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Standard Specification for Copper Rod, Bar, and Shapes¹

This standard is issued under the fixed designation B 133; 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.

This specification has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue that has been adopted by the Department of Defense.

1. Scope

1.1 This specification² covers copper rod, bar, and shapes for general purposes. The following coppers are covered:

Copper UNS No. ³	Reference Designation ⁴
C10100	OFE
C10200	OF
C10300	OFXLP
C10400	OFS
C10500	OFS
C10700	OFS
C10800	OFLP
C11000	ETP
C12000	DLP
C12200	DHP
C14200	DPA

⁴ Designations as defined in Classification B 224, of Coppers.

1.2 The material may also be supplied in such other coppers as may be agreed upon between purchaser and supplier. If a particular kind of copper is not specified, any of the above coppers may be supplied.

NOTE 1—Material for hot forging is covered by Specification B 124.

NOTE 2—Material for copper bus bar, rod, and shapes is covered by Specification B 187.

NOTE 3—A complete metric companion to Specification B 133 has been developed—B 133M; therefore, no metric equivalents are presented in this specification.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.1.1 ASTM Standards:

B 124 Specification for Copper and Copper-Alloy Forging Rod, Bar, and Shapes⁴

B 170 Specification for Oxygen-Free Electrolytic Copper-Refinery Shapes⁴

B 187 Specification for Copper Bus Bar, Rod, and Shapes⁴

¹ This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rod, Bar, Wire, Shapes, and Forgings.

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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-133 in Section II of that Code.

³ The UNS system for copper and copper alloys (see Practice E 527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

⁴ Annual Book of ASTM Standards, Vol 02.01.

B 193 Test Method for Resistivity of Electrical Conductor Materials⁴

B 224 Classification of Coppers⁴

B 249 Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes⁴

B 577 Test Methods for Hydrogen Embrittlement of Copper⁴

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast⁴

E 8 Test Methods for Tension Testing of Metallic Materials⁵

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁶

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification⁷

E 53 Test Methods for Chemical Analysis of Copper⁸

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes⁸

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁸

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁸

E 118 Test Methods for Chemical Analysis of Copper-Chromium Alloys⁸

E 478 Test Methods for Chemical Analysis of Copper Alloys⁸

E 527 Practice for Numbering Metals and Alloys (UNS)⁹

3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Quantity or weight for each size,

3.1.2 Copper UNS No. (Section 1),

3.1.3 Form: cross section, such as round, hexagonal, square, etc. (see Section 12),

3.1.4 Temper (Sections 6, 7, and 8),

3.1.5 Diameter or distance between parallel surfaces (see 12.2),

3.1.6 Length (see 12.5), or coil size (see 12.4),

3.1.7 Edge contours (see 12.7),

3.1.8 Resistivity, if required (see 9.1),

⁵ Annual Book of ASTM Standards, Vols 02.01 and 03.01.

⁶ Annual Book of ASTM Standards, Vols 02.03 and 03.01.

⁷ Annual Book of ASTM Standards, Vols 14.02, 02.03, 03.01, and 03.05.

⁸ Annual Book of ASTM Standards, Vol 03.05.

⁹ Annual Book of ASTM Standards, Vols 01.01 and 02.01.



TABLE 1 Chemical Requirements

Element	Composition, % max (unless shown as range or min)										
	Copper UNS No.										
	C10100 ^A	C10200 ^B	C10300	C10400 ^C	C10500 ^C	C10700 ^C	C10800	C11000	C12000	C12200	C14200
Copper, incl silver, min	99.99 ^D	99.95	99.95 ^E	99.95	99.95	99.95	99.95 ^E	99.90	99.90	99.9	99.4
Phosphorus	^A	...	0.001–0.005	...	...	...	0.005–0.012	...	0.004–0.012	0.015–0.040	0.015–0.040
Lead	^A	...	...	...	...	...	...	...	...	...	...
Arsenic	^A	...	...	...	...	...	...	...	...	...	0.15–0.50
Silver, min	...	...	...	8 ^F	10 ^F	25 ^F	...	...	...	...	...
Antimony	^A	...	...	...	...	...	...	...	...	...	...
Selenium + tellurium	^A	...	...	...	...	...	...	...	...	...	...
Nickel	...	...	...	...	...	...	...	...	...	...	...
Bismuth	^A	...	...	...	...	...	...	...	...	...	...

^A Impurity maximums in ppm for C10100 shall be: antimony 4, arsenic 5, bismuth 1, cadmium 1, iron 10, lead 5, manganese 0.5, mercury 1, nickel 10, oxygen 5, phosphorus 3, selenium 3, silver 25, sulfur 15, tellurium 2, tin 2, and zinc 1.

^B Oxygen in C10200 shall be 10 ppm max.

^C Copper UNS Nos. C10400, C10500, and C10700 are produced from oxygen-free Copper UNS No. C10200 with the addition of a specified amount of silver.

^D This value is exclusive of silver and shall be determined by difference of "impurity total" from 100%. "Impurity total" is defined as the sum of sulfur, silver, lead, tin, bismuth, arsenic, antimony, iron, nickel, zinc, phosphorus, selenium, tellurium, manganese, cadmium, and oxygen present in the sample.

^E Copper + silver + phosphorus, min.

^F Values are in troy ounces per avoirdupois ton (1 oz/ton is equivalent to 0.0034 %).

3.1.9 Embrittlement test, if required (Section 11),

3.1.10 Certification, if required (see Specification B 249, Section 13),

3.1.11 Mill test report, if required (see Specification B 249, Section 14).

3.1.12 ASTM designation and year of issue, and

3.1.13 Special tests or exceptions, if any.

3.2 When material is purchased for 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 in the current issue of Specification B 249.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current issue of Specification B 249.

5. Chemical Composition

5.1 The material shall conform to the chemical requirements in Table 1.

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

6. Temper

6.1 Tempers available under this specification and as defined in Practice B 601 are as follows:

Temper Designation	
Standard	Former
O60	soft anneal
H04	hard

7. Requirements for Shapes

7.1 Shapes shall conform to all requirements of this specification except temper (Section 6) and dimensional tolerances (Section 12) for which special agreement shall be made between the manufacturer and the purchaser.

8. Mechanical Properties

8.1 *Tensile Requirements*—The tension test shall be the standard test for all tempers and acceptance or rejection shall depend only on the tensile strength, which shall conform to the requirements specified in Table 2.

8.2 *Bending Requirements*—The bend test specimen shall stand being bent cold through an angle as specified in Table 2 without fracture on the outside of the bent portion. 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.

8.3 *Rockwell Hardness*—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.

8.4 If the purchaser desires to waive both the tensile strength and elongation requirements for specified tempers, such agreement shall be made by the purchaser and the manufacturer or supplier as a part of the purchase order. In this case, the following hardness requirements would apply:

Temper Designation		Rockwell Hardness, F Scale	
Standard	Former	min	max
O60	soft anneal	...	65
H04	hard	68	95

9. Physical Properties

9.1 *Electrical Resistivity*: When specified in the order, the electrical resistivity determined on samples of Copper UNS Nos. C10100, C10200, C10300, C10400, C10500, C10700, and C11000, shall not exceed the limits shown in Table 2 when tested in accordance with Test Method B 193.

10. Microscopical Examination

10.1 Samples of Copper UNS Nos. C10100, C10200, C10300, C10400, C10500, C10700, and C12000, shall be free of cuprous oxide as determined by Procedure A,