



Designation: B 824 – 04

## Standard Specification for General Requirements for Copper Alloy Castings<sup>1</sup>

This standard is issued under the fixed designation B 824; 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 Department of Defense.*

### 1. Scope\*

1.1 This specification establishes general requirements common to ASTM copper alloy casting specifications B 22, B 61, B 62, B 66, B 67, B 148, B 176, B 271, B 369, B 427, B 505, B 584, B 763, B 770, and B 806. These requirements apply to the casting specifications to the extent referenced therein.

1.1.1 In the event of conflict between this specification and a casting specification, the requirements of the casting specification shall take precedence.

1.2 The chemical composition and other requirements not included in this specification shall be prescribed in the casting product specifications.

1.3 *Units*—The values stated in inch-pound units are the standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and not considered standard.

1.4 No precise quantitative relationship can be stated between the properties of the metal in various locations of the same casting or between the properties of castings and those of a test bar casting from the same metal. (See Appendix X1.)<sup>2</sup>

### 2. Referenced Documents

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

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

- B 22 Specification for Bronze Castings for Bridges and Turntables
- B 61 Specification for Steam or Valve Bronze Castings
- B 62 Specification for Composition Bronze or Ounce Metal Castings

- B 66 Specification for Bronze Castings for Steam Locomotive Wearing Parts
- B 67 Specification for Car and Tender Journal Bearings, Lined<sup>4</sup>
- B 148 Specification for Aluminum-Bronze Sand Castings
- B 176 Specification for Copper-Alloy Die Castings<sup>4</sup>
- B 194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
- B 208 Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings
- B 271 Specification for Copper-Base Alloy Centrifugal Castings
- B 369 Specification for Copper-Nickel Alloy Castings
- B 427 Specification for Gear Bronze Alloy Castings
- B 505/B 505M Specification for Copper Alloy Continuous Castings
- B 584 Specification for Copper Alloy Sand Castings for General Applications
- B 763 Specification for Copper Alloy Sand Castings for Valve Application
- B 770 Specification for Copper-Beryllium Alloy Sand Castings for General Applications
- B 806 Specification for Copper Alloy Permanent Mold Castings for General Applications
- B 846 Terminology for Copper and Copper Alloys
- E 8 Test Methods for Tension Testing of Metallic Materials
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- 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)
- E 76 Test Methods for Chemical Analysis of Nickel-Copper Alloys<sup>4</sup>
- E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition
- E 478 Test Methods for Chemical Analysis of Copper Alloys

<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> For ASME Boiler and Pressure Vessel Code application see related specification in Section II of that code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Withdrawn.

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

**E 581** Test Methods for Chemical Analysis of Manganese-Copper Alloys

### 3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B 846**.

### 4. Materials and Manufacture

4.1 *Manufacture*—Mechanical properties of Copper Alloy UNS Nos. C94700, C95300, C95400, C95410, C95500, C95520, and C96800 can be changed by heat treatment. Suggested heat treatments are given in the casting specifications containing these alloys.

### 5. Chemical Composition

5.1 The casting material shall conform to the chemical requirements of the casting product specification involved.

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

### 6. Mechanical Property Requirements

6.1 When tension testing is required by the casting product specification, the results shall conform to the requirements of that specification, when tested in accordance with Test Methods **E 8**.

### 7. Other Requirements

7.1 *Hydrostatic Test*—When specified in the purchase order, a hydrostatic test shall be performed on the castings. The details of the test and acceptance criteria shall be established by agreement between the manufacturer and the purchaser.

7.2 *Soundness*—When specified in the purchase order, castings shall meet soundness requirements furnished or referenced by the purchaser. In the absence of standards for soundness, the requirement shall be as agreed upon between the manufacturer and the purchaser.

### 8. Dimensions, Mass, and Permissible Variations

8.1 The manufacturer shall be responsible for conforming to the dimensional requirements of the castings as related to the drawing when the pattern equipment is produced by the manufacturer.

