

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 4161D
Superseding 4161C

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ALUMINUM ALLOY EXTRUSIONS
1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T4)
Solution Heat Treated and Naturally Aged

UNS A96061

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 requiring moderate strength, especially where such parts require brazing or welding during fabrication.

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

AMS 2770 - Heat Treatment of Aluminum Alloy Parts

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AMS 4161D

- 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

- 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
Magnesium	0.8	- 1.2
Silicon	0.40	- 0.8
Copper	0.15	- 0.40
Chromium	0.04	- 0.35
Iron	--	0.7
Zinc	--	0.25
Manganese	--	0.15
Titanium	--	0.15
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

- 3.2 Condition: Solution heat treated in accordance with MIL-H-6088 and
Ø naturally aged.

- 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.

- 3.3 Properties: Extrusions shall conform to the following requirements, determined in accordance with AMS 2355:

- 3.3.1 As Solution Heat Treated and Naturally Aged:

3.3.1.1 Tensile Properties: Shall be as follows:

Tensile Strength, min	26,000 psi (180 MPa)
Yield Strength at 0.2% Offset, min	16,000 psi (110 MPa)
Elongation in 2 in. (50 mm) or 4D, min	16%

3.3.1.2 Hardness: Should be not lower than 55 HB/10/500 or 60 HB/10/1000 but the Ø extrusions shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.3.2 After Precipitation Heat Treatment: Extrusions precipitation heat treated in accordance with AMS 2770 shall have the following properties:

3.3.2.1 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	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Up to 0.250, excl	38,000	35,000	8
0.250 and over	38,000	35,000	10

TABLE I (SI)

Nominal Diameter or Least Thickness (bars, rods, wire, shapes) or Nominal Wall Thickness (tubing) Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
Up to 6.25, excl	260	240	8
6.25 and over	260	240	10

3.4 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.

3.4.1 When specified, extrusions shall be subjected to ultrasonic inspection in Ø accordance with ASTM B594. 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 2205 or MAM 2205.

AMS 4161D

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 as solution heat treated (3.3.1.1), ultrasonic inspection (3.4.1) when specified, and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for hardness as solution heat treated and naturally aged (3.3.1.2) and tensile properties after precipitation heat treatment (3.3.2.1) 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.

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 4161D, 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 4161D, 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: