



Standard Specification for Copper-Base Alloy Centrifugal Castings¹

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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 requirements for centrifugal castings of copper-base alloys having the nominal compositions shown in Table 1.

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

2. Referenced Documents

2.1 The following documents in the current issue of the Book of Standards form a part of this specification to the extent referenced herein:

2.2 ASTM Standards:

B 208 Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings²

B 824 Specification for General Requirements for Copper Alloy Castings²

B 846 Terminology for Copper and Copper Alloys²

3. Terminology

3.1 Definitions of terms relating to copper alloys can be found in Terminology B 846.

4. Ordering Information

4.1 Orders for centrifugal castings under this specification should include the following information:

4.1.1 Specification title, number, and year of issue,

4.1.2 Quantity (length or number) of castings,

4.1.3 Copper Alloy UNS Number (Table 1) and temper (as-cast, heat-treated, etc.),

4.1.4 Dimensions or drawing number and condition (as-cast, machined, etc.),

4.1.5 ASME Boiler and Pressure Vessel Code requirements (Section 9),

4.1.6 When castings are purchased for agencies of the U.S. Government, the Supplementary Requirements in Specification B 824 may be specified.

4.2 The following are optional and should be specified in

the purchase order when required:

4.2.1 Chemical analysis of residual elements (Section 6.3),

4.2.2 Pressure test or soundness requirements (Specification B 824),

4.2.3 Approval of weld repair (Section 8),

4.2.4 Certification (Specification B 824),

4.2.5 Foundry test report (Specification B 824),

4.2.6 Witness inspection (Specification B 824),

4.2.7 Product marking (Specification B 824), and

4.2.8 Castings for seawater service (Section 5.2).

5. Materials and Manufacture

5.1 Castings in Copper Alloy UNS Nos. C95300, C95400, C95410, and C95500 may be supplied in the heat treated condition to obtain the higher mechanical properties shown in Table 2. Suggested heat treatments for these alloys and Copper Alloy UNS No. C95520 are given in Table 3. Actual practice may vary by manufacturer.

5.2 For better corrosion resistance in seawater applications, castings in Copper Alloy UNS No. C95800 shall be given a temper anneal heat treatment at $1250 \pm 50^\circ\text{F}$ ($675 \pm 10^\circ\text{C}$) for 6 h minimum. Cooling shall be by the fastest means possible that will not cause distortion or cracking which renders the castings unusable for the intended application.

5.3 Castings in Copper Alloy UNS No. C95900 are normally supplied annealed between 1100°F (595°C) and 1300°F (705°C) for 4 h followed by air cooling.

5.4 Castings in Copper Alloy UNS No. C95520 are used in the heat treated condition only.

6. Chemical Composition

6.1 The centrifugal castings shall conform to the chemical requirement shown in Table 4 for the Copper Alloy UNS Numbers specified in the purchase order.

6.2 These specification limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements agreed upon between the manufacturer or supplier and the purchaser. Copper or zinc may be given as remainder and may be taken as the difference between the sum of all elements analyzed and 100 %. When all named elements in Table 2 are analyzed, their sum shall be as specified in Table 5.

6.3 It is recognized that residual elements may be present in cast copper-base alloys. Analysis shall be made for residual

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² Annual Book of ASTM Standards, Vol 02.01.

