



Designation: ~~B379-04~~ Designation: B379 - 11

## Standard Specification for Phosphorized Coppers—Refinery Shapes<sup>1</sup>

This standard is issued under the fixed designation B379; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification establishes the requirements for phosphorized copper wire bars, billets, and cakes.

NOTE 1—Wire bars furnished under this specification do not conform in dimensions with that furnished under Specification B5.

~~1.2 The values in inch-pound units are the standard. SI values given in parentheses are for information only.~~

~~1.3 The following hazard caveat applies to 14.2 and 14.3 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 and health practices and determine the applicability of regulatory limitations prior to use.*~~

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, which are provided for information only and are not considered standard.

1.3 The following safety hazard caveat pertains only to the test method in sections 14.2 and 14.3 in this specification.

1.3.1 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

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

B5 Specification for High Conductivity Tough-Pitch Copper Refinery Shapes

B193 Test Method for Resistivity of Electrical Conductor Materials

B224 Classification of Coppers

B577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper

B846 Terminology for Copper and Copper Alloys

E83 Guide for Preparation of Metallographic Specimens

E8 Test Methods for Tension Testing of Metallic Materials

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

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

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

### 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 *billet*—refinery shape used for piercing or extrusion into tubular products or for extrusion into rod, bars, and shapes. Circular in cross section, usually 3 to 16 in. (76 to 406 mm) in diameter, normally ranging in weight from 100 to 4200 lb (45 to 1905 kg).~~

~~3.2.2 *cake*—refinery shape used for rolling into plate, sheet, strip, or shape. Rectangular in cross section and of various sizes, normally ranging in weight from 140 to 62000 lb (64 to 28123 kg).~~

~~3.2.3 *capable of*—possessing the required properties or characteristics, or both, necessary to conform to specification requirements when subjected to specified test(s).~~

~~3.2.4 *copper, electrolytic*—copper of any origin refined by electrolytic deposition including electrowinning. When used alone,~~

<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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<sup>2</sup> 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.

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

this term usually refers to electrolytic tough pitch copper.

~~3.2.5copper, fire-refined~~—copper of any origin or type finished by furnace refining without having been processed at any stage by electrolytic or chemical refining. When used alone, the term usually refers to fire refined tough pitch copper.

~~3.2.6copper, oxygen-free~~—electrolytic copper produced without the use of metallic or metalloidal deoxidizers, free of cuprous oxide as determined by metallographic examination at 75× under polarized light.

~~3.2.7wire bar~~—refinery shape used for rolling into rod or flat products for subsequent processing into wire, strip, or shape. Approximately 3½ to 5 in. (89 to 127 mm) square in cross-section, usually 54 in. (1372 mm) in length and ranging in weight from 200 to 420 lb (91 to 191 kg). Usually tapered at both ends.

#### 4. Ordering Information

4.1 Contracts or purchase orders for product under this specification should include the following information:

4.1.1 ASTM designation and year of issue (for example, B379 – XX),

4.1.2 Copper UNS Number (for example, C10800),

4.1.3 Shape required: wire bar, billet or cake,

4.1.3.1 Billet end type,

4.1.4 Dimensions and tolerances (Section 10), and

~~4.1.5Quantity; total weight or number of pieces for each shape, size, and Copper UNS No. designation.~~

~~4.1.5 Quantity; total weight or number of pieces for each shape, size,~~

4.2 The following are optional and should be specified in the contract or purchase order when required:

4.2.1 Hydrogen embrittlement test (Section 8),

4.2.2 Certification (Section 19), and

4.2.3 Test report (Section 20).

#### 5. Materials and Manufacture

##### 5.1 Material:

5.1.1 The product furnished shall be produced from one of the following coppers as specified in the contract or purchase order:

UNS Nos.	Former <sup>3</sup>	Description
C10300	OFXLP	Oxygen-free, extra low phosphorus
C10800	OFLP	Oxygen-free, low phosphorus
C12000	DLP	Phosphorus deoxidized, low residual phosphorus
C12200	DHP	Phosphorus deoxidized, high residual phosphorus
C14200	DPA	Phosphorus deoxidized, arsenical

##### 5.2 Manufacture:

5.2.1 *Billets*—Unless specified otherwise, product up to and including 4 in. (102 mm) in diameter may be supplied sheared on one end with the other end flat. Billets over 4 in. in diameter shall be supplied with both ends flat. Billets shall not be cupped except by specific agreement between the manufacturer or supplier and the purchaser at the time of purchase and the agreement shall be part of the contract or purchase order.

#### 6. Chemical Composition

6.1 The product material shall conform to the requirements prescribed in Table 1 for the specified copper.

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, or supplier, and the purchaser.

#### 7. Physical Property Requirements

##### 7.1 ~~Electrical Resistivity~~ Electrical Resistivity Requirement:

<sup>3</sup> Refer to Table X1.1 of Classification B224 for former copper designations.

