

# AEROSPACE MATERIAL SPECIFICATION

Issued JUN 1940  
Revised AUG 2005  
Superseding AMS 4640F

Aluminum Bronze, Bars, Rods, Shapes, Tubes, and Forgings  
81.5Cu - 10.0Al - 4.8Ni - 3.0Fe  
Drawn and Stress Relieved (HR50) or Temper Annealed (TQ50)  
(Composition similar to UNS C63000)

## 1. SCOPE:

### 1.1 Form:

This specification covers an aluminum bronze alloy in the form of bars, rods, shapes, tubes, forgings, and forging stock.

### 1.2 Application:

These products have been used typically for parts requiring strength and wear 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://www.sae.org).

AMS 2221	Tolerances, Copper and Copper Alloy Bars and Rods
AMS 2223	Tolerances, Copper and Copper Alloy Seamless Tubing
AMS 2808	Identification, Forgings

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## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM B 154	Mercurous Nitrate Test for Copper and Copper Alloys
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)
ASTM B 251	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
ASTM B 251M	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric)
ASTM B 858M	Determination of Susceptibility to Stress Corrosion Cracking in Copper Alloys Using an Ammonia Vapor Test
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
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 E 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element (3.1.1)	min	max
Aluminum	9.0	11.0
Nickel	4.0	5.5
Iron	2.0	4.0
Manganese	--	1.5
Zinc	--	0.30
Tin	--	0.20
Silicon	--	0.25
Copper + Silver (3.1.2)	remainder	
Copper + Silver + 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 and silver 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 percent 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, Rods, Shapes, and Tubes: Hot rolled or extruded, drawn or otherwise cold finished if necessary, and annealed by heating within the range 1100 to 1300 °F (593 to 704 °C) and cooling in air (HR50 temper - See 8.2).

3.2.2 Forgings: Quenched in room temperature water from 1625 °F ± 25 (885 °C ± 14), annealed by heating within the range 1100 to 1300 °F (593 to 704 °C), and cooling in air (TQ50 temper - See 8.2).

3.2.3 Forging Stock: As ordered by the forging manufacturer.

### 3.3 Properties:

The product shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E 8 or ASTM E 8M.

3.3.1.1 Rounds, Hexagons, and Octagons: Shall be as shown in Table 2.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.5% Extension Under Load		Elongation in 4D %
		ksi	ksi	
Up to 1.00, incl	110	68.0	68.0	10
Over 1.00 to 2.00, incl	110	60.0	60.0	10
Over 2.00 to 3.00, incl	105	55.0	55.0	10
Over 3.00 to 5.00, incl	100	50.0	50.0	10

3.3.1.2 Flats, Squares, Shapes, and Tubes: Shall be as shown in Table 3.

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness or OD Inches	Tensile Strength ksi	Yield Strength at 0.5% Extension Under Load ksi	Elongation in 4D %
Up to 1.00, incl	100	52.0	10
Over 1.00 to 3.00, incl	95.0	50.0	10
Over 3.00	90.0	48.0	10

TABLE 3B - Minimum Tensile Properties, SI Units

Nominal Thickness or OD Millimeters	Tensile Strength MPa	Yield Strength at 0.5% Extension Under Load MPa	Elongation in 4D %
Up to 25.4, incl	689	359	10
Over 25.4 to 76.2, incl	655	345	10
Over 76.2	621	330	10

3.3.2 Hardness: Shall be as follows or equivalent, determined in accordance with ASTM E 10:

3.3.2.1 Rounds, Hexagons, and Octagons: Shall be as shown in Table 4.

TABLE 4 - Hardness

Nominal Diameter or Distance Between Parallel Sides Inches	Nominal Diameter or Distance Between Parallel Sides Millimeters	Elongation in 4D %
Up to 2.00, incl	Up to 50.8, incl	201 to 248 HB
Over 2.00 to 5.00, incl	Over 50.8 to 127.0, incl	187 to 241 HB

3.3.2.2 Flats, Squares, Shapes, and Tubes: Shall be as shown in Table 5.

TABLE 5 - Hardness

Nominal Thickness or OD Inches	Nominal Thickness or OD Millimeters	Hardness
Up to 3.00, incl	Up to 76.2, incl	187 to 241 HB
Over 3.00	Over 76.2	183 to 241 HB

3.3.2.3 Forgings: Shall have hardness of 201 to 248 HB.

3.3.3 Embrittlement: Specimens as in 4.3.1.2, 4.3.2.2, and 4.3.3.1 shall withstand, without cracking, the mercurous nitrate test performed in accordance with ASTM B 154, Procedure A, or the Ammonia Vapor Test performed in accordance with ASTM B 858M.

3.4 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.

3.5 Tolerances:

Shall conform to the following as applicable to refractory alloys:

3.5.1 Bars and Rods: AMS 2221.

3.5.2 Tubes: AMS 2223.

3.5.3 Shapes: As agreed upon by purchaser and vendor.

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, Rods, and Shapes: Shall be in accordance with ASTM B 249 or ASTM B 249M and the following:

4.3.1.1 Specimens for tensile testing of bars, rods, and shapes over 1.50 inches (38.1 mm) in nominal diameter or distance between parallel sides shall have their axes located approximately midway between center and surface.

- 4.3.1.2 Specimens for embrittlement test shall be full cross-section of the product and shall have length of approximately 6 inches (152 mm) or twice the diameter or least distance between parallel sides, whichever is greater.
- 4.3.2 Tubes: Shall be in accordance with ASTM B 251 or ASTM B 251 M and the following:
- 4.3.2.1 Specimens for tensile testing of tubes shall be taken with the axis of specimens located at the approximate midwall.
- 4.3.2.2 Specimens for embrittlement test shall be taken as in 4.3.1.2.
- 4.3.3 Forgings: Two samples from each lot; a lot shall be all forgings of one part number processed consecutively under the same fixed forging parameters and presented for vendors inspection at one time.
- 4.3.3.1 Specimens for embrittlement test shall be of any convenient size and shape agreed upon by purchaser and vendor or an entire forging may be used.
- 4.3.4 Forging Stock: As agreed upon by purchaser and vendor.
- 4.4 Reports:
- 4.4.1 The vendor of bars, rods, shapes, tubes, and forgings shall furnish with each shipment a report showing the results of tests for chemical composition of each melt and for tensile properties and hardness of each lot and stating that the product conforms to the other technical requirements.
- This report shall include the purchase order number, lot number, AMS 4640G, size or part number, and quantity. If forgings are supplied, part number and the size and melt source of stock used to make the forgings shall also be included.
- 4.4.2 The vendor of forging stock shall furnish with each shipment a report stating that the chemical composition of the stock conforms to specified requirements. This report shall include the purchase order number, AMS 4640G, melt number, size, and quantity.
- 4.5 Resampling and Retesting:
- If any specimen used in the above tests fails to meet 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 specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.