

Aluminum Alloy, Extruded Profiles (2196-T8511)
2.9Cu - 1.7Li - 0.4Mg - 0.4Ag - 0.10Zr
Solution Heat Treated, Stress Relieved by Stretching and Artificially Aged
(Composition similar to UNS A92196)

RATIONALE

AMS4416 is a proposed draft of a new material specification which covers aluminum-lithium alloy 2196-T8511 in the form of extruded profiles.

1. SCOPE

1.1 Form

This specification covers an aluminum-lithium alloy in the form of extruded profiles.

1.2 Application

These extrusions have been used typically for machined parts requiring dimensional stability during machining processes, and high strength, but usage is not limited to such applications.

1.2.1 Certain processing procedures may cause this product to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

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 Alloy, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
AMS2772	Heat Treatment of Aluminum Alloy Raw Materials
ARP823	Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products
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.

ASTM B 594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666/B 666M	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.

ANSI H 35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H 35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS

3.1 Composition

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

TABLE 1 - COMPOSITION

Element	min	max
Silicon	--	0.12
Iron	--	0.15
Copper	2.5	3.3
Manganese		0.35
Magnesium	0.25	0.8
Zinc	--	0.35
Titanium	--	0.10
Zirconium	0.04	0.18
Silver	0.25	0.6
Lithium	1.4	2.1
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

Extruded, solution heat treated and stress relieved by stretching to produce a nominal permanent set of 2.5%, but not less than 1% nor more than 4%, and aged to T8511 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 3.6.

3.3 Heat Treatment

Solution heat treatment shall be in accordance with AMS2772 as applicable to 2XXX alloys. Aging treatment is considered proprietary.

3.4 Properties

Product shall conform to the following requirements, determined on the mill produced size in accordance with AMS2355:

- 3.4.1 Longitudinal and long transverse tensile properties of extrusions, with a maximum cross-sectional area of 19 square inches (123 cm²) and a maximum circle size of 11 inches (279 mm), shall be as specified in Table 2.

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

Nominal Thickness Inches	Specimen Orientation	Tensile Strength ksi	Yield Strength At 0.2% Offset ksi	Elongation in 2 inches or 4D %
0.063 to 0.125, incl	Longitudinal	76.0	69.0	6
Over 0.125 to 0.249,	Longitudinal	76.0	71.0	7

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength At 0.2% Offset MPa	Elongation in 50.8 mm %
1.60 to 3.20 incl	Longitudinal	524	476	6
Over 3.20 to 6.30	Longitudinal	524	490	7

3.5 Quality

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

- 3.5.1 When specified, each extruded profile having a maximum width-to-thickness ratio of 10:1 shall meet ultrasonic class B requirements, as described in ASTM B 594.

3.6 Tolerances

Shall conform to all applicable requirements of ANSI H 35.2 or ANSI H 35.2M.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the products 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), longitudinal and long transverse tensile properties (3.4.1), ultrasonic inspection when specified (3.5.1), and tolerances (3.6) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.3 Sampling and Testing

Shall be in accordance with AMS2355.

4.4 Reports

The vendor of the product shall furnish with each shipment a report stating that the product conforms to the composition, ultrasonic inspection when specified, 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, AMS4416, size or section identification number, and quantity. This 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 AMS2355.

5. PREPARATION FOR DELIVERY

5.1 Identification

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

5.2 Packaging

Products 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. ACKNOWLEDGEMENT

A vendor shall include this specification number and its revision letter 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 A change bar (I) 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 Extrusions produced to this specification exhibit a thin re-crystallized surface layer similar to other high strength 2xxx alloys. Limits on the thickness of the re-crystallized surface layer can be guaranteed for specific profiles if requested by purchaser.

8.3 Terms used in AMS are clarified in ARP1917.

8.4 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.