AEROSPACE MATERIAL SPECIFICATION

AMS3353™	REV. A
Issued 2009-04 Revised 2023-03 Superseding AMS3353	

(R) Elastomer: Fluorocarbon (FKM)
Aircraft Engine Oil, Fuel and Hydraulic Fluid Resistant
Low Temperature Sealing Tg -40 °F (-40 °C) / 70 to 80 Hardness,
for Products in Aircraft Engine Oil, Fuel, and Hydraulics Systems

RATIONALE

This specification has been revised to change the glass transition testing method from ASTM D3418 to ASTM D7426 to make this specification consistent with AMS7379 and the AMS3xxx template, as well as a general update of the specification to the latest template format.

1. SCOPE

1.1 Form

This specification covers a fluorocarbon elastomer that can be used to manufacture product in the form of sheet, strip, tubing, extrusions, and molded shapes. For molded rings, molded compression seals, and molded-in-place gaskets for aeronautical and aerospace applications, use the AMS7379 specification.

1.2 Application

This fluorocarbon material has resistance to aircraft engine oil (including high thermal stability (HTS) oils), fuel, and hydraulic fluids, but usage is not limited to such applications. This fluorocarbon material has a typical service temperature range of -50 to +400 °F (-45 to +204 °C). The service temperature range of the material is a general temperature range, but the presence of particular fluids and specific design requirements may modify this range. Each application should be considered separately. It is the responsibility of the user to determine that this specification is appropriate for the environments (temperature range, fluids exposure, etc.) in which it is sought to be used.

1.3 Order of Precedence

This specification is in addition to and in no way limiting, superseding, or abrogating any contractual obligation as required by the applicable procurement document. In the event of conflict in requirements, the order of precedence shall be:

1. Procurement Document or Contractual Agreement and all statutory and regulatory requirements (excluding this document)
2. Applicable purchaser's drawing and/or design data
3. Specifications referenced on the drawing
4. This document
5. All specifications referenced in this document

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

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2279 Tolerances, Rubber Products

AMS2810 Identification and Packaging, Elastomeric Products

AMS3085 Fluid, Reference for Testing AS5780 HPC Class (Polyol) Resistant Material (Also known as Eastman Reference Oil 300)

AMS7379 Rubber: Fluorocarbon Elastomer (FKM), 70 to 80 Hardness, Low Temperature Sealing Tg -40 °F (-40 °C), for Elastomeric Seals in Aircraft Engine Oil, Fuel, and Hydraulic Systems

AS5316 Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D297 Standard Test Methods for Rubber Products - Chemical Analysis

ASTM D395 Standard Test Methods for Rubber Property - Compression Set

ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D471 Standard Test Method for Rubber - Effect of Liquids

ASTM D573 Standard Test Method for Rubber Property - Deterioration in an Air Oven

ASTM D1329 Standard Test Method for Evaluating Rubber Property - Retraction at Lower Temperatures (TR Test)

ASTM D1418 Standard Practice for Rubber and Rubber Latices - Nomenclature

ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

ASTM D7426 Standard Test Method for Assignment of the DSC Procedure for Determining Tg of a Polymer or an Elastomeric Compound

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2.3 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, Nato Code Number H-537

2.4 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico), or +1-414-272-8575 (all other locations), www.asq.org.

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be prepared from ingredients as shall be necessary to achieve the requirements detailed in this standard and shall be a compound, based on the polymer specified in 1.1, suitably cured to produce product meeting the requirements of 3.2. The compound shall be based on 100% virgin fluorocarbon (FKM) elastomer meeting ASTM D1418 Type 3. Reprocessed vulcanized material is not acceptable.

3.2 Properties

The product shall conform to the requirements shown in Table 1.

Table 1 - Physical property requirements

The following testing shall be performed every 5 years and test reports shall be made available upon request.

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	As Received			
3.2.1.1	Hardness, Durometer “A”	BUTTON or Plied Platens	75 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, Minimum	ASTM Platen	1600 psi (11.02 MPa)	ASTM D412, Die C
3.2.1.3	Elongation, Minimum	ASTM Platen	120%	ASTM D412, Die C
3.2.1.4	Specific Gravity/Relative Density	ASTM Platen	Preproduction Value ±0.03	ASTM D297, Hydrostatic Method
3.2.1.5	Low-Temperature Resistance Temperature Retraction, (TR_{10}), °F (°C) Maximum	ASTM Platen	-37 (-38.3)	ASTM D1329
3.2.1.6	Low-Temperature Resistance Glass Transition (Tg) Mid-Point, Maximum °F (°C)	ASTM Platen	-40 (-40)	ASTM D7426
3.2.2	Aromatic Fuel Resistance			ASTM D471 ASTM Reference Fuel B Temperature: 73 °F ± 5 °F (23 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.2.1	Hardness Change, Durometer “A,” Maximum	BUTTON or Plied Platens	-10	
3.2.2.2	Tensile Strength Change, Maximum	ASTM Platen	-35%	

