

AEROSPACE MATERIAL SPECIFICATION



AMS 7276G

Issued JUN 1974
Revised MAY 2001

Superseding AMS 7276F

Rings, Sealing, Fluorocarbon (FKM) Rubber High-Temperature-Fluid Resistant Low Compression Set 70 to 80

1. SCOPE:

1.1 Form:

This specification covers a fluorocarbon (FKM) rubber in the form of O-rings, compression seals, O-ring cord, and molded-in-place gaskets.

1.2 Application:

These products have been used typically as sealing rings, compression seals, O-ring cord, and molded-in-place gaskets in contact with air and a wide variety of fuels, lubricants, and specific hydraulic fluids from -29 to +204 °C (-20 to +400 °F), but usage is not limited to such applications. Each application should be considered individually. This class of fluoroelastomers is not recommended for use in high temperature stabilized, "HTS", engine oils. Each "HTS" oil should be evaluated separately.

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 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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright 2001 Society of Automotive Engineers, Inc.
All rights reserved.

Printed in U.S.A.

QUESTIONS REGARDING THIS DOCUMENT:

TO PLACE A DOCUMENT ORDER:

SAE WEB ADDRESS:

(724) 772-7161

(724) 776-4970

<http://www.sae.org>

FAX: (724) 776-0243

FAX: (724) 776-0790

2.1 SAE Publications:

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

AMS 2817 Packaging and Identification, Preformed Packings

AMS 3023 Fluid, Reference for Testing Polyol Ester (and Diester) Resistant Material

AS568 Aerospace Size Standard for O-Rings

AS871 Manufacturing and Inspection Standard for Preformed Packings (O-Rings)

AIR851 O-Ring Tension Testing Calculations

PD 2000 Procedures for an Industry Qualified Product Management Process

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 297 Rubber Products - Chemical Analysis

ASTM D 395 Rubber Property - Compression Set

ASTM D 412 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

ASTM D 471 Rubber Property - Effect of Liquids

ASTM D 573 Rubber - Deterioration in an Air Oven

ASTM D 1329 Rubber Property - Retraction at Lower Temperatures (TR Test)

ASTM D 1414 Rubber O-Rings

ASTM D 2240 Rubber Property - Durometer Hardness

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a compound, based on a fluorocarbon (FKM) elastomer, suitably cured to sealing rings, compression seals and moded-in-place gaskets meeting the requirements of 3.2 and 3.3. A dihydroxy/bisphenol cure system shall be used. Material shall be based on 100% virgin fluorocarbon (FKM) elastomer. No reprocessed or non-fluorocarbon polymer is acceptable.

3.1.1 Color: Shall be black or brown. No other color shall be acceptable.

3.2 Properties:

Rings shall conform to the requirements shown in Table 1 and Table 2; tests shall be performed on the rings supplied and in accordance with ASTM D 1414, insofar as practicable. O-ring sizes that are suitable for test are shown in Table 3. For all other sizes tests shall be conducted on a size -214 O-ring of identical batch and state of cure as the end item. If at all possible compression set and specific gravity tests shall be conducted on the end item. Calculations of tensile strength and elongation may be made in accordance with AIR851.

TABLE 1 - Properties

	Property	Requirement	Test Method
3.2.1	Hardness, Durometer "A" or equivalent	75 ± 5	ASTM D 2240
3.2.2	Tensile Strength, min	1400 psi (9.65 MPa)	ASTM D 412
3.2.3	Elongation, min	125%	ASTM D 412
3.2.4	Density	Preproduction Value ±0.02	ASTM D 297 (Hydrostatic Method)
3.2.5	Aromatic Fuel Resistance		ASTM D 471 ASTM Ref. Fuel B 23 °C ± 2 (73 °F ± 5) 70 hours ± 0.5
3.2.5.1	Hardness Change, Durometer "A" or equivalent	-5 to +5	
3.2.5.2	Tensile Strength Change, max	-20%	
3.2.5.3	Elongation Change, max	-20%	
3.2.5.4	Volume Change	0 to +5%	
3.2.6	Synthetic Lubricant Resistance		ASTM D 471 (Note A) AMS 3023 200 °C ± 3 (392 °F ± 5) 70 hours ± 0.5
3.2.6.1	Hardness Change, Durometer "A" or equivalent	-15 to 0	

TABLE 1 - Properties (Continued)

