



## Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar<sup>1</sup>

This standard is issued under the fixed designation B 152/B 152M; 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.

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

### 1. Scope\*

1.1 This specification<sup>2</sup> establishes the requirements for copper sheet, strip, plate, and rolled bar produced from the following coppers.

Copper UNS No. <sup>A</sup>	Previous Designation	Type of Copper
C10100 <sup>B</sup>	OFE	Oxygen-free electronic
C10200 <sup>B</sup>	OF	Oxygen-free without residual deoxidants
C10300	...	Oxygen-free extra low phosphorus
C10400, C10500, C10700	OFS	Oxygen-free, silver bearing
C10800	...	Oxygen-free low phosphorus
C10910	...	Low oxygen
C11000 <sup>B</sup>	ETP	Electrolytic tough pitch
C11300, C11400, C11600 <sup>B</sup>	STP	Silver bearing tough pitch
C12000	DLP	Phosphorized, low residual phosphorus
C12200 <sup>B</sup>	DHP	Phosphorized, high residual phosphorus
C12300	DPS	Phosphorized, silver bearing
C14200	DPA	Phosphorus deoxidized, arsenical
C14420	...	Tin bearing tellurium copper
C14530	...	Tin tellurium bearing copper

<sup>A</sup> Except Copper UNS Nos. C10910 (low oxygen), C14200 (phosphorus deoxidized, arsenical), C14420 (tin bearing tellurium), and C14530 (tin tellurium bearing) these types of copper are classified in Classification B 224.

<sup>B</sup> SAE Specification CA101 conforms to Copper UNS No. C10100; SAE Specification CA102 conforms to the requirements for Copper UNS No. C10200; SAE Specification CA110 conforms to the requirements for Copper UNS No. C11000; SAE Specifications CA113, CA114, and CA116 conform to the requirements for Copper UNS Nos. C11300, C11400, and C11600; SAE Specification CA120 conforms to Copper UNS No. C12000; and SAE Specification CA122 conforms to the requirements for Copper UNS No. C12200.

NOTE 1—Each of the coppers listed has unique properties that can make it suitable for specific applications. The purchaser should consult with the supplier to determine which copper would be best suited for the intended application.

NOTE 2—This specification is not intended to establish requirements for material rolled to ounce-weight thicknesses. Such material is defined in Specification B 370.

Plates for locomotive fireboxes are defined in Specification B 11.

Flat copper products with finished (rolled or drawn) edges (flat wire and strip) are defined in Specification B 272.

1.1.1 When a specific copper is not identified in the contract or purchase order, the supplier may furnish product from any of the listed coppers.

1.2 The values stated in inch-pound or SI units are to be regarded separately as standard. The values in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 The following safety hazards caveat only pertains to the test method portion, Section 13 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.*

<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 B05.01 on Plate, Sheet, and Strip.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SB-152 in Section 11 of that Code.

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



## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

- B 11 Specification for Copper Plates for Locomotive Fireboxes<sup>4</sup>
- B 170 Specification for Oxygen-Free Electrolytic Copper Refinery Shapes
- B 193 Test Method for Resistivity of Electrical Conductor Materials
- B 216 Specification for Tough-Pitch Fire-Refined Copper Refinery Shapes
- B 224 Classification of Coppers
- B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar
- B 248M Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar (Metric)
- B 272 Specification for Copper Flat Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)
- B 370 Specification for Copper Sheet and Strip for Building Construction
- B 577 Test Methods for Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper
- B 601 Classification for Temper Designations for Copper and Copper Alloys Wrought and Cast
- B 846 Terminology for Copper and Copper Alloys
- E 3 Guide for Preparation of Metallographic Specimens
- E 8 Test Methods for Tension Testing of Metallic Materials
- E 8M Test Methods for Tension Testing of Metallic Materials [Metric]
- E 53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry
- E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)
- E 112 Test Methods for Determining Average Grain Size
- E 478 Test Methods for Chemical Analysis of Copper Alloys
- E 527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

