SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4143 | REV. E

Issued 1965-02
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Reaffirmed 2012-09

Superseding AMS4143D

Aluminum Alloy Forgings and Rolled or Forged Rings
6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-T6)
Solution and Precipitation Heat Treated
(Composition similar to UNS A92219)

RATIONALE

AMS4143E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of die forgings, hand forgings, forged rings, rolled rings, and stock for forging or rings.

1.2 Application

These products have been used typically for structural, machined parts but usage is not limited to such applications.

1.2.1 This material may be welded in the T6 condition but properties are improved by heat treatment after welding.

1.2.2 Certain design and fabricating procedures may cause these products 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.

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 Material
AMS 2808	Identification, Forgings
ARP823	Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products
AS1990	Aluminum Alloy Tempers

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

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 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 1417	Liquid Penetrant Examination

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 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	--	0.20
Iron	--	0.30
Copper	5.8	6.8
Manganese	0.20	0.40
Magnesium	--	0.02
Zinc	--	0.10
Titanium	0.02	0.10
Vanadium	0.05	0.15
Zirconium	0.10	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 and Rings

Solution and precipitation heat treated in accordance with AMS 2772 to the T6 temper (See AS1990).

3.2.2 Stock for Forging or Rings

As ordered by the forging manufacturer.

3.3 Properties

The product shall conform to the following requirements, determined in accordance with AMS 2355:

3.3.1 Forgings

3.3.1.1 Tensile Properties

Shall be as shown in Tables 2 and 3, determined on the mill produced size.

3.3.1.1.1 Die Forgings

3.3.1.1.1.1 With Grain Flow

Specimens, machined from forgings 4 inches (102 mm) and under in thickness or from prolongations on such forgings, with axis of specimen in area of gage length varying not more than 15 degrees from parallel to the forging flow lines, shall meet the requirements shown in Table 2.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	58.0 ksi (400 MPa)
Yield Strength at 0.2% Offset	38.0 ksi (262 MPa)
Elongation in 4D	8%
in 5D	7%

3.3.1.1.1.2 Across Grain Flow

Specimens, machined from forgings 4 inches (102 mm) and under in thickness or from prolongations on such forgings, with axis of specimen in area of gage length varying not more than 15 degrees from perpendicular to the forging flow lines shall meet the requirements shown in Table 3.

TABLE 3 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	56.0 ksi (386 MPa)
Yield Strength at 0.2% Offset	36.0 ksi (248 MPa)
Elongation in 4D	4%
in 5D	4%

3.3.1.1.1.2.1 The elongation requirement of 3.3.1.1.1.2 applies only to test specimens having a gage-length diameter less than 0.250 inch (6.35 mm).

3.3.1.1.2 Hand Forgings

Specimens machined from forgings 4 inches (102 mm) and under in thickness shall have the properties shown in Table 4, tests need not be made in the longitudinal direction unless specifically required by purchaser.

TABLE 4A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Longitudinal	58.0	40.0	6
Long-Transverse	55.0	37.0	4
Short-Transverse	53.0	35.0	2

TABLE 4B - MINIMUM TENSILE PROPERTIES, SI UNITS

Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 5D %
Longitudinal	400	276	5
Long-Transverse	379	255	4
Short-Transverse	365	241	2

3.3.1.1.2.1 Short-transverse property requirements of Table 4 apply only to thicknesses over 2 inches (50 mm).

3.3.1.1.3 Rolled or Forged Rings

3.3.1.1.3.1 Tangential

Specimens, machined from rings 2.50 inches (63.5 mm) and under in radial thickness with axis of specimen tangential to ring OD (axis parallel to direction of rolling), shall meet the requirements shown in Table 5.

TABLE 5 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	56.0 ksi (386 MPa)
Yield Strength at 0.2% Offset	40.0 ksi (276 MPa)
Elongation in 4D	6%
in 5D	5%

3.3.1.1.3.2 Axial

Specimens, machined from rings 2.50 inches (63.5 mm) and under in radial thickness with axis of specimen tangential to axis of the ring (axis transverse to direction of rolling), shall meet the requirements shown in Table 6.

TABLE 6 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	55.0 ksi (379 MPa)
Yield Strength at 0.2% Offset	37.0 ksi (255 MPa)
Elongation in 4D	4%
in 5D	4%

3.3.1.1.4 Test Specimens

Tensile specimens machined from separately-forged coupons or from stock representing the forgings or rings and, in either case, heat treated with the forgings or rings shall conform to the requirements shown in Table 7.

TABLE 7 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	58.0 ksi (400 MPa)
Yield Strength at 0.2% Offset	38.0 ksi (262 MPa)
Elongation in 4D	10%
in 5D	9%

3.3.1.2 Hardness

3.3.1.2.1 Die Forgings should have hardness not lower than 100 HBW/10/500 or equivalent, but shall not be rejected on the basis of hardness if the applicable tensile property requirements are met on specimens with similar nonconforming hardness.

3.3.2 Stock for Forgings or Rings

When a sample of stock is forged or rolled to a test coupon having a degree of cold working not greater than the forging or rings and heat treated in accordance with 3.2.1, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.1.4. If specimens taken from the stock after heat treatment in accordance with 3.2.1 conform to the requirements of 3.3.1.1.4, 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 Each die forging and, when specified, each rolled or forged ring shall be caustic etched to produce a surface suitable for visual inspection. Surfaces shall be evaluated for defects and, if defects can be removed so they do not appear on re-etching and if the required section thickness is maintained, the forgings and rings are acceptable.

3.4.1.1 When approved by purchaser, a sampling plan may be used in lieu of etching each forging and ring.

3.4.2 When specified, forgings and rings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417 and/or to ultrasonic inspection in accordance with ASTM B 594. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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

3.5 Tolerances

Stock for forging or rings 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 product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties (3.3.1.1) hardness (3.3.1.2), visual inspection of each die forgings and, when specified, each rolled or forged ring (3.4.1), and, when specified ultrasonic and fluorescent penetrant inspection (3.4.2) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Tests of stock for forging or rings (3.3.2) to demonstrate ability to develop required properties and for grain flow of die forgings (3.4.3) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS 2355.

4.3.1 Rings

At least two tensile specimens shall be taken from a ring or ring prolongation representing the lot. One specimen shall be tangential to the ring OD and the other parallel to the axis of the ring.

4.3.2 Surface Inspection

All die forgings and, when specified, each ring.

4.3.3 Ultrasonic and Fluorescent Penetrant Inspection

Each forging and ring, when specified.