



Designation: B 283 – 99a

## Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)<sup>1</sup>

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*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 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
C36500	leaded Muntz metal
C37700	forging brass
C46400	naval brass
C48200	medium leaded naval brass
C48500	leaded naval 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)
C67500	manganese bronze (A)
C67600	...
C70620	copper-nickel 90-10
C71520	copper-nickel 70-30
C77400	nickel silver, 45-10

1.2 The values stated in inch-pound units are the standard. The SI values in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

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.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

B 249 Specification for General Requirements for Wrought

Copper and Copper Alloy Rod, Bar, Shapes and Forgings<sup>2</sup>  
B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast<sup>2</sup>  
B 846 Terminology for Copper and Copper Alloys<sup>2</sup>  
E 8 Test Methods for Tension Testing of Metallic Materials<sup>3</sup>  
E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes<sup>4</sup>  
E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)<sup>4</sup>  
E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys<sup>4</sup>  
E 478 Test Methods for Chemical Analysis of Copper Alloys<sup>4</sup>

#### 2.2 ISO Standard:

7602 Determination of Tellurium Content (High Content)—Flame Atomic Absorption Spectrometric Method<sup>5</sup>

#### 2.3 Military Standards:

MIL-STD-792 Identification Marking Requirements for Special Purpose Components<sup>6</sup>  
NAVSEA T9074-AS-GIB-010/271 Requirements for Non-destructive Testing Method<sup>6</sup>

### 3. General Requirements

3.1 The following sections of Specification B 249 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 Reheating,
- 3.1.11 Certification,

<sup>2</sup> Annual Book of ASTM Standards, Vol 02.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 03.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 03.05.

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

<sup>6</sup> Available from DODSSP, Bldg. 4/Sec. D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

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

- 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 appears in this specification, it contains additional requirements that supplement those appearing in Specification B 249.

#### 4. Terminology

##### 4.1 Definitions:

4.1.1 For definitions of terms used in this specification, refer to Terminology B 846.

##### 4.2 Definition of Term Specific to This Standard:

4.2.1 *hot pressed forging, n*—a product made by pressing a heated blank or section of wrought copper or copper alloy in a closed impression die.

#### 5. Ordering Information

5.1 Orders for product produced to this specification shall include the following information:

5.1.1 ASTM designation and year of issue,

5.1.2 Copper or Copper Alloy UNS No. designation (Section 1.1),

5.1.3 Drawing showing the shape dimensions and tolerances (Section 11),

5.1.4 Temper (Section 8),

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 (Section 12), and

5.1.7 When product must adhere to the requirements of ASME Boiler and Pressure Vessel Code (Section 9).

5.2 The following requirements are optional and shall be specified in the contract or purchase order.

5.2.1 Certification (Section 14 and Supplementary Requirements),

5.2.2 Mill test report (Specification B 249), and

5.2.3 Ultrasonic inspection report (Supplementary Requirements).

#### 6. Material and Manufacture

##### 6.1 Materials:

6.1.1 The starting material shall be rods, billets, or blanks cut from cast or wrought material of one of the copper or copper alloys listed in 1.1 of this specification.

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

NOTE 2—Because of 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. C63200 shall be heat treated (Section 10).

#### 7. Chemical Composition

7.1 The materials shall conform to the requirements specified in Table 1 for the Copper or Copper Alloy UNS No. designated in the ordering information.

7.2 These composition limits do not preclude the presence of other elements. When limits for unnamed elements are required, they shall be established by agreement between manufacturer or supplier and the purchaser.

7.2.1 For copper alloys in which zinc is specified as a remainder, either copper or zinc is permitted to be taken as the difference between the sum of results for all the elements analyzed and 100 %. When copper is so determined, that difference value shall conform to the requirements given in Table 1.

7.2.2 For copper alloys for which copper is specified as the remainder, copper may be taken as the difference between the sum of all the elements analyzed and 100 %.

7.3 When all the elements in Table 1 are determined for the individual alloy, the sum of results shall be 99.6 % min for Copper Alloy UNS No. C36500, C46400, C48200, C48500 and 99.5 % for all others.

#### 8. Temper

8.1 Tempers, as defined in Practice B 601, available under this specification are M10 (as hot forged-air cooled), M11 (as forged-quenched), TQ50 (quench hardened and temper annealed), and O20 (hot forged and annealed).

8.2 Alloys C70620 and C71520 shall be furnished in the M10 temper unless the O20 temper is specified.

#### 9. Mechanical Property Requirements

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

9.2 Alloys C70620 and C71520 and product specified to meet the requirements of the *ASME Boiler and Pressure Vessel Code* shall have tensile properties as prescribed in Table 2 when tested in accordance with Test Methods E 8.

#### 10. Heat Treatment

10.1 Product produced from Copper Alloy UNS No. 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 at 1300+ and –25°F (704+ and –14°C) for 3 to 9 h as required to meet mechanical properties.

