AEROSPACE MATERIAL SPECIFICATION

AMS3218™	REV. E
Issued 1997-10 Revised 2023-11 Superseding AMS3218D	

Elastomer: Fluorocarbon (FKM) Rubber
High-Temperature-Fluid Resistant
Low Compression Set / 85 to 95 Type A Hardness
For Seals in Fuel Systems and Specific Engine Oil Systems

RATIONALE

For SAE Five-Year Review and to update to latest 3XXX series template.

1. SCOPE

1.1 Form

This specification covers a fluorocarbon (FKM) elastomer that can be used to manufacture product in the form of sheet, strip, tubing, extrusions, and molded shapes. For molded rings, compression seals, molded O-ring cord, and molded-in-place gaskets for aeronautical and aerospace applications, use the AMS7259 specification.

1.2 Applications

This type of elastomer has been used typically in components in contact with air and a wide variety of fuels, synthetic lubricants, and specific hydraulic fluids with a typical service temperature range from -20 to +400 °F (-29 to +204 °C), but usage is not limited to such applications. 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.

This class of fluoroelastomers may not be suitable for use in some high temperature stabilized (HTS) engine oils. Each HTS oil should be evaluated separately. Examples of HTS oils are those oils conforming to MIL-PRF-23699 Class HTS, MIL-L-7808 Grade 4, and AS5780 Class HPC.

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. Statutory and regulatory requirements
2. Procurement document or contractual agreement and all statutory and regulatory requirements (excluding this document)
3. Applicable purchaser's drawing and/or design data

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS3218

4. Specifications referenced on the drawing and/or design data

5. This document

6. All specifications referenced in this document

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

AMS2629 Fluid, Jet Reference

AMS2810 Identification and Packaging, Elastomeric Products

AMS3023 Fluid, Reference for Testing Polyol Ester (and Diester) Resistant Material

AMS7259 Rubber: Fluorocarbon (FKM), High Temperature/Fluid Resistant, Low Compression Set/ 85 to 95 Hardness for Seals In Fuel Systems and Specific Engine Oil 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 Rubbers and Thermoplastic Elastomers - Tension

ASTM D471 Standard Test Methods for Rubber Property - Effect of Liquids

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

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

ASTM D2240 Standard Test Methods for Rubber Property - Durometer Hardness

2.3 U.S. Government Publications

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

MIL-STD-289 Visual Inspection Guide for Rubber Sheet Material

2.4 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.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 and, as applicable, 3.3. A dihydroxy/bisphenol cure system shall be used. Material shall be based on 100% virgin fluorocarbon (FKM) elastomer. Reprocessed vulcanized material is not acceptable.

3.1.1 Color

Shall be black or brown. No other color shall be acceptable.

3.2 Properties

The product shall conform to the requirements shown in Table 1 and, as applicable, Table 2.

