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Standard Specification for Copper-Nickel-Silicon Alloy Rod and Bar[1]

This standard is issued under the fixed designation B 411/B 411M; 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 standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification establishes the requirements for copper-nickel-silicon alloy rod and bar produced from Copper Alloy UNS No. C64700 in straight lengths.

1.2 *Units*—The values stated in either ~~inch-pound~~ SI units or ~~in SI~~ inch-pound units are to be regarded separately as standard. ~~Within the text, the SI units are shown in brackets.~~ The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B 193 Test Method for Resistivity of Electrical Conductor Materials
B 249/B 249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings
B 601 Classification for Temper Designations for Copper and Copper AlloysWrought and Cast
B 846 Terminology for Copper and Copper Alloys
E 8 Test Methods for Tension Testing of Metallic Materials
E 8M Test Methods for Tension Testing of Metallic Materials [Metric]
E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes
E 478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B 249/B 249M constitute a part of this specification:

3.1.1 Terminology,
3.1.2 Workmanship, Finish, and Appearance,
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 Significance of Numerical Limits,
3.1.8 Inspection,
3.1.9 Rejection and Rehearing,
3.1.10 Certification,
3.1.11 Mill Test Report,
3.1.12 Packaging and Package Marking, and
3.1.13 Supplementary Requirements.

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 249/B 249M.

4. Terminology

4.1 For the definition of terms related to copper and copper alloys, refer to Terminology B 846.

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[1] 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,~~Shapes and Forgings.

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[2] 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.**

5. Ordering Information

5.1 Include the following information when placing orders for product under this specification, as applicable:
5.1.1 ASTM designation and year of issue (for example, B 411/B 411M – 06),
5.1.2 Copper alloy UNS No. designation,
5.1.3 Temper,
5.1.4 Product form (cross section such as round, hexagonal, square, and so forth),
5.1.5 Dimensions (diameter or distance between parallel surfaces, width, thickness),
5.1.6 Edge contours,
5.1.7 Length, nominal,
5.1.8 Quantity; total weight, length, or number of pieces for each form and size, and
5.1.9 When product is purchased for agencies of the U.S. government.
5.2 The following options are available and should be specified at the time of placing the order, when required:
5.2.1 Certification (Specification B 249/B 249M), and
5.2.2 Mill test report (Specification B 249/B 249M).

6. Material and Manufacture

6.1 *Material*—The material of manufacture shall be cast billets or ingots of Copper Alloy UNS No. C64700 of such soundness and structure that they are suitable for processing into the products prescribed herein.
6.2 *Manufacture*— The product shall be manufactured by hot extrusion or rolling and finished by such cold working, annealing, cooling, straightening, and heat treatment as may be necessary to achieve the required properties.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements specified in Table 1.
7.1.1 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and the purchaser, limits may be established and analysis required for the unnamed elements.
7.2 Copper, given as the remainder, is the difference between the sum of results of all elements determined and 100 %.
7.3 When all elements specified in Table 1 are determined, the sum of results shall be 99.5 % minimum.

8. Temper

8.1 The standard temper for product described in this specification is given in Table 2.
8.2 Tempers are as defined in Classification B 601.
8.3 Other tempers available when specified are:
8.3.1 TB00 (solution heat-treated).
8.3.2 TD00 (solution heat-treated and cold-worked ⅛ hard).
8.3.3 TD01 (solution heat-treated and cold-worked ¼ hard).
8.3.4 TD02 (solution heat-treated and cold-worked ½ hard).
8.3.5 TD03 (solution heat-treated and cold-worked ¾ hard).
8.3.6 TD04 (solution heat-treated and cold-worked hard).

9. Physical Property Requirements

9.1 *Electrical Resistivity Requirement* —The precipitation heat-treated product furnished shall conform to the electrical mass resistivity of 0.348 36 to 0.589 54 $\Omega \cdot g/m^2$ or conductivity of 44.0 to 26.0 % IACS at 68°F ~~[20°C]~~(20°C) when tested in accordance with Test Method B 193.

10. Mechanical Property Requirements

10.1 *Tensile Strength Requirements* :
10.1.1 Product furnished in the precipitation-hardened TF00 temper, as normally supplied, shall conform to the tensile requirements prescribed in Table 2, when tested in accordance with Test Methods E 8 or E 8M.

TABLE 1 Chemical Requirements

Element	Composition, %
Nickel, incl cobalt	1.6–2.2
Silicon	0.40–0.8
~~Lead, max~~	~~0.10~~
Lead, max	0.09
Iron, max	0.10
Zinc, max	0.50
Copper, incl silver	remainder