



AEROSPACE MATERIAL SPECIFICATION

AMS4610™**REV. P**

Issued 1939-12
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Revised 2024-05

Superseding AMS4610N

Brass, Free-Cutting Bars and Rods

61.5Cu - 35Zn - 3.1Pb or 2.8Pb

Half Hard (H02)

(Composition similar to UNS C36000)

RATIONALE

AMS4610P results from a Five-Year Review and update of this specification with changes to add Types (see 1.3), revise the Title to acknowledge alternate composition based on Types, revise Composition (see 3.1) and Tensile Properties (see 3.3.1) to support new types, update terminology from Embrittlement to Residual Stress based on test method description (see 3.3.2 and 4.3.3), add general agreement language to prohibit unauthorized exceptions (see 3.3.1.5, 3.6, 4.4.1, 5.1.1, and 8.5), update Form (see 1.1), Applicable Documents (see Section 2), Hardness (see 8.2), and Ordering Information (see 8.6), relocate Definitions (see 2.3), and add language to allow use of immediate prior specification revision for Type A and restrict use of prior specification revision for Type B (see 8.4).

1. SCOPE

1.1 Form

This specification covers one type of copper alloy (brass) in the form of bars and rods up to 4.000 inches (101.60 mm) in nominal diameter, thickness between parallel sides, or width as defined in Tables 3 through 6 (see 8.6).

1.2 Applications

These products have been used typically for automatic high-speed screw machine parts where free-cutting characteristics are desirable, but usage is not limited to such applications.

1.3 Classification

The brass for free-cutting bars and rods is classified by two types:

Type A represents the composition and mechanical properties defined by AMS4610; suppliers are less likely to offer this material.

Type B represents the composition and mechanical properties currently contained in ASTM B16/B16M based on material availability across the supply base. Type B material has a reduced lead limit and yield strength is presented using 0.5% extension under load.

Unless otherwise specified, Type A shall be supplied (see 8.6).

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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

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 B16/B16M Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

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 B601 Temper Designations for Copper and Copper Alloys – Wrought and Cast

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

ASTM E8/E8M Tension Testing 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 for Type A or Table 2 for Type B, determined in accordance with ASTM E478 or by other analytical methods acceptable to the purchaser (see 8.6).

Table 1 - Composition, Type A

Element (see 3.1.1)	Min	Max
Copper	60.0	63.0
Lead	2.5	3.7
Iron	--	0.35
Sum of Named Elements (see 3.1.3)	99.5	--
Zinc (see 3.1.2)	remainder	--

Table 2 - Composition, Type B

Element (see 3.1.1)	Min	Max
Copper	60.0	63.0
Lead	2.5	3.0
Iron	--	0.35
Sum of Named Elements (see 3.1.3)	99.5	--
Zinc (see 3.1.2)	remainder	--

- 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 the purchaser.
- 3.1.2 Zinc 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 or Table 2 are analyzed, the sum shall be 99.5% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition

Cold finished, half-hard (H02) temper (see 2.3.1).

3.3 Properties

The product shall conform to the following requirements:

3.3.1 Tensile Properties

Shall be as shown in Table 3 and Table 5 for Type A or Table 4 and Table 6 for Type B determined in accordance with ASTM E8/E8M except as specified in 4.3.2.1.

3.3.1.1 Rounds, Hexagons, and Octagons (Rod)

Table 3A - Type A - minimum tensile properties, inch/pound units

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.500, incl	60.0	28.0	10 (see 3.3.1.3)
Over 0.500 to 1.000, incl	55.0	25.0	15
Over 1.000 to 2.000, incl	50.0	20.0	20
Over 2.000 to 4.000, incl	45.0	15.0	15

Table 3B - Type A - minimum tensile properties, SI units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 12.70, incl	414	193	10 (see 3.3.1.3)
Over 12.70 to 25.40, incl	379	172	15
Over 25.40 to 50.80, incl	345	138	20
Over 50.80 to 101.60, incl	310	103	15

Table 4A - Type B - minimum tensile properties, inch/pound units (see 3.3.1.4)

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.5% Extension Under Load ksi	Elongation in 2 Inches or 4D %
Up to 0.500, incl	57.0	25.0	7 (see 3.3.1.3)
Over 0.500 to 1.000, incl	55.0	25.0	10
Over 1.000 to 2.000, incl	50.0	20.0	15
Over 2.000 to 4.000, incl	45.0	15.0	20

Table 4B - Type B - minimum tensile properties, SI units (see 3.3.1.4)

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.5% Extension Under Load MPa	Elongation in 50.8 mm or 4D %
Up to 12.70, incl	393	172	7 (see 3.3.1.3)
Over 12.70 to 25.40, incl	379	172	10
Over 25.40 to 50.80, incl	345	138	15
Over 50.80 to 101.60, incl	310	103	20