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3.2.2.3	Elongation Change, Maximum	ASTM Platen	-20%	
3.2.2.4	Volume Change, Maximum	ASTM Platen	1 to +10%	
3.2.3	Turbine Engine Oil Resistance			ASTM D471 (Note 1) AMS3085 Reference Oil 300 Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.3.1	Hardness Change, Durometer "A," Maximum	BUTTON or Plied Platens	-10	
3.2.3.2	Tensile Strength Change, Maximum	ASTM Platen	-30%	
3.2.3.3	Elongation Change, Maximum	ASTM Platen	-20%	
3.2.3.4	Volume Change, Maximum	ASTM Platen	0 to +10%	
3.2.3.5	Compression Set, Maximum	ASTM Platen, Plied Discs	25%	ASTM D395 Method B AMS3085 Reference Oil 300 Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.3.6	Long Term Compression Set, Maximum	ASTM Platen, Plied Discs	55%	ASTM D395 Method B AMS3085 Reference Oil 300 Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 336 hours ± 0.5 hour
3.2.4	Hydraulic Fluid Resistance			ASTM D471 (Note 1) MIL-PRF-83282 Temperature: 275 °F ± 5 °F (135 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.4.1	Hardness Change, Durometer "A," Maximum	BUTTON or Plied Platens	-7	
3.2.4.2	Tensile Strength Change, Maximum	ASTM Platen	-25%	
3.2.4.3	Elongation Change, Maximum	ASTM Platen	-15%	
3.2.4.4	Volume Change, Maximum	ASTM Platen	+6%	
3.2.4.5	Compression Set, Maximum	ASTM Platen, Plied Discs	20%	ASTM D395 Method B MIL-PRF-83282 Temperature: 275 °F ± 5 °F (135 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.4.6	Long Term Compression Set, Maximum	ASTM Platen, Plied Discs	40%	ASTM D395 Method B MIL-PRF-83282 Temperature: 275 °F ± 5 °F (135 °C ± 3 °C) Time: 336 hours ± 0.5 hour
3.2.5	Dry Heat Resistance			ASTM D573 Temperature: 518 °F ± 5 °F (270 °C ± 3 °C) Time: 70 hours ± 0.5 hour
3.2.5.1	Hardness Change, Durometer "A"	BUTTON or Plied Platens	-10 to +5	

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3.2.5.2	Tensile Strength Change, Maximum	ASTM Platen	-45%	
3.2.5.3	Elongation Change, Maximum	ASTM Platen	-15%	
3.2.5.4	Weight Loss, Maximum	ASTM Platen	10%	4.6.1
3.2.5.5	Compression Set, Percent of Original Deflection, Maximum	ASTM Platen, Plied Discs	20%	ASTM D395 Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 22 hours ± 0.5 hour
3.2.5.6	Long Term Compression Set, Maximum	ASTM Platen, Plied Discs	55%	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 336 hours ± 0.5 hour

Note 1: Do not dip specimens in acetone; blot dry residual oil from specimen.

3.3 Quality

Product, as received by purchaser, shall conform to dimensional requirements, be uniform in quality and condition, as free from foreign material as commercially practical, and free from internal imperfections (such as voids, etc.) that are detrimental to usage of the product.

3.4 Tolerances

Shall conform to all applicable requirements of AMS2279 unless otherwise specified in drawing, PO, design data, or contract.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer of the product shall be responsible to assure that all required testing and product inspection has been performed and that test data is available. Unless specified otherwise by contractual requirements, testing may be performed at either the product vendor's own internal test facility, at the mixer, or at a suitable independent test facility. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Preproduction Tests

Preproduction testing is defined as the necessary testing required to show that a compound complies with all of the technical requirements of this specification as listed in 3.2 and includes all such testing. This testing must be performed upon the initial development of the compound in order for any product to be certified to this specification. Once performed, a copy of this testing must be kept on file as objective evidence of compliance and must be made available upon request. Preproduction testing is valid for a period of 5 years and must be re-performed if any one of the following occurs:

- At the end of the current 5 year validity period, or
- When a change in ingredients and/or process requires reapproval (see 4.4), or
- If contractually required by the purchaser

4.2.2 Acceptance Tests

Tests for the following requirements are acceptance tests and shall be performed on each lot. If test specimens cannot be prepared from the end item, the applicable ASTM method shall be applied using material from the same batch and same state of cure and tested within 90 days of the manufacture subject lot.

