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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-4163 REV B

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Superseding AMS-4163A

Submitted for recognition as an American National Standard

ALUMINUM ALLOY EXTRUSIONS
6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-T3511)
Solution Heat Treated and Stress-Relieved by Stretching

UNS A92219

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 structural parts requiring high strength up to 500°F (260°C) after proper precipitation heat treatment. May be welded. Certain design and fabricating procedures may cause extrusions in the specified condition 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
AMS-2770 - Heat Treatment of Aluminum and Aluminum Alloys
AMS-2811 - Identification, Aluminum and Magnesium Alloy Wrought Products

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 117 - Salt Spray (Fog) Testing
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, determined in accordance with AMS-2355 or MAM-2355:

	min	max
Copper	5.8	6.8
Manganese	0.20	0.40
Zirconium	0.10	0.25
Vanadium	0.05	0.15
Titanium	0.02	0.10
Iron	--	0.30
Silicon	--	0.20
Zinc	--	0.10
Magnesium	--	0.02
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

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

3.2.1 Extrusions may receive minor straightening, after stretching, of an amount necessary to meet the requirements of 3.5.

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 dimensional tolerances.

3.3 Properties: The product shall conform to the following requirements, determined in accordance with AMS-2355 or MAM-2355. Requirements apply to extrusions under 3.00 inches (76.2 mm) in nominal diameter or least distance between parallel sides with cross-sectional area 25 square inches (161 cm^2) and under; properties of extrusions 3.00 inches (76.2 mm) and over in nominal diameter or least distance between parallel sides or over 25 square inches (161 cm^2) in nominal cross-sectional area shall be as agreed upon by purchaser and vendor.

3.3.1 As Solution Heat Treated and Stress Relieved by Stretching:

3.3.1.1 Tensile Properties: Shall be as specified in Table I:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 Inches or 4D %, min
Up to 0.499, incl	42,000	26,000	14
Over 0.499 to 2.999, incl	45,000	27,000	14

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min
Up to 12.67, incl	290	179	14
Over 12.67 to 76.17, incl	310	186	14

3.3.1.2 Hardness: Should be not lower than 77 HB/10/500 or 82 HB/10/1000 but the extrusions shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.1.1 are met.

3.3.2 After Precipitation Heat Treatment: Extrusions shall meet the following requirements after being precipitation heat treated in accordance with AMS-2770:

3.3.2.1 Tensile Properties:

3.3.2.1.1 Longitudinal:

Tensile Strength, minimum	58,000 psi (400 MPa)
Yield Strength at 0.2% Offset, minimum	42,000 psi (290 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, minimum	6%

3.3.2.1.2 Long-Transverse:

Tensile Strength, minimum	56,000 psi (386 MPa)
Yield Strength at 0.2% Offset, minimum	39,000 psi (269 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, minimum	4%

3.3.2.1.2.1 Long-transverse tensile requirements apply only to extrusions from which a test specimen not less than 2.50 inches (63.5 mm) in length can be taken.

3.3.2.2 Stress-Corrosion Resistance: Specimens cut from extrusions Ø 0.750 inch (19.05 mm) and over in nominal thickness shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction to 30,000 psi (207 MPa).

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 When specified, extrusions shall be subjected to ultrasonic inspection in Ø accordance with AMS-2630. Extrusions 0.50 inch (12.7 mm) and over in nominal diameter or least distance between parallel sides, under 600 pounds (272 kg) per piece in weight, and having a maximum width-to-thickness ratio of 10:1, shall meet discontinuity Class B.

3.4.1.1 Ultrasonic inspection acceptance standards for extrusions exceeding the Ø thickness, weight per piece, or width-to-thickness ratio limits of 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 except that surface roughness tolerances shall be double those specified therein.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of extrusions shall supply all Ø 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.