

ALUMINUM ALLOY EXTRUSIONS

5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7175-T73511)

Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated

UNS A97175

1. SCOPE:

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

1.2 Application: Primarily for structural applications requiring a combination of high tensile properties, moderate fatigue strength, 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 (AMS and MAM) 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-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 B594 - Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications

ASTM B645 - Plane Strain Fracture Toughness Testing of Aluminum Alloys

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

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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

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	5.1	6.1
Magnesium	2.1	2.9
Copper	1.2	2.0
Chromium	0.18	0.28
Iron	--	0.20
Silicon	--	0.15
Manganese	--	0.10
Titanium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Extruded and 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 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.

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

3.3 Heat Treatment: Shall be performed as follows, using equipment and procedural controls of MIL-H-6088:

3.3.1 Solution Heat Treatment: Heat to $870^{\circ}\text{F} \pm 10$ ($465^{\circ}\text{C} \pm 5$); soaking times and quenching conditions should conform to MIL-H-6088.

3.3.2 Precipitation Heat Treatment: Heat to $250^{\circ}\text{F} \pm 10$ ($120^{\circ}\text{C} \pm 5$), hold at heat for 1 - 24 hr, increase temperature to $335^{\circ}\text{F} \pm 10$ ($170^{\circ}\text{C} \pm 5$), hold at heat for 10 hr ± 1 , and cool in air. Other temperatures or times, or both, for the second step may be necessary due to extrusion configuration, furnace equipment, load, etc.

3.4 Properties: Extrusions shall conform to the following requirements; tensile and conductivity properties shall be determined in accordance with AMS 2355:

3.4.1 Tensile Properties: Shall be as specified in Table I, determined on specimens from extrusions 0.250 - 2.000 in. (6.25 - 50.00 mm) in nominal diameter or least thickness or nominal wall thickness and 32 - 65 sq in. (205 - 405 cm²) in cross-sectional area.

TABLE I

Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Longitudinal	69,000	59,000	8
Long Trans.	63,000	52,000	4

TABLE I (SI)

Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 5D %, min
Longitudinal	475	405	8
Long Trans.	435	360	4

3.4.1.1 Tensile properties for extrusions outside the size limitations of 3.4.1 shall be as agreed upon by purchaser and vendor.

3.4.2 Fracture Toughness: When specified, plane strain fracture toughness (K_{Ic}) shall be not lower than the values specified in Table II, determined in accordance with ASTM B645.

TABLE II

Nominal Diameter or Least Thickness Inches	Specimen Orientation (See 8.2)	K_{Ic} ksi $\sqrt{\text{in.}}$
Over 0.749 to 1.800, incl	L-T	30
Over 0.749 to 1.800, incl	T-L	22

TABLE II (SI)

Nominal Diameter or Least Thickness Millimetres	Specimen Orientation (See 8.2)	K_{Ic} MPa $\sqrt{\text{in.}}$
Over 18.75 to 45.00, incl	L-T	33
Over 18.75 to 45.00, incl	T-L	24

3.4.2.1 When agreed upon by purchaser and vendor, alternate fracture toughness tests may be employed in lieu of the plane-strain fracture toughness test.

3.4.3 Conductivity:

3.4.3.1 If the conductivity is 40.0% IACS (International Annealed Copper Standard) or higher and the longitudinal tensile properties meet specified requirements, extrusions are acceptable.

3.4.3.2 If the conductivity is 38.0 - 39.9% IACS, the longitudinal tensile properties meet specified requirements, and the longitudinal yield strength does not exceed the specified minimum by more than 11,900 psi (82 MPa), the extrusions are acceptable.

3.4.3.3 If the conductivity is lower than 40.0% IACS and the longitudinal yield strength exceeds the specified minimum by more than 11,900 psi (82 MPa), the extrusions are suspect.

3.4.3.3.1 When extrusions are suspect, they may either be given additional precipitation treatment and retested or be completely reprocessed or a sample of the extrusions may be solution heat treated for not less than 30 min. at $870^{\circ}\text{F} \pm 10$ ($465^{\circ}\text{C} \pm 5$) and quenched in cold water. Conductivity shall be measured within 15 min. after quenching. If this measurement exceeds the original measurement on the product by 6% IACS or more, the extrusions are acceptable. If the difference is less than 6% IACS, the extrusions shall be reprocessed.

3.4.3.4 If the conductivity is below 38.0% IACS, the extrusions are not acceptable and shall be given additional precipitation treatment and retested or be completely reprocessed.

3.4.4 Stress-Corrosion Resistance: Specimens, cut from extrusions 0.750 in. (18.75 mm) and over in nominal diameter or section thickness, stressed in the short-transverse (perpendicular to grain flow) direction to 44,000 psi (305 MPa) shall meet the requirements of 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 ASTM B594. 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 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 (3.4.3), tolerances (3.6), and, when specified, ultrasonic inspection (3.5.1) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for fracture toughness (3.4.2) and stress-corrosion resistance (3.4.4) 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:

4.3.1 When fracture toughness testing is required, at least two specimens from an extrusion from a lot shall be tested; one in the LT direction and one in the TL direction (See 8.2).

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, lot number, AMS 4344, size or section identification number, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4344, 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.