Designation: ~~B124/B124M – 18a~~ B124/B124M – 19

Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes[1]

This standard is issued under the fixed designation B124/B124M; 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.

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.		Copper Alloy EN 1412 Nos.
~~C11000~~	~~C27450~~	~~C49350~~	~~CW612N~~
C11000	C27450	C49355	CW612N
~~C14500~~	~~C27451~~	~~C49355~~	~~CW617N~~
C14500	C27451	C49360	CW617N
~~C14700~~	~~C27453~~	~~C49360~~	
C14700	C27453	C61900	
	~~C28500~~	~~C61900~~	
	C28500	C62300	
	~~C35330~~	~~C62300~~	
	C35330	C63000	
	~~C36500~~	~~C63000~~	
	C36500	C63200	
	~~C37000~~	~~C63200~~	
	C37000	C64200	
	~~C37700~~	~~C64200~~	
	C37700	C64210	
	~~C46400~~	~~C64210~~	
	C46400	C65500	
	~~C46500~~	~~C65500~~	
	C46500	C65680	
	~~C46750~~	~~C65680~~	
	C46750	C67500	
	~~C48200~~	~~C67500~~	
	C48200	C67600	
	~~C48500~~	~~C67600~~	
	C48500	C69150	
	~~C48600~~	~~C69150~~	
	C48600	C69240	
	~~C48640~~	~~C69240~~	
	C48640	C69300	
	~~C49250~~	~~C69300~~	
	C49250	C69410	
	~~C49255~~	~~C69410~~	
	C49255	C69850	
	C49260	C70620	
	C49265	C71520	
	C49300	C77400	
	C49340	C87700	
	C49345	C87710	
	C49350		

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

NOTE 1—Additional information about forging practice and forgings produced from these alloys is given in Appendix X1 and in Specification B283/B283M.

1.2 *Units*—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~~are not ~~be~~necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the ~~other. Combining~~other, and values from the two systems ~~may result in non-conformance with the standard.~~shall not be combined.

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, health, and environmental practices and determine the applicability of regulatory requirements prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings
B283/B283M Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]
E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]
E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)[3]
E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]
E121 Test Methods for Chemical Analysis of Copper-Tellurium Alloys (Withdrawn 2010)[3]
E478 Test Methods for Chemical Analysis of Copper Alloys

2.2 *Other Standards:*

ASME Boiler and Pressure Vessel Code[4]
EN 1412 Copper and Copper Alloys—European Numbering System[5]
EN 12165 Copper and Copper Alloys—Wrought and Unwrought Forging Stock[5]
ISO 3110, Part 2 (TC 26 Ref. No. N 670 E/F) Determination of Aluminum Content: Flame Atomic Absorption Spectrometric Method[5]
JIS H 1068:2005 Methods for Determination of Bismuth in Copper and Copper Alloys[6] (Japanese Industrial Standards)

3. General Requirements

3.1 The following sections of Specification B249/B249M, as applicable, constitute 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 additional requirements that supplement those appearing in Specification B249/B249M.

[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.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[6] Available from Japanese Standards Association (JSA), Mita MT Bldg., 3-13-12 Mita, Minato-ku, Tokyo, 108-0073, Japan, http://www.jsa.or.jp.

4. Ordering Information

4.1 Include the following information when placing orders for products under this specification:
4.1.1 ASTM designation and year of issue (B124/B124M – XX), or EN 12165 and year of issue;
4.1.2 Copper or Copper-Alloy UNS No. designation, or EN 1412 No. designation;
4.1.3 Form (rod, bar, or shape) and size (Dimensions and Permissible Variations Section);
4.1.4 Permissible Variations (Dimensions and Permissible Variations Section);
4.1.5 Temper (Temper Section);
4.1.6 Length (Dimensions and Permissible Variations Section);
4.1.7 Quantity: total weight for each size and form;
4.1.8 If the product is purchased for agencies of the U.S. Government (see the Supplementary Requirements Section of this specification for additional requirements, if specified.).

4.2 The following options are available and, when required, should be specified at the time of placing of the order:
4.2.1 Mechanical Properties for Temper designated (Mechanical Properties Section),
4.2.2 Certification (Specification B249/B249M),
4.2.3 Test Report (Specification B249/B249M),
4.2.4 When product is ordered for ASME Boiler and Pressure Vessel Code Application (see Certification Section of Specification B249/B249M), and
4.2.5 Shapes; dimensional tolerances required and agreed upon (see 10.1.3).

