AEROSPACE MATERIAL SPECIFICATION

AMS4179™	REV. E

Issued 1974-06
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Revised 2023-10

Superseding AMS4179D

Aluminum Alloy Forgings
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7175-T7452)
Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated
(Composition similar to UNS A97175)

RATIONALE

AMS4179E results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (see 3.3.1.2, 3.6, 4.4.1.1, and 8.6), relocate Definitions (see 2.4), update Applicable Documents (see Section 2), Acceptance Tests (see 4.2.1), and Ordering Information (8.7), and allow the use of the immediate prior specification revision (see 8.5).

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1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of die forgings not over 3 inches (76 mm) and hand forgings up to 6 inches (150 mm), inclusive, in nominal thickness at the time of heat treatment, and forging stock of any size (see 8.7).

1.2 Application

These products have been used typically for parts requiring a high level of mechanical properties and good 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.

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

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS4179E/

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 E1417/E1417M Liquid Penetrant Testing

2.3 ANSI Accredited Publications

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

ANSI H35.1/H35.1M Alloy and Temper Designation Systems 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.

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	--	0.15
Iron	--	0.20
Copper	1.2	2.0
Manganese	--	0.10
Magnesium	2.1	2.9
Chromium	0.18	0.28
Zinc	5.1	6.1
Titanium	--	0.10
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

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3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Forgings

Solution heat treated, stress relieved by compression to produce a permanent set of 1 to 5%, and precipitation heat treated (see 8.3). Heat treatment shall be performed using pyrometry in accordance with AMS2772.

3.2.2 Forging Stock

Forging stock used to produce forgings to this specification shall be ingot or wrought stock in the O or F temper (refer to ANSI H35.1/H35.1M). Forge stock ordered to this specification is for manufacturing forgings defined in 3.2.1. Material shall comply with the requirements of Table 1.

3.3 Properties

The product shall conform to the following requirements determined in accordance with AMS2355 on the mill produced size.

3.3.1 Die and Hand Forgings

3.3.1.1 Tensile Properties

Shall be as follows:

3.3.1.1.1 Die Forgings

3.3.1.1.1.1 Longitudinal (With Grain Flow)

Specimens, machined from forgings not over 3 inches (76 mm) in nominal thickness at time of heat treatment with axis of specimen in the area of gage length varying not more than 15 degrees from parallel to the forging flow lines, shall have the properties shown in Table 2.

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	73.0 ksi (503 MPa)
Yield Strength at 0.2% Offset	63.0 ksi (434 MPa)
Elongation	
in 4D	7%
in 5D	6%

3.3.1.1.1.2 Transverse (Across Grain Flow)

Specimens, machined from forgings not over 3 inches (76 mm) in nominal section thickness at time of heat treatment with axis of specimens in the area of the gage length varying not more than 15 degrees from perpendicular to the forging flow lines, shall have the properties shown in Table 3.

Table 3 - Minimum tensile properties

Property	Value
Tensile Strength	68.0 ksi (469 MPa)
Yield Strength at 0.2% Offset	55.0 ksi (379 MPa)
Elongation	
in 4D	4%
in 5D	3%

3.3.1.1.1.2.1 Elongation requirement applies only to specimens having a gage length diameter not less than 0.250 inch (6.35 mm) and cut so that the length of the specimen is in a plane parallel to the parting plane.

3.3.1.1.2 Hand Forgings

Specimens, machined from forgings not over 6 inches (152 mm) in nominal as-forged thickness and having an essentially rectangular or square cross section not exceeding 156 square inches (1007 cm^2) in area and heat treated in the indicated thickness, shall have the properties specified in Table 4.

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Table 4A - 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 4D %
Up to 2, incl	Longitudinal	71.0	61.0	9
	Long.-Trans.	69.0	58.0	5
Over 2 to 3, incl	Longitudinal	71.0	61.0	9
	Long.-Trans.	69.0	58.0	5
	Short-Trans.	67.0	54.0	4
Over 3 to 4, incl	Longitudinal	68.0	57.0	9
	Long.-Trans.	67.0	55.0	5
	Short-Trans.	65.0	51.0	4
Over 4 to 5, incl	Longitudinal	65.0	54.0	8
	Long.-Trans.	64.0	52.0	5
	Short-Trans.	63.0	49.0	4
Over 5 to 6, incl	Longitudinal	63.0	51.0	8
	Long.-Trans.	61.0	49.0	5
	Short-Trans.	60.0	46.0	4

Table 4B - 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 4D %
Up to 50, incl	Longitudinal	490	420	9
	Long.-Trans.	476	400	5
Over 50 to 75, incl	Longitudinal	490	420	9
	Long.-Trans.	476	400	5
	Short-Trans.	462	372	4
Over 75 to 100, incl	Longitudinal	469	393	9
	Long.-Trans.	462	379	5
	Short-Trans.	448	352	4
Over 100 to 125, incl	Longitudinal	448	372	8
	Long.-Trans.	441	359	5
	Short-Trans.	434	338	4
Over 125 to 150, incl	Longitudinal	434	351	8
	Long.-Trans.	420	338	5
	Short-Trans.	414	317	4

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3.3.1.2 Mechanical property requirements for product outside the range listed in 1.1 shall be agreed upon between the purchaser and producer and reported per 4.4.1.1 (see 8.7).

