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12 July 1983
SUPERSEDING
MIL-R-25988A(USAF)
29 July 1969

MILITARY SPECIFICATION

RUBBER, FLUOROSILICONE ELASTOMER, OIL-AND-FUEL-RESISTANT, SHEETS, STRIPS, MOLDED PARTS, AND EXTRUDED SHAPES

This specification is approved for use by the Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers oil-and-fuel-resistant fluorosilicone elastomer rubber sheets, strips, molded parts, and extruded shapes for aeronautical and aerospace applications.

1.2 Classification. The fluorosilicone elastomer rubber shall be of the following types, classes, and grades, as specified (see 6.2).

Type I - O-rings (available only in class 1, grades 60, 70, and 80 and class III, grade 75).
Type II - Molded parts (other than O-rings) 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, type I and II.
Grade 70 - Nominal 70 type A durometer hardness, type I and II.
Grade 80 - Nominal 80 type A durometer hardness, type I and II.

Class 2 - High-strength general purpose, type II, only.
Class 3 - High modulus, increased temperature resistance, type I and II.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AFWAL/MLSE, Wright-Patterson AFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

TT-S-735	-	Standard Test Fluids; Hydrocarbons.
UU-P-268	-	Paper, Kraft, Untreated Wrapping.
PPP-B-601	-	Boxes, Wood, Cleated-Plywood.
PPP-B-636	-	Box, Fiberboard.
PPP-T-45	-	Tape, Paper, Gummed (Sealing and Securing).

MILITARY

MIL-P-4861	-	Packing, Preformed, Rubber, Packing, Packaging of.
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.

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	-	Marking for Shipment and Storage.
MIL-STD-190	-	Identification Marking of Rubber Products.
MIL-STD-289	-	Visual Inspection Guide for Rubber Sheet Material.
MIL-STD-298	-	Visual Inspection Guide for Rubber Extruded Goods.
MIL-STD-407	-	Visual Inspection Guide for Rubber Molded Items.
MIL-STD-413	-	Visual Inspection Guide for Rubber O-rings.
MIL-STD-831	-	Test Report, Preparation of.

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(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	-	Chemical Analysis of Rubber Products.
ASTM D 395	-	Tests for Compression Set of Vulcanized Rubber.
ASTM D 412	-	Tension Testing of Vulcanized Rubber.
ASTM D 471	-	Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids.
ASTM D 573	-	Test for Accelerated Aging of Vulcanized Rubber by the Oven Method.
ASTM D 624	-	Tear Resistance of Vulcanized Rubber.
ASTM D 1329	-	Evaluation Low-Temperature Characteristics of Rubber and Rubber-Like Materials by a Temperature-Retraction Procedure.
ASTM D 1414	-	Testing of Rubber O-rings.
ASTM D 2240	-	Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer.

(Application for copies should be addressed to the American Society of Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 3021	-	Reference Fluid for Testing Di-Ester (Polyol) Resistant Material.

(Application for copies should be addressed to the Society for Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

CONSOLIDATED CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

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2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet.

3.2 First article. When specified, a sample shall be subjected to first article inspection (see 4.3 and 6.2).

3.2.1 Test report. A test report shall be prepared for each type, class, and grade. An updated test report shall be prepared whenever a change is made in the materials, processes, or this specification. First article tests over three years old shall not be acceptable.

3.3 Materials. The cured compound of fluorosilicone elastomer rubber shall be entirely suitable for the intended purpose and shall be of the same composition and quality as the materials used for the first article sample.

3.4 Dimensions and tolerances.

3.4.1 Sheets and strips. Unless otherwise specified (see 6.2) sheets and strips shall be supplied in the lengths and widths and to the length and width tolerances specified in 3.4.1.1 and 3.4.1.2, and the tolerance on thickness shall be as shown in table I. The dimensions and tolerances of shapes cut from sheet and strip shall be as specified on the detail drawings.

3.4.1.1 Sheets. The width of sheet material shall be 36 ±1 inch (91.4 ±2.54 cm) and the length shall be 120 inches (3.05 m) ±1 percent.

3.4.1.2 Strips. The width of strip shall be 4 inches (102 mm) ±5 percent and the length shall be 75 feet ±1 foot (22.86 m ±.305 m).

TABLE I. Thickness tolerances of sheet and strip.

