

ALUMINUM ALLOY EXTRUSIONS
7.7Zn - 2.4Mg - 1.6Cu - 0.16Cr (7149-T73511)
Solution Heat Treated, Stress Relieved, and Overaged

UNS A97149

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 a combination of high strength, moderate fatigue strength, good stress-corrosion resistance, and good fracture toughness.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications 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 2205 - Tolerances, Aluminum Alloy and Magnesium Alloy Extrusions
MAM 2205 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Extrusions
AMS 2350 - Standards and Test Methods
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

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

ASTM B594 – Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications

ASTM B660 – Packaging/Packing of Aluminum and Magnesium Products

ASTM E399 – Plane-Strain Fracture Toughness of Metallic Materials

- 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-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
Zinc	7.2	8.2
Magnesium	2.0	2.9
Copper	1.2	1.9
Chromium	0.10	0.22
Iron	--	0.20
Manganese	--	0.20
Silicon	--	0.15
Titanium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

- 3.2 Condition: Extruded; solution heat treated, stress-relieved by stretching to produce a nominal permanent set of 1.5% but not less than 1% nor more than 3%, and overaged.

- 3.2.1 Extrusions may receive minor straightening after stretching of an amount necessary to meet the tolerance requirements of 3.6.

- 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 Heat Treatment: Extrusions shall be solution heat treated by heating to $875^{\circ}\text{F} \pm 10$ ($468^{\circ}\text{C} \pm 6$), holding at heat for a time commensurate with section thickness but not less than 60 minutes, and quenching in water at room temperature; held at room temperature for not less than 48 hours (See 8.2); and overaged by heating to $250^{\circ}\text{F} \pm 10$ ($121^{\circ}\text{C} \pm 6$), holding at heat for 24 hours ± 1 , followed by heating to $330^{\circ}\text{F} \pm 5$ ($166^{\circ}\text{C} \pm 3$) for 12 - 21 hours, and cooling in air (See 8.2). Heat treatments shall be performed using furnace surveys and calibration of temperature controllers and recorders in accordance with MIL-H-6088.

3.4 Properties: Extrusions 5.000 inches (127.00 mm) and under in nominal diameter or section thickness (wall thickness of tubing) shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355; properties of extrusions over 5.000 inches (127.00 mm) in nominal diameter or section thickness shall be as agreed upon by purchaser and vendor:

3.4.1 Tensile Properties: Shall be as specified in Table I.

TABLE I

Nominal Diameter or Least Thickness (bars, rods, wire, shapes) or Nominal Wall Thickness (tubing) Inches	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, minimum	Elongation in 2 inches or 4D %, minimum
Up to 2.999, incl	Longitudinal	74,000	64,000	7
	Long-Trans.	70,000	60,000	5
2.500 to 2.999, incl	Short-Trans.	70,000	60,000	5
Over 2.999 to 5.000, incl	Longitudinal	72,000	62,000	7
	Long-Trans.	68,000	58,000	5
	Short-Trans.	68,000	58,000	5

TABLE I (SI)

Nominal Diameter or Least Thickness (bars, rods, wire, shapes) or Nominal Wall Thickness (tubing) Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, minimum	Elongation in 50.8 mm or 4D %, minimum
Up to 76.17, incl	Longitudinal	510	441	7
	Long-Trans.	483	414	5
Over 63.50 to 76.17, incl	Short-Trans.	483	414	5
Over 76.17 to 127.00, incl	Longitudinal	496	427	7
	Long-Trans.	469	400	5
	Short-Trans.	469	400	5

3.4.2 Conductivity: Shall be not lower than 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m).

3.4.2.1 If the conductivity is below 40.0% IACS (23.2 MS/m), the extrusions are not acceptable.

3.4.2.2 Extrusions found to be unacceptable may be given additional overaging heat treatment and if, upon completion of such treatment, they develop conductivity/property relationships conforming to 3.4.1 and 3.4.2, they shall be acceptable.

3.4.3 Stress-Corrosion Resistance: Specimens, cut from extrusions 0.750 inch (19.05 mm) and over in nominal diameter or section thickness shall show no evidence of stress-corrosion cracking when stressed in the short-transverse (perpendicular to grain flow) direction to 65% of the specified minimum longitudinal (parallel to grain flow) yield strength.

3.4.4 Fracture Toughness: When specified, the minimum K_{IC} for the T73511 condition shall be 26 ksi $\sqrt{\text{in.}}$ (28.6 MPa $\sqrt{\text{m}}$) in the longitudinal (LT) direction and 19 ksi $\sqrt{\text{in.}}$ (21 MPa $\sqrt{\text{m}}$) in the transverse (TL and ST) directions.

3.4.4.1 Fracture toughness tests shall be in accordance with ASTM E399.

Ø A compact tension specimen 1 inch $\pm$ 0.025 (25.4 mm $\pm$ 0.64) is recommended. Testing shall be in air at room temperature.

3.4.4.1.1 If a test is invalid due to any single ASTM validity criterion, the test shall be interpreted as having met the requirement if the calculated K_Q is equal to or higher than the minimum K_{IC} required. If a test fails two ASTM validity requirements, one additional test shall be conducted before submittal to purchaser for disposition.

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3.5 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.

3.5.1 When specified, extrusions shall be subjected to ultrasonic inspection in accordance with ASTM B594. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of extrusions 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 extrusions conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.4.1), conductivity (3.4.2), fracture toughness (3.4.4) and ultrasonic inspection (3.5.1) when specified, and tolerances (3.6) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for stress-corrosion resistance (3.4.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with AMS 2355 or MAM 2355.

4.3.1 When specified, one specimen shall be tested for each orientation specified in 3.4.4.

4.4 Reports:

4.4.1 The vendor of extrusions shall furnish with each shipment a report stating that the extrusions conform to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, AMS 4343B, size or section identification number, and quantity.