TABLE 1 Nominal Compositions

Classification	Copper Alloy UNS No.	Commercial Designation	Copper	Tin	Lead	Zinc	Nickel	Iron	Alum- inum	Mang- anese	Silicon
Leaded red brass	C83600	85-5-5-5	85	5	5	5	...	...	...	...	...
	C83800	83-4-6-7 or commercial red brass	83	4	6	7	...	...	...	...	...
Leaded semi-red brass	C84400	81-3-7-9 or valve composition	81	3	7	9	...	...	...	...	...
	C84800	76-2½-6½-15 or semi-red brass	76	2½	6½	15	...	...	...	...	...
Leaded yellow brass	C85200	high copper yellow brass	72	1	3	24	...	...	...	...	...
	C85400	commercial No. 1 yellow brass	67	1	3	29	...	...	...	...	...
	C85700	leaded naval brass	61	1	1	37	...	...	...	...	...
High-strength yellow brass	C86200	high-strength manganese bronze	63	...	...	27	...	3	4	3	...
	C86300	high-strength manganese bronze	61	...	...	27	...	3	6	3	...
	C86400	leaded manganese bronze	58	1	1	38	...	1	½	½	...
	C86500	No. 1 manganese bronze	58	...	...	39	...	1	1	1	...
	C86700	leaded manganese bronze	58	1	1	34	...	2	2	2	...
Silicon bronze and silicon brass	C87300	silicon bronze	95	...	...	...	...	...	...	1	4
	C87400	silicon brass	82	...	½	14	...	...	...	...	3½
	C87500	silicon brass	82	...	...	14	...	...	...	...	4
	C87600	silicon bronze	89	...	...	6	...	...	...	...	5
Tin bronze and leaded tin bronze	C90300	88-8-0-4, or modified "G" bronze	88	8	...	4	...	...	...	...	...
	C90500	88-10-0-2, or "G" bronze	88	10	...	2	...	...	...	...	...
	C92200	88-6-2-4 or "M" bronze	88	6	2	4	...	...	...	...	...
	C92300	87-8-1-4, or Navy PC	87	8	1	4	...	...	...	...	...
High-lead tin bronze	C93200	83-7-7-3	83	7	7	3	...	...	...	...	...
	C93500	85-5-9-1	85	5	9	1	...	...	...	...	...
	C93600	81-7-12	81	7	12	...	...	...	...	...	...
	C93700	80-10-10	80	10	10	...	...	...	...	...	...
	C93800	78-7-15	78	7	15	...	...	...	...	...	...
	C94300	71-5-24	71	5	24	...	...	...	...	...	...
Aluminum bronze	C95200	Grade A	88	...	...	...	...	3	9	...	...
	C95300	Grade B	89	...	...	...	...	1	10	...	...
	C95400	Grade C	85	...	...	...	...	4	11	...	...
	C95410		84	...	...	...	2	4	10	...	...
	C95900		82.5	...	...	...	...	4.5	13	...	...
Nickel aluminum bronze	C95500	Grade D	81	...	...	...	4	4	11	...	...
	C95520		78.5	...	...	...	5.5	5.0	11	...	...
	C95800		81.3	...	...	...	4.5	4	9	1.2	...
Leaded nickel bronze	C97300	12 % leaded nickel silver	57	2	9	20	12	...	...	...	...
	C97600	20 % leaded nickel silver	64	4	4	8	20	...	...	...	...
	C97800	25 % leaded nickel silver	66	5	2	2	25	...	...	...	...

elements only when specified in the purchase order.

7. Mechanical Properties

7.1 Mechanical properties shall be determined from test bar castings cast in accordance with Practice B 208 and shall meet the requirements shown in Table 2.

8. Weld Repair

8.1 The castings shall not be weld repaired without customer approval.

9. ASME Requirements

9.1 When specified in the purchase order to meet *ASME Boiler and Pressure Vessel Code* requirements castings in Copper Alloy UNS Nos. C95200 and C95400 shall comply with the following:

9.1.1 Certification requirements of Specification B 824.

9.1.2 Foundry test report requirements of Specification B 824.

9.1.3 Castings shall be marked with the manufacturer's name, the Copper Alloy UNS No., and the casting quality factor. In addition, heat numbers or serial numbers that are traceable to heat numbers shall be marked on all pressure-containing castings individually weighing 50 lb (22.7 kg) or more. Pressure-containing castings weighing less than 50 lb (22.7 kg) shall be marked with either the heat number or a

serial number that will identify the casting as to the month in which it was poured. Marking shall be in such a position as to not injure the usefulness of the casting.

10. General Requirements

10.1 The following sections of Specification B 824 form a part of this specification. In the event of a conflict between this specification and Specification B 824, the requirements of this specification shall take precedence.

