AEROSPACE MATERIAL SPECIFICATION

AMS4143™	REV. F

Issued 1965-02
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Revised 2019-12

Superseding AMS4143E

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

AMS4143F prohibits unauthorized exceptions (3.6), revises Condition (3.2.1), Properties (3.3.1.1.5), and Reports (4.4), and results from a Five-Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of die and hand forgings 4 inches (102 mm) and under in thickness, rolled or forged rings 2.50 inches (63.5 mm) and under in radial thickness, and stock of any size for forging or rings (see 8.5).

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; however, the properties contained herein apply only to the unwelded parent material.

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.

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 values your input. To provide feedback on this Technical Report, please visit
http://standards.sae.org/AMS4143F

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 Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Material

AMS2808 Identification, Forgings

ARP823 Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

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 B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM E1417/E1417M Liquid Penetrant Testing

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	--	0.20
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 AMS2772 to the T6 temper (refer to ANSI H35.1/H35.1M).

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 AMS2355:

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%

3.3.1.1.5 Mechanical property requirements for product outside the thickness ranges of 1.1 shall be as agreed upon by purchaser and producer.

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 E1417/E1417M and/or to ultrasonic inspection in accordance with ASTM B594. Standards for acceptance shall be as agreed upon by purchaser and producer.

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.

3.6 Exceptions

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

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

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 producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2355.

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.

4.4 Reports

The producer of product shall furnish with each shipment a report stating that the product conforms to the composition, tolerances, nondestructive tests when specified (visual inspection, liquid penetrant inspection and/or ultrasonic inspection) and showing the numerical results of tests on each lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, lot number(s), AMS4143F, size, and quantity. The report shall also identify the producer, the product form, 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 purchaser are taken to the technical requirements listed in Section 3, the report shall contain a statement “This material is certified as AMS4143F(EXC) because of the following exceptions:” and the specific exceptions shall be listed.

4.4.2 The producer of stock for forgings or rings shall furnish with each shipment a report stating that the chemical composition of the stock conforms to specified requirements. This report shall include the purchase order number, lot number, AMS4143F, size, and quantity.

4.5 Resampling and Retesting

Shall be in accordance with AMS2355.

5. PREPARATION FOR DELIVERY

5.1 Identification

Shall be as follows:

5.1.1 Die Forgings and Rings

In accordance with AMS2808.

5.1.2 Hand Forgings

Marked with the alloy number and temper, the characters recurring at intervals not greater than 6 inches (152 mm) and applied in the longitudinal grain direction.

5.1.3 Stock for Forging or Rings

As agreed upon by purchaser and producer.

5.2 Packaging

The product shall be prepared for shipment in accordance with ASTM B660 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. ACKNOWLEDGMENT

A producer shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Product not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES

8.1 Revision Indicator

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 Terms used in AMS are clarified in ARP1917.

8.3 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.

8.4 Unless otherwise specified, the material producer shall work to the revision of this specification (AMS4143) in effect on the date of order placement. Unless otherwise specified, material manufactured and certified to the immediately previous revision of this specification (AMS4143) may be procured and used until inventory is depleted.

8.5 Purchase orders should specify not less than the following:

AMS4143F
Type of product (hand forging, die forging, forged ring, or rolled ring) or part number desired
Quantity of product desired
Property and acceptance requirements from the cognizant engineering organization applicable to sizes outside the range listed in 1.1
Acceptance standards for fluorescent penetrant and ultrasonic inspection, if specified (see 3.4.1)

PREPARED BY AMS COMMITTEE “D”