

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS-R-83412

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Rubber, Ethylene-Propylene, Hydrazine Resistant

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1. SCOPE:

1.1 Scope:

This specification covers three types of rubber having good resistance to high and low temperature and hydrazine type propellants, but poor resistance to hydrocarbon oils or solvents. Hydrazines are hazardous chemicals. See "Dangerous Properties of Industrial Materials" by N. Irving Sax.

1.2 Classification:

The rubber covered by this specification shall be of the following types as specified (see 6.3):

Type I - Seal Material

Type II - Bladder and Diaphragm Material

Type III- Valve Seal Material

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

L-P-378	Plastic Sheet and Strip, Thin Gauge, Polyolefin
UU-P-268	Paper, Kraft, Untreated Wrapping
PPP-B-585	Box, Wood Wirebound
PPP-B-591	Box, Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Box, Wood, Nailed and Lock Corner
PPP-B-636	Box, Fiberboard
PPP-T-45	Tape, Gummed, Paper, Reinforced and Plain, For Easling and Securing

MIL-P-4861	Packing, Preformed, Rubber, Packing; Packaging of
MIL-P-26536	Propellant, Hydrazine

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-289	Visual Inspection Guide for Rubber Sheet Material
MIL-STD-407	Visual Inspection Guide for Rubber Molded Items
MIL-STD-413	Visual Inspection Guide for Rubber O-Rings

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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 624	Test for Tear Resistance of Vulcanized Rubber
ASTM D 1329	Evaluating Low-Temperature Characteristics of Rubber and Rubber-Like Materials by a Temperature-Retracton Procedure (TR Test)
ASTM D 2240	Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer

3. REQUIREMENTS:

3.1 First article:

The ethylene-propylene rubber furnished to this specification shall conform to the requirements of Section 3 when tested and inspected in accordance with Section 4 (see 4.3).

3.2 Materials:

The base polymer used to formulate the rubber covered by this specification shall be ethylene-propylene polymers.

3.3 Shape and dimensions:

Shape and dimensions of the rubber shall be as specified by the procuring activity.

3.4 Dimensions and tolerances:

- 3.4.1 Sheets and strips: Unless otherwise specified (see 6.2) the width of the sheet material shall be 36 ± 1 inches, the length shall be 120 inches ± 1 percent, and tolerances on thickness shall be as shown in Table I. The width of strip shall be 4 inches with a tolerance of ± 5 percent, the length shall be 75 feet ± 1 foot; the tolerances on thickness shall be as shown in Table I. The dimensions and tolerances of the shapes cut from sheets shall be as specified on the detail drawings.
- 3.4.2 Molded parts and extruded shapes (including tubing): Unless otherwise specified (see 6.2) dimensions and tolerances of molded parts and extruded shapes (including tubing) shall be as specified on the drawing or in the contract or order.

TABLE I. Thickness tolerances of sheet and strip

NOMINAL THICKNESS (Inch)	TOLERANCE (inch)
.031 and less	$\pm .010$
over .031 to .063 inclusive	$\pm .012$
over .063 to .125 inclusive	$\pm .016$
over .125 to .188 inclusive	$\pm .020$
over .188 to .375 inclusive	$\pm .031$
over .375 to .563 inclusive	$\pm .047$
over .563 to .750 inclusive	$\pm .063$
over .750 to 1.000 inclusive	$\pm .093$
over 1.000	$\pm 10\%$

3.5 Physical properties:

Physical properties shall conform to the requirements specified in Table II.

3.6 Identification of product:

Identification marking on the surface of this material is not allowed. The unit package, label, or tag shall be marked to show the specification number, type, the manufacturer, the manufacturer's designation (compound number), and the cure date by quarter and year.

EXAMPLE:

MIL-R- (USAF)
TYPE
XYZ COMPANY
COMPOUND NO. 123
CURE DATE 1Q73

When used, the unit package shall show the marking of shipments (see 5.3) in addition to the above markings. The identification shall recur constantly from one end of the unit package, label or tag to the other end if possible in rows, spaced approximately 5 inches apart, and shall be clearly legible, contrasting in color, and not less than 3/8 inch high.

3.7 Workmanship:

The product shall be free from defects, foreign materials, surface irregularities such as unbonded sections, holes, dents, blisters, pits, etc., pigmentation discolorations, and shall be uniform in quality; also it shall be free from flash unless otherwise permitted on the drawing or contract.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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.

4.1.1 Inspection records: Inspection records shall be kept complete and available to the procuring activity at all times.

4.1.2 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.

4.2 Classification of inspection:

The inspection and testing of the ethylene-propylene 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:

First article inspection shall consist of all the tests specified (see 6.4).

