



Designation: B5 – 22

# Standard Specification for High Conductivity Tough-Pitch Copper Refinery Shapes<sup>1</sup>

This standard is issued under the fixed designation B5; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification establishes the requirements for high conductivity, tough-pitch, copper wire bars, cakes, slabs, billets, ingots, and ingot bars.

1.2 Copper under this specification corresponds to the designations “ETP” (UNS C11000) and “FRHC” (UNS C11020) as shown in Classification B224. These coppers may also be used to produce coppers corresponding to the following:

| Copper UNS No.                     | Classification B224 Designation |
|------------------------------------|---------------------------------|
| C11300, C11400, C11500, and C11600 | STP                             |
| C12000                             | DLP                             |
| C12200                             | DHP                             |
| C12300                             | DHPS                            |
| C14520                             | DPTE                            |

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.

1.4.1 *Exception*—Electrical resistivity is expressed in SI units.

1.5 *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.*

<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 B05.07 on Refined Copper.

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## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

B193 Test Method for Resistivity of Electrical Conductor Materials

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

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry (Withdrawn 2022)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

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

E478 Test Methods for Chemical Analysis of Copper Alloys

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 Terminology B846. For definitions of terms related to standard classification of coppers, refer to Classification B224.

## 4. Ordering Information

4.1 Include the following information, as applicable:

4.1.1 ASTM Specification Designation and year of issue;

4.1.2 Copper UNS No. Designation;

4.1.3 Quantity, shape, and dimension of each piece, and weight;

4.1.4 Should cakes, slabs, or billets be ordered for electrical use, it must be stated in the contract or purchase order.

4.1.5 Silver content in silver-bearing shapes, when required, in troy oz per short ton.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

## 5. Materials and Manufacture

### 5.1 Materials:

5.1.1 The material of manufacture shall be a form (copper wire bar, cake, slabs, billets, ingots, and ingot bars) of Copper Alloy “ETP” (UNS C11000) or “FRHC” (UNS C11020) of such purity and soundness as to be suitable for processing into the prescribed herein.

5.1.2 When specified in the contract or purchase order that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify a specific casting analysis with a specific quantity of finished material.

### 5.2 Manufacture:

5.2.1 The product shall be hot- or cold-worked as to produce a uniform wrought structure in the finished product.

## 6. Chemical Composition

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

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

6.2 For the STP (silver-bearing) coppers, the addition of silver up to an average of 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 %).

## 7. Physical Property Requirements

### 7.1 Electrical Resistivity:

7.1.1 The maximum mass resistivity for wire bars, cakes, slabs, and billets for electrical use shall be 0.153 28  $\Omega \cdot \text{g}/\text{m}^2$  (conductivity 100.00 % minimum, International Annealed Copper Standard, (IACS)), at 68 °F (20 °C), annealed.

7.1.2 The maximum mass resistivity for other uses shall be 0.156 94  $\Omega \cdot \text{g}/\text{m}^2$  (conductivity 97.66 % minimum IACS), at 68 °F (20 °C), annealed.

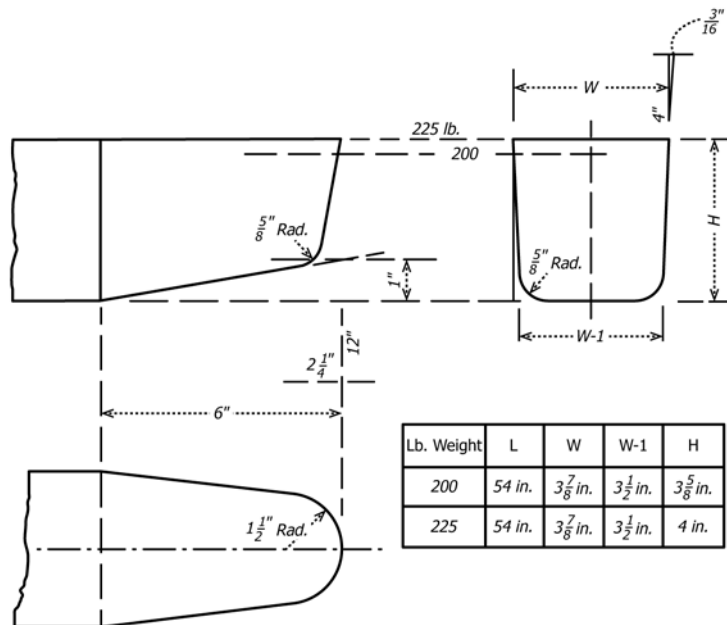
7.1.3 The maximum mass resistivity for ingots and ingot bars shall be 0.156 94  $\Omega \cdot \text{g}/\text{m}^2$  (conductivity 97.66 % minimum IACS), at 68 °F (20 °C), annealed.

## 8. Dimensions, Mass, and Permissible Variations

### 8.1 Standard Sizes and Shapes of Wire Bars:

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

8.1.2 One size of mold shall be used for casting 240 lb to 300 lb (109 kg to 136 kg) wire bars, the bottom width of these bars to be 4 in. (102 mm), the listed weights being 250 lb, 265 lb, 275 lb, and 300 lb (113 kg, 120 kg, 125 kg, and 136 kg) (Fig. 2).



| Inch-Pound Units | SI Units  | Inch-Pound Units | SI Units |
|------------------|-----------|------------------|----------|
| 3/16 in.         | 4.763 mm  | 3 7/8 in.        | 98 mm    |
| 5/8 in.          | 15.875 mm | 4 in.            | 102 mm   |
| 1 in.            | 25.4 mm   | 6 in.            | 152.4 mm |
| 1 1/2 in.        | 38.1 mm   | 12 in.           | 304.8 mm |
| 2 1/4 in.        | 57.15 mm  | 54 in.           | 1.372 m  |
| 3 1/2 in.        | 89 mm     | 200 lb           | 91 kg    |
| 3 5/8 in.        | 92 mm     | 225 lb           | 102 kg   |

FIG. 1 Copper Wire Bars, 200 lb and 225 lb