SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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# AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3534B

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Superseding AMS 3534A

Submitted for recognition as an American National Standard

## ETHYLENE TETRAFLUOROETHYLENE (ETFE) MOLDINGS
## Stress-Relieved



1. SCOPE:

1.1 Form:

This specification covers a melt-processible, copolymer resin of ethylene and tetrafluoroethylene (ETFE) in the form of molded rods, tubes, and shapes.

1.2 Application:

These products have been used typically for parts such as seals, insulators, back-up rings, valve liners, and bearings requiring good mechanical, chemical, electrical, environmental (including limited radiation resistance), and elevated-temperature properties, but usage is not limited to such applications.

1.2.1 ETFE offers improved mechanical properties compared to both polytetrafluoroethylene and polyfluoroethylene propylene, while offering essentially the same outstanding chemical, electrical, and environmental performance of these other materials. ETFE is capable of continuous operation up to 150 °C (302 °F) and, depending on exposure time, load, and environment, can be used intermittently up to 200 °C (392 °F).

1.3 Classification:

Moldings covered by this specification are classified as follows:

a. Type 1: For parts requiring mechanical, chemical, electrical, environmental, and elevated-temperature properties. Testing for all specified properties is required.

b. Type 2 : For parts requiring mechanical, chemical, environmental, and elevated-temperature properties. Testing for dielectric strength is not required.

1.3.1 Unless a specific Type is ordered, Type 1 shall be supplied.

1.4 Safety-Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 149 Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 638 Tensile Properties of Plastics
ASTM D 638M Tensile Properties of Plastics (Metric)
ASTM D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1708 Tensile Properties of Plastics by Use of Microtensile Specimens

2.2 U.S. Government Publications:

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

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be molded from ethylene tetrafluoroethylene (ETFE) copolymer resin pellets without admixture of fillers, pigments, or adulterants.

3.1.1 Moldings shall be stress-relief annealed after molding for dimensional stability.

3.2 Color:

Shall be translucent white. Minor discoloration will be acceptable.

3.3 Properties:

Moldings shall conform to requirements shown in Table 1 and 3.3.5; tests shall be performed on the moldings supplied and in accordance with specified test methods, insofar as practicable.

TABLE 1 - Properties

| Paragraph | Property | Requirement | Test Method |
|---|---|---|---|
| 3.3.1 | Tensile Strength at 23 °C ± 1 (73 °F ± 2), minimum | 5500 psi (37.9 MPa) | 4.5.1 |
| 3.3.2 | Elongation at 23 °C ± 1 (73 °F ± 2), minimum | 225% | 4.5.1 |
| 3.3.3 | Specific Gravity at 23/23 °C (73/73 °F) | 1.68 to 1.73 | ASTM D 792; add 2 drops of wetting agent to the water |
| 3.3.4 | Dielectric Strength, applicable only to Type 1 moldings, Short Time Test, minimum | 1800 volts per mil (70.9 kV/mm) | 4.5.2 |

3.3.5 Dimensional Stability: Rods and shapes 2.000 inches (50.80 mm) and under in nominal diameter or distance between parallel sides and all tubes shall not change in length, diameter, or distance between parallel sides by more than 0.5%, determined as in 4.5.3. Dimensional stability of rods and shapes over 2.000 inches (50.80 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and supplier.

3.4 Quality:

Moldings, as received by purchaser, shall be uniform in quality and condition, smooth, and free from foreign materials and from imperfections detrimental to usage of the moldings.

3.5 Tolerances:

Shall be as follows, determined at 23 to 30 °C (73 to 86 °F):

3.5.1 Rods: As shown in Table 2.

TABLE 2A - Diameter Tolerances, Inch/Pound Units

| Nominal Diameter Inches | Tolerance, Inch Plus Only |
|---|---|
| 0.750 to 2.000, incl | 0.062 |
| Over 2.000 to 3.000, incl | 0.125 |
| Over 3.000 to 5.000, incl | 0.187 |
| Over 5.000 to 12.000, incl | 0.250 |
| Over 12.000 | As agreed upon by purchaser and supplier |

TABLE 2B - Diameter Tolerances, SI Units

| Nominal Diameter mm | Tolerance, mm Plus Only |
|---|---|
| 19.05 to 50.80, incl | 1.57 |
| Over 50.80 to 76.20, incl | 3.18 |
| Over 76.20 to 127.00, incl | 4.75 |
| Over 127.00 to 304.80, incl | 6.35 |
| Over 304.80 | As agreed upon by purchaser and supplier |

