Designation: B283/B283M – 22

Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)[1]

This standard is issued under the fixed designation B283/B283M; 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 die forgings produced by the hot pressing method. The following copper and copper alloys are included:

Copper or Copper Alloy UNS No.	Name
C11000	copper
C14500	copper-tellurium
C14700	copper-sulfur
C27450	plumbing brass
C27451	plumbing brass
C27453	copper zinc alloy
C28500	copper-zinc brass
C35330	leaded brass
C36300	copper-zinc-lead
C36500	leaded Muntz metal
C37000	free-cutting Muntz metal
C37700	forging brass
C46400	naval brass
C46500	naval brass, arsenical
C46750	tin brass
C48200	medium leaded naval brass
C48500	leaded naval brass
C48600	naval brass
C48640	DZR brass
C48645	DZR tin brass
C49250	copper-zinc-bismuth alloy
C49255	copper-zinc-bismuth-nickel alloy
C49260	copper-zinc-bismuth alloy
C49265	copper-zinc-tin-bismuth, low leaded
C49300	copper-zinc-tin-bismuth alloy
C49340	copper-zinc-tin-bismuth alloy
C49345	copper-zinc-tin-bismuth, low leaded
C49350	copper-zinc-tin-bismuth alloy
C49355	bismuth brass
C61900	aluminum bronze
C62300	aluminum bronze, 9 %
C63000	aluminum-nickel bronze
C63200	aluminum-nickel bronze
C64200	aluminum-silicon bronze
C64210	aluminum-silicon bronze, 6.7 %
C65500	high-silicon bronze (A)
C65680	high-silicon bronze
C67500	manganese bronze (A)
C67600	. . .
C69300	copper-zinc-silicon
C69410	copper-zinc-silicon
C69850	copper-zinc-silicon
C70620	copper-nickel 90-10
C71520	copper-nickel 70-30
C77400	nickel silver, 45-10
C87700	silicon bronze
C87710	silicon bronze

Copper Alloy EN 1412 Nos.	Name
CW612N	forging brass
CW617N	forging brass

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 are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other and values from the two systems shall not be combined.

NOTE 1—Nominal composition and relative forgeability ratings are given in Appendix X1. Copper-nickel alloys C70620 and C71520 are intended for welded applications with seawater exposure.

NOTE 2—Guidelines for design and development of forgings are included in Appendix X2.

NOTE 3—Wrought product intended for hot forging is described in Specification B124/B124M.

1.3 The following safety caveat pertains only to Section 10 of this specification. *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 limitations 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]

B124/B124M Specification for Copper and Copper Alloy

[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.

Current edition approved Oct. 1, 2022. Published October 2022. Originally approved in 1953. Last previous edition approved in 2020 as B283/B283M–20. DOI: 10.1520/B0283_B0283M-22.

[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.

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

Forging Rod, Bar, and Shapes
B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings
B846 Terminology for Copper and Copper Alloys
E8/E8M Test Methods for Tension Testing of Metallic Materials
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]
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]
ISO 7602 Determination of Tellurium Content (High Content)—Flame Atomic Absorption Spectrometric Method[6]
JIS H 1068:2005 Method for Determination of Bismuth in Copper and Copper Alloys[7] (Japanese Industrial Standards)

2.3 *Military Standards:*[8]
MIL-STD-792 Identification Marking Requirements for Special Purpose Components
NAVSEA T9074-AS-GIB-010/271 Requirements for Nondestructive Testing Method

3. General Requirements

3.1 The following sections of Specification B249/B249M constitute 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 Reports;
3.1.13 Packaging and Package Marking; and
3.1.14 Supplementary Requirements.

3.1.15 In addition, when a section with a title identical to one of those referenced in 3.1, above, appears in this specification, it contains additional requirements that supplement those appearing in Specification B249/B249M.

4. Terminology

4.1 *Definitions:*
4.1.1 For definitions of terms related to copper and copper alloys, refer to Terminology B846.
4.2 *Definitions of Terms Specific to This Standard:*
4.2.1 *hot pressed forging, n*—a product made by pressing a heated blank or section of wrought or cast copper or copper alloy in a closed impression die.

