Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4162A
Superseding AMS 4162
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UNS A92219

ALUMINUM ALLOY EXTRUSIONS
6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-T8511)
Solution Treated, Stress Relief Stretched, Precipitation Heat Treated

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). May be welded in the specified condition but properties are improved by reheat treatment after welding. Reheat treatment after welding, however, may reduce resistance to stress-corrosion cracking.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2205 - Tolerances, Aluminum-Base and Magnesium-Base Alloy Extrusions
AMS 2350 - Standards and Test Methods
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum-Base and Magnesium-Base Alloys, Wrought Products (Except Forgings and Forging Stock) and Flash Welded Rings
AMS 2630 - Ultrasonic Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B117 - Salt Spray (Fog) Testing

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with
ø AMS 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, stress relieved by stretching to produce a nominal permanent set of
ø 1-1/2% but not less than 1% nor more than 3%, and precipitation heat treated. Heat treatments 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: Extrusions shall conform to the following requirements, determined in accordance with AMS 2355.

3.3.1 Tensile Properties: Shall be as follows for extrusions up to 3.00 in. (76.2 mm), excl, in nominal diameter or least thickness (bars, rods, wire, shapes) or nominal wall thickness (tubing) and 25 sq in. (161 cm^2) and under in cross-sectional area; tensile property requirements for extrusions with nominal diameter or thickness 3.00 in. (76.2 mm) and over or cross-sectional area over 25 sq in. (161 cm^2) shall be as agreed upon by purchaser and vendor:

3.3.1.1 Longitudinal:

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

3.3.1.2 Long-Transverse:

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

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

3.3.1.3 Tensile tests in the longitudinal direction are not required from extrusions tested in the long-transverse direction.

3.3.2 Hardness: Should be not lower than 115 HB/10/500, 115 HB/14.3/1000, or 122 HB/10/1000, but the extrusions shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.3.3 Stress-Corrosion Resistance: A test specimen, cut from the extrusion so that the axis of loading of the specimen is approximately parallel to the short-transverse direction of the extrusion, shall be stressed to 30,000 psi (207 MPa) and held at constant strain in a suitable fixture. The stressed specimen shall show no evidence of stress-corrosion cracking when subjected to cyclic immersion at room temperature for 30 days in a 3-1/2% solution of sodium chloride conforming to the purity and pH requirements of ASTM B117; each cycle shall consist of 10 min. immersion in the solution and 50 min. out of the solution. Specimens shall be dry prior to each immersion.

3.4 Quality: Extrusions, as received by the purchaser, shall be uniform in quality and condition, sound, and Ø free from foreign materials and from internal and external imperfections detrimental to the usage of the extrusions.

3.4.1 When specified, extrusions shall be subjected to ultrasonic inspection in accordance with AMS 2630. Ø Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS Ø 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 samples and shall be responsible Ø 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 perform such confirmatory testing as he deems necessary to ensure that the extrusions conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), longitudinal tensile property Ø (3.3.1.1), ultrasonic inspection (3.4.1) when specified, and tolerance (3.5) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to long-transverse tensile property (3.3.1.2), hardness Ø (3.3.2), and stress-corrosion resistance (3.3.3) requirements are classified as periodic tests.

4.3 Sampling: Shall be in accordance with AMS 2355. Frequency and extent of sampling and locations from Ø which specimens are taken for periodic tests shall be as agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 The vendor of extrusions shall furnish with each shipment three copies of a report stating that the Ø extrusions conform to the chemical composition, and stating that the extrusions conform to the other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, size or section identification number, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of extrusions, part number, and quantity. When extrusions for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of extrusions to determine conformance to the requirements of this specification, and shall include in the report a statement that the extrusions conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.