



AEROSPACE MATERIAL SPECIFICATION

AMS4456™

REV. B

Issued	2012-05
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Superseding AMS4456A

Aluminum Alloy, Hand Forgings
8.0Zn - 1.0Cu - 1.6Mg - 0.12Zr (7037-T7452)
Solution Heat Treated, Compression Stress Relieved, and Overaged
(Composition similar to UNS A97037)

RATIONALE

AMS4456B has been declared "STABILIZED" by AMS Committee D Nonferrous Alloys Committee. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because Committee D can find no producers for this document.

NOTE: Previously this document was revised. The last technical update of this document occurred in November, 2019. Users of this document should refer to the cognizant engineering organization for disposition of any issues with reports/certifications to the specification; including exceptions listed on the certification. In many cases, the purchaser may represent a sub tier supplier and not the cognizant engineering organization.

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1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of hand forgings 11.000 inches (280 mm) and under in nominal thickness and of forging stock of any size (see 8.6).

1.2 Application

These forgings have been used typically for machined structural parts subject to warpage during machining and requiring high strength and resistance to stress-corrosion cracking, 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.

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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
- AMS2808 Identification Forgings
- ARP1917 Clarification of 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 E399 Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials
- ASTM G34 Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
- ASTM G47 Determining Susceptibility to Stress Corrosion Cracking of 2XXX and 7XXX Aluminum Alloys

2.3 ANSI Accredited Publications

Copies of these documents are available online at <http://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)

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	--	0.10
Iron	--	0.10
Copper	0.6	1.1
Manganese	--	0.50
Magnesium	1.3	2.1
Chromium	--	0.04
Zinc	7.8	9.0
Titanium	--	0.10
Zirconium	0.06	0.25
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Forgings

Heat treatment shall be in accordance with AMS2772 to the -T7452 temper (refer to ANSI H35.1/H35.1M) and as follows: Solution heat treatment and artificial aging practices are proprietary. Material shall be stress-relieved by compressing to produce a 1 to 5% permanent set prior to artificial aging.

3.2.2 Forging Stock

As ordered by the forging manufacturer.

3.3 Properties

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

3.3.1 Forgings

3.3.1.1 Tensile Properties

Specimens machined from forgings having essentially a rectangular or square cross-section, heat treated in the indicated thickness, shall have the properties shown in Table 2 provided that the as-forged thickness does not exceed 11.000 inches (280 mm). The long-transverse direction for square forgings shall be identified by the producer.

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

Nominal Thickness at Time of Heat Treatment Inches	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 4.000, incl	Longitudinal	71	64	10
	Long-Trans.	72	64	10
	Short-Trans.	72	60	6
Over 4.000 to 6.000, incl	Longitudinal	71	64	10
	Long-Trans.	71	64	6
	Short-Trans.	71	58	6
Over 6.000 to 8.000, incl	Longitudinal	70	63	10
	Long-Trans.	70	62	4
	Short-Trans.	69	57	6
Over 8.000 to 11.000, incl	Longitudinal	67	59	8
	Long-Trans.	67	58	4
	Short-Trans.	66	54	6

Table 2B - Minimum tensile properties, SI units

Nominal Thickness at Time of Heat Treatment Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 5D % (1)
Up to 100, incl	Longitudinal	490	442	9
	Long-Trans.	497	442	9
	Short-Trans.	497	414	5
Over 100 to 152, incl	Longitudinal	490	442	9
	Long-Trans.	490	442	6
	Short-Trans.	490	400	5
Over 152 to 203, incl	Longitudinal	483	435	9
	Long-Trans.	483	428	4
	Short-Trans.	476	393	5
Over 203 to 280, incl	Longitudinal	462	407	7
	Long-Trans.	462	400	4
	Short-Trans.	455	373	4

Note 1: 5D elongation values for Table 2B were derived from experimental data (not converted from US customary units).

3.3.1.1.1 Tensile specimens shall be excised from the T/2 and W/2 location at a distance not less than T from the "as heat-treated" edges of the forging.

3.3.1.2 Corrosion Resistance

Resistance to stress-corrosion cracking and to exfoliation-corrosion is acceptable if the requirements of 3.3.1.2.1 and 3.3.1.2.2 are met.

3.3.1.2.1 Electrical Conductivity

Shall be not lower than 34.8% IACS (International Annealed Copper Standard) (20.2 MS/m).

