



Designation: B148 – 18

# Standard Specification for Aluminum-Bronze Sand Castings<sup>1</sup>

This standard is issued under the fixed designation B148; 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 ( $\epsilon$ ) 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 requirements for sand castings produced from copper-base alloys having the alloy numbers,<sup>2</sup> commercial designations, and nominal compositions shown in [Table 1](#).

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

2.2 *ASTM Standards:*<sup>3</sup>

[B208 Practice for Preparing Tension Test Specimens for Copper Alloy Sand, Permanent Mold, Centrifugal, and Continuous Castings](#)

[B824 Specification for General Requirements for Copper Alloy Castings](#)

[B846 Terminology for Copper and Copper Alloys](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E10 Test Method for Brinell Hardness of Metallic Materials](#)

[E18 Test Methods for Rockwell Hardness of Metallic Materials](#)

[E527 Practice for Numbering Metals and Alloys in the Unified Numbering System \(UNS\)](#)

## 3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology [B846](#).

## 4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification [B824](#).

## 5. Ordering Information

5.1 Include the following specified choices when placing orders for product under this specification as applicable:

5.1.1 ASTM designation and year of issue,

5.1.2 Copper or Copper Alloy UNS. No. designation,

5.1.3 Temper, must include optional Heat Treatment when needed,

5.1.4 Dimensions, diameter, and wall thickness (For tube or pipe: specify either O.D./I.D., O.D./Wall, or I.D./Wall unless standard size such as type K are ordered; for flat products: thickness, width, and edges; for rod, bar, or shapes: by diameter or distance between parallel surfaces),

5.1.5 Quantity of castings required,

5.1.6 Intended applications,

5.1.7 Specification title, number, and year of issue,

5.1.8 Pattern or drawing number and condition (cast, machined, and so forth),

5.1.9 Analysis of residual elements, if specified in the purchase order (Specification [B824](#)),

5.1.10 Pressure test requirements, if specified in the purchase order (Specification [B824](#)),

5.1.11 Soundness requirements, if specified in the purchase order (Specification [B824](#)),

5.1.12 Certification, if specified in the purchase order (Specification [B824](#)),

5.1.13 Test report, if specified in the purchase order (Specification [B824](#)),

5.1.14 Witness inspection, if specified in the purchase order (Specification [B824](#)),

<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 B05.05 on Castings and Ingots for Remelting.

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<sup>2</sup> The UNS system for copper and copper alloys (see Practice [E527](#)) 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.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

**TABLE 1 Nominal Compositions**

Copper Alloy UNS No.	Old Designation	Commercial Designation	Nominal Composition, %						
			Copper	Nickel	Iron	Aluminum	Silicon	Manganese	
C95200	9A	Grade A	88.0	...	3.0	9.0	...	...	
C95300 <sup>A</sup>	9B	Grade B	89.0	...	1.0	10.0	...	...	
C95400 <sup>A</sup>	9C	Grade C	85.0	...	4.0	11.0	...	...	
C95410 <sup>A</sup>	...	...	84.0	2.0	4.0	10.0	...	...	
C95500 <sup>A</sup>	9D	Grade D	81.0	4.0	4.0	11.0	...	...	
C95520 <sup>A</sup>	...	...	78.5	5.5	5.0	11.0	...	...	
C95600	9E	Grade E	91.0	...	...	7.0	2.0	...	
C95700	9F	Grade F	75.0	2.0	3.0	8.0	...	12.0	
C95800	...	...	81.3	4.5	4.0	9.0	...	1.2	
C95820	...	...	79.0	5.2	4.5	9.5	...	1.0	
C95900	...	...	87.5	...	4.5	13.0	...	...	

<sup>A</sup> These grades respond to heat treatment.

5.1.15 Approval of weld procedure and records of repairs, if specified in the purchase order (Section 10),

5.1.16 ASME Boiler and Pressure Vessel Code<sup>4</sup> application (12.2 and Section 14),

5.1.17 Castings for seawater service (6.2.3), and

5.1.18 Product marking, if specified in the purchase order (Specification B824).

5.2 When material is purchased for agencies of the U.S. Government, the Supplementary Requirements of this specification may be specified.

<sup>4</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

## 6. Materials and Manufacture

### 6.1 Materials:

6.1.1 The material of manufacture shall be sand castings of Copper Alloys, UNS No. C95200, C95300, C95400, C95410, C95500, C95520, C95600, C95700, C95800, C95820, C95900 of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.1.2 When specified in the contract or purchase order, that heat identification or traceability is required, the purchaser shall specify the details desired.

### 6.2 Manufacture:

6.2.1 As a specified option, Copper Alloy UNS Nos. C95300, C95400, C95410, C95500, and C95520 may be supplied in the heat-treated condition to obtain the higher

