

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4596A

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Superseding AMS4596

Copper Nickel Tin Alloy, Bars, Rods, and Tubes
77Cu – 15Ni – 8Sn
Solution Annealed and Spinodal Hardened (TX 00)

(Composition similar to UNS 72900)

RATIONALE

AMS4596A results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a copper-nickel-tin alloy in the form of bars, rods, and tubes.

1.2 Application

These products have been used typically for parts requiring high strength, wear resistance, and corrosion resistance at moderate temperatures, but usage is not limited to such applications.

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.

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.

AMS2750 Pyrometry

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<http://www.sae.org/technical/standards/AMS4596A>**

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	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings
ASTM B 249M	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings (Metric)
ASTM B 251	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
ASTM B 251M	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric)
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness of Metallic Materials
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 the purchaser.

TABLE 1 - COMPOSITION

Element (3.1.1)	min	max
Nickel (+ Cobalt)	14.5	15.5
Tin	7.5	8.5
Iron	--	0.50
Zinc	--	0.50
Manganese	--	0.30
Columbium	--	0.10
Magnesium	--	0.15
Lead	--	0.02
Copper (3.1.2)	remainder	
Copper + 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

The product shall be supplied in the following condition:

3.2.1 Bars, Rods, and Tubes

Hot rolled or extruded, and, if necessary, cold finished, solution annealed and spinodal hardened; TX 00 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 Annealing

Heat within the range 1450 to 1600 °F (788 to 870 °C), hold at heat for 45 to 360 minutes and water quench in room temperature water.

3.3.2 Spinodal Hardening

Heat to 600 to 800 °F (315 to 425 °C), hold at heat for a total time at temperature greater than 1 hour and less than 10 hours, depending on section thickness to meet the property requirements of Section 3.4, then air cool or quench (TX 00 temper, see 8.2).

3.4 Properties

The product shall conform to the following requirements:

3.4.1 Tensile Properties

Shall be as shown in Tables 2 and 3, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2 - MINIMUM LONGITUDINAL TENSILE PROPERTIES (BARS, RODS)

Nominal Thickness Between Parallel Sides (bars, rods)	Ultimate Tensile Strength	Yield Strength (at 0.2% offset)	Elongation in 4D
Up to 4.249 inches (108 mm), incl	132 ksi (910 MPa)	107 ksi (738MPa)	9.5%
4.250 to 8.500 inches (108 to 216 mm), incl	127 ksi (876 MPa)	108 ksi (745MPa)	3%

TABLE 3 – MINIMUM LONGITUDINAL TENSILE PROPERTIES (TUBES)

Nominal Outside Diameter (tubes)	Ultimate Tensile Strength	Yield Strength (at 0.2% offset)	Elongation in 4D
1.100 (28mm) to 6.500 inches (165 mm), incl	130 ksi (896 MPa)	101 ksi (696 MPa)	8%

3.4.2 Hardness

Bars, rods, and tubes 1.00 inch (25.4 mm) and over in nominal diameter or least distance between parallel sides shall have a minimum hardness of 30 HRC, or equivalent (See 8.5) determined in accordance with ASTM E 18.

3.5 Quality

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

3.5.1 Soundness

Where applicable, the product shall be ultrasonically inspected to a specification agreed to by the purchaser and supplier.

3.6 Tolerances

3.6.1 Bars and Rods

Shall be in accordance with ASTM B249.

3.6.2 Tubes

Shall be in accordance with Table 4.

TABLE 4 – HOT WORKED TUBE DIAMETER TOLERANCES	
Specified Outside or Inside Diameter, inches (mm)	Tolerance, Plus and Minus, inch (mm)
Over 0.5 (1.27) to 1 (25.4), incl	0.020 (0.51)
Over 1 (25.4) to 2 (50.8), incl	0.030 (0.76)
Over 2 (50.8) to 3 (76.2), incl	0.040 (1.02)
Over 3 (76.2) to 4 (102), incl	0.050 (1.27)
Over 4 (102) to 8 (203), incl	0.060 (1.52)
Over 8 (203)	0.060 (1.52)

3.6.3 Bars, Rods and Tubes

Straightness as measured by maximum depth of arc along any longitudinal surface or edge shall not exceed ¼ inch (6.35 mm) (for product length less than 10 feet (3.05 M)) or ½ inch (12.7 mm) (for product 10 feet (3.05 M) or longer).

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 melt or lot as applicable.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Rods and Tubes

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

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

4.3.1.2 One or more longitudinal tensile specimens from each lot shall be tested in accordance with 3.4.1.

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