Nominal thickness (inch)	mm	Tolerances (in.)	mm
.031 and less	0.787	±.010	±0.254
over .031 to .063 inclusive	0.787 to 1.60	±.012	±0.305
over .063 to .125 inclusive	1.60 to 3.18	±.016	±0.406
over .125 to .188 inclusive	3.18 to 4.78	±.020	±0.508
over .188 to .375 inclusive	4.78 to 9.53	±.031	±0.787
over .375 to .563 inclusive	9.53 to 14.3	±.047	±1.19
over .563 to .750 inclusive	14.3 to 19.1	±.063	±1.60
over .750 to 1.000 inclusive	19.1 to 25.4	±.093	±2.36
over 1.000	25.4	±10%	±10%

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3.4.2 Molded parts (excluding O-rings) and extruded shapes (including tubing). Unless otherwise specified (see 6.2), dimensions and tolerances of molded parts (excluding O-rings) and extruded shapes (including tubing) shall be as specified on the drawing.

3.4.3 O-rings. Dimensions and tolerances of O-rings shall be in accordance with the applicable military specification sheet. Those are as follows:

a.	Class 1, Grade 60	MIL-R-25988/3 (USAF)
b.	Class 1, Grade 70	MIL-R-25988/1 (USAF)
c.	Class 1, Grade 80	MIL-R-25988/4 (USAF)
d.	Class 3	MIL-R-25988/2 (USAF)

3.4.4 Color. Unless otherwise specified, material procured to this specification shall be blue. A pigment that can be used is Ferro Blue No. 3247, supplied by Ferro Corporation, 4150 East 56th St., Cleveland, Ohio or 5309 South District Blvd., Los Angeles, California. A formula of 1.5 parts of this pigment per 100.0 parts of fluorosilicone is suggested.

3.5 Physical properties. The physical properties of the fluorosilicone elastomer rubber shall conform to the values given in tables II and III.

TABLE II. Physical properties, type I (O-rings).

	Class 1 grade 60	Class 1 grade 70	Class 1 grade 80	Class 3 grade 75
Original Properties				
Specific gravity 2/	As determined 1/	As determined 1/	As determined 1/	As determined 1/
Hardness, points	60 ±5	70 ±5	80 ±5	75 ±5
Tensile strength, psi, min.	700 (4.83 kPa)	750 (5.17 kPa)	750 (5.17 kPa)	700 (4.83 kPa)
Elongation, %, min.	150	125	70	90
Temperature retraction, °F, max.	-70 (-56.7°C)	-70 (-56.7°C)	-70 (-56.7°C)	-70 (-56.7°C)
After air aging 70 hours @ 75° ±5°F (23.9 ±2.8°C)				
Compression set, %, max.				
Under 0.110 inch (2.79 mm)	20	15	25	25
Over 0.110 inch (2.79 mm)	15	15	20	20
After aging 70 hours @ the temperatures indicated:	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	437 ±5°F (250 ±2.8°C)
Hardness change, point, max.	+10, -5	+10, -5	+10, -5	+10, -5
Tensile strength decrease, %, max.	25	25	20	35
Elongation decrease, %, max.	25	25	20	45
Weight loss, %, max.	2	2	2	2
After air aging 22 hours @ 347° ±5°F (175 ±2.8°C)				
Compression set, %, max.				
Under 0.110 inch (2.79 mm)	45	30	50	45
Over 0.110 inch (2.79 mm)	40	30	45	35

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TABLE II. Physical properties, type I (O-rings) - Continued.

	Class 1 grade 60	Class 1 grade 70	Class 1 grade 80	Class 3 grade 75
After aging 70 hours in AMS 3021 @ the temperatures indicated:	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	347 ±5°F (175 ±2.8°C)
Hardness change, points, max.	±15	±15	±15	±20
Tensile strength decrease, %, max.	45	40	30	30
Elongation decrease, %, max.	30	25	15	20
Volume change, %	1 to 15	1 to 15	1 to 15	1 to 15
Compression set, %, max.				
Under 0.110 inch (2.79 mm)	50	30	65	85
Over 0.110 inch (2.79 mm)	45	30	60	80
After aging 22 hours @ 75° ±5°F (23.9 ±2.8°C) in TT-S-735, type III				
Hardness change, points, max.	-20	-20	-20	-15
Tensile strength decrease, %, max.	50	45	30	35
Elongation decrease, %, max.	40	35	30	30
Volume change, %	1 to 25	1 to 25	1 to 25	1 to 25

1/ The permissible variation in specific gravity during actual production from that in first article tests shall be ±0.03.

