

AEROSPACE MATERIAL SPECIFICATION



AMS 7273C

Issued NOV 1968
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Reaffirmed APR 2001

Superseding AMS 7273B

Rings, Sealing, Fluorosilicone (FVMQ) Rubber High Temperature Fuel and Oil Resistant 70 - 80

FOREWORD

This Reaffirm contains format/editorial changes only.

1. SCOPE:

1.1 Form:

This specification covers a fluorosilicone (FVMQ) rubber in the form of molded rings.

1.2 Application:

Primarily for use from -55 to +175 °C (-67 to +347 °F) in fuels and from -55 to +150 °C (-67 to +302 °F) in lubricating oils. The cross-section of such rings is usually not over 0.275 inch (6.98 mm) in diameter or thickness.

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.

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.

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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
- AMS 3021 Reference Fluid for Testing Di-Ester (Polyol) Resistant Material
- AMS 5645 Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 18Cr - 10Ni - 0.40Ti (SAE 30321), Solution Heat Treated
- AMS 5646 Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 18Cr - 11Ni - 0.60(Cb +Ta) (SAE 30347), Solution Heat Treated

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 Reports:

- AIR851 O-Ring Tension Testing Calculations

2.2 ASTM Publications:

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

- ASTM D 471 Rubber Property - Effect of Liquids
- ASTM D 1414 Testing Rubber O-Rings

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Air Force - Aeronautical Standards:

- AN816 Adapter, Straight, Pipe to Tube

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a compound, based on a fluorosilicone (FVMQ) elastomer, suitably cured to produce sealing rings meeting the requirements of 3.2.

3.1.1 Color: Shall be blue.

3.2 Properties:

Rings shall conform to the following requirements; tests shall be performed on the rings supplied and, except as otherwise specified herein, in accordance with ASTM D 1414, insofar as practicable. Tensile strength testing is not required on rings which are too small to permit assembly on rollers and are, after cutting, too short to permit testing as a single strand. Eliminating testing for tensile strength does not eliminate testing for elongation; elongation test can be made by stretching a ring over a mandrel of a size which will stretch the ring sufficiently to produce the required elongation when figured on the ID of the ring. Calculations of tensile strength may be made in accordance with AIR851.

TABLE 1

| | | | | |
|---------|---|-------------------------------------|--------------|-------------------------------|
| 3.2.1 | As Received: | | | |
| 3.2.1.1 | Hardness, Durometer "A" or equivalent | 75 ± 5 | | |
| 3.2.1.2 | Tensile Strength, minimum | 800 psi (5.52 MPa) | | |
| 3.2.1.3 | Elongation, minimum | 100% | | |
| 3.2.1.4 | Tensile Stress at 100% Elongation | 700 - 1000 psi (4.83 - 6.90 MPa) | | |
| 3.2.1.5 | Corrosion | Nil | | |
| 3.2.1.6 | Specific Gravity | Preproduction Value ± 0.03 | | |
| 3.2.2 | Aromatic Fuel Resistance: (Immediate Deteriorated Properties) | | Medium: | ASTM Ref. Fuel B (ASTM D 471) |
| | | | Temperature: | 20 - 30 °C (68 - 86 °F) |
| | | | Time: | 70 hours ± 0.5 |
| 3.2.2.1 | Hardness Change, Durometer "A" or equivalent | -10 to 0 | | |
| 3.2.2.2 | Tensile Strength Change, maximum | -30% | | |
| 3.2.2.3 | Elongation Change, maximum | -15% | | |
| 3.2.2.4 | Volume Change | 0 to +20% | | |
| 3.2.3 | Synthetic Lubricant Resistance: | | | |
| 3.2.3.1 | Hardness Change, Durometer "A" or equivalent | -10 to 0 | Medium: | AMS 3021 |
| | | | Temperature: | 150 °C ± 3 (302 °F ± 5) |
| | | | Time: | 70 hours ± 0.5 |