5. Ordering Information

5.1 Include the following information when placing orders for products to this specification, as applicable:
5.1.1 ASTM designation and year of issue;
5.1.2 Copper or Copper Alloy UNS No. or EN 1412 No. designation (Scope);
5.1.3 Drawing showing the shape dimensions and tolerances (Dimensions and Permissible Variations);
5.1.4 Temper (as specified herein);
5.1.5 Quantity: total weight or number of pieces for each form, temper, and copper or copper alloy;
5.1.6 When product is purchased for agencies of the U.S. Government (as specified herein); and
5.1.7 When product must adhere to the requirements of *ASME Boiler and Pressure Vessel Code* (Mechanical Property Requirements).

5.2 The following requirements are optional and shall be specified in the contract or purchase order.
5.2.1 Certification (as specified herein and Supplementary Requirements),
5.2.2 Mill test report (as specified in Specification B249/B249M), and
5.2.3 Ultrasonic inspection report (Supplementary Requirements).

6. Materials and Manufacture

6.1 *Materials:*
6.1.1 The material of manufacture shall be a form of rods, billets, or blanks cut from cast or wrought material of one of the copper or copper alloys listed in the Scope of this specification and of such purity and soundness as to be suitable for processing into the products prescribed herein.
6.1.2 In the event heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 4—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify specific casting analysis with a specific quantity of finished material.

6.2 *Manufacture:*
6.2.1 The product shall be manufactured by hot pressing material between the upper and lower sections of a set of dies conforming to the configuration defined by the purchaser's submitted drawings.
6.2.2 Product of Copper Alloy UNS No. C63000 and C63200 shall be heat treated (as specified herein).

[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 EN Standard Store, Krimicka 134, 318 13 Pilsen, Czech Republic, https://www.en-standard.eu/.
[6] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[7] Available from Japanese Standards Association (JSA), Mita MT Bldg., 3-13-12 Mita, Minato-ku, Tokyo, 108-0073, Japan, http://www.jsa.or.jp.
[8] Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil/.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in Table 1 for the Copper or Copper Alloy UNS No. designation specified in the ordering information.

7.2 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and purchaser, limits may be established and analysis required for unnamed elements.

7.2.1 For alloys in which copper is listed as "remainder," copper is the difference between the sum of results of all elements determined and 100 %.

7.2.2 For alloys in which zinc is listed as "remainder," either copper or zinc may be taken as the difference between the sum of results of all other elements determined and 100 %.

7.3 When all the elements in Table 1 are determined for Copper Alloy C65680, the sum of results shall be 99.2 % min. When all elements in Table 1 are determined for Copper Alloy UNS Nos. C36500, C37000, C46400, C46500, C48200, C48500, C48600, the sum of results shall be 99.6 % min; for Copper Alloy UNS No. C28500, the sum of results shall be 99.1 % min; for EN 1412 Nos. CW612N and CW617N, the sum of the results shall be 99.8 % min; and for all other alloys, the sum of results shall be 99.5 % min.

8. Temper

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

8.1.1 As hot forged-air cooled M10,

8.1.2 Hot forged and annealed O20.

8.2 Alloys C70620 and C71520 shall be furnished in the following tempers:

8.2.1 As hot forged-air cooled M10, unless,

8.2.2 Hot forged and annealed O20 is specified.

8.3 Other tempers shall be subjected to agreement between the manufacturer and the purchaser.

9. Mechanical Property Requirements

9.1 Mechanical property requirements are subject to agreement between the manufacturer and the purchaser.

9.2 Product furnished to this specification for UNS Alloy No. C70620 and C71520 and specified to meet the requirements of the *ASME Boiler and Pressure Vessel Code* shall conform to the tensile requirements prescribed in Table 2, when tested in accordance with Test Methods E8/E8M.

9.2.1 Acceptance or rejection based upon mechanical properties for UNS Alloy No. C70620 and C71520 shall depend only on tensile strength.

