



AEROSPACE MATERIAL SPECIFICATION

AMS-R-25988™**REV. B**

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Revised 2023-06

Superseding MIL-DTL-25988D/
AMS-R-25988A

Rubber: Fluorosilicone (FVMQ),
Engine Oil / Fuel-Resistant,
For Seals in Engine Oil Systems/Fuel Systems

RATIONALE

Superseding MIL-DTL-25988 and adding a Qualified Product List for Type I materials. Updating to 7xxx template for Type I and 3xxx template for Type II where possible.

NOTICE

The initial SAE publication of this document was taken directly from U.S. Military Standard MIL-R-25988B. This revision incorporates updates from MIL-R-25988C, and the templates for AMS7xxx documents (Type I) and AMS3xxx documents (Type II). This SAE Standard retains the same part numbers established by the original military document.

1. SCOPE

1.1 Form

Type I of this specification covers a fluorosilicone rubber in the form of molded rings, compression seals, molded o-ring cord, and molded-in-place gaskets for aeronautical and aerospace applications.

Type II of this specification covers a fluorosilicone elastomer that can be used to manufacture product in the form of sheet, strip, tubing, extrusions, and molded shapes.

1.2 Application

This material has resistance to diester-based engine oil (MIL-PRF-7808) and fuel, but usage is not limited to such applications. This material is not suitable for use in synthetic phosphate ester based hydraulic fluids (AS1241) or helicopter transmission lubricating oils (DOD-PRF-85734, MIL-PRF-32538). For gas turbine engine lubricating oils (AS5780, MIL-PRF-23699), resistance varies by class and should be evaluated individually (see Note regarding high performance oils). This material has a typical service temperature range of -70 to +392 °F (-56.7 to +200 °C) for Class 1 and Class 2 and -70 to +437 °F (-56.7 to +225 °C) for Class 3. 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.

NOTE: The evolution of synthetic ester engine oil formulations has resulted in the determination that fluorosilicone elastomers are no longer suitable for use in high performance oils such as AS5780 HPC or MIL-PRF-23699 HTS Class. This specification should not be used for new design with high performance oils.

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Documents

Document Sharing Hub

1.3 Order of Precedence

Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. 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 or MIL-DTL-25988 Slash Sheets in accordance with 3.4.1
3. Specification referenced on the drawing
4. This document
5. 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.

1.5 Classification

The fluorosilicone elastomer rubber shall be of the following types, classes, and grades, as specified (see 8.5):

Type I: O-rings (available only in Class 1, Grades 60, 70, and 80 and Class III, Grade 75) and other compression seals.

Type II: Molded parts (other than compression seals) sheets, strips, and extruded shapes.

Class 1: General purpose.

Grade 40: Nominal 40 Type A durometer hardness, Type II only.

Grade 50: Nominal 50 Type A durometer hardness, Type II only.

Grade 60: Nominal 60 Type A durometer hardness, Types I and II.

Grade 70: Nominal 70 Type A durometer hardness, Types I and II.

Grade 80: Nominal 80 Type A durometer hardness, Types I and II.

Class 2: High-strength general purpose, Type II only.

Grade 50: Nominal 50 Type A durometer hardness, Type II only.

Class 3: High modulus, increased temperature resistance, Types I and II.

Grade 75: Nominal 75 Type A durometer hardness, Types I and II.

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.

AMS2629	Fluid, Jet Reference
AMS2810	Identification and Packaging, Elastomeric Products
AMS2817	Packaging and Identification of Molded Elastomeric Seals and Sealing Components
AMS3021	Fluid, Reference for Testing Di-Ester (Polyol) Resistant Material
AIR851	O-Ring Tension Testing Calculations
ARP3050	Suitable Test Sizes for O-Ring Specifications
AS568	Aerospace Size Standard for O-Rings
AS5316	Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly
AS5752	Aerospace - Visual Inspection Standard for Elastomeric, Sealing Elements Other than O-Rings
AS6414	Manufacturing Processing Requirements for Molded Elastomer Components Used in Aerospace Applications
AS6837	Required O-ring Sizes for Quality Conformance Testing
AS9100	Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations

