

INCH-POUND

MIL-DTL-25988C

11 August 2006

SUPERSEDING

MIL-R-25988B

12 July 1983

DETAIL SPECIFICATION

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

Reactivated after 11 August 2006 and may be used for new and existing designs and acquisitions.

This specification is approved 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 should be of the following types, classes, and grades, as specified (see [6.2](#)).

Comments, suggestions, or questions on this document should be addressed to ASC/ENOI, 2530 Loop Road West, Wright-Patterson AFB OH 45433-7101 or emailed to Engineering.Standards@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

AMSC N/A

FSC 5330

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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, 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.

2. APPLICABLE DOCUMENTS**2.1 General**

The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents**2.2.1 Specifications, standards, and handbooks**

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

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DEPARTMENT OF DEFENSE STANDARDS

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 Elastomeric O-rings

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications

The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL AVIATION ADMINISTRATION

FAA AC 00-56A	–	Voluntary Industry Distributor Accreditation Program
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(Copies of this document are accessible online at <http://www.faa.gov/>.)

2.3 Non-Government publications

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	–	Rubber Products—Chemical Analysis
ASTM D 395	–	Rubber Property—Compression Set
ASTM D 412	–	Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D 471	–	Rubber Property—Effect of Liquids
ASTM D 573	–	Rubber—Deterioration in an Air Oven
ASTM D 624	–	Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1329	–	Evaluating Rubber Property—Retraction at Lower Temperatures (TR Test)
ASTM D 1414	–	Rubber O-Rings
ASTM D 2240	–	Rubber Property—Durometer Hardness

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(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, or online at <http://www.astm.org/>.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- ISO 17025 – General requirements for the competence of testing and calibration laboratories

(Application for copies should be addressed to the International Organization for Standardization (ISO), 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, or online at <http://www.iso.org/>.)

SAE INTERNATIONAL

- AMS 2629 – Fluid, Jet Reference
- AMS 3021 – Reference Fluid for Testing Di-Ester (Polyol) Resistant Material
- AS 9100 – Quality Management Systems - Aerospace - Requirements-Technically Equivalent to AECMA prEN 9100
- AS 9120 – Quality Management Systems - Aerospace Requirements for Stockist Distributors

(Application for copies should be addressed to SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001, or online at <http://www.sae.org/>.)

2.4 Order of precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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 4.2 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.

MIL-DTL-25988C**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.

TABLE I. Thickness tolerances of sheet and strip.

Nominal thickness (inch)	Mm	Tolerances (inch)	Mm
0.031 and less	0.787	±0.010	±0.254
Over 0.031 to 0.063 inclusive	0.787 to 1.60	±0.012	±0.305
Over 0.063 to 0.125 inclusive	1.60 to 3.18	±0.016	±0.406
Over 0.125 to 0.188 inclusive	3.18 to 4.78	±0.020	±0.508
Over 0.188 to 0.375 inclusive	4.78 to 9.53	±0.031	±0.787
Over 0.375 to 0.563 inclusive	9.53 to 14.3	±0.047	±1.19
Over 0.563 to 0.750 inclusive	14.3 to 19.1	±0.063	±1.60
Over 0.750 to 1.000 inclusive	19.1 to 25.4	±0.093	±2.36
Over 1.000	25.4	±10%	±10%

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 ± 0.305 m).

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.

MIL-DTL-25988C**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](#)
- b. Class 1, Grade 70 [MIL-R-25988/1](#)
- c. Class 1, Grade 80 [MIL-R-25988/4](#)
- d. Class 3 [MIL-R-25988/2](#)

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 44101 or 1395 Aspen Way, Vista, California 92083. 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 [TABLE II](#) and [TABLE III](#).

MIL-DTL-25988C**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	As determined <u>1/</u>	As determined <u>1/</u>	As determined <u>1/</u>	As determined <u>1/</u>
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

MIL-DTL-25988C**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 AMS 2629, Type 1				
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.

MIL-DTL-25988C**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
After air aging 22 hrs. @ 347 ±5 °F (175 ±2.8 °C) Compression set, %, max.	25	35	40	25	45	40	35

MIL-DTL-25988C**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 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 AMS 2629, Type 1							
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.

MIL-DTL-25988C**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-DTL-25988C XYZ Co.
Compound No.
Type II, class 1, 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 $5 \pm 1/2$ inch (127 ± 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 [5.1](#). 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. Parts, as received by purchaser, shall be uniform in quality and condition, smooth, as free from foreign materials as commercially practicable, and free from internal imperfections detrimental to the usage of the seals. Care shall be taken during manufacturing, inspection and packaging to prevent contamination. Labeling and traceability shall follow the parts throughout the manufacturing, inspection and packaging processes.

MIL-DTL-25988C**4. VERIFICATION****4.1 Classification of inspections**

The inspection and testing of the synthetic rubber shall be classified as follows:

- a. First article inspection (see [4.2](#)).
- b. Conformance inspection (see [4.3](#)).

