SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4302 | REV. B

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Superseding AMS 4302A

Aluminum Alloy, Laminated Sheet, Aramid Fiber Reinforced 5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T761) 3, 5, 7, or 9 Ply

RATIONALE

This document has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENT NOTICE

This specification has been declared “NONCURRENT” by the Aerospace Materials Division, SAE, as of September, 2006. It is recommended, therefore, that this specification not be specified for new designs.

“NONCURRENT” refers to those specifications which have previously been widely used and which may be required for production or processing of existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. “NONCURRENT” specifications are available from SAE upon request.

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http://www.sae.org/technical/standards/AMS4302B

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of sheet laminated with one or more layers of unidirectional aramid fiber/epoxy prepreg.

1.2 Application:

This product has been used typically for structural parts requiring a combination of high fatique-crack-growth resistance, fracture toughness, and resistance to corrosion, but usage is not limited to such applications.

1.3 Classification:

Laminated sheet supplied shall be of one of the types shown in Table 1, as specified by purchaser; aluminum alloy sheet is represented in the lay-up sequence by the letter A and prepreg by the letter P.

TABLE 1 - Laminate Types

Type	Lay-up Sequence
Type 2/1	A/P/A
Type 3/2	A/P/A/P/A
Type 4/3	A/P/A/P/A/P/A
Type 5/4	A/P/A/P/A/P/A/P/A

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2202	Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate
MAM 2202	Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Sheet and Plate
AMS 2355	Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
MAM 2355	Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) Units
AMS 2468	Hard Coating Treatment of Aluminum Alloys
AMS 2470	Anodic Treatment of Aluminum Alloys, Chromic Acid Process
AMS 4085	Aluminum Alloy Sheet, 5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr, (7475-T761), Solution Heat Treated and Overaged

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 557	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM B 557M	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products, (Metric)
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM D 3167	Floating Roller Peel Resistance of Adhesives
ASTM E 338	Sharp-Notch Tension Testing of High-Strength Sheet Materials

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MMM-A-132 Adhesive, Heat Resistant, Airframe Structural, Metal to Metal

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 The sheet layers shall be AMS 4085 aluminum alloy 0.012 inch (0.30 mm) thick.

3.1.2 Interior layers of the laminate shall consist of one or more layers of unidirectional aramid fibers preimpregnated with epoxy resin adhesive, hereafter referred to as prepreg. If more than one layer of prepreg is used, they shall be separated by sheets of aluminum as described in 3.2.1.

3.1.3 The nominal thickness of laminated sheet shall be as shown in Table 2.

TABLE 2 - Nominal Thickness

Type	Inch	Millimeters
Type 2/1	0.032	0.81
Type 3/2	0.053	1.35
Type 4/3	0.073	1.85
Type 5/4	0.094	2.39

3.2 Laminating:

3.2.1 Faying (bonding) surfaces of the aluminum sheets, before assembly as a laminate, shall be cleaned, rinsed, and anodized (but not sealed) in accordance with AMS 2468, AMS 2470, or other process acceptable to purchaser. All anodized surfaces shall be primed prior to lay-up with prepreg.

3.2.2 The epoxy adhesive in the prepreg shall conform to MMM-A-132, Type I. The aramid fiber and the quality characteristics of the prepreg shall be as agreed upon by purchaser and vendor. The prepreg shall be laid-up in the laminate assembly so that the fibers of all layers are oriented longitudinally, corresponding to the rolling direction of the aluminum sheets.

3.2.3 After lay-up, laminates shall be cured (bonded) using heat and pressure by a process, such as autoclaving, to produce the required properties. A typical practice is one hour at 260 °F ± 10 (127 °C ± 6) at a pressure of 70 - 75 psi (483 - 517 kPa).

3.2.4 The laminate shall be processed to adjust residual stresses (ARS) by causing the aluminum components to be in longitudinal compression rather than in tension. Adjustment shall be accomplished by stretching after curing, or by other means, to achieve 0.35 to 0.50% permanent set (See 8.2).