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TABLE III. Physical properties, type II (molded parts (other than o-rings), sheets, strips, and extruded shapes).

	Class 1					Class 2	Class 3
	Grade 40	Grade 50	Grade 60	Grade 70	Grade 80	Grade 50	Grade 75
Specific gravity	As determined 1/	As determined 1/	As determined 1/	As determined 1/	As determined 1/	As determined 1/	As determined 1/
Hardness, points	40 ±5	50 ±5	60 ±5	70 ±5	80 ±5	50 ±5	75 ±5
Tensile strength, psi, min.	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)
Elongation, %, min.	225	200	175	150	70	350	100
Tensile stress @ 100% elongation, psi, min.	--	--	--	--	--	--	700
Tear strength, psi, min.	40 (276 Pa)	40 (276 Pa)	40 (276 Pa)	75 (517 Pa)	40 (276 Pa)	150 (1034 Pa)	40 (276 Pa)
Temperature retraction, °F, max.	-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)
After air aging 70 hrs. @ the 75° ±5°F (23.9 ±2.8°C)							
Compression set, %, max.	15	15	15	15	15	15	15
After air aging 70 hrs. @ the temperatures indicated:	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	392 ±5°F (200 ±2.8°C)	437 ±5°F (250 ±2.8°C)
Hardness change, points, max.	±10, -5	±10, -5	±10, -5	±10, -5	±10, -5	±10, -5	±10, -5
Tensile strength decrease, %, max.	30	25	25	20	20	30	35
Elongation decrease, %, max.	25	25	25	25	20	30	45
Weight loss, %, max.	2	2	2	2	2	2	2

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TABLE III. Physical properties, type II (molded parts (other than o-rings), sheets, strips, and extruded shapes) - Continued.

	Class 1					Class 2	Class 3
	Grade 40	Grade 50	Grade 60	Grade 70	Grade 80	Grade 50	Grade 75
After air aging 22 hrs. @ 347° ±5°F (175 ±2.8°C)							
Compression set, %, max.	25	35	40	25	45	40	35
After aging 70 hrs. in AMS 3021 @ the temperatures indicated:	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	302 ±5°F (150 ±2.8°C)	347 ±5°F (175 ±2.8°C)
Hardness change, points, max.	±15	±15	±15	±15	±15	±15	±20
Tensile strength decrease, %, max.	45	45	45	40	30	40	30
Elongation decrease, %, max.	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, %, max.	35	35	45	30	60	45	80
After aging 22 hrs. @ 75° ±5°F (23.9 ±2.8°C) in TT-S-735, Type III							
Hardness change, points, max.	-15	-15	-20	-20	-20	-25	-15
Tensile strength decrease, %, max.	65	55	50	45	30	40	35
Elongation decrease, %, max.	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

1/ The permissible variation in specific gravity during actual production from that value established in first article tests shall be ±0.03.

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3.6 Identification of product.

3.6.1 Sheet and strip. Unless otherwise specified (see 6.2), sheet material (including strip cut from sheet) shall be marked to show the specification number, the manufacturer, the manufacturer's designation (compound number), class, type, grade (if applicable), and the date of manufacture (by quarter and year; for example, 1Q82), thus:

MIL-R-25988B(USAF) XYZ Co.
Compound No.
Type II, class I, grade 60
Date of manufacture

The material shall be marked for identification in compliance with MIL-STD-190. The identification shall be applied in recurring pattern in lines from one end of the sheet to the other; shall be in intervals spaced 8 inches (203.2 mm) maximum apart on the line; shall be in rows 5 ±1/2 inch (127 mm ±12.7 mm) apart lengthwise of the sheet. The marking shall be applied by suitable means using a marking fluid that is not deleterious to the fluorosilicone elastomer rubber. The marking shall not be obliterated by normal handling and the color shall be of sufficient contrast to permit easy reading.

3.6.2 Molded parts and extruded shapes (including tubing). Where the size of the product permits, the identification shall be marked as indicated in 3.6.1. When identification marking of the product is impractical, the unit package shall show the compound number and manufacturer in addition to those markings specified in 5.3. Temporary marking of O-rings for the manufacturer's identification shall be permitted at the time of manufacture, but shall in no way affect the properties or function of the O-rings.