### 2.2 ASME Standard:

- ASME Boiler Pressure Vessel Code<sup>5</sup>

## 3. General Requirements

3.1 The following sections of Specification B 248 or B 248M constitute a part of this specification.

- 3.1.1 Terminology.
- 3.1.2 Materials and Manufacture.
- 3.1.3 Sampling.
- 3.1.4 Number of Tests and Retests.
- 3.1.5 Specimen Preparation.
- 3.1.6 Test Methods.
- 3.1.7 Packaging and Package Marking.
- 3.1.8 Workmanship, Finish, and Appearance.
- 3.1.9 Significance of Numerical Limits.
- 3.1.10 Rejection and Rehearing.

3.2 In addition, when a section with a title identical to that referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specification B 248 or B 248M.

## 4. Terminology

4.1 *Definitions*—Terms used in this specification are in accordance with Terminology B 846 and Specifications B 248 and B 248M.

### 4.2 Definitions of Terms Specific to This Standard:

4.2.1 *capable of*—the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements the material shall be subject to rejection.

## 5. Ordering Information

5.1 Orders for products under this specification shall include the following:

- 5.1.1 ASTM specification designation and year of issue,
- 5.1.2 Quantity,
- 5.1.3 Copper UNS No. (Section 1). When Alloys C10400, C10500, C10700, C11300, C11400, C11600, or C12300, the amount of silver in ounces per ton,

<sup>3</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>4</sup> Withdrawn.

<sup>5</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

- 5.1.4 Temper (Section 7),
- 5.1.5 Dimensions: thickness, width, and weight (Section 12),
- 5.1.6 How furnished (straight lengths or coils),
- 5.1.7 Length (Section 12),
- 5.1.8 Weight of coils: coil weights or coil size limitations, if required,
- 5.1.9 When the product is purchased for agencies of the U.S. Government,
- 5.2 The following requirements shall be specified if applicable:
  - 5.2.1 Certification, if required (Section 15),
  - 5.2.2 Mill test report, if required (Section 16),
  - 5.2.3 Resistivity test for alloys listed in Table 5 (see Section 9),
  - 5.2.4 Embrittlement test for the alloys listed in 11.2,
  - 5.2.5 Type of edge, if other than slit, and
  - 5.2.6 Supplemental requirements for agencies of the U.S. government as given in Specifications B 248 and B 248M.

## 6. Chemical Composition

- 6.1 The materials shall conform to the chemical requirements prescribed in Table 1.
- 6.2 These limits do not preclude the presence of other elements. Limits for unnamed elements may be established and analysis required by agreement between manufacturer and the purchaser.

## 7. Temper

- 7.1 *As Hot-Rolled (M20)*—The standard temper of copper sheet and plate produced by hot rolling as designated in Tables 2 and 3 with the prefix “M”. Former designation and standard designation are detailed in Classification B 601 are shown.
  - 7.1.1 Plate not specified for ASME Boiler Pressure Vessel Code applications are generally available in the M20 temper.
- 7.2 *Rolled (H)*—The standard tempers of cold rolled copper sheet, strip, plate, and rolled bar are as designated in Tables 2 and 3 with the prefix “H”. Former designation and standard designation are detailed in Classification B 601 are shown.
- 7.3 *Annealed (O)*—The standard temper of annealed copper sheet, strip, and plate are as designated in Tables 2-4 with the prefix “O”. Former designation and standard designation are detailed in Classification B 601 are shown.
  - 7.3.1 The temper of copper sheet and plate hot-rolled and annealed shall be that produced by hot rolling and subsequent annealing is designated in Tables 2 and 3 as O25.
    - 7.3.1.1 Plates specified for ASME Boiler Pressure Vessel Code applications shall be furnished in the O25 temper.
  - 7.3.2 The standard tempers of copper sheet, strip, and plate cold-rolled annealed are designated in Table 4 as follows: O60, soft anneal and O68, deep drawing anneal.

NOTE 3—Any product produced in a temper other than those listed in Table 2, Table 3 or Table 4 will be produced and sold by contract and cannot be said to be produced under this specification.

