SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

AMS 4597

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Copper-Nickel-Tin Alloy, Bars and Rods
77Cu - 15Ni - 8Sn
Solution Annealed, Cold Finished and Spinodal Hardened (TX TS)

(Composition similar to UNS C72900)

RATIONALE

This is a new specification to cover a copper-nickel-tin alloy in the form of bars and rods in the spinodal hardened (TX TS) condition.

1. SCOPE

1.1 Form

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

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 canceled 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.

AMS 2221	Tolerances, Copper and Copper Alloy Bars and Rods
AMS 2750	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	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)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

ASTM B 601	Copper Temper Designations
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 140	Hardness Conversion Tables
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 B 478, by spectrochemical methods, or by other analytical methods acceptable to 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 (Niobium)	--	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 and Rods

Hot rolled or extruded, solution annealed, cold finished, and spinodal hardened; TX TS temper (see 8.3).

3.3 Heat Treatment

Product shall be heat treated as follows; pyrometry shall be in accordance with AMS 2750.

3.3.1 Solution

Heat within the range 1450 to 1600 °F (788 to 870 °C), hold at heat for 60 to 180 minutes and quench in room temperature water.

3.3.2 Spinodal Hardening

Heat to 600 to 800 °F (315 to 425 °C), hold at heat for 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 TS temper, see 8.3).

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 or ASTM E 8M.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Nominal Thickness Between Parallel Sides (bars, rods) Nominal Wall Thickness (tubing)	Ultimate Tensile Strength	Yield Strength (at 0.2% offset)	Elongation in 4D
Up to 1.60 inches (40 mm), excl	165 ksi (1137 MPa)	155 ksi (1069 MPa)	6%
1.60 to 2.75 inches (40 to 70 mm), incl	156 ksi (1075 MPa)	148 ksi (1020 MPa)	3%

3.4.2 Hardness

3.4.2.1 Bars and rods shall have a hardness of 34 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.

3.6 Tolerances

Shall conform to AMS 2221 as applicable to refractory alloys.

3.6.1 Bars and Rods

Shall be in accordance with AMS 2221.

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, and Rods

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. The axis of the tensile specimens shall be located midway between the center and surface of product over 1.0 inches (25.4 mm) in nominal cross section thickness.

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

4.4 Reports

4.4.1 The vendor of bars and rods shall furnish with each shipment a report showing the results of the tests for 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, AMS 4597, size or part number, and quantity.

4.5 Resampling and Retesting

If any specimen used in the above tests fails 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 reported.

5. PREPARATION FOR DELIVERY

5.1 Identification

Shall be as follows:

5.1.1 Bars and Rods

Individual pieces or bundles shall have attached a durable tag marked with not less than the purchase order number, AMS 4597, and nominal size or configuration number or shall be boxed and the box marked with the same information.

5.2 Packaging

5.2.1 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 and safe delivery.

6. ACKNOWLEDGMENT

A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Product not conforming to this specification, or to modifications authorized by purchaser will be subject to rejection.

8. NOTES

8.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of a specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revision. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 Copper temper designations are defined in ASTM B 601.

8.3 Purchaser may specify special combinations of properties such as ductility and fatigue life. These characteristics are achieved by special fabrication and processing and the requirements of 3.4 do not apply to such products that may require tensile properties and hardness limits different from those designated by 3.4. Purchaser and vendor shall agree upon specific technical requirements and testing of these special products.