TABLE 1 (Continued)

| | | | | |
|---------|--|-------------------------|--------------|----------------------------|
| 3.2.3.2 | Tensile Strength Change, maximum | -25% | | |
| 3.2.3.3 | Elongation Change, maximum | -20% | | |
| 3.2.3.4 | Volume Change | 0 to +12% | | |
| 3.2.4 | Dry Heat Resistance: | | Temperature: | 200 °C ± 3 (392 °F ± 5) |
| 3.2.4.1 | Hardness Change, Durometer "A" or equivalent | -5 to +5 | Time: | 70 hours ± 0.5 |
| 3.2.4.2 | Tensile Strength Change, maximum | -10% | | |
| 3.2.4.3 | Elongation Change, maximum | -15% | | |
| 3.2.4.4 | Bend (Flat) | No cracking or checking | | |
| 3.2.5 | Compression Set: | | Temperature: | 175 °C ± 3 (347 °F ± 5) |
| | Percent of Original Deflection | | Time: | 22 hours ± 0.25 |
| | Ring Cross Section Diameter | | | |
| | 0.066 to 0.110 inch, incl (1.68 to 2.79 mm, incl) | 50% | | |
| | Over 0.110 inch (2.79 mm) | 30% | | |
| 3.2.6 | Low-Temperature Resistance: | | | |
| | Temperature Retraction, TR ₁₀ point, maximum | -55 °C (-67 °F) | | |
| 3.2.7 | Simulated Component Test: | Pass | 4.5.1 | |

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 AS871 for minor defects.

3.4 Sizes and Tolerances:

Shall be as specified on the drawing. Inspection for conformance to dimensional requirements shall be in accordance with AS871. Standard sizes are as shown in AS568.

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. 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:

TABLE 2

| 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 |
| Tensile Stress, as received | 3.2.1.4 |
| Specific Gravity, as received | 3.2.1.6 |
| Volume Change in fuel | 3.2.2.4 |
| Compression Set | 3.2.5 |

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:

TABLE 3

| Requirement | Paragraph Reference |
|--|---------------------|
| Corrosion, as received | 3.2.1.5 |
| Tensile Strength Change in oil | 3.2.3.2 |
| Elongation Change in oil | 3.2.3.3 |
| Volume Change in oil | 3.2.3.4 |
| Hardness Change after dry heat exposure | 3.2.4.1 |
| Bend after dry heat exposure | 3.2.4.4 |
| Temperature Retraction, TR ₁₀ point | 3.2.6 |
| Simulated Component Test | 3.2.7 |

- 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:
- Shall be as follows.
- 4.3.1 For Acceptance Tests: Sufficient rings shall be selected at random from each lot to perform all required tests. The number of determinations 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 nominal size produced from the same batch of compound processed in one continuous series of operations and presented for vendor's inspection at one time plus rings as required for the simulated component test when the size used for that test is not part of the lot. A lot shall not exceed 1000 rings or 300 pounds (136 kg), whichever is the greater 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 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.
- 4.3.2 For Periodic Tests: As in 4.3.1 for the batch from which the samples are taken.
- 4.3.3 For Preproduction Tests: As agreed upon by purchaser and vendor.
- 4.4 Approval:
- 4.4.1 Sample rings 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 samples.
- 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 of this specification. These shall constitute the approved procedure 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. 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:

Compound ingredients or 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 pressure; variation of $\pm 10\%$ is permissible
Basic and minimum curing temperatures
Finishing methods
Methods of inspection

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:

Testing fuel at high temperature and high pressure can be dangerous. Proper safety procedures and precautions shall be used.

4.5.1 Simulated Component Test: Sample rings shall pass the following test; any loss of test fluid in excess of "weeping" at any time or pressure on any fixture will be considered failure. Weeping is defined as the formation of small bubbles at a rate not greater than 10 per minute and which do not break the surface of the oil when tested under oil, and as slight wetting of the area around the fitting, with no visible flow of fuel, when tested in air.

4.5.1.1 Test Specimens: Shall be O-rings conforming in dimensions to AS568-018, -120, and -214.

4.5.1.2 Apparatus: Shall consist of special blocks and plugs, as shown in Figures 1 and 2, to be assembled as shown in Figure 3, plus associated valves, piping, fittings, and means of applying nitrogen at gage pressures up to 1500 psi (10,342 kPa) as shown in Figure 4.

