



Designation: B187/B187M – 20

# Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes<sup>1</sup>

This standard is issued under the fixed designation B187/B187M; 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 U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> establishes the requirements for copper conductor bar, rod, and shapes for electrical (bus) applications and rod, bar, and shapes for general applications.

1.1.1 The products for electrical (bus) applications shall be made from the following coppers:<sup>3</sup>

Copper UNS No. <sup>3</sup>	Reference Designation
C10100	OFE
C10200	OF
C10300	OFXLP
C10400, C10500, C10700	OFS
C10920, C10930, C10940	—
C11000	ETP
C11020	FRHC
C11300, C11400, C11500, C11600	STP
C12000	DLP

1.1.1.1 The product may be furnished from any copper listed unless otherwise specified in the contract or purchase order.

1.2 The product for general applications shall be made from any of the coppers in 1.1.1 or the following coppers:

Copper UNS No. <sup>3</sup>	Reference Designation
C10800	OFLP
C12200	DHP

1.2.1 The product may be furnished from any copper listed above unless otherwise specified in the contract or purchase order. Other coppers may be used upon agreement between the supplier and purchaser.

1.3 *Units*—The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each

<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 B05.02 on Rod, Bar, Wire, Shapes and Forgings.

Current edition approved June 1, 2020. Published June 2020. Originally approved in 1944. Last previous edition approved in 2019 as B187/B187M-19. DOI: 10.1520/B0187\_B0187M-20.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-187 in Section II of that Code.

<sup>3</sup> Refer to Practice E527 for an explanation of the Unified Numbering System.

system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

NOTE 1—Material for hot forging will be found in Specification B124/B124M.

1.4 *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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>4</sup>

[B124/B124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes](#)

[B170 Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes](#)

[B193 Test Method for Resistivity of Electrical Conductor Materials](#)

[B216 Specification for Tough-Pitch Fire-Refined Copper—Refinery Shapes](#)

[B224 Classification of Coppers](#)

[B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings](#)

[B577 Test Methods for Detection of Cuprous Oxide \(Hydrogen Embrittlement Susceptibility\) in Copper](#)

[B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast](#)

[B846 Terminology for Copper and Copper Alloys](#)

[B900 Practice for Packaging of Copper and Copper Alloy Mill Products for U.S. Government Agencies](#)

[E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry](#)

<sup>4</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.

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

**E62** Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)<sup>5</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)  
**E1004** Test Method for Determining Electrical Conductivity Using the Electromagnetic (Eddy Current) Method  
**E2575** Test Method for Determination of Oxygen in Copper and Copper Alloys by Inert Gas Fusion

2.2 Other Standard:

**ASME** Boiler and Pressure Vessel Code<sup>6</sup>

### 3. Terminology

3.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

3.2 Definitions:

3.2.1 *bus bar, n*—includes material of solid rectangular or square cross section or a solid section with two plane parallel surfaces and round or other simple regularly shaped edges up to and including 12 in. in width and 0.090 in. and over in thickness.

3.2.2 *bus conductor stock, n*—a bar, rod, or shape of high conductivity copper used to make electrical conductors.

3.2.3 *bus rod, n*—includes solid round and regular polygons of six and eight sides.

3.2.4 *bus shapes, n*—a solid section other than regular rod, bar, plate, sheet, strip, or flat wire, that may be oval, half oval, half round, triangular, pentagonal, or of any special cross section furnished in straight lengths. Shapes shall not include tube and pipe or other hollow sections.

3.3 Definitions of Terms Specific to This Standard:

3.3.1 *orange peel, n*—the surface roughness resulting from working metal of large grain size. The surface is similar in texture to that of the outside surface of an orange.