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 as to be suitable for processing into the products prescribed herein.
5.1.2 In the event that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 2—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 product 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 properties specified.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements in Table 1 for the copper or copper alloy UNS No. or EN 1412 No. designation specified in the ordering information.
6.1.1 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and the purchaser, limits may be established and analysis required for unnamed elements.

6.2 For alloys in which either copper or zinc is listed as "remainder," copper or zinc is the difference between the sum of results of all elements 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 or EN 1412 No.	Sum of Results, % min
CW612N, CW617N	99.8
C36500, C37000, C46400, C46500, C48200, C48500, C48600, C69150	99.6
C27450, C27451, C27453, C35330, C37700, C46750, C48640, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, C49360, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C67500, C67600, C69240, C69300, C69410, C69850, C70620, C71520, C77400	99.5
C28500	99.1
C65680, C87700, C87710	99.2

TABLE 1 Chemical Requirements

Copper or Copper Alloy UNS or EN 1412 No.	Composition, %														
	Copper	Lead	Tin	Iron	Nickel (incl Co)	Aluminum	Silicon	Manganese	Zinc	Sulfur	Tellurium	Phos-phorus	Arsenic	Bismuth	Copper Plus Elements with Specific Limits Present, min
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	...	...	...
C27450	60.0–65.0	0.25 max	...	0.35 max	...	...	...	...	remainder	...	...	...	...	...	99.5
C27451	61.0–65.0	0.25 max	...	0.35 max	...	...	...	...	remainder	...	...	0.05–0.20	...	...	99.5
C27453	61.5–63.5	0.25 max	0.15 max	0.15 max	...	...	...	...	remainder	...	...	...	0.02–0.15	...	99.5
C28500	57.0–59.0	0.25 max	...	0.35 max	...	...	...	...	remainder	...	...	...	...	...	99.1
C35330	59.5–64.0	1.5–3.5	...	...	...	...	...	...	remainder	...	...	...	0.02–0.25	...	...
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
C46500	59.0–62.0	0.20 max	0.50–1.0	0.10 max	...	...	...	...	remainder	...	...	...	0.02–0.06	...	...
C46750[E]	59.2–62.5	0.25 max	1.00–1.80	0.10 max	0.50 max	...	...	...	remainder	...	...	0.05–0.15	...	...	99.5
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
C48600	59.0–62.0	1.0–2.5	0.30–1.5	...	...	...	...	...	remainder	...	...	...	0.02–0.25	...	...
C48640	59.0–62.0	1.5–3.0	0.50–2.0	0.40 max	0.3 max[F]	...	...	...	remainder	...	...	0.05–0.25	...	...	99.5
C49250[G]	58.0–61.0	0.09 max	0.30 max	0.50 max	...	...	...	...	remainder	...	...	...	...	1.8–2.4	99.5
C49255[H]	58.0–60.0	0.09 max	0.50 max	0.10 max	0.3 max[F]	...	0.10 max	...	remainder	...	...	0.10 max	...	1.7–2.9	99.5
C49260[I]	58.0–63.0	0.09 max	0.50 max	0.50 max	...	...	0.10 max	...	remainder	...	...	0.05–0.15	...	0.50–1.8	99.5
C49265[G]	58.0–62.0[A]	0.09–0.25	0.50 max	0.30 max	...	...	0.10 max	...	remainder	...	...	0.05–0.12	...	0.50–1.3	99.5
C49300[J]	58.0–62.0	0.09 max	1.0–1.8	0.10 max	0.3 max[F]	...	0.10 max	...	remainder	...	...	...	...	0.5–2.5	99.5
C49340[K]	60.0–63.0	0.09 max	0.50– 1.5	0.12 max	...	...	0.10 max	...	remainder	...	...	0.05–0.15	...	0.50–2.2	99.5
C49345[G]	60.0–64.0[A]	0.09–0.25	0.50–1.5	0.30 max	...	...	0.10 max	...	remainder	...	...	0.05–0.12	...	0.50–1.3	99.5
C49350[L]	61.0–63.0	0.09 max	1.5–3.0	0.12 max	...	...	0.30 max	...	remainder	...	...	0.04–0.15	...	0.50–2.5	99.5
C49355[M]	63.0–69.0	0.09 max	0.50–2.0	0.10 max	...	...	1.0–2.0	0.10 max	27.0–35.0	...	...	...	...	0.50–1.5	99.5
C49360	remainder	0.09 max	1.0–2.0	...	...	...	2.0–3.5	...	19.0–22.0	...	...	...	...	0.50–1.5	99.5
C61900	remainder[A]	0.02 max	0.6 max	3.0–4.5	...	8.5–10.0	...	...	0.8 max	...	...	...	...	...	99.5
C62300	remainder[A]	...	0.6 max	2.0–4.0	1.0 max	8.5–10.0	0.25 max	0.50 max	...	...	...	...	...	...	99.5
C63000	remainder[A]	...	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[A]	0.02 max	...	3.5–4.3[N]	4.0–4.8[N]	8.7–9.5	0.10 max	1.2–2.0	...	...	...	...	...	...	99.5
C64200	remainder[A]	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	...	...	...	0.09 max	...	99.5
C64210	remainder[A]	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	...	...	...	0.09 max	...	99.5
C65500	remainder[A]	0.05 max	...	0.8 max	0.6 max	...	2.8–3.8	0.50–1.3	1.5 max	...	...	...	...	...	99.5
~~C65680~~	~~remainder~~	~~0.09 max~~	~~0.30 max~~	~~0.30 max~~	~~0.10[F]~~	~~0.30 max~~	~~2.5–4.5~~	~~0.01–0.09~~	~~7.0–11.0~~	~~...~~	~~...~~	~~0.05–0.15~~	~~...~~	~~...~~	~~99.2~~
C65680	84.0 min	0.09 max	0.30 max	0.30 max	0.10[F]	0.30 max	2.5–4.5	0.01–0.09	7.0–11.0	...	...	0.05–0.15	...	...	99.2

