

AEROSPACE
MATERIAL
SPECIFICATION

AMS 7269A

Superseding AMS 7269

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RINGS, SEALING, SILICONE RUBBER
Low Outgassing, Space and Vacuum Service
45 - 55

1. SCOPE:

- 1.1 Form: This specification covers a low-outgassing silicone rubber compound in the form of molded rings.
- 1.2 Application: Sealing rings specifically formulated, formed, and postcured for use in interplanetary space and other hard vacuums from -75° to +150°C (-100° to +300°F), with a minimum of condensable outgassing products. While within the earth's atmosphere, the silicone rubber compound is resistant to deterioration by ozone, smog, and weathering. Standard sizes are as shown in AS 568.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS), Aerospace Standards (AS), and Aerospace Information Reports (AIR) 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 2817 - Packaging and Identification, Preformed Packings

2.1.2 Aerospace Standards:

AS 568 - Aerospace Size Standard for O-Rings
AS 871 - Manufacturing and Inspection Standards for Preformed Packings (O-Rings)

2.1.3 Aerospace Information Report:

AIR 851 - O-Ring Tension Testing Calculations

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

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

ASTM D624 - Rubber Property - Tear Resistance
ASTM D1329 - Rubber Property - Retraction at Low Temperature (TR Test)
ASTM D1414 - Testing Rubber O-Rings
ASTM D3182 - Rubber - Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

- 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120, except as noted in 2.3.2.

2.3.1 Military Standards:

MIL-STD-413 - Visual Inspection Guide for Rubber O-Rings

2.3.2 National Aeronautics and Space Administration (NASA) Publications:

- 2.3.2.1 NASA Johnson Space Center Publication: Available from Lyndon B. Johnson Space Center, Houston, TX 77058.

SP-R-0022 - Vacuum Stability Requirements of Polymeric Material for Spacecraft Application

- 2.3.2.2 NASA Goddard Space Flight Center (GSFC) Publication: Available from Goddard Space Flight Center, Greenbelt, MD 20771.

GSFC X-735-69-471 - Micro-Volatile Condensable Materials System for Polymer Outgassing Studies

3. TECHNICAL REQUIREMENTS:

- 3.1 Material: Shall be a compound based on methyl-phenyl-vinyl silicone rubber selected, formulated, cured, postcured, and otherwise processed to outgas a minimal amount of condensable material in hard vacuum (below 1×10^{-6} torr) when heated to any temperature up to 150°C (300°F) and meeting the requirements of 3.2.

- 3.2 Properties: The product shall conform to the following requirements; tests shall be performed on the product supplied, except for the tests of 3.2.1.4 and 3.2.5, and in accordance with ASTM D1414 except as specified in 4.5, insofar as practicable:

3.2.1 As Received:

- 3.2.1.1 Hardness, Durometer 50 ± 5
"A" or equiv.

3.2.1.2	Tensile Strength, min	900 psi (6.21 MPa)
3.2.1.3	Elongation, min	400%
3.2.1.4	Tear Resistance, min	100 lb per in. (17.5 kN/m)
3.2.1.5	Corrosion	None
3.2.1.6	Specific Gravity	Preproduction Value $\pm$ 0.03

3.2.2 Dry Heat Resistance:

Temperature: $225^{\circ}\text{C} \pm 2$
 $(437^{\circ}\text{F} \pm 4)$
 Time: 70 hr $\pm$ 0.5

3.2.2.1 Hardness Change, -10 to +10
 Durometer "A" or
 or equiv

3.2.2.2 Tensile Strength -20%
 Change, max

3.2.2.3 Elongation Change, -35%
 max

3.2.3 Compression Set:

Temperature: $175^{\circ}\text{C} \pm 2$
 $(347^{\circ}\text{F} \pm 4)$
 Time: 22 hr $\pm$ 0.3

Percent of Original
 Deflection, max
 Ring Cross Section
 Diameter
 0.066 to 0.110 in. 25
 (1.65 to 2.75 mm),
 incl
 Over 0.110 in. 20
 (2.75 mm)

3.2.4 Low-Temperature Resistance:

Temperature Retraction, -73°C (100°F)
 TR_{10} point, max

3.2.5 Outgassing Hard Vacuum:

3.2.5.1 Total Mass Loss, max 1%

GSFC X-735-69-471 or
 JSC SP-R-0022
 (See 8.2)