10. Heat Treatment

10.1 Product produced from Copper Alloy UNS Nos. C63000 and C63200 shall be heat treated as follows:

10.1.1 Heat to 1550 °F [843 °C] minimum for 1 h minimum and quench in water or other suitable medium.

10.1.2 Temper Anneal at 1300 °F ± 25 °F [704 °C ± 14 °C] for 3 to 9 h as required to meet mechanical properties.

10.2 Heat treatment of other alloys, if needed, to be established by specific agreement between the supplier and purchaser.

11. Special Government Requirements

11.1 Product purchased for agencies of the U.S. Government shall conform to the additional requirements prescribed in the Supplementary Requirements section of this specification.

12. Dimensions, Mass, and Permissible Variations

12.1 The dimensions and tolerances for forgings shall be those agreed upon between the manufacturer and the purchaser, and such dimensions and tolerances shall be specified on the drawings which form a part of the contract or purchase order.

NOTE 5—Typical tolerances commonly used for forgings are shown in Table X2.1.

NOTE 6—Typical deviations for mismatch, flatness, ejector marks, flash projection, and die parting line are included in the Appendix X2.

13. Workmanship, Finish, and Appearance

13.1 The forging process gives to the forgings a surface condition related to the hot forging process itself. Ridges, indentations, folds, shocks from automatic hot forging, smooth flow lines due to brass rod slug positioning and material flow, that do not have deleterious effects in use, shall not be cause for rejection.

13.2 Customer-specific requirements for as-forged surface quality shall be by agreement between the purchaser and supplier.

14. Test Methods

14.1 *Chemical Analysis:*

14.1.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. The following table is a list of published methods, some of which may no longer be viable, which along with others not listed, may be used subject to agreement.

Element		ASTM Test Method
Aluminum		E478
Antimony		E62
Arsenic		E62
Bismuth		JIS H 1068:2005
Copper		E478
Iron	<1.3 %	E478, E75 for CuNi
	>1.3 %	E478, E75 for CuNi
Lead		E478 (AA)
Manganese		E62, E75 for CuNi
Nickel	<5 %	E478 (photometric)
	>5 %	E478 (gravimetric)
Phosphorus		E62
Silicon		E62 (perchloric acid)
Tin	<1.3 %	E478
	>1.3 %	E478
Zinc	<2 %	E478 (AA)
	>2 %	E478 (titrimetric)
Tellurium		ISO Test Method 7602

NOTE— < = less than: > = greater than

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	Phosphorus	Arsenic	Bismuth
C11000	99.90[A] min	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
C14500[B]	99.90[C] min	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.40–0.7	0.004–0.012[D]	. . .	. . .
C14700[B]	99.90[E] min	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.20–0.50	. . .	0.002–0.005[D]	. . .	. . .
C27450	60.0–65.0	0.25 max	. . .	0.35 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C27451	61.0–65.0	0.25 max	. . .	0.35 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	0.05–0.20	. . .	. . .
C27453	61.5–63.5	0.25 max	0.15 max	0.15 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	0.02–0.15	
C28500	57.0–59.0	0.25 max	. . .	0.35 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C35330	59.5–64.0	1.5–3.5	. . .	. . .	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	0.02–0.25	. . .
C36300	61.0–63.0	0.25–0.7	. . .	0.15 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	0.04–0.15	. . .	. . .
C36500	58.0–61.0	0.25–0.7	0.25 max	0.15 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C37000	59.0–62.0	0.8–1.5	. . .	0.15 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C37700	58.0–61.0	1.5–2.5	. . .	0.30 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C46400	59.0–62.0	0.20 max	0.50–1.0	0.10 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C46500	59.0–62.0	0.20 max	0.50–1.0	0.10 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	0.02–0.06	. . .
C46750[F]	59.2–62.5	0.25 max	1.00–1.80	0.10 max	0.50 max	. . .	. . .	. . .	remainder	. . .	. . .	0.05–0.15	. . .	. . .
C48200	59.0–62.0	0.40–1.0	0.50–1.0	0.10 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C48500	59.0–62.0	1.3–2.2	0.50–1.0	0.10 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
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[G]	. . .	. . .	. . .	remainder	. . .	. . .	0.05–0.25	. . .	. . .
C48645	60.0–63.0	1.0–2.5	0.10–1.5	0.30 max	0.10–1.0[G]	. . .	. . .	. . .	remainder	. . .	. . .	0.02–0.25	. . .	. . .
C49250[H]	58.0–61.0	0.09 max	0.30 max	0.50 max	. . .	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	1.8–2.4
C49255[I]	58.0–60.0	0.09 max	0.50 max	0.10 max	0.3 max[G]	. . .	0.10 max	. . .	remainder	. . .	. . .	0.10 max	. . .	1.7–2.9
C49260[H]	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
C49265[H]	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
C49300[J]	58.0–62.0	0.09 max	1.0–1.8	0.10 max	0.3 max[G]	. . .	0.10 max	. . .	remainder	. . .	. . .	. . .	. . .	0.5–2.5
C49340[H]	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
C49345[H]	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
C49350[K]	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
C49355[L]	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

