



Designation: B216 – 22

Standard Specification for Tough-Pitch Fire-Refined Copper—Refinery Shapes¹

This standard is issued under the fixed designation B216; 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.

1. Scope*

1.1 This specification establishes the requirements for tough-pitch fire-refined copper wire bars, cakes, slabs, and billets for fabricating into wrought products and ingot and ingot bars for use in the manufacture of copper and copper alloy castings. This copper is not intended for electrical purposes.

1.2 Copper under this specification corresponds to the designation “FRTP” (UNS C12500) as shown in Classification B224. This copper may also be used to produce other designations of copper where the chemical composition limits are not lower than those listed for C12500 in Table 1.

1.3 Although this specification includes certain UNS designations as described in Practice E527, these designations are for cross reference only and are not specification requirements. Therefore, in case of conflict, this ASTM specification shall govern.

1.4 *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.

1.5 The following safety hazard caveat pertains only to the test method described in the annex of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and to determine the applicability of regulatory limitations prior to use.*

1.6 *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.*

¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.07 on Refined Copper.

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2. Referenced Documents

2.1 *ASTM Standards*:²

B224 Classification of Coppers

B846 Terminology for Copper and Copper Alloys

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

E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry (Withdrawn 2022)³

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

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 Classification B224 and Terminology B846.

4. Ordering Information

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

4.1.1 ASTM designation and year of issue,

4.1.2 Shape and Size: wire bar, cake, slab, billet, ingot, or ingot bar, and

4.1.3 Quantity: total weight or number of pieces for each shape and size.

4.2 When material is purchased for the U.S. government, this shall be specified in the contract or purchase order, and the material shall conform to the supplementary requirements as defined herein.

4.3 The following options are available and, when required, shall be specified at the time of placing the order:

4.3.1 Certification (Section 16),

4.3.2 Test Report (Section 17).

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 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

TABLE 1 Chemical Requirements^A

Element	Composition, %
Copper (including silver), min	99.88
Arsenic, max	0.012
Antimony, max	0.003
Bismuth, max	0.003
Lead, max	0.004
Nickel, max	0.050
Selenium + Tellurium, max	0.025

^A Analytical variance is not incorporated into the specified limits. Refer to 10.1.

5. Materials

5.1 Any copper that will yield a product with a chemical composition conforming to the requirements of Table 1 may be used.

6. Chemical Composition

6.1 The product material shall conform to the chemical composition requirements in Table 1.

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

7. Dimensions, Mass, and Permissible Variations

7.1 A permissible variation of $\pm 5\%$ in weight and $\pm 1/4$ in. (6.35 mm) in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery; provided, however, that cakes may vary $\pm 3\%$ from the listed or specified size in any dimension greater than 8 in. (203.2 mm). The weight of copper in ingots and ingot bars shall not exceed that specified by more than 10%, but otherwise its variation is not important.

8. Workmanship, Finish, and Appearance

8.1 Shapes intended for fabrication shall be substantially free of shrink holes, cold sets, pits, sloppy edges, concave tops, and similar defects in set or casting. This requirement shall not apply to ingots or ingot bars, in which physical defects are of no consequence.

9. Sampling

9.1 For routine sampling, the sampling practice shall be at the discretion of the sampler.

9.2 In case of dispute the lot size, portion size, and selection of pieces shall be as follows:

9.2.1 *Lot Size*—An inspection lot shall consist of all pieces the same shape and size from the same production lot or fraction thereof.

9.2.2 *Portion Size*—The portion shall be four or more pieces randomly selected to be representative of the lot. Should the lot consist of less than five pieces, each piece shall be sampled.

9.3 Chemical Analysis:

9.3.1 In case of dispute the sample for chemical analysis shall be taken from the pieces selected in 9.2.2 and combined into one composite sample in accordance with Practice E255

for a product in its final form. The minimum weight of the composite sample shall be 150 g.

9.3.2 Instead of sampling in accordance with 9.2.2, the manufacturer shall have the option of taking samples at the time the castings are poured.