3.3.1.2.2 Forgings with electrical conductivity measured to be 34.8 to 36.0% IACS on tensile bar blanks at T/2 shall have SCC testing performed per 3.3.1.4 in order to verify acceptable SCC resistance. This provision is being added into the governing specification until enough data is acquired to assure that electrical conductivities within the range of 34.8 to 35.3% IACS can satisfy the requirements of 3.3.1.4.

3.3.1.2.3 Forgings not conforming to 3.3.1.2.1 may be given additional overaging and retested to determine conformance to 3.3.1.1, 3.3.1.2.1, and 3.3.1.2.2 and when specified 3.3.1.5. Forgings with electrical conductivity greater than 36.0% IACS are acceptable without SCC testing for lot acceptance.

3.3.1.3 Exfoliation-Corrosion Resistance

Specimens cut from forgings at any plane shall show a level of exfoliation-corrosion less than that illustrated by Photograph EB, Figure 2, of ASTM G34.

3.3.1.4 Stress-Corrosion Resistance

Specimens as in 4.3.1 cut from forgings shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction at 35.0 ksi (241 MPa) when tested in accordance with ASTM G47.

3.3.1.5 Fracture Toughness

When specified, forgings shall meet the values of K_{IC} shown in Table 3, determined in accordance with ASTM B645.

Table 3A - Fracture toughness parameters, inch/pound units

Specimen Orientation	Nominal Thickness Inches	Minimum K_{IC} ksi $\sqrt{\text{inch}}$
L-T	Up to 4.000, incl	30
	Over 4.000 to 6.000, incl	30
	Over 6.000 to 8.000, incl	30
	Over 8.000 to 11.000, incl	30
T-L	Up to 4.000, incl	29
	Over 4.000 to 6.000, incl	23
	Over 6.000 to 8.000, incl	21
	Over 8.000 to 11.000, incl	19
S-L	Up to 4.000, incl	21
	Over 4.000 to 6.000, incl	21
	Over 6.000 to 8.000, incl	21
	Over 8.000 to 11.000, incl	21

Table 3B - Fracture toughness parameters, SI units

Specimen Orientation	Nominal Thickness Millimeters	Minimum K_{IC} MPa $\sqrt{\text{m}}$
L-T	Up to 100, incl	33
	Over 100 to 152, incl	33
	Over 152 to 203 incl	33
	Over 203 to 280, incl	33
T-L	Up to 100, incl	32
	Over 100 to 152, incl	26
	Over 152 to 203 incl	23
	Over 203 to 280, incl	21
S-L	Up to 100, incl	23
	Over 100 to 152, incl	23
	Over 152 to 203 incl	23
	Over 203 to 280, incl	23

3.3.1.5.1 K_Q values shall meet all requirements of ASTM E399 for K_{Ic} except that invalid K_Q values which are meaningful as defined by ASTM B645 and which equal or exceed the K_{Ic} limit (3.3.1.6) shall be evidence of acceptable fracture toughness.

3.3.1.6 Mechanical property requirements for forgings outside the thickness range of 1.1 shall be as agreed upon by purchaser and producer.

3.3.2 Forging Stock

When a sample of stock is forged to a test coupon having a degree of mechanical working not greater than the forging and heat treated as in 3.2.1, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.1. If specimens taken from the stock after heat treatment as in 3.2.1 conform to the requirements of 3.3.1.1, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4 Quality

The product, 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 product.

3.4.1 When specified, forgings shall be subjected to ultrasonic inspection in accordance with ASTM B594 and shall meet the following requirements:

3.4.1.1 Forgings with nominal section thicknesses from 2.500 to 11.000 inches (60.00 to 280.00 mm), inclusive, shall meet ultrasonic Class A.

3.5 Tolerances

Forging stock shall conform to all applicable requirements of ANSI H35.2 or ANSI H35.2M.

3.6 Any exceptions shall be authorized by purchaser and reported as in 4.4.1.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and, except for composition, shall be performed on each inspection lot as applicable:

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties (3.3.1.1), corrosion resistance (3.3.1.2), and, when specified, fracture toughness (3.3.1.5) and ultrasonic soundness (3.4.1) of each inspection lot of forgings.

4.2.1.3 Tolerances (3.5) of forging stock.

4.2.2 Periodic Tests

Exfoliation-corrosion resistance (3.3.1.3), and stress-corrosion resistance (3.3.1.4), and tests of forging stock to demonstrate ability to develop required properties (3.3.2) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.