



AEROSPACE MATERIAL SPECIFICATION

AMS4257™

REV. A

Issued 2014-09
Reaffirmed 2019-11
Revised 2025-01

Superseding AMS4257

Aluminum Alloy, Extrusion,
3.7Cu - 1.15Li - 0.5Zn - 0.45Ag - 0.4Mg - 0.3Mn - 0.1Zr (2055-T84),
Solution Heat Treated, Stress Relieved by Stretching 2% to 5% and Aged
(Composition similar to UNS A92055)

RATIONALE

AMS4257A results from a Five-Year Review and update of this specification with changes to provide consistent significant figures for thickness values (see 1.1.1, Table 2A, and Table 3A), update Title to add UNS reference, update wording to prohibit unauthorized exceptions (see 3.3.1, 3.6, 4.4.1, 5.1.1, and 8.7), relocate Definitions (see 2.4), update Form (see 1.1.1) and Applicable Documents (see Section 2 and 3.2), and allow use of the immediate prior revision of this document (see 8.7).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of extruded bars, rods, and profiles.

1.1.1 This specification covers an aluminum alloy in the form of extruded bars, rods, and profiles (shapes) produced with thicknesses 0.040 to 1.500 inches (1.02 to 38.10 mm), inclusive, in nominal thickness having a maximum cross-sectional area of 18.5 square inches (11935 mm²) and a maximum circumscribing circle diameter (circle size) of 14.5 inches (368.3 mm) (see 2.4.1 and 8.8).

1.2 Application

These extrusions have been used typically for structural applications requiring a combination of high strength and compressive properties and with good corrosion resistance, but usage is not limited to such applications.

1.3 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.

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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
AMS2772	Heat Treatment of Aluminum Alloy Raw Materials
ARP823	Minimizing Stress-Corrosion Cracking in Wrought High-Strength Aluminum Alloy Products
AS7766	Terms Used in Aerospace Metals Specifications

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 B594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products.
ASTM B645	Linear-Elastic Plane-Strain Fracture Toughness Testing of Aluminum Alloys
ASTM B660	Packaging/Packing of Aluminum and Magnesium Products.
ASTM B666/B666M	Identification Marking of Aluminum and Magnesium Products
ASTM E9	Compression Testing of Metallic Materials at Room Temperature
ASTM E399	Linear-Elastic Plain-Strain Fracture Toughness of Metallic Materials
ASTM G34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Aluminum Alloys (EXCO Test)
ASTM G47	Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products
ASTM G85	Modified Salt Spray (Fog) Testing, Annex A2 (cyclic acidified salt spray test - dry bottom MASTMAASIS)
ASTM G112	Standard Guide for Conducting Exfoliation Corrosion Tests in Aluminum Alloys

2.3 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ANSI H35.1/H35.1M	Standard Alloy and Temper Designation System for Aluminum
ANSI H35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

2.4 Definitions

Terms used in AMS are defined in AS7766 and as follows:

- 2.4.1 The circumscribing circle diameter is the diameter of the smallest circle, which completely encloses the cross section of the as-extruded product.

3. TECHNICAL REQUIREMENTS

3.1 Composition

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

Table 1 - Composition

Element	Min	Max
Silicon	--	0.07
Iron	--	0.10
Copper	3.2	4.2
Manganese	0.10	0.50
Magnesium	0.20	0.6
Zinc	0.30	0.7
Titanium	--	0.10
Silver	0.20	0.7
Lithium	1.0	1.3
Zirconium	0.05	0.15
Other impurities, each	--	0.05
Other impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition

Extruded, solution heat treated, stress relieved by stretching to produce a nominal permanent set of 2 to 5% (target of 3%), and then artificially aged to the -T84 (refer to ANSI H35.1/H35.1M). Solution and precipitation heat treatment shall be performed in accordance with AMS2772 as applicable to 2XXX alloys. The actual practices are considered proprietary.

The 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.

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

3.3 Properties

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

- 3.3.1 Mechanical property requirements for product outside of the range covered by 1.1.1 and Tables 2A and 2B shall be agreed upon between the purchaser and producer and reported per 4.4.1 (see 8.8).
- 3.3.2 Longitudinal and, when specified, long-transverse tensile properties shall be as shown in Tables 2A and 2B (see 8.8).

Table 2A - Minimum longitudinal tensile properties, inch/pound units

Nominal Thickness Inches	Test Direction	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
0.040 to 0.125, incl	L	82.0	78.0	5
0.126 to 0.249, incl	L	83.0	79.0	6
	LT	84.0	78.0	5
0.250 to 0.499, incl	L	85.0	80.0	7
	LT	84.0	78.0	5
0.500 to 0.749, incl	L	87.0	82.0	8
	LT	84.0	78.0	5
0.750 to 1.249, incl	L	88.0	84.0	8
	LT	84.0	78.0	5
1.250 to 1.500, incl	L	90.0	86.0	8
	LT	84.0	78.0	5

Table 2B - Minimum longitudinal tensile properties, SI units

Nominal Thickness Millimeters	Test Direction	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
1.02 to 3.18, incl	L	565	538	5
3.20 to 6.32, incl	L	572	545	6
	LT	579	538	5
6.35 to 12.67, incl	L	586	552	7
	LT	579	538	5
12.70 to 19.02, incl	L	600	565	8
	LT	579	538	5
19.05 to 31.72, incl	L	607	579	8
	LT	579	538	5
31.75 to 38.10, incl	L	621	593	8
	LT	579	538	5

3.3.3 Compression Yield Strength

When specified, the longitudinal compressive strength, determined in accordance with ASTM E9, shall be as shown in Tables 3A and 3B (see 8.8).

