



400 Commonwealth Dr., Warrendale, PA 15096-0001

**AEROSPACE  
MATERIAL  
SPECIFICATION**

Submitted for recognition as an American National Standard

**AMS 4590A**Issued 1-15-77  
Revised 10-1-89

Superseding AMS 4590

EXTRUSIONS, NICKEL-ALUMINUM BRONZE, MARTENSITIC  
78.5Cu - 10.5Al - 5.1Ni - 4.8Fe  
Solution Heat Treated and Tempered (TQ50)

UNS C63020

**1. SCOPE:**

1.1 **Form:** This specification covers one type of nickel-aluminum bronze in the form of extruded bars, rods, and tubes.

1.2 **Application:** Primarily for parts requiring a combination of high strength and hardness with some ductility and toughness.

2. **APPLICABLE DOCUMENTS:** The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications 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 2221 - Tolerances, Copper and Copper Alloy Bars and Rods

MAM 2221 - Tolerances, Metric, Copper and Copper Alloy Bars and Rods

AMS 2350 - Standards and Test Methods

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM B249 - General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes

ASTM B249M - General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes (Metric)

ASTM E8 - Tension Testing of Metallic Materials

ASTM E8M - Tension Testing of Metallic Materials (Metric)

ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E478 - Chemical Analysis of Copper Alloys

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

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 E478, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

|                                        | min       | max  |
|----------------------------------------|-----------|------|
| Aluminum                               | 10.0      | 11.0 |
| Nickel (Including Cobalt)              | 4.2       | 6.0  |
| Iron                                   | 4.0       | 5.5  |
| Manganese                              | --        | 1.5  |
| Zinc                                   | --        | 0.30 |
| Tin                                    | --        | 0.25 |
| Cobalt                                 | --        | 0.20 |
| Silicon                                | --        | 0.15 |
| Chromium                               | --        | 0.05 |
| Lead                                   | --        | 0.03 |
| Copper (3.1.1)                         | remainder |      |
| Copper + Sum of Named Elements (3.1.2) | 99.5      | --   |

3.1.1 Applicable when copper is not determined by analysis. The reported (certified) value is the difference between the sum of all other specified elements and 100%; and will therefore include unnamed elements. Limits for unnamed elements may be established by agreement between purchaser and manufacturer or supplier.

3.1.2 Applicable only when copper is determined by direct analysis.

3.2 Condition: Extruded, solution heat treated, tempered (TQ50), and straightened, having an as-extruded surface finish (See 8.2).

3.3 Heat Treatment: Product shall be solution heat treated by heating to a temperature within the range 1550° - 1650°F (843° - 899°C), holding at the selected temperature within  $\pm 25^\circ\text{F}$  ( $\pm 14^\circ\text{C}$ ) for not less than 2 hours, and quenching in water and tempered by heating to a temperature within the range 900° - 1000°F (482° - 538°C), holding at the selected temperature within  $\pm 15^\circ\text{F}$  ( $\pm 8^\circ\text{C}$ ) for not less than 2 hours, and cooling in air to room temperature.

3.4 Properties: Product 4.00 inches (101.6 mm) and under in nominal diameter or distance between parallel sides shall conform to the following requirements; product over 4.00 inches (101.6 mm) in nominal diameter or distance between parallel sides shall have properties as agreed upon by purchaser and vendor:

3.4.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8 or ASTM E8M.

TABLE I

Nominal Diameter or Distance  
Between Parallel Sides  
(bars, rods)

Nominal Wall Thickness  
(tubing)  
Inches

Tensile  
Strength  
psi, min

Yield Strength  
at 0.2% Offset  
psi, min

Elongation in  
2 Inches or 4D  
%, min

Up to 1.00, incl  
Over 1.00 to 2.00, incl  
Over 2.00 to 4.00, incl

135,000  
130,000  
130,000

100,000  
95,000  
90,000

6  
6  
6

TABLE I (SI)

Nominal Diameter or Distance  
Between Parallel Sides  
(bars, rods)

Nominal Wall Thickness  
(tubing)  
Millimetres

Tensile  
Strength  
MPa, min

Yield Strength  
at 0.2% Offset  
MPa, min

Elongation in  
50.8 mm or 4D  
%, min

Up to 25.4, incl  
Over 25.4 to 50.8, incl  
Over 50.8 to 101.6, incl

931  
896  
896

689  
655  
621

6  
6  
6

3.4.2 Hardness: Shall be not lower than 26 HRC, or equivalent, determined in accordance with ASTM E18.

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

3.6 Tolerances: Shall conform to AMS 2221 or MAM 2221 as applicable to refractory alloys.

#### 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 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 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 or ASTM B249M.
- 4.4 Reports: The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition, tensile properties, and hardness of each lot. This report shall include the purchase order number, lot number, AMS 4590A, size or section identification 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 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: Shall be as follows:

- 5.1.1 Each straight bar, rod, and tube over 0.500 inch (12.70 mm) in nominal OD or least width of flat surface shall be marked in a row of characters recurring at intervals not greater than 3 feet (914 mm) with AMS 4590A, lot number, and manufacturer's identification. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be removable in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the product or its performance and shall be sufficiently stable to withstand normal handling.
- 5.1.2 All straight extrusions other than those of 5.1.1 shall be securely bundled and identified by a durable tag marked with the purchase order number, AMS 4590A, lot number, nominal size, and manufacturer's identification and attached to each bundle or shall be boxed and the box marked with the same information.