

# AEROSPACE MATERIAL SPECIFICATION

**SAE** AMS 4254

REV. B

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Superseding AMS 4254A	

Aluminum Alloy, Aramid Fiber Reinforced, Laminated Sheet  
4.4Cu - 1.5Mg - 0.6Mn (2024-T3)  
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.

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## 1. SCOPE:

## 1.1 Form:

This specification covers aluminum alloy sheet laminated with one or more layers of unidirectional aramid fiber/epoxy prepreg. The outer layers are always aluminum alloy.

## 1.2 Application:

This product has been used typically for structural parts requiring strength, fatigue-crack-growth resistance, and damage tolerance properties, 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 Lay-up

Laminate 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, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
MAM 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units

AMS 2470 Anodic Treatment of Aluminum Alloys, Chromic Acid Process  
 AMS 3901 Organic Fiber (Para-Aramid), Yarn and Roving, High Modulus  
 AMS 4037 Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; - T3 Flat Sheet,  
 - T351 Plate), Solution Heat Treated

## 2.2 ASTM Publications:

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

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products  
 ASTM D 3167 Floating Roller Peel Resistance of Adhesives

## 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 aluminum layers shall be 0.012 inch (0.30 mm) thick AMS 4037 aluminum alloy sheet.

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 3.1.1 and 3.2.1.

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

TABLE 2 - Nominal Thickness

Laminate Type	Thickness Inch	Thickness Millimeters
2/1	0.032	0.81
3/2	0.053	1.35
4/3	0.073	1.85
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 and rinsed, etched and rinsed, and anodized (but not sealed) in accordance with AMS 2470 or other process agreed upon by purchaser and vendor. All anodized surfaces shall be primed prior to bonding.
- 3.2.2 The epoxy adhesive in the prepreg shall conform to MMM-A-132, Type I, Class 2, Form F, Group 3. The aramid fiber shall be in accordance with AMS 3901. The quality characteristics of the prepreg shall be controlled by a specification mutually acceptable to purchaser and vendor. The prepreg shall be laid 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 250 °F ± 10 (121 °C ± 6) at a pressure of 70 to 75 psi (483 to 517 KPa).
- 3.2.4 When specified, the laminate shall be processed to adjust residual stresses (ARS) by causing the aluminum components to be in longitudinal compression rather than in tension. Adjusting residual stresses, as by stretching after curing to achieve 0.35 to 0.5% permanent set, slightly increases the tensile ultimate and the tensile yield strengths and enhances resistance to fatigue crack growth.
- 3.2.5 When specified by purchaser, exterior surfaces of laminates shall be anodized and primed.

### 3.3 Properties:

Laminated sheet shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355 except as specified in 3.3.2 and 3.3.3.

- 3.3.1 Tensile Properties: Shall be as specified in Table 3, determined using a specimen with a 3-inch (76-mm) fillet radius instead of the 0.500 inch (12.70 mm).

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

Nominal Thickness Inch	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Strain at Failure, % in 2-Inch Gage Length
0.032	Longitudinal	90.0	48.0	2
	Long-Transverse	48.0	33.0	12
0.053	Longitudinal	96.0	49.0	2
	Long-Transverse	44.0	30.0	12
0.073	Longitudinal	101	49.0	2
	Long-Transverse	43.0	30.0	12
0.094	Longitudinal	101	49.0	2
	Long-Transverse	42.0	30.0	14

TABLE 3B - Minimum Tensile Properties, SI Units

Nominal Thickness Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Strain at Failure, % in 51-mm Gage Length
0.81	Longitudinal	620	331	2
	Long-Transverse	331	228	12
1.35	Longitudinal	662	338	2
	Long-Transverse	303	207	12
1.85	Longitudinal	696	338	2
	Long-Transverse	296	207	12
2.39	Longitudinal	696	338	2
	Long-Transverse	290	207	14

3.3.2 Notch Tensile Strength: Shall be determined using a 2-inch (51-mm) wide by 12-inch (305-mm) long specimen having a 0.2-inch (5-mm) diameter open hole. Results of tests shall be reported.

3.3.3 Roller Peel Strength: Adhesion of either outer layer shall be determined in accordance with ASTM D 3167 using a 1-inch (25-mm) wide specimen. Results of tests shall be reported.

#### 3.4 Quality:

Laminated sheet, 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 sheet.

3.4.1 Internal Soundness: Each laminated panel shall be inspected for anomalies and continuity of bond using ultrasonic techniques acceptable to purchaser. Ultrasonic transducers shall operate with a minimum nominal frequency of 5 megahertz regardless of the inspection method employed. No C-Scan indication greater than the response from a 0.25 inch (6.4 mm) diameter reference defect is acceptable.

#### 3.5 Tolerances:

Laminated sheet shall conform to all applicable requirements of AMS 2202 or MAM 2202.

### 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.