SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4328

Issued JAN 2003

Aluminum Alloy, Plate (2397-T87)
2.8Cu - 1.4Li - 0.30Mn - 0.12Zr - 0.10Zn
Solution Heat Treated, Cold Worked, and Artificially Aged
(Composition similar to UNS A92397)

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 in aerospace applications where low density is needed in combination with moderate strength, high fatigue resistance, good stress corrosion properties, and improved stiffness, 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001, or www.sae.org.

AMS 2355	Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
MAM 2355	Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units
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: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, or 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 B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666/B666M	Identification Marking of Aluminum Products
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials
ASTM E 1251	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge
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, 25 West 43rd Street, New York, NY 10036, or www.ansi.org.

ANSI H 35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H 35.2M	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 ASTM E 1251 and AMS 2355 or MAM 2355.

TABLE 1 - Composition

Element	min	max
Silicon	--	0.10
Iron	--	0.10
Copper	2.5	3.1
Manganese	0.10	0.50
Magnesium	--	0.25
Zinc	0.05	0.15
Titanium	--	0.12
Lithium	1.1	1.7
Zirconium	0.08	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition:

Heat treatment shall be in accordance with AMS 2772 and as follows: Solution heat treated at 960 to 980 °F (516 to 527 °C); stretched to produce a nominal permanent set of 2.75% but not less than 1.5% nor more than 4%; artificially aged at 320 °F (160 °C) for 59 to 61 hours, to the T87 temper (See AS1990).

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties:

Plate shall conform to the following requirements, determined on the mill produced size, in accordance with AMS 2355 or MAM 2355 and as specified herein:

3.3.1 Tensile Properties: Shall be as shown in Table 2.

TABLE 2A - Minimum Tensile Properties (Inch/Pound Units)

Thickness, Inclusive (inches)	Grain Direction	Ultimate Tensile Strength (ksi)	Yield Strength 0.2% offset (ksi)	% Elongation in 2 inches or 4D
4.001-5.000	L	62.0	56.0	6
	LT	62.0	56.0	4
	ST	60.0	55.0	1.5
5.001-6.000	L	60.0	55.0	5
	LT	60.0	55.0	4
	ST	57.0	52.0	1.5

TABLE 2B - Minimum Tensile Properties (SI Units)

Thickness, Inclusive (mm)	Grain Direction	Ultimate Tensile Strength (MPa)	Yield Strength 0.2% offset (MPa)	% Elongation in 50.8 mm or 4D
101.62-127.00	L	427	386	6
	LT	427	386	4
	ST	414	379	1.5
127.02-152.40	L	414	379	5
	LT	414	379	4
	ST	393	359	1.5

3.3.2 Corrosion Resistance:

3.3.2.1 Stress-Corrosion Resistance: Direct tension specimens machined and tested in accordance with ASTM G 47 shall show no evidence of stress corrosion failure when stressed in the short-transverse direction at 35.0 ksi (241 MPa) and exposed for 30 days.

3.3.2.2 Exfoliation Corrosion Resistance: Specimens shall show exfoliation corrosion resistance equal to or better than EB when tested at the T/10 plane per ASTM G 34.

3.3.3 Fracture Toughness: Fracture toughness shall be determined in accordance with ASTM E 399 and ASTM B 645 and shall meet the requirements for K_{Ic} shown in Table 3. For L-T and T-L test directions, use specimens with 1.5-inch (38.1 mm) minimum thickness. For the S-L test direction, specimen thickness should be maximized to the nearest 0.25 inch (6.35 mm). L-T, T-L, and S-L specimens shall be centered at T/4 for plate 4.001 inches (101.6 mm) and greater in nominal thickness. If a valid K_{Ic} or meaningful K_Q cannot be obtained due to insufficient specimen thickness or crack length, then the fracture toughness (K_Q) of the specimen will be acceptable for lot release if the following conditions are met:

3.3.3.1 The B dimension of the specimen tested was the maximum possible up to 2.5 inches (63.5 mm) for the given plate thickness.

3.3.3.2 The specimen centerline location was maintained at the specified plate thickness location.

3.3.3.3 All fracture toughness validity checks except specimen thickness, crack length or P_{max}/P_Q meet the criteria of ASTM E 399 or ASTM B 645.

3.3.3.4 If the only invalidity with B=1.5 inches (38.1 mm) is P_{max}/P_Q, test result is acceptable for lot release.

TABLE 3A – Minimum Fracture Parameters, Inch/Pound Units

Thickness, Inclusive (inches)	Specimen Orientation	Required Minimum Plane-Strain Fracture Toughness, K_{Ic} (ksi $\sqrt{in}$)
4.001 to 5.000	L-T	32
	T-L	26
	S-L	18
5.001 to 6.000	L-T	29
	T-L	25
	S-L	18

TABLE 3B - Minimum Fracture Toughness, SI Units

Thickness, Inclusive (mm)	Specimen Orientation	Required Minimum Plane-Strain Fracture Toughness, K_{Ic} (MPa $\sqrt{m}$)
101.62 to 127.00	L-T	35.2
	T-L	28.6
	S-L	19.8
127.02 to 152.40	L-T	31.9
	T-L	27.5
	S-L	19.8

3.4 Quality:

Plate, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the plate. Light scratches and discoloration or streaking shall not be reason for rejection.

3.4.1 Plate shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the requirements of Class A.

3.5 Tolerances:

Dimensional tolerances shall conform to all applicable requirements of ANSI H35.2 or H35.2M.

4. QUALITY ASSURANCE PROVISIONS::

4.1 Responsibility for Inspection:

The vendor of the plate 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 plate conforms to the specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1) shall be performed on each ingot or each group of ingots poured simultaneously from the same source of molten metal. Tensile properties (3.3.1), fracture toughness (3.3.2.3), and ultrasonic inspection (3.4.1) shall be performed on each parent plate.

4.2.2 Periodic Tests: Stress-corrosion resistance (3.3.2.1) and exfoliation corrosion resistance testing (3.3.2.2) are periodic tests and shall be performed on the first three lots and thereafter at a frequency selected by the vendor unless frequency of testing is specified by purchaser.