3.7 Workmanship. Workmanship shall conform to the best commercial practice for fluorosilicone elastomer rubber products. Parts shall be smooth and free from flash.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements. Inspection records shall be kept complete and available to the procuring activity at all times.

4.1.1 Fabricator's Data. Test data obtained from base polymer and pre-compounded materials supplier is not acceptable for fulfillment of the fabricator's additional responsibility for final cured product quality control.

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4.2 Classification of tests. The inspection and testing of the synthetic rubber shall be classified as follows:

a. First article inspection (see 4.3).

b. Quality conformance inspection (see 4.4).

4.3 First article inspection.

4.3.1 Samples. Test samples for type I material shall be restricted to O-rings conforming to size -214 of MIL-R-25988/1. Hardness shall be determined on specimens of sufficient dimensions to comply with ASTM D 2240. Samples for type II material shall be obtained from 6 inches by 6 inches by 0.075 inch (152.4 mm by 152.4 mm by 1.905 mm) platen sheets.

4.3.2 Tests. First article tests shall consist of all the tests supplied in 4.6.

4.3.3 First article test report. First article tests are required for each type, class, and grade of material furnished to this specification. After the supplier completes the first article inspection he shall prepare a first article test report in accordance with MIL-STD-831. Three copies of this report shall be furnished to the procuring activity.

4.3.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in applicable test method document or applicable paragraphs in the specification.

4.4 Quality conformance inspection.

4.4.1 Sampling for inspection. Sampling for quality conformance inspection shall be in accordance with MIL-STD-105, except where otherwise indicated herein. Quality conformance tests are required on final products for all production batches of material.

4.4.1.1 Batch. A batch shall be the quantity of material compounded on a mill or mixer at one time.

4.4.1.2 Lot. A lot shall consist of all material of the same identity, cured in the same production run, from the same batch, and submitted at the same time for inspection.

4.4.2 Quality conformance test samples. Whenever possible, the end item, or specimens cut from the end item, shall be used as the sample. If these items are unsuitable for use as test samples, tests shall be performed on samples of identical composition and comparable state of cure as that of the end item. If the end item is an O-ring with an inside diameter of less than 0.5 inch (12.7 mm), -214 size O-rings shall be used for test samples.

4.4.3 Inspection of materials and components. The supplier is responsible for insuring that materials and components used were

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manufactured, tested, and inspected in accordance with referenced subsidiary specifications and standards to the extent specified, or if none, in accordance with this specification (see 4.1). In the event of conflict, this specification shall govern.

4.4.4 Inspection of the end item. Examination of the end item shall be in accordance with the classification of defects, inspection levels, and acceptance quality levels (AQLs) set forth herein. The batch size, for the purpose of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of O-rings, molded parts, or yards of sheets, strips, or extruded shapes, as applicable, for examinations as specified in 4.4.4.1, 4.4.4.2, and 4.4.4.3. If the end item is less than 1 yard (91.4 mm), the sample unit shall be the end item.

4.4.4.1 Examination for defects in appearance and workmanship.

4.4.4.1.1 Molded parts including O-rings. The sample unit shall be one molded part and the examination shall be in accordance with MIL-STD-413 for O-rings and MIL-STD-407 for other molded products. The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 1.5.

4.4.4.1.2 Sheets, strips, and extruded shapes. The sample unit shall be 1 linear yard (91.4 mm), except if the end item is less than 1 yard, the sample unit shall be the end item. The examination shall be in accordance with MIL-STD-289 and MIL-STD-298, as applicable. Defects in marking such as "incomplete, not legibly identified", or not as specified in 3.6, shall be considered minor. The sample size shall be in accordance with inspection level II of MIL-STD-105, and the AQL related to percent defective shall be 2.5.

4.4.4.2 Examination for dimensional defects.

4.4.4.2.1 Molded parts including O-rings. The sample unit shall be one molded part and the examination shall be made to the tolerances specified in the applicable military specification sheets. The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent shall be 1.5.

4.4.4.2.2 Sheets, strips, and extruded shapes. The sample unit shall be 1 linear yard, except if the end item is less than 1 linear yard, the sample unit shall be the end item. The dimensions shall be within the tolerances specified in 3.4.1. Dimensions for extruded shapes shall be as specified on the drawing or in the contract or order. The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 1.5.

4.4.4.3 Examination for defects in preparation for delivery. An examination shall be made to determine that the packaging, packing, and marking comply with section 5. The sample unit for this examination shall be one shipping container fully packed, selected just prior to the closing operation. Shipping containers fully prepared for delivery shall be examined for closure defects.