4.2 First article inspection**4.2.1 Samples**

Test samples for type I material shall be restricted to O-rings from a production lot 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. All samples shall be of identical composition and comparable state of cure as that of the end items.

4.2.2 Tests

First article tests shall consist of all the tests specified in [4.5](#) and shall be performed at a laboratory accredited to *AS 9100* or *ISO 17025*.

4.2.3 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 (see [6.2.1](#)).

4.2.4 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.

4.3 Conformance inspection**4.3.1 Sampling for inspection**

The method shall be specified in a purchase order/contract. If not specified, product shall be taken at random from each lot to perform all the required acceptance tests. The number of test iterations for each requirement shall be specified in the applicable test procedure. Quality conformance tests are required on final products for all production lots of material.

4.3.1.1 Batch

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

MIL-DTL-25988C**4.3.1.2 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.

4.3.2 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 not conforming to [TABLE IV](#), -214 size O-rings may be used for test samples.

TABLE IV. Suitable O-ring test sizes.

MIL-DTL-25988/1 Size Designation
-011 through -045
-112 through -155
-206 through -242
-310 through -345
-904 through -932

4.3.3 Inspection of materials and components

The supplier is responsible for insuring that materials and components used were manufactured, tested, and inspected in accordance with referenced subsidiary specifications and standards to the extent specified, or if none, in accordance with this specification. In the event of conflict, this specification shall govern.

4.3.4 Inspection of the end item**4.3.4.1 Type I compression seals**

Each individual product shall be inspected according to [MIL-STD-413](#) under 1X magnification minimum. Entire seal surface shall be manually or electronically inspected. Dimensional tolerances shall be as specified in the applicable slash sheet.

4.3.4.2 Type II

Product shall be inspected according to [MIL-STD-407](#) under 1X magnification minimum. 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 as listed in [TABLE V](#). 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.

MIL-DTL-25988C**TABLE V. 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

4.3.5 Conformance tests

The following tests shall be conducted on each lot of material (see 4.3.2):

<u>Original</u>	<u>Air aged 22 hours at 347 °F (175 ±2.8 °C)</u>
Tensile strength	Compression set
Elongation	<u>Fuel aged 22 hours at 75 °F (23.9 °C) in</u>
Hardness	<u>AMS 2629, Type 1.</u>
	Volume change

4.3.5.1 Rejection criteria

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

4.4 Test conditions**4.4.1 Control fluid**

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

4.4.2 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).

MIL-DTL-25988C**4.5 Test methods****4.5.1 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	<i>D 2240</i>
Tensile strength and elongation	
Type I	<i>D 1414</i>
Type II	<i>D 412</i> , (use die C for oil aging)
Tensile stress	
Type I	<i>D 1414</i>
Type II	<i>D 412</i>
Tear strength	<i>D 624</i> , die B
Volume change	<i>D 471</i>
Specific gravity	<i>D 297</i> , hydrostatic method

4.5.2 Temperature retraction (TR-10)

The temperature retraction test shall be conducted in accordance with *ASTM D 1329*. Three O-ring specimens as specified in 4.2.1 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.

4.5.3 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 [TABLE II](#) or [TABLE III](#) as applicable. Tensile strength, elongation, and hardness changes shall be determined as specified in 4.5.1.

4.5.3.1 Weight loss

The weight loss test shall be conducted on samples air aged in accordance with 4.5.3. 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:

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$$\frac{W_1 - W_2}{W_1} \times 100$$

where W_1 = weight of sample before air aging.
 W_2 = weight of sample after air aging.

4.5.4 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 ½ 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 ⅝ 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 ½ inches (38.1 mm), 3 ½ inches (88.9 mm), and 5 ½ 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.

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 [4.5.1](#).

4.5.5 Fuel aging

Specimens shall be immersed in test fluid conforming to *AMS 2629, type 1* 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

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tensile strength, elongation, hardness, and volume change tests shall be conducted in accordance with [4.5.1](#).

4.5.6 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.

4.5.6.1 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.

4.6 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.

5. PACKAGING**5.1 Packaging**

For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military

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Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use

The rubber covered by this specification is 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](#)).
- e. Quantity.
- f. Detail drawing and additional requirements, if any.
- g. Unit quantity of molded parts if other than specified in [5.1](#).
- h. If first article tests are required (see [3.2.1](#)).
- i. Applicable levels of preservation-packaging and packing (see [5.1](#)).

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](#) and [4.2](#). 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 should be furnished to the Air Force Research Laboratory, Attn: AFRL/MLSA, 2179 12th Street, Wright-Patterson AFB, OH 45433-7718. The first article

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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.

6.3 Subject term (key word) listing

O-rings
tubing

6.4 Changes from previous issue

Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL**Custodians:**

Army – MR
Navy – AS
Air Force – 11
DLA – IS

Preparing Activity:

Air Force – 11

(Project 5330-2006-004)

Review activities:

Army – MI
Navy – OS
Air Force – 71, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil/>.