



AEROSPACE MATERIAL SPECIFICATION

AMS4313™**REV. F**

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Superseding AMS4313E

Aluminum Alloy, Rolled or Forged Rings
6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-T351, 2219-T352)
Solution Heat Treated and Mechanically Stress Relieved
(Composition similar to UNS A92219)

RATIONALE

AMS4313F 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 This document will no longer be updated and may no longer represent standard industry practice.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 December, 2016. 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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AMS4313F has been declared "STABILIZED" by SAE AMS Committee D, Nonferrous Alloys Committee, and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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<https://www.sae.org/standards/content/AMS4313F/>

1. SCOPE

1.1 Purpose

This specification covers aluminum alloy rolled or forged rings up to 6 inches (152 mm) which are produced and shipped in the –T351 or –T352 temper and are artificially aged to the –T82 temper prior to being put into service.

1.2 Application

These rings have been used typically for structural applications requiring good fusion weldability, a combination of good strength and resistance to stress-corrosion cracking, and for parts requiring good stability during machining, but usage is not limited to such applications.

1.2.1 Certain design and fabrication procedures may cause these rings to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

1.3 Classification

Rings covered by this specification are classified by type of mechanical stress relief as follows:

Type 1 - Stress relieved by stretching (2219-T351)

Type 2 - Stress relieved by compression (2219-T352)

1.3.1 Either type may be supplied, unless a specific type is ordered.

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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 Alloys, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings
AMS2772	Heat Treatment of Aluminum Alloy Raw Materials
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 B594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products
ASTM B660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E3	Preparation of Metallographic Specimens
ASTM E10	Brinell Hardness of Metallic Materials
ASTM E340	Macroetching Metals and 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
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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

Rings shall be solution heat treated and mechanically stress-relieved, to the T351 or T352 condition as applicable (see ANSI H35.1/H35.1M). Heat treatment shall be performed in accordance with AMS2772.

3.2.1 Type 1

Solution heat treated and stress relieved by stretching to produce a permanent set of 1-1/2 to 5%.

3.2.2 Type 2

Solution heat treated and stress relieved by compression to produce a permanent set of 1-1/2 to 5%. During compression, primary forces shall be applied in the axial direction.

3.3 Properties

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

3.3.1 As Solution Heat Treated and Stress Relieved

3.3.1.1 Grain Size

When specified (see 8.6), shall be not larger than 0.030 inch (0.76 mm) in thickness, measured in the radial direction, and determined as follows:

- 3.3.1.1.1 The radial/axial cross-section shall be macroetched in accordance with ASTM E340 for examination, at not greater than 10X magnification, to select an area representing the largest grain size for metallographic examination. The metallographic specimen thus selected shall be prepared in accordance with ASTM E3. Grain size shall be determined by counting the grains in the radial direction across the microscopic field at approximately 100X magnification, dividing the diameter of the field of view by the number of grains, and dividing the result by the actual magnification used.

3.3.2 Response to Temper Conversion

Samples from product in the T351 or T352 temper, as applicable, after artificial aging to the T82 temper in accordance with AMS2772, shall have properties as follows (see 4.3.1):

3.3.2.1 Tensile Properties

3.3.2.1.1 Rings with OD to Wall Thickness Ratio Less Than 10

Shall be as agreed upon between purchaser and producer.

3.3.2.1.2 Rings with OD to Wall Thickness Ratio of 10 or Greater

Shall be as specified in Table 2. Tensile tests are not required in any direction from which a specimen at least 2.375 inches (60.32 mm) in length cannot be obtained.

Table 2A - T82 Temper minimum tensile properties, inch/pound units

Nominal Thickness at Time of Heat Treatment Inches (see 3.3.2.1.2.1)	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Up to 3, incl	Tangential	60	48.0	6
	Axial	60	46.0	4
	Radial	58	44.0	3
Over 3 to 4, incl	Tangential	58	46.0	6
	Axial	58	44.0	4
	Radial	56	42.0	3
Over 4 to 5, incl	Tangential	56	44.0	5
	Axial	56	42.0	3
	Radial	54	40.0	2
Over 5 to 6, incl	Tangential	54	42.0	5
	Axial	54	40.0	3
	Radial	52	40.0	2

Table 2B - T82 Temper minimum tensile properties, SI units

Nominal Thickness at Time of Heat Treatment Millimeters (see 3.3.2.1.2.1)	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %
Up to 76, incl	Tangential	414	331	6
	Axial	414	317	4
	Radial	400	303	3
Over 76 to 102, incl	Tangential	400	317	6
	Axial	400	303	4
	Radial	386	290	3
Over 102 to 127, incl	Tangential	386	303	5
	Axial	386	290	3
	Radial	372	276	2
Over 127 to 152, incl	Tangential	372	290	5
	Axial	372	276	3
	Radial	359	276	2

- 3.3.2.1.2.1 Thickness shall be the smaller of the wall thickness (one-half the difference between nominal OD and nominal ID) and height (axial) dimensions.
- 3.3.2.1.2.2 Mechanical property requirements for product outside of the range covered by Table 2 shall be agreed upon between purchaser and producer.
- 3.3.2.1.2.3 Elongation requirements do not apply to test specimens having a gage-length diameter under 0.250 inch (6.35 mm), or located in immediate proximity to an abrupt change in section thickness.

3.4 Quality

Rings, 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 rings.

- 3.4.1 Each ring shall be ultrasonically inspected in accordance with ASTM B594 and shall meet the Class A acceptance limits of that specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of rings 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 rings conform to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Grain Size (3.3.1.1), when specified, Tensile Properties in the T82 condition (3.3.2), and Ultrasonic Inspection (3.4.1) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.3 Sampling and Testing

Shall be in accordance with AMS2355. A lot shall be all rings of the same size solution heat treated in the same batch-furnace load or consecutively in a continuous furnace during an eight-hour period.

4.3.1 Tensile Properties for Response to Temper Conversion (T82 temper)

Except when testing in one or more directions is not required by 3.3.2.1.2, test specimens in the tangential, axial, and radial directions shall be taken from a ring, ring prolongation, or ring segment representing the lot. When ring segments, prolongations, or representative separately forged test material are used for testing, the segments shall be cut from a ring after solution heat treatment and stress-relief. Ring segments, shall be included in each artificially aged furnace load.

- 4.3.1.1 When requested by purchaser, a minimum of one-half of each ring segment obtained as in 4.3.1 or one-half of each ring prolongation tested shall be submitted to purchaser with the rings represented.

4.3.2 Internal Quality

Each ring.

4.3.3 Grain Size

When specified and agreed upon between purchaser and producer (see 8.6), one or more radial/axial specimens from a ring, ring prolongation, or ring segment representing the lot shall be tested in accordance with 3.3.1.1.

4.4 Reports

The producer of rings shall furnish with each shipment a report stating that the product conforms to the composition, tolerances, and ultrasonic inspection, and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, inspection lot number(s), AMS4313F, size, and quantity. The report shall also identify the producer, the product form, and the size of the mill product.

- 4.4.1 When the product is outside the size range covered by Table 2, the report shall contain a statement to that effect.