4.3.1 First article test samples: First article test samples shall consist of molded sheets, 6 by 6 by 0.075 ± 0.010 inches.

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 lots 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.

TABLE II. Physical properties

PROPERTY AND CONDITION	TYPE I	TYPE II	TYPE III
Original physical values			
Tensile Strength, psi, min.	2100	1650	1600
Elongation, %, min.	150	260	80
Tensile Stress (modulus), psi at 100% elongation	--	1200+250	--
Hardness, points	88+5	90+5	90+5
Tear Strength, lb./in., min.	--	300	--
Temperature Retraction, 10% (TR-10), °F, max.	-45	-30	-45
Dry heat resistance, 70 hr @ 257°F			
Tensile Strength Change, %, max.	-35	-20	-20
Elongation Change, %, max.	-30	-30	-30
Hardness Change, points, max.	+5	+5	+5
Fuel resistance, Hydrazine, 96 hours @ 160°F			
Compatibility, Pressure Rise, psi, max. (Greater than control container)	2	2	2
Tensile Strength Change, %, max.	-20	-20	-20
Elongation Change, %, max.	-20	-20	-20
Volume Change, %, max.	3	3	3
Compression set in hydrazine, %, max.	25	25	25

- 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 (see 6.4).
- 4.4.3 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 (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 (AQL's) set forth herein. The lot size, for the purpose of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of molded parts, yards of sheets, or strips, as applicable, for examinations as specified (see 4.4.4.1, 4.4.4.2, and 4.4.4.3). If the end item is less than 1 yard, 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 parts. The sample size shall be in accordance with MIL-STD-105, inspection level II, and the AQL related to percent defective shall be 1.5.

- 4.4.4.1.2 Sheets and strips: The sample unit shall be 1 linear yard, 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. The sample size shall be in accordance with MIL-STD-105, inspection level II, and AQL related to percent defective shall be 2.5.
- 4.4.4.2 Examination for dimensional defects:
- 4.4.4.2.1 Molded parts: The sample unit shall be one molded part. The dimensions shall be within the tolerances specified on the drawing, contract or order. The sample size shall be in accordance with MIL-STD-105, inspection level II, and the AQL related to percent defective shall be 1.5.
- 4.4.4.2.2 Sheets and strips: 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 (see 3.3.1) or the drawing, contract or order as applicable. The sample size shall be in accordance with MIL-STD-105, inspection level II, and 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 in accordance with Table III to determine that the packaging, packing, and markings 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. The sample size shall be in accordance with MIL-STD-105, inspection level II, and the AQL related to percent defective shall be 2.5.
- 4.4.5 Quality conformance tests: The following tests shall be conducted on each lot of material (see 4.4.1.2):
- | | |
|-------------------------|--------------------------------|
| Original: | Fluid Resistance: |
| Tensile strength | 96 hours at 160°F in Hydrazine |
| Elongation | Pressure Rise |
| Hardness | Tensile Strength Change |
| Tear Strength (Type II) | Elongation Change |
| | Volume Change |
| | Compression Set |
- 4.4.5.1 Rejection criteria: A lot shall be rejected upon the failure of any sample to meet the test requirements specified herein. A lot that has been rejected may be reworked to correct the deficiencies and resubmitted for acceptance.
- 4.5 Test conditions:
- All test specimens shall be conditioned and tested at standard conditions (see 4.5.1) unless otherwise specified herein or in the applicable ASTM test method.
- 4.5.1 Standard conditions: Standard conditions shall be 50 ± 15 percent relative humidity and a temperature of $75 \pm 5^\circ\text{F}$.

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
Tensile strength and elongation	D 412, Die B
Hardness	D 2240
Temperature retraction (TR 10)	D 1329
Volume increase	D 471
Tear Strength	D 624 (Use Die B)

