AEROSPACE MATERIAL SPECIFICATION

AMS4640™	REV. J

Issued 1940-06
Reaffirmed 2018-05
Revised 2023-11

Superseding AMS4640H

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)

RATIONALE

AMS4640J results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (see 3.6, 4.4.4, 5.1.2, and 8.4), relocate Definitions (see 2.3), update Applicable Documents (see Section 2), Composition (see 3.1), Forgings (see 3.3.1.3), Ordering Information (see 8.5), and allow the use of the immediate prior specification revision (see 8.3).

1. SCOPE

1.1 Form

This specification covers an aluminum bronze alloy in the form of bars, rods, shapes, tubes, forgings, and forging stock (see 8.5).

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 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

AMS2223 Tolerances, Copper and Copper Alloy Seamless Tubing

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https://www.sae.org/standards/content/AMS4640J

AMS2808 Identification, Forgings

AS7766 Terms Used in Aerospace Metals Specifications

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 B154 Mercurous Nitrate Test for Copper Alloys

ASTM B249/B249M General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings

ASTM B251/B251M General Requirements for Wrought Seamless Copper and Copper-Alloy Tube

ASTM B858 Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys

ASTM B601 Temper Designations for Copper and Copper Alloys—Wrought and Cast

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E478 Chemical Analysis of Copper Alloys

2.3 Definitions

Terms used in AMS are defined in AS7766.

2.3.1 Copper temper designations are defined in ASTM B601.

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 the purchaser (see 8.5).

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,” 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.

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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 2.3.1).

3.2.2 Forgings

Quenched in room temperature water from 1625 °F ± 25 °F (885 °C ± 14 °C), annealed by heating within the range 1100 to 1300 °F (593 to 704 °C), and cooling in air (TQ50 temper - see 2.3.1).

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 E8/E8M:

3.3.1.1 Rounds, Hexagons, and Octagons (Bars, Rods, and Shapes)

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 ksi	Elongation in 4D %
Up to 1.00, incl	110	68.0	10
Over 1.00 to 2.00, incl	110	60.0	10
Over 2.00 to 3.00, incl	105	55.0	10
Over 3.00 to 5.00, incl	100	50.0	10

Table 2B - Minimum tensile properties, SI units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.5% Extension Under Load MPa	Elongation in 4D %
Up to 25.4, incl	758	469	10
Over 25.4 to 50.8, incl	758	414	10
Over 50.8 to 76.2, incl	724	379	10
Over 76.2 to 127.0, incl	689	345	10

3.3.1.2 Flats, Squares, Shapes (Bars), and Tubes

Shall be as shown in Table 3.

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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

3.3.1.3 Forgings

As agreed upon by the purchaser and producer (see 8.5).

3.3.2 Hardness

Shall be as follows or equivalent, determined in accordance with ASTM E10:

3.3.2.1 Rounds, Hexagons, and Octagons (Bars, Rods, and Shapes)

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	Hardness Range
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 (Bars), and Tubes

Shall be as shown in Table 5.

Table 5 - Hardness

Nominal Thickness or OD Inches	Nominal Thickness or OD Millimeters	Hardness Range
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 B154, Procedure A, or the Ammonia Vapor Test performed in accordance with ASTM B858.

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3.4 Quality

The product, as received by the 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

AMS2221.

3.5.2 Tubes

AMS2223.

3.5.3 Shapes

As agreed upon by the purchaser and producer (see 8.5).

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.4.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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 B249/B249M 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 B251/B251M 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.

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