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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 7265A

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Superseding AMS 7265

RINGS, SEALING, ETHYLENE PROPYLENE (EPM) RUBBER
Phosphate Ester Hydraulic Fluid Resistant
75 - 85

1. SCOPE:

1.1 Form: This specification covers an ethylene propylene (EPM) rubber in the form of molded rings.

1.2 Application: Sealing rings for use in phosphate-ester-base, fire-resistant, hydraulic fluids from -55° to +150°C (-67° to +302°F). Standard sizes are as shown in AS 568.

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 specificaton 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 Aerospace Material Specifications , Aerospace Standards , and Aerospace Information Reports 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 2406 - Chromium Plating, Hard Deposit
AMS 2817 - Packaging and Identification, Preformed Packings
AMS 6440 - Steel Bars, Forgings, and Tubing, 1.45Cr (0.98 - 1.10C) (SAE 52100), for Bearing Applications

2.1.2 Aerospace Standards:

AS568 - Aerospace Size Standard for O-Rings
AS871 - Manufacturing and Inspection Standards for Preformed Packings (O-Rings)
AS1241 - Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft

2.1.3 Aerospace Information Reports:

AIR 851 - O-Ring Tension Testing Calculations

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

ASTM D1414 - Testing Rubber O-Rings

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a compound, based on an ethylene propylene (EPM) elastomer, suitably cured to produce sealing rings meeting the requirements of 3.2.

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 D1414, insofar as practicable. Testing for tensile strength and tensile stress 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 and tensile stress 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, elongation, and tensile stress may be made in accordance with AIR 851.

3.2.1 As Received:

3.2.1.1	Hardness, Durometer "A" or equiv.	80 ± 5
3.2.1.2	Tensile Strength, minimum	1400 psi (9.65 MPa)
3.2.1.3	Elongation, minimum	125%
3.2.1.4	Tensile Stress at 100% Elongation, minimum	800 psi (5.52 MPa)
3.2.1.5	Corrosion	Nil
3.2.1.6	Specific Gravity	Preproduction Value ±0.02

3.2.2 Fluid Resistance: (Immediate Deteriorated Properties)		Medium: AS1241, Type IV, Class 1 or Class 2	
3.2.2.1 Hardness Change, Durometer "A" or equiv.	-15 to 0	Temperature:	120°C ± 3 (248°F ± 5)
		Time:	70 hr ± 0.5
3.2.2.2 Tensile Strength Change, maximum	-15%		
3.2.2.3 Elongation Change, maximum	-10%		
3.2.2.4 Volume Change	0 to +15%		
3.2.3 Dry Heat Resistance:		Temperature:	150°C + 3 (302°F ± 5)
3.2.3.1 Hardness Change, Durometer "A" or equiv.	0 to +10	Time:	70 hr ± 0.5
3.2.3.2 Tensile Strength Change, maximum	-25%		
3.2.3.3 Elongation Change, maximum	-10%		
3.2.3.4 Bend (Flat)	No cracking or checking		
3.2.4 Compression Set:		Temperature:	100°C ± 1 (212°F ± 2)
Percent of Original Deflection, maximum	30	Time:	70 hr ± 0.5
3.2.5 Low-Temperature Resistance:			
3.2.5.1 Temperature Retraction TR_{10} point, maximum	-45°C (-49°F)		
3.2.6 Performance:	Pass	4.5.1	
3.2.7 Endurance:	Pass	4.5.2	
3.2.8 Fatigue:	Pass	4.5.3	
3.2.9 Chew Resistance:	Pass	4.5.4	

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 imperfections detrimental to their performance. 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 made in accordance with AS871.

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 4.6. 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	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 hydraulic fluid	3.2.2.4
Compression Set	3.2.4

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 exceeding six months unless frequency of testing is specified by purchaser.

Requirement	Paragraph Reference
Corrosion, as received	3.2.1.5
Tensile Strength Change in hydraulic fluid	3.2.2.2
Elongation Change in hydraulic fluid	3.2.2.3
Hardness Change after dry heat exposure	3.2.3.1
Bend after dry heat exposure	3.2.3.4
Temperature Retraction, TR_{10} point	3.2.5.1
Performance	3.2.6
Endurance	3.2.7
Fatigue	3.2.8

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 prior to or 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, contracting officer, or 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 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 size produced from the same batch of compound in one continuous series of operations and presented for vendor's inspection at one time. A lot shall not exceed 1000 rings or 100 pounds (45 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 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 4.6 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 use ingredients, manufacturing procedures, processes, and methods of inspection on production rings which are essentially the same as those used on the approved sample rings. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material and/or processing and when requested, sample rings. Production rings made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Performance: Rings, tested in triplicate in the sequence listed, shall show no evidence of wear, permanent set, or extrusion of the seals, or corrosion, sticking, or discoloration of the adapters or metals adjacent to the packings during or after the entire performance tests. Leakage shall be recorded.

