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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Copper-Base Alloy Continuous Castings[1]

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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 continuously cast rod, bar, tube, and shapes produced from copperbase alloys with nominal compositions as listed in Table 1.[2]

1.2 The values stated in inch-pound units are the standard. SI values given in parentheses are provided for information purposes 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 Castings[3]

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

E 8 Test Methods for Tension Testing of Metallic Materials[4]

E 10 Test Method for Brinell Hardness of Metallic Materials[4]

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[4]

E 527 Practice for Numbering Metals and Alloys (UNS)[5]

3. Ordering Information

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

3.1.1 Specification title, number, and year of issue,

3.1.2 Quantity, dimensions, and temper,

3.1.3 Copper Alloy UNS Number,

3.1.4 Tolerances, if different from Section 8 and Tables 2-8,

3.1.5 *ASME Boiler and Pressure Vessel Code*[6] requirements (Section 7),

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

3.2 The following requirements are optional and should be specified in the purchase order when required.

3.2.1 Chemical analysis of residual elements (Section 5),

3.2.2 Mechanical requirements, (Section 6),

3.2.3 Witness inspection (Specification B 824),

3.2.4 Certification (Specification B 824),

3.2.5 Foundry test report (Specification B 824),

3.2.6 Product marking (Specification B 824),

3.2.7 Castings for seawater service (Section 4),

3.2.8 Approval of weld repair and records of repair (Section 9).

4. Materials and Manufacture

4.1 For better corrosion resistance in sea water applications, castings in Copper Alloy C95800 shall be given a temperature anneal heat treatment at 1250 ± 50°F (675 ± 10°C) for 6 h minimum. Cooling shall be by the fastest means possible that will not cause excessive distortion or cracking. Propeller castings shall be exempt from this requirement.

4.2 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 9. Suggested heat treatments for these alloys and Copper Alloy UNS No. C95520 are given in Table 2. Actual practice may vary by manufacturer.

4.3 Copper Alloy UNS No. C95520 is used only in the quench-hardened and tempered (TQ30) condition.

4.4 Copper Alloy UNS No. C96900 is normally supplied heat treated at 1520°F (825°C) for 1 h followed by a water quench, then aged at 800°F (425°C) for 4 h followed by a water quench.

4.5 If test bar coupons representing castings made in Copper Alloy UNS Nos. C94700HT, C95300HT, C95400HT, C95410HT, C95500HT, C95520HT, C95800 temper annealed, C95900 annealed and C96900 are removed from the continuous castings before heat treatment, the coupons shall be heat

[1] This specification 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 03.01.

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

[6] Available from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th St., New York, NY 10017.

