

AEROSPACE MATERIAL SPECIFICATION

AMS 4302

Submitted for recognition as an American National Standard

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LAMINATED SHEET, ALUMINUM ALLOY, ARAMID FIBER REINFORCED
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T761)
3, 5, or 7 Ply

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: Primarily for structural parts requiring a combination of high fatigue-crack-growth resistance, fracture toughness, and resistance to corrosion.

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 as specified in AMS 2350.

- 2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2202 - Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate
MAM 2202 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Sheet and Plate
AMS 2350 - Standards and Test Methods
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

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2.1.1 Aerospace Material Specifications (Continued):

- 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
- AMS 4100 - Aluminum Alloy Sheet, Alclad, 5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr, (7475-T761), Solution and Precipitation Heat Treated

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

- 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 Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Specifications:

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. When specified by purchaser, one or both outside plies of the laminate shall be alclad one side AMS 4100 aluminum alloy sheet with the cladding being the exposed surface.
- 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 3, 5, and 7 ply sheets are 0.032, 0.053, and 0.073 inch (0.81, 1.35, and 1.85 mm), respectively, in nominal thickness.

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 agreed upon by purchaser and vendor. 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 Assembly sequence or lay-up of the laminate components, with aluminum sheet represented by A and prepreg represented by p, shall be as follows:

Thickness		Laminate Type	Lay-up Sequence
Inch	Millimetres		
0.032	0.81	Type 2/1	A/p/A
0.053	1.35	Type 3/2	A/p/A/p/A
0.073	1.85	Type 4/3	A/p/A/p/A/p/A

3.2.4 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 $260^{\circ}\text{F} \pm 10$ ($127^{\circ}\text{C} \pm 6$) at a pressure of 70 - 75 psi (483 - 517 kPa).

3.2.5 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 8.1).

3.2.6 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 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). Typical properties are shown in 8.3; criteria for acceptance shall be as agreed upon by purchaser and vendor.

3.3.2 Notch Tensile Strength: Shall be determined in accordance with ASTM E 338 using a center-cracked 3 inch (76 mm) wide specimen. Acceptance standards shall be as agreed upon by purchaser and vendor.

3.3.3 Roller Peel Strength: Adhesion of either outer layer shall be determined in accordance with ASTM D 3167. Acceptance standards shall be as agreed upon by purchaser and vendor.

3.4 Quality: Laminated sheet, as received by purchaser, shall be 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 100% inspected for anomalies and continuity of bond using either transmission or immersion ultrasonic techniques compatible with ASTM standards. 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 follows:

Type 2/1	± 0.0025 inch (± 0.064 mm)
Types 3/2 and 4/3	± 0.003 inch (± 0.08 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. Results of such tests shall be reported to the purchaser as required by 4.4. 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; the number of specimens to be sampled shall be the minimum number of specimens tested:

4.3.1 Inspection Lot: An identifiable quantity of laminated sheet of the same type (thickness) containing bare aluminum sheet from one heat treat lot, alclad one side aluminum sheet, if any, from one heat treat 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.