



Designation: B 623 – 93

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Tough-Pitch Fire-Refined High-Conductivity Copper—Refinery Shapes¹

This standard is issued under the fixed designation B 623; 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 covers tough-pitch high-conductivity fire-refined copper wire bars, cakes, slabs, billets, ingots, and ingot bars.

1.2 Copper under this specification corresponds to the designation “FRHC” (UNS 11020) as shown in Classification B 224. This copper may also be used to produce coppers corresponding to the following:

Designation	UNS No.
STP	C11300, C11400, C11500 and C11600
DHP	C12200
DLP	C12000
DHPS	C12300
DPA	C14200
DPTE	C14520

1.3 Although this specification includes certain UNS designations as described in Practice E 527, these designations are for cross reference only and are not specification requirements. Therefore, in case of conflict, this ASTM specification shall govern.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

- B 193 Test Method for Resistivity of Electrical Conductor Material²
- B 224 Classification of Coppers³
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴
- E 53 Test Methods for Chemical Analysis of Copper⁵
- E 255 Practice for Sampling Copper and Copper Alloys for Determination of Chemical Composition⁵
- E 527 Practice for Numbering Metals and Alloys (UNS)⁶

3. Terminology

3.1 For definitions specific to this specification, refer to Classification B 224.

¹ This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.07 on Refined Copper.

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² Annual Book of ASTM Standards, Vols 02.01 and 02.03.

³ Annual Book of ASTM Standards, Vol 02.01.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 03.05.

⁶ Annual Book of ASTM Standards, Vols 01.01 and 02.01.

4. Ordering Information

4.1 Orders for materials under this specification shall include the following information:

- 4.1.1 Shape and dimension of each piece,
- 4.1.2 Should cakes, slabs, or billets be ordered for electrical use, it must be stated in the contract or purchase order,
- 4.1.3 Silver content, if required,
- 4.1.3.1 For silver bearing, the amount of silver required in troy oz per short ton,
- 4.1.3.2 The addition of silver up to 30 troy oz per short ton (0.10 %) will be considered within the specification, with no individual silver analysis to exceed 35 troy oz per short ton (0.12 %), and
- 4.1.4 Quantity.

4.2 When material is purchased for the agencies of 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.

5. Chemical Composition

5.1 The copper in all shapes shall meet the minimum requirement for copper, including silver, of 99.90 %.

6. Physical Properties

6.1 Electrical Resistivity:

6.1.1 The maximum mass resistivity for wire bars, cakes, slabs, and billets for electrical use shall be 0.15328 Ω·g/m² (conductivity 100.0 % minimum, International Annealed Copper Standard, (IACS)), at 20°C (68°F), annealed.

6.1.2 The maximum mass resistivity for other uses shall be 0.15694 Ω·g/m² (conductivity 97.66 % minimum IACS), at 20°C (68°F), annealed.

6.1.3 The maximum mass resistivity for ingots and ingot bars shall be 0.15694 Ω·g/m² (conductivity for 97.66 % minimum IACS, at 20°C (68°F) annealed.

7. Dimensions, Mass, and Permissible Variations

7.1 Standard Sizes and Shapes of Wire Bars:

7.1.1 One size of mold shall be used for casting 200 to 230 lb (91 to 104 kg) wire bars, the bottom width of these bars to be 3½ in. (89 mm), the listed weights being 200 and 225 lb (91 to 102 kg) (Fig. 1).

7.1.2 One size of mold shall be used for casting 240 to 300 lb (109 to 136 kg) wire bars, the bottom width of these bars to be 4 in. (102 mm), the listed weights being 250, 265, 275, and 300 lb (113, 120, 125, and 136 kg).

