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Title of Document: Aluminum Alloy Rings, Rolled or Forged 4.5 Cu-0.85 Si-0.80 Mn 0.50 Mg (2014-T651, 2014-T652), Solution Heat Treated, Mechanically Stress Relieved and Precipitation Heat Treated

Date of Specific Issue Adopted: 1 Jan 1987

Releasing Industry Group: Society of Automotive Engineers, Inc.

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Custodians:
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Navy - AS
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AEROSPACE MATERIAL SPECIFICATION

An American National Standard

AMS 4314B

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Superseding AMS 4314A

ALUMINUM ALLOY RINGS, ROLLED OR FORGED
4.5cu - 0.85Si - 0.80Mn - 0.50Mg (2014-T651, 2014-T652)
Solution Heat Treated, Mechanically Stress Relieved, and Precipitation Heat Treated
UNS A92014

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of rolled or forged rings.

1.2 Application: Primarily for moderately high strength structural machined parts where good stability is required during machining. Not recommended for fusion welding. Certain design and fabricating procedures may cause these products to become subject to stress-corrosion cracking; ARP 823 recommends practices to minimize such conditions.

1.3 Classification: The rings covered by this specification are classified by type of mechanical stress relief as follows:

Type 1 - Stress relieved by stretching (2014-T651)
Type 2 - Stress relieved by compression (2014-T652).

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

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications and Aerospace Recommended Practices shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2375 - Control of Forgings Requiring First Article Approval
AMS 2808 - Identification, Forgings

2.1.2 Aerospace Recommended Practices:

ARP 823 - Minimizing Stress-Corrosion Cracking in Wrought Heat Treatable Aluminum Alloy Products

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B557 - Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM B594 - Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications
ASTM El0 - Brine11 Hardness of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum Alloys

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, 0 determined by wet chemical methods in accordance with ASTM E34 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Copper	3.9	5.0
Silicon	0.50	1.2
Manganese	0.40	1.2
Magnesium	0.20	0.8
Iron	--	0.7
Zinc	--	0.25
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Rings shall be supplied in the following condition; heat treatments shall be performed in accordance with MIL-H-6088:

3.2.1 Type 1 (Temper T651): Solution heat treated, stress relieved by stretching to produce a permanent set of l-l/2 - 5%, and precipitation heat treated.

3.2.2 Type 2 (Temper T652): Solution heat treated, stress relieved by compression to produce a permanent set of l-1/2 - 5%, and precipitation heat treated, During compression, primary forces shall be applied in the axial direction and on individual rings approximating final dimensions.

3.3 Properties: Rings shall conform to the following requirements:

3.3.1 Tensile Properties:

3.3.1.1 Rings With OD to Wall Thickness Ratio Less than 10: Shall be as agreed upon by purchaser and vendor.

3.3.1.2 Rings With OD to Wall Thickness Ratio of 10 or Greater: Shall meet the requirements of Table I, determined in accordance with ASTM B557. Tensile tests are not required in any direction from which a specimen at least 2.375 in. (60 mm) in length cannot be obtained.

TABLE I

Nominal Thickness at Time of Heat Treatment Inches (See 3.3.1.2.1)	Specimen Orientation (See 3.3.1.2.2)	Tensile Strength psi, min	Yield Strength at 0.2% psi, min	Elongation in 4D %, min
Up to 2, incl	Tangential	65,000	56,000	8
	Axial	65,000	56,000	3
Over 2 to 3, incl	Tangential	64,000	56,000	8
	Axial	64,000	56,000	3
	Radial	62,000	52,000	2
Over 3 to 4, incl	Tangential	63,000	55,000	8
	Axial	63,000	55,000	3
	Radial	61,000	51,000	2
	Tangential	62,000	54,000	7
Over 4 to 5, incl	Axial	62,000	54,000	2
	Radial	60,000	50,000	1
Over 5 to 6, incl	Tangential	61,000	53,000	7
	Axial	61,000	53,000	2
	Radial	59,000	50,000	1
	Tangential	60,000	52,000	6
Over 6 to 7, incl	Axial	60,000	52,000	2
	Radial	58,000	49,000	1
Over 7 to 8, incl	Tangential	59,000	51,000	6
	Axial	59,000	51,000	2
	Radial	57,000	48,000	1

3.3.1.2 (Continued):

TABLE I (SI)

Nominal Thickness at Time of Heat Treatment Millimetres (See 3.3.1.2.1)	Specimen Orientation (See 3.3.1.2.2)	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min
Up to 51, incl	Tangential	450	385	8
	Axial	450	385	3
Over 51 to 76, incl	Tangential	440	385	8
	Axial	440	385	3
	Radial	425	360	2
Over 76 to 102, incl	Tangential	435	380	8
	Axial	435	380	3
	Radial	420	350	2
Over 102 to 127, incl	Tangential	425	370	7
	Axial	425	370	2
	Radial	415	345	1
Over 127 to 152, incl	Tangential	420	365	7
	Axial	420	365	2
	Radial	405	345	1
Over 152 to 178, incl	Tangential	415	360	6
	Axial	415	360	2
	Radial	400	340	1
Over 178 to 203, incl	Tangential	405	350	6
	Axial	405	350	2
	Radial	395	330	1

3.3.1.2.1 Thickness is defined as the smaller of the wall thickness (one-half the difference between nominal OD and nominal ID) and height (axial) dimensions.

3.3.1.2.2 Tangential test requirements apply to specimens machined with axis of specimen tangential to the ring OD (parallel to the direction of rolling). Axial test requirements apply to specimens machined with axis of specimen parallel to the axis of the ring (long transverse to the direction of rolling). Radial test 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 Hardness: Should be not lower than 120 HB/10/500 or 125 HB/lO/lOOO, determined in accordance with ASTM ElO, but the rings shall not be rejected on the basis of hardness if the tensile property requirements are met.

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, unless otherwise specified, 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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the rings conform to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed prior to or on the first-article shipment of a ring to a purchaser, on each lot, when a change in material, processing, or both requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows; 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 in an 8-hr period and precipitation heat treated as a unit.

4.3.1 Composition: At least one sample shall be taken by the producer from each group of ingots poured simultaneously from the same source of molten metal.

4.3.1.1 Unless compliance with 4.3.1 is established, an analysis shall be made for each 4000 lb (1800 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 3.3.1, 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 which has been solution heat treated and stress-relieved with the production rings. Solution heat treated and stress-relieved ring segments shall be included in each precipitation heat treatment furnace load.