9.3.2.1 When composition of the material has been determined during the course of manufacture, sampling of the finished product by the manufacturer is not required.

9.3.3 The number of samples to be taken for determination of chemical composition shall be as follows:

9.3.3.1 When sampled at the time the castings are poured, at least two samples, one soon after the start of the pour and one near the end of the pour, shall be taken for each group of castings poured from the same source of molten metal.

10. Number of Tests and Retests

10.1 *Tests*—The chemical composition shall be determined as the average of results obtained from at least two replicate analyses for each specified element.

10.2 Retests:

10.2.1 When requested by the manufacturer or supplier, a retest shall be permitted when test results obtained by the purchaser fail to conform with the product specification requirement(s).

10.2.2 Retesting shall be as directed in the product specification for the initial test except for the number of test specimens which shall be twice that required for the original test. Test results for all specimens shall conform to the product specification requirement(s) in retest and failure to comply shall be cause for lot rejection.

11. Specimen Preparation

11.1 The preparation of the analytical specimen is the responsibility of the reporting laboratory.

12. Test Methods

12.1 For routine analysis, the method of analysis shall be at the discretion of the reporting laboratory.

12.2 In case of dispute concerning copper content, the method of analysis shall be in accordance with Test Method E53.

12.3 In case of dispute concerning antimony, arsenic, bismuth, lead, nickel, selenium, or tellurium content, the method of analysis shall be by electrothermal atomization atomic absorption spectrometry as described in the Annex.

12.4 Test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and the purchaser.

13. Significance of Numerical Limits

13.1 Calculated values shall be rounded to the nearest unit in the last right-hand significant digit used in expressing the limiting value in accordance with the rounding method in Practice E29.

14. Inspection

14.1 The manufacturer or supplier shall inspect and make tests necessary to verify the furnished product conforms to the specification requirements.

15. Rejection and Rehearing

15.1 Rejection:

15.1.1 Product that fails to conform to the specification requirements when tested by the purchaser or purchaser's agent shall be subject to rejection.

15.1.2 Rejection shall be reported to the manufacturer or supplier promptly. In addition, a written notification of rejection shall follow.

15.1.3 In case of dissatisfaction with results of the test upon which rejection was based, the manufacturer or supplier shall have the option to make claim for a rehearing.

15.2 *Rehearing*—As a result of product rejection, the manufacturer or supplier shall have the option to make claim for a retest to be conducted by the manufacturer or supplier and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and subjected to test by both parties using the test method(s) specified in the product specification, or, alternatively, upon agreement by both parties, an independent laboratory may be selected for the tests using the test method(s) specified in the product specification.

16. Certification

16.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples repre-

senting each lot have been tested and inspected as directed in this product specification and requirements have been met.

17. Test Report

17.1 When specified in the contract or purchase order, a report of test results shall be furnished.

18. Product Marking

18.1 All shapes intended for fabrication shall be identified with the producer's brand, furnace charge, or other identifying number.

18.2 Ingots and ingot bars shall have a brand identification but need have no other number.

19. Packaging and Package Marking

19.1 Packaging:

19.1.1 The product shall be separated by size and composition and prepared for shipment by common carrier in such a manner to afford protection from the normal hazards of transportation.

19.2 Package Marking:

19.2.1 Each package shall be legibly marked with the metal or alloy designation, size, shape, gross and net weight, and name of supplier. Upon agreement between the purchaser and supplier, the purchase order number shall be indicated on each package or on the shipping documents.

19.2.2 When specified in the contract or purchase order, the product specification number shall be shown.

20. Keywords

20.1 fire refined copper; refinery shapes; tough pitch copper

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order, for agencies of the U.S. government.

S1. Referenced Documents

S1.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

S1.1.1 *ASTM Standard*:²

B900, Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies

S1.1.2 *Federal Standard*:⁴

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

S1.1.3 *Military Standards*:⁴

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-2073-1E Standard Practice for Military Packaging

S1.1.4 *Civil Agencies*:

AMS-STD-185 Identification Marking of Copper and Copper-Base Alloy Mill Products

S2. Quality Assurance

S2.1 *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections or tests set forth when such inspections and tests are deemed necessary to ensure that the material conforms to prescribed requirements.