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

Table 1 - Physical property requirements

Paragraph	Property	Test Sample	Requirement	Test Method
3.2.1	As Received			
3.2.1.1	Hardness, Durometer Type "A"	Buttons or Plied Platens	90 ± 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	100%	ASTM D412, Die C
3.2.1.4	Specific Gravity/Relative Density	ASTM Platen	Preproduction Value ±0.02	ASTM D297 (Hydrostatic Method)
3.2.1.5	Compression Set: Percent of Original Deflection, Maximum	Button, or ASTM Platen, or Plied Discs	25%	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 22 hours ± 0.5 hour
3.2.1.6	Long-Term Compression Set: Percent of Original Deflection, Maximum	Button, or ASTM Platen, or Plied Discs	65%	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 336 hours ± 0.5 hour
3.2.1.7	Low-Temperature Resistance Temperature Retraction, TR_{10}, Point, Maximum	ASTM Platen	+5 °F (-15 °C)	ASTM D1329
3.2.2	Dry Heat Resistance - ASTM D573			
3.2.2.1	Hardness Change, Durometer Type "A"	Buttons or Plied Platens	-5 to +10	ASTM D573 Temperature: 518 °F ± 4 °F (270 °C ± 2.2 °C) Time: 70 hours ± 0.5 hour
3.2.2.2	Tensile Strength Change, Maximum	ASTM Platen	-45%	
3.2.2.3	Elongation Change, Maximum	ASTM Platen	-20%	
3.2.2.4	Weight Loss, Maximum	ASTM Platen	10%	4.7.1 (Weight loss)
3.2.3	Fluid Resistance - ASTM D471 - Reference Fuel B* (Aromatic Fuel Resistance)			
3.2.3.1	Hardness Change, Durometer Type "A"	Buttons or Plied Platens	-5 to +5	ASTM D471 Temperature: 73 °F ± 4 °F (23 °C ± 2 °C) Time: 70 hours ± 0.7 hour Fluid: Reference Fuel B*
3.2.3.2	Tensile Strength Change, Maximum	ASTM Platen	-20%	
3.2.3.3	Elongation Change, Maximum	ASTM Platen	-20%	
3.2.3.4	Volume Change	ASTM Platen	0 to +5%	
3.2.4	Fluid Resistance - ASTM D471 - AMS3023 (Synthetic Lubricant Resistance)			
3.2.4.1	Hardness Change, Durometer Type "A"	Buttons or Plied Platens	-15 to 0	ASTM D471 (Note A) Temperature: 392 °F ± 4 °F (200 °C ± 2 °C) Time: 70 hours ± 0.7 hour Fluid: AMS3023
3.2.4.2	Tensile Strength Change, Maximum (based on area before immersion)	ASTM Platen	-35%	
3.2.4.3	Elongation Change, Maximum	ASTM Platen	-20%	
3.2.4.4	Volume Change	ASTM Platen	+1 to +25%	
3.2.4.5	Compression Set, Percent of Original Deflection, Maximum	Button, or ASTM Platen, or Plied Discs	25	ASTM D395, Method B

Note A: Do not dip specimen in acetone; blot dry residual oil from specimen.
* ASTM D471, AMS 2629 Type 1 is an acceptable alternate test fluid

3.3 Properties After Humidity Aging on Brown Parts Only

The properties shown in Table 2 shall be determined on brown specimens that have been aged for 28 days ± 2 hours at 77 °F ± 5 °F (25 °C ± 2.8 °C) and 95% ± 3% relative humidity.

Table 2 - Humidity aged properties

Paragraph	Property	Test Sample	Requirement	Test Method
3.3.1	Tensile Strength, Minimum	ASTM Platen	1600 psi (11.02 MPa)	ASTM D412, Die C
3.3.2	Elongation, Minimum	ASTM Platen	100%	ASTM D412, Die C
3.3.3	Tensile Strength Change, Maximum(1)	ASTM Platen	-15%	ASTM D412, Die C
3.3.4	Elongation Change, Maximum(1)	ASTM Platen	-15%	ASTM D412, Die C
3.3.5	Fluid Resistance - ASTM D471 - AMS3023 (Synthetic Lubricant Resistance)			
3.3.5.1	Tensile Strength Change, Maximum(2)	ASTM Platen	-35%	ASTM D471 (Note A) Temperature: 392 °F ± 4 °F (200 °C ± 2 °C) Time: 70 hours ± 0.7 hour ASTM D395, Method B Fluid: AMS3023
3.3.5.2	Elongation Change, Maximum(2)	ASTM Platen	-20%	
3.3.5.3	Compression Set, Percent of Original Deflection, Maximum	Buttons or Plied Discs	20	
3.3.6	Dry Heat Resistance After Humidity Age - ASTM D573			
3.3.6.1	Tensile Strength Change, Maximum	ASTM Platen	-45%	ASTM D573 Temperature: 518 °F ± 4 °F (270 °C ± 2.2 °C) Time: 70 hours ± 0.7 hour
3.3.6.2	Elongation Change, Maximum	ASTM Platen	-25%	
3.3.7	Compression Set, Percent of Original Deflection, Maximum	Buttons or Plied Discs	25	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 22 hours ± 0.5 hour

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

(1) This change calculation shall be based on the “As Received” tensile strength (see 3.2.1.2) and elongation (see 3.2.1.3) found when tested to the requirements of Table 1.

