



Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes¹

This standard is issued under the fixed designation B 124/B 124M; 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 and copper alloy rod, bar, and shapes intended for hot forging. The following coppers and copper alloys are involved:

Copper UNS Nos.	Copper Alloy UNS Nos.
C11000	C36500
C14500	C37000
C14700	C37700
	C46400
	C48200
	C48500
	C61900
	C62300
	C63000
	C63200
	C64200
	C64210
	C65500
	C67500
	C67600
	C70620
	C71520
	C77400

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.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- 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

B 283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)²

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes³

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)³

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys³

E 76 Test Methods for Chemical Analysis of Nickel-Copper Alloys³

E 121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys³

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

2.2 ISO Standard:

No. 3110, Part 2 (TC 26 Ref. No. N 670 E/F) Determination of Aluminum Content: Flame Atomic Absorption Spectrometric Method⁵

3. General Requirements

3.1 The following sections of Specifications B 249 or B 249M form a part of this specification:

- 3.1.1 Terminology,
- 3.1.2 Material 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 Reports,
- 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 that referenced in 3.1, appears in this specification, it contains

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

³ *Annual Book of ASTM Standards*, Vol 03.05.

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

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

additional requirements that supplement those appearing in Specifications B 249 or B 249M.

4. Ordering Information

4.1 Include the following in orders for products:

- 4.1.1 ASTM designation and year of issue (B 124/B 124M-XX),
- 4.1.2 Copper or Copper-Alloy UNS No. designation,
- 4.1.3 Form (rod, bar, or shape) and size,
- 4.1.4 Dimensions, Mass, and Permissible Variations (Section 10),
- 4.1.5 Temper (Section 7),
- 4.1.6 Length (Section 10),
- 4.1.7 Quantity; total weight for each size and form,
- 4.1.8 When the product is purchased for agencies of the U.S. Government.

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

- 4.2.1 Mechanical Properties for Temper designated,
- 4.2.2 Certification, and
- 4.2.3 Test Report.

5. Materials and Manufacture

5.1 Materials:

5.1.1 The material of manufacture shall be a cast rod, bar, or billet of the designated copper or copper-alloy of such purity and soundness to be suitable for processing in to the products prescribed herein.

5.1.2 In the event that heat identification or traceability is required, the purchaser shall specify the details desired. It should be noted that 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.

5.2 Manufacture:

5.2.1 The products shall be manufactured by such hot working, cold working, and annealing processes as to produce a uniform wrought structure in the finished product.

5.2.2 The product shall be hot or cold worked to the finished size and subsequently annealed, when required, to meet the temper designated, and mechanical properties agreed upon.

6. Chemical Composition

6.1 The material shall conform to the chemicals compositional requirements in Table 1 for the copper or copper alloy UNS No. designation specified in the ordering information.

6.1.1 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.

6.2 When the value of an element for a specified copper alloy is identified as the "Remainder," that "Remainder" value shall be determined as the difference between the sum of results for specified elements and 100 %.