10.1.1 Terminology (Section 3),

10.1.2 Other Requirements (Section 6),

10.1.3 Dimensions, Mass, and Permissible Variations (Section 7),

10.1.4 Workmanship, Finish, and Appearance (Section 8),

10.1.5 Sampling (Section 9),

10.1.6 Number of Tests and Retests (Section 10),

10.1.7 Specimen Preparation (Section 11),

10.1.8 Test Methods (Section 12),

10.1.9 Significance of Numerical Limits (Section 13),

10.1.10 Inspection (Section 14),

10.1.11 Rejection and Rehearing (Section 15),

10.1.12 Certification (Section 16),

10.1.13 Test Report (Section 17),

10.1.14 Packaging and Package Marking (Section 19), and

10.1.15 Supplementary Requirements.

TABLE 2 Mechanical Requirements

Copper Alloy UNS No.	Tensile Strength, min		Yield Strength, ^A min		Elongation in 2 in. Or 50 mm, min, %	Brinell Hardness No. ^B (3000-kG Load), min
	ksi ^C	MPa ^D	ksi ^C	MPa ^D		
C83600	30	207	14	97	20	...
C83800	30	207	13	90	20	...
C84400	29	200	13	90	18	...
C84800	28	193	12	83	16	...
C85200	35	241	12	83	25	...
C85400	30	207	11	76	20	...
C85700	40	276	14	97	15	...
C86200	90	621	45	310	18	...
C86300	110	758	60	414	12	...
C86400	60	414	20	138	15	...
C86500	65	448	25	172	20	...
C86700	80	552	32	221	15	...
C87300	45	310	18	124	20	...
C87400	50	345	21	145	18	...
C87500	60	414	24	165	16	...
C87600	60	414	30	207	16	...
C87610	45	310	18	124	20	...
C90300	40	276	18	124	20	...
C90500	40	276	18	124	20	...
C92200	34	234	16	110	22	...
C92300	36	248	16	110	18	...
C93200	30	207	14	97	15	...
C93500	28	193	12	83	15	...
C93600	32	221	16	110	15	...
C93700	30	207	12	83	15	...
C93800	26	179	14	97	12	...
C94300	24	165	...	...	10	...
C95200	65	450	25	170	20	110
C95300	65	450	25	170	20	110
C95300(HT)	80	550	40	275	12	160
C95400	75	515	30	205	12	150
C95400(HT)	90	620	45	310	6	190
C95410	75	515	30	205	12	150
C95410(HT)	90	620	45	310	6	190
C95500	90	620	40	275	6	190
C95500(HT)	110	760	60	415	5	200
C95520(HT)	125	862	95 ^E	655 ^E	3	262
C95800 ^F	85	585	35	240	15	...
C95900	...	...	...	...	...	241 min
C97300	30	207	15	97	8	...
C97600	40	276	17	117	10	...
C97800	50	345	22	152	10	...

^A Yield strength shall be determined as the stress producing an elongation under load of 0.5 %, that is 0.01 in. (0.254 mm) in a gage length of 2 in. (50.8 mm).

^B For information only.

^C ksi – 1000 psi.

^D See Appendix.

^E Yield strength at 0.2 % offset.

^F As cast or temper annealed.

TABLE 3 Suggested Heat Treatments

Copper Alloy UNS No.	Solution Treatment (not less than 1 h followed by water quench)	Annealing Treatment (not less than 2 h followed by air cool)
C95300	1585–1635°F (860–890°C)	1150–1225°F (620–660°C)
C95400		
C95410	1600–1675°F (870–910°C)	1150–1225°F (620–660°C)
C95500		
C95520	(2 h followed by water quench) 1600–1700°F (870–925°C)	925–1000°F (495–540°C)

11. Sampling

11.1 Separate centrifugally cast test bars shall be made in accordance with Practice B 208.

11.2 At the manufacturer's option test bars may be removed from the casting instead of from a separately cast coupon.

11.3 Separately cast test bars representing castings in Copper Alloy UNS Nos. C95300HT, C95400HT, C95410HT, C95500HT, C95520HT, C95800 temper annealed, and C95900 annealed shall be heat treated with the castings.

12. Test Methods

12.1 Analytical chemical methods are given in Specification B 824.

12.1.1 Test methods to be followed 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.

12.2 Brinell hardness readings shall be taken on the grip end of the tension test bar and shall be made in accordance with Test Method E 10, with the exception that a 3000 kg load shall be used.

