SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4173 | REV. F

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Superseding AMS4173E

Aluminum Alloy, Extrusions
1.0Mg - 0.60Si - 0.30Cu - 0.20Cr (6061-T6511 or T6510)
Solution Heat Treated, Stress Relieved by Stretching, Straightened, and Precipitation Heat Treated

(Composition similar to A96061)

RATIONALE

AMS4173F was revised to add provisions for billet types for tubing (1.1.1), for T6510 temper material (3.2.2), and for press solution heat treatment (3.2.3), 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, profiles, and tubing.

1.1.1 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 extrusions have been used typically for parts requiring moderate strength and where distortion during machining must be minimized, 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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4173F

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

Material shall be produced in one of the following tempers. If no temper is specifed, Temper –T6511 shall be supplied.

3.2.1 Temper –T6511

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 to the T6511 temper (See AS1990). Extrusions may receive minor straightening, after stretching, of an amount necessary to meet the requirements of 3.5.

3.2.1.1 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 specified dimensional tolerances.

3.2.2 Temper –T6510

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 to the T6510 temper (See AS1990). Extrusions shall receive no additional straightening or stretching to meet requirements of 3.5.

3.2.3 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.

3.2.4 Heat Treatment shall be classified as follows:

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

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 on the mill product size.

3.3.1 Tensile Properties

Shall be as shown in Table 2.

TABLE 2A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Diameter or Least Thickness (bars, rods, wire, profiles) 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 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Diameter or Least Thickness (bars, rods, wire, profiles) 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. Extrusions, 0.50 inch (12.7 mm) and over in nominal diameters or least distance between parallel sides, not exceeding 600 pounds (272 kg) per piece, or a 10 to 1 width-to-thickness ratio, shall meet ultrasonic Class B.

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

Composition (3.1), tensile properties (3.3.1), 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.

4.3 Sampling and Testing

Shall be in accordance with AMS 2355.

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.

4.4 Reports

The vendor of extrusions, shall furnish with each shipment a report stating that the extrusions conform to the chemical composition, ultrasonic inspection when specified, and tolerances and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, inspection lot number, AMS4173F, size or section identification number, extrusion type, class of heat treatment, and quantity. The report shall also identify the producer, the product form, and the size of the mill product.