



AEROSPACE MATERIAL SPECIFICATION

AMS4590™**REV. D**

Issued 1977-01
Reaffirmed 2015-09
Revised 2021-12

Superseding AMS4590C

Extrusions, Nickel-Aluminum Bronze, Martensitic

78.5Cu – 10.5Al – 5.1Ni – 4.8Fe

Quenched and Tempered (TQ50)

(Composition similar to UNS C63020)

RATIONALE

AMS4590D results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (3.7, 4.4.1, 5.1.3, 8.6), update Applicable Documents (2.1), Composition (3.1), and to allow the use of the immediate prior specification revision (8.5).

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

These extrusions have been used typically for parts requiring a combination of high strength and hardness with some ductility and toughness, 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 +1 724-776-4970 (outside USA), www.sae.org.

AMS2221 Tolerances, Copper and Copper Alloy Bars and Rods

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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<https://www.sae.org/standards/content/AMS4590D/>

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 B249/B249M	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings
ASTM E8/E8M	Tension Testing of Metallic Materials
ASTM E18	Rockwell Hardness of Metallic Materials
ASTM E478	Chemical Analysis of Copper Alloys

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM E478 or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element (3.1.1)	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	--	(see 3.1.2)
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 producer 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 named elements in Table 1 are analyzed, the sum shall be 99.5% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition

Extruded, quench hardened and temper annealed (TQ50), and straightened.

3.3 Heat Treatment

Product shall be hardened by heating to a temperature within the range 1550 to 1650 °F (843 to 899 °C), holding at the selected temperature within ± 25 °F (± 14 °C) degrees for not less than 2 hours, and quenching in water and tempered by heating to a temperature within the range 900 to 1000 °F (482 to 538 °C), holding at the selected temperature within ± 15 °F (± 8 °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.

3.4.1 Tensile Properties

Shall be specified in Table 2, determined in accordance with ASTM E8/E8M.

Table 2A - Minimum tensile properties, inch/pound units

Nominal Diameter or Distance Between Parallel Sides (Bars, Rods) Nominal Wall Thickness (Tubing) Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 1.00, incl	135	100	6
Over 1.00 to 2.00, incl	130	95	6
Over 2.00 to 4.00, incl	130	90	6

Table 2B - Minimum tensile properties, SI units

Nominal Diameter or Distance Between Parallel Sides (Bars, Rods) Nominal Wall Thickness (Tubing) Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 25.4, incl	931	689	6
Over 25.4 to 50.8, incl	896	655	6
Over 50.8 to 101.6, incl	896	621	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 be in accordance with AMS2221 as applicable to refractory alloys.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 the specified requirements.

4.2 Classification of Tests

All technical requirements of this specification are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing

Shall be in accordance with ASTM B249/B249M.

4.4 Reports

The producer 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, AMS4590D, size or section identification number, and quantity.

4.4.1 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS4590D(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

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 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

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 AMS4590D, 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, AMS4590D, 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.

5.1.3 When technical exceptions are taken (see 4.4.1), the material shall be identified with AMS4590D(EXC).

5.2 Packaging

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

6. ACKNOWLEDGMENT

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

7. REJECTIONS

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