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The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-4164 REV F

Issued 1960-06-30
Revised 1990-04-01
Superseding AMS-4164E

Submitted for recognition as an American National Standard

ALUMINUM ALLOY EXTRUSIONS
4.4Cu - 1.5Mg - 0.60Mn (2024-T3510)
Stress-Relief Stretched, Unstraightened

UNS A92024

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of extruded bars, rods, wire, shapes, and tubing.

1.2 Application: Primarily for parts subject to excessive warpage during machining, and for parts requiring high strength and whose fabrication does not normally involve welding. Certain design and processing procedures may cause these extrusions to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

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 publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS-2205 - Tolerances, Aluminum Alloy and Magnesium Alloy Extrusions
MAM-2205 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Extrusions
AMS-2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
MAM-2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) Units
AMS-2630 - Ultrasonic Inspection

2.1.2 Aerospace Recommended Practices:

ARP823 - Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 660 - Packaging/Packing of Aluminum and Magnesium Products

2.3 U.S. Government Publications: Available from Naval Publications and Forms Center, Attn: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, Ø determined in accordance with AMS-2355 or MAM-2355:

	min	max
Copper	3.8	4.9
Magnesium	1.2	1.8
Manganese	0.30	0.9
Iron	--	0.50
Silicon	--	0.50
Zinc	--	0.25
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution heat treated in accordance with MIL-H-6088 and stress relieved by stretching to produce a nominal permanent set of 1-1/2%, but not less than 1% nor more than 3%.

3.2.1 Extrusions shall receive no straightening after stretching.

3.2.2 Extrusions shall be supplied with an as-extruded surface finish; light polishing to remove minor surface imperfections is permissible provided such imperfections can be removed within the dimensional tolerances.

3.3 Properties: Extrusions shall conform to the following requirements, determined in accordance with AMS-2355 or MAM-2355:

3.3.1 Tensile Properties: Shall be as specified in Table I, Table II, and 3.3.1.3.

3.3.1.1 Bars, Rods, Wire, and Shapes:

TABLE I

Nominal Dimensions		Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 Inches or 4D %, min
Diameter or Thickness Inches	Cross Sectional Area Square Inches			
Up to 0.249, incl	All areas	57,000	42,000	12
Over 0.249 to 0.749, incl	All areas	60,000	44,000	12
Over 0.749 to 1.499, incl	All areas	65,000	46,000	10
Over 1.499	Up to 25, incl	70,000	52,000	10
Over 1.499	Over 25 to 32, incl	68,000	48,000	8

TABLE I (SI)

Nominal Dimensions		Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min
Diameter or Thickness Millimetres	Cross Sectional Area Square Centimetres			
Up to 6.32, incl	All areas	393	290	12
Over 6.32 to 19.02, incl	All areas	414	303	12
Over 19.02 to 38.07, incl	All areas	448	317	10
Over 38.07	Up to 161, incl	483	359	10
Over 38.07	Over 161 to 206, incl	469	331	8

3.3.1.2 Round Tubing:

TABLE II

Nominal Wall Thickness, Inches, and Area, Square Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 inches or 4D %, min
Up to 0.249, incl, all areas	57,000	42,000	10
Over 0.249 to 0.749, incl, all areas	60,000	44,000	10
Over 0.749 to 1.499, incl, all areas	65,000	46,000	10
Over 1.499			
Area up to 25, incl	70,000	48,000	10
Area over 25 to 32, incl	68,000	46,000	8

TABLE II (SI)

Nominal Wall Thickness, Millimetres, and Area, Square Centimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min
Up to 6.32, incl, all areas	393	290	10
Over 6.32 to 19.02, incl, all areas	414	303	10
Over 19.02 to 38.07, incl, all areas	448	317	10
Over 38.07			
Area up to 161, incl	483	331	10
Area over 161 to 206, incl	469	317	8

3.3.1.3 Tensile property requirements for sizes over 1.499 inches (38.07 mm) in nominal diameter or distance between parallel sides or in nominal wall thickness or over 32 square inches (206 cm^2) in nominal cross-sectional area shall be as agreed upon by purchaser and vendor.

3.3.2 Hardness: Should be not lower than 100 HB/10/500 or 106 HB/10/1000 but extrusions shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4 Quality: Extrusions, 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 extrusions.

3.4.1 Ø When specified, extrusions shall be subjected to ultrasonic inspection in accordance with AMS-2630. Bars and shapes 0.500 inch (12.70 mm) and over in thickness, not over 600 pounds (272 kg) in weight per piece, and not exceeding a width-to-thickness ratio of 10 to 1 shall meet discontinuity class B.

3.4.1.1 Ø Ultrasonic inspection acceptance standards for bars and shapes exceeding the limitations stated in 3.4.1 shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Shall conform to all applicable requirements of AMS-2205 or MAM-2205.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Ø Responsibility for Inspection: The vendor of extrusions shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the extrusions conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), tensile properties (3.3.1), ultrasonic inspection, when specified (3.4.1), and tolerances (3.5) are acceptance tests and shall be performed on each lot.