NOTE 4—Soft-anneal temper is suitable for most industrial users of copper such as forming, spinning, and simple drawing operations in which close control of temper is not essential. Deep drawing anneal temper is especially suited for very severe drawing and forming operations in which maximum ductility and close control of temper is required.

## 8. Grain Size for Cold Rolled Annealed Tempers

- 8.1 Grain Size shall be standard requirement for all products of the cold rolled annealed (O60 and O68) tempers.
- 8.2 Acceptance or rejection based upon grain size shall depend only on the average grain size of the test specimens and shall be within the limits prescribed in Table 4 when determined in accordance with Test Methods E 112.
- 8.3 The test specimen shall be prepared in accordance with Guide E 3. The average grain size shall be determined on a plane parallel to the surface of the product.

## 9. Physical Property Requirements

- 9.1 *Electrical Resistivity Requirement* :
  - 9.1.1 When specified in the contract or purchase order on the alloys listed below, the electrical resistivity determined on representative samples shall not exceed the limits in Table 5 when test in accordance with Test Method B 193.
  - 9.1.2 Copper UNS Nos. C10800, C12000, C12200, C12300, C14200, C14420, and C14530 when specified at the time of purchase for electrical conductor use shall meet resistivity requirements as agreed upon between the manufacturer or supplier and the purchaser.

NOTE 5—The International Annealed Copper Standard electrical conductivity equivalents are as follows:



TABLE 1 Chemical Requirements

Element	Composition, %																		
	Copper UNS No.																		
	C10100 <sup>A</sup>	C10200	C10300	C10400 <sup>B</sup>	C10500 <sup>B</sup>	C10700 <sup>B</sup>	C10800	C10910	C11000	C11300 <sup>C</sup>	C11400 <sup>C</sup>	C11600 <sup>C</sup>	C12000	C12200	C12300 <sup>D</sup>	C14200	C14420	C14530	
Copper (incl silver), min	99.99 <sup>E</sup>	99.95	99.95 <sup>F</sup>	99.95	99.95	99.95	99.95 <sup>F</sup>	99.95	99.90	99.90	99.90	99.90	99.90	99.9	99.90	99.4	99.90 <sup>G</sup>	99.90 <sup>H</sup>	
Phosphorus	A	...	0.001–0.005	...	...	...	0.005–0.012	...	...	...	...	0.004–0.012	0.015–0.040	0.015–0.040	0.015–0.040	0.015–0.040	...	0.001–0.010	...
Arsenic	A	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.50	...	...	...
Oxygen, max	0.0005	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0050	...	...	...	...	...	...	...	...	...	...	...
Silver	A	...	...	8'/10'	10'/25'	25'/	...	0.005	...	10'	25'	...	...	...	4'	...	0.05	...	...
Selenium + tellurium, max	A	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tellurium	A	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tin	A	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

<sup>A</sup> Impurity maximums in ppm of C10100 shall be: antimony 4, arsenic 5, bismuth 1-6, cadmium 1, iron 10, lead 5, manganese 0.5, nickel 10, oxygen 5, phosphorus 3, selenium 3, silver 25, sulfur 15, tellurium 2, tin 2, and zinc 1.

<sup>B</sup> C10400, C10500, and C10700 are oxygen-free coppers with the addition of a specified amount of silver. The compositions of these alloys are equivalent to C10200 plus the intentional addition of silver.

<sup>C</sup> C11300, C11400, and C11600 are electrolytic tough-pitch copper with silver additions. The compositions of these alloys are equivalent to C11000 plus the intentional addition of silver.

<sup>D</sup> Copper UNS No. C12300 is produced by the addition of silver to phosphorus-deoxidized copper.

<sup>E</sup> Copper shall be determined by difference between impurity total and 100 %.

<sup>F</sup> Copper + silicon + tellurium + selenium.

<sup>G</sup> Includes tellurium + tin.

<sup>H</sup> Includes copper + silver + tin + tellurium + selenium.

<sup>I</sup> Values are minimum silver Troy oz/Avoirdupois ton (1 oz/ton is equivalent to 0.0034 %).