

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4161

REV. H

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Superseding AMS4161G

Aluminum Alloy, Extrusions
1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T4)
Solution Heat Treated and Naturally Aged
(Composition similar to UNS A96061)

RATIONALE

AMS4161H adds provisions for billet types for tubing (1.1.1) and for press solution heat treatment (3.2.2), and revises Sampling and Testing (4.3.1) and Reports (4.4).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of extruded bars, rods, wire, shapes, profiles and tubing.

1.1.1 Tubing

Tubing shall be additionally classified as follows:

Type	Description
I -	Seamless tubing extruded from hollow billets using die and mandrel
II -	Tubing extruded from solid billets using porthole or spider die or similar tooling

When no Type is specified, Type I shall apply.

1.2 Application

These products have been used typically for parts requiring moderate strength, especially where such parts require brazing or welding during fabrication, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

AS1990 Aluminum Alloy Tempers

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 594 Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B 666/B 666M Identification Marking of Aluminum and Magnesium Products

ASTM B 807/B 807M Extrusion Press Solution Heat Treatment for Aluminum Alloys

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products

ANSI H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2355.

TABLE 1 - COMPOSITION

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

3.2 Condition

Solution heat treated and naturally aged to the T4 temper (See AS1990).

3.2.1 Extrusions shall be supplied with the as-extruded surface finish; light polishing to remove minor surface imperfections is permissible provided such imperfections can be removed within specified dimensional tolerances.

3.2.2 Heat Treatment shall be classified as follows:

Class	Description
1	Furnace solution heat treated in accordance with AMS2772 .
2	Extruded and press solution heat treated in accordance with ASTM B807/B807M.

If no Class is specified, either Class may be provided.

3.3 Properties

Extrusions shall conform to the following requirements, determined in accordance with AMS2355.

3.3.1 As Solution Heat Treated and Naturally Aged

3.3.1.1 Tensile Properties

Shall be as shown in Table 2.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	26.0 ksi (179 MPa)
Yield Strength at 0.2% Offset	16.0 ksi (110 MPa)
Elongation in 2 inches (50.8 mm) or 4D	16%

3.3.2 Response to Heat Treatment

Extrusions, precipitation heat treated in accordance with AMS2772 to the T62 temper (See AS1990), shall have the following properties:

3.3.2.1 Tensile Properties

Shall be as shown in Table 3.

TABLE 3A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Diameter or Least Thickness (Bars, Rods, Wire, Shapes) or Nominal Wall Thickness (Tubing), Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.250, excl	38.0	35.0	8
0.250 and over	38.0	35.0	10

TABLE 3B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Diameter or Least Thickness (Bars, Rods, Wire, Shapes) or Nominal Wall Thickness (Tubing), Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 6.35, excl	262	241	8
6.35 and over	262	241	10

3.4 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.

3.4.1 When specified, extrusions shall be subjected to ultrasonic inspection in accordance with ASTM B 594. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances

Shall conform to all applicable requirements of ANSI H35.2 or ANSI H35.2M.

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the extrusions conform to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties as solution heat treated and naturally aged (3.3.1.1), ultrasonic inspection when specified (3.4.1), and tolerances (3.5) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.2.2 Periodic Tests

Tensile properties after precipitation heat treatment (3.3.2.1) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2355.

4.3.1 Additional Sampling and Testing of Material Press Solution Heat Treated

Compliance with the requirements of Table 2 shall be determined by hardness tests followed by tension tests performed on samples from the two softest extrusions in the inspection lot. The method of hardness testing shall be left to the discretion of the producer.