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Standard Specification for General Requirements for Copper Alloy 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 general requirements common to ASTM copper alloy casting specifications B22, B61, B62, B66, B67, B148, B176, B271, B369, B427, B505/B505M, B584, B763, B770, and B806. 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 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.

1.4 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](#).)²

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*:³

B22 Specification for Bronze Castings for Bridges and Turntables

B61 Specification for Steam or Valve Bronze Castings

B62 Specification for Composition Bronze or Ounce Metal Castings

B66 Specification for Bronze Castings for Steam Locomotive Wearing Parts

B67 Specification for Car and Tender Journal Bearings, Lined

B148 Specification for Aluminum-Bronze Sand Castings

B176 Specification for Copper-Alloy Die Castings

B194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

B208 Practice for Preparing Tension Test Specimens for Copper Alloy Sand, Permanent Mold, Centrifugal, and Continuous Castings

B271 Specification for Copper-Base Alloy Centrifugal Castings

B369 Specification for Copper-Nickel Alloy Castings

B427 Specification for Gear Bronze Alloy Castings

B505/B505M Specification for Copper Alloy Continuous Castings

B584 Specification for Copper Alloy Sand Castings for General Applications

B763 Specification for Copper Alloy Sand Castings for Valve Applications

B770 Specification for Copper-Beryllium Alloy Sand Castings for General Applications

B806 Specification for Copper Alloy Permanent Mold Castings for General Applications

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)⁴

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁴

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)⁴

E255 Practice for Sampling Copper and Copper Alloys for

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² For *ASME Boiler and Pressure Vessel Code* application see related specification in Section II of that code.

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

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

the Determination of Chemical Composition
E478 Test Methods for Chemical Analysis of Copper Alloys
E581 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 B846.

3.2 *Definitions of Terms Specific to this Standard:*

3.2.1 *lot*—a collection of like final product (same alloy, temper, dimensions, as applicable) produced under the same or identical conditions from which samples were drawn for inspection or testing, or both.

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 E8/E8M.

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 Size*—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 E255 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 E255, one retest cycle shall be permitted with a second composite sample prepared in accordance with Practice E255.

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 E255. Analytical specimen preparation shall be the responsibility of the reporting laboratory.

12.2 Tension-test specimens shall be prepared in accordance with Practice B208.

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 B770) are given in Table 1. Referee analytical methods for copper-beryllium alloys are given in the Annex of Specification B194.

TABLE 1 Referee Chemical Analytical Methods

Element	Range or % max	Test Methods
Aluminum (Al)	0.005–13.5	E478
Antimony (Sb)	0.05-0.70	E62
Arsenic (As)	0.0-0.50	E62
Carbon (C)	0.0-0.50	E76
Copper (Cu)	50.0-99.75	E478
Iron (Fe)	0.003-1.25	E478
	0.0-5.0	E54
Lead (Pb)	0.002-15.0	E478;
	2.0-30.0	Atomic Absorption
		E478; Titrimetric
Manganese (Mn)	0.10-12.0	E62
	12.0-23.0	E581
Nickel (Ni)	0.0-5.0	E478; Photometric
(incl Cobalt (Co))		
Phosphorus (P)	0.01-1.0	E62
Silicon (Si)	0.005-5.50	E54;
		Perchloric Acid
		Dehydration
Sulfur (S)	0.05-0.08	E76; Direct
		Combustion
Tin (Sn)	0.01-1.0	E478; Photometric
	0.50-20.0	E478; Titrimetric
Zinc (Zn)	0.02-2.0	E478; Atomic
	2.0-40.0	Absorption
		E478; Titrimetric

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:*

13.2.1 Tension testing shall be performed in accordance with Test Methods E8/E8M.

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 E29.

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