3.2.5.2 Collected Volatile 0.1%
Condensable Material,
max

GSFC X-735-69-471 or
JSC SP-R-0022

3.2.5.3 Visible Condensable None
Material

4.5.4

3.3 Quality: Rings, as received by purchaser, shall be uniform in quality and condition, clean, smooth, as free from foreign material as commercially practicable, and free from internal imperfections detrimental to their performance. Surface imperfections shall, unless otherwise specified, be no greater than permitted by MIL-STD-413 for minor defects.

3.4 Sizes and Tolerances: Shall be as specified on the drawing. Standard size O-rings as shown in AS 568 may be described by a part number composed of this specification number followed by a dash and three digits indicating the desired AS 568 size. Inspection for conformance to dimensional requirements shall be made in accordance with AS 871, unless otherwise agreed upon by purchaser and vendor.

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 except for outgassing in hard vacuum (3.2.5). The outgassing in hard vacuum tests shall be the responsibility of the purchaser. Results of tests shall be reported to the purchaser as required by 4.6. 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:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

Requirement Test	Paragraph Reference
Hardness as-received	3.2.1.1
Tensile Strength as-received	3.2.1.2
Elongation as-received	3.2.1.3
Specific Gravity	3.2.1.6
Compression Set	3.2.3

- 4.2.2 Periodic Tests: Tests to determine conformance to the following requirements are classified as periodic tests and shall be performed at a frequency selected by the vendor but not greater than 6 months unless other frequency of testing is specified by purchaser:

Requirement	Paragraph Reference
Tear Resistance, Die "B"	3.2.1.4
Corrosion	3.2.1.5
Dry Heat Resistance	3.2.2
Low-Temperature Resistance	3.2.4

- 4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the first-article shipment of rings to a purchaser, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

- 4.2.3.1 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:

- 4.3.1 For Acceptance Tests: Sufficient rings shall be taken at random from each lot to perform all required tests; the number of tests for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

- 4.3.1.1 A lot shall be all rings of the same size from the same batch of compound processed in one continuous run and presented for vendor's inspection at one time but shall not exceed 1000 rings or 100 lb (45 kg), whichever is the lesser mass.

- 4.3.1.2 A batch shall be the quantity of compound run through a mill or mixer at one time.

- 4.3.1.3 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.5.1 shall state that such plan was used.

- 4.3.1.4 If rings smaller than AS 568-010 are ordered, seven rings of -214 or -218 size shall be provided for determining tensile strength and elongation; such rings shall be from the same batch of compound cured in the same press and under the same conditions as the rings they represent and postcured with those rings.

4.3.1.5 Not less than two rings for compression set tests.

4.3.2 For Periodic Tests: As in 4.3.1 for the batch from which the samples are
 Ø taken.

4.3.2.1 One ASTM D3182 test sheet for tear resistance tests.

4.3.2.2 Not less than one ring for corrosion tests.

4.3.2.3 Not less than seven rings for dry heat resistance tests.

4.3.2.4 Not less than one ring for low-temperature resistance tests.

4.3.3 For Preproduction Tests: As agreed upon by purchaser and vendor and as
 Ø follows:

4.3.3.1 Tests for resistance to outgassing in hard vacuum shall be performed on specimens cut from ASTM D3182 test sheets.

4.4 Approval:

4.4.1 Sample rings and test sheets shall be approved by purchaser before rings
 Ø for production use are supplied, unless such approval be waived by purchaser. Results of tests on production rings shall be essentially equivalent to those on the approved sample rings.

4.4.2 Vendor shall establish for each size of ring parameters for the control factors of processing which will produce rings meeting all requirements of this specification. These shall constitute the approved procedures and shall be used for manufacturing production rings. If necessary to make
 Ø any change in parameters for the control factors of processing, vendor shall submit for reapproval a statement of the revised procedures and, when requested, sample rings and test sheets. Production rings incorporating the revised procedures shall not be shipped prior to receipt of reapproval.