6.3 For alloys in which either copper or zinc is listed as

TABLE 1 Chemical Requirements

Copper or Copper Alloy UNS No.	Composition, %													Copper Plus Elements with Specific Limits Present, min
	Copper	Lead	Tin	Iron	Nickel (incl Co)	Aluminum	Silicon	Manganese	Zinc	Sulfur	Tellurium	Phosphorus	Arsenic	
C11000	99.90 min ^A...	...	...	...	...	...	...	...	...	...	...	...	...	...
C14500 ^B	99.90 min ^C...	...	...	...	...	...	...	...	...	...	0.40-0.7	0.004-0.012	...	...
C14700 ^B	99.90 min ^D...	...	...	...	...	...	...	...	...	0.20-0.50	...	0.002-0.005	...	...
C36500	58.0-61.0	0.25-0.7	0.25 max	0.15 max	...	...	...	...	remainder	...	...	...	...	99.6
C37000	59.0-62.0	0.8-1.5	...	0.15 max	...	...	...	...	remainder	...	...	...	...	99.6
C37700	58.0-61.0	1.5-2.5	...	0.30 max	...	...	...	...	remainder	...	...	...	...	99.5
C46400	59.0-62.0	0.20 max	0.50-1.0	0.10 max	...	...	...	...	remainder	...	...	...	...	99.6
C48200	59.0-62.0	0.40-1.0	0.50-1.0	0.10 max	...	...	...	...	remainder	...	...	...	...	99.6
C48500	59.0-62.0	1.3-2.2	0.50-1.0	0.10 max	...	...	...	...	remainder	...	...	...	...	99.6
C61900	remainder	0.02 max	0.6 max	3.0-4.5	...	8.5-10.0	...	...	0.8 max	...	...	...	...	99.5
C62300	remainder	...	0.6 max	2.0-4.0	1.0 max	8.5-10.0	0.25 max	0.50 max	...	...	...	...	...	99.5
C63000	remainder	...	0.20 max	2.0-4.0	4.0-5.5	9.0-11.0	0.25 max	1.5 max	0.30 max	...	...	...	...	99.5
C63200	remainder	0.02 max	...	3.5-4.3 ^E	4.0-4.8 ^E	8.7-9.5	0.10 max	1.2-2.0	...	...	...	...	...	99.5
C64200	remainder	0.05 max	0.20 max	0.30 max	0.25 max	6.3-7.6	1.5-2.2	0.10 max	0.50 max	...	...	...	0.15 max	99.5
C64210	remainder	0.05 max	0.20 max	0.30 max	0.25 max	6.3-7.0	1.5-2.0	0.10 max	0.50 max	...	...	...	0.15 max	99.5
C65500	remainder	0.05 max	...	0.8 max	0.6 max	...	2.8-3.8	0.50-1.3	1.5 max	...	...	...	...	99.5
C67500	57.0-60.0 ^A	0.20 max	0.50-1.5	0.8-2.0	...	0.25 max	...	0.05-0.50	remainder	...	...	...	...	99.5
C67600	57.0-60.0 ^A	0.50-1.0	0.50-1.5	0.40-1.3	...	...	...	0.05-0.50	remainder	...	...	...	...	99.5
C70620 ^F	86.5 min ^A	0.02 max	...	1.0-1.8	9.0-11.0	...	...	1.0 max	0.50 max	0.02 max	...	0.02 max	...	99.5
C71520 ^F	65.0 min ^A	0.02 max	...	0.40-1.0	29.0-33.0	...	...	1.0 max	0.50 max	0.02 max	...	0.02 max	...	99.5
C77400	43.0-47.0 ^A	0.20 max	...	...	9.0-11.0	...	...	...	remainder	...	...	...	...	99.5

^ASilver counts as copper.

^BIncludes oxygen-free or deoxidized grades with deoxidizers (such as phosphorus, boron, lithium, or others) in amount agreed upon.

^CThis includes copper + silver + tellurium.

^DThis includes copper + silver + sulfur + phosphorus.

^EIron content shall not exceed nickel content.

^FCarbon shall be 0.05 %.

“remainder,” copper or zinc is the difference between the sum of results determined and 100 %. When all elements in Table 1 for the specified copper-alloy are determined, the sum of results shall be as follows:

Copper Alloy UNS No.	Sum of Results, % min
C36500, C37000, C46400, C48200, C48500	99.6
C37700, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C67500, C67600, C70620, C71520, C77400	99.5

7. Temper

7.1 The standard tempers for products described in this specification are as follows:

- 7.1.1 H50—Extruded and drawn.
- 7.1.2 M20—As hot-rolled.
- 7.1.3 M30—As hot-extruded.

8. Mechanical Property Requirements

8.1 Mechanical properties, if any, are subject to agreement between the manufacturer and the purchaser.

9. Other Requirements

9.1 When specified in the contract or purchase order, products purchased for agencies of the U.S. Government shall conform to the special governmental regulations specified in the Supplementary Requirements sections of this specification and of B 249 or B 249M.

