Designation: B453/B453M – 11$^{\varepsilon 1}$

Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes[1]

This standard is issued under the fixed designation B453/B453M; 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 U.S. Department of Defense.

ε[1] NOTE—Editorial corrections were made in Table 6 and throughout in March 2014.

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, C35350, 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 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 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 B16/B16M and B140/B140M for copper-zinc-lead (leaded-brass) rod and bar for screw machine applications.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

B140/B140M Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes

B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

B250/B250M Specification for General Requirements for Wrought Copper Alloy Wire

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

E8 Test Methods for Tension Testing of Metallic Materials

E8M Test Methods for Tension Testing of Metallic Materials [Metric] (Withdrawn 2008)[3]

E18 Test Methods for Rockwell Hardness of Metallic Materials

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B249/B249M and B250/B250M 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 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

[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.

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[2] 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.

[3] 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**

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
C35350	62.0	34.5	3.2
C35600	61.5	36.0	2.5

contains additional requirements which supplement those appearing in Specifications B249/B249M and B250/B250M.

4. Ordering Information

4.1 Include the following information in orders for product:

4.1.1 ASTM designation and year of issue (for example, B453/B453M – 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.

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[A]	59.5–64.0	1.5–3.5[B]	–	remainder
C35350[C]	61.0-63.0	2.0-4.5	0.40	remainder
C35600	60.0–63.0	2.0–3.0	0.15 max	remainder

[A] .02 – .25 As
[B] Pb may be reduced to 1.0 % by agreement.
[C] Includes nickel 0.05-0.30, phosphorus 0.05-0.20, tin 0.30 max.

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, C35330, C35350, 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 B601, 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) (UNS Alloy No. C35350 is available only in this temper).

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 E18.

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 E8 or E8M.

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 E8 or E8M.

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

TABLE 3 Rockwell Hardness Requirements, Inch-Pound[A]

NOTE 1—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 (All Alloys except C35350)	Rockwell Hardness Determined on the Cross Section Midway Between Surface and Center (Alloy C35350)
Code	Name			
		Rod and Wire		
O60	soft anneal	½ and over	45 max	
H01	¼ hard	½ to 1, both incl	50–75	...
		over 1 to 2, incl	40–70	...
		over 2	35–65	...
HR01	¼ hard and Stress Relieved	½ to 1, both incl	50–75	...
		over 1 to 2, incl	40–70	...
		over 2	35–65	...
H02	½ hard	½ to 1, both incl	60–80	68–85
		over 1 to 2, incl	50–75	62–80
		over 2	40–70	53–70
		Bar[B]		
O60	soft anneal	½ and over	35 max	...
H01	¼ hard	½ to 1, both incl	45–75	...
		over 1 to 2, incl	35–70	...
		over 2	35–65	
H02	½ hard	½ to 1, both incl	45–85	68–85
		over 1 to 2, incl	40–80	62–80
		over 2	35–70	53–70

[A] Rockwell hardness requirements are not established for diameters less than ½ in.
[B] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

TABLE 4 Rockwell Hardness Requirements, SI[A]

NOTE 1—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 (All Alloys except C35350)	Rockwell Hardness Determined on the Cross Section Midway Between Surface and Center (Alloy C35350)
Code	Name			
		Rod and Wire		
O60	soft anneal	12 and over	45 max	
H01	¼ hard	12 to 25, both incl	50–75	...
		over 25 to 50, incl	40–70	...
		over 50	35–65	...
HR01	¼ hard and Stress Relieved	12 to 25, both incl	50–75	...
		over 25 to 50, incl	40–70	...
		over 50	35–65	...
H02	½ hard	12 to 25, both incl	60–80	68–85
		over 25 to 50, incl	50–75	62–80
		over 50	40–70	53–70
		Bar[B]		
O60	soft anneal	12 and over	35 max	...
H01	¼ hard	12 to 25, both incl	45–75	...
		over 25 to 50, incl	35–70	...
		over 50	35–65	...
H02	½ hard	12 to 25, both incl	45–85	68–85
		over 25 to 50, incl	40–80	62–80
		over 50	35–70	53–70

[A] Rockwell hardness requirements are not established for diameters less than 12 mm.
[B] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

TABLE 5 Tensile Requirements, Inch-Pound

NOTE 1—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[A] in 4× Diameter or 4× Thickness, min, %
Code	Name		min	max	ksi	
		Rod and Wire				
O60	soft anneal	under ½	46		16	20
		½ to 1, both incl	44		15	25
		over 1	40		15	30
H01	¼ hard	under ½	52	65	25	10[B]
		½ to 1, both incl	50	62	20	15
		over 1	42	62	15	20
HR01	¼ hard and Stress Relieved	under ½	52	65	25	10[B]
		½ to 1, both incl	50	62	20	15
		over 1	42	62	15	20
H02	½ hard	under ½	57	80	25	7[C]
		½ to 1, both incl	55	70	25	10
		over 1	50	62	20	15
		Bar[D]				
O60	soft anneal	under ½	46		16	20
		½ to 1, both incl	44		15	25
		over 1	40		15	25
H01	¼ hard	under ½	48		25	10
		½ to 1, both incl	45		20	15
		over 1	40		15	20
H02	½ hard	under ½	50		25	10
		½ to 1, both incl	45		17	15
		over 1	40		15	20

[A] In any case, a minimum gage length of 1 in. shall be used.
[B] For product furnished as wire, the elongation shall be 7 % min.
[C] For product furnished as wire, the elongation shall be 4 % min.
[D] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.

the Supplementary Requirements section of Specifications B249/B249M and B250/B250M.

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 B249/B249M 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 B250/B250M.

10. Test Methods

10.1 *Chemical Analysis:*

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

Element	Method
Arsenic	E62
Copper	E478
Iron	E478
Lead	E478 (AA)
Nickel	E478
Phosphorus	E62
Tin	E478
Zinc	E478 (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; UNS No. C33500; UNS No. C34000; UNS No. C34500; UNS No. C35000; UNS No. C35300; UNS No. C35330; UNS No. C35350; UNS No. C35600

TABLE 6 Tensile Requirements, SI

NOTE 1—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[A] in 4× Diameter or 4× Thickness, min, %
Code	Name		min	max	MPa	
		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[B]
		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[B]
		12 to 25, both incl	345	425	140	15
		over 25	290	425	105	20
H02	½ hard	under 12	395	555	170	7[C]
		12 to 25, both incl	380	485	170	10
		over 25	345	425	140	15
		Bar[D]				
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

[A] In any case, a minimum gage length of 25 mm shall be used.
[B] For product furnished as wire, the elongation shall be 7 % min.
[C] For product furnished as wire, the elongation shall be 4 % min.
[D] 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 (B453/B453M – 08) that may impact the use of this standard. (Approved Oct. 1, 2011.)

(1) Addition of alloy C35350.