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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Copper-Beryllium Alloy Sand Castings for General Applications[1]

This standard is issued under the fixed designation B 770; 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 requirements for copper-beryllium alloy sand castings for general applications. Nominal compositions of the alloys defined by this specification are shown in Table 1.[2]

1.2 The values stated in inch-pound units are to be regarded as the standard. Metric values in parentheses are for information only.

2. Referenced Documents

2.1 The following documents in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

B 30 Specification for Copper-Base Alloys in Ingot Form[2]

B 208 Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal and Continuous Castings[3]

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast[3]

B 824 Specification for General Requirements for Copper Alloy Castings[3]

E 527 Practice for Numbering Metals and Alloys (UNS)[4]

3. Ordering Information

3.1 Orders for castings under this specification shall include the following information:

3.1.1 Quantity of castings required,

3.1.2 Copper alloy UNS number (Table 2) and temper (as-cast, heat treated, etc.) (Section 5),

3.1.3 Specification number, title, and year of issue,

3.1.4 Pattern or drawing number, and condition (cast, machined, etc.),

3.1.5 Chemical analysis of residual elements, if specified in the purchase order (Specification B 824),

3.1.6 Mechanical requirements, if specified in the purchase order (Section 6),

3.1.7 Pressure test requirements, if specified in the purchase order (Specification B 824),

3.1.8 Soundness requirements, if specified in the purchase order (Specification B 824),

3.1.9 Repair of castings (Section 8),

3.1.10 Certification, if specified in the purchase order (Specification B 824),

3.1.11 Foundry test report, if specified in the purchase order (Specification B 824),

3.1.12 Witness inspection, if specified in the purchase order (Specification B 824), and

3.1.13 Product marking, if specified in the purchase order (Specification B 824).

3.2 When material is purchased for agencies of the U.S. Government, the Supplementary Requirements of Specification B 824 may be specified.

4. Chemical Composition

4.1 The castings shall conform to the requirements shown in Table 2.

4.2 These specification limits do not preclude the presence of other elements. Limits may be established for unnamed elements by agreement between manufacturer or supplier and purchaser. Copper may be given as remainder and may be taken as the difference between the sum of all elements analyzed and 100 %. When all elements in Table 2 are analyzed, their sum shall be 99.5 % minimum.

4.3 It is recognized that residual elements may be present in cast copper-base alloys. Analysis shall be made for residual elements only when specified in the purchase order (Specification B 824).

5. Temper

5.1 The standard tempers are listed as follows:

5.1.1 *TF00*—Cast, solution heat treated and precipitation heat treated.

5.1.2 *M01*—As sand cast.

5.1.3 Special or non-standard tempers are subject to negotiation between the supplier and purchaser. Standard temper

[1] This practice is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.05 on Castings and Ingots for Remelting.

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[2] The UNS system for copper and copper alloys (see Practice E 527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00". The suffix can be used to accommodate composition variations of the base alloy.

[3] *Annual Book of ASTM Standards*, Vol 02.01.

[4] *Annual Book of ASTM Standards*, Vol 01.01.

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

TABLE 1 Nominal Compositions

Copper Alloy UNS No.	Previous Designation	Copper	Nickel	Silicon	Beryllium	Cobalt	Chromium	Iron	Zirconium	Tin	Manganese
C81400	70C	99.1	...	...	0.06	...	0.8	...	...	...	...
C82000	10C	97	...	...	0.5	2.5	...	...	...	...	...
C82200	3C, 14C	98	1.5	...	0.5	...	...	...	...	...	...
C82400[A]	165C, 165CT[A]	97.8	...	...	1.7	0.5	...	...	...	...	...
C82500[A]	20C, 20CT[A]	97.2	...	0.3	2.0	0.5	...	...	...	...	...
C82510	21C	96.6	...	0.3	2.0	1.1	...	...	...	...	...
C82600[A]	245C, 245CT[A]	96.8	...	0.3	2.4	0.5	...	...	...	...	...
C82800[A]	275C, 275CT[A]	96.6	...	0.3	2.6	0.5	...	...	...	...	...
C96700	72C	67.2	31.0	...	1.2	...	...	0.6	0.3	0.3	0.6

[A] When fine-grained castings are specified, 0.02 to 0.12 Ti is added for grain refinement, usually in the remelt ingot. See Specification B 30.

designations are in accordance with Practice B 601.

6. Mechanical Properties

6.1 Material furnished under this specification is not normally sold with mechanical requirements.

6.2 When tension tests are required, separately cast test bar castings shall be used to determine mechanical properties, and shall meet the requirements shown in Table 3 in the as cast, or solution heat-treated and precipitation heat-treated condition.

7. Precipitation Heat Treatment

7.1 For the purpose of determining conformance to the appropriate requirement in Table 3, the castings and test specimens shall be precipitation heat treated at a uniform temperature from the solution heat treated condition. Solution heat treatment and precipitation heat treatments are listed in Table 4. Other treatment times and temperatures may be preferable for end products made from this material.

7.2 Special combinations of properties such as increased ductility, electrical conductivity, dimensional accuracy, endurance life, may be obtained by special precipitation heat treatments. The mechanical requirements of Table 3 do not apply to such special heat treatments. Specific test requirements as needed shall be agreed upon between the manufacturer or supplier and purchaser of the end product.