10. Dimensions, Mass, and Permissible Variations

10.1 Except for shapes, length, and straightness, the dimensions and tolerances for products produced under this specification shall be as prescribed in the section titled “Diameter or Distance Between Parallel Surfaces” in Specification B 249 or B 249M as follows:

10.1.1 *Diameter or Distance Between Parallel Surfaces:*

10.1.1.1 For M30 rod, Copper Alloy UNS Nos. C36500, C37000, C37700, C46400, C48200, C48500, C61900, C62300, C63000, C63200, C64200, C64210, C67500, C67600, C70620, and C71520, refer to Table 4.

10.1.1.2 For M30 rod, Copper UNS Nos. C11000, C14500, and C14700 and Copper Alloy UNS Nos. C65500 and C77400, refer to Table 5.

10.1.1.3 For M20, round rod, refer to Table 6.

10.1.1.4 For M30, bar, refer to Table 4 for width tolerances for Copper Alloy UNS Nos. C36500, C37000, C37700, C46400, C48200, C48500, C61900, C62300, C63000, C63200, C64200, C64210, C67500, C67600, C70620, and C71520.

10.1.1.5 For M30 bar refer to Table 5 for width tolerances for Copper UNS Nos. C11000, C14500, and C14700 and Copper Alloy UNS Nos. C65500 and C77400.

10.1.1.6 For H50 rod, refer to Table 1 for Copper UNS Nos. C11000, C14500, C14700, and Copper Alloy UNS Nos. C46400, C48200, and C48500.

10.1.1.7 For H50 rod, refer to Table 2 for Copper Alloy UNS Nos. C36500, C37000, C37700, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C67500, C67600, C70620, C71520, and C77400.

10.1.1.8 For H50 bar, refer to Tables 7 and 10 for Copper UNS Nos. C11000, C14500, and C14700.

10.1.1.9 For H50 bar, refer to Tables 8 and 10 for Copper Alloy UNS Nos. C46400, C48200, and C48500.

10.1.1.10 For H50, bar, refer to Tables 9 and 11 for Copper Alloy UNS Nos. C36500, C37000, C37700, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C67500, C67600, C70620, C71520, and C77400.

10.2 *Shapes*—The dimensional tolerances for shapes shall be agreed upon between the manufacturer and the purchaser and shall be specified in the order.

10.3 *Length*—Rod, bar, and shapes for forging, when ordered to any length, will be furnished in stock lengths, unless it is specifically stated in the purchase order that the lengths are to be specific.

10.3.1 Stock lengths for all rod, bar, and shapes for forging up to and including 1 in. (25 mm) in diameter shall be as listed in Table 2, but the weight of lengths less than the ordered length, shall not exceed 40 % of any one shipment. The tolerance for the full-length pieces shall be plus 1 in. (25 mm).

10.3.2 For rod and bar for forging over 1 in. (25 in.) up to and including 2 in. (50 mm) in diameter, the lengths shall be random lengths, from 4 to 12 ft (1.2 to 3.7 m).

10.3.3 Rod and bar for forging, over 2 in. (50 mm) in diameter shall be ordered in special lengths.

10.4 *Straightness*— The material shall be straight, within 1 in. (25 mm) maximum depth of arc in 6 ft (1.8 m).

11. Test Methods

11.1 *Chemical Analysis:*

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

Element	Range, %	Method
Aluminum	0.005–12	ISO No. 3110 (AA)
	6–12	E 478
Arsenic	0–0.15	E 62
Copper	43–99.9	E 478
Carbon		E 76
Iron	0.15–5	E 54, E 75 for CuNi
Lead	0.02–3	E 478 (AA)
Manganese	0.10–2.0	E 62, E 75 for CuNi
Nickel	0–5	E 478 (Photometric)
	>5	E 478 (Gravimetric)
Phosphorous	0.004–0.7	E 62
Silicon	0.10–4	E 62
Sulfur	0–0.5	E 76 (Gravimetric)
Tellurium	0.40–1	E 121
Tin	0.2–1.5	E 478 (Photometric)
Zinc	0.3–1.5	E 478 (AA)
	2–40	E 478 (Titrametric)

11.1.2 Test methods for the determination of elements resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer, or supplier, and the purchaser.