### 4. General Requirements

4.1 The following sections of Specification **B249/B249M** are a part of this specification:

- 4.1.1 Terminology;
- 4.1.2 Materials and Manufacture;
- 4.1.3 Workmanship, Finish, and Appearance;
- 4.1.4 Sampling;
- 4.1.5 Number of Tests and Retests;
- 4.1.6 Test Methods;
- 4.1.7 Specimen Preparation;
- 4.1.8 Significance of Numerical Limits;
- 4.1.9 Inspection;
- 4.1.10 Rejection and Rehearing;
- 4.1.11 Certification;

<sup>5</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>6</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

- 4.1.12 Test Reports; and
- 4.1.13 Packaging and Package Marking.

4.2 Identical sections in this specification supplement the referenced section.

### 5. Ordering Information

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

- 5.1.1 ASTM specification designation and year of issue,;
- 5.1.2 Copper UNS No. (see **7.1** and **Table 1**);
- 5.1.3 Temper required (see **8.1** and **Table 2**);
- 5.1.4 Dimensions and form;
- 5.1.5 When product is ordered for *ASME Boiler and Pressure Vessel Code* applications (see Section **16**);
- 5.1.6 Shapes: dimensional tolerances required and agreed upon (see **13.3**);
- 5.1.7 Quantity: number of pounds, pieces, or footage required;
- 5.1.8 Length: stock or specific (see **13.5**); and
- 5.1.9 When material is purchased for agencies of the U.S. Government (see Section **12**).

5.2 The following options are available but may not be included unless specified at the time of placing of the order when required:

- 5.2.1 Heat identification or traceability details required,
- 5.2.2 Hydrogen embrittlement test,
- 5.2.3 Bend test,
- 5.2.4 Certification,
- 5.2.5 Mill test reports,
- 5.2.6 Special packaging requirements,
- 5.2.7 Edges other than finished edges (see **6.2.1.2**),
- 5.2.8 Edge contours other than square edge (see **13.7**), and
- 5.2.9 Location for the determination of the Rockwell hardness (see **10.2.2**).

### 6. Materials and Manufacture

6.1 *Material:*

6.1.1 The materials shall conform to the published compositional requirements of the Copper or Copper Alloy UNS No. designation specified in the ordering information.

6.1.2 In the event heat identification or traceability is required, the purchaser shall specify the details desired.

6.2 *Manufacture:*

6.2.1 *Edges:*

6.2.1.1 Bar shall be furnished with finished edges (see **13.7**) unless otherwise specified at the time of order placement.

6.2.1.2 Bar may be furnished with sawed edges and deburred corners upon agreement between the manufacturer or supplier and the purchaser (see **5.2.7**).

### 7. Chemical Composition

7.1 The specified copper shall conform to the chemical requirements prescribed in **Table 1**.

7.2 These specification limits do not preclude the possible presence of other elements. Limits for unnamed elements may be established and analysis required by agreement between the manufacturer or the supplier and the purchaser.

**TABLE 1 Chemical Requirements**

NOTE 1—If the type of silver-bearing copper is not specified (that is whether tough pitch, phosphorized, or oxygen-free), any one of the three types may be supplied at the option of the manufacturer.

Composition % Maximum (Unless shown as a range or minimum)						
Copper UNS No.	Copper (Incl. Silver)	Phosphorus	Silver	Oxygen	Tellurium	Tin
		<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>
C10100	99.99 <sup>A</sup> min	...	...	...	...	...
C10200	99.95 <sup>C</sup> min	...	...	0.0010	...	...
C10300	99.95 <sup>D</sup> min	0.001–0.005	...	...	...	...
C10400 <sup>E</sup>	99.95 <sup>C</sup> min	...	8 <sup>F</sup>	0.0010	...	...
C10500 <sup>E</sup>	99.95 <sup>C</sup> min	...	10 <sup>F</sup>	0.0010	...	...
C10700 <sup>E</sup>	99.95 <sup>C</sup> min	...	25 <sup>F</sup>	0.0010	...	...
C10800	99.95 <sup>D</sup> min	0.005–0.012	...	...	...	...
C10920	99.90 min	...	...	0.02	...	...
C10930	99.90 min	...	13 <sup>F</sup>	0.02	...	...
C10940	99.90 min	...	25 <sup>F</sup>	0.02	...	...
C11000	99.90 min	...	...	<sup>G</sup>	...	...
C11020	99.90 min	...	...	<sup>G</sup>	...	...
C11300 <sup>H</sup>	99.90 min	...	8 <sup>F</sup>	<sup>G</sup>	...	...
C11400 <sup>H</sup>	99.90 min	...	10 <sup>F</sup>	<sup>G</sup>	...	...
C11500 <sup>H</sup>	99.90 min	...	16 <sup>F</sup>	<sup>G</sup>	...	...
C11600 <sup>H</sup>	99.90 min	...	25 <sup>F</sup>	<sup>G</sup>	...	...
C12000	99.90 min	0.004–0.012	...	...	...	...
C12200	99.90 min	0.015–0.040	...	...	...	...