3.2.5 When specified, exterior surfaces of laminates shall be supplied anodized and primed.

3.3 Properties:

Laminated sheet shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as specified in Table 3, determined in accordance with ASTM B 557 or ASTM B 557M using specimens with 3-inch (76-mm) fillet radii in lieu of 0.500-inch (12.70-mm).

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Laminate Type	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi
2/1	Longitudinal	103.0	76.0
	Long-Transverse	56.0	48.0
3/2	Longitudinal	111.0	82.0
	Long-Transverse	51.0	43.0
4/3	Longitudinal	114.0	82.0
	Long-Transverse	50.0	42.0
5/4	Longitudinal	116.0	84.0
	Long-Transverse	48.0	40.0

TABLE 3B - Minimum Tensile Properties, SI Units

Laminate Type	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa
2/1	Longitudinal	710	524
	Long-Transverse	386	331
3/2	Longitudinal	765	565
	Long-Transverse	352	296
4/3	Longitudinal	786	565
	Long-Transverse	345	290
5/4	Longitudinal	800	579
	Long-Transverse	331	276

3.3.2 Notch Tensile Strength: Shall be determined in accordance with ASTM E 338 using a center-cracked 2-inch (51-mm) wide by 12-inch (305-mm) long specimen having a 0.2 inch (5-mm) open hole. Acceptance standards shall be as specified by purchaser.

3.3.3 Roller Peel Strength: Adhesion of either outer layer shall be determined in the long transverse direction in accordance with ASTM D 3167 on a 1-inch (25-mm) wide specimen. Acceptance standards shall be as specified by purchaser.

3.4 Quality:

Laminated sheet, as received by purchaser, shall uniform in quality and condition, sound, and free from foreign materials and imperfections detrimental to usage of the sheet.

3.4.1 Each laminated panel shall be inspected for anomalies and continuity of bond using either transmission or immersion ultrasonic techniques acceptable to purchaser. Ultrasonic transducers shall operate with a minimum frequency of 5 megahertz regardless of the inspection method employed. Imperfections that produce, in a single pass through the laminated panel, a 50% or greater attenuation of ultrasound at 5 megahertz frequency over an area not to exceed 0.25 inch (6.4 mm) in diameter are not acceptable.

3.5 Tolerances:

Laminated sheet shall conform to all applicable requirements of AMS 2202 or MAM 2202 except as specified in 3.5.1.

3.5.1 Thickness tolerances shall be as shown in Table 4.

TABLE 4 - Thickness Tolerances

Type	Tolerances
Type 2/1	±0.0025 inch (±0.064 mm)
Type 3/2 and 4/3	±0.003 inch (±0.08 mm)
Type 5/4	±0.0035 inch (±0.089 mm)

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of laminated sheet shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the sheet conforms to the requirements of this specification.

4.2 Classification of Tests:

Tests for all technical requirements are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355 or MAM 2355 and the following:

4.3.1 Inspection Lot: An identifiable quantity of laminated sheet of the same type (thickness) containing aluminum sheet from one heat treatment lot, prepreg from one manufacturer's batch lot, cured in the same lamination cycle, and presented for vendor's inspection at one time.

4.3.2 Tensile Properties: One sample in full thickness, from each 1000 pounds (454 kg) or part thereof from each inspection lot, in both the longitudinal and the long-transverse directions.

4.3.3 Notch Tensile Test: One sample from each inspection lot taken in the longitudinal direction.

4.3.4 Roller Peel Test: One sample from each inspection lot taken in the long-transverse direction.

4.4 Reports:

The vendor of laminated sheet shall furnish with each shipment a report showing the results of tests on each inspection lot to determine conformance to the acceptance test requirements. This report shall include the purchase order number, laminate type, inspection lot number, AMS 4302A, size, and quantity.