SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7269B

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Superseding AMS 7269B

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

1. SCOPE:

1.1 Form:

This specification covers a low-outgassing silicone (PVMQ) rubber compound in the form of molded rings.

1.2 Application:

Primarily for use in interplanetary space and other hard vacuums from -75° to +150°C (-103° to +302°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.

1.2.1 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, etc) when 0such critical surfaces may be as cold as 23°C (73°F) and the seal may be as hot as 150°C (302°F). Seals for man-inhabited areas of spacecraft may require additional testing and approval.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
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SAE WEB ADDRESS: **http://www.sae.org**

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS 2817 Packaging and Identification, Preformed Packings

2.1.2 Aerospace Standards:

AS568 Aerospace Size Standard for O-Rings
AS871 Manufacturing and Inspection Standards for Preformed Packings (O-Rings)

2.1.3 Aerospace Information Report:

AIR851 O-Ring Tension Testing Calculations

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 624 Rubber Property - Tear Resistance
ASTM D 1329 Evaluating Rubber Property - Retraction at Low Temperature (TR Test)
ASTM D 1414 Testing Rubber O-Rings
ASTM D 3182 Rubber - Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094 except as shown in 2.3.2.

2.3.1 Military Standards:

MIL-STD-413 Visual Inspection Guide for Elastomeric 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 (PVMQ) rubber, selected, formulated, cured, postcured, and otherwise processed to outgas a minimal amount of condensable material in hard vacuum (below 1 x 10-6 torr) when heated to any temperature up to 150°C (302°F) and meeting the requirements of 3.2 (See 8.3).

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 D 1414 except as specified in 4.5, insofar as practicable:

3.2.1 As Received:

3.2.1.1	Hardness, Durometer "A" or equivalent	50 ± 5	
3.2.1.2	Tensile Strength, minimum	900 psi (6.21 MPa)	4.5.1
3.2.1.3	Elongation, minimum	400%	4.5.1
3.2.1.4	Tear Resistance, minimum	100 pounds force/ inch (17.5 kN/m)	4.5.2
3.2.1.5	Corrosion	None	
3.2.1.6	Specific Gravity	Preproduction Value ± 0.03	

3.2.2	Dry Heat Resistance:		Temperature: 225°C ± 2 (437°F ± 4) Time: 70 hours ± 0.5
3.2.2.1	Hardness Change Durometer "A" or equivalent	-10 to +10	
3.2.2.2	Tensile Strength Change, maximum	-20%	
3.2.2.3	Elongation Change, maximum	-35%	
3.2.3	Compression Set: Percent of Original Deflection, maximum		Temperature: 175°C ± 2 (347°F ± 4) Time: 22 hours ± 0.3
	Ring Cross Section Diameter 0.066 to 0.110 inch (1.68 to 2.79 mm), incl	25	
	Over 0.110 inch (2.79 mm)	20	
3.2.4	Low-Temperature Resistance: Temperature Retraction, TR10 point, maximum	-73°C (-99°F)	4.5.3
3.2.5	Outgassing Hard Vacuum:		4.5.4
3.2.5.1	Total Mass Loss, maximum	1%	GSFC X-735-69-471 or JSC SP-R-0022
3.2.5.2	Collected Volatile Condensable Material, maximum	0.1%	GSFC X-735-69-471 or JSC SP-R-0022
3.2.5.3	Visible Condensable Material	None	4.5.5

3.3 Quality:

Rings, as received by purchaser, shall be uniform in quality and condition, smooth, as free from foreign material as commercially practicable, and free from internal imperfections detrimental to usage of the rings. Surface imperfections shall be no greater than permitted by MIL-STD-413.

3.4 Sizes and Tolerances:

Shall be as specified on the drawing. Standard size O-rings, as shown in AS568, may be described by a part number composed of this specification number followed by a dash and three digits indicating the desired AS568 size. Inspection for conformance to dimensional requirements shall be made in accordance with AS871.

4. QUALITY ASSURANCE ROVISIONS:

4.1 Responsibility for Inspection:

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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. 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 for the following requirements are acceptance tests and shall be performed on each lot:

Requirement	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
Quality	3.3
Sizes and Tolerances	3.4

4.2.2 Periodic Tests: Tests for the following requirements are periodic tests and shall be performed at a frequency selected by the vendor unless 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 for all technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of rings to a purchaser, when a change in ingredients 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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

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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 ϕ 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. A lot shall not exceed 1000 rings or 300 pounds (136 kg), whichever is the lesser mass, and may be packaged in smaller quantities and delivered under the basic lot approval provided lot identification is maintained.

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 ϕ When a statistical sampling plan has 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 4.6 shall state that such plan was used.

4.3.1.4 If rings smaller than AS568-010 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 taken.

4.3.2.1 One ASTM D 3182 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 follows:

4.3.3.1 Tests for resistance to outgassing in hard vacuum shall be performed on specimens cut from ASTM D 3182 test sheets.

4.4 Approval:

4.4.1 ϕ Sample rings and test sheets shall be approved by purchaser before rings 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 process control factors which will produce rings meeting the technical requirements; these shall constitute the approved procedures and shall be used for manufacturing production rings. If necessary to make any change in parameters for the process control factors, vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or processing 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 ±10% are permissible)
First postcure step for complete removal of curing by-products
Overall postcure steps, times, and temperatures
Finishing methods
Methods of inspection
Protection from external contamination

4.4.2.1.1 Any of the above process control factors 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 inch (12.7 mm) diameter spools, use successively smaller spools having diameters half the diameter of the next larger size, 1/4 inch (6.4 mm), 1/8 inch (3.2 mm), or 1/16 inch (1.6 mm), as required. Spool mounts shall be rotated 180 degrees 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 AIR851: d = (D – S)/2. Calculations of tensile strength and elongation may be made in accordance with AIR851.

4.5.2 Tear Resistance: Shall be determined in accordance with ASTM D 624 on specimens cut from a standard sheet, using Die B.

4.5.3 Low-Temperature Resistance: May be determined in accordance with ASTM D 1329, using 1-inch (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° (-148°F) in a bath of denatured alcohol chilled with liquid nitrogen.

4.5.4 Total Mass Loss and Collected Volatile Condensable Material: The major parameters of the mass loss and collected volatile condensable material test of both GSFC X-735-69-471 and JSC SP-R-0022 are essentially as follows: A sample of not less than 100 mg is reduced to pieces less than 1/16 inch (1.6 mm) in any dimension. The sample is preconditioned at 23°C ± 2 (73°F ± 4) and approximately 50% relative humidity for 24 hours before being weighed to the nearest microgram. The sample is placed in the outgassing equipment described in the applicable specification and the equipment evacuated to 1 x 10-6 torr or less. The specimen temperature is raised to 125°C ± 1 (257°F ± 2) and held at temperature for 24 hours ± 0.5. Volatile material is allowed to condense on a guarded collector plate of 1.5 inches (38 mm) diameter maintained at 25°C ± 2 (77°F ± 4). The vacuum source and heater current are cut off and clean, dry nitrogen is bled into the system to cool the heater bar rapidly. When the heater bar has cooled to approximately 50°C (122°F), the sample holder and collector plate are removed from the equipment and weighed individually as rapidly as possible. The percentage of total mass lost from the sample and percentage of collected volatile condensable material are calculated.