**TABLE 1 Chemical Requirements**

Copper UNS No.	Type	Composition, %				
		Copper (Including Silver), min	Phosphorus		Arsenic	
			min	max	min	max
C10300	OFXLP	99.95 <sup>A</sup>	0.001	0.005	...	...
C10800	OFLP	99.95 <sup>A</sup>	0.005	0.012	...	...
C12000	DLP	99.90	0.004	0.012	...	...
C12200	DHP	99.9	0.015	0.040	...	...
C14200	DPA	99.4 <sup>B</sup>	0.015	0.040	0.15	0.50

<sup>A</sup> Includes phosphorus.

<sup>B</sup> Copper (including phosphorus and arsenic) = 99.9 % min.

7.1.1 The maximum mass resistivity for Copper UNS No. C10300, in the annealed condition, shall be 0.15614 ohms · g/m<sup>2</sup> (conductivity 98.16%, minimum, International Annealed Copper Standard (IACS)) at 68°F (20°C).

7.1.1 The product furnished shall conform to the electrical mass resistivity requirement prescribed in Table 2, when tested in

**TABLE 2 Electrical Resistivity Requirements for UNS nos. C10300, C 10800, and C12000**

Alloy	Electrical Resistivity max. Ω.g/m <sup>2</sup>	Conductivity % IACS <sup>A</sup>
C10300	0.15614	98.16
C10800	0.17081	90
C12000	0.17081	90

<sup>A</sup>International Annealed Copper Standard.

accordance with Test Method B193.

7.1.2 The maximum mass resistivity for Copper UNS Nos. C10800 and C12000, in the annealed condition, shall be 0.17081 ohm · g/m<sup>2</sup> (conductivity 90 %, minimum, International Annealed Copper Standard (IACS)) at 68°F (20°C).

## 8. Performance Requirements

8.1 *Reverse Bend Test (Hydrogen Embrittlement Susceptibility):*

8.1.1 When specified in the contract or purchase order, specimens of product produced of coppers UNS Nos. C10300, C10800, and C12000 shall be capable of withstanding a minimum of four bends without fracturing when tested in accordance with Test Method D of the current revision of Test Methods B577.

## 9. Microscopical Examination

9.1 Coppers UNS Nos. C10300, C10800, and C12000 shall be essentially free of cuprous oxide as determined by examination in accordance with Test Method A of the current revision of Test Methods B577.

## 10. Dimensions, Mass, and Permissible Variations

10.1 *Wire Bars:*

10.1.1 The manufacturer or supplier should be consulted for dimensions and shapes available.

10.2 *Billets:*

10.2.1 A variation of ±5 % in weight and/or ±1/16 in. (±2 mm) in diameter from the manufacturer's published list or the purchaser's specified size shall be considered good delivery for billets up to 6 in. (152 mm) in diameter.

10.2.2 A variation of -1/8 in. (-3 mm) to +1/16 in. (+2 mm) in diameter and ±2 % in length shall be permitted for billets 6 in. (152 mm) and over in diameter.

10.2.3 Deviation from straightness shall not exceed 1/4 in. (6 mm) in 4 ft (1219 mm) as measured at the center of the billet.

10.2.4 Special diameter tolerances are subject to agreement between the manufacturer or supplier and the purchaser.

10.3 *Cakes:*

10.3.1 A variation up to 5 % in weight or 1/4 in. (6 mm) in any dimension shall be permitted for dimensions up to 8 in. (203 mm). A variation of 3 % in size shall be permitted for dimensions greater than 8 in. (203 mm).

## 11. Workmanship, Finish and Appearance

11.1 The product shall be free from defects; however, but blemishes of a nature that do not interfere with the intended application are acceptable. The product shall be well cleaned and free from dirt.

## 12. Sampling

12.1 The lot size, portion size, and selection of sample pieces shall be as follows:

12.1.1 *Lot Size*—An inspection lot shall consist of all pieces in a shipment produced during a single production period.

12.1.2 *Portion Size*— One piece shall be randomly selected from each 25 000 lb (11 340 kg) or fraction thereof.

12.2 *Chemical Composition:*

12.2.1 The sample for chemical analysis shall be taken in accordance with Practice E255 from the piece(s) selected in 12.1.2. The minimum weight of the composite sample shall be 1/3 lb (150 g).

12.2.2 Instead of sampling in accordance with Practice E255, the manufacturer shall have the option of determining composition from samples taken at the time the castings are poured or from samples taken from semifinished product. When the manufacturer determines chemical composition during the course of manufacture, sampling of the finished product by the manufacturer is not required. The number of samples to be taken for the determination of chemical composition shall be as follows:

12.2.2.1 When castings are poured, at least two samples shall be taken, one at the beginning of the pour and one at the end of the pour, for each group of castings poured from the same source of molten metal.

12.2.2.2 When taken from semi-finished product, at least two samples shall be taken, each from a different piece, to represent each 20 000 lb (9072 kg), or fraction thereof, except that not more than one sample shall be required per product piece.