# AEROSPACE MATERIAL SPECIFICATION

**AMS4355™**

Issued 2015-12

Aluminum Alloy, Discontinuously Reinforced Hot Isostatically Pressed Shapes
2124A/SiC/25p (3μm) (T1P)

RATIONALE

AMS4355 is a new specification for aluminum alloy hot isostatically pressed shapes produced from 2124A discontinuously reinforced with silicon carbide particulates.

## 1. SCOPE

### 1.1 Form

This specification covers discontinuously reinforced aluminum alloy (DRA) metal matrix composites (MMC) made by mechanical alloying of the 2124A powder and SiC particulate, which is then consolidated by Hot Isostatic Pressing (HIP) into shapes less than 62 $in^2$ (0.04 $m^2$) cross-section (see 8.11).

### 1.2 Application

HIP'ed shapes have been used typically for structural applications requiring high static strength, fatigue strength and high elastic modulus, but usage is not limited to such applications. HIP'ed shapes may also be used as input to forging and extrusion processes.

## 2. APPLICABLE DOCUMENTS

A change bar (l) 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.

### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (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

AMS2750 Pyrometry





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**http://www.sae.org/technical/standards/AMS4355**

2.2 ANSI Accredited Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ANSI B46.1 Surface Texture, Surface Roughness, Waviness and Lay

2.3 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 B311 Density of Powder Metallurgy (PM) Materials Containing Less Than Two Percent Porosity

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B666/B666M Identification Marking of Aluminum and Magnesium Products

ASTM E8/E8M Tension Testing of Metallic Materials

2.4 FEPA

Available from Federation of the European Producers of Abrasives www.fepa-abrasives.org.

FEPA-42-GB

3. TECHNICAL REQUIREMENTS

3.1 Aluminum Matrix Composition

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

***Table 1 – 2124A Composition***

| Element | Min | max |
|---|---|---|
| Silicon | -- | 0.20 |
| Iron | -- | 0.30 |
| Copper | 3.8 | 4.9 |
| Magnesium | 1.2 | 1.8 |
| Manganese | 0.30 | 0.9 |
| Chromium | -- | 0.10 |
| Zinc | -- | 0.25 |
| Titanium | -- | 0.15 |
| Oxygen | -- | 0.6 |
| Other Elements, each | -- | 0.05 |
| Other Elements, total | -- | 0.15 |
| Aluminum | remainder | |



3.2 Reinforcement Type and Volume Fraction

3.2.1 Reinforcement

Shall consist of silicon carbide particulate (SiCp) having the following characteristics:
Mean Diameter 3 micrometer determined in accordance with F1200 from the FEPA-42-GB.

3.2.2 Reinforcement Volume Fraction

The content of silicon carbide particulate shall be 25% ± 0.5% by volume determined through conversion from measured input material weights.

3.2.3 The aluminum matrix alloy and reinforcement particulate shall be mechanically alloyed to produce a uniform distribution of the reinforcement particulate within the resultant discontinuously reinforced aluminum powder.

3.3 Condition

Hot Isostatically Pressed (see 8.4), and air cooled to T1P condition.

3.3.1 Surface Condition

If no surface finish is specifed, the material shall be furnished with an as-sawn, as HIP, and/or machined surface. Machined surfaces shall have surface finish no greater than 125 Ra µinch (3.2 µm), determined in accordance with ANSI B46.1.

3.4 Response to T4P/T42P Heat Treatment

Samples taken from the material (see 4.3) shall be solution heat treated followed by a cold water quench and naturally aged to the T4P/T42P condition (see 8.6). Pyrometry shall be in accordance with AMS2750.

3.4.1 Tensile Properties

A sample with less than 1 $in^2$ (645 $mm^2$) cross-section from a lot shall be heat treated to the T4P/T42P condition, and shall have the properties shown in Table 2.

***Table 2 - Minimum tensile properties***

| Property | Value |
|---|---|
| Tensile Strength | 70.0 ksi (470 MPa) |
| Yield Strength | 64.0 ksi (430 MPa) |
| Strain to Failure | 1% |

3.4.1.1 Properties for sizes larger than 62 $in^2$ shall be as agreed between purchaser and producer.

3.4.2 Density

Shall be within the range of 2.88 to 2.91 $g/cm^3$ (0.104 to 0.105 $lb/inch^3$) determined using a water displacement method in accordance with ASTM B311; measurement may be made on the product or a sample after HIP or a sample after heat treatment.

3.5 Quality

HIP'ed shapes, as received by purchaser, shall be uniform in quality and condition, sound, and free from imperfections detrimental to usage of the shapes.

3.6 Tolerances

Shall conform to +0.25/-0.000 inch (+6.35/-0.00 mm), unless specified by agreement between purchaser and supplier (see 8.3).

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The vendor of HIP'ed shape 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 HIP'ed blanks conforms to specified requirements.

### 4.2 Classification of Tests

All technical requirements are acceptance tests and shall be performed on each lot or each powder blend, as applicable.

### 4.3 Sampling and Testing

Shall be in accordance with the following: a lot shall consist of all shapes manufactured from a specific powder blend and HIP'd together in a single cycle. Mechanical properties shall be determined using samples (see 3.4.1) taken from a sample shape (component) or from material produced as an integral part (prolongation) of a shape (component) from the lot.

#### 4.3.1 Tensile Properties

One tensile specimen from any location of a lot.

4.3.1.1 Tensile specimens shall be machined from a sample heat treated to the T4P/T42P condition (see 8.6).

4.3.1.2 Tensile testing shall be done in accordance with ASTM E8/8M.

#### 4.3.2 Density

One sample from each lot (see 3.4.1.1) unless a sampling plan has been agreed upon by purchaser and vendor.

#### 4.3.3 Dimensions

Each piece, unless a sampling plan has been 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 numerical results of tests on each lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, lot number, AMS4355, serial numbers, when specified, part number when applicable, as Hip'ed cross section area, and quantity.

4.4.1 Properties for sizes larger than 62 $in^2$ shall be as agreed between purchaser and producer.

### 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.