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	Phosphorus	Arsenic	Bismuth
C61900	remainder	0.02 max	0.6 max	3.0–4.5[M]	. . .	8.5–10.00	. . .	. . .	0.8 max	. . .	. . .	. . .	. . .	. . .
C62300	remainder	. . .	0.6 max	2.0–4.0	1.0 max	8.5–10.0	0.25 max	0.50 max	. . .	. . .	. . .	. . .	. . .	. . .
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	. . .	. . .	. . .	. . .	. . .
C63200	remainder	0.02 max	. . .	3.5–4.3[N]	4.0–4.8	8.7–9.5	0.10 max	1.2–2.0	. . .	. . .	. . .	. . .	. . .	. . .
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	. . .	. . .	. . .	0.09 max	. . .
C64210	remainder	0.05 max	0.20 max	0.30 max	0.25 max	6.3–7.0	1.50–2.0	0.10 max	0.50 max	. . .	. . .	. . .	0.09 max	. . .
C65500	remainder	0.05 max	. . .	0.8 max	0.6 max	. . .	2.8–3.8	0.50–1.3	1.5 max	. . .	. . .	. . .	. . .	. . .
C65680	84.0 min	0.09 max	0.30 max	0.30 max	0.10 max[G]	0.30 max	2.5–4.5	0.01–0.09	7.0–11.0	. . .	. . .	0.05–0.15	. . .	. . .
C67500	57.0–60.0	0.20 max	0.50–1.5	0.8–2.0	. . .	0.25 max	. . .	0.05–0.50	remainder	. . .	. . .	. . .	. . .	. . .
C67600	57.0–60.0	0.50–1.0	0.50–1.5	0.40–1.3	. . .	. . .	. . .	0.05–0.50	remainder	. . .	. . .	. . .	. . .	. . .
C69300	73.0–77.0	0.09 max	0.20 max	0.10 max	0.10 max	. . .	2.7–3.4	0.10 max	remainder	. . .	. . .	0.04–0.15	. . .	. . .
C69410	81.0 min	0.09 max	. . .	0.20 max	. . .	. . .	3.5–4.5	. . .	11.0–15.0	. . .	. . .	. . .	. . .	. . .
C69850	67.5–69.0	0.09 max	0.20 max	0.10 max	0.10 max[G]	. . .	1.53–2.0	0.10 max	remainder	. . .	. . .	0.04–0.15	. . .	. . .
C70620[O]	86.5[A] min	0.02 max	. . .	1.0–1.8	9.0–11.0	. . .	. . .	1.0 max	0.50 max	0.02 max	. . .	0.02 max	. . .	. . .
C71520[O]	65.0[A] min	0.02 max	. . .	0.40–1.0	29.0–33.0	. . .	. . .	1.0 max	0.50 max	0.02 max	. . .	0.02 max	. . .	. . .
C77400	43.0–47.0	0.09 max	. . .	. . .	9.0–11.0	. . .	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
C87700[P]	87.5 min	0.09 max	2.0 max	0.50 max	0.25 max	. . .	2.5–3.5	0.8 max	7.0–9.0	. . .	. . .	0.15 max	. . .	. . .
C87710[P]	84.0 min	0.09 max	2.0 max	0.50 max	0.25 max	. . .	3.0–5.0	0.8 max	9.0–11.0	. . .	. . .	0.15 max	. . .	. . .
CW612N	59.0–60.0	1.6–2.5	0.3 max	0.3 max	0.3 max[G]	0.05 max	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .
CW617N	57.0–59.0	1.6–2.5	0.3 max	0.3 max	0.3 max[G]	0.05 max	. . .	. . .	remainder	. . .	. . .	. . .	. . .	. . .