4.5.1.1 Test Specimen: Shall be O-rings having the dimension shown for test ring size No. 3 in Table I mounted between two chrome-tanned leather back-up rings having an OD of 1-7/8 inches ± 1/64 (47.62 mm ± 0.40), cross-sectional width of 0.188 inch +0.010, -0.005 (4.78 mm ±0.25, -0.13, and thickness of 0.094 inch ± 0.010 (2.39 mm ± 0.25). Fluid shall be AS1241 Type IV, Class 1 or Class 2.

4.5.1.2 Apparatus: Hydraulic piston and cylinder assembly designed for 3000 psi (20,684 kPa) use, together with the required actuating mechanism, hydraulic pressure source, and thermal controls and equipment. The cylinder bore diameter shall be 1.876 inches ± 0.001 (47.65 mm ± 0.025) with taper not greater than 0.001 inch per foot (0.08 mm/m) and out-of-round not greater than 0.005 inch (0.13 mm) total indicator reading; piston groove diameter shall be 1.502 inches +0.002, -0 (38.15 mm + 0.050, -0); total diametral clearance shall be 0.007 inch ± 0.005 (0.18 mm + 0.13; groove length shall be 0.410 inch ± 0.005, -0 (10.41 mm + 0.13, -0); top or corner radius shall be 0.002 - 0.008 inch (0.05 - 0.20 mm); surface finish of grooves shall be 4 to 32 microinches (0.10 to 0.81 m); and surface roughness of cylinder bore over which packing slides shall be 8 - 16 microinches (0.20 - 0.41 m). The assembly shall be set for a 4-1/2 inches (114.3 mm) stroke and adjustable in cycle rate from 0 - 40 cycles per minute. The assembly shall be mounted in a thermal chamber with a temperature range of -55° to +70°C (-67° to +158°F) and capable of control to ±1°C (±2°F). Suitable differential pressure (for hydraulically actuated equipment) or strain gage (for mechanically actuated equipment) measuring apparatus shall be provided for determining relative packing break-out and running friction values.

4.5.1.3 High-Temperature Performance Procedure: Packing specimens and backup rings shall be installed in groove assembly filled with fluid at no pressure. Assembly shall be maintained at 70°C + 1 (158°F + 2) for 6 days prior to performance tests. Assembly shall be disassembled at the end of this time and packings and all metals in contact with packings shall be inspected for adhesion, gum, residues, permanent set or swelling of packing, and discoloration or corrosion of metals. After reassembly, the pressure in the entire system shall be raised to 3000 psi (20,684 kPa) with the piston near one end of cylinder, but not bottomed, and the necessary valve adjustments made to prevent motion. The temperature shall be raised within 1 hour to 70°C + 1 (158°F + 2) and the assembly held at this temperature and pressure for 24 hours. On completion of this period, the following cyclic and static tests shall be performed in the order listed and at the temperature specified. Total leakage during the following sequence shall not exceed 20 drops (approximatley 1.2 mL) from each packing gland.

4.5.1.3.1 Initial High-Pressure Break-Out: Following the 24-hour standby period, and with the assembly at 70°C + 1 (158°F + 2) and 3000 psi (20,684 kPa) hydraulic pressure, slowly apply sufficient force (hydraulic or mechanical) to initiate movement of the piston. The pressure required for break-out of hydraulically actuated mechanisms shall not exceed 40 psi (276 kPa) and the break-out force for mechanically actuated equipment shall not exceed 110 pounds force (489 N).

4.5.1.3.2 High-Pressure Cycling: Not less than 10 cycles of operation at 3000 psi (20,684 kPa) shall be made. The differential pressure required to maintain movement at 20 cycles per minute (cpm) for hydraulically actuated mechanisms shall not exceed 20 psi (138 kPa), and for mechanically actuated equipment the force required shall not exceed 55 pounds force (245 N).

4.5.1.3.3 Low-Pressure Cycling: The piston shall be actuated not less than 110 times at no-load pressure. For hydraulically actuated mechanisms, use sufficient differential pressure to maintain movement at 20 cycles per minute. Mechanically actuated equipment should be set at 30 cpm and 10 psi (169 kPa) piston packing pressure. Record differential pressure (hydraulically actuated mechanisms) or force (mechanically actuated equipment) required to maintain movement of the piston.

4.5.1.3.4 Low-Pressure Static: The hydraulic pressure in the test assembly shall be lowered to 5 - 10 psi (134 - 169 kPa) and the installation allowed to set 1 hour. After the standby period, record the differential pressure (hydraulically actuated mechanisms) or force against the piston (mechanically actuated equipment) required to initiate movement of the piston.