7.1.3 All bars shall be 54 in. (1.372 m) in length. The side draft or taper shall be ⅜ in. (9.5 mm) in 4 in. (3⅛ in. (4.8 mm) in 4 in. on each side of the bar). The radius of the

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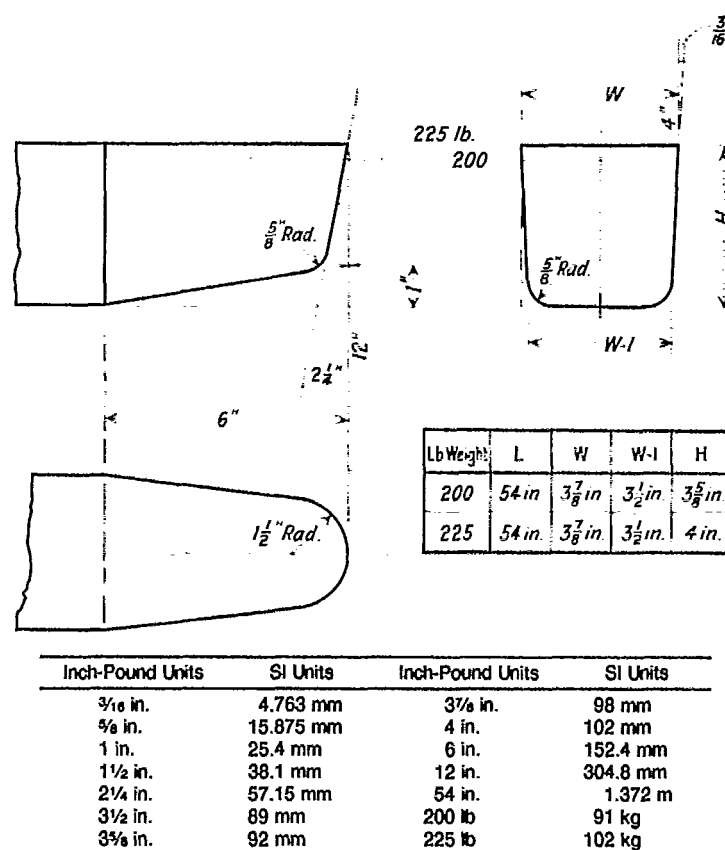


FIG. 1 Copper Wire Bars, 200 and 225 lb

corners at the bottom of the bars shall be $\frac{5}{8}$ in. (15.9 mm). The end taper at the bottom shall be 6 in. (152.4 mm) in overall length and approximately 2 in. (50.8 mm)/ft (304.8 mm). The vertical end taper shall be approximately $2\frac{1}{4}$ in. (57.1 mm)/ft and the end of the bar shall be approximately $3\frac{3}{8}$ in. (85.7 mm) in depth at the point.

7.1.4 Wire bars not conforming to the requirements of Fig. 1 or Fig. 2 but otherwise meeting the requirements of this specification, may be supplied by agreement between manufacturer and the purchaser.

7.2 *Permissible Variations in Weight and Dimensions*—A permissible variation of $\pm 5\%$ in weight or $\pm \frac{1}{4}$ in. (6.3 mm) in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery; provided, however, that wire bars may vary in length $\pm 1\%$ from the listed or specified length, and 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 Wire bars, cakes, slabs, and billets 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, a lot shall consist of all pieces the same shape and size bearing a common single identifying number.

9.3 *Chemical Composition*—In case of dispute concerning chemical composition, sampling shall be in accordance with Practice E 255.

9.4 Resistivity:

9.4.1 In case of dispute concerning the mass resistivity, each party shall select two pieces from the lot. In the presence of both parties, and by means mutually agreeable, a single sample of adequate size shall be cut from each of the four pieces and fabricated into a wire.

9.4.2 Each wire coil shall be cut into four wires of approximately the same length, and the sixteen wires thus obtained shall be individually identified. The sixteen wires shall be divided into four groups of four wires each, one wire from each of the four originally selected pieces; one group each for the producer, the purchaser, contingencies, and the umpire.

10. Number of Tests and Retest

10.1 Number of Tests:

10.1.1 The original composition shall be determined as the mean of the observations from at least three replicate analyses.

10.1.2 The mass resistivity shall be determined as the