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400 Commonwealth Dr., Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4610L

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Superseding AMS 4610K

BRASS BARS AND RODS, FREE-CUTTING
61.5Cu - 3.1Pb - 35Zn
Half Hard (H02)

UNS C36000

1. SCOPE:

1.1 Form: This specification covers one type of brass in the form of bars and rods.

1.2 Applications: Primarily for automatic high-speed screw machine parts where free-cutting characteristics are desirable.

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

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

ASTM B154 - Mercurous Nitrate Test for Copper and Copper Alloys
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, Ø determined by wet chemical methods in accordance with ASTM 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Copper	60.0	63.0
Lead	2.5	3.7
Iron	--	0.35
Zinc + Sum of Named Elements (3.1.2)	99.5	--
Zinc (3.1.1)	remainder	

3.1.1 Applicable when zinc is not determined by analysis. The reported Ø (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.

3.1.2 Applicable only when zinc is determined by direct analysis. Ø

3.2 Condition: Cold finished, half-hard (H02) temper (See 8.2).

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as specified in Table I or Table II, determined in accordance with ASTM E8 or ASTM E8M and 4.3.2.1.

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3.3.1.1 Rounds, Hexagons, and Octagons:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, minimum	Elongation in 2 Inches or 4D %, minimum
Up to 0.500, incl	60,000	28,000	10 (See 3.3.1.3)
Over 0.500 to 1.000, incl	55,000	25,000	15
Over 1.000 to 2.000, incl	50,000	20,000	20
Over 2.000	45,000	15,000	15

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, minimum	Elongation in 50.8 mm or 4D %, minimum
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	310	103	25

3.3.1.2 Squares and Rectangles:

TABLE II

Nominal Thickness Inches	Nominal Width Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, minimum	Elongation in 2 Inches or 4D %, minimum
Up to 0.500, incl	Up to 1.000, incl	50,000	25,000	10 (See 3.3.1.3)
	Over 1.000 to 6.000, incl	45,000	17,000	15 (See 3.3.1.3)
Over 0.500 to 2.000, incl	Up to 2.000, incl	45,000	17,000	20
	Over 2.000 to 6.000, incl	40,000	15,000	20
Over 2.000	Over 2.000 to 4.000, incl	40,000	15,000	20

TABLE II (SI)

Nominal Thickness Millimetres	Nominal Width Millimeters	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, minimum	Elongation in 50.8 mm or 4D %, minimum
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

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

3.3.2 Hardness: Should be as specified in Table III, or equivalent, determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

TABLE III

Nominal Diameter or Distance Between Parallel Sides		Hardness, HRB		
Inches	Millimetres	Rounds	Hexagons Octagons	Squares Rectangles
Up to 1.000, incl	Up to 25.40, incl	65 - 85	60 - 80	50 - 80
Over 1.000 to 2.000, incl	Over 25.40 to 50.80, incl	60 - 80	50 - 70	40 - 70
Over 2.000	Over 50.80	60 - 80	45 - 65	40 - 70

3.3.2.1 Hardness determinations shall be made on the surface, except on rounds where a flat, as necessary for accuracy, may be made.

3.3.3 Embrittlement: Specimens as in 4.3.3.1 shall withstand, without cracking, immersion in mercurous nitrate solution in accordance with ASTM B154, Procedure A.

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 AMS 2221 or MAM 2221 as applicable to nonrefractory 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 and the following:

4.3.1 Composition: One sample from each lot.

4.3.2 Tensile Properties: One sample from each lot.