4.5.1.3.5 Final High-Pressure Break-Out: After completion of the preceding test sequence, the hydraulic pressure in the test assembly shall be raised to 3000 psi (20,684 kPa) with the piston near one end of the cylinder but not bottomed, and maintained at that pressure for 3 hours at 70°C + 1 (158°F + 2). The test assembly shall then be allowed to cool to 25°C + 5 (77°F + 10) over a 20-hour period. Pressure shall not fall below 2000 psi (13,790 kPa) during this period. Pressure shall then be relieved from the test assembly without permitting the piston to move, and a non-load break-out friction test performed. The pressure required for break-out of hydraulically actuated mechanisms shall not exceed 40 psi (276 kPa) and the break-out force for mechanically actuated equipment shall not exceed 110 pounds force (489 N). Leakage during this portion of the test shall not exceed 2 drops (approximately 0.10 mL) per gland.

4.5.1.4 Low-Temperature Performance Procedure: The same apparatus and packing rings used in previous tests shall be charged to 3000 psi (20,684 kPa) for 3 minutes to position the rings within the packing gland. The pressure shall then be lowered to 5 - 10 psi (134 - 169 kPa) and the test assembly lowered within 1 hour to -55°C + 1 (-67°F + 2) and maintained at that temperature for not less than 24 hours. The following cycling and static tests shall then be performed in the order specified, using fluid no warmer than -55°C (-67°F). Leakage during the entire sequence of low-temperature performance tests shall not exceed 20 drops (approximately 1.2 mL) per gland.

4.5.1.4.1 Low-Pressure Break-Out: Following the 24-hour standby period, and with the assembly at -55° (-67°F) and 5 - 10 psi (134 - 169 kPa) slowly apply sufficient force (hydraulic or mechanical) to initiate movement of the piston. Differential break-out pressure for hydraulically actuated mechanisms shall not exceed 80 psi (552 kPa). No more than 220 pounds breakout force (979 N) shall be required for mechanically actuated piston.

4.5.1.4.2 Low-Pressure Cycling: The piston shall be actuated not less than 10 times at no load pressure. Differential pressure required to maintain 20 cpm movement of hydraulically actuated mechanisms shall not exceed 100 psi (689 kPa). Force required to maintain 20 cpm with mechanically actuated pistons shall not exceed 275 pounds force (1223 N). (See 4.5.1.4.2.1).

4.5.1.4.2.1 At the start of 4.5.1.4.2 and 4.5.1.4.3, the piston rod shall be forcefully moved from side to side in each of two planes 90 degrees apart.

4.5.1.4.3 High-Pressure Break-Out: After completing the preceding test sequence, the hydraulic pressure in the test assembly shall be maintained at 3000 psi (20,684 kPa) with the piston near one end of the cylinder, but not bottomed, and maintained at that pressure for 1 hour. Following completion of the 1-hour standby period, sufficient force (hydraulic of mechanical) shall be applied to initiate movement of the piston. The pressure required for break-out of hydraulically actuated mechanisms shall not exceed 120 psi (827 kPa) and the break-out force for mechanically actuated equipment shall not exceed 330 pounds force (1468 N). Pressure shall then be reduced to ambient and the apparatus allowed to warm to room temperature over an 18-hour period (See 4.5.1.4.2.1).

4.5.2 Endurance Requirements:

4.5.2.1 Test Specimen: Shall be O-rings and back-up rings identical to those required for performance tests of 4.5.1.

4.5.2.2 Apparatus: Shall be similar to that required for performance tests of 4.5.1. Hydraulically actuated mechanisms shall be so constructed that during the filling stroke of the inboard end of the cylinder (at which time the piston rod is retracting), the fluid pressure shall be between ambient and 5 psi (34.5 kPa) absolute pressure. Mechanically actuated equipment shall be so constructed that impulse pressure of 3000 psi (20,684 kPa) at a rate of 25,000 psi (172 MPa) per second will be applied at mid-stroke as the piston is retracting and remain at 3000 psi (20,684 kPa) for 1/2 cycle, being reduced to 20 - 50 psi (138 - 345 kPa) absolute pressure as the piston reaches mid-stroke in the opposite direction.

4.5.2.3 Aged Ring Cycling Test Procedure: The same O-rings and back-up rings as were used in 4.5.1 shall be reinstalled in the test cylinder. All test data, determined under the following test conditions, shall be recorded:

Fluid: AS1241, Type IV, Class 1 or Class 2
Temperature: 50°C ± 3 (122°F ± 5)
Stroke: 4 inches (102 mm), minimum
Operating Pressure, Hydraulically actuated mechanisms:
2600 - 3000 psi (17,926 - 20,684 kPa) driving and 3000 psi (20,684 kPa) minimum loading.
Operating Pressure, Mechanically actuated equipment:
1/2 cycle at 3000 psi (20,684 kPa), 1/2 cycle at 20 - 50 psi (138 - 345 kPa) absolute pressure. Pressure to change at mid-stroke.