[A] Silver counting 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 plus silver plus tellurium plus phosphorus.
[D] Other deoxidizers may be used as agreed upon, in which case phosphorus need not be present.
[E] This includes copper plus silver plus sulfur plus phosphorus.
[F] Includes antimony 0.05–0.15.
[G] Not including Co.
[H] Includes cadmium 0.001 % max.
[I] Includes cadmium 0.0075 % max, selenium 0.02–0.07.
[J] Includes cadmium 0.0075 % max, antimony 0.50 % max, and selenium 0.20 % max.
[K] Includes antimony 0.02–0.10 %.
[L] Includes Boron 0.001 % max.
[M] For boiler code application maximum iron content shall be 4.0 %.
[N] Iron content shall not exceed nickel content.
[O] Carbon shall be 0.05 % max.
[P] Antimony shall be 0.10 Max.

TABLE 2 Tensile Requirements

Diameter or Section Thickness, in. [mm]	Temper Designation Standard Former	Tensile Strength, min		Yield Strength at 0.5 % Extension Under Load, min		Elongation in 4 × Diameter or Thickness of Specimen, min, %
		ksi	[MPa][A]	ksi	[MPa][A]	
Copper Alloy UNS No. C27450, C27451						
All Sizes	M10 As Hot Forged-Air Cooled	50	[345]	18	[124]	25
Copper Alloy UNS No. C27453						
All Sizes	M10 As Hot Forged-Air Cooled	49	[340]	29	[200]	30
Copper Alloy UNS No. C28500						
All Sizes	M10 As Hot Forged-Air Cooled	58	[400]	24	[165]	20
Copper Alloy UNS Nos. C35330 and C37700 and EN 1412 Alloy Nos. CW612N and CW617N						
Up to 1½ [38.1], incl	M10 As Hot Forged-Air Cooled	50	[345]	18	[124]	25
Over 1½ [38.1]	M10 As Hot Forged-Air Cooled	46	[317]	15	[103]	30
Copper Alloy UNS No. C36300						
All sizes	M10 As Hot Forged-Air Cooled	50	[345]	18	[124]	25
Copper Alloy UNS No. C46400						
All sizes	M10 As Hot Forged-Air Cooled	52	[358]	22	[152]	25
Copper Alloy UNS No. C46500						
All sizes	M10 As Hot Forged-Air Cooled	63	[435]	30	[207]	40
Copper Alloy UNS No. C46750						
All sizes	M10 As Hot Forged-Air Cooled	45.7	[315]	22.0	[152]	15
	O20 Hot Forged and Annealed	45.7	[315]	22.0	[152]	15
Copper Alloy UNS Nos. C48200, C48500, C48600, C49250, C49255, C49260, C49265, and C49300						
All sizes	M10 As Hot Forged-Air Cooled	52	[358]	22	[152]	25
Copper Alloy UNS No. C48640, C48645						
	M10 As Hot Forged-Air Cooled	45.7	[315]	18	[124]	15
	O20 Hot Forged and Annealed	45.7	[315]	18	[124]	15
Copper Alloy UNS Nos. C49340, C49345, and C49350						
All sizes	M10 As Hot Forged-Air Cooled	50	[345]	20	[140]	20
Copper Alloy UNS No. C49355						
All Sizes	M10 As Hot Forged-Air Cooled	50	[345]	20	[140]	15
All Sizes	O20 Hot Forged and Annealed	50	[345]	20	[140]	15
Copper Alloy UNS No. C64200						
Up to 1½ [38.1], incl	M10 As Hot Forged-Air Cooled	70	[483]	25	[172]	30
Over 1½ [38.1]	M10 As Hot Forged-Air Cooled	68	[469]	23	[156]	35
Copper Alloy UNS No. C65680						
All Sizes	M10 As Hot Forged-Air Cooled	43.5	[300]	14.5	[100]	8
All Sizes	O20 Hot Forged and Annealed	29.0	[200]	11.6	[80]	15
Copper Alloy UNS No. C69300						
All sizes	M10 As Hot Forged-Air Cooled	65	[450]	26	[180]	15
Copper Alloy UNS No. C69850						
All sizes	M10 As Hot Forged-Air Cooled	55	[379]	22	[151]	15
Copper Alloy UNS No. C70620						
Up to 6 [152], incl	M10 As Hot Forged-Air Cooled	45	[310]	18	[124]	30
Over 6 [152]	M10 As Hot Forged-Air Cooled	40	[276]	15	[103]	30
All sizes	O20 Hot Forged and Annealed	40	[276]	15	[103]	30
Copper Alloy UNS No. C71520						
Up to 6 [152], incl	M10 As Hot Forged-Air Cooled	50	[345]	20	[138]	30
Over 6 [152]	M10 As Hot Forged-Air Cooled	45	[310]	18	[124]	30
All sizes	O20 Hot Forged and Annealed	45	[310]	18	[124]	30
Copper Alloy UNS No. C69410, C87700 and C87710						
All sizes	M10 as Hot Forged-Air Cooled	40	[310]	15	[103]	15