8.2 When the pattern equipment is provided by the purchaser, the manufacturer shall be responsible for conforming to the dimensional requirements of the castings, but with any mutually agreed to exceptions relating to the provided pattern equipment.

8.3 Where thick and thin sections of the casting adjoin, the manufacturer shall be permitted to add fillets of adequate size, where not previously provided, subject to approval of the purchaser.

### 9. Workmanship, Finish, and Appearance

9.1 The surface of the casting shall be free of adhering sand, cracks, and hot tears. Other surface discontinuities shall meet visual acceptance standards agreed upon between the manufacturer and the purchaser.

## 10. Sampling

10.1 *Lot*—A lot shall consist of: (1) all of the metal poured from a single furnace or crucible melt, or (2) all the metal poured from two or more furnaces into a single ladle, or (3) all of the metal poured from a continuous melting furnace between charges, or (4) all of the metal poured from an individual melting furnace or group of melting furnaces having a uniform melting stock, operating during the course of one-half shift, not to exceed 5 h.

### 10.2 Chemical Analysis:

10.2.1 The sample for chemical analysis shall be taken in accordance with Practice **E 255** for product in the final form from the pieces selected in **10.1** and combined into one composite sample. The minimum weight of the composite sample shall be 150 g.

10.2.2 Instead of sampling as directed in **10.2.1**, the manufacturer shall have the option of sampling at the time castings are poured or from the semifinished product. When samples are taken during the course of manufacture, sampling of the finished product by the manufacturer is not required. The number of samples taken for the determination of composition shall be as follows:

10.2.2.1 When samples are taken at the time the castings are poured, at least one sample shall be taken for each group of castings poured from the same source of molten metal.

10.3 Tension-test bars used in meeting the requirements of **6.1** shall be separately cast for the sand, permanent mold, and centrifugal casting processes. The results represent the properties of the metal going into castings poured from the same heat. The mechanical properties may not be the same as the properties of the corresponding castings because of the solidification effects of varying size, section, and design. Test bars for continuous castings are taken from the castings and therefore represent the properties of the casting.

10.3.1 When the requirements of **6.1** have been complied with using separately cast test bars, additional tests may be performed using test bars removed from the casting with test bar location and mechanical properties agreed upon between the manufacturer and the purchaser. It should be noted that the minimum requirements, listed in applicable specifications, were obtained using data from separately cast coupons. Test specimens machined from castings may not achieve these results.

## 11. Number of Tests and Retests

### 11.1 Tests:

11.1.1 A chemical analysis of each element with a specified limiting value shall be made on each lot. Chemical analysis for residual elements is not required unless specified in the purchase order.

11.1.2 One tension test shall be performed on each lot.

11.1.3 Should the percent elongation of any tensile-test specimen be less than that specified and any part of the fracture is outside the middle two-thirds of the gage length or in a punched or scribed mark within the reduced section, the specimen may be discarded and replaced by another from the same lot.

11.1.4 If the result of any test fails to conform to the specified requirements, two retests shall be performed. If either retest fails to meet the specified requirements, the lot shall be rejected.

11.1.5 Should any of the properties be less than that specified and there is a discontinuity in the cross-sectional area of the fracture, the specimen may be discarded and replaced by another of the same lot.

**11.2 Retests:**

11.2.1 When requested by the manufacturer, a retest shall be permitted when test results obtained by the purchaser fail to conform to the casting specification requirements.

11.2.2 Retesting shall be as prescribed in the casting specification for the initial test, except the number of test specimens shall be twice that normally required for the test. Test results for all specimens shall comply with the casting specification requirements. Failure to comply shall be cause for rejection.

11.2.3 *Chemical Analysis*—If one or more of the elements with specified limits fail to meet the compositional requirement of the product specification when determined from the sample prepared in accordance with Practice E 255, one retest cycle shall be permitted with a second composite sample prepared in accordance with Practice E 255.