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Table 2

Paragraph	Property	Test Sample	Requirements	Test Method
3.2.1	As Received			
3.2.1.1	Hardness, Durometer Type "A"	Part, BUTTON, or Plied Platens	75 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, Minimum	Part or ASTM Platen	1600 psi (11.02 MPa)	ASTM D412, Die C
3.2.1.3	Elongation, Minimum	Part or ASTM Platen	120%	ASTM D412, Die C
3.2.1.4	Specific Gravity/Relative Density	Part or ASTM Platen	Preproduction Value ±0.03	ASTM D297 Hydrostatic Method
3.2.5.5	Compression Set Percent of Original Deflection, Maximum	Part or ASTM Platen, Plied Discs	20%	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 22 hours ± 0.5 hour

4.2.3 Lot Acceptance Testing

Should the purchaser require additional or reduced product lot acceptance testing other than what is stated in Table 2, then the details of such testing shall be agreed upon between the purchaser and the manufacturer and shall be defined in the purchase agreement and/or specified in the design data.

4.3 Retesting

4.3.1 If any original test fails to meet the specified requirements, the re-sampling and retesting requirement of the relevant ASTM test method shall be observed (see Note 1). If the relevant ASTM test method makes no mention of a re-sampling or retesting requirement, then repeat the test using valid test specimens from the same lot under consideration for product acceptance. If the repeat test using valid test specimens from the same lot under consideration also fails, then it is an indication of a lot-specific process issue; the lot must be reviewed to determine probable cause, and the cause resolved (rework or re-sort of the product). After such a review, one additional test set is permitted. If a failure occurs using this one additional test set, then the lot shall be rejected. The same lot and batch of product as was used for the original test shall be used for retesting. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the products represented. If failure is due to a testing error, then the test is considered invalid and new specimens can be issued for testing.

NOTE 1: Example - As ASTM D412 for tensile tests: run three samples, if any fail, then two additional samples shall be tested with test results reporting the median of the five.

4.3.2 No batch may be retested more than two times.

4.4 Blending of Compound

4.4.1 If the practice is observed for blending batches, the compounder/manufacturer shall have a material approval process, which shall include these minimum requirements:

4.4.1.1 The original batch numbers and weights utilized in the blended batch shall be documented and easily accessible.

4.4.1.2 The original batches used shall be the same formulation and the same mix location.

4.4.1.3 The original batches used in creating a blended batch shall meet all of the acceptance testing criteria prior to blending and shelf life requirements. The manufacturer shall run batch acceptance tests on stored compound if it has exceeded its initial shelf life per the applicable specification. If all the values are within the acceptance testing requirements per the applicable specification, then the material is still approved for use. This process shall not exceed a maximum of 1 year for all specifications and, if beyond 1 year, the manufacturer shall have a process to run a batch/acceptance test prior to extending the shelf life for an additional shelf life cycle per the applicable specification.

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4.4.1.4 The new, blended batch shall be tested for batch and lot acceptance testing prior to shipment.

4.4.1.5 The new, blended batch shelf life shall be determined based upon the shelf life of the oldest original batch date of manufacture and shall follow the requirements of 4.2.5.1.3 used in the blend.

4.4.1.6 Blended material cannot be blended a second time.

4.5 Random Sampling

The method shall be as specified in the parts standard, drawing, or purchase document. If not specified, product shall be taken at random from each lot to perform all the required acceptance tests. The number of test specimens for each requirement shall be specified in the applicable test procedure.

4.5.1 A lot shall be all product of the same size and dimensions, cured from the same batch of compound, processed in one continuous production run, and presented for inspection at one time.

4.5.2 A batch shall be the quantity of compound run through a mill or mixer at one time (if different batches of the same compound are blended then the compounder/manufacturer shall have a material approval process, which shall include the minimum requirements listed in 4.2.5).

4.6 Test Methods

4.6.1 Weight Loss Tests

The weight loss test shall be conducted on samples air-aged at 518 °F ± 4 °F (270 °C ± 2 °C). Test specimens shall be conditioned for 24 hours ± 0.5 hour in a desiccator before and after air aging. The specimens shall be weighed immediately after the desiccation period before and after aging. The percentage weight loss shall be calculated as shown in Equation 1.

$$\text{Percentage Weight Loss} = 100*(W1-W2)/W1 \quad \text{(Eq. 1)}$$

where:

W1 = weight of sample before air-aging

W2 = weight of sample after air-aging

4.7 Approval

4.7.1 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production products which are essentially the same as those used on the qualification sample. If any change in process control factors procedures is necessary, manufacturer shall submit, for reapproval to the customer, a statement of the proposed changes in ingredients and/or processing and, when requested, sample product. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.7.2 Manufacturer shall establish, for each size of product, parameters for the process control factors which will produce products meeting the technical requirements of this specification. These shall constitute the approved procedures and shall be used for manufacturing production of products. 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 products shall be submitted in accordance with the provisions of 4.1. Products manufactured using a revised procedure shall not be shipped prior to reapproval of qualification in writing.

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