SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4202 | REV. D

Issued 1978-07
Revised 2005-07
Reaffirmed 2012-03

Superseding AMS4202C

Aluminum Alloy Plate
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T7351)
Solution Heat Treated, Stress Relieved by Stretching, and Precipitation Heat Treated

(Composition similar to UNS A97475)

RATIONALE

AMS4202D 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 structural applications requiring high strength and resistance to stress-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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or 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/AMS4202D

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 Products for Aerospace Applications
ASTM B 645	Plane Strain Fracture Toughness Testing of Aluminum Alloys
ASTM B 646	Fracture Toughness Testing of Aluminum
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666	Identification Marking of Aluminum Products
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials
ASTM E 602	Sharp-Notch Tension Testing with Cylindrical Specimens
ASTM E 1304	Plane-Strain (Chevron-Notch) Fracture Toughness of Metallic Materials

2.3 ANSI Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036 or 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

Elements	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
Titanium	--	0.06
Zinc	5.2	6.2
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 –T7351 temper (See AS1990). Heat treatment shall be in accordance with AMS 2772.

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties:

Plate shall conform to the following requirements, determined in accordance with AMS 2355 on the mill product except that fracture toughness (K_{IC}) and chevron-notch fracture toughness (K_{IVM}) or notch tensile testing (NTS/TYS) shall be performed as in 3.3.2.1, 3.3.2.2 or 3.3.2.3, respectively.

3.3.1 Tensile Properties: Shall be as shown in Table 2 and 3.3.1.2.

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 1.500, excl	Longitudinal	71.0	60.0	10
	Long-Trans.	71.0	60.0	9
1.500	Longitudinal	71.0	60.0	10
	Long-Trans.	71.0	60.0	9
	Short-Trans	67.0	56.0	4
Over 1.500 to 2.000, incl	Longitudinal	70.0	58.0	10
	Long-Trans.	70.0	58.0	8
	Short-Trans	66.0	54.0	4
Over 2.000 to 2.500, incl	Longitudinal	69.0	57.0	10
	Long-Trans.	69.0	57.0	8
	Short-Trans	65.0	53.0	4
Over 2.500 to 3.000, incl	Longitudinal	68.0	56.0	10
	Long-Trans.	68.0	56.0	8
	Short-Trans	65.0	53.0	3
Over 3.000 to 3.500, incl	Longitudinal	65.0	53.0	10
	Long-Trans.	65.0	53.0	8
	Short-Trans	64.0	51.0	3
Over 3.500 to 4.000, incl	Longitudinal	64.0	52.0	9
	Long-Trans.	64.0	52.0	7
	Short-Trans	63.0	50.0	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 50.8 mm or 4D %
Over 6.35 to 38.10, excl	Longitudinal	490	414	10
	Long-Trans.	490	414	9
38.10	Longitudinal	490	414	10
	Long-Trans.	490	414	9
	Short-Trans	462	386	4
Over 38.10 to 50.80, incl	Longitudinal	483	400	10
	Long-Trans.	483	400	8
	Short-Trans	455	372	4
Over 50.80 to 63.50, incl	Longitudinal	476	393	10
	Long-Trans.	476	393	8
	Short-Trans	448	365	4
Over 63.50 to 76.20, incl	Longitudinal	469	386	10
	Long-Trans.	469	386	8
	Short-Trans	448	365	3
Over 76.20 to 88.90, incl	Longitudinal	448	365	10
	Long-Trans.	448	365	8
	Short-Trans	441	352	3
Over 88.90 to 101.60, incl	Longitudinal	441	359	9
	Long-Trans.	441	359	7
	Short-Trans	434	345	3

3.3.1.1 Short-transverse tensile property requirements apply only to plate 1.500 inches (38.10 mm) and over in nominal thickness.

3.3.2 Fracture Toughness: Determination of fracture toughness is specified in 3.3.2.1 (K_{Ic}), 3.3.2.2 (K_{IVM}), and 3.3.2.3 (NTS/TYS ratios). The plane-strain (chevron-notch) fracture toughness test or the notched tensile test may be used as an alternate test method for the plane-strain fracture toughness (K_{IC}) test requirements of Table 3, provided the vendor has an established correlation between the (K_{IC}) properties and the alternate tests (i.e., K_{IVM} or NTS/TYS). Correlation data shall be provided to the purchaser when requested.

3.3.2.1 Plane-Strain Fracture Toughness (K_{IC}): K_{IC} properties shall be as specified in Table 3.

TABLE 3 - Minimum Plane-Strain Fracture Toughness, K_{IC}

Nominal Thickness Inches	Nominal Thickness Millimeters	Specimen Orientation (See 8.2)	K_{IC} ksi $\sqrt{inch}$	K_{IC} Mpa $\sqrt{m}$
Over 0.749 to 1.249, incl	Over 19.02 to 31.72, incl	L-T[(1)]	38	42
Over 0.749 to 1.249, incl	Over 19.02 to 31.72, incl	T-L	32	35
Over 1.249 to 4.000, incl	Over 31.72 to 101.60, incl	L-T[(1)]	40	44
Over 1.249 to 4.000, incl	Over 31.72 to 101.60, incl	T-L	33	36
2.750 to 4.000, incl	69.85 to 101.60, incl	S-L	25	27

(1) L-T not required if T-L and S-L acceptable for 2.750 to 4.000-inch (69.85 to 101.60-mm) thickness.