8. Casting Repair

8.1 The castings shall not be weld repaired without approval of the purchaser (3.1.8).

8.2 The castings shall not be impregnated without approval of the purchaser (3.1.8).

9. General Requirements

9.1 Material furnished under this specification shall conform to the applicable requirements of Specification B 824.

10. Sampling

10.1 *Lot Size*:

10.1.1 A lot shall consist of all castings produced from one furnace melt or crucible melt.

10.1.2 When two or more furnace melts or crucible melts, or both, are used to charge a ladle for pouring, the castings produced therefrom shall constitute a lot.

10.1.3 A lot may consist of such groups of melts as agreed upon by the manufacturer and purchaser and in such case a lot shall consist of not more than 1000 lb (455 kg) of castings (gates and risers removed).

10.2 Test bar castings for the Copper Alloy UNS Nos. in this specification shall be cast to the form and dimensions shown in Figs. 1, Figs. 2, Figs. 3, or Figs. 4 in Practice B 208.

11. Keywords

11.1 copper alloy castings; copper-base alloy castings; copper beryllium castings

TABLE 2 Chemical Requirements[A]

Composition,% max, except as indicated																		
		Major Elements										Residual Elements						
Copper Alloy UNS No.	Copper,[B] min	Beryllium	Cobalt	Nickel	Iron	Silicon	Zirco-nium	Titanium	Chro-mium	Lead	Manga-nese	Iron	Silicon	Zinc	Chro-mium	Lead	Alu-mi-num	Tin
C81400	remainder	0.02–0.10	...	...	...	...	...	...	0.6–1.0	...	...	...	...	...	...	...	...	...
C82000	remainder	0.45–0.80	2.40–2.70	0.20	...	...	...	...	...	...	...	0.10	0.15	0.10	0.10	0.02	0.10	0.10
C82200	remainder	0.35–0.80	0.30	1.0–2.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...
C82400[C]	remainder	1.60–1.85	0.20–0.65	0.20	...	...	...	...	...	...	...	0.20	...	0.10	0.10	0.02	0.15	0.10
C82500[C]	remainder	1.90–2.25	0.35–0.70	0.20	...	0.20–0.35	...	...	...	...	...	0.25	...	0.10	0.10	0.02	0.15	0.10
C82510	remainder	1.90–2.15	1.0–1.2	0.20	...	0.20–0.35	...	...	...	...	...	0.25	...	0.10	0.10	0.02	0.15	0.10
C82600[C]	remainder	2.25–2.55	0.35–0.65	0.20	...	0.20–0.35	...	...	...	...	...	0.25	...	0.10	0.10	0.02	0.15	0.10
C82800[C]	remainder	2.50–2.85	0.35–0.70	0.20	...	0.20–0.35	...	...	...	...	...	0.25	...	0.10	0.10	0.02	0.15	0.10
C96700	remainder	1.10–1.40	...	29.0–33.0	0.40–1.0	0.15	0.15–0.35	0.15–0.35	...	0.01	0.40–1.0	...	...	...	...	...	...	...

[A] Analysis shall regularly be made only for the major elements. All others are considered residual elements, and if above the noted maximums, may influence performance of the casting, particularly in conductivity, magnetic permeability, and machinability.

[B] In reporting chemical analyses obtained by use of instruments such as spectrograph, X ray, and atomic absorption, copper may be indicated as “remainder”, and taken by difference.

[C] When fine grained castings are specified, 0.02–0.12 Ti is added for grain refinement, usually in the remelt ingot. See Specification B 30.

TABLE 3 Mechanical Requirements

NOTE 1—"TF00" property values denote product in the standard solution heat-treated and precipitation heat-treated condition.
NOTE 2—"M01" property values denote product in the as sand cast condition.

Copper Alloy UNS No.	Temper Designation	Tensile Strength, min		Yield Strength 0.2 % Offset		Elongation in 2 in., or 50 mm, min,%
		ksi[A]	MPa[B]	ksi[A]	MPa[B]	
C81400	TF00	53	366	36	248	11
C81400	M01	45	311	15	104	15
C82000	TF00	90	621	70	483	3
C82000	M01	45	311	15	104	15
C82200	TF00	90	621	70	483	5
C82200	M01	55	380	25	173	15
C82400	TF00	145	1001	135	932	1
C82400	M01	70	483	35	242	15
C82500	TF00	150	1035	120	828	1
C82500	M01	75	518	40	276	15
C82510	TF00	160	1104	150	1035	1
C82510	M01	80	552	45	311	10
C82600	TF00	165	1139	155	1070	1
C82600	M01	80	552	45	311	10
C82800	TF00	165	1139	155	1070	1/2
C96700	TF00	125	863	80	552	10

[A] ksi = 1000 psi.
[B] See Appendix.

TABLE 4 Thermal Treatments

NOTE 1—The values given for solution heat treatment, precipitation temperature, and heat treatment time are the same for UNS Nos. C82400, C82500, C82510, C82600, and C82800.

Copper Alloy UNS No.	Solution Heat Treatment		Precipitation Temperature	Heat Treatment Time, h
	Temperature	Time, h/in.		
C81400, C96700	1800–1850°F (982–1010°C)	1 h/in. of cross section and water quench	900–950°F (482–510°C)	2
C82000, C82200	1675-1700°F (913–927°C)	1 h/in. of cross section and water quench	850–900°F (454–482°C)	3
C82400, C82500, C82510, C82600, C82800	1400–1475°F (760–802°C)	1 h/in. of cross section and water quench	625–650°F (330–343°C)	3

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

This section identifies principle changes to this specification since the last issue.

1. Paragraph 1.1 was rewritten.

2. The entire specification was revised to comply with Specification B 824.