Table 3A - Minimum longitudinal compressive yield strength, inch/pound units

Nominal Thickness Inches	Test Direction	Longitudinal Compressive Yield Strength ksi
0.040 to 0.125, incl	L	80.0
0.126 to 0.249, incl	L	81.0
0.250 to 0.499, incl	L	81.0
0.500 to 0.749, incl	L	83.0
0.750 to 1.249, incl	L	84.0
1.250 to 1.500, incl	L	87.0

Table 3B - Minimum longitudinal compressive yield strength, SI units

Nominal Thickness Millimeters	Test Direction	Longitudinal Compressive Yield Strength MPa
1.02 to 3.18, incl	L	552
3.20 to 6.32, incl	L	558
6.35 to 12.67, incl	L	558
12.70 to 19.02, incl	L	572
19.05 to 31.72, incl	L	579
31.75 to 38.10, incl	L	600

3.3.4 Fracture Toughness

When specified, plane-strain fracture toughness shall be tested in the L-T and T-L orientations in accordance with ASTM E399 and ASTM B645 (see 8.8). A valid K_{Ic} meeting the requirements of ASTM E399, or a K_Q “usable for lot release” in accordance with ASTM B645, shall meet or exceed the values shown in Table 4.

Table 4 - Fracture toughness parameters

Nominal Thickness Inches	Nominal Thickness Millimeters	Specimen Orientation	Minimum K_{Ic} and K_Q “usable for lot release” ksi $\sqrt{\text{inch}}$	Minimum K_{Ic} and K_Q “usable for lot release” MPa $\sqrt{\text{m}}$
0.750 to 1.500, incl	19.05 to 38.10, incl	L-T	22	24
0.750 to 1.500, incl	19.05 to 38.10, incl	T-L	19	21

3.3.5 Exfoliation-Corrosion Resistance

Specimens cut from extrusions shall not exhibit exfoliation corrosion at a T/10 plane greater than that illustrated by Photograph EA, Figure 2, of ASTM G34 when specimens are exposed for 2 weeks according to the procedures in ASTM G85, Annex A2, using the dry-bottom MASTMAASIS test method (see 8.3).

3.3.6 Stress-Corrosion Cracking

Specimens from extrusions with section thickness 0.750 inch (19.05 mm) and greater, tested in accordance with ASTM G47, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 25 ksi (172 MPa) (see 8.4).

3.4 Quality

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

3.4.1 When specified, each extrusion shall be subjected to ultrasonic inspection in accordance with ASTM B594. Extrusions 0.500 inch (12.7 mm) and over in nominal diameter or least distance between parallel sides shall meet ultrasonic Class B requirements, as described in ASTM B594 (see 8.8).

3.5 Tolerances

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

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility

The producer of the products shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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 (see 3.1), longitudinal tensile properties (see 3.3.2), long-transverse tensile properties (when specified) (see 3.3.2), compression yield strength (when specified) (see 3.3.3), fracture toughness (when specified) (see 3.3.4), ultrasonic inspection (when specified) (see 3.4.1), and tolerances (see 3.5) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Exfoliation-corrosion resistance (see 3.3.5) and stress-corrosion cracking (see 3.3.6) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2355.

4.3.1 The fracture toughness test specimens shall meet the following requirements:

4.3.1.1 For extrusions having a nominal thickness of 0.750 to 1.000 inch (19.05 to 25.40 mm), inclusive, use a test specimen having a width (W) of 2.0 inches (50.8 mm) and a thickness (B) of full extrusion thickness or the maximum thickness obtainable from the extrusion cross section while meeting the dimensional requirements of ASTM E399.

4.3.1.2 For extrusions having a nominal thickness over 1.000 to 1.500 inches (25.42 to 38.10 mm), inclusive, use a test specimen having a width (W) of 2.0 inches (50.8 mm) and a thickness (B) of 1.0 inch (25.4 mm) or the maximum thickness obtainable from the extrusion cross section while meeting the dimensional requirements of ASTM E399.

4.3.1.3 When allowed by the profile shape, the test specimen (especially the pre-crack and crack path) shall be located away from junctions and other areas in the extruded shape with mixed grain flow.

4.3.1.4 When fracture toughness tests of material less than 0.750-inch (19.05-mm) thick is required by the customer, specimen size, test method, and minimum K_{Ic} and K_{Ic} "usable for lot release" value shall be agreed upon by the customer and supplier.

4.4 Reports

The producer of product shall furnish with each shipment a report stating that the product conforms to the chemical composition, tolerances, and ultrasonic inspection (when specified) and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements. The report shall state that the final product conforms to the other technical requirements and shall include the purchase order number, inspection lot number, AMS4257A, size or section identification number, and quantity. The report shall also identify the producer and the size of the mill product.

4.4.1 When material produced to this specification is beyond the sizes allowed in the scope or tables, or exceptions authorized by the purchaser are taken to the technical requirements listed in Section 3 (see 5.1.1), the report shall contain a statement "This material is certified as AMS4257A(EXC) because of the following exceptions:" and the specific exceptions shall be listed.