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

TABLE 1 Nominal Composition

Copper Alloy UNS No.	Designation	Composition, %							
		Copper	Tin	Lead	Zinc	Nickel	Aluminum	Iron	Manganese
C83600	leaded red brass	85	5	5	5	...	...	...	...
C83800	leaded red brass	83	4	6	7	...	...	...	...
C84200	leaded semi-red brass	80	5	2	13	...	...	...	...
C84400	leaded semi-red brass	81	3	7	9	...	...	...	...
C84800	leaded semi-red brass	76	3	6	15	...	...	...	...
C85700	leaded naval brass	61	1	1	37	...	...	...	...
C86200	high-strength yellow brass	66	...	...	23	...	5	3	3
C86300	high-strength yellow brass	62	...	...	26	...	6	3	3
C86500	high-strength yellow brass	58	...	...	39	...	1	1	1
C89320[A]	bismuth tin bronze	89	6	...	...	...	...	...	...
C90300	tin bronze	88	8	...	4	...	...	...	...
C90500	tin bronze	88	10	...	2	...	...	...	...
C90700	tin bronze	89	11	...	...	...	...	...	...
C91000	tin bronze	85	15	...	...	...	...	...	...
C91300	tin bronze	81	19	...	...	...	...	...	...
C92200	leaded tin bronze	88	6	2	4	...	...	...	...
C92300	leaded tin bronze	87	8	1	4	...	...	...	...
C92500	nickel-phosphor bronze	86.5	11	1	...	1.5	...	...	...
C92700	leaded tin bronze	88	10	2	...	...	...	...	...
C92800	leaded tin bronze	79	16	5	...	...	...	...	...
C92900	leaded nickel-tin bronze	84	10	2.5	...	3.5	...	...	...
C93200	high-leaded tin bronze	83	7	7	3	...	...	...	...
C93400	high-leaded tin bronze	84	8	8	...	...	...	...	...
C93500	high-leaded tin bronze	85	5	9	1	...	...	...	...
C93600	high-leaded tin bronze	81	7	12	...	...	...	...	...
C93700	high-leaded tin bronze	80	10	10	...	...	...	...	...
C93800	high-leaded tin bronze	78	7	15	...	...	...	...	...
C93900	high-leaded tin bronze	78	6	16	...	...	...	...	...
C94000	high-leaded tin bronze	72	13	15	...	...	...	...	...
C94100	high-leaded tin bronze	75	5	20	...	...	...	...	...
C94300	high-leaded tin bronze	70	5	25	...	...	...	...	...
C94700	nickel-tin bronze	88	5	0	2	5	...	...	...
C94800	leaded nickel-tin bronze	87	5	1	2	5	...	...	...
C95200	aluminum bronze	88	...	...	...	...	9	3	...
C95300	aluminum bronze	89	...	...	...	...	10	1	...
C95400	aluminum bronze	85	...	...	...	...	11	4	...
C95410	aluminum bronze	84	...	...	...	2	10	4	...
C95500	nickel-aluminum bronze	81	...	...	...	4	11	4	...
C95520	nickel-aluminum bronze	78.5	...	...	...	5.5	11	5.0	...
C95700	manganese nickel aluminum bronze	75	...	...	...	2	8	3	12
C95800	nickel-aluminum bronze	81.3	...	...	...	4.5	9	4	1.2
C95900	aluminum bronze	82.5	...	...	...	...	13	4.5	...
C96400	copper-nickel	70	...	...	...	30	...	...	...
C96900	copper-nickel	76.6	8	...	...	15	...	...	0.4
C97300	leaded nickel bronze	57	2	9	20	12	...	...	...
C97600	leaded nickel bronze	64	4	4	8	20	...	...	...
C97800	leaded nickel bronze	66	5	2	2	25	...	...	...
C99500[B]	special alloy	87	...	...	1.5	4.5	1.7	4.0	...

[A] Bismuth 5.0
[B] Silicon 1.3

TABLE 2 Suggested Heat Treatments

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

TABLE 3 Finishing Allowances for Tube (Round Only)

Finished Outside Diameter, in. (mm)	Finish Allowances Added to Finished or Print Dimensions of the Part, in. (mm)	
	Inside Diameter	Outside Diameter
All Alloys Except as Noted Below		
Up to 4 (102), excl	−0.031 (−0.79)	+ 0.031 (0.79)
4 (102)–5 (127), incl	−0.063 (−1.6)	+ 0.063 (1.6)
Over 5 (127)	−0.094 (−2.4)	+ 0.094 (2.4)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, and C96400		
Up to 3 (76.2), incl	−0.125 (−3.2)	+ 0.063 (1.6)
Over 3 (76.2)–4 (102), incl	−0.125 (−3.2)	+ 0.094 (2.4)
Over 4 (102)–5½ (140), incl	−0.188 (−4.8)	+ 0.125 (3.2)
Over 5½ (140)	−0.250 (−6.4)	+ 0.188 (4.8)

treated with the continuous castings.

5. Chemical Composition

5.1 The continuous castings shall conform to the requirements for major elements shown in Table 10.

5.2 These specification limits do not preclude the presence of other elements. Limits may be established and analysis

TABLE 4 Finishing Allowances for Rod and Bar

Finished Outside Diameter or Distance Between Parallel Surfaces, in. (mm)	Rounds	Squares, Rectangles, Hexagons, Octagons
All Alloys Except as Noted Below		
Up to 4 (102), excl	+ 0.031 (0.79)	+ 0.031 (0.79)
4 (102)–5 (127), incl	+ 0.063 (1.6)	+ 0.063 (1.6)
Over 5 (127)	+ 0.094 (2.4)	+ 0.094 (2.4)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, C96400		
Up to 3 (76.2), incl	+ 0.0625 (1.6)	+ 0.0625 (1.6)
Over 3 (76.2)–4 (102), incl	+ 0.093 (2.4)	+ 0.0625 (1.6)
Over 4 (102)–5½ (140), incl	+ 0.125 (3.2)	+ 0.0625 (1.6)
Over 5½ (140)	+ 0.188 (4.8)	+ 0.0625 (1.6)

TABLE 5 Diameter Tolerances for Rod and Bar

Diameter or Distance Between Parallel Surfaces, in. (mm)	Tolerances, Plus[A] and Minus,[A] in. (mm)	
	Rounds	Squares, Rectangles, Hexagons, Octagons
All Alloys Except as Noted Below		
Up to 4 (102), excl	0.005 (0.13)	0.016 (0.41)
4 (102)–5 (127), incl	0.008 (0.20)	0.016 (0.41)
Over 5 (127)	0.016 (0.41)	0.016 (0.41)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, and C96400		
Up to 3 (76.2), incl	0.010 (0.25)	0.020 (0.51)
Over 3 (76.2)–4 (102), incl	0.015 (0.38)	0.020 (0.51)
Over 4 (102)–5½ (140), incl	0.020 (0.51)	0.020 (0.51)
Over 5½ (140)	0.025 (0.64)	0.025 (0.64)

[A] When tolerances are specified as all plus or all minus, double the values given.