#### 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 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 3—Typical tolerances commonly used for forgings are shown in Table X2.1.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, %												
	Copper	Lead	Tin	Iron	Nickel (incl Co)	Aluminum	Silicon	Manganese	Zinc	Sulfur	Tellurium	Phosphorus	Arsenic
C11000	99.90 <sup>A</sup> min	...	...	...	...	...	...	...	...	...	...	...	...
C14500 <sup>B</sup>	99.90 <sup>C</sup> min	...	...	...	...	...	...	...	...	...	...	0.004–0.012 <sup>D</sup>	...
C14700 <sup>B</sup>	99.90 <sup>E</sup> min	...	...	...	...	...	...	...	0.20–0.50	0.40–0.7	...	0.002–0.005 <sup>D</sup>	...
C36500	58.0–61.0	0.25–0.7	0.25 max	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	...	...	...	...
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	...	...	...	...
C61900	remainder	0.02 max	0.6 max	3.0–4.5 <sup>F</sup>	...	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 <sup>G</sup>	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	...	...	...	0.15 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	...	...	...	0.15 max
C65500	remainder	0.05 max	...	0.8 max	0.6 max	6.3–7.0	2.8–3.8	0.50–1.3	1.5 max	...	...	...	...
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	0.50–1.0	0.40–1.3	...	...	...	0.05–0.50	remainder	...	...	...	...
C70620 <sup>H</sup>	86.5 <sup>A</sup> min	0.02 max	...	1.0–1.8	9.0–11.0	...	...	1.0 max	0.02 max	...	...	0.02 max	...
C71520 <sup>H</sup>	65.0 <sup>A</sup> min	0.02 max	...	0.40–1.0	29.0–33.0	...	...	1.0 max	0.02 max	...	...	0.02 max	...
C77400	43.0–47.0	0.20 max	...	...	9.0–11.0	...	...	...	remainder	...	...	...	...

<sup>A</sup>Silver counting as copper.  
<sup>B</sup>Includes oxygen-free or deoxidized grades with deoxidizers (such as phosphorus, boron, lithium, or others) in amount agreed upon.  
<sup>C</sup>This includes copper plus silver plus tellurium.  
<sup>D</sup>Other deoxidizers may be used as agreed upon, in which case phosphorus need not be present.  
<sup>E</sup>This includes copper plus silver plus sulfur plus phosphorus.  
<sup>F</sup>For boiler code application maximum iron content shall be 4.0 %.  
<sup>G</sup>Iron content shall not exceed nickel content.  
<sup>H</sup>Carbon shall be 0.05 % max.

**TABLE 2 Tensile Requirements**

Diameter or Section Thickness, in. (mm)	Tensile Strength, min		Yield Strength at 0.5 % Extension Under Load, min		Elongation in 4 × Diameter or Thickness of Specimen, min, %	
	ksi	MPa <sup>A</sup>	ksi	MPa <sup>A</sup>		
Copper Alloy UNS No. C37700						
Up to 1½ (38.1), incl	50	345	18	124	25	
Over 1½ (38.1)	46	317	15	103	30	
Copper Alloy UNS No. C64200						
Up to 1½ (38.1), incl	70	483	25	172	30	
Over 1½ (38.1)	68	469	23	156	35	
Copper Alloy UNS Nos. C46400, C48200 and C48500						
All sizes	52	358	22	152	25	
Copper Alloy UNS No. C70620						
Up to 6 (152.3), incl	M10 temper	45	310	18	124	30
Over 6 (152.3)	M10 temper	40	276	15	103	30
All sizes	O20 temper	40	276	15	103	30
Copper Alloy UNS No. C71520						
Up to 6 (152.3), incl	M10 temper	50	345	20	138	30
Over 6 (152.3)	M10 temper	45	310	18	124	30
All sizes	O20 temper	45	310	18	124	30

<sup>A</sup>See Appendix X3.

**13. Test Methods**

13.1 *Chemical Analysis:*

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

Element	ASTM Test Method
Aluminum	E 478
Arsenic	E 62
Copper	E 478
Iron	E 478, E 75 for CuNi
	E 54, E 75 for CuNi
Lead	E 478 (AA)
Manganese	E 62, E 75 for CuNi
Nickel	E 478 (photometric)
	E 478 (gravimetric)
Phosphorus	E 62
Silicon	E 54 (perchloric acid)
Tin	E 478
	E 54
Zinc	E 478 (AA)
	E 478 (titrimetric)
Tellurium	ISO Test Method 7602

NOTE—< = less than; > = greater than

13.1.2 Test method(s) to be followed for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon between the supplier and the purchaser.

Property	Rounded Unit for Observed or Calculated Value
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Chemical composition Tensile strength Yield strength Elongation	}	nearest unit in the last right-hand place of figures nearest ksi, nearest 5 MPa for over 10 to 100 ksi, incl nearest 1 %
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**14. Certification**

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

**15. Keywords**

15.1 copper and copper alloy die forgings (hot pressed); die forgings (hot pressed)