<sup>A</sup> Copper value is determined by the difference between the impurity total and 100 %. The copper value is exclusive of Ag.  
<sup>B</sup> Impurity maximums in ppm of C10100 shall be: antimony 4, arsenic 5, bismuth 1, 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>C</sup> Copper value is determined by the difference between the impurity total and 100 %.  
<sup>D</sup> Copper (includes silver) + phosphorus, min.  
<sup>E</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>F</sup> Values are minimum silver in Troy ounces per Avoirdupois ton (1 oz/ton is equivalent to 0.0034 %).  
<sup>G</sup> Oxygen and trace elements may vary depending on the process.  
<sup>H</sup> C11300, C11400, C11500, 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.

**8. Temper**

8.1 Tempers available under this specification and as described in Classification **B601** are as follows:

Standard	Temper Designation	Former
O60		soft anneal
H02		half hard
H04		hard

**9. Physical Property Requirements**

9.1 *Electrical Resistivity*—Bar, rod, and shapes of alloys Copper UNS Nos. C10100, C10200, C10300, C10400, C10500, C10700, C10920, C10930, C10940, C11000, C11020, C11300, C11400, C11500, C11600, and C12000 shall conform to the electrical resistivity limits prescribed in **Table 2** for specified copper, temper, form, and size when determined in accordance with Test Method **B193**.

9.2 *Electrical Resistivity*—Unless otherwise specified in the contract or ordering information, the manufacturer has the option of using Test Method **E1004** to determine conformance to the electrical resistivity limits prescribed in **Table 2** for Copper UNS Nos. C10100, C10200, C10300, C10400, C10500, C10700, C10920, C10930, C10940, C11000, C11020, C11300, C11400, C11500, C11600, and C12000. In case of dispute, Test Method **B193** shall be used.

**10. Mechanical Property Requirements**

10.1 *Tensile Requirements:*

10.1.1 The bars and rod shall conform to the tensile, yield, and elongation requirements of **Table 2**.

10.1.1.1 For shapes, the tensile requirements (if any) shall be by agreement between the manufacturer and the purchaser.

10.2 *Rockwell Hardness:*

10.2.1 Rockwell hardness tests offer a quick and convenient method of checking copper of any temper for general conformity to the requirements of tensile strength. The approximate Rockwell hardness values for the specified tempers are given in **Table 2** for general information and assistance in testing.

10.2.2 When specified at the time of order and as agreed to by the purchaser and supplier or manufacturer, the location for the determination of the Rockwell hardness may be specified.

**11. Performance Requirements**

11.1 *Bending Requirements:*

11.1.1 When specified in the contract or purchase order, for bar, bus bar, flat wire, and rod, test specimens shall withstand being bent cold (right way bend) through an angle as specified in **Table 2** for the specified temper and size without fracture on the outside of the bent portion and with no evidence of slivers, cracks, orange peel, or similar surface defects being visible to the unaided eye.

11.1.2 The bend shall be made on a radius equal to the minimum cross-sectional dimension of the specimen, and this dimension shall be radial to the bend.

11.1.3 The axis of the bend shall be at an angle of 90° to the direction of rolling, drawing, or extrusion (right way bend).