2.2 U.S. Government Publications

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

MIL-R-25988/1	Rubber, Fluorosilicone Elastomer, Oil and Fuel-Resistant, O-Rings, Class 1, Grade 70
MIL-R-25988/2	Rubber, Fluorosilicone Elastomer, Oil and Fuel-Resistant, O-Rings, Class 3
MIL-R-25988/3	Rubber, Fluorosilicone Elastomer, Oil and Fuel-Resistant, O-Rings, Class 1, Grade 60
MIL-R-25988/4	Rubber, Fluorosilicone Elastomer, Oil and Fuel-Resistant, O-Rings, Class 1, Grade 80
MIL-STD-289	Visual Inspection Guide for Rubber Sheet Material
MIL-STD-407	Visual Inspection Guide for Rubber Molded Items

2.3 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 Chemical Analysis of Rubber Products

ASTM D395 Tests for Compression Set of Vulcanized Rubber

ASTM D412 Tension Testing of Vulcanized Rubber

ASTM D471 Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids

ASTM D573 Test for Accelerated Aging of Vulcanized Rubber by the Oven Method

ASTM D624 Tear Resistance of Vulcanized Rubber

ASTM D1329 Evaluation Low-Temperature Characteristics of Rubber and Rubber-Like Materials by a Temperature-Retracton Procedure

ASTM D1414 Testing of Rubber O-Rings

ASTM D2240 Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer

2.4 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 3601-1 Fluid Power Systems - O-rings - Part 1: Inside diameter, cross sections, tolerances and size identification code

ISO 3601-3 Fluid Power Systems - O-rings - Part 3: Quality Acceptance Criteria

2.5 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2000 Procedures for an Industry Qualified Product Management Process

OP 2007 Appendix AMS CE QPL Program Operating Procedures

3. TECHNICAL REQUIREMENTS

3.1 Compound

3.1.1 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 3.2.1 (Type I) or 3.2.2 (Type II). Reprocessed vulcanized material is not acceptable.

3.1.2 Unless otherwise specified, material procured to this specification shall be blue.

3.2 Properties

3.2.1 Qualification Properties, Type I

Type I material as processed by the molder shall conform to the requirements shown in Table 1. Calculations of tensile strength and elongation may be made in accordance with AIR851.

Material shall be tested on the part standard according to 3.4.1 and if no part standard exists then testing shall be on size standard AS568-214 o-rings to determine the qualification properties.

Table 1 - Qualification properties, Type I (O-rings)

	Class 1 Grade 60	Class 1 Grade 70	Class 1 Grade 80	Class 3 Grade 75	Test Method
Original Properties					
Specific Gravity	As determined	As determined	As determined	As determined	ASTM D1414 (D297) Hydrostatic Method
Hardness, Durometer Type "A"	60 ± 5	70 ± 5	80 ± 5	75 ± 5	ASTM D1414 (ASTM D2240)
Tensile Strength, psi, Minimum	700 (4.83 kPa)	750 (5.17 kPa)	750 (5.17 kPa)	700 (4.83 kPa)	ASTM D1414
Elongation, %, Minimum	150	125	70	90	ASTM D1414
Temperature Retraction (TR-10), °F, Maximum	-70 (-56.7 °C)	-70 (-56.7 °C)	-70 (-56.7 °C)	-70 (-56.7 °C)	ASTM D1414 (D1329) and 4.4.1
Compression Set, %, Maximum, 70 hours at 75 °F ± 4 °F (23.9 °C ± 2 °C)	15	15	20	20	ASTM D1414 (D395, Method B) and 4.4.5
Compression Set, %, Maximum, 22 hours at 347 °F ± 4 °F (175 °C ± 2 °C)	40	30	45	35	
After Aging 70 hours at the Temperatures Indicated	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	437 °F ± 4 °F (250 °C ± 2 °C)	ASTM D1414 (D573) and 4.4.2
Hardness Change, Type "A", Maximum	+10, -5	+10, -5	+10, -5	+10, -5	
Tensile Strength Decrease, %, Maximum	25	25	20	35	
Elongation Decrease, %, Maximum	25	25	20	45	
Weight Loss, %, Maximum	2	2	2	2	
After Aging 70 hours in AMS3021 at the Temperatures Indicated	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	347 °F ± 4 °F (175 °C ± 2 °C)	ASTM D1414 (D471), 4.4.3, and 4.4.5
Hardness Change, Type "A", Maximum	±15	±15	±15	±20	
Tensile Strength Decrease, %, Maximum	45	40	30	30	
Elongation Decrease, %, Maximum	30	25	15	20	
Volume Change, %	1 to 15	1 to 15	1 to 15	1 to 15	
Compression Set, %, Maximum	45	30	60	80	ASTM D1414 (D471) and 4.4.4
After Aging 22 hours at 75 °F ± 4 °F (23.9 °C ± 2 °C) in AMS2629, Type 1 FL1					
Hardness Change, Type "A", Maximum	-20	-20	-20	-15	
Tensile Strength Decrease, %, Maximum	50	45	30	35	
Elongation Decrease, %, Maximum	40	35	30	30	
Volume Change, %	1 to 25	1 to 25	1 to 25	1 to 25	

FL1 ASTM D471, Reference Fuel B is an acceptable substitute should AMS2629, Type 1 become commercially unavailable for purchase.