4.5.1.3 Procedure: The following tests shall be run in sequence, holding for 10 minutes ± 1 at each pressure. In raising pressure, any momentary leaking while O-rings are seating themselves shall be disregarded. If escape of test fluid in excess of weeping occurs, the test shall be discontinued at the step; if no escape of test fluid in excess of weeping occurs, the test shall be continued to the next step.

4.5.1.3.1 Fill recesses in blocks with ASTM Reference Fuel B (ASTM D 471). Wipe specimens with ASTM No. 1 oil (ASTM D 471) to provide a lubricating oil film. Assemble specimens in their respective grooves in the plugs and assemble plugs to blocks. Tighten bolts to 90 - 100 pounds force/inch (10.2 - 11.3 N·m) torque. Fill test fixtures to top of each fitting, using a hypodermic syringe, with ASTM Reference Fuel B. Test for leakage at room temperature, using 100 psi (689 kPa) nitrogen pressure. If escape of test fluid in excess of weeping occurs, disassemble and reassemble test fixture, refill as necessary with ASTM Reference Fuel B, and again pressure test.

- 4.5.1.3.2 Place fixture in a suitable oil bath in an oven at $175\text{ }^{\circ}\text{C} \pm 3$ ($347\text{ }^{\circ}\text{F} \pm 5$), attach pressure lines (See Figure 4), and close all valves. A suitable oil is one which is clear, light in color, and stable at the test temperature (See 8.2). Heat fixture at $175\text{ }^{\circ}\text{C} \pm 3$ ($347\text{ }^{\circ}\text{F} \pm 5$) for $6\text{ hours} \pm 0.25$. Pressure test, using nitrogen as the pressurizing medium, at 250, 500, 1000, and 1500 psi (1724, 3447, 6895 and 10,342 kPa) gage pressure, respectively, noting any leakage by bubble formation in the oil. The valve systems shall be used to isolate leakage of any particular ring.
- 4.5.1.3.3 Shut off heat input to the oven, allow apparatus to cool to room temperature, and release pressure. Remove fixture from the oil bath (See 8.2) and pressure test at room temperature in air at pressure of 250, 500, 1000, and 1500 psi (1724, 3447, 6895, and 10,342 kPa) gage pressure, respectively, for $5\text{ minutes} \pm 1$ at each pressure, using nitrogen as the pressurizing medium.
- 4.5.1.3.4 Place the fixture, still filled with ASTM Reference Fuel B at atmospheric pressure, in refrigerator at $-55\text{ }^{\circ}\text{C} \pm 1$ ($-67\text{ }^{\circ}\text{F} \pm 2$) for $5\text{ hours} \pm 0.25$. While still in the refrigerator, pressure test at 250, 500, 1000, and 1500 psi (1724, 3447, 6895, and 10,342 kPa) gage pressure, respectively, for $5\text{ minutes} \pm 1$ at each pressure, using nitrogen as the pressurizing medium.
- 4.5.1.3.5 Remove the fixture from the refrigerator, warm to room temperature, and pressure test as in 4.5.1.3.3.
- 4.5.1.3.6 Repeat the tests of 4.5.1.3.2 through 4.5.1.3.5 twice, making a total of three complete cycles. At the conclusion of the final cycle, disassemble the fixture and visually examine the rings. There shall be no evidence of extrusion, cracking, splitting, or other defects.

4.6 Reports:

The vendor of rings shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and, when performed, to the periodic test requirements and stating that the rings conform to other technical requirements. This report shall include the purchase order number, lot number, AMS 7273C, vendor's compound number, part number, and quantity.

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 Identification:

Individual rings shall be packaged and identified in accordance with AMS 2817 or other method acceptable to purchaser, except that cure date is not required.

6. ACKNOWLEDGMENT:

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

7. REJECTIONS:

Rings not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES:

8.1 A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the "C" revision of this specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revisions. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 Immersion Fluid:

Silicone oils having nominal viscosities between 20 and 50 centistokes at 25 °C (77 °F) are recommended for use in the high temperature exposure portion (4.5.1.3.2) of the simulated component test; the fluid used should have a flash point higher than the exposure temperature.

