SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7254

Issued NOV 2002

Perfluoroether Elastomer

1. SCOPE:

1.1 Form:

This specification covers a perfluoroether elastomer in the form of molded rings.

1.2 Application:

These rings have been used typically as static sealing rings and molded in place gaskets at temperatures between -65 and +400 °F (-54 and +203 °C). The cross-section of such rings is usually not over 0.275 inch (6.98 mm) in diameter or thickness. The material has resistance to a variety of fuels, engine oils, hydraulic oil, and hydraulic fluid, but usage is not limited to such applications. Each application should be considered individually.

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

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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)
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AIR851	O-Ring Tension Testing Calculations
PD 2000	Procedures for an Industry Managed Product Qualification Process

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM D 297	Rubber Products - Chemical Analysis
ASTM D 395	Rubber Property - Compression Set
ASTM D 471	Rubber Property - Effects 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 1415	Rubber Property – International Hardness, Micro Method

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

Fed-Std-595	Colors Used in Government Procurement
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be a compound, based on a perfluoroether elastomer, suitably cured to produce sealing rings meeting the requirements of 3.2. Material used shall be based on 100% virgin perfluoroether elastomer. No reprocessed or non-perfluoroether polymer is acceptable.

3.1.1 Color: Shall be green, approximating Fed-Std-595 Table V, color 14193.

3.2 Properties:

Rings shall conform to the requirements shown in Table 1; tests shall be performed on AS568 - 214 O-rings, in accordance with ASTM D 1414 and ASTM D 395, insofar as practicable, with the following exceptions. 1) TR_{10} shall be performed on test slabs measuring 2.0 mm ± 0.2 in thickness. 2) All compression set fixtures shall be cooled to 72 °F ± 5 and let equilibrate for 30 minutes before releasing the compressive load. 3) Calculations of tensile strength and elongation may be made in accordance with AIR851.

TABLE 1 – Properties

	Property	Requirement	Test Method
3.2.1	Hardness, International Rubber	70 ± 5	ASTM D 1415, Micro Method
3.2.2	Initial Tensile Strength, min	600 psi	ASTM D 1414
3.2.3	Initial Elongation, min	100%	ASTM D 1414
3.2.4	Temperature Retraction, 10% (TR_{10}), max	-55 °F (-48 °C)	ASTM D 1329
3.2.5	Specific Gravity	Qualification Value ± 0.02	ASTM D 297 Hydrostatic Method
3.2.6	Aromatic Fuel Resistance		ASTM D 471 ASTM Ref. Fuel B 73 °F ± 5 (23 °C ± 2) 70 hours ± 0.5
3.2.6.1	Volume Change	0 to +12%	
3.2.6.2	Hardness Change, International Rubber	0 to -15	
3.2.6.3	Tensile Strength Change, max	- 20%	
3.2.6.4	Elongation Change, max	- 20%	
3.2.7	Synthetic Lubricant Resistance		ASTM D 471 AMS 3023 400 °F ± 5 (203 °C ± 2) 70 hours ± 0.5
3.2.7.1	Volume Change	0 to +5%	
3.2.7.2	Hardness Change, International Rubber	0 to -10	
3.2.7.3	Tensile Strength Change, max	- 20%	
3.2.7.3	Elongation Change, max	- 20%	
3.2.7.4	Compression Set, max	35%	ASTM D 395 Method B(1)

TABLE 1 – Properties (Continued)