3.2.2 Physical Properties, Type II

Type II material shall conform to the requirements shown in Table 2.

Table 2. Physical Properties, Type II (molded parts other than o-rings, sheets, strips, and extruded shapes)

	Class 1 Grade 40	Class 1 Grade 50	Class 1 Grade 60	Class 1 Grade 70	Class 1 Grade 80	Class 2 Grade 50	Class 3 Grade 75	Test Method
Original Properties								
Specific Gravity	As determined	As determined	As determined	As determined	As determined	As determined	As determined	ASTM D297 Hydrostatic Method
Hardness, Durometer Type "A"	40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	50 ± 5	75 ± 5	ASTM D2240
Tensile Strength, psi, Minimum	800 (5.52 kPa)	900 (6.20 kPa)	900 (6.20 kPa)	950 (6.55 kPa)	750 (5.17 kPa)	1150 (7.93 kPa)	800 (5.52 kPa)	ASTM D412, Die C
Elongation, %, Minimum	225	200	175	150	70	350	100	ASTM D412, Die C
Tensile Stress at 100% Elongation, psi, Minimum	--	--	--	--	--	--	700	ASTM D412, Die C
Tear Strength, ppi, Minimum	40 (276 Pa)	40 (276 Pa)	40 (276 Pa)	75 (517 Pa)	40 (276 Pa)	150 (1034 Pa)	40 (276 Pa)	ASTM D624, Die B
Temperature Retraction (TR-10), °F, Maximum	-70 (-56.6 °C)	-70 (-56.6 °C)	-70 (-56.6 °C)	-70 (-56.6 °C)	-70 (-56.6 °C)	-70 (-56.6 °C)	-70 (-56.6 °C)	ASTM D1329
Compression Set, %, Maximum, 70 hours at 75 °F ± 4 °F (23.9 °C ± 2 °C)	15	15	15	15	15	15	15	ASTM D395, Method B and 4.4.5
Compression Set, %, Maximum, 22 hours at 347 °F ± 4 °F (175 °C ± 2 °C)	25	35	40	25	45	40	35	
After Air Aging 70 hours at the Temperatures Indicated	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	392 °F ± 4 °F (200 °C ± 2 °C)	437 °F ± 4 °F (250 °C ± 2 °C)	ASTM D573 and 4.4.2
Hardness Change, Type "A", Maximum	+10, -5	+10, -5	+10, -5	+10, -5	+10, -5	+10, -5	+10, -5	
Tensile Strength Decrease, %, Maximum	30	25	25	20	20	30	35	
Elongation Decrease, %, Maximum	25	25	25	25	20	30	45	
Weight Loss, %, Maximum	2	2	2	2	2	2	2	
After Aging 70 hours in AMS3021 at the Temperatures Indicated	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	302 °F ± 4 °F (150 °C ± 2 °C)	347 °F ± 4 °F (175 °C ± 2 °C)	ASTM D471, 4.4.3, and 4.4.5
Hardness change, Type "A", Maximum	±15	±15	±15	±15	±15	±15	±20	
Tensile Strength Decrease, %, Maximum	45	45	45	40	30	40	30	
Elongation Decrease, %, Maximum	30	30	30	25	15	30	20	
Volume Change, %	1 to 15	1 to 15	1 to 15	1 to 15	1 to 15	1 to 15	1 to 15	
Compression Set, %, Maximum	35	35	45	30	60	45	80	
After Aging 22 hours at 75 °F ± 4 °F (23.9 °C ± 2 °C) in AMS2629, Type 1 FL1								ASTM D471 and 4.4.4
Hardness Change, Type "A", Maximum	-15	-15	-20	-20	-20	-25	-15	
Tensile Strength Decrease, %, Maximum	65	55	50	45	30	40	35	
Elongation Decrease, %, Maximum	60	50	40	35	30	30	30	
Volume Change, %	1 to 30	1 to 25	1 to 25	1 to 25	1 to 25	1 to 25	1 to 25	

FL1 ASTM D471, Reference Fuel B is an acceptable substitute should AMS2629, Type 1 become commercially unavailable for purchase