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Examine	Defect
Packaging (O-rings, molded parts and extruded shapes)	Not the level specified. Not packaged as specified or required. Packaging material, closures not as specified. Unit items not individually wrapped when specified.
(Sheets)	Not interleaved; separator sheets or dusting powder do not fully cover the full area of contact between the sheets. Stacked over 10 inches high.
(Strips)	Not in rolls; not wound on suitable cores. Rolls not wrapped or sealed as specified. Total length per roll varies by more than the indicated tolerances (5.1.1.2.2).
Packing	Not level specified; not in accordance with contract requirements. Container not as specified, closures not accomplished by specified or required methods or materials. Any nonconforming component, component missing, damaged or otherwise defective, affecting serviceability. Inadequate application of components, such as incomplete closure of case liners, containing flaps loose or inadequate strapping, bulged or distorted containers.
Count	Less than specified or indicated quantity, linear footage, or units, as applicable.
Weight	Gross weight exceeds specified requirements.
Markings	Interior or exterior markings, as applicable, omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements. Date of cure, storage instructions missing.

The sample size shall be in accordance with inspection level II of MIL-STD-105 and the AQL related to percent defective shall be 2.5.

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4.4.5 Quality conformance tests. The following tests shall be conducted on each lot of material (see 4.4.2):

Original	Air aged 22 hours at 347°F (175 ±2.8°C)
Tensile strength	Compression set
Elongation	
Hardness	Fuel aged 22 hours at 75°F (23.9°C) in TT-S-735 type III
	Volume change

4.4.5.1 Rejection criteria. Failure to meet the test requirements specified herein shall constitute cause for rejection of the lot.

4.5 *Test conditions.*

4.5.1 Control fluid. The oil aging in this specification shall be conducted using AMS 3021 as a control fluid.

4.5.2 Atmospheric conditions. All fluid cooling, conditioning, and physical property determinations of rubber shall be conducted in an atmosphere of 50 ±15 percent relative humidity and at a temperature of 75° ±5°F (23.9 ± 2.8°C).

4.6 Test methods.

4.6.1 Physical properties. Unless otherwise specified herein, physical properties shall be determined in accordance with ASTM test methods for rubber products as follows:

Property	*ASTM method*
Hardness	D 2240
Tensile strength and elongation	
Type I	D 1414
Type II	D 412, (use die C for oil aging)
Tensile stress	
Type I	D 1414
Type II	D 412
Tear strength	D 624, die B
Volume change	D 471
Specific gravity	D 297, hydrostatic method

4.6.2 Temperature retraction (TR-10). The temperature retraction test shall be conducted in accordance with ASTM D 1329. Three O-ring specimens as specified in 4.3.1 shall be used for type I and shall be elongated 50 percent in accordance with the rod markings. The temperature retraction test for type II shall be conducted on three 2-inch (50.8 mm) specimens. Elongation of type II materials shall be 50 percent of the ultimate elongation. The test shall be conducted at a heating rate of 1°C per minute.

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4.6.3 Air aging. Air aging shall be conducted in accordance with ASTM D 573, except that the aging time and temperature shall be in accordance with tables II or III as applicable. Tensile strength, elongation, and hardness changes shall be determined as specified in 4.6.1.

4.6.3.1 Weight loss. The weight loss test shall be conducted on samples air aged in accordance with 4.6.3. Test specimens shall be conditioned for 24 hours 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 follows:

$$\frac{w_1 - w_2}{w_1} \times 100$$

where w_1 = weight of sample before air aging.

w_2 = weight of sample after air aging.

4.6.4 Oil aging. Oil aging of specimens shall be conducted in clean 39 millimeters (mm) OD by 300 mm pyrex glass test tubes fitted with two-hole cork stoppers. Each stopper shall be fitted with two lengths of 8 mm pyrex glass tubing (chimneys), one 3 inches (76.2 mm) in length, the other 5 inches (127 mm) in length. The 3-inch (76.2 mm) chimney shall extend through and one-half (12.7 mm) inch above the top of the stopper. The 5-inch (127 mm) chimney shall extend through and 3 1/2 inches (88.9 mm) above the top of the stopper. An aluminum block heater shall be used for aging the specimens. Use of an oil bath is permissible but is not desired. For each test 140 milliliters (ml) of oil shall be used. The test tubes shall be inserted into the aluminum block or oil bath in such manner that the fluid level in the test tubes shall be approximately 1 5/8 inches (41.3 mm) above the heating unit of the aluminum block or surface of the oil bath. This distance shall not be measured from the top of the aluminum block or covering of the oil bath. The specimens shall be suspended in the oil by soft iron or nichrome wire hangers as follows:

