

Aluminum Alloy, Plate (7140-T7651)
6.6Zn - 1.8Cu - 2.0Mg - 0.10Zr
Solution Heat Treated, Stress Relieved, and Overaged
(Composition similar to UNS A97140)

RATIONALE

AMS4408 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 plate has been used typically for parts requiring a high level of mechanical properties and 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 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 of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
AMS 2772	Heat Treatment of Aluminum Alloy Raw Materials
AS1990	Aluminum Alloy Tempers

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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 660	Packing/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 B 645	Plane Strain Fracture Toughness Testing of Aluminum Alloys
ASTM G 47	Determining Susceptibility to Stress-Corrosion Cracking of High-Strength Aluminum Alloy 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	--	0.10
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 artificially aged to T7651 temper (See AS1990).

3.2.1 Plate 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 Treat

Heat to 890 °F $\pm$ 10 (477 °C $\pm$ 6), hold for a time commensurate with product thickness, rapidly cool in a suitable quenching medium.

3.3.2 Overaging Heat Treatment

Overaging shall be performed at a specific temperature and time as required to meet requirements of 3.4.

3.4 Properties

Plate shall conform to the following requirements, determined in accordance with AMS 2355 on the mill produced product and as specified herein.

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 %
4.000 to 5.000, incl	Longitudinal	74.0	70.0	7
	Long-Trans.	76.0	69.0	6
	Short Trans.	73.0	63.0	3
Over 5.000 to 6.000, incl	Longitudinal	74.0	70.0	7
	Long-Trans.	75.0	68.0	4
	Short Trans.	72.0	62.0	3
Over 6.000 to 7.000, incl	Longitudinal	73.0	69.0	7
	Long-Trans.	75.0	68.0	3
	Short Trans.	71.0	62.0	3
Over 7.000 to 8.000, incl	Longitudinal	72.0	68.0	6
	Long-Trans.	74.0	67.0	3
	Short Trans.	71.0	61.0	3
Over 8.000 to 9.000, incl	Longitudinal	72.0	68.0	5
	Long-Trans.	73.0	65.0	3
	Short Trans.	69.0	60.0	3
Over 9.000 to 10.000, incl	Longitudinal	71.0	67.0	5
	Long-Trans.	71.0	64.0	2
	Short Trans.	68.0	59.0	3

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 %
101.6 to 127.0, incl	Longitudinal	510	483	6
	Long-Trans.	524	476	5
	Short Trans.	503	434	3
Over 127.0 to 152.4, incl	Longitudinal	510	483	6
	Long-Trans.	517	469	3
	Short Trans.	496	427	3
Over 152.4 to 177.8, incl	Longitudinal	503	476	6
	Long-Trans.	517	469	3
	Short Trans.	490	427	3
Over 177.8 to 203.2, incl	Longitudinal	496	469	6
	Long-Trans.	510	462	3
	Short Trans.	490	421	3
Over 203.2 to 229.0, incl	Longitudinal	496	469	4
	Long-Trans.	503	448	3
	Short Trans.	476	414	3
Over 229.0 to 254.0, incl	Longitudinal	490	462	4
	Long-Trans.	490	441	2
	Short Trans.	469	407	3

3.4.2 Corrosion-Resistance

Resistance to stress-corrosion cracking and to exfoliation-corrosion shall be considered acceptable if the plate conforms to the requirements of 3.4.2.1, 3.4.2.2 and 3.4.2.3. Plate not meeting the requirements of 3.4.2.1, 3.4.2.2 and/or 3.4.2.3 shall be given addition precipitation heat treatment or reheat treated. After such treatment, if all specified property requirements are met, the plate is acceptable.

3.4.2.1 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.

3.4.2.2 Exfoliation-Corrosion Test

Material shall not exhibit exfoliation corrosion greater than that illustrated by Photograph B of Figure 2 of ASTM G 34.

3.4.2.3 Stress-Corrosion Test

When specified, specimens shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction at 26.0 ksi (179 MPa) for 20 days in accordance with ASTM G 47.

3.4.3 Fracture Toughness

When specified, plate shall meet the values for K_{1C} specified in Table 3. For T-L and L-T test directions for plate over 4 inches (102 mm) in nominal thickness, use specimens 2-inch (51-mm) minimum thickness centered at T/4. For the S-L test direction, the test specimen shall be centered at T/2. Required specimen orientation(s) shall be specified by purchaser.

TABLE 3A - MINIMUM FRACTURE TOUGHNESS PARAMETERS, INCH/POUND UNITS

Nominal Thickness, Inches	L-T ksi $\sqrt{\text{inch}}$	T-L ksi $\sqrt{\text{inch}}$	S-L ksi $\sqrt{\text{inch}}$
4.000 to 5.000, incl	27	22	22
Over 5.000 to 6.000, incl	25	21	22
Over 6.000 to 7.000, incl	24	20	22
Over 7.000 to 8.000, incl	22	19	21
Over 8.000 to 9.000, incl	20	18	20
Over 9.000 to 10.000, incl	18	17	20

TABLE 3B - MINIMUM FRACTURE TOUGHNESS PARAMETERS, SI UNITS

Nominal Thickness, Millimeters	L-T MPa $\sqrt{\text{m}}$	T-L MPa $\sqrt{\text{m}}$	S-L MPa $\sqrt{\text{m}}$
101.6 to 127.0, incl	30	24	24
Over 127.0 to 152.4, incl	28	23	24
Over 152.4 to 177.8, incl	26	22	24
Over 177.8 to 203.2, incl	24	21	23
Over 203.2 to 229.0, incl	22	20	22
Over 229.0 to 254.0, incl	20	19	22

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 plate.

3.5.1 Each plate shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the requirements of 3.5.1.1 or 3.5.1.2 as applicable.

3.5.1.1 Plates weighing 2000 pounds (907 kg) and under shall meet the requirements for ultrasonic Class A for plate 4.000 to 8.000 inches (76 to 203 mm), incl in nominal thickness.

3.5.1.2 The ultrasonic class for plates weighing over 2000 pounds (907 kg) or over 8.000 inches (203 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

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 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 (3.4.1), electrical conductivity (3.4.2.1), tolerances (3.6), ultrasonic soundness (3.5.1) and, when specified, fracture toughness (3.4.3) are acceptance tests and, except for composition, shall be performed on each inspection lot.