TABLE 4 Chemical Requirements

Composition, % max Except as Indicated

Copper Alloy UNS No.	Major Elements							Residual Elements									
	Copper	Tin	Lead	Zinc	Iron	Nickel incl Cobalt	Aluminum	Manganese	Silicon	Iron	Antimony	Nickel incl Cobalt	Sulfur	Phosphorus	Aluminum	Other	Silicon
C83600	84.0-86.0	4.0-6.0	4.0-6.0	4.0-6.0	...	1.0 ^A	...	...	...	0.30	0.25	...	0.08	0.05	0.005	...	0.005
C83800	82.0-83.8	3.3-4.2	5.0-7.0	5.0-8.0	...	1.0 ^A	...	...	...	0.30	0.25	...	0.08	0.03	0.005	...	0.005
C84400	78.0-82.0	2.3-3.5	6.0-8.0	7.0-10.0	...	1.0 ^A	...	...	...	0.40	0.25	...	0.08	0.02	0.005	...	0.005
C84800	75.0-77.0	2.0-3.0	5.5-7.0	13.0-17.0	...	1.0 ^A	...	...	...	0.40	0.25	...	0.08	0.02	0.005	...	0.005
C85200	70.0-74.0	0.7-2.0	1.5-3.8	20.0-27.0	...	...	...	...	...	0.6	0.20	1.0	0.05	0.02	0.005	...	0.05
C85400	65.0-70.0	0.50-1.5	1.5-3.8	24.0-32.0	...	...	...	...	...	0.7	...	1.0	...	...	0.35	...	0.05
C85700	58.0-64.0	0.50-1.5	0.8-1.5	32.0-40.0	...	...	...	...	...	0.7	...	1.0	...	...	0.55	...	0.05
C86200	60.0-66.0	0.20	0.20	22.0-28.0	2.0-4.0	...	3.0-4.9	2.5-5.0	...	...	...	1.0	...	...	...	...	...
C86300	60.0-66.0	0.20	0.20	22.0-28.0	2.0-4.0	...	5.0-7.5	2.5-5.0	...	...	...	1.0	...	...	...	...	...
C86400	56.0-62.0	0.50-1.5	0.50-1.5	34.0-42.0	0.40-2.0	...	0.50-1.5	0.10-1.0	...	...	...	1.0	...	...	...	...	...
C86500	55.0-60.0	1.0	0.40	36.0-42.0	0.40-2.0	...	0.50-1.5	0.10-1.5	...	...	...	1.0	...	...	...	...	...
C86700	55.0-60.0	1.5	0.50-1.5	30.0-38.0	1.0-3.0	...	1.0-3.0	1.0-3.5	...	...	...	1.0	...	...	...	...	...
C87300	94.0 min	...	0.20	0.25	...	...	...	0.8-1.5	3.5-5.0	0.20	...	...	...	...	0.80	...	...
C87400	79.0 min	...	1.0	12.0-16.0	...	...	...	...	2.5-4.0	...	...	...	...	...	0.50	...	...
C87500	79.0 min	...	0.50	12.0-16.0	...	...	...	...	3.0-5.0	...	...	...	...	...	...	...	...
C87600	88.0 min	...	0.50	4.0-7.0	...	...	...	...	3.5-5.5	...	...	...	...	...	...	...	...
C90300	86.0-89.0	7.5-9.0	0.30	3.0-5.0	...	1.0 ^A	...	...	...	0.20	0.20	...	0.05	0.05	0.005	...	0.005
C90500	86.0-89.0	9.0-11.0	0.30	1.0-3.0	...	1.0 ^A	...	...	...	0.20	0.20	...	0.05	0.05	0.005	...	0.005
C92200	86.0-90.0	5.5-6.5	1.0-2.0	3.0-5.0	...	1.0 ^A	...	...	...	0.25	0.25	...	0.05	0.05	0.005	...	0.005
C92300	85.0-89.0	7.5-9.0	0.30-1.0	2.5-5.0	...	1.0 ^A	...	...	...	0.25	0.25	...	0.05	0.05	0.005	...	0.005
C93200	81.0-85.0	6.3-7.5	6.0-8.0	2.0-4.0	...	1.0 ^A	...	...	...	0.20	0.35	...	0.08	0.15	0.005	...	0.005
C93500	83.0-86.0	4.3-6.0	8.0-10.0	2.0	...	1.0 ^A	...	...	...	0.20	0.30	...	0.08	0.05	0.005	...	0.005
C93600	79.0-83.0	6.0-8.0	11.0-13.0	1.0	...	1.0 ^A	...	...	...	0.20	0.55	...	0.08	0.15	0.005	...	0.005
C93700	78.0-82.0	9.0-11.0	8.0-11.0	0.8	...	1.0 ^A	...	...	...	0.15	0.50	...	0.08	0.15	0.005	...	0.005
C93800	75.0-79.0	6.3-7.5	13.0-16.0	0.8	...	1.0 ^A	...	...	...	0.15	0.80	...	0.08	0.05	0.005	...	0.005
C94300	67.0-72.0	4.5-6.0	23.0-27.0	0.8	...	1.0 ^A	...	...	...	0.15	0.80	...	0.08	0.05	0.005	...	0.005
C95200	86.0 min	...	...	...	2.5-4.0	...	8.5-9.5	...	...	...	...	...	...	...	...	...	...
C95300	86.0 min	...	...	...	0.8-1.5	...	9.0-11.0	...	...	...	...	...	...	...	...	...	...
C95400	83.0 min	...	...	...	3.0-5.0	1.5	10.0-11.5	0.50	...	...	...	...	...	...	...	...	...
C95410	83.0 min	...	...	...	3.0-5.0	1.5-2.5	10.0-11.5	0.50	...	...	...	...	...	...	...	...	...
C95500	78.0 min	...	...	...	3.0-5.5	3.0-5.5	10.0-11.5	3.5	...	...	...	...	...	...	...	...	...
C95520	74.5 min	...	...	...	4.0-5.5	4.2-6.0	10.5-11.5	1.5	...	...	...	...	...	...	...	CR 0.05 CO 0.20	0.15
C95800	79.0 min	...	...	...	3.5-4.5 ^B	4.0-5.0 ^B	8.5-9.5	0.80-1.5	...	...	...	...	...	...	...	SN 0.25	0.10
C95900	rem.	...	...	...	3.0-5.0	0.5	12.0-13.5	1.5	...	...	...	...	...	...	...	Pb 0.03	...
C97300	53.0-58.0	1.5-3.0	8.0-11.0	17.0-25.0	1.5	11.0-14.0	...	...	...	...	0.35	...	0.08	0.05	0.005	0.50	0.15
C97600	63.0-67.0	3.5-4.5	3.0-5.0	3.0-9.0	1.5	19.0-21.5	...	...	...	...	0.25	...	0.08	0.05	0.005	1.0	0.15
C97800	64.0-67.0	4.0-5.5	1.0-2.5	1.0-4.0	1.5	24.0-27.0	...	...	...	...	0.20	...	0.08	0.05	0.005	1.0	0.15