**TABLE 2 Mechanical Requirements**

Classification	Aluminum Bronze			Nickel Aluminum Bronze		Silicon Aluminum Bronze	Manganese-Nickel Aluminum Bronze	Nickel Aluminum Bronze	Aluminum Bronze
	As-Cast	As-Cast	As-Cast	As-Cast	As-Cast				
Copper Alloy UNS No.	C95200	C95300	C95400 and C95410	C95500	C95820	C95600	C95700	C95800 <sup>A</sup>	C95900 <sup>B</sup>
Tensile strength, min, ksi <sup>C</sup> (MPa <sup>D</sup> )	65 (450)	65 (450)	75 (515)	90 (620)	94 (650)	60 (415)	90 (620)	85 (585)	...
Yield strength, <sup>E</sup> min, ksi <sup>C</sup> (MPa <sup>D</sup> )	25 (170)	25 (170)	30 (205)	40 (275)	39 <sup>F</sup> (270) <sup>F</sup>	28 (195)	40 (275)	35 (240)	...
Elongation in 2 in. (50.8 mm), %	20	20	12	6	13	10	20	15	...
Brinell hardness No. <sup>G</sup> (3000-kg load)	110	110	150	190	...	...	...	...	...
Heat-Treated									
Copper Alloy UNS No.	...	C95300	C95400 and C95410	C95500	C95520 <sup>H</sup>	...	...	...	...
Tensile strength, min, ksi <sup>C</sup> (MPa <sup>D</sup> )	...	80 (550)	90 (620)	110 (760)	125 (862)	...	...	...	...
Yield strength, <sup>E</sup> min, ksi <sup>C</sup> (MPa <sup>D</sup> )	...	40 (275)	45 (310)	60 (415)	95 <sup>F</sup> (655) <sup>F</sup>	...	...	...	...
Elongation in 2 in. (50.8 mm), %	...	12	6	5	2	...	...	...	...
Brinell hardness No. <sup>G</sup> (3000-kg load)	...	160	190	200	255 <sup>I</sup>	...	...	...	241 min

<sup>A</sup> As cast or temper annealed.

<sup>B</sup> Normally supplied annealed between 1100 and 1300 °F for 4 h followed by air cooling.

<sup>C</sup> ksi = 1000 psi.

<sup>D</sup> See Appendix X1.

<sup>E</sup> 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).

<sup>F</sup> Yield strength at 0.2 % offset, min, ksi<sup>C</sup> (MPa<sup>D</sup>).

<sup>G</sup> For information only.

<sup>H</sup> Copper Alloy UNS No. C95520 is used in the heat-treated condition only.

<sup>I</sup> Sand castings and sand cast test specimens shall be 25 HRC minimum.

mechanical properties shown in [Table 2](#). Suggested heat treatments for these alloys are given in [Table 3](#). Actual practice may vary by manufacturer.

6.2.2 For better corrosion resistance in seawater applications, castings in Copper Alloy UNS No. C95800 may be given a temper anneal heat treatment at 1200 to 1300 °F (650 to 705 °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.

6.2.3 Copper Alloy UNS No. C95520 is used in the heat-treated condition only.

6.2.4 Copper Alloy UNS No. C95900 is normally supplied annealed between 1100 °F (595 °C) and 1300 °F (705 °C) followed by air cooling.

6.2.5 Copper Alloy UNS No. C95820 is supplied in the as-cast condition.

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

## 7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in [Table 4](#) for the copper alloy UNS. No. designation specified in the ordering information.

7.1.1 Results of analysis of the product sample shall conform to the composition requirements within the permitted analytical variance specified in [Table 4](#).

7.1.2 These composition limits do not preclude the presence of other elements. Limits may be established by agreement between manufacturer or supplier and purchaser for the unnamed elements.

7.1.3 For alloys in which Copper is listed as remainder, copper is the difference between the sum of results of all elements determined and 100 %. When all the elements in [Table 4](#) are determined, the sum of results shall be as specified in the following table:

**TABLE 3 Suggested Heat Treatments**

Copper Alloy UNS No.	Solution Treatment (Not Less than 1 h/in. 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)
C95800 <sup>A</sup>		1200–1300 °F (650–705 °C), 6 h minimum followed by air cooling

<sup>A</sup> Corrosion inhibiting heat treatment, depends on agreement between the manufacturer and buyer.

Copper Alloy UNS Number	Copper Plus Named Elements, min, %
C95200	99.0
C95300	99.0
C95400	99.5
C95410	99.5
C95500	99.5
C95520	99.5
C95600	99.0
C95700	99.5
C95800	99.5
C95820	99.2
C95900	99.5

## 8. Temper

8.1 The suggested heat treatment (tempers) for products described in this specification are given in [Table 3](#).

## 9. Mechanical Property Requirements

### 9.1 Tensile Strength Requirements:

9.1.1 The mechanical properties shall be determined from separately cast test bar castings.

9.1.2 Product furnished under this specification shall conform to the mechanical properties requirements specified in [Table 2](#), when tested in accordance with Test Methods [E8/E8M](#).

9.1.3 Acceptance or rejection based upon mechanical properties shall depend on tensile strength, yield strength, and elongation.

### 9.2 Hardness Requirement:

9.2.1 The approximate Brinell hardness values given in [Table 2](#) are for general information and assistance in testing, and shall not be used as a basis for product rejection.

## 10. Casting Repair

10.1 Alloys included in this specification are generally weldable. Weld repairs may be made at the manufacturer's discretion provided each excavation does not exceed 20 % of the casting section or wall thickness or 4 % of the casting surface area.

10.2 Excavations that exceed those described in [10.1](#) may be made at the manufacturer's discretion except that when required ([5.1.15](#)) the weld procedure shall be approved by the purchaser and the following records shall be maintained:

- 10.2.1 A sketch or drawing showing the dimensions, depth, and location of excavations,
- 10.2.2 Postweld heat treatment, when applicable,
- 10.2.3 Weld repair inspection results,
- 10.2.4 Casting identification number,
- 10.2.5 Weld procedure identification number,
- 10.2.6 Welder identification, and
- 10.2.7 Name of inspector.

10.3 The castings shall not be impregnated without approval of the purchaser.

## 11. Workmanship, Finish, and Appearance

11.1 The product shall be free of defects, but blemishes of a nature that do not interfere with the intended application are acceptable.