4.4.2.1 Control factors for producing rings include, but are not limited to, the following:

Base polymer, molecular weight distribution, and pretreatment
 Compound ingredients and proportions thereof within established limits
 Sequence of mixing compound ingredients
 Type of mixing equipment
 Method and equipment for preparing preforms
 Basic molding procedure (compression, transfer, injection)
 Curing time and temperature (must be held within plus two, minus zero half lives of the decomposition of the peroxide used)
 Pressure (variations of $\pm 10\%$ are permissible)
 First postcure step for complete removal of curing by-products

4.4.2.1 (Continued):

Overall postcure steps, times, and temperatures
Finishing methods
Methods of inspection
Protection from external contamination

- 4.4.2.1.1 Any of the above control factors of processing for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Test Methods:

- 4.5.1 Tensile Strength and Elongation: For rings smaller than can be tested using 1/2 in. (12.5 mm) diameter spools, use successively smaller spools having diameters half the diameter of the next larger size, 1/4 in. (6.2 mm), 1/8 in. (3.2 mm), 1/16 in. (1.6 mm), as required. Spool mounts shall be rotated 180 deg relative to each other to allow closing to the compound zero elongation for small o-rings. The spool center-to-center distance for zero elongation of the ring can be computed from the following formula from AIR 851: $d = (D - S)/2$. Calculations of tensile strength and elongation may be made in accordance with AIR 851.
- 4.5.2 Tear Resistance: Shall be determined in accordance with ASTM D624 on specimens cut from a standard sheet, using Die B.
- 4.5.3 Low-Temperature Resistance: May be determined in accordance with ASTM D1329, using 1-in. (25-mm) long T-50 specimens cut from a standard test sheet in lieu of testing rings. In all cases, specimens shall be stretched to 300% elongation and cooled to below -100°C (-150°F) in a bath of denatured alcohol chilled with liquid nitrogen.
- 4.5.4 Visible Condensable Material: Shall be determined in a test tube conforming to Fig. 1. The specimen shall be 6 sq in. (39 cm²) of surface area cut from a standard test sheet or 4 - 5 g of ring. The test tube shall be connected to a high-vacuum system and pumped to pressure lower than 3×10^{-6} torr. The temperature of the specimen shall be raised gradually, by radiant heat, so as not to raise the system pressure above 5×10^{-6} torr. The specimen temperature shall be sensed by a thermocouple contacting the specimen. The temperature shall be raised to 144° - 150°C (290° - 300°F) and the specimen maintained at that temperature and under that vacuum for not less than four days. The temperature of the room where the equipment is operated shall be maintained at 22° - 27°C (72° - 80°F) to limit variations in the condensing surface temperature. The tube above the heated region shall be carefully examined visually (normal or corrected to normal) for condensation, using optimum lighting and viewing angles. The appearance of fog, droplets, or film on the unheated portion of the test tube at any time during the test shall be cause for rejection. Any subjective, possible condensation which may be controversial between observers shall be resolved in favor of acceptability of the specimen.

4.6 Reports:

- 4.6.1 The vendor of rings shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the rings conform to the other technical requirements of this specification. This report shall include the purchase order number, AMS 7269A, vendor's compound number, lot number, part number, and quantity.
- 4.6.2 In addition to the reports of 4.6.1, the vendor shall furnish at six-month intervals the results of tests to determine conformance to the periodic test requirements. This report shall be included with, or shall form a part of, the report of results of acceptance tests on the first lot of rings shipped following determination of conformance to the periodic test requirements.
- 4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the rings may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the rings represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

- 5.1 Packaging and Marking: Rings shall be packaged and identified as follows:

- 5.1.1 Individual rings shall be packaged and identified in accordance with AMS 2817. In addition, the package shall be marked: "SPECIAL LOW-OUTGASSING SILICONE O-RINGS FOR SPACE AND VACUUM SERVICE." Containers for shipping and storage of individual packages shall be similarly marked.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts not conforming to this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

- 8.1 Marginal Indicia: The phi (ϕ) symbol is used to indicate technical changes from the previous issue of this specification.
- 8.2 Intended Use: Seals conforming to this specification are intended for use in electrical connectors, components, assemblies, and vehicle segments on the external configuration of spacecraft, where no condensation can be tolerated on critical surfaces (windows, optics, thermal control coatings,