AEROSPACE MATERIAL SPECIFICATION

AMS4401™	REV. B

Issued 2006-08
Reaffirmed 2017-09
Revised 2022-11

Superseding AMS4401A

Aluminum Alloy, Plate (7140-T7451)
6.6Zn - 1.8Cu - 2.0Mg - 0.10Zr
Solution Heat Treated, Stress Relieved, and Overaged
(Composition similar to UNS A97140)

RATIONALE

AMS4401B results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (3.3.1.1, 3.6, 4.4.1, 5.1.1, 8.4), correct dimensions (Tables 2A and 2B), add "inclusive" to thickness range dimensions (Table 3), update form (1.1), applicable documents (Section 2, 3.2), ultrasonic testing (3.4.1), ordering information (8.5), and allow the use of the immediate prior specification revision (8.3).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate 4.001 to 10.000 inches (101.60 to 254.00 mm), inclusive, in nominal thickness.

1.2 Application

This product has been used typically for parts requiring a high level of mechanical properties and fracture toughness with good 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 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 +1 724-776-4970 (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
AS7766	Terms Used in Aerospace Metals Specifications

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**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4401B/

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 B594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products
ASTM B645	Linear-Elastic Plane Strain Fracture Toughness Testing of Aluminum Alloys
ASTM B660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B666/B666M	Identification Marking of Aluminum and Magnesium Products
ASTM G34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
ASTM G47	Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloys Products

2.3 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI H35.1/H35.1M	Alloy and Temper Designation Systems for Aluminum
ANSI H35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

2.4 Definitions

Terms used in AMS are defined in AS7766.

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	--	0.13
Copper	1.3	2.3
Manganese	--	0.04
Magnesium	1.5	2.4
Chromium	--	0.04
Zinc	6.2	7.0
Titanium	--	0.06
Zirconium	0.05	0.12
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 T7451 (refer to ANSI H35.1/H35.1M).

3.2.1 Heat Treatment

Heat treatment shall be in accordance with the requirements of AMS2772 and the following:

- Solution heat treat at 890 °F ± 10 °F (477 °C ± 6 °C),
- Recommended aging practice: 250 °F ± 10 °F (121 °C ± 6 °C) for 6 to 12 hours followed by 310 °F ± 10 °F (154 °C ± 6 °C) for 20 to 30 hours to the T7451 temper.

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 AMS2355.

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 %
4.001 to 5.000, incl	Longitudinal	71.0	66.0	9
	Long-Transverse	73.0	65.0	5
	Short-Transverse	69.0	60.0	3
5.001 to 6.000, incl	Longitudinal	71.0	66.0	8
	Long-Transverse	72.0	65.0	4
	Short Transverse	69.0	60.0	3
6.001 to 7.000, incl	Longitudinal	71.0	65.0	7
	Long-Transverse	72.0	64.0	4
	Short Transverse	68.0	59.0	3
7.001 to 8.000, incl	Longitudinal	70.0	65.0	6
	Long-Transverse	71.0	63.0	4
	Short Transverse	68.0	58.0	3
8.001 to 9.000, incl	Longitudinal	70.0	65.0	6
	Long-Transverse	71.0	63.0	3
	Short Transverse	67.0	58.0	3
9.001 to 10.000, incl	Longitudinal	70.0	65.0	5
	Long-Transverse	70.0	63.0	2
	Short Transverse	67.0	58.0	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 50.8 mm or 4D %
101.60 to 127.00, incl	Longitudinal	490	455	9
	Long-Transverse	503	448	5
	Short Transverse	476	414	3
Over 127.00 to 152.40, incl	Longitudinal	490	455	8
	Long-Transverse	496	448	4
	Short Transverse	476	414	3
Over 152.40 to 177.80, incl	Longitudinal	490	448	7
	Long-Transverse	496	441	4
	Short Transverse	469	407	3
Over 177.80 to 203.20, incl	Longitudinal	483	448	6
	Long-Transverse	490	434	4
	Short Transverse	469	400	3
Over 203.20 to 228.60, incl	Longitudinal	483	448	6
	Long-Transverse	490	434	3
	Short Transverse	462	400	3
Over 228.60 to 254.00, incl	Short Transverse	483	448	5
	Long-Transverse	483	434	2
	Short Transverse	462	400	2

3.3.1.1 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between purchaser and producer and reported per 4.4.1 (see 8.5).

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

Shall be not lower than 38.0 % IACS (International Annealed Copper Standard) (22.0 MS/m), determined on the surface of the tensile coupon.

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 (see 8.5), specimens tested in accordance with ASTM G47, shall show no evidence of stress corrosion cracking when stressed in the short-transverse direction at 35 ksi (241 MPa).

3.3.5 Fracture Toughness

When specified (see 8.5), specimens tested in accordance with ASTM B645, shall meet the requirements for K_{Ic} specified in Table 3. 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.

Table 3 - Minimum fracture toughness parameters

Nominal Thickness Inches	Nominal Thickness Millimeters	Specimen Orientation	K_{Ic} ksi √inch	K_{Ic} MPa √m
4.001 to 5.000, incl	101.60 to 127.00, incl	L-T	29	32
		T-L	24	26
		S-L	23	25
5.001 to 6.000, incl	Over 127.00 to 152.40, incl	L-T	26	29
		T-L	23	25
		S-L	22	24
6.001 to 7.000, incl	Over 152.40 to 177.80, incl	L-T	24	26
		T-L	21	23
		S-L	22	24
7.001 to 8.000, incl	Over 177.80 to 203.20, incl	L-T	22	24
		T-L	19	21
		S-L	22	24
8.001 to 9.000, incl	Over 203.20 to 228.60, incl	L-T	22	24
		T-L	19	21
		S-L	20	22
9.001 to 10.000, incl	Over 228.60 to 254.00, incl	L-T	22	24
		T-L	19	21
		S-L	20	22

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 3.4.1.1.

3.4.1.1 Plates shall meet the requirements for ultrasonic class A for plate 4.001 to 10.000 inches (101.60 to 203.20 mm) in nominal thickness.

3.5 Tolerances

Shall conform to all requirements of ANSI H35.2 or ANSI H35.2M.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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), corrosion resistance (3.3.2), ultrasonic inspection (3.4.1), dimensional tolerances (3.5), and when specified, stress corrosion cracking (3.3.4) and fracture toughness (3.3.5) are acceptance tests and, except for composition, shall be conducted on each lot.