^A In determining copper minimum copper may be calculated as copper plus nickel.

^B Iron content shall not exceed nickel content.

13. Product Marking

13.1 When specified in the purchase order the castings shall be marked with the alloy number.

14. Keywords

14.1 centrifugal castings; copper alloy castings; copper-base alloy castings

TABLE 5 Sum of All Named Elements Analyzed

Copper Alloy UNS No.	Copper Plus Named Elements % min	Copper Alloy UNS No.	Copper Plus Named Elements % min
C83600	99.3	C92200	99.3
C83800	99.3	C92300	99.3
C84400	99.3	C93200	99.2
C84800	99.3	C93500	99.4
C85200	99.1	C93600	99.3
C85400	98.9	C93700	99.0
C85700	98.7	C93800	98.9
C86200	99.0	C94300	99.0
C86300	99.0	C95200	99.0
C86400	99.0	C95300	99.0
C86500	99.0	C95400	99.5
C86700	99.0	C95410	99.5
C87300	99.5	C95500	99.5
C87400	99.2	C95520	99.5
C87500	99.5	C95800	99.5
C87600	99.5	C95900	99.5
C90300	99.4	C97300	99.0
C90500	99.7	C97600	99.7
		C97800	99.6

SUMMARY OF CHANGES

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

- (1) Corrected the zinc range of Copper Alloy UNS No. C86400.

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