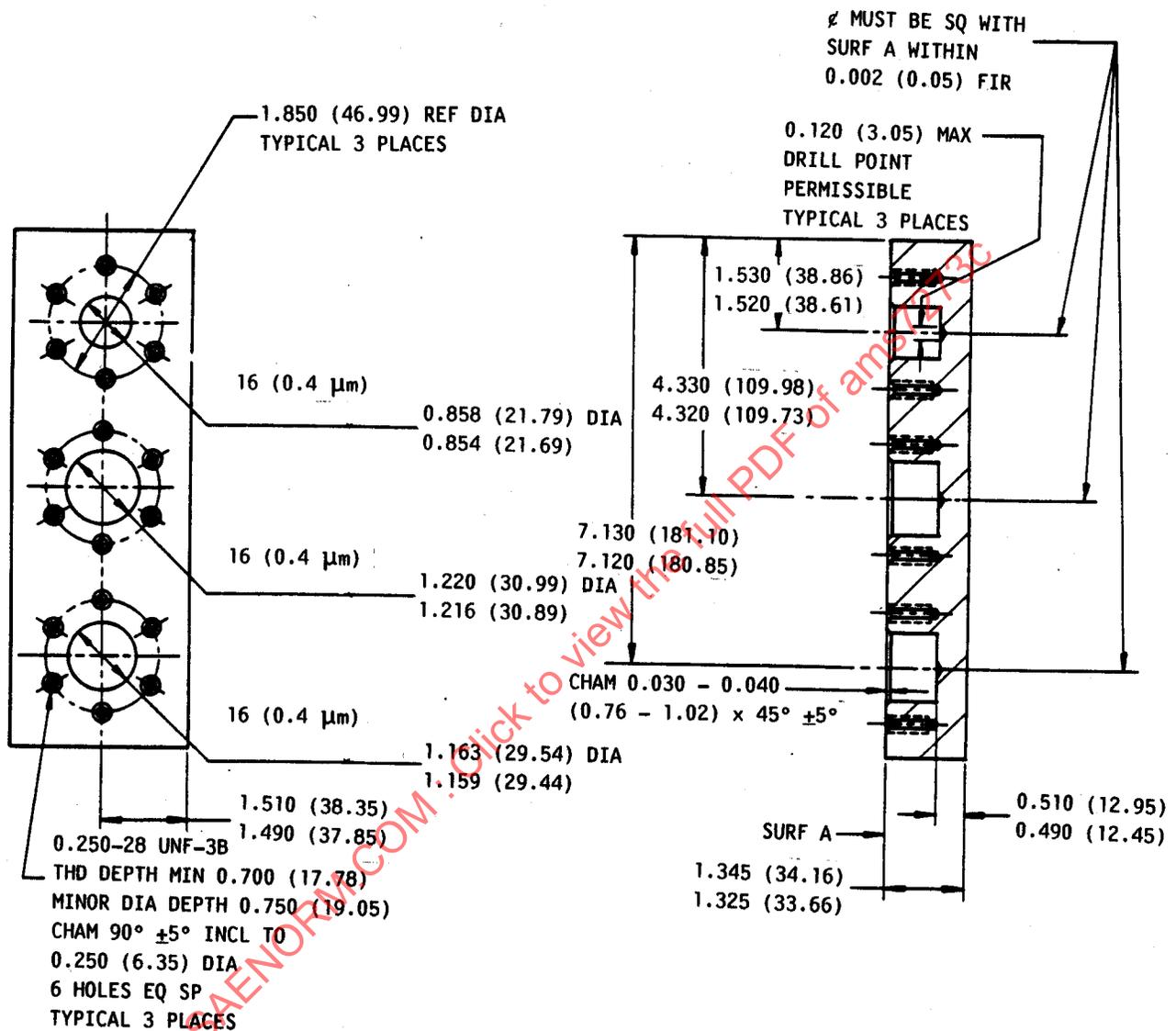
8.3 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.4 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size or part number of rings desired
Quantity of rings desired
Level A packaging, if required (See AMS 2817).

8.5 Rings meeting the requirements of this specification have been classified under Federal Supply Classification (FSC) 5330.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "CE"



DIMENSIONS IN INCHES (MILLIMETRES)
 BREAK EDGES 0.003-0.015 (0.08-0.38)
 CORNER FILLETS 0.005-0.020 (0.13-0.51) R
 MATERIAL: AMS 5645 OR AMS 5646

FIGURE 1 - Sealing Ring Test Fixture Block