	Property	Requirement	Test Method
3.2.8	Long-term Compression Set, max	70%	ASTM D 395, Method B(1) AMS 3023 400 °F ± 5 (203 °C ± 2) 500 hours ± 0.5
3.2.9	Dry Heat Resistance		ASTM D 573 400 °F ± 5 (203 °C ± 2) 70 hours ± 0.5
3.2.9.1	Hardness Change, International Rubber	-5 to +5	
3.2.9.2	Tensile Strength Change, max	- 25%	
3.2.9.3	Elongation Change, max	- 25%	
3.2.9.4	Compression Set, max	45%	ASTM D 395 Method B(1)
3.2.10	Hydraulic Oil Resistance		ASTM D 471 MIL-PRF-83282 275 °F ± 5 (135 °C ± 2) 70 hours ± 0.5
3.2.10.1	Volume Change	0 to +5%	
3.2.10.2	Hardness Change, International Rubber	0 to -10	
3.2.10.3	Tensile Strength Change, max	- 20%	
3.2.10.4	Elongation Change, max	- 20%	
3.2.10.5	Compression Set, max	20%	ASTM D 395 Method B(1)
3.2.11	Long-term Compression Set, max	40%	ASTM D 395, Method B(1) MIL-PRF-83282 275 °F ± 5 (135 °C ± 2) 1000 hours ± 0.5
3.2.12	Hydraulic Fluid Resistance		ASTM D 471 AS1271, Type V 300 °F ± 5 (149 °C ± 2) 70 hours ± 0.5
3.2.12.1	Volume Change	0 to +12%	
3.2.12.2	Hardness Change, International Rubber	0 to -15	
3.2.12.3	Tensile Strength Change, max	- 20%	
3.2.12.4	Elongation Change, max	- 20%	

TABLE 1 – Properties (Continued)

	Property	Requirement	Test Method
3.2.12.5	Compression Set, max	20%	ASTM D 395 Method B(1)
3.2.13	Long-term Compression Set, max	45%	ASTM D 395, Method B(1) AS1241, Type V

(1) All compression set fixtures shall be cooled to 72 °F ± 5 and let equilibrate for 30 minutes before releasing the compressive load.

3.2.14 Corrosion: The product shall not have a corrosive effect on other materials when exposed to conditions normally encountered in service, determined by a procedure agreed upon by purchaser and supplier.

3.3 Quality:

Seals, 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 seals. Surface imperfections shall be no greater than permitted by AS871 for minor defects. The entire surface of an O-ring is considered a critical sealing surface. Critical sealing surfaces for specialty seals are defined by product drawings and shall be plainly referenced on the drawings.

3.4 Sizes and Tolerances:

Shall be as specified on the drawing. Standard sizes are as 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 3.1 and 3.2 and 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 3.1 and 3.2.

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 is the product formulation, basic methods of manufacturer, or plant site, for qualified perfluoroether 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 the seals 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 the rings conform to the specified requirements.

4.3 Classification of Tests:

4.3.1 Acceptance Tests: Requirements shown in Table 2 are acceptance tests and shall be performed on each lot. Whenever possible, the end item, or specimens cut from the end item, shall be used as a sample. If these items are unsuitable for use as test samples, tests shall be performed on samples of identical composition and state of cure as the end item. O-Rings sizes that are suitable for tensile strength and elongation testing are shown in Table 3. If at all possible, hardness, specific gravity, and compression set testing shall be conducted on the end item.

TABLE 2 - Acceptance Tests

Requirement	Paragraph
Hardness	3.2.1
Tensile Strength	3.2.2
Elongation	3.2.3
Specific Gravity	3.2.5
Compression Set	3.2.9.4
Quality	3.3
Sizes and Tolerances	3.4

TABLE 3 - Suitable Test Size

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

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 product by the manufacturer, and 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 For Acceptance Tests: Sufficient product shall be selected at random from each lot to perform all required tests in Table 2; 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.

4.4.1.1 A lot shall be all rings 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 may be used in lieu of sampling as in 4.4.1. Sample size for visual inspection for surface defects and dimensional requirements shall be as shown in Table 3; 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 should be one molded part. The sample size for both visual inspection for surface defects and dimensional inspection shall be as shown in Table 4. Acceptance is based on zero defects. Sample size for visual and dimensional requirements shall be as shown in Table 4.

TABLE 4 - 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 AS568 - 214 O-rings from one production lot. Test slabs for TR-10 testing should 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 rings 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 make no significant change to materials, processes or controls from those on which the approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the parts.

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 ± 10% are permissible
Finishing methods
Methods of inspection.

4.5.2.2 Any of the above process control factors for which parameters are considered proprietary by the manufacturer may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.6 Reports:

The supplier of the product shall furnish with each shipment a report from the manufacturer showing the results of tests to determine conformance to the acceptance test requirements (4.3.1) and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 7254, manufacturer's identification 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 seals 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 seals represented. Results of all tests shall be reported.