S3. Identification Marking

S3.1 All material shall be properly marked for identification in accordance with AMS-STD-185 except that the ASTM specification number and the alloy number shall be used.

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

S4. Preparation for Delivery

S4.1 Preservation, Packaging, Packing:

S4.1.1 *Military Agencies*—The material shall be separated by size, composition, grade, or class and shall be preserved and packaged, Level A or C, packed, Level A, B, or C as specified in the contract or purchase order, in accordance with the requirements of B900.

S4.1.2 *Civil Agencies*—The requirements of MIL-STD-2073-1E shall be referenced for definitions of the various levels of packaging protection.

S4.2 Marking:

S4.2.1 *Military Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with MIL-STD-129.

S4.2.2 *Civil Agencies*—In addition to any special marking required by the contract or purchase order, marking for shipment shall be in accordance with Fed. Std. No. 123.

ANNEX

(Mandatory Information)

A1. TEST METHOD FOR DETERMINATION OF COMPLIANCE WITH CHEMICAL COMPOSITIONAL REQUIREMENT FOR ANTIMONY, ARSENIC, BISMUTH, LEAD, NICKEL, SELENIUM, AND TELLURIUM IN SPECIFICATION B216 BY ELECTROTHERMAL ATOMIZATION ATOMIC ABSORPTION SPECTROMETRY

A1.1 Scope

A1.1.1 This test method covers the analysis of antimony, arsenic, bismuth, lead, nickel, selenium, and tellurium in tough-pitch fire-refined copper.

A1.1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

A1.1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

A1.2 Summary of Test Method

A1.2.1 The test sample is dissolved in nitric acid and the solution diluted to a known volume. An aliquot is introduced into an electrothermal atomic absorption spectrometer, with background correction capability. The absorbance of the resonance line energy from the spectrum of the element is measured and compared with that of calibration solutions of the same element in a matched matrix.

A1.3 Significance and Use

A1.3.1 This test method is primarily intended to test tough-pitch fire-refined copper for compliance with chemical compositional requirements of Specification B216.

A1.3.2 It is assumed that all who use this test method will be trained analysts capable of performing common laboratory procedure skillfully and safely. It is expected that work will be performed in a properly equipped laboratory.

A1.4 Interferences

A1.4.1 Elements normally present in tough-pitch fire-refined copper do not interfere.

A1.4.2 Potential background interference is eliminated by instrumental background correction and by use of matrix-matched calibration solutions.

A1.5 Apparatus

A1.5.1 *Atomic Absorption Spectrometer and Electrothermal Atomizer*—The instrument shall be equipped with a background corrector, and high-speed read-out electronics or a high-speed recorder, or both. The instrument should be capable of using single-element hollow cathode lamps or electrodeless discharge lamps. Follow the manufacturer's manual for installation and operations.

A1.5.2 *Graphite Tubes*—Pyrolytically coated graphite tubes and L'vov platforms for use in the electrothermal atomizer.

A1.5.3 *Micropipets*—5 μ L to 100 μ L.

A1.5.4 *Operating Parameters*—Operating parameters vary instrument to instrument and must be established for a particular instrument following the recommendations of the manufacturer.

A1.5.4.1 The analytical wavelengths are:

Elements	Wavelength, nm
Antimony	217.6
Arsenic	193.9
Bismuth	223.0
Lead	283.3
Nickel	232.0
Selenium	196.0
Tellurium	214.3

A1.6 Reagents and Materials

A1.6.1 *Argon*—Purity: 99.98 %, min.

A1.6.2 *Copper Solution* (1 mL = 0.01 g Cu)—Dissolve 2 g of well-characterized high-purity copper (National Bureau of Standards, Standard Reference Material, NBS SRM 393) in 40 mL of HNO₃ (1 + 1). Heat gently to dissolve the metal and expel the brown fumes. Cool, transfer to a 200 mL volumetric flask. Add 20 mL of HNO₃, dilute to volume, and mix.