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|  <b>SAE Aerospace</b><br><i>An SAE International Group</i>  | <b>AEROSPACE<br/>MATERIAL<br/>SPECIFICATION</b> | <b>AMS 4404</b> |          |
|   |   | Issued          | JUN 2006 |
| Aluminum Alloy, Extruded Profiles (6056-T4511)<br>1.0Si - 0.90Mg - 0.80Cu - 0.60Mn - 0.40Zn<br>Solution Heat Treated and Stress-Relieved by Stretching<br>(Composition similar to UNS A96056) |   |                 |          |

## RATIONALE

AMS 4404 is a new specification to cover aluminum alloy 6056-T4511 extruded profiles.

### 1. SCOPE

#### 1.1 Form

This specification covers an aluminum alloy procured in the form of extruded profiles (shapes) with cross-sections up to 7.75 in<sup>2</sup> (5,000 mm<sup>2</sup>).

#### 1.2 Application

These extrusions have been used typically for structural applications requiring moderate tensile and good formability, 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 canceled 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](http://www.sae.org).

|          |  |
|----------|--|
| AMS 2355 | Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock and Rolled, Forged, or Flash Welded Rings |
| AMS 2772 | Heat Treatment of Aluminum Alloy Raw Materials   |
| AS1990   | Aluminum Alloy Tempers   |

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## 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](http://www.astm.org).

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products  
ASTM B 666/B666M Identification Marking of Aluminum and Magnesium Products

## 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](http://www.ansi.org).

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products  
ANSI H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS 2355.

TABLE 1 - COMPOSITION

| Element               | min       | max  |
|-----------------------|-----------|------|
| Silicon               | 0.7       | 1.3  |
| Iron                  | --        | 0.5  |
| Copper                | 0.50      | 1.1  |
| Manganese             | 0.40      | 1.0  |
| Magnesium             | 0.6       | 1.2  |
| Chromium              | --        | 0.25 |
| Zinc                  | 0.10      | 0.7  |
| Zirconium + Titanium  | --        | 0.20 |
| Other Elements, each  | --        | 0.05 |
| Other Elements, total | --        | 0.15 |
| Aluminum              | remainder |      |

### 3.2 Condition

Solution heat treated, stress-relieved by stretching to produce a nominal permanent set of 1.5%, but not less than 1% nor more than 3%, and naturally aged to the -T4511 temper (See AS1990).

3.2.1 Product shall be supplied with an as-extruded surface finish; light polishing to remove minor surface conditions is permissible provided such conditions can be removed within specified dimensional tolerances.

3.2.2 Product may receive minor straightening, after stretching, of an amount necessary to meet the requirements of 3.5.

### 3.3 Heat Treatment

Shall be performed in accordance with AMS 2772 and as follows:

#### 3.3.1 Solution Heat Treatment

1012 to 1032 °F (544 to 557 °C).

### 3.4 Properties

Extrusions shall conform to the following requirements, determined on the mill produced size in accordance with AMS 2355.

#### 3.4.1 As Solution Heat Treated and Naturally Aged

Shall be as shown in Table 2.

TABLE 2A - T4511 MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

| Nominal Thickness<br>Inches | Specimen<br>Orientation | Tensile Strength<br>ksi | Yield Strength at<br>0.2% Offset ksi | Elongation in<br>2 inches or 4D<br>% |
|-----------------------------|-------------------------|-------------------------|--------------------------------------|--------------------------------------|
| Over 0.040 to 0.375, incl   | Longitudinal            | 51.0                    | 36.0                                 | 15                                   |

TABLE 2B - T4511 MINIMUM TENSILE PROPERTIES, SI UNITS

| Nominal Thickness<br>Millimeters | Specimen<br>Orientation | Tensile Strength<br>MPa | Yield Strength at<br>0.2% Offset MPa | Elongation in 50.8<br>mm or 4D<br>% |
|----------------------------------|-------------------------|-------------------------|--------------------------------------|-------------------------------------|
| 1.00 to 9.5 mm, incl.            | Longitudinal            | 352                     | 248                                  | 15                                  |

#### 3.4.2 Response to Heat Treatment

The product, as received by purchaser, shall have the properties shown in Table 3 after being aged in accordance with AMS 2772 and as follows:

Age to T6511 for 2 to 6 hours at 369 to 379 °F (187 to 193 °C).

TABLE 3A - T6511 MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

| Nominal Thickness<br>Inches | Specimen<br>Orientation | Tensile Strength<br>ksi | Yield Strength at<br>0.2% Offset ksi | Elongation in<br>2 inches or 4D<br>% |
|-----------------------------|-------------------------|-------------------------|--------------------------------------|--------------------------------------|
| Over 0.040 to 0.375, incl   | Longitudinal            | 57.0                    | 54.0                                 | 10                                   |

TABLE 3B - T6511 MINIMUM TENSILE PROPERTIES, SI UNITS

| Nominal Thickness<br>Millimeters | Specimen<br>Orientation | Tensile Strength<br>MPa | Yield Strength at<br>0.2% Offset MPa | Elongation in<br>50.8 mm or 4D<br>% |
|----------------------------------|-------------------------|-------------------------|--------------------------------------|-------------------------------------|
| 1.00 to 9.5 mm, incl.            | Longitudinal            | 393                     | 372                                  | 10                                  |

### 3.5 Quality

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

### 3.6 Tolerances

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

#### 4. QUALITY ASSURANCE PROVISIONS

##### 4.1 Responsibility for Inspection

The vendor of the product 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 products conform to specified requirements.

##### 4.2 Classification of Tests

###### 4.2.1 Acceptance Tests

Composition (3.1), tensile properties as solution heat treated and naturally aged (3.4.1), response to heat treatment (3.4.2) and tolerances (3.5) are acceptance tests and, except for composition, shall be performed on each inspection lot.

##### 4.3 Sampling and Testing

Shall be in accordance with AMS 2355.

##### 4.4 Reports

The vendor of product shall furnish with each shipment a report stating that the product conforms to the composition and tolerances and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, inspection lot number(s), AMS 4404, size or section identification number, and quantity. The report shall also identify the producer, the product form, and the size of the mill product.

##### 4.5 Resampling and Retesting

Shall be in accordance with AMS 2355.

#### 5. PREPARATION FOR DELIVERY

##### 5.1 Identification

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

##### 5.2 Packaging

Extrusions 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 product to ensure carrier acceptance and safe delivery.

#### 6. ACKNOWLEDGMENT

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

#### 7. REJECTIONS

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

#### 8. NOTES

8.1 Terms used in AMS are clarified in ARP1917.