Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4602A
Superseding AMS 4602
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UNS C10200

COPPER BARS, RODS, AND SHAPES
Oxygen-Free, Hard Temper (CDA 102)

1. SCOPE:

1.1 Form: This specification covers one type of copper in the form of bars, rods, and shapes.

1.2 Application: Primarily for parts requiring high electrical or thermal conductivity.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2221 - Tolerances, Copper and Copper Alloy Rods and Bars
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 B249 - General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes
ASTM B577 - Hydrogen Embrittlement of Copper
ASTM E8 - Tension Testing of Metallic Materials
ASTM E53 - Chemical Analysis of Copper (Electrolytic Determination of Copper)
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

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

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Specifications:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be oxygen-free copper conforming to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E53, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

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	min	max
Copper + Silver	99.95	--
Other Elements, total	--	0.05

3.2 Condition: Cold drawn or cold rolled, hard temper.

3.3 Properties: The product shall conform to the following requirements:

ø 3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.2, determined in accordance with ASTM E8.

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Elongation in 4D or 4T (See 3.3.1.1) %, min
Rounds, Hexagons, Octagons		
Up to 0.250, incl	50,000	--
Over 0.250 to 0.375, incl	45,000	10
Over 0.375 to 1.000, incl	40,000	12
Over 1.000 to 2.000, incl	35,000	15
Over 2.000 to 3.000, incl	33,000	15
Squares, Rectangles		
Over 0.188 to 0.375, incl	42,000	12
Over 0.375 to 0.500, incl	40,000	12
Over 0.500 to 2.000, incl	33,000	15
Over 2.000 to 4.000, incl	32,000	15
Shapes		
All sizes	32,000	15

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tensile Strength MPa, min	Elongation in 4D or 4T (See 3.3.1.1) %, min
Rounds, Hexagons, Octagons		
Up to 6.35, incl	345	--
Over 6.35 to 9.52, incl	310	10
Over 9.52 to 25.40, incl	276	12
Over 25.40 to 50.80, incl	241	15
Over 50.80 to 76.20, incl	228	15
Squares, Rectangles		
Over 4.78 to 9.52, incl	290	12
Over 9.52 to 12.70, incl	276	12
Over 12.70 to 50.80, incl	228	15
Over 50.80 to 101.60, incl	221	15
Shapes		
All sizes	221	15

3.3.1.1 Elongation shall be measured over a gage length of 4D, where D is the diameter of a machined test specimen or the full diameter of a round rod and over a gage length of 4T where T is the distance between parallel sides of a hexagon, octagon, or square or the thickness of a rectangle when such forms are tested in full section. In no case, shall a gage length less than 1 in. (25 mm) be used.

3.3.1.2 Ø Tensile property requirements for rounds, hexagons, and octagons over 3.000 in. (76.20 mm) in nominal diameter or distance between parallel sides and for squares and rectangles over 4.000 in. (101.60 mm) in nominal least distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.3.2 Ø Bending: Product shall withstand, without cracking, bending in accordance with ASTM E290 through an angle of 120 deg around a radius equal to the minimum cross-sectional dimension of the specimen and this dimension shall be radial to the bend.

3.3.3 Electrical Resistivity: Shall not be greater than 0.15775 $\Omega \cdot g/m^2$ at 20°C (68°F), determined in accordance with ASTM B193.

3.3.4 Ø Embrittlement: The product, after exposure to hydrogen, shall withstand, without cracking, eight bends, determined in accordance with ASTM B577, Procedure D.

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

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to AMS 2221 as applicable to non-refractory alloys.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems necessary to ensure that the product 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 B249 and the following:

4.3.1 Composition: One sample from each lot.

4.3.2 Tensile Properties: One sample from each lot.

4.3.2.1 The axis of tensile test specimens shall be located approximately midway between center and surface of product over 1.500 in. (38.10 mm) in nominal diameter or distance between parallel sides.

4.3.3 Bending: One sample from each lot.

4.3.3.1 Specimens for bending test shall be the full section of the product or shall be rectangular specimens nominally 1 in. (25 mm) wide and 0.5 in. (13 mm) in thickness.

4.3.4 Electrical Resistivity: One sample from each lot.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition and electrical resistivity of each lot and for tensile properties of each size from each lot and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, lot number, material specification number and its revision letter, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include 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 meet the specified requirements, disposition of the product 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 product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Individual pieces or bundles shall have attached a durable tag marked with the purchase order number, AMS4602A, and nominal size, or shall be boxed and the box marked with the same information.