Property	Requirement	Test Method
3.2.6.2 Tensile Strength Change, max (based on area before immersion)	-35%	
3.2.6.3 Elongation Change, max	-20%	
3.2.6.4 Volume Change	+1 to +25%	
3.2.6.5 Compression Set, Percent of Original Deflection, max Ring Cross Section Diameter 0.066 to 0.110, inch (1.68 to 2.79 mm), incl Over 0.110 inch (2.79 mm)	30 10	ASTM D 395 Method B
3.2.7 Dry Heat Resistance		ASTM D 573 270 °C ± 3 (518 °F ± 5) 70 hours ± 0.5
3.2.7.1 Hardness Change, Durometer "A" or equivalent	-5 to +10	
3.2.7.2 Tensile Strength Change, max	-35%	
3.2.7.3 Elongation Change, max	-15%	
3.2.7.4 Weight Loss, max	10%	4.5.1

TABLE 1 - Properties (Continued)

	Property	Requirement	Test Method
3.2.8	Compression Set, Percent of Original Deflection, max Ring Cross Section Diameter, 0.066 to 0.110, inch (1.68 to 2.79 mm), incl Over 0.110 inch (2.79 mm)	20 15	ASTM D 395 Method B 200 °C ± 3 (392 °F ± 5) 22 hours ± 0.5
3.2.9	Long-Term Compression Set, Percent of Original Deflection, max Ring Cross Section Diameter, 0.066 to 0.110, inch (1.68 to 2.79 mm), incl Over 0.110 inch (2.79 mm)	45 40	ASTM D 395 Method B 200 °C ± 3 (392 °F ± 5) 336 hours ± 0.5
3.2.10	Low-Temperature Resistance, Temperature Retraction, TR ₁₀ , Point, max	-15 °C (+5 °F)	ASTM D 1329

(Note A) Do not dip specimen in acetone; blot dry residual oil from specimen.

3.3 Properties After Humidity Aging of Brown Seals Only:

The properties shown in Table 2 shall be determined on brown seals that have been aged for 28 days \pm 2 hours at 25 °C \pm 2 (77 °F \pm 4) and 95% \pm 3 relative humidity.

TABLE 2 - Humidity Aged Properties

	Property	Requirement	Test Method
3.3.1	Tensile Strength, min	1400 psi (9.65 MPa)	ASTM D 412
3.3.2	Elongation, min	125%	ASTM D 412
3.3.3	Tensile Strength Change, max ⁽¹⁾	-15%	
3.3.4	Elongation Change, max ⁽¹⁾	-15%	
3.3.5	Synthetic Lubricant Resistance		ASTM D 471 (Note A) AMS 3023 200 °C \pm 3 (392 °F \pm 5) 70 hours \pm 0.5
3.3.5.1	Tensile Strength Change, max ⁽²⁾	-35%	
3.3.5.2	Elongation Change, max ⁽²⁾	-20%	
3.3.5.3	Compression Set, Percent of Original Deflection, max	10%	ASTM D 395 Method B
3.3.6	Dry Heat Resistance		ASTM D 573 270 °C \pm 3 (518 °F \pm 5) 70 hours \pm 0.5

TABLE 2 - Humidity Aged Properties (Continued)

	Property	Requirement	Test Method
3.3.6.1	Tensile Strength Change, max	-35%	
3.3.6.2	Elongation Change, max	-25%	
3.3.7	Compression Set, Percent of Original Deflection, max	15%	ASTM D 395 Method B 200 °C ± 3 (392 °F ± 5) 22 hours ± 0.5
(Note A) Do not dip specimen in acetone; blot dry residual oil from specimen.			
(1) Shall be based on the original tensile strength and elongation found when tested to the requirements of Table 1.			
(2) Shall be based on the tensile strength and elongation found after aging 28 days ± 2 hours at 25 °C ± 2 (77 °F ± 5) and 95% ± 3 relative humidity.			

TABLE 3 - Suitable Test Size, (See 3.2)

1/8 inch Spool		
CS	0.070	-011 to -014
1/4 inch Spool		
CS	0.070	-015 to -021
	0.103	-113 to -119
	0.139	-211 to -213
1/2 inch Spool		
CS	0.070	-022 to -050
	0.103	-120 to -163
	0.139	-214 to -258

- 3.4 Seals, as received by purchaser, shall be uniform in quality and condition, smooth, as free from foreign materials as commercially practicable, and free from internal imperfections detrimental to the usage of the seals. Surface imperfections shall be no greater than permitted by AS871 for minor defects.