3.3.2.1.1 The test specimen location shall be the T/2 plane for all orientations. For plate thickness 0.750 to 2.500 inches (19.05 to 63.50 mm) inclusive, the specimen shall be full thickness for both the L-T and T-L orientations. For plate thickness over 2.500 to 4.000 inches (63.50 to 101.60 mm) inclusive, the specimen thickness shall be machined to 2.50 inches (63.5 mm). A thicker specimen shall be used if needed to obtain valid test results. For the S-L orientation, the specimen shall be as large as possible for material 2.750 to 4.000 inches (69.85 to 101.60 mm) thick.

3.3.2.1.2 Lot acceptance of invalid K_Q values shall be per the guidelines of ASTM B 645, section "Interpretation of Results".

3.3.2.2 Plane-Strain (Chevron-Notch) Fracture Toughness (K_{IVM}): For plate thickness 1.000 to 4.000 inches (25.40 to 101.60 mm) inclusive, plane-strain (chevron-notch) fracture toughness (K_{IVM}) shall be determined in accordance with ASTM E 1304 and ASTM B 646. K_{IVM} test directions shall be in accordance with the orientation presented in Table 3. The measured value of K_{IVM} shall not fall below the critical values established by the producer from the correlation between K_{IC} and K_{IVM}. If such failures occur, the performance of a plane-strain fracture toughness (K_{IC}) test is required to demonstrate the material's inherent toughness capability. The K_{IVM} test specimens shall be 1.00 inch (25.4 mm) thick or round, have a W/B ratio equal to 1.45 and shall be centered at T/2 plane.

3.3.2.3 Notch Tensile Strength/Tensile Yield Strength (NTS/TYS) Ratio: For plate thickness 0.750 to 4.000 inches (19.05 to 101.60 mm) inclusive, notch tensile strengths shall be determined in accordance with ASTM E 602 and ASTM B 646, as applicable, from specimens taken in both the longitudinal and long-transverse directions. The values for each direction shall be divided by the corresponding tensile yield strength to obtain NTS/TYS ratios. The NTS/TYS ratio values used shall not fall below the critical values established by the producer from the correlation between K_{IC} and NTS/TYS. If such failures occur, the performance of a plane-strain fracture toughness (K_{IC}) test is required to demonstrate the material's inherent toughness capability.

3.3.3 Corrosion Resistance: Shall conform to 3.3.3.1 and 3.3.3.2.

3.3.3.1 Indicator (Conductivity) Test:

3.3.3.1.1 If the conductivity is 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m) or higher, determined on the surface of the tensile samples and tensile properties meet specified requirements, the plate is acceptable.

3.3.3.1.2 If the conductivity is below 40.0% IACS (23.2 MS/m), the plate shall be re-heat treated or given additional precipitation heat treatment to meet the specified requirements.

3.3.3.2 Stress Corrosion (Alternate-Immersion) Test: 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 to 40.0 ksi (276 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 When specified, each plate 0.500 to 4.000 inches (12.70 to 101.60 mm) in nominal thickness shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the following requirements:

3.4.1.1 Plates weighing 2000 pounds (907 kg) or less shall meet the requirements for ultrasonic class as shown in Table 4.

TABLE 4 - Ultrasonic Class

Nominal Thickness Inches	Nominal Thickness Millimeters	Ultrasonic Class
0.500 to 1.499, incl	12.70 to 38.07, incl	B
Over 1.499 to 3.000, incl	Over 38.07 to 76.20, incl	A
Over 3.000 to 4.000, incl	Over 76.20 to 101.60, incl	B

3.5 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 (3.3.1), fracture toughness (3.3.2), and tolerances (3.5) are acceptance tests and except for composition shall be performed on each lot. Compliance to the fracture toughness requirements shall be met by use of plane-strain fracture toughness (3.3.2.1), unless the alternate plane-strain (chevron-notch) fracture toughness (3.3.2.2) or notch tensile test (3.3.2.3) is used. Use of alternative tests for fracture toughness require the vendor to have an established correlation between K_{Ic} and K_{IVM} or NTS/TYS tests. When specified on the purchase order, ultrasonic soundness (3.4.1) is an acceptance test and shall be performed on each lot.

4.2.2 Periodic Tests: Stress corrosion cracking (alternate immersion) (3.3.3.2) is classified as a periodic test and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355, except that a lot shall be all plate of the same thickness, taken from the same ingot processed by the same procedure, from the same heat treat load, and presented for inspection at one time.

4.3.1 Specimens for conductivity testing shall be the tensile samples.

4.4 Reports:

The vendor of the product shall furnish with each shipment a report stating that the product conforms to the chemical composition, tolerances, and ultrasonic testing when specified, showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements, and stating that the product conforms to the other specified requirements. This report shall include the purchase order number, inspection lot number(s), AMS 4202D, size, and quantity. The report shall also identify the producer, the mill product form, and the mill produced size.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Shall be in accordance with ASTM B 666/B 666M.