3.3.1.3 Conductivity

Shall be as follows, determined on the surface of the tensile sample:

3.3.1.3.1 If the conductivity is 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m), or higher and tensile properties meet specified requirements, the forgings are acceptable.

3.3.1.3.2 If the conductivity is 38.0 to 39.9% IACS (22.0 to 23.1 MS/m), if the tensile properties meet specified properties, and if the longitudinal yield strength does not exceed the specified minimum by more than 11.9 ksi (82 MPa), the forgings are acceptable.

3.3.1.3.3 If the conductivity is below 40.0% IACS (23.2 MS/m) and longitudinal yield strength exceeds the specified minimum value by more than 11.9 ksi (82 MPa), the forgings are not acceptable.

3.3.1.3.4 If the conductivity is below 38.0% (22.0 MS/m), forgings are not acceptable and shall be reprocessed regardless of tensile properties.

3.3.1.3.5 Forgings that are not acceptable, according to the requirements of 3.3.1.3.3 or 3.3.1.3.4, may be given additional precipitation heat treatment or may be resolution heat treated and reprecipitation heat treated, and retested. After such treatment, if all specified properties are met, the forging is acceptable.

3.3.1.4 Stress-Corrosion Resistance

Specimens cut from forgings 0.750 inch (19.05 mm) and over in nominal thickness, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) at 35.0 ksi (241 MPa) for die and hand forgings 3 inches (76 mm) and under in section thickness or to 50% of the specified minimum longitudinal (with grain flow) yield strength for hand forgings over 3 inches (76 mm) in section thickness and held at constant strain.

3.3.1.5 Grain Flow

Grain flow of die forgings, except in areas which contain end grain, shall follow the general contour of the forging, showing no evidence of reentrant flow.

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 in the same manner as forgings, specimens taken from the heat-treated coupon shall conform to the requirements of 3.3.1.1 and 3.3.1.2. If specimens taken from the stock after heat treatment in the same manner as forgings conform to the requirements of 3.3.1.1 and 3.3.1.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4 Quality

The product, as received by the 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 Each hand forging, and when specified, each die forging, shall be subjected to ultrasonic inspection in accordance with ASTM B594 and shall meet the following acceptance criteria:

3.4.1.1 Hand Forgings

Class A.

3.4.1.2 Die Forgings

Class B.

3.4.2 Each forging shall be free from surface defects, such as seams, laps, bursts, and quench cracks, when etched by swabbing or immersing in an aqueous solution of sodium hydroxide, thoroughly rinsing in tap water, followed by washing in nitric acid or chromic-sulfuric acid solution or equivalent solution which will produce a surface suitable for visual inspection. Surfaces shall be evaluated for defects and, if defects can be removed so that they do not reappear on re-etching and if the required section thickness is maintained, the forgings are acceptable. Forgings shall be thoroughly dried after each etch and rinse operation to prevent fluid entrapment.

3.4.2.1 When approved by the purchaser, a sampling plan may be used in lieu of etching each forging.

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3.4.3 When specified, each die forging shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M. Forgings shall be free from surface defects such as seams, laps, bursts, and quench cracks.

3.4.4 Forge stock shall be uniform in quality and condition, sound, and free of foreign materials and from imperfections detrimental to use as starting stock for product produced to this specification.

3.5 Tolerances

Forging stock 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 4.4.1.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product 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 product conforms to the specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (see 3.1), tensile properties (see 3.3.1.1 and 3.3.1.2), electrical conductivity (see 3.3.1.3), ultrasonic inspection for hand forgings (see 3.4.1), surface evaluation (see 3.4.2), tolerances (see 3.5), and, when specified, ultrasonic inspection for die forgings (see 3.4.1) and fluorescent penetrant examination (see 3.4.3) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Stress-corrosion resistance (see 3.3.1.4), grain flow of die forgings (see 3.3.1.5), and ability of forging stock to develop required properties 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 and the following: a lot shall be all forgings of the same nominal cross section and configuration, heat treated in the same batch furnace load or in a continuous furnace consecutively during an 8-hour period. Maximum lot size for forgings heat treated in a continuous furnace and charged consecutively during continuous furnace operation shall be 2000 pounds (907 kg) for forgings weighing 5 pounds (2.6 kg) and under and shall be 6000 pounds (2721 kg) for forgings weighing over 5 pounds (2.6 kg).

4.4 Reports

4.4.1 The producer of the product shall furnish with each shipment a report stating that the product conforms to the composition and tolerances, results of nondestructive inspection, and showing the numerical results of tests on each lot to determine conformance to the acceptance test requirements and when performed, the periodic test requirements. This report shall include the purchase order number, lot number(s), AMS4179E, sizes, and quantity. The report shall also include the identity of the producer and the size of the mill product.

4.4.1.1 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS4179E(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

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