

# AEROSPACE MATERIAL SPECIFICATION

**SAE** AMS4596

REV. B

Issued 2002-11  
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Revised 2010-12

Superseding AMS4596A

Copper Nickel Tin Alloy, Bars and Rods  
77Cu – 15Ni – 8Sn  
Solution Annealed and Spinodal Hardened (TX 00)  
(Composition similar to UNS C72900)

## RATIONALE

AMS4596B revises condition (3.2) and quality (3.5.1, 4.3.1.4), and removes tubes as an applicable product form. This alloy in the form of mechanical tubing is specified by AMS4598.

### 1. SCOPE

#### 1.1 Form

This specification covers a copper-nickel-tin alloy in the form of bars and rods. When tube is ordered to AMS4596, it shall be supplied to AMS4598.

#### 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](http://www.sae.org).

AMS2750 Pyrometry

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## 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](http://www.astm.org).

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

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

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<br>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

Input material is vertically continuous cast, hot worked by extrusion or forging and, if necessary, cold finished. Thermal treatments include solution annealing followed by spinodal hardening to the TX00 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 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 Table 2, determined in accordance with ASTM E 8/E 8M.

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

| Nominal Thickness<br>Between Parallel Sides<br>(bars, rods) | Ultimate<br>Tensile Strength | Yield Strength<br>(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%               |

#### 3.4.2 Hardness

Bars and rod 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

When specified, the product shall be ultrasonically inspected to a specification and acceptance criterion agreed upon by the purchaser and supplier (See 8.7).

### 3.6 Tolerances

Shall be in accordance with ASTM B 249/B 249M.

Straightness as measured by maximum depth of arc along any longitudinal surface or edge shall not exceed 1/4 inch (6.35 mm) (for product length less than 10 feet (3.05 m)) or 1/2 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 in accordance with ASTM B 249/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.

4.3.1.4 Soundness shall be tested in accordance with 3.5.1 and sampled at a frequency agreed upon by the purchaser and supplier, but not less than one tube length per lot.

##### 4.4 Reports

The vendor shall furnish with each shipment a report showing the results of the tests for the composition of each heat and for tensile properties and hardness of each lot and stating that the product conforms to the other technical requirements. The report shall include the purchaser order number, heat and lot numbers, AMS4596B, size or part number, and quantity.

##### 4.5 Resampling and Retesting

If any specimen used in the above tests fail to meet the specified requirements, disposition of the product may be based on the results of testing two additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be recorded.

#### 5. PREPARATION FOR DELIVERY

##### 5.1 Identification

Individual pieces or bundles shall have attached a durable tag marked with not less than the purchase order number, AMS4596B, and nominal size or configuration number or shall be boxed and the box marked with the same information.

##### 5.2 Packaging

The product shall be prepared for shipment in accordance with commercial practice and in compliance with the applicable rules pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance.

#### 6. ACKNOWLEDGMENT

A vendor shall include this specification number and its revision letter in all quotations and when acknowledging purchase orders.