**12. Specimen Preparation**

12.1 The specimen for chemical analysis shall be taken from the lot in such a manner as to avoid contamination and be representative of the molten metal. Sample preparation shall be in accordance with Practice E 255. Analytical specimen preparation shall be the responsibility of the reporting laboratory.

12.2 Tension-test specimens shall be prepared in accordance with Practice B 208.

12.2.1 If any specimen is machined improperly or if flaws are revealed by machining or during testing, the specimen shall be discarded and replaced by another from the same lot.

**13. Test Methods**

**13.1 Chemical Composition:**

13.1.1 The chemical analysis methods used for the routine determination of specification compliance and preparation of test reports shall be at the discretion of the laboratory performing the analysis.

13.1.2 In case of disagreement on chemical composition, referee analytical methods for copper alloys other than copper-beryllium alloys (Specification B 770) are given in Table 1. Referee analytical methods for copper-beryllium alloys are given in the Annex of Specification B 194.

13.1.3 The determination of magnesium, niobium, zirconium, and titanium, for which no recognized test method is known to be published, shall be subject to agreement between the manufacturer and the purchaser.

13.1.4 Analytical methods for elements with ranges beyond those given in Table 1 shall be subject to agreement between the manufacturer and the purchaser.

13.1.5 Analytical methods for the determination of elements required by the purchase order agreement shall be as agreed upon between the manufacturer and the purchaser.

**13.2 Mechanical Properties:**

**TABLE 1 Referee Chemical Analytical Methods**

Element	Range or % max	Test Methods
Aluminum (Al)	0.005–13.5	E 478
Antimony (Sb)	0.05-0.70	E 62
Arsenic (As)	0.0-0.50	E 62
Carbon (C)	0.0-0.50	E 76
Copper (Cu)	50.0-99.75	E 478
Iron (Fe)	0.003-1.25	E 478
	0.0-5.0	E 54
Lead (Pb)	0.002-15.0	E 478;
	2.0-30.0	Atomic Absorption
		E 478; Titrimetric
Manganese (Mn)	0.10-12.0	E 62
	12.0-23.0	E 581
Nickel (Ni)	0.0-5.0	E 478; Photometric
(incl Cobalt (Co))		
Phosphorus (P)	0.01-1.0	E 62
Silicon (Si)	0.005-5.50	E 54;
		Perchloric Acid
		Dehydration
Sulfur (S)	0.05-0.08	E 76: Direct
		Combustion
Tin (Sn)	0.01-1.0	E 478; Photometric
	0.50-20.0	E 478; Titrimetric
Zinc (Zn)	0.02-2.0	E 478; Atomic
	2.0-40.0	Absorption
		E 478; Titrimetric

13.2.1 Tension testing shall be performed in accordance with Test Methods E 8.

**14. Significance of Numerical Limits**

14.1 For the purpose of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded as indicated in accordance with the rounding method of Practice E 29.

Property	Rounded Limit for Observed or Calculated Value
Chemical Composition	
Hardness	nearest unit in the last right-hand significance digit used in expressing the limiting value
Electrical Resistivity	
Electrical Conductivity	
Tensile Strength	nearest ksi (5 MPa)
Yield Strength	
Elongation	nearest 1 %
Grain Size:	
Under 0.060 mm	nearest multiple of 0.005 mm
0.060 mm and over	nearest 0.01 mm

**15. Inspection**

15.1 The manufacturer shall inspect and make tests necessary to verify that the product furnished conforms to the specified requirements.

15.2 The purchaser may have a representative inspect or witness the inspection and testing of the material prior to shipment. Such an arrangement shall be made by the purchaser and the manufacturer as part of the purchase order. When such inspection or witness of inspection and testing is agreed upon, the manufacturer shall afford the purchaser's representative all reasonable facilities necessary to confirm that the product meets the requirements of the purchase order. The purchaser's