# AEROSPACE MATERIAL SPECIFICATION

| AMS4304 | REV. B |
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Revised 2009-09
Reaffirmed 2015-03

Superseding AMS4304B

## Aluminum Alloy, Discontinuously Reinforced Sheet 2009/SiC/15w (T8P) Solution Heat Treated, Stretched, and Precipitation Heat Treated

RATIONALE

AMS4304B has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers discontinuously reinforced aluminum alloy (DRA) metal matrix composites (MMC) in the form of sheet.

1.2 Application

This sheet has been used typically for structural applications requiring high static strength, moderate fatigue strength, and high elastic modulus, 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 Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings |
| AMS2750 | Pyrometry |
| AS1990 | Aluminum Alloy Tempers |





**TO PLACE A DOCUMENT ORDER:** **Tel: 877-606-7323 (inside USA and Canada)**
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**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/AMS4304B**

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 646 | Fracture Toughness Testing of Aluminum Alloys |
| ASTM B 660 | Packaging/Packing of Aluminum and Magnesium Products |
| ASTM B 666/B 666M | Identification Marking of Aluminum and Magnesium Products |
| ASTM D 3553 | Fiber Content by Digestion of Reinforced Metal Matrix Composites |

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products

3. TECHNICAL REQUIREMENTS

3.1 Matrix Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2355.

TABLE 1 - COMPOSITION

| Element | min | max |
|---|---|---|
| Silicon | -- | 0.25 |
| Iron | -- | 0.05 |
| Copper | 3.2 | 4.4 |
| Magnesium | 1.0 | 1.6 |
| Zinc | -- | 0.10 |
| Oxygen (3.1.1) | -- | 0.60 |
| Other Elements, each | -- | 0.05 |
| Other Elements, total | -- | 0.15 |
| Aluminum | remainder | |

3.1.1 Not required for routine acceptance.

3.2 Reinforcement Type and Volume Fraction

3.2.1 Reinforcement

Shall consist of silicon carbide whiskers (SiCw) having the following characteristics:

Crystal structure - Beta and alpha
Color - Gray-green
Width - One-half micrometer
Length - Up to 100 micrometers

3.2.2 Reinforcement Volume Fraction

The content of silicon carbide whiskers shall be 0.15% ± 0.02, determined in accordance with ASTM D 3553.

3.3 Condition

Solution heat treated, stretched one-half to 1 percent, and precipitation heat treated to T8P condition (See AS1990). Pyrometry shall be in accordance with AMS2750.

3.4 Properties

Sheet shall conform to the following requirements, determined in accordance with AMS2355:

3.4.1 Tensile Properties

Shall be shown in Table 2 for sheet 0.060 to 0.130 inch (1.52 to 3.30 mm), inclusive, in thickness.

TABLE 2 - MINIMUM TENSILE PROPERTIES

| Property | Specimen Orientation | Value |
|---|---|---|
| Tensile Strength | L | 85.0 ksi (586 MPa) |
| | LT | 71.0 ksi (490 MPa) |
| Yield Strength | L | 64.0 ksi (441 MPa) |
| | LT | 52.0 ksi (359 MPa) |
| Strain to Failure (One-inch gage) | L | 3.3% |
| | LT | 5.1% |

3.4.2 Compressive Yield Strength

When specified, shall be not less than 58.0 ksi (400 MPa) in the longitudinal direction and not less than 55.0 ksi (379 MPa) in the transverse direction for sheet 0.060 to 0.130 inch (1.52 to 3.30 mm), inclusive, in thickness.

3.4.3 Fracture Toughness

When specified, the critical stress intensity factor ($K_C$) shall be not less than 40 ksi $\sqrt{\text{inch}}$ (44 MPa $\sqrt{\text{m}}$) for sheet 0.070 to 0.090 inch (1.78 to 2.29 mm), inclusive, in thickness, determined in the L-T direction with 4 inch (102 mm) wide specimens in accordance with ASTM B 646.

3.5 Quality

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.

3.6 Tolerances

Shall conform to all applicable requirements of ANSI H35.2.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of sheet 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 sheet conforms to specified requirements.

4.2 Classification of Tests

Composition (3.1), reinforcement type and volume fraction (3.2), longitudinal and long-transverse tensile properties (3.4.1), and when specified, compressive yield strength (3.4.2) and fracture toughness (3.4.3), and tolerances (3.6) are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing

With the following exceptions, shall be in accordance with AMS2355:

4.3.1 Longitudinal and long-transverse tensile properties shall be measured.

4.3.2 When specified, sampling and testing for determination of compressive yield strength and for critical-stress-intensity factor shall be as agreed upon by purchaser and vendor.

4.4 Reports

The vendor of the product shall furnish with each shipment a report stating that the product conforms to the composition of the matrix and the volume fraction of the reinforcement component, and showing the results of tests to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, lot number, AMS4304B, size, and quantity. The report shall also identify the producer, the product form, and the mill produced size.

4.5 Resampling and Retesting

If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing two additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

5. PREPARATION AND DELIVERY

5.1 Identification

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

5.2 Protective Treatment

Flat sheet shall be protected, during shipment and storage, by interleaving with suitable paper or plastic sheets.

5.3 Packaging

5.3.1 Sheet 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 sheet to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Sheet not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES

8.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 ANSI H35.5, Nomenclature System for Aluminum Metal Matrix Composite Materials, is used to describe the matrix composition, type, volume fraction, and composition of the reinforcement materials and temper as 2009/SiC/15w-T8P.