3.5.2 Tubes: As shown in Table 3.

TABLE 3A - ID and OD Tolerances, Inch/Pound Units

| Nominal OD or ID Inches | ID Tolerance Inch Minus Only | OD Tolerance Inch Plus Only |
|---|---|---|
| Up to 2.000, incl | 0.062 | 0.062 |
| Over 2.000 to 3.000, incl | 0.125 | 0.125 |
| Over 3.000 to 5.000, incl | 0.187 | 0.187 |
| Over 5.000 to 12.000, incl | 0.250 | 0.250 |

TABLE 3B - ID and OD Tolerances, SI Units

| Nominal OD or ID mm | ID Tolerance mm Minus Only | OD Tolerance mm Plus Only |
|---|---|---|
| Up to 50.80, incl | 1.57 | 1.57 |
| Over 50.80 to 76.20, incl | 3.18 | 3.18 |
| Over 76.20 to 127.00, incl | 4.75 | 4.75 |
| Over 127.00 to 304.80, incl | 6.35 | 6.35 |

3.5.3 Shapes: As agreed upon by purchaser and supplier.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

The manufacturer of moldings shall supply all samples for required tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the moldings conform to the requirements of this specification.

4.2 Classification of Tests:
(R)

Tests for all technical requirements are acceptance tests and preproduction tests and shall be performed prior to or on the initial shipment of moldings by the manufacturer, on each lot, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:
(R)

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient moldings shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all moldings produced in a single production run from the same batch of raw material and presented for manufacturer's inspection at one time but shall not exceed 200 pounds (91 kg).

4.3.1.2 When a statistical sampling plan has been agreed upon by purchaser and supplier, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and supplier.

4.4 Approval:

4.4.1 Sample moldings shall be approved by purchaser before moldings for production use are supplied, unless such approval be waived by purchaser. Results of tests on production moldings shall be essentially equivalent to those on the approved sample.

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production moldings which are essentially the same as those used on the approved sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample moldings. Production moldings made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Tensile Strength and Elongation: Shall be determined in accordance with ASTM D 638 or ASTM D 638M, using the microtensile specimen of ASTM D 1708. The initial jaw separation shall be 0.875 inch ± 0.005 (22.22 mm ± 0.13) and the speed of testing shall be 2 inches per minute (0.85 mm/s). Specimens shall be prepared from slices 0.031 inch ± 0.002 (0.78 mm ± 0.05) thick cut from the product.

4.5.2 Dielectric Strength: Shall be determined in accordance with ASTM D 149 under oil on 0.020-inch ± 0.002 (0.51-mm ± 0.05) thick specimens. When practicable, specimens shall be 1 inch (25 mm) in nominal diameter but may be 0.50 inch (12.7 mm) in nominal diameter if 1-inch (25-mm) diameter specimens cannot be obtained from the molding. Electrodes shall be of corrosion-resistant steel, nominally 0.25 inch (6.4 mm) in diameter with 0.031 inch (0.78 mm) radius at the edges for 1-inch (25-mm) diameter specimens and nominally 0.062 inch (1.57 mm) in diameter with round edges for 0.5-inch (13-mm) diameter specimens.

4.5.3 Dimensional Stability: Cut specimens from the product, each 1.000 inch ± 0.005 (25.40 mm ± 0.13) in length, and measure their length and their diameter or distance between parallel sides at midlength to the nearest 0.001 inch (0.025 mm). Mark the points of original measurement so that measurements after heating and cooling can be made at the same points. Place the specimens in a heating chamber which is at approximately 23 °C (73 °F) and raise the temperature of the chamber to 220° C ± 3 (428 °F ± 5). The heating medium may be either oil or air. Hold the specimens at 220 °C ± 3 (428° ± 5) for 120 minutes ± 5. Lower the temperature at a rate not greater than 30 C (54 F) degrees per hour to approximately 23 °C (73 °F). Measure the length and diameter of the specimens to the nearest 0.001 inch (0.025 mm) at the same points as used for the original measurements. Calculate the changes in dimensions using Equation 1 and average the results for each dimension:

$$D = \frac{L_i - L_n}{L_i} \times 100 \qquad \text{(Eq.1)}$$

where, D = dimensional change in %
$L_n$ = dimension of section after heating
$L_i$ = dimension of section before heating

4.6 Reports:

The supplier of moldings shall furnish with each shipment a report showing the results of tests to determine conformance to the technical requirements. This report shall include the purchase order number, lot number, AMS 3534B, type, manufacturer's compound number, size or part number, and quantity.

4.7 Resampling and Retesting:
(R)

If any specimen used in the above tests fails to meet the specified requirements, disposition of the moldings may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the moldings represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 A lot of moldings may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.

5.1.2 Packaging shall be accomplished to ensure that the moldings, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any other normal hazard.