TABLE 2 Stock Lengths

Ordered Length		Shortest Permissible Length	
ft	m	ft	m
12	4	6	2
10	3	6	2
8	2	4	1
6	...	4	...

12. Keywords

12.1 brass forging shapes; brass forgings; bronze forging shapes; copper alloy forging rod; copper alloy forging bar; copper alloy forging shapes; copper forging rod; copper

forging bar; copper forging shapes; copper alloy forgings; copper forgings; hot forging stock; nickel silver forging shapes; nickel silver forgings; copper nickel forging rod; copper nickel forgings

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order for agencies of the U.S. Government.

S1. Supplementary requirements S1, S2, and S4 of Specification B 249 or B 249M shall apply.

S2. *Identification Marking*—Forging stock shall be marked with the producer's name or trademark, this ASTM specifica-

tion number, the UNS number, and the heat number or lot number. Marking shall be by low stress die stamps or vibro-etching.

APPENDIX

(Nonmandatory Information)

X1. FORGING PRACTICE

X1.1 The data in Table X1.1 do not constitute a part of this specification. The suggested forging temperatures give the range suitable for hot forging of the alloys and the forgeability

ratings illustrate the relative difference in ease of forging, with forging brass being the most readily forgeable. For the relative strength of these alloy forgings, as hot pressed, see Specification B 283, Appendix 2, Table 4.

TABLE X1.1 Forging Temperatures and Forgeability

Copper or Copper Alloy UNS No.	Name	Suggested Forging Temperatures		Forgeability Rating ⁴
		°F	K	
C11000	Copper	1400–1700	1030–1200	65
C14500	Copper-tellurium	1350–1650	1010–1170	65
C14700	Copper-sulfur	1400–1600	750–875	65
C36500	Leaded muntz metal, uninhibited	1200–1450	920–1060	100
C37000	Free-cutting muntz metal	1200–1450	920–1060	100
C37700	Forging brass	1200–1450	920–1060	100
C46400	Naval brass	1200–1500	920–1090	90
C48200	Medium leaded naval brass	1200–1500	920–1090	90
C48500	Leaded naval brass	1200–1500	920–1090	90
C61900	Aluminum bronze	1300–1600	980–1140	75
C62300	Aluminum bronze, 9 %	1300–1600	980–1140	75
C63000	Aluminum-nickel bronze	1450–1700	1060–1200	75
C63200	Aluminum-nickel bronze	1450–1700	1060–1200	75
C64200	Aluminum-silicon bronze	1300–1600	980–1140	75
C64210	Aluminum-silicon bronze, 6.7 %	1300–1600	980–1140	75
C65500	High-silicon bronze (A)	1300–1600	980–1140	40
C67500	Manganese bronze (A)	1350–1550	1010–1120	80
C67600	Leaded manganese bronze A	1350–1550	1010–1120	80
C70620	Copper-nickel 90–10	1550–1750	1120–1230	75
C71520	Copper-nickel 70–30	1700–1900	1030–1310	40
C77400	Nickel silver, 45–10	1300–1500	980–1090	85

⁴Relative forgeability rating takes into consideration such variable factors as pressure, die wear, and plasticity (hot). Since it is impracticable to reduce these variables to common units, calibration in terms of a percentage of the most generally used alloy, forging brass (100 %), is considered the most practical basis for such ratings. The values shown represent the general opinion and are intended for information to enable the designer to better understand the forging characteristics of these various alloys. Intricate parts are more likely to be available in alloys having a high rating.

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this specification since the last issue (B 124–99) that may impact the use of this standard.

- (1) Incorporated SI units and made into a dual standard.
- (2) Added alloys C37000 and C67600 throughout text.
- (3) Corrected alloy composition requirements for Copper UNS No. C14700.

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