SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4213 REV. A

Issued 2005-10
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Superseding AMS4213

Aluminum Alloy Plate (2027-T351)
4.4Cu - 1.2Mg - 0.8Mn - 0.10Zr
Solution Heat Treated, Cold Worked and Naturally Aged
(Composition similar to UNS A92027)

RATIONALE

AMS4213A revises heat treatment (3.3) and results from 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 product has been used typically for structural parts requiring a high level of mechanical properties and good damage tolerance, 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 Alloy, 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

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 Packaging of Aluminum and Magnesium Products

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

ASTM E 561 Standard Practice for K-R Curve Determination

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 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	--	0.12
Iron	--	0.15
Copper	3.9	4.9
Manganese	0.50	1.2
Magnesium	1.0	1.5
Zinc	--	0.20
Titanium	--	0.08
Zirconium	0.05	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

Solution heat treated, stretched to produce a permanent set not less than 1.5% nor more than 3%, and aged to the T351 temper (See AS1990).

3.3 Heat Treatment

Solution heat treatment shall be in accordance with AMS2772.

3.4 Properties

Product shall conform to the following requirements, determined on the mill product in accordance with AMS2355.

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 %
0.500 to 1.500, incl	Longitudinal	68.0	52.0	14
	Long-Transverse	67.0	46.0	14
1.501 to 2.250, incl	Longitudinal	66.0	50.0	14
	Long-Transverse	65.0	45.0	14
	Short-Transverse	60.0	41.0	4

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 5D %
Over 12.7 to 38.1, incl	Longitudinal	469	359	12
	Long-Transverse	462	317	12
Over 38.1 to 57.2, incl	Longitudinal	455	345	12
	Long-Transverse	448	310	12
	Short-Transverse	414	283	4

3.4.2 Fracture Toughness

Plane stress fracture toughness (K_{app}) determined using a 16-inch (406 mm) wide, 0.25 inch (6 mm) thick center-cracked panel in accordance with ASTM B 646 shall be not lower than the tentative values specified in Table 3.

TABLE 3 - MINIMUM FRACTURE TOUGHNESS PARAMETERS (TENTATIVE)

Nominal Thickness Inches	Nominal Thickness Millimeters	Specimen Orientation	K_{app} ksi √inch	K_{app} MPa √m
0.500 to 2.250, incl	Over 12.7 to 57.2, incl	L-T	97	107

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 product.

3.5.1 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 requirements.

3.6 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 the product 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 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 (3.4.1), ultrasonic soundness (3.5.1) and dimensional tolerances (3.6) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.2.2 Periodic Tests

Fracture toughness (3.4.2) is a periodic test 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 Tensile specimens shall be taken with axis of specimens parallel to each applicable grain flow direction specified in Table 2.

4.4 Reports

The vendor of the product shall furnish with each shipment a report stating that the product conforms to the composition, tolerances and ultrasonic inspection; and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements and to the periodic test, if performed. This report shall include the purchase order number, inspection lot number(s), AMS4213A, size and quantity. The report shall also identify the mill producer and the size of the mill product.

4.5 Resampling and Retesting

Shall be in accordance with AMS2355.

5. PREPARATION FOR DELIVERY

5.1 Identification

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

5.2 Packaging

The product shall be prepared for shipment in accordance with ASTM B 660 and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.