



AEROSPACE MATERIAL SPECIFICATION

AMS4650™**REV. P**

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Superseding AMS4650N

Copper-Beryllium Alloy, Bars, Rods, Shapes, and Forgings,
98Cu - 1.9Be,
Solution Heat Treated (TB00)
(Composition similar to UNS C17200)

RATIONALE

AMS4650P results from a Five-Year Review and update of this specification with changes to update the temper designations (see Title, 3.4.1, 3.4.2, and 3.4.3), update standard wording prohibiting unauthorized exceptions (see 8.4), relocate Definitions (see 2.3), clarify that metric values are primary for grain size measurements (see 8.2), and update Applicable Documents (see Section 2), Composition (see 3.1), Maximum Average Grain Size (see 3.4.1.1.2), Microstructure (see 3.4.1.3.1), and Ordering Information (see 8.5).

1. SCOPE

This specification covers a copper-beryllium alloy in the form of bars, rods, shapes, and forgings (see 8.5).

1.1 Application

These products have been used typically for parts after aging requiring a combination of high strength, good wear resistance, and corrosion resistance and where electrical conductivity or low magnetic susceptibility may be important, but usage is not limited to such applications.

1.2 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

AMS2221 Tolerances, Copper and Copper Alloy Bars and Rods

AMS2750 Pyrometry

AMS2808 Identification, Forgings

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B194 Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

ASTM B249/B249M General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings

ASTM B601 Standard Classification for Temper Designations for Copper and Copper Alloys – Wrought and Cast

ASTM E3 Preparation of Metallographic Specimens

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E18 Rockwell Hardness of Metallic Materials

ASTM E112 Determining Average Grain Size

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM B194 or by other analytical methods acceptable to the purchaser.

Table 1 - Composition

Element	Min	Max
Beryllium	1.80	2.00
Nickel plus Cobalt	0.20	--
Nickel plus Cobalt plus Iron	--	0.6
Aluminum	--	0.20
Silicon	--	0.20
Copper (see 3.1.2)	remainder	
Sum of Named Elements (see 3.1.3)	99.5	--

3.1.1 These composition 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 purchaser.

3.1.2 Copper may be reported as “remainder,” as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.

3.1.3 When all the elements in the table are analyzed, the sum shall be 99.5% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars, Rods, and Shapes

Hot or cold worked to size, solution heat treated (TB00 temper), and cold straightened if necessary (refer to ASTM B601).

3.2.1.1 The cross-sectional area of bars, rods, and shapes shall be less than one-half that of the ingots from which they are formed (i.e., bars, rods, and shapes shall have been subjected to over 50% reduction of area during formation).

3.2.2 Forgings

Solution heat treated

3.2.3 Stock for Forging

As ordered by the forging manufacturer (see 8.5).

3.3 Heat Treatment

Product shall be solution heat treated by heating within the range 1400 to 1475 °F (760 to 802 °C), holding at heat for a minimum time of 30 minutes, and quenching in water. Pyrometry shall be in accordance with AMS2750.

3.4 Properties

The product shall conform to the following requirements:

3.4.1 As Solution Heat Treated (TB00 Temper)

3.4.1.1 Bars, Rods, and Shapes

3.4.1.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M; elongation requirement applies only to product over 0.311 inch (7.90 mm) in nominal diameter or distance between parallel sides.

Table 2 - Tensile properties

Property	Value
Tensile Strength, Maximum	85.0 ksi (586 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, Minimum	35%

3.4.1.1.2 Maximum Average Grain Size

Product under 3 inches (76.20 mm) in nominal diameter or least distance between parallel sides shall be as specified in Table 3, determined in accordance with ASTM E112. Product may be precipitation heat treated as in 3.4.2 before examination. Grain size values are stated and measured in millimeters (see 8.2).