a. Type I: Three specimens shall be suspended horizontally in the fluid, one each at depths of 1 1/2 inches (38.1 mm), 3 1/2 inches (88.9 mm), and 5 1/2 inches (140 mm) below the surface of the fluid. Hardness specimens shall be placed in a separate chimney stoppered tube keeping approximately the same rubber to oil ratio.

b. Type II: Four dumbbells cut with a die "C", conforming to ASTM D 412, shall be tested. There shall be only two specimens aged in a single test tube. The specimens shall be suspended vertically in the fluid, one each at depths of 1 inch (25.4 mm) and 2 inches (50.8 mm) below the surface of the fluid. The measurement of specimen depth in the fluid shall be made between the top edge of the specimen and the fluid level. Care shall be taken to prevent contact of specimens with each other or the wall of the test tube.

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The oil aging time and temperature shall be in accordance with table II. After aging and prior to the physical property determinations, the specimens shall be removed from the hot fluid and cooled 30 minutes in fresh fluid. Tensile strength, elongation, hardness, and volume change shall then be determined as specified in 4.6.1.

4.6.5 Fuel aging. Specimens shall be immersed in test fluid conforming to TT-S-735, type III, for 22 hours at room temperature. The ratio of fluid to rubber shall be approximately 40 ml per gram. Aging shall be conducted in a glass container. An airtight seal shall be maintained for the duration of the test. One sample at a time shall be removed from the fluid, immediately blotted dry, and tested. The tensile strength, elongation, hardness, and volume change tests shall be conducted in accordance with 4.6.1.

4.6.6 Compression set. Except where otherwise specified herein, compression set shall be determined in accordance with ASTM D 395, method B. Specimens for type I materials shall be two O-rings. Two circular plied-up buttons with dimensions of 1.129 ±0.001 inches (28.677 ±0.25 mm) diameter and approximately 0.5 inch (12.7 mm) thick shall be cut from sheet for type II material.

4.6.6.1 Oil aged. Compression set shall be determined on specimens aged 70 hours at the applicable temperature as specified in table II, immersed in AMS 3021. The compression set plates for testing type I material shall be approximately 0.375 inch by 2 inches by 4 inches (9.52 mm by 50.8 mm by 102 mm). There shall be six, one-fourth inch (6.35 mm) bolt holes, one on each corner and one located in the middle of each 4-inch (102 mm) edge and on the center line of the corner holes. There shall also be one-fourth inch (6.35 mm) holes through the middle of each half of the plates to allow fluid to be in contact with the inside diameter of the O-rings. The compression set plates for type II material shall be in accordance with ASTM D 395. The original thickness of the specimens shall be measured and the test fixtures shall be assembled using two test specimens. The specimens shall be compressed 25 percent. The test fixture shall be placed in a 1 liter stainless beaker. The beaker shall be fitted with a suitable vented stainless steel cap. The cap shall be sealed with an O-ring conforming to type I, class 1 of this specification (size -240, MIL-R-25988/1, has been used). The beaker shall be placed in a suitable oven at the applicable temperature with vent open. After the fluid has reached the test temperature (approximately two hours) the vent shall be closed and the beaker left in the oven for a total aging time of 70 hours. At the end of the aging time, the specimens shall be removed from the compression plates immediately and allowed to cool on paper towels for 30 minutes. The excess fluid shall be blotted from the specimens and the final thickness measurement made.

4.7 Packaging inspection. Sample packages and packs and the inspection of the packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified herein or as otherwise specified in the control or order.

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5. PACKAGING

5.1 Preservation-packaging. Preservation-packaging shall be level A or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Type I material. Type I material shall be packaged in accordance with the requirements of MIL-P-4861.

5.1.1.2 Type II material.

5.1.1.2.1 Sheets. A suitable paper or dusting powder shall be used between the sheets extending over the full area of contact between sheet. Unit quantity shall be a stack not to exceed 10 inches (254 mm).

