AEROSPACE MATERIAL SPECIFICATION

AMS4089	REV. E

Issued 1976-07
Revised 2014-07

Superseding AMS4089D

Aluminum Alloy, Plate
1.6Cu - 2.2Mg - 0.22Cr - 5.7Zn (7475-T7651)
Solution Heat Treated, Stress Relieved by Stretching,
and Precipitation Heat Treated
(Composition similar to UNS A97475)

RATIONALE

AMS4089E removes the requirement for notch tensile testing as an alternate procedure for evaluation of fracture toughness, revises Fracture Toughness (3.3.2, Table 3), Classification of Tests (4.2), and is a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

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

1.2 Application

This plate has been used typically for structural applications requiring material with high strength and resistance to exfoliation-corrosion, moderate fatigue strength, and high fracture-toughness, 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.

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

AMS2772 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/AMS4089E

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 Linear-Elastic Plane-Strain Fracture Toughness Testing of Aluminum Alloys

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

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

ASTM E 399 Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials

ASTM G 34 Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

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 B46.1 Surface Texture

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	--	0.10
Iron	--	0.12
Copper	1.2	1.9
Manganese	--	0.06
Magnesium	1.9	2.6
Chromium	0.18	0.25
Zinc	5.2	6.2
Titanium	--	0.06
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% but not less than 1-1/2% nor more than 3%, and precipitation heat treated to the T7651 temper (See AS1900) in accordance with AMS2772.

3.2.1 Plate shall receive no straightening operations after stretching.

3.3 Properties

Plate shall conform to the following requirements, determined in accordance with AMS2355:

3.3.1 Tensile Properties

Shall be as shown 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 %
0.250 to 0.499, incl	Longitudinal	70.0	60.0	9
	Long-Transverse	71.0	60.0	9
Over 0.499 to 1.000, incl	Longitudinal	69.0	59.0	8
	Long-Transverse	70.0	59.0	8
Over 1.000 to 1.500, incl	Longitudinal	69.0	59.0	6
	Long-Transverse	70.0	59.0	6

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness mm	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
6.35 to 12.67, incl	Longitudinal	483	414	9
	Long-Transverse	490	414	9
Over 12.67 to 25.40, incl	Longitudinal	476	407	8
	Long-Transverse	483	407	8
Over 25.40 to 38.10, incl	Longitudinal	476	407	6
	Long-Transverse	483	407	6

3.3.2 Fracture Toughness

Plane-strain fracture toughness shall be tested in accordance with ASTM E 399 and ASTM B 645 for plate 1.000 to 1.500 inches (25.40 to 38.10 mm) inclusive in nominal thickness. A valid K_{IC} meeting the requirements of ASTM E399 or a K_Q "useable for lot release" in accordance with ASTM B645 shall meet or exceed the values shown in Table 3.

TABLE 3 - MINIMUM PLANE STRAIN FRACTURE TOUGHNESS VALUES, KIC OR KQ "USEABLE FOR LOT RELEASE"

Specimen Orientation (See 8.2)	K_{IC} ksi $\sqrt{\text{inch}}$	K_{IC} MPa $\sqrt{\text{m}}$
L-T	33.0	36.3
T-L	30.0	33.0

3.3.3 Corrosion Resistance Indicator Test

3.3.3.1 If the conductivity is 39.0% IACS (International Annealed Copper Standard) (22.6 MS/m) or higher and the long-transverse yield strength does not exceed the specified minimum by 9000 psi (60 MPa) or more, the plate is acceptable.

3.3.3.2 If the conductivity is 39.0% IACS (22.6 MS/m) or higher and the long-transverse yield strength exceeds the specified minimum by 9000 psi (62 MPa) or more, or if the conductivity is at least 38.0% IACS (22.0 MS/m) but less than 39.0% IACS (22.6 MS/m) and tensile properties meet specified requirements, plate may be given additional precipitation heat treatment and then retested.

3.3.3.3 If the conductivity is lower than 38.0% IACS (22.0 MS/m), the plate is not acceptable and shall be reheat treated or additionally precipitation heat treated and retested.

3.3.4 Exfoliation Resistance

Plate shall not exhibit exfoliation corrosion at the T/10 plane greater than that illustrated by Photo B, Figure 2 of ASTM G 34.

3.3.5 Stress-Corrosion Resistance

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 (172 MPa).

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 plate.

3.4.1 Each plate, 0.500 inch (12.70 mm) and over in nominal thickness, shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet ultrasonic Class A.

3.5 Tolerances

Shall conform to all applicable requirements of ANSI H 35.2 or ANSI H 35.2M.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of 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 specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties (3.3.1), fracture toughness (3.3.2), corrosion resistance indicator test (3.3.3), quality (3.4), and tolerances (3.5) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Exfoliation resistance (3.3.4) and stress-corrosion resistance (3.3.5) 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 and the following:

4.3.1 Specimens for corrosion resistance indicator test shall be the tensile specimens.

4.4 Reports

The vendor of plate shall furnish with each shipment a report stating that the product conforms to the chemical composition, ultrasonic inspection, 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(s), AMS4089E, size, and quantity.The report shall also identify the producer, the product form, and the size of the mill product.