SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4407

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Reaffirmed 2012-04

Aluminum Alloy, Plate (7056-T7651)
9.1Zn - 1.6Cu - 1.9Mg
Solution Heat Treated, Stress Relieved, and Overaged
(Composition similar to UNS A97056)

RATIONALE

AMS4407 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate.

1.2 Application

This product has been used typically for parts requiring high mechanical properties and fracture toughness, coupled with moderate stress corrosion and exfoliation corrosion resistance 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.

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.

AMS 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
AMS 2772	Heat Treatment of Aluminum Allow Raw Materials
AS1990	Aluminum Alloy Tempers

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4407

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 645	Plane Strain Fracture Toughness Testing of Aluminum Alloys
ASTM T 660	Packaging/Packaging of Aluminum and Magnesium Products
ASTM B 666/666M	Identification Marking of Aluminum and Magnesium Products
ASTM E 9	Compressive Testing of Metallic Materials at Room Temperature
ASTM E 399	Plane Strain Fracture Toughness of Metallic Materials
ASTM G 34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
ASTM G 47	Determining Susceptibility to Stress-Corrosion cracking of High-Strength Aluminum Alloy Products

2.3 ANSI Publications

Available from ANSI American National Standards Institute, 25 West 43rd Street, New York, NY 10036, 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 AMS 2355.

TABLE 1 - COMPOSITION

Element	min	max
Silicon	--	0.10
Iron	--	0.12
Copper	1.2	1.9
Manganese	--	0.20
Magnesium	1.5	2.3
Zinc	8.5	9.7
Titanium	--	0.08
Zirconium	0.05	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

Solution heat treated, stress relieved by stretching to produce a nominal permanent set of 2.5%, but not less than 1.5% nor more than 3%, and over-aged to the T7651 temper. (See AS1990).

3.2.1 Product shall receive no further straightening operations after stretching.

3.3 Heat Treatment

Shall be in accordance with AMS 2772 and as follows:

3.3.1 Solution Heat Treatment

Heat to 860 to 890 °F (460 to 477 °C), hold at heat for a time commensurate with product thickness, rapidly cool in a suitable quenching medium.

3.3.2 Overaging Heat Treatment

Over-aging shall be performed at a specific temperature and time as required to meet requirements of 3.4. (See 8.2).

3.4 Properties

The product shall conform to the following requirements, determined in accordance with AMS 2355 on the mill product.

3.4.1 Tensile Properties

Shall be as specified in Table 2.

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

Nominal Thickness (Inches)	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 inches or 4D %
0.500 to 1.000, incl	Longitudinal	83.0	79.0	10
	Long-Transverse	83.0	79.0	10
1.001 to 1.500, incl	Longitudinal	81.0	77.0	10
	Long-Transverse	81.0	77.0	9

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 5D %
Over 12.7 to 25.4, incl	Longitudinal	572	545	9
	Long-Transverse	572	545	9
Over 25.4 to 38.1, incl	Longitudinal	558	531	9
	Long-Transverse	558	531	8

3.4.2 Compressive Yield Strength

When specified, the compressive yield strength, determined in accordance with ASTM E 9, shall be as shown in Table 3.

TABLE 3 - MINIMUM COMPRESSIVE YIELD STRENGTH

Nominal Thickness Inches	Nominal Thickness Millimeters	Compressive Yield Strength Longitudinal/Long Transverse ksi	Compressive Yield Strength Longitudinal/Long Transverse MPa
0.500 to 1.000, incl	12.7 to 25.4, incl	78.0 / 83.0	538 / 572
Over 1.001 to 1.500, incl	Over 25.4 to 38.1, incl	76.0 / 81.0	524 / 558

3.4.3 Corrosion Resistance

3.4.3.1 Stress-Corrosion Cracking

Specimens, cut from plate 0.750 inch (19.05 mm) and over in nominal thickness, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction to 25.0 ksi (170 MPa) in accordance with ASTM G 47.

3.4.3.2 Exfoliation Corrosion Resistance

Specimens cut from plate shall not exhibit exfoliation corrosion at a T/2 plane greater than that illustrated by Photograph B Figure 2, of ASTM G34.

3.4.4 Fracture Toughness

Plain-strain fracture toughness (K_{IC}) for the L-T and T-L specimen orientations and configurations conforming to ASTM E 399 and ASTM B 645 shall be not lower than the values specified in Table 4 for plate 0.500 to 1.500 inches (12.7 to 38.1 mm) in nominal thickness.

TABLE 4 - MINIMUM FRACTURE TOUGHNESS PARAMETERS

Nominal Thickness Inches	Nominal Thickness Millimeters	Specimen Orientation	K_{IC} ksi √inch	K_{IC} MPa √m
0.500 to 1.500, incl	12.7 to 38.1, incl	L-T	27	30
		T-L	23	25

3.5 Quality

Plate, 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 product.

3.5.1 Each plate shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet ultrasonic class A requirements.

3.6 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 the product 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 product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), longitudinal and long-transverse tensile properties (3.4.1), stress corrosion cracking (when specified) (3.4.3.1), fracture toughness (3.4.4), ultrasonic soundness (3.5.1), dimensional tolerances (3.6) and, when specified, longitudinal compressive yield strength (3.4.2), are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Exfoliation corrosion resistance (3.4.3.2) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.