3.5 Sizes and Tolerances:

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Qualification:

4.1.1 Seals that qualify are placed on a Qualified Product List (QPL) maintained by the QPL agency. To qualify, seals shall meet the tests specified in Tables 1 and 2, performed in accordance with the provisions of 8.2.

4.1.2 Qualification shall be in accordance with the provisions of 4.1.4 and 4.1.5.

4.1.3 Recertification of qualification is required every three years. Recertification consists of complete qualification tests in accordance with the requirements listed in Tables 1 and 2.

4.1.4 Qualification testing, review of test results, approval, reapproval, and recertification of qualification for QPL listing shall be in accordance with PD 2000 or equivalent and the instructions from the responsible QPL agency.

4.1.5 Seals furnished to this specification will be listed or approved for listing on the qualified products list (QPL) in accordance with the provisions of 8.2 and 8.3. Changes in the product formulation, basic methods of manufacturer, or plant site, for qualified fluorocarbon rubber seals listed or approved for listing on the "QPL", are not permitted without first notifying the responsible QPL agency to assess the need for requalification and/or revision to the QPL.

4.2 Responsibility for Inspection:

The manufacturer of product shall supply all samples 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 product conforms to the specified requirements.

4.3 Classification of Tests:

4.3.1 Acceptance Tests: Requirements shown in Table 4 are acceptance tests and shall be performed on each lot.

TABLE 4 - Acceptance Requirements

Requirement	Paragraph
Hardness	3.2.1
Tensile Strength	3.2.2
Elongation	3.2.3
Specific Gravity	3.2.4
Compression Set	3.2.8
Quality	3.4
Sizes and Tolerances	3.5

4.3.2 Qualification Tests: All technical requirements are qualification tests and shall be performed, and approved by the QPL agency, prior to or on the initial shipment of the product by the manufacturer, when a change in ingredients and/or processing requires reapproval as in 4.5.1.

4.4 Sampling and Testing:

Shall be as follows.

4.4.1 Acceptance Tests: Sufficient product shall be taken at random from each lot to perform all the required tests in Table 4. 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, except as otherwise specified in 4.4.1.3.

4.4.1.1 A lot shall be all rings of the same size, from the same batch of compound processed in one continuous run and presented for manufacturer's inspection at one time.

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

4.4.1.3 A statistical sampling plan acceptable to the purchaser may be used in lieu of sampling as in 4.4.1. Sample size for visual and dimensional requirements shall be as shown in Table 5; sample unit shall be one molded part and acceptance based on zero defects.

4.4.1.4 End of Manufacturing Process Inspection: Each individual seal shall be inspected according to AS871 under 1X magnification minimum. Entire seal surface shall be manually or electronically inspected.

4.4.1.5 Final Inspection Sampling Plan: The sample unit shall be one molded part. The sample size for both visual and dimensional inspection shall be as shown in Table 5. Acceptance is based on zero defects. Sample size for visual and dimensional requirements shall be as shown in Table 5.

TABLE 5 - Visual and Dimensional Inspection

Lot Size	Sample Size
2 to 8	Entire Lot
9 to 90	8
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1200	27
1201 to 3200	35
3201 to 10,000	38
10,001 to 35,000	46
35,001 to 150,000	56
150,001 and Over	65

4.4.2 Qualification Tests: Samples shall consist of 50 AS568 - 214 O-rings from one production lot. Eight 1-inch (25 mm) nominal diameter by 1/4 inch (6.4 mm) minimum thickness hardness buttons shall be supplied from the same lot.

4.5 Approval:

4.5.1 Manufacturer shall establish, for each size of seal, parameters for the process control factors which will produce seals meeting the technical requirements of this specification. These shall constitute the approved procedures and shall be used for manufacturing production of seals. If necessary to make any change in parameters for the process control factors, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing. When requested, sample seals shall be submitted in accordance with the provisions of 4.1. Seals manufactured using a revised procedure shall not be shipped prior to reapproval of qualification in writing.

4.5.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection in production which are essentially the same as those used on the approved sample.

4.5.2.1 Control factors for producing seals include, but are not limited to, the following:

- 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 pressure; variations of $\pm 10\%$ are permissible
- Finishing methods
- Methods of inspection.