SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4411

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Reaffirmed 2013-05

Aluminum Alloy Plate (7081-T7651)
7.2Zn - 1.5Cu - 2.0Mg - 0.10Zr
Solution Heat Treated, Stress Relieved and Overaged
(Composition similar to UNS A97081)

RATIONALE

AMS4411 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 a high level of mechanical properties and fracture toughness with moderate resistance to stress-corrosion cracking, 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 canceled 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 Alloy 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/AMS4411

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 557 Tension Testing

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 B 660 Packaging of Aluminum and Magnesium Products

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

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 2XXX and 7XXX Aluminum Alloys Products

2.3 ANSI Publications

Available from 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	--	0.12
Iron	--	0.15
Copper	1.2	1.8
Manganese	--	0.25
Magnesium	1.8	2.2
Chromium	--	0.04
Zinc	6.9	7.5
Titanium	--	0.06
Zirconium	0.06	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 1-1/2 to 3% and overaged to T7651 (See AS1990).

3.2.1 Heat Treatment

Heat treatment shall be in accordance with the requirements of AMS 2772. Solution heat treatment and aging practices are proprietary.

3.2.2 Plate shall receive no further straightening operations after stretching.

3.3 Properties

Product shall conform to the following requirements, determined on the mill produced size in accordance with AMS 2355.

3.3.1 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 %
1.000 to 2.000, incl.	Longitudinal	77.0	72.0	8
	Long-Transverse	77.0	71.0	8
2.001 to 3.000, incl.	Longitudinal	77.0	72.0	8
	Long-Transverse	77.0	71.0	8
	Short Transverse	76.0	67.0	3
3.001 to 4.000, incl.	Longitudinal	75.0	72.0	8
	Long-Transverse	76.0	70.0	7
	Short Transverse	75.0	66.0	3
4.001 to 5.000, incl.	Longitudinal	75.0	72.0	7
	Long-Transverse	76.0	70.0	6
	Short Transverse	74.0	66.0	3
5.001 to 6.000, incl.	Longitudinal	75.0	72.0	7
	Long-Transverse	76.0	70.0	6
	Short Transverse	73.0	65.0	2

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.4 mm or 4D %
25.40 to 50.80, incl.	Longitudinal	531	497	8
	Long-Transverse	531	490	8
Over 50.80 to 76.20, incl.	Longitudinal	531	497	8
	Long-Transverse	531	490	8
	Short Transverse	524	462	3
Over 76.20 to 101.60, incl.	Longitudinal	517	497	8
	Long-Transverse	524	483	7
	Short Transverse	517	455	3
Over 101.60 to 127.00, incl.	Longitudinal	517	497	7
	Long-Transverse	524	483	6
	Short Transverse	510	455	3
Over 127.00 to 152.40, incl.	Longitudinal	517	497	7
	Long-Transverse	524	483	6
	Short Transverse	503	448	2

3.3.2 Corrosion Resistance

Resistance to stress-corrosion cracking and exfoliation corrosion shall be considered acceptable if the plate conforms to the requirements of 3.3.2.1 and 3.3.2.2

3.3.2.1 Electrical Conductivity

The conductivity will be not lower than 37.0 % IACS (International Annealed Copper Standard) (21.5 MS/m), determined on the surface of the tensile coupon. For conductivities from 33 (19.1MS/m) to 37 % IACS, the material is acceptable if the requirements of 3.3.4 are met.

3.3.2.2 Plate not meeting the requirements of 3.3.2.1 shall be given additional precipitation heat treatment or reheat treated. After such treatment, if all specified property requirements are met, the plate is acceptable.

3.3.3 Exfoliation Corrosion Test

As a part of periodic or surveillance testing, specimens shall not exhibit exfoliation corrosion greater than that illustrated by Photo B, Figure 2 of ASTM G34.

3.3.4 Stress-Corrosion Cracking Test

When specified, specimens tested in accordance with ASTM G 47, shall show no evidence of stress corrosion cracking when stressed in the short-transverse direction at 26 ksi (179 MPa).

3.3.5 Fracture Toughness Test

When specified, specimens tested in accordance with ASTM B 645, shall meet the requirements for K_{Ic} or K_Q agreed between the purchaser and the mill. For T-L and L-T test directions on plate 2 inches (51 mm) and under in nominal thickness, use full thickness specimens, for plate over 2 to 4 inches (51 mm to 102 mm), inclusive, in nominal thickness, use 2-inch (51 mm) specimens centered at T/2. For plate 4.001 and greater L-T and T-L shall be centered at T/4 plane. For S-L test direction, the test specimen shall be centered at T/2. Test specimen(s) orientation requirements shall be specified by purchaser.

3.4 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.

3.4.1 Each plate shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the requirements of 3.4.2 or 3.4.3 as applicable.

3.4.2 When specified, each plate 1.000 inch to 6.000 inches (25 mm to 150 mm) in nominal thickness shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the requirements of 3.4.3

3.4.3 Plates shall meet the requirements for ultrasonic class A for plate 1.000 to 6.000 inches (25 mm to 150 mm) in nominal thickness.

3.5 Tolerances

Shall conform to all 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), short transverse, long-transverse and longitudinal tensile properties (3.3.1), electrical conductivity (3.3.2.1), ultrasonic inspection (3.4.1), dimensional tolerances (3.5); when specified, fracture toughness (3.3.5), are acceptance tests and, except for composition, shall be conducted on each lot.