>C</sup> For product furnished as wire, the elongation shall be 4 % min.

<sup>D</sup> For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

**TABLE 6 Tensile Requirements, SI**

NOTE—Inch-pound values are stated in Table 5.

Temper Designation		Diameter or Distance Between Parallel Surfaces, mm	Tensile Strength, Mpa		Yield Strength at 0.5 % Extension Under Load, min	Elongation <sup>A</sup> in 4× Diameter or 4× Thickness, min, %
Code	Name		min	max	ksi	
Rod and Wire						
O60	soft anneal	under 12	315		110	20
		12 to 25, both incl	305		105	25
		over 25	275		105	30
H01	¼ hard	under 12	360	450	170	10 <sup>B</sup>
		12 to 25, both incl	345	425	140	15
		over 25	290	425	105	20
HR01	¼ hard and Stress Relieved	under 12	360	450	170	10 <sup>B</sup>
		12 to 25, both incl	345	425	140	15
		over 25	290	425	105	20
H02	½ hard	under 12	395	555	170	7 <sup>C</sup>
		12 to 25, both incl	380	485	170	10
		over 25	345	425	140	15
Bar <sup>D</sup>						
O60	soft anneal	under 12	315		110	20
		12 to 25, both incl	305		105	25
		over 25	275		105	25
H01	¼ hard	under 12	330		170	10
		12 to 25, both incl	310		140	15
		over 25	275		105	20
H02	½ hard	under 12	345		170	10
		12 to 25, both incl	310		115	15
		over 25	275		105	20

<sup>A</sup> In any case, a minimum gage length of 25 mm shall be used.

<sup>B</sup> For product furnished as wire, the elongation shall be 7 % min.

<sup>C</sup> For product furnished as wire, the elongation shall be 4 % min.

<sup>D</sup> For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

## 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.

X1.1.4 Arsenic is added to improve corrosion resistance due to dezincification.

X1.1.5 HR01 temper is used to improve resistance to stress corrosion cracking.

**SUMMARY OF CHANGES**

Committee B05 has identified the location of selected changes to this standard since the last issue (B 453/B 453M – 05) that may impact the use of this standard. (Approved Oct. 1, 2008.)

- (1) Addition of alloy C35330
- (2) Addition of Temper HR01

- (3) Addition of Test Method **E 62**

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