

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 4157A

Superseding AMS 4157

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UNS A97049

ALUMINUM ALLOY EXTRUSIONS

7.7Zn - 2.4Mg - 1.6Cu - 0.16Cr (7049-T73511)

Solution Heat Treated, Stress Relieved, and 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 parts in structural applications requiring a combination of high strength with good stress-corrosion resistance.

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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2205 - Tolerances, Aluminum Alloy and Magnesium 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

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

ASTM G47 - Determining Susceptibility to Stress-Corrosion Cracking of High-Strength Aluminum Alloy Products

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

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2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

MIL-I-8950 - Inspection, Ultrasonic, Wrought Metals, Process for

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 AMS 2355:

	min	max
Zinc	7.2	- 8.2
Magnesium	2.0	- 2.9
Copper	1.2	- 1.9
Chromium	0.10	- 0.22
Iron	--	0.35
Silicon	--	0.25
Manganese	--	0.20
Titanium	--	0.10
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 1.5%, but not less than 1% nor more than 3%, and precipitation heat treated.

3.2.1 Extrusions may receive minor straightening, after stretching, of an amount necessary to meet the 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: Shall be in accordance with equipment and procedural controls of MIL-H-6088 and the following:

3.3.1 Solution Heat Treatment: Heat to $875^{\circ}\text{F} \pm 10$ ($470^{\circ}\text{C} \pm 5$), hold at heat for a time commensurate with section thickness but not less than 60 min., and quench in water at room temperature. Hold at room temperature for not less than 48 hours (See 8.2).

3.3.2 Precipitation Heat Treatment: Heat to $250^{\circ}\text{F} \pm 10$ ($120^{\circ}\text{C} \pm 5$), hold at heat for 24 hr ± 1 , heat to $330^{\circ}\text{F} \pm 5$ ($165^{\circ}\text{C} \pm 3$), hold at heat for 12 - 21 hr depending on furnace equipment, load, configuration, etc., and cool in air.

3.4 Properties: Extrusions 5.000 in. (125.00 mm) and under in nominal diameter or least thickness (wall thickness of tubing) shall conform to the following requirements, determined in accordance with AMS 2355 and as specified in 3.4.3; requirements for extrusions over 5.000 in. (125.00 mm) in nominal diameter or least thickness (wall thickness of tubing) 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, min	Elongation in 2 in. or 4D %, min
Up to 3.000, excl	Longitudinal	74,000	64,000	7
	Long Trans.	70,000	60,000	5
3.000 to 5.000, incl	Longitudinal	72,000	62,000	7
	Long 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, min	Elongation in 50 mm or 4D %, min
Up to 75.00, excl	Longitudinal	510	440	7
	Long Trans.	485	415	5
75.00 to 125.00, incl	Longitudinal	495	425	7
	Long Trans.	470	400	5

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

3.4.2.1 If the conductivity is below 40.0% IACS, the extrusions are not acceptable.

3.4.2.2 Extrusions found to be unacceptable may be given additional precipitation heat treatment as in 3.3.2 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 in. (19 mm) and over in nominal diameter or least thickness processed to meet the requirements of 3.4.1 and 3.4.2 and stressed in the short-transverse (perpendicular to grain flow) direction to 65% of the specified minimum longitudinal (parallel to grain flow) yield strength, shall exhibit no evidence of stress-corrosion cracking when tested in accordance with ASTM G47.

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

3.5.1 When specified, extrusions shall be subjected to ultrasonic inspection in accordance with MIL-I-8950. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 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), 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 and the following:

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4.3.1 For Tensile Properties and Electrical Conductivity: From extrusions having a nominal weight of less than 1 lb per linear ft (1.5 kg/m), one tension-conductivity sample shall be selected from each lot weighing 1,000 lb (455 kg) or less; from lots weighing more than 1,000 lb (455 kg) one additional sample shall be taken from each 1,000 lb (455 kg) or fraction thereof in excess of the first 1,000 lb (455 kg). From extrusions having a nominal weight of 1 lb per linear ft (1.5 kg/m) or more, one tension-conductivity sample shall be taken from each lot consisting of 1,000 ft (305 m) or less; from lots consisting of more than 1,000 ft (305 m), one additional sample shall be taken for each 1,000 ft (305 m) or fraction thereof in excess of the first 1,000 ft (305 m). Only one tension-conductivity sample shall be taken from any one piece when more than one piece is available.

4.4 Reports:

4.4.1 The vendor of extrusions shall furnish with each shipment three copies of 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 4157A, 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, AMS 4157A, 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 either a statement that the extrusions conform or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Extrusions shall be identified as follows:

5.1.1 Each straight bar, rod, and tube 0.500 in. (12.50 mm) and over in nominal OD or least width of flat surface and each straight shape with configuration allowing access to a flat surface at least 0.500 in. (12.50 mm) wide recessed not more than 1/8 in. (3 mm) below the outline of the shape shall be marked in a row of characters recurring at intervals not greater than 3 ft (900 mm) with the alloy number and temper, AMS 4157, and manufacturer's identification. The inspection lot number shall be included in the row marking or shall be marked near one end. The