- 4.6.2 Fuel Resistance: ^{1/} Specimens shall be thoroughly cleaned by washing with deionized water in an ultrasonic cleaner, rinsing in filtered water, followed by a rinse in isopropyl alcohol, and drying with dry, filtered nitrogen. The specimens shall then be placed in a moisture tight cylindrical stainless steel container that is capable of being sealed and fitted with a 0-100 psi pressure gauge. The total volume of the test container is 305 cubic centimeters. The following strips of rubber shall be placed in the container: three 1-inch by 6 inch by .075-inch (for tensile specimens), three 1-inch by 2-inch by .075-inch (for volume change specimens), and sufficient additional rubber to make a total rubber volume of 39.3 cc. The additional rubber shall also be cut from .075 inch thick sheet and shall be 1-inch wide. Add 226.9 cc of hydrazine conforming to MIL-P-26536 and seal the container. The sealed container shall be exposed to 160°F for 96 hours. A control container of the same type, containing the same volume of hydrazine, except without rubber specimens shall be subjected to identical conditions. The pressure rise in all containers shall be monitored periodically through the 96-hour aging period. The maximum pressure difference observed at 160°F between the rubber-containing vessels and the control vessel shall be the measure of compatibility. Since very small amounts of contamination can cause catalytic decomposition of hydrazine, absolute cleanliness must be maintained for specimens, for containers, and for handling equipment. All safety precautions normal to propellant handling should be observed. At the end of 96 hours the containers shall be cooled to room temperature and the specimens removed. The specimens should be placed on laboratory wiping tissues and carefully blotted dry. The tensile specimens should be cut from the 1-inch by 6-inch strips using Die B of ASTM D 412. Tensile, elongation, and volume change properties are to be determined within 4 hours of removal from the hydrazine. During the time between drying and testing, the specimens should be protected by placing in polyethylene bags. NOTE: This test method describes one particular test apparatus. Other test apparatus may be used providing the same sample/propellant/ullage ratio is maintained.

- 4.6.3 Compression set in hydrazine: Compression set shall be determined in accordance with Method B of ASTM D 395 except as otherwise specified. The compressed specimens shall be exposed to hydrazine at 160°F for 96 hours using an appropriate size container. Compression set tests shall be conducted on test specimens plied up from applicable test samples.

^{1/} Hydrazine is a hazardous chemical. See "Dangerous Properties of Industrial Materials", by N. Irving Sax.

TABLE III. Examination for defects in preparation for delivery

EXAMINE	DEFECTS
Packaging (molded parts)	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 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 (5.1.1.4).
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.

5. PREPARATION FOR DELIVERY:

5.1 Preservation and packaging:

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

5.1.1 Level A:

5.1.1.1 Molded parts: Molded rubber parts other than o-rings shall preferably be placed in polyethylene bags or be individually wrapped with kraft paper conforming to UU-P-268 and packaged in containers. The polyethylene bags shall be made from material conforming to L-P-378.

5.1.2 O-Rings: O-Rings shall be packaged in accordance with the Level A requirements of MIL-P-4861.

5.1.1.3 Sheets: Kraft paper conforming to UU-P-268 shall be used between the sheets extending over the full area of contact between each sheet. Unit quantity shall be a stack not to exceed 10 inches.

5.1.1.4 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 \pm 1 foot of rubber strip.

5.1.1.5 Extruded shapes: Extruded rubber shapes shall be individually wrapped with kraft paper conforming to UU-P-268.

5.1.2 Level C: The 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: Shipping containers shall contain identical 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. 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 and, unless otherwise specified by the procuring activity, a maximum length of 10 feet. Unless otherwise specified by the procuring activity, rubber material shall be packed in overseas-type wooden containers conforming to PPP-B-601 or PPP-B-621. 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 applicable box specification or appendix thereto. Gross weight of containers shall not exceed 200 pounds. O-rings shall be packed in accordance with the level A requirements of MIL-P-4861.

5.2.2 Level B: All rubber material packaged as specified in 5.1, shall be packed in domestic type shipping containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621 or PPP-B-636. Exterior shipping containers shall be of minimum cube and tare consistent with the protection required. As far as practicable, exterior shipping containers shall be of uniform shape and size and contain identical quantities. The gross weight of wood and wood-type shipping containers shall not exceed two hundred (200) pounds. The gross weight of fiberboard shipping containers shall not exceed the weight limitations of the box specifications. Closure and strapping shall be in accordance with the applicable box specification or appendix thereto. O-rings shall be packed in accordance with level B requirements of MIL-P-4861.

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 Uniform 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 shipment:

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 as specified (see 3.4). The nomenclature shall be as follows:

Rubber (sheet, strip or molded parts)

Type

Cross section and length (inches) or part number

Compound number, lot number

Specification MIL-R- (USAF)

Cure date (quarter and year)

STORE IN A COOL DRY PLACE

6. NOTES:

6.1 Intended use:

The elastomeric material specified herein is intended primarily for use in applications which require excellent resistance to hydrazine. They are particularly useful where decomposition of hydrazine is a problem. A compatibility test is conducted to insure that ingredients in the rubber formulation will cause only minimal decomposition. These materials can also be used in other hydrazine fuels such as monomethyl hydrazine and the 50/50 mixture of hydrazine/unsymmetrical dimethyl hydrazine. Hydrazines are hazardous chemicals. See "Dangerous Properties of Industrial Materials", by N. Irving Sax.