TABLE 1 *Continued*

Copper or Copper Alloy UNS or EN 1412 No.	Composition, %														
	Copper	Lead	Tin	Iron	Nickel (incl Co)	Aluminum	Silicon	Manganese	Zinc	Sulfur	Tellurium	Phos-phorus	Arsenic	Bismuth	Copper Plus Elements with Specific Limits Present, min
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
C69150[A]	82.5–87.5	0.05 max	0.025 max	0.25 max	0.20 max	0.7–1.3	0.02 max	0.25–0.6	remainder	. . .	. . .	. . .	. . .	. . .	99.6
C69240	71.0–72.5	0.25 max	0.30 max	0.20 max	0.10–0.50	. . .	1.8–2.2	0.6–1.2	remainder	. . .	. . .	0.06–0.12	. . .	. . .	99.5
C69300	73.0–77.0[A]	0.09 max	0.20 max	0.10 max	0.10 max	. . .	2.7–3.4	0.10 max	remainder	. . .	. . .	0.04–0.15	. . .	. . .	99.5
C69410	81.0 min	0.09 max	. . .	0.20 max	. . .	. . .	3.5–4.5	. . .	11.0–15.0	. . .	. . .	. . .	. . .	. . .	99.5
C69850	67.5–69.0	0.09 max	0.20 max	0.10 max	0.10 max[F]	. . .	1.53–2.0	0.10 max	remainder	. . .	. . .	0.04–0.15	. . .	. . .	99.5
C70620[O]	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[O]	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]	0.09 max	. . .	. . .	9.0–11.0	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .	99.5
C87700[P]	87.5 min	0.09 max	2.0 max	0.50 max	0.25 max[F]	. . .	2.5–3.5	0.8 max	7.0–9.0	. . .	. . .	0.15 max	. . .	. . .	99.2
C87710[P]	84 min	0.09 max	2.0 max	0.50 max	0.25 max[F]	. . .	3.0–5.0	0.8 max	9.0–11.0	. . .	. . .	0.15 max	. . .	. . .	99.2
CW612N	59.0–60.0	1.6–2.5	0.3 max	0.3 max	0.3 max[F]	0.05 max	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .	99.8
CW617N	57.0–59.0	1.6–2.5	0.3 max	0.3 max	0.3 max[F]	0.05 max	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .	99.8