Rating of Cycling: 30 cycles per minute, minimum. Total cycles: Not less than 40,000 with thin-walled type cylinders, or not less than 70,000 if thick (non-breathing) cylinders are used.

Standby Period: Internal pressure of 3000 psi (20,684 kPa) shall be applied for not less than 17 hours after every second day's cycling. Standby pressure shall be 5 - 10 psi (134 - 169 kPa) during all other periods. In no case, however, shall more than 10,000 cycles be made between two standby periods.

4.5.2.3.1 Acceptable leakage rates will vary according to the particular test apparatus used. In no case, shall average leakage during the entire cycling test, including standby, exceed 0.2 mL per 1000 cycles of operation (approximately 4 drops per 1000 cycles) per gland. Leakage over the last 5,000 cycles of operation shall not exceed 0.2 mL per gland. The leakage shall be recorded.

4.5.2.4 New Ring Cycling Test Procedure: New packings (as molded with no aging) shall be installed in the test cylinder and cycled in the same manner in the same grooves as specified in 4.5.2.3. All test data shall be recorded.

4.5.2.4.1 Leakage of the new rings shall not exceed the rate allowed in 4.5.2.3.1. Leakage shall be recorded.

4.5.3 Fatigue Tests: New (unaged) rings shall withstand 24 hours and aged rings shall withstand 16 hours of rotation in the machine without failure and without signs of cracking, flaking, wear, or other deterioration. All test data, determined on at least two air-aged rings, two fluid-aged rings, and two unaged rings of each size specified in 4.5.4.1 under the following test conditions, shall be recorded. Aged conditions shall be 7 days at 70°C ± 1 (158°F ± 2). Fluid shall be AS1241, Type IV, Class 1 or Class 2.

4.5.3.1 Test Specimens: Shall be as listed in Table 1.

4.5.3.2 Apparatus: O-rings shall be mounted in the apparatus shown in Fig. 1. The driven mandrel shall be mounted on movable slides such that a 15% stretch can be maintained on the rings. The driving mandrel shall rotate at 1750 rpm ± 50.

4.5.3.3 Fatigue Test Procedure: The six rings of each size may be installed in the apparatus and evaluated simultaneously. The rotation need not be continuous, but the 15% stretch should not be maintained during extended periods of no rotation, and the test time specified should be a summation of only those periods of time in which rotation takes place.

4.5.4 Chew Resistance: Average chew resistance ratings shall be not less than 88 for aged samples and not less than 92 for unaged samples, determined on at least 12 rings in both the aged and unaged condition. Individual ratings lower than 70 in either the aged or unaged condition are not acceptable.

4.5.4.1 Test Specimens: O-rings having the dimensions shown for test ring size Ø No. 1 in Table I, mounted between two chrome-tanned leather back-up rings having an OD of 1-1/4 inches ± 1/64 (31.8 mm ± 0.40) and a cross-sectional width of 0.123 inch +0.010, -0.005 (3.12 mm +0.25, -0.13). Fluid shall be AS1241, Type IV, Class 1 or Class 2.

4.5.4.2 Apparatus: Cylinder 2-1/4 inches (57.2 mm) long with 1.0057 - 1.0060 inch (25.545 - 25.552 mm) diameter bore designed to withstand 3000 psi (20,684 kPa) operation with internal packing glands 1/4 inch (6.4 mm) from each end. Packing groove dimensions shall be as follows: Groove diameter, 1.243 inches ± 0.001 (31.57 mm ± 0.03 mm); bottom corner radii, 1/32 inch ± 1/64 (0.8 mm ± 0.4); top and cylinder bore edge corner radii, 0.002 - 0.008 inch (0.05 - 0.20 mm); gland length, 0.268 inch ± 0.005 (6.81 mm ± 0.13); groove wall surface finish: 8 - 32 microinches (0.20 - 0.81 µm). Pressure entry port shall be midway between the packing glands. The entire cylinder assembly shall be mounted horizontally and supported by a mechanically aligned horizontal rod running through the cylinder bore. The rod shall be made from AMS 6440 steel, heat treated to not lower than 60 HRC, chromium plated in accordance with AMS 2406, and finish ground to 0.9987 - 0.9990 in. (25.367 - 25.375 mm) with a surface roughness of 8 - 16 microin. (0.20 - 0.41 µm). The rod shall be mounted between two rigidly supported linear ball bushings, 6 inches (152 mm) apart, such that total side-to-side free play is no more than 0.0002 inch (0.051 mm). Means shall be provided for actuating the rod through a 5/32-inch (4.0-mm) stroke at 300 cpm while maintaining the floating cylinder in a fixed position midway between the two linear ball bushings. Hydraulic pressure shall be provided for steady 3000 psi (20,684 kPa) operation.