[A] See Appendix X5.

14.1.2 Test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and purchaser.

15. Certification

15.1 Certification to this specification is mandatory for product purchased for *ASME Boiler and Pressure Vessel* applications.

16. Keywords

16.1 copper and copper alloy die forgings (hot pressed); die forgings (hot pressed); EN 1412 No. CW612N; EN 1412 No. CW617N; UNS No. C11000; UNS No. C14500; UNS No. C14700; UNS No. C27450; UNS No. C27451; UNS No. C27453; UNS No. C28500; UNS No. C35330; UNS No. C36300; UNS No. C36500; UNS No. C37000; UNS No. C37700; UNS No. C46400; UNS No. C46500; UNS No. C46750; UNS No. C48200; UNS No. C48500; UNS No. C48600; UNS No. C48640; UNS No. C48645; UNS No. C49250; UNS No. C49255; UNS No. C49260; UNS No. C49265; UNS No. C49300; UNS No. C49340; UNS No. C49345; UNS No. C49350; UNS No. C49355; UNS No. C61900; UNS No. C62300; UNS No. C63000; UNS No. C63200; UNS No. C64200; UNS No. C64210; UNS No. C65500; UNS No. C65680; UNS No. C67500; UNS No. C67600; UNS No. C69300; UNS No. C69410; UNS No. C69850; UNS No. C70620; UNS No. C71520; UNS No. C77400; UNS No. C87700; UNS No. C87710

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 ASTM B249/B249M shall apply.

S2. **Identification Marking**—Individual forgings shall be marked with the producer's name or trademark, this ASTM specification number, the UNS number or the EN 1412 number, and the heat number or serial number. The method and location of marking shall be in accordance with MIL-STD-792. If approved by the purchaser, the forgings may be bundled or boxed and each bundle or box provided with a metal or oil-proof tag showing the above information.

S2.1 **Sampling**—The lot size, portion size, and selection of sample pieces shall be as follows:

1. *Lot Size*—For forgings weighing 250 lb [114 kg] or less, a lot shall be 2000 lb [909 kg] or less, and shall consist of forgings of the same design and alloy forged from the same material heat and heat treated at the same time. For forgings exceeding 250 lb [114 kg], each individual forging shall constitute a lot.

S2.2 *Portion Size*—For forgings less than 250 lb [114 kg], two forgings per lot shall be selected for tensile testing. Tensile tests shall be performed on each forging over 250 lb [114 kg].