5.1.1.2.2 Strip. Rubber strips shall be wound on suitable cores that will provide rigid support and that will not distort nor change shape during handling or shipping. Each roll shall be wrapped in kraft paper conforming to UU-P-268 and sealed with tape conforming to PPP-T-45. Unless otherwise specified, each roll shall consist of 75 feet ±1 foot (22.86 m ±.305 m) of rubber strip.

5.1.1.2.3 Extruded shapes. Extruded rubber shapes shall be wrapped in any suitable wrapping.

5.1.1.2.4 Molded parts. Molded rubber parts shall be packaged in containers conforming to PPP-B-636. The unit quantity shall be 25 or as specified by the procuring activity (see 6.2).

5.1.2 Level C. Fluorosilicone rubber shall be preserved and packaged in a manner which will afford adequate protection against deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. This level may conform to the supplier's commercial practice when such meets the requirements of this level.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 Type I material. Type I material shall be packed in accordance with the requirements of MIL-P-4861.

5.2.1.2 Type II material. Shipping containers shall contain identical synthetic rubber items of the same shape and size and shall inclose the contents in a snug, tight-fitting manner. The inside height of containers for rubber sheet shall not exceed 10 inches (254 mm). Rubber strip shall be packed one roll per container. Containers for extruded rubber shapes shall have an inside maximum cross-sectional area of 36 square inches (232.26 cm^2) and, unless otherwise specified by the procuring activity, a maximum length of 10 feet (3.05 m). Unless otherwise specified by the procuring activity, rubber material, other than

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O-rings, shall be packed in wood, cleated-plywood shipping containers conforming to PPP-B-601, overseas type. As far as practical, containers shall be uniform in shape and size and contain identical quantities. Container closure and strapping shall be in accordance with the appendix to PPP-B-601. Gross weight of containers shall not exceed 200 pounds (90.7 kg).

5.2.2 Level B. Level B shall be the same as level A except containers shall conform to domestic type and the gross weight shall not exceed 500 pounds (226 kg).

5.2.3 Level C. Packages which require overpacking for acceptance by the carrier shall be packed in exterior-type shipping containers in a manner that will insure transportation at the lowest rate to the point of delivery. Containers shall conform to the United Freight Classification Rules or regulations of other common carrier, as applicable to the mode of transportation. This level may conform to the supplier's commercial practice when such meets the requirements of this level.

5.3 Marking of shipments. In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with the requirements of MIL-STD-129. When applicable, interior packages shall also be marked in accordance with 3.6.2. The nomenclature shall be as follows:

Rubber (angle, channel, special-shaped section, as applicable)
Type _____ Class _____ Grade _____
Cross section and length (inches) or part number
Solid (molded, extruded, as applicable)
Compound number, lot number
Specification MIL-R-25988B
Date of manufacture (quarter and year)
STORE IN A COOL DRY PLACE

6. NOTES

6.1 Intended use. The rubber covered by this specification is in for use where resistance to jet fuel and lubricating oil is required. The elevated test temperatures (note table II) were selected as the maximum temperatures at which good reproducible laboratory data could be obtained. These temperatures do not necessarily indicate nor are they to be construed as the maximum operating temperatures at which these materials can be used.

6.2 Ordering data. Acquisition documents should specify:

a. Title, number and date of this specification.

b. Type, class, and grade (see 1.2).

c. First article when required (see 3.2).

d. Dimensions and tolerances (see 3.4).

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e. Quantity.

f. Detail drawing and additional requirements, if any.

g. Unit quantity of molded parts if other than specified in 5.1.1.

h. If first article tests are required (see 3.2.1).

i. Applicable levels of preservation-packaging and packing (see 5.1 and 5.2).

6.2.1 First article. When a first article inspection is required, the item will be tested and should be a first article sample. Testing will be as specified in 3.2, 4.3. The first article should consist of four units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, test approval of the first article of the documents.

A copy of the first article test report shall be furnished to the Air Force Wright Aeronautical Laboratories, Attn: MLSE, Wright-Patterson AFB, OH 45433. The first article test need not be repeated for new orders or different parts provided the materials and processes have not been changed and a certified statement to this effect is furnished to the procuring activity. The waiving of the first article tests will be strictly at the discretion of the procuring activity. Test results to previous revisions of this specification are not acceptable.

Custodian:
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Army - MR
Navy - AS

Review activities:
Air Force - 82, 99
Army - MI
Navy - OS
DSC - IS

User:
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