TABLE 6 Diameter Tolerances for Tube (Round Only)

Average Outside Diameter, in. (mm)	Tolerances, in. (mm)		
	Outside Diameter	Inside Diameter	
	Plus[A] or Minus[A]	Plus[B]	Minus[B]
All Alloys Except as Noted Below			
Up to 4 (102), excl	0.005 (0.13)	0.012 (0.30)	0.033 (0.84)
4 (102)–5 (127), incl	0.008 (0.20)	0.016 (0.41)	0.046 (1.2)
Over 5 (127)	0.016 (0.41)	0.032 (0.81)	0.064 (1.6)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, and C96400			
Up to 3 (76), incl	0.010 (0.25)	0.012 (0.32)	0.033 (0.84)
Over 3 (76)–4 (102), incl	0.015 (0.38)	0.015 (0.38)	0.050 (1.3)
Over 4 (102)–5½ (140), incl	0.020 (0.51)	0.025 (0.64)	0.070 (1.8)
Over 5½ (140)	0.025 (0.64)	0.035 (0.86)	0.090 (2.3)

[A] When tolerances are specified as all plus or all minus double the values given.
[B] When tolerances are specified as all plus or all minus, total the values given.

TABLE 7 Roundness Tolerances

Outside Diameter, in. (mm)	Maximum Out-of-Roundness,[A] in. (mm)
Up to 4 (102), excl	0.020 (0.51)
4 (102)–5 (127), incl	0.032 (0.81)
Over 5 (127)	0.064 (1.6)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, and C96400	
Up to 3 (76.2), incl	0.025 (0.64)
Over 3 (76.2)–4 (102), incl	0.040 (1.0)
Over 4 (102)–5½ (140), incl	0.060 (1.5)
Over 5½ (140)	0.075 (1.9)

[A] The deviation from roundness is measured as the difference between major and minor diameters as determined at any one cross section of the tube.

TABLE 8 Tolerances for Shapes

Outside Dimension,[A] in. (mm)		Inside Dimension,[B] in. (mm)	
All Alloys Except as Noted Below			
Plus	Minus	Plus	Minus
0.016 (0.41)	0.016 (0.41)	0.032 (0.81)	0.064 (1.6)
Copper Alloy UNS Nos. C86200, C86300, C86500, C95200, C95300, C95400, C95500, C95800, C95900, and C96400			
Dimensional tolerances for all other shapes (not covered by 4.1 or 4.2) shall be subject to agreement between purchaser and manufacturer.			

[A] When tolerances are specified as all plus or all minus, double the values given.
[B] When tolerances are specified as all plus or all minus, total the values given.

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 10 are analyzed, their sum shall be as specified in Table 11.

5.3 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.

6. Mechanical Properties

6.1 Reference should be made to Table 9 for minimum mechanical requirements.

6.2 Mechanical tests are required only when specified by the purchaser in the purchase order.

6.3 Exceptions to mechanical property requirements may be taken in the case of small diameter solids or castings having section thicknesses less than the ½-in. (12.7-mm) diameter nominal size of the standard tension test specimen. In these cases, mechanical property requirements shall be subject to agreement between the purchaser and the manufacturer. For suggested dimensions of subsize test bars see Test Methods E 8.

7. ASME Requirements

7.1 When specified in the purchase order to meet *ASME Boiler and Pressure Vessel Code* requirements, continuous castings shall comply with the following:

7.1.1 Certification requirements of Specification B 824.

7.1.2 Foundry test report requirements of Specification B 824.

7.1.3 Continuous 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 not to injure the usefulness of the casting.

7.1.4 When Copper Alloy UNS No. C95200 is specified to meet *ASME Boiler and Pressure Vessel Code* requirements a sample from each 2000-lb interval or continuous casting shall be tested. Each continuous casting from which the test bar was taken shall be identified should retesting be required. If all of the test bars from the initial sampling meet the requirements the lot shall be acceptable. The fractured bars shall be retained for chemical verification.