



Designation: ~~B644-05~~ Designation: B644-11

Standard Specification for Copper Alloy Addition Agents¹

This standard is issued under the fixed designation B644; 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 (ϵ) 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 the requirements for copper nickel, ferro copper, phosphor copper, and silicon copper master alloys in ingot, shot, and waffle form to be used as addition agents for cast and wrought alloys.

~~1.2 The values~~ 1.2 *Units*—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.

2. Referenced Documents

2.1 *ASTM Standards:*²

B846 Terminology for Copper and Copper Alloys

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

E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes

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

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys

E478 Test Methods for Chemical Analysis of Copper Alloys

E1371 Test Method for Gravimetric Determination of Phosphorus in Phosphorus-Copper Alloys or Phosphorus-Copper-Silver Alloys

2.2 *ISO Standard:*

No. 4748 Determination of Iron Content; Na₂EDTA Titrimetric Method³

3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology B846.

4. Ordering Information

34.1 Include the following information when placing orders for product under this specification, as applicable:

34.1.1 ASTM designation and year of issue (for example B644 – XX).

34.1.2 Alloy number and letter; generic name (Table 1),

34.1.3 Form; size, weight, screen distribution,

34.1.4 Quantity or total weight; each form, size, weight, screen distribution.

4.5. Material and Manufacture

~~4.1~~

~~5.1~~ *Material—Any:*

~~5.1.1~~ Any material may be used which, when melted, will form an alloy of the required composition.

~~4.25.2~~ *Manufacture—Any:*

~~5.2.1~~ Any manufacturing process may be used that will yield a product uniform in composition and free of defects of a nature that would render the product unsuitable for the intended application.

¹ 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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² 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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

TABLE 1 Chemical Requirements

Element	Composition, max, % (unless shown as a range or minimum)								
	Copper-Nickel	Ferro Copper		Phosphor Copper		Silicon Copper			
	Alloy 1A	Alloy 2A	Alloy 2B	Alloy 3A	Alloy 3B	Alloy 4A	Alloy 4B	Alloy 4C	Alloy 4D
Copper, min	46.5	88.7	48.2						
Nickel (incl. cobalt)	48.0–51.0	0.10	0.10						
Silicon	0.05					9.0–11.0	13.5–16.5	18.5–21.5	28.5–31.5
Copper + silicon + iron						99.4 min	99.4 min	99.4 min	99.4 min
Phosphorus				14.0 min	8.0–8.8				
Phosphorus + copper				99.75 min	99.75 min				
Iron	1.20	9.0–11.0	48.5–51.5	0.15	0.15	0.50	0.50	0.50	0.50
Aluminum						0.25	0.25	0.25	0.25
Tin	0.10					0.25	0.25	0.25	0.25
Calcium						0.15	0.15	0.15	0.15
Carbon	0.05	0.05	0.05						
Sulfur	0.02								
Lead	0.05								
Zinc	0.10					0.10	0.10	0.10	0.10
Manganese	0.7	0.10	0.10						

5.6. Chemical Composition

5.6.1 The product in final form shall conform to the requirements prescribed in Table 1 for the specified alloy.

5.6.1.1 These specification 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.

6.7. Sampling

6.7.1 The inspection lot size, portion size, and selection of portion pieces shall be as follows:

6.7.1.1 *Lot Size*—An inspection lot shall consist of all product from a single heat.

6.7.1.2

7.1.2 *Portion Size*:

6.7.1.2.1

7.1.2.1 *Ingot and Shot*—The portion size shall be not less than 1 ingot.

6.7.1.2.2

7.1.2.2 *Shot and Waffle*—The portion size for product in shot or waffle form shall be not less than 1 lb (0.453 kg) and shall be selected to consist of an average of all sizes of product in the lot.

6.7.1.3

7.1.3 *Selection of Portion Pieces*—The individual pieces shall be randomly selected.

6.2

7.2 *Chemical Analysis*:

6.2.1 The 7.2.1 The sample for chemical analysis shall be taken from the pieces selected in 6.7.2.1.2 in accordance with Practice E255. The minimum weight of the composite sample shall be 150 g.

6.7.2.2 Instead of sampling in accordance with Practice E255, the manufacturer shall have the option of sampling during the pouring of the product. At least two samples shall be taken for each lot poured from the same source of molten metal.

6.7.2.2.1 When the manufacturer determines chemical composition during the course of manufacture, sampling of the finished product is not required.

7.8. Number of Tests and Retests

7.1

8.1 *Tests*:

7.1.1

8.1.1 *Chemical Analysis*—Composition shall be determined as the average of results from at least two replicate determinations for each element specified in Table 1 for the specified alloy.

7.2

8.2 *Retests*:

7.2.1

8.2.1 *Chemical Analysis*:

7.2.1.1 When requested by the manufacturer or supplier, a retest shall be permitted should test results obtained by the purchaser fail to conform with the requirements of Table 1 for the specified alloy.

7.2.1.2 The retest shall be as directed in 7.8.1 except the number of replicate determinations shall be twice that normally required by this specification. All determinations shall conform to specification requirements. Failure to comply shall be cause for lot rejection.

8.

9. Specimen Preparation

8.1

9.1 Chemical Composition—Preparation of the analytical specimen shall be the responsibility of the reporting laboratory.

9.

10. Test Methods

9.1.1 Test Methods used for quality control or production control, or both, for the determination of conformance to chemical compositional requirements are discretionary.

9.1.1.1 Test methods used for obtaining data for the preparation of certification or test report shall be made available to the purchaser on request.

9.2 Chemical Composition:

9.2.1 In case of disagreement, the test method to be followed for a specific element and concentration shall be as indicated in the following table:

Element	Range or Max %	Method
Aluminum	0.25	E478
Carbon	0.05	E76
Copper	99.75	E478
Iron	1.25	E478
	9.0–11.0	ISO 4748; Titrimetric
	48.5–51.5	ISO 4748; Titrimetric
Lead	0.05	E478; Atomic Absorption
Manganese	0.10–0.7	E62
Nickel	0.10	E478; Photometric
incl Cobalt	48–51	E76
Phosphorus	0.01–1.0	E62
	8.0–14.0	E1371
Silicon	0.05–32	E54; Perchloric Acid Dehydration
Sulfur	0.05–0.08	E76; Direct Combustion
Tin	0.01–1	E478 Photometric
Zinc	0.10	E478; Atomic Absorption

9.2.2 The determination of calcium and magnesium, for which no recognized test method is known to be published, shall be subject to agreement between the manufacturer or supplier and the purchaser.

9.2.3 Test method(s) for the determination of elements required by contractual or purchase order agreement shall be as agreed upon between the manufacturer and the purchaser.

10.11. Significance of Numerical Limits

10.11.1 For purposes of determining compliance with the specified limits for chemical composition an observed or calculated value shall be rounded as indicated in accordance with the Rounding method of Practice E29.

Property	Rounded Limit for Observed or Calculated Value
Property	Rounded Unit for Observed or Calculated Value
Chemical Composition	nearest unit in the last right hand significant digit used in expressing the limiting value
Chemical Composition	Nearest unit in the last right-hand significant digit used in expressing the limiting value

11. Inspection

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

12. Inspection

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

13. Rejection and Rehearing

12.1

13.1 Rejection:

12.1.1 Product which fails to conform to the requirements of this specification when inspected or tested by the purchaser or purchaser's agent may be rejected.

12.1.2 Rejection shall be reported to the manufacturer, or supplier, promptly and in writing.

12.1.3 When dissatisfied with test results upon which rejection was based, the manufacturer, or supplier, may make claim for a rehearing.