S2.3 *Chemical Analysis*—If heat identification is required, one sample for chemical analysis shall be taken for each heat at the time of pouring or from semifinished or finished product.

S2.4 *Tensile Testing*—The tensile specimens shall be taken from integral forging prolongations or shall be removed from the forgings by trepanning. Alternatively, samples may be taken from separately forged test bars of the same heat as the forgings in the lot provided the wall thickness and amount of working for the test bar are equivalent to those for the forgings. The axis of the tensile specimen shall be located at any point midway between the center and the surface of solid forgings and at any point midway between the inner and outer surfaces of the wall of hollow forgings, and shall be parallel to the direction of greatest grain flow to the greatest extent possible.

S2.5 **Liquid Penetrant Inspection**—When specified by the purchaser, each piece of each lot shall be inspected in accordance with NAVSEA T9074-AS-GIB-101/271.

S2.6 **Ultrasonic Inspection**—When specified by the purchaser, each piece of each lot shall be inspected.

1. *General Requirements*—Ultrasonic testing shall be performed in accordance with NAVSEA T9074-AS-GIB-101/271. Acoustic compatibility between the production material and the calibration standard material shall be within 75 %. If the acoustic compatibility is within 25 %, no gain compensation is required for the examination. If the acoustic compatibility difference is between 25 % and 75 %, a change in the gain or dB controls shall be accomplished to compensate for the differences in acoustic compatibility. This method cannot be used if the ultrasonic noise level exceeds 50 % of the rejection value.

S3. *Calibration:*

S3.1 *Shear Wave*—The shear wave test shall be calibrated on two notches, one notch cut into the inside and one into the outside surface. The notches shall be cut axially and shall have a depth of 5 % of the material thickness or ¼ in. [6.4 mm], whichever is less. Notch length shall not exceed 1 in. [25.4 mm]. Notches shall be made either in the piece to be examined or in a separate defect-free specimen of the same size (within ±⅛ in. [3.2 mm]), shape, material, and condition, or acoustically similar material. The position and amplitude of the response from each notch shall be marked on the instrument screen or a transparent overlay, and these marks shall be used as the evaluation reference. Indications that appear between these points shall be evaluated on the basis of a straight line joining the two peak amplitudes.

S3.2 *Longitudinal Wave*—The longitudinal wave test shall be calibrated on a flat-bottomed reference hole of a given diameter in accordance with Table S5.1 for specified material thickness drilled either into the piece to be tested or into a separate defect-free specimen of the same size (within ±⅛ in. [3.2 mm]), shape, material, and condition or acoustically similar material. Holes are to be drilled to midsection and the bottom of the hole shall be parallel to the entrant surface. The ultrasonic test instrument shall be adjusted so that the response from the reference hole shall not be less than 25 % and not more than 75 % of screen height.

S3.3 *Recalibration*—During quality conformance inspection, any realignment of the search unit that will cause a decrease in the calibrated sensitivity and resolution, or both, or any change in search unit, couplant, instrument settings, or scanning speed from that used for calibration shall require recalibration. Recalibration shall be performed at least once per 8 h shift.

S4. *Procedure:*

S4.1 *Ring and Hollow Round Products*—Rings and other hollow cylindrical products shall be tested using the shear wave method by the contact or immersion technique. The shear wave entrant angle shall be such as to ensure reflection from the notch or notches used in calibration. For contact testing, the search unit shall be fitted with a wedge or shoe machined to fit the curvature of the piece being inspected. The product also shall be inspected with a longitudinal wave test from the external circumferential and end surfaces.

S4.2 *Disk or Pancake Forgings*—Disk or pancake forgings shall be inspected with a longitudinal wave technique from both parallel surfaces.

TABLE S5.1 Ultrasonic Testing Reference Hole for Rod, Bar, Disk Pancake Forgings, and Forgings

Material Thickness, in. [mm]	Hole Diameter, in. [mm]
Up to and including 6 [152]	⅛ [3.2]
Over 6 [152] and including 16 [406]	¼ [6.4]
Over 16 [406]	As agreed upon