(2) This change calculation shall be based on the tensile strength (see 3.3.1) and elongation (see 3.3.2) found after aging 28 days ± 2 hours at 77 °F ± 5 °F (25 °C ± 2.8 °C) and 95% ± 3% relative humidity.

3.4 Quality

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

3.5 Tolerances

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer shall be responsible to assure that all 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. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure 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 3.3 (as applicable) 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
- When a change in ingredients and/or process requires reapproval (see 4.5)
- 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.

Table 3

Ref. Tests from Table 1	Property	Test Sample	Requirements	Test Method
3.2.1	As Received			
3.2.1.1	Hardness, Durometer Type "A"	Part	90 ± 5	ASTM D2240
3.2.1.2	Tensile Strength, Minimum	Part	1600 psi (11.02 MPa)	ASTM D412, Die C
3.2.1.3	Elongation, Minimum	Part	100%	ASTM D412, Die C
3.2.1.4	Specific Gravity/Relative Density	Part	Preproduction Value ±0.02	ASTM D297, Hydrostatic Method
3.2.1.5	Compression Set Percent of Original Deflection, Maximum	Part	25%	ASTM D395, Method B Temperature: 392 °F ± 5 °F (200 °C ± 3 °C) Time: 22 hours ± 0.5 hour
3.4	Quality	Part	Dimensional & Imperfections	Dimensional per 3.4 & 3.5 Visual per MIL-STD-289 and 3.4

4.2.3 Lot Acceptance Testing

Should the purchaser require additional or reduced product lot acceptance testing other than what is stated in Table 3, 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.

4.2.4 Retesting

4.2.4.1 If any original test fails to meet the specified requirements, the resampling 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 resampling 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 - In 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.

4.2.4.2 No batch may be retested more than two times.

4.3 Blending of Compound

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

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

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

4.3.3 The original batches used in creating a blended batch shall meet all of the acceptance testing criteria of any applicable specifications prior to blending and shall be within shelf-life requirements. If a batch that is selected for blending has exceeded its shelf life, the manufacturer shall run batch acceptance tests per the applicable specification prior to its utilization. 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.

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

4.3.5 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 4.3.3 used in the blend.

4.3.6 Blended material cannot be blended a second time.

4.4 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.

4.4.1 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.

4.4.2 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 4.3).

4.5 Approval

4.5.1 The 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, the 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.

4.5.2 The manufacturer shall establish for each size of product parameters for the process control factors which will produce product 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 changes in the parameters for process control factors, the 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.

4.5.2.1 Process control factors include, but are not limited to:

- Compound ingredients and proportions thereof within established limits
- Major change in sequence of mixing compound ingredients, as defined within the manufacturer's and compounder's agreed-upon mixing procedure
- Type of mixing equipment
- Blending process (as applicable)
- Method and equipment for preparing preforms
- Basic molding procedure (compression, transfer, and injection)
- Curing time, temperature, and pressure (beyond the manufacturer's typical requirements)
- Finishing methods
- Method of inspection

4.6 Inspection

It is the responsibility of the end user to provide an inspection plan. The plan shall be agreed upon by the manufacturer and the end user and shall be conveyed via the procurement document. Sampling plan shall be agreed upon by the manufacturer and the end user per the purchase order. If not specified, the sampling plan shall be per ANSI/ASQ Z1.4, single sampling plan, inspection level II with an AQL 1.0 except that the acceptance number shall be zero [c=0]. The sample unit shall be one part.