[A] Silver counts as copper.
[B] Includes oxygen-free or deoxidized grades with deoxidizers (such as phosphorus, boron, lithium, or others) in amount agreed upon.
[C] This includes copper + silver + tellurium + phosphorus.
[D] This includes copper + silver + sulfur + phosphorus.
[E] Includes antimony 0.05–0.15
[F] Not including Co.
[G] Includes cadmium 0.001 % max.
[H] Includes cadmium 0.0075 % max, selenium 0.02–0.07 %.
[I] Includes cadmium 0.001 % max.
[J] Includes cadmium 0.0075 % max, antimony 0.50 % max, and selenium 0.20 % max.
[K] Includes cadmium 0.001 % max.
[L] Includes antimony 0.02–0.10 %.
[M] Includes boron 0.001 % max.
[N] Iron content shall not exceed nickel content.
[O] Carbon shall be 0.05 % max.
[P] Antimony shall be 0.10 % max.

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 H80—Hard drawn.
7.1.3 M20—As hot-rolled.
7.1.4 M30—As hot-extruded.
7.1.5 060—Soft Annealed.
7.1.6 O61—Annealed.
7.1.7 O30—Hot Extruded and Annealed.
7.1.8 M—As-manufactured without specified mechanical properties (EN 12165).
7.1.9 H070—Minimum value of hardness requirement for the product with mandatory hardness requirements (EN 12165).
7.1.10 H080—Minimum value of hardness requirement for the product with mandatory hardness requirements (EN 12165).

8. Mechanical Property Requirements

8.1 Mechanical property requirements, if any, are to be established by agreement between the manufacturer and the purchaser.

9. Purchases for U.S. Government

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 Specification B249/B249M.

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B249/B249M with particular reference to the following tables and related paragraphs:
10.1.1 *Diameter or Distance Between Parallel Surfaces:*
10.1.1.1 For M30 rod, Copper Alloy UNS Nos. C27450, C27451, C27453, C28500, C35330, C36500, C37000, C37700, C46400, C46500, C46750, C48200, C48500, C48600, C48640, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, C49360, C61900, C62300, C63000, C63200, C64200, C64210, C67500, C67600, C69150, C69240, C69300, C69410, C69850, C70620, and C71520, refer to Table 4.
10.1.1.2 For M30 rod, Copper UNS Nos. C11000, C14500, C14700, C65500, C65680, C77400, C87700, and C87710, refer to Table 5.
10.1.1.3 For M20, round rod, refer to Table 6.
10.1.1.4 For H50 rod, refer to Table 1 for Copper UNS Nos. C11000, C14500, C14700, and Copper Alloy UNS Nos. C46400, C46500, C46750, C48200, C48500, C48640, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49360, and C69150.
10.1.1.5 For H50 rod, refer to Table 2 for Copper Alloy UNS Nos. C27450, C27451, C27453, C28500, C36500, C37000, C37700, C61900, C62300, C63000, C63200, C64200, C64210, C65500, C65680, C67500, C67600, C69240, C69300, C69410, C69850, C70620, C71520, C77400, C87700, and C87710.
10.1.2 *Width and Thickness:*
10.1.2.1 For M30 bar, refer to Table 4 for Copper Alloy UNS Nos. C27450, C27451, C27453, C28500, C35330, C36500, C37000, C37700, C46400, C46500, C46750, C48200, C48500, C48600, C48640, C49250, C49255, C49260, C49265, C49300, C49340, C49345, C49350, C49355, C49360, C61900, C62300, C63000, C63200, C64200, C64210, C67500, C67600, C69150, C69240, C69300, C69410, C69850, C70620, and C71520.
10.1.2.2 For M30 bar, refer to Table 5 for Copper UNS Nos. C11000, C14500, and C14700 and Copper Alloy UNS Nos. C65500, C65680, C77400, C87700, and C87710.
10.1.2.3 For H50 bar, refer to Tables 7 and 10 for Copper UNS Nos. C11000, C14500, and C14700.
10.1.2.4 For H50 bar, refer to Tables 8 and 10 for Copper Alloy UNS Nos. C35330, C46400, C46500, C48200, C48500, and C48600.

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	. . .