SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4534 | REV. C

Issued 1991-07
Revised 2013-02

Superseding AMS4534B

Copper-Beryllium Alloy, Bars and Rods
98Cu - 1.9Be
Solution Heat Treated, Cold Worked, and Precipitation Heat Treated (TH04, formerly HT)

(Composition similar to UNS C17200)

RATIONALE

AMS4534C revises solution and precipitation heat treatment times (3.3.1, 3.3.2) and is a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a copper-beryllium alloy in the form of bars and rods.

1.2 Application

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

1.3 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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4534C

2.1 SAE Publications

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

AMS2221 Tolerances, Copper and Copper Alloy Bars and Rods

AMS2750 Pyrometry

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 B 249/B 249M General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes

ASTM E 3 Preparation of Metallographic Specimens

ASTM E 8/E 8M Tension Testing of Metallic Materials

ASTM E 18 Rockwell Hardness of Metallic Materials

ASTM E 112 Determining Average Grain Size

ASTM E 478 Chemical Analysis of Copper Alloys

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element (3.1.1)	min	max
Beryllium	1.80	2.00
Nickel + Cobalt	0.20	--
Nickel + Cobalt + Iron	--	0.6
Aluminum	--	0.20
Silicon	--	0.20
Copper (3.1.2)	remainder	
Sum of Named Elements (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”, or 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

Hot reduced or hot and cold reduced, solution heat treated, cold worked, and precipitation heat treated, TH04 temper (See 8.2).

3.3 Heat Treatment

Product shall be heat treated as follows; pyrometry shall be in accordance with AMS2750:

3.3.1 Solution

Heat within the range 1400 to 1475 °F (760 to 802 °C), hold at heat for a minimum of 30 minutes, and water quench.

3.3.2 Precipitation

Heat to 600 to 675 °F (316 to 357 °C), hold at heat for a minimum of 2 hours, and air cool.

3.4 Properties

Product shall conform to the following requirements:

3.4.1 Tensile Properties

Shall be in accordance with Table 2, determined in accordance with ASTM E 8/E 8M.

TABLE 2A - MINIMUM TENSILE PROPERTIES, INCH-POUND UNITS

Nominal Diameter or Least Distance Between Parallel Sides, Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 inches %
Up to 0.375, incl	182	157	3
Over 0.375 to 1.000, excl	180	154	3
Over 1.000 to 2.000, excl	177	150	3
Over 2.000 to 2.500, excl	175	147	3
Over 2.500 to 3.000, incl	172	145	3

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Diameter or Least Distance Between Parallel Sides, Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm %
Up to 9.52, incl	1255	1082	3
Over 9.52 to 25.40, excl	1241	1062	3
Over 25.40 to 50.80, excl	1220	1034	3
Over 50.80 to 63.50, excl	1207	1014	3
Over 63.50 to 76.20, incl	1186	1000	3

3.4.2 Hardness

Bars and rods 0.188 to 2.0 inches (4.78 to 50.8 mm), inclusive, in nominal diameter or least distance between parallel sides shall have hardness of 37 to 45 HRC, or equivalent (See 8.3) determined in accordance with ASTM E 18.

3.4.3 Average Grain Size

The product shall have average grain size not larger than shown in Table 3, determined in accordance with ASTM E 112.

TABLE 3 - MAXIMUM AVERAGE GRAIN SIZE

Nominal Diameter or Least Distance Between Parallel Sides, Inches	Nominal Diameter or Least Distance Between Parallel Sides, Millimeters	Maximum Average Grain Size Millimeter
Up to 1.000, incl	Up to 25.40, incl	0.050
1.000 to 1.500, incl	25.40 to 38.10, incl	0.075
1.500 to 2.000, incl	38.10 to 50.80, incl	0.100
2.000 to 3.000, incl	50.80 to 76.20, incl	0.125

3.4.4 Microstructure

Product shall contain not more than 6% beta phase constituent, determined at 100X magnification on specimens prepared in accordance with ASTM E 3.

3.5 Quality

Product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6 Tolerances

Shall conform to AMS2221 as applicable to refractory alloys.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing

Shall be in accordance with ASTM B 249/B 249M and the following; a lot shall be all product with the same form, from the same heat, processed at one time through all steps of manufacture.

4.3.1 One or more chemical analysis samples from each heat shall be analyzed in accordance with 3.1.

4.3.2 One or more longitudinal tensile specimens from each lot shall be tested in accordance with 3.4.1. The axis of tensile specimens shall be located midway between the center and surface of product over 1.500 inches (38.10 mm) in nominal cross-sectional thickness.

4.3.3 One or more hardness specimens from each lot shall be tested in accordance with 3.4.2.

4.3.4 One or more specimens for grain size from each lot shall be tested in accordance with 3.4.3.

4.3.5 One or more specimens for microstructure from each lot shall be tested in accordance wth 3.4.4.