SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4311D

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Superseding AMS 4311C

Aluminum Alloy, Rolled or Forged Rings
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075-T7351, 7075-T7352)
Solution Heat Treated, Mechanically Stress Relieved, and Precipitation Heat Treated

(Composition similar to UNS A97075)

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 applications requiring a combination of high strength, resistance to stress-corrosion cracking, and good stability during machining, but usage is not limited to such applications.

1.3 Classifications:

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

Type 1 - Stress-relieved by stretching (7075-T7351)
Type 2 - Stress-relieved by compression (7075-T7352)

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: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or 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 Materials
AS1990	Aluminum Alloy Tempers

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or 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 B 666/B 666M	Identification of Aluminum and Magnesium Alloy Products

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	--	0.40
Iron	--	0.50
Copper	1.2	2.0
Manganese	--	0.30
Magnesium	2.1	2.9
Chromium	0.18	0.28
Zinc	5.1	6.1
Titanium	--	0.20
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition:

Rings shall be supplied in the following condition; heat treatments shall be performed in accordance with AMS 2772 to the following tempers:

3.2.1 Type 1: Solution heat treated, stress relieved by stretching to produce a permanent set of 1 to 5%, and precipitation heat treated to the T7351 temper (See AS1990).

3.2.2 Type 2: Solution heat treated, stress relieved by compression to produce a permanent set of 1 to 5%, and precipitation heat treated to the T7352 temper (See AS1990). 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, determined in accordance with AMS 2355.

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 be in accordance with Table 2. Tensile tests are not required in any direction from which a specimen at least 2.50 inches (63.5 mm) in length cannot be obtained.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness at Time of Heat Treatment, Inch (See 3.3.1.2.1)	Specimen Orientation (See 3.3.1.2.2)	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Up to 3, incl	Tangenital	66.0	54.0	7
	Axial	64.0	50.0	4
	Radial	61.0	50.0	3
Over 3 to 4, incl	Tangenital	64.0	53.0	7
	Axial	63.0	48.0	3
	Radial	60.0	48.0	2
Over 4 to 5, incl	Tangenital	62.0	51.0	7
	Axial	61.0	46.0	3
	Radial	58.0	46.0	2
Over 5 to 6, incl	Tangenital	61.0	49.0	6
	Axial	59.0	44.0	3
	Radial	57.0	44.0	2

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Thickness at Time of Heat Treatment, Millimeters (See 3.3.1.2.1)	Specimen Orientation (See 3.3.1.2.2)	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %
Up to 76, incl	Tangenital	455	372	7
	Axial	441	345	4
	Radial	421	345	3
Over 76 to 102, incl	Tangenital	441	365	7
	Axial	434	331	3
	Radial	414	331	2
Over 102 to 127, incl	Tangenital	427	352	7
	Axial	421	317	3
	Radial	400	317	2
Over 127 to 152, incl	Tangenital	421	338	6
	Axial	407	303	3
	Radial	393	303	2

3.3.1.2.1 Thickness is 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 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.

3.3.1.2.3 Elongation requirements do not apply to test specimens having a gage-length diameter less than 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.

3.3.2 Hardness: Shall be not lower than 130 HB/10/500 or 135 HB/10/1000.

3.3.3 Stress-Corrosion Resistance: Specimens cut from rings shall meet the conductivity test of 3.3.3.1 and shall exhibit no evidence of stress-corrosion cracking when tested in accordance with 3.3.3.2. The test of 3.3.3.2 need not be performed on rings meeting the requirements of 3.3.3.1.1 and 3.3.3.1.2.

3.3.3.1 Conductivity: Shall be as follows, determined on the surface of the sample (See 4.3.3):

3.3.3.1.1 If the conductivity is 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m) or higher and tangential tensile properties meet specified requirements, the rings are acceptable.

3.3.3.1.2 If the conductivity is between 38.0 to 39.9% IACS (22.0 to 23.1 MS/m), if the tangential tensile properties meet the specified requirements, and if the tangential yield strength does not exceed the specified minimum by more than 11.9 ksi (82 MPa), the rings are acceptable.

3.3.3.1.3 If the conductivity is between 38.0 to 39.9% IACS (22.0 to 23.1 MS/m) and the tangential yield strength exceeds the specified minimum value by more than 11.9 ksi (82 MPa), the rings shall be given additional precipitation heat treatment. If, after such treatment, the rings meet the requirements of 3.3.1 and 3.3.3.1.1 or 3.3.3.1.2, the rings are acceptable.

3.3.3.1.4 If the conductivity is below 38.0% IACS (22.0 MS/m), the rings are not acceptable but may be re-heat treated or given additional precipitation heat treatment to meet the specified requirements.

3.3.3.2 Stress-Corrosion Cracking Resistance: Specimens as in 4.3.4 from rings 0.750 inch (19.05 mm) and over in least dimension, shall show no evidence of stress-corrosion cracking when stressed to 75% of the specified minimum tangential yield strength with axis of loading parallel to the axial direction of the ring.

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 the specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), tensile properties (3.3.1), hardness (3.3.2), stress-corrosion resistance (3.3.3), conductivity (3.3.3.1), and ultrasonic soundness (3.4.1) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests: Tests for stress-corrosion cracking resistance (3.3.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.