SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS4313 REV. D

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Superseding AMS4313C

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

AMS4313D removes hardness as a technical requirement 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 rolled or forged rings.

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 (2219T351)
Type 2 - Stress relieved by compression (2219T352)

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

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 WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4313D

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.

AMS2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
AMS2770 Heat Treatment of Aluminum and Aluminum Alloys
AMS2772 Heat Treatment of Aluminum Alloy Raw Materials
AMS2808 Identification, Forgings

ARP823 Minimizing Stress-Corrosion for Aerospace Applications in Wrought Heat-Treatable Aluminum Alloy Products

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 594 Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications
ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products
ASTM E 3 Preparation of Metallographic Specimens
ASTM E 340 Macroetching Metals and Alloys

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 supplied in the following condition; solution 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 11/2 to 5%.

3.2.2 Type 2

Solution heat treated and stress relieved by compression to produce a permanent set of 11/2 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 Hardness

Should be not lower than 77 HB/10/500 or 82 HB/10/100 but the rings shall not be rejected on the basis of hardness if the applicable tensile property requirements are met.

3.3.1.2 Grain Size

When specified, shall be not larger than 0.030 inch (0.76 mm) in thickness, determined as follows:

3.3.1.2.1 The radial/axial cross-section shall be macroetched in accordance with ASTM E 340 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 E 3. 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 After Precipitation Heat Treatment

Shall be as follows, determined on rings precipitation heat treated in accordance with AMS2770:

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 by purchaser and vendor.

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 - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Thickness at Time of Heat Treatment Inches (See 3.3.2.1.2.1)	Specimen Orientation (See 3.3.2.1.2.2)	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 - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness at Time of Heat Treatment Millimeters (See 3.3.2.1.2.1)	Specimen Orientation (See 3.3.2.1.2.2)	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 Tangential requirements apply to specimens machined with axis of specimen tangential to the ring OD (parallel to the direction of rolling). Axial requirements apply to specimens machined with axis of specimen parallel to the ring axis (long transverse to the direction of rolling). Radial requirements apply to specimens machined with axis of specimen parallel to the radius of the ring (short transverse to the direction of rolling). All specimens shall be machined from the core of the ring.

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, or located so that any part of the specimen gage length is located within 0.125 inch (3.18 mm) of the trimmed flash line.

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 B 594 and shall meet the Class A acceptance limits of that specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of rings 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 rings conform to specified requirements.

4.2 Classification of Tests

All technical requirements are acceptance tests and except for composition shall be performed on each 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 Composition

One or more samples shall be taken by the producer from each group of ingots poured simultaneously from the same source of molten metal. Complete ingot analysis records shall be available to purchaser at producer's facility.

4.3.1.1 Unless compliance with 4.3.1 is established, an analysis shall be made for each 4000 pounds (1814 kg) or less of alloy comprising the lot except that not more than one analysis shall be required per piece.

4.3.2 Tensile Properties

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 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 precipitation heat treatment furnace load.

4.3.2.1 When requested by purchaser, a minimum of one-half of each ring segment obtained as in 4.3.2 or one-half of each ring prolongation tested shall be submitted to purchaser with the rings represented.

4.3.3 Quality

Each ring.

4.3.4 Grain Size

One or more radial/axial specimens from a ring, ring prolongation, or ring segment representing the lot, when specified.