3.3.1.2 Squares and Rectangles (Bar)

Table 5A - Type A - minimum tensile properties, inch/pound units

Nominal Thickness Inches	Nominal Width Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 5.00, incl	Up to 1.000, incl	50.0	25.0	10 (see 3.3.1.3)
	Over 1.000 to 6.000, incl	45.0	17.0	15 (see 3.3.1.3)
Over 5.00 to 2.000, incl	Up to 2.000, incl	45.0	17.0	20
	Over 2.000 to 6.000, incl	40.0	15.0	20
Over 2.000	Over 2.000 to 4.000, incl	40.0	15.0	20

Table 5B - Type A - minimum tensile properties, SI units

Nominal Thickness Millimeters	Nominal Width Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 12.70, incl	Up to 25.40, incl	345	172	10 (see 3.3.1.3)
	Over 25.40 to 152.40, incl	310	117	15 (see 3.3.1.3)
Over 12.70 to 50.80, incl	Up to 50.80, incl	310	117	20
	Over 50.80 to 152.40, incl	276	103	20
Over 50.80	Over 50.80 to 101.60, incl	276	103	20

Table 6A - Type B - minimum tensile properties, inch/pound units (see 3.3.1.4)

Nominal Thickness Inches	Nominal Width Inches	Tensile Strength ksi	Yield Strength at 0.5% Extension Under Load ksi	Elongation in 2 Inches or 4D %
Up to 0.500, incl	Up to 1.000, incl	50.0	25.0	10 (see 3.3.1.3)
	Over 1.000 to 6.000, incl	45.0	17.0	15 (see 3.3.1.3)
Over 5.00 to 2.000, incl	Up to 2.000, incl	45.0	17.0	15
	Over 2.000 to 6.000, incl	40.0	15.0	20
Over 2.000	Over 2.000 to 4.000, incl	40.0	15.0	20

Table 6B - Type B - minimum tensile properties, SI units (see 3.3.1.4)

Nominal Thickness Millimeters	Nominal Width Millimeters	Tensile Strength MPa	Yield Strength at 0.5% Extension Under Load MPa	Elongation in 50.8 mm or 4D %
Up to 12.70, incl	Up to 25.40, incl	345	172	10 (see 3.3.1.3)
	Over 25.40 to 152.40, incl	310	117	15 (see 3.3.1.3)
Over 12.70 to 50.80, incl	Up to 50.80, incl	310	117	15
	Over 50.80 to 152.40, incl	276	103	20
Over 50.80	Over 50.80 to 101.60, incl	276	103	20

3.3.1.3 In no case shall the gage length be less than 1 inch (25 mm).

3.3.1.4 Mechanical properties for Type B product have been taken from ASTM B16/B16M and have not been substantiated by AMS statistical procedures.

3.3.1.5 Mechanical property requirements for product outside the sizes covered by Tables 3 through 6 shall be as agreed between the purchaser and producer and reported per 4.4.1 (see 8.6).

3.3.2 Residual Stress Test

Specimens as in 4.3.3.1 shall withstand, without cracking, immersion in mercurous nitrate solution in accordance with ASTM B154, Procedure A, or the Ammonia Vapor Test in accordance with ASTM B858.

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 AMS2221 as applicable to nonrefractory alloys.

3.6 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 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 lot.

4.3 Sampling and Testing

Shall be in accordance with ASTM B249/B249M 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 Tensile tests shall be performed on full-section specimens when practicable. When machined specimens are required, the axis of the specimen shall coincide with the central axis of the piece except that for bars and rods over 1.50 inches (38.1 mm) in nominal diameter or distance between parallel sides, the axis shall be midway between the center and surface of the piece. The longitudinal axis of the tensile specimen shall be parallel to the direction of rolling or drawing.

4.3.3 Residual Stress Test

One sample from each lot, unless otherwise agreed upon by the purchaser and producer.

4.3.3.1 Specimens for residual stress test shall be full cross sections of the product and shall have length of approximately 6 inches (152 mm) or twice the nominal diameter or least distance between parallel sides, whichever is greater.

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 embrittlement of each lot and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS4610P, size, and quantity.

4.4.1 When material produced to this specification is beyond the size ranges defined in Tables 3 through 6, or has exceptions authorized by the purchaser taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS4610P(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 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.

5. PREPARATION FOR DELIVERY

5.1 Identification

Individual pieces or bundles shall have attached a durable tag legibly marked with not less than the purchase order number, AMS4610P, lot number, and nominal size, or shall be boxed and the box marked with the same information.