



400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

# AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4700A

Issued 11-1-69

Revised 4-1-88

Superseding AMS 4700

COPPER WIRE, BARE  
High Purity

UNS C10100

## 1. SCOPE:

- 1.1 Form: This specification covers one type of copper in the form of wire.
- 1.2 Application: Primarily for use as electronic component leads which must be resistance welded to produce high quality weld joints.
2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

### 2.1.1 Aerospace Material Specifications:

AMS 2224 - Tolerances, Copper and Copper Alloy Wire  
MAM 2224 - Tolerances, Metric, Copper and Copper Alloy Wire  
AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B193 - Resistivity of Electrical Conductor Materials  
ASTM B250 - General Requirements for Wrought Copper-Alloy Wire  
ASTM E3 - Preparation of Metallographic Specimens  
ASTM E53 - Chemical Analysis of Copper

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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### 2.3.1 Military Specifications:

MIL-C-3993 - Copper and Copper-Base Alloy Mill Products, Packaging of

### 3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E53, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Copper (3.1.1)	99.99	--
Sulfur	--	0.0018 (18 ppm)
Lead	--	0.0010 (10 ppm)
Bismuth (3.1.2)	--	0.0010 (10 ppm)
Selenium (3.1.2)	--	0.0010 (10 ppm)
Tellurium (3.1.2)	--	0.0010 (10 ppm)
Phosphorus	--	0.0003 (3 ppm)
Zinc	--	0.0001 (1 ppm)
Cadmium	--	0.0001 (1 ppm)
Mercury	--	0.0001 (1 ppm)
Arsenic (3.1.2)	--	--
Antimony (3.1.2)	--	--
Tin (3.1.2)	--	--
Manganese (3.1.2)	--	--

3.1.1 Copper shall be determined by taking the difference between 100% and the sum of the other elements listed.

3.1.2 The sum of the bismuth, selenium, tellurium, arsenic, antimony, tin, and manganese shall not exceed 0.0040% (40 ppm).

3.2 Condition: Cold-drawn or cold-rolled, annealed, and cleaned.

3.3 Properties: Wire shall conform to the following requirements:

3.3.1 Resistivity: The weight resistivity, determined in accordance with ASTM B193, shall not exceed 0.15328 ohm-g per square metre at 20°C (68°F), which corresponds to a conductivity of not less than 100% IACS (International Annealed Copper Standard) (58 MS/m).

3.3.2 Embrittlement: Wire shall withstand a minimum of 10 bends without cracking or breaking, when tested as in 3.3.2.1 and then subjected to additional bending until failure occurs.

3.3.2.1 Specimens shall be degreased, chemically cleaned by any suitable method, and then heated at  $850^{\circ}\text{C} + 25$  ( $1562^{\circ}\text{F} + 45$ ) for not less than 30 minutes in an atmosphere containing not less than 10% hydrogen. Specimen shall then be clamped between jaws having edge radii equal to 2.5 times the nominal diameter of the wire. Specimen, held under a tension of approximately 3,000 psi (21 MPa), shall be bent 90 degrees over the edge of one jaw and returned to its initial position; this constitutes one bend. Specimen shall then be bent 90 degrees in the reverse direction and returned to its initial position; this constitutes another bend. Each bend shall be made in the opposite direction from that of the preceding bend.

3.3.2.1.1 Specimens shall be examined at the bend after 10 bends and at the broken area after failure under a magnification of 10X. The bend shall have no surface cracks or blisters. The break shall show a necked-down section, characteristic of a ductile material, with no evidence of grain faces or boundaries.

3.3.3 Microstructure: Specimens, prepared as specified in ASTM E3, from wire heated as in 3.3.2.1, when suitably etched to reveal the structure and examined at 100X, shall show no evidence of copper oxide or other inclusions.

3.4 Quality: Wire, as received by purchaser, shall be uniform in quality and condition, sound, smooth, and free from foreign materials and from imperfections detrimental to usage of the wire.

3.5 Tolerances: Shall conform to AMS 2224 or MAM 2224 as applicable to copper and non-refractory alloys.

#### 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of wire shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.3 Sampling: Shall be in accordance with ASTM B250.

#### 4.4 Reports:

4.4.1 The vendor of wire shall furnish with each shipment a report showing the results of tests to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 4700A, size, and quantity.

4.4.2 When parts made from this wire or assemblies requiring use of this wire are supplied, the vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4700A, contractor or other direct supplier of wire, part number, and quantity. When wire for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of wire to determine conformance to the requirements of this specification and shall include in the report either a statement that the wire conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: If any specimen used in the above tests fails to  $\emptyset$  meet the specified requirements, disposition of the wire may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the wire represented and no additional testing shall be permitted. Results of all tests shall be reported.

## 5. PREPARATION FOR DELIVERY:

5.1 Wire shall be supplied on spools or in coils except when straight lengths are ordered.

### 5.2 Identification:

5.2.1 Spools and Coils: Shall be marked with a durable tag or label showing not  $\emptyset$  less than the manufacturer's identification, purchase order number, AMS 4700A, nominal size, and quantity; boxes or drums shall be marked with the same information.

5.2.2 Straight Lengths: Shall have attached to each bundle or enclosed in each  $\emptyset$  box a durable tag or label marked with the information of 5.2.1; when boxed, the box shall be marked with the same information.

### 5.3 Packaging:

5.3.1 Spools and Coils: Coils shall be individually wrapped with waterproof  $\emptyset$  paper or packed in waterproof drums. Spools, when ordered, shall be boxed.

5.3.2 Straight Lengths: Shall be bundled or boxed.

5.3.3 Wire shall be prepared for shipment in accordance with commercial practice  $\emptyset$  and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the wire to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3.4 For direct U.S. Military procurement, packaging shall be in accordance  $\emptyset$  with MIL-C-3993, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.3.1 or 5.3.2 and in 5.3.3 will be acceptable if it meets the requirements of Level C.