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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3533B

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Superseding AMS 3533A

Submitted for recognition as an American National Standard

ETHYLENE TETRAFLUOROETHYLENE (ETFE) EXTRUSIONS

1. SCOPE:

1.1 Form:

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

1.2 Application:

These extrusions 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 (PTFE) 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:

Extrusions covered by this specification are classified as follows:

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

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.

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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

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

3.1.1 Annealing of the product is optional. However, if dimensional stability is critical, extrusions shall be annealed when specified by purchaser.

3.2 Color:

Shall be translucent white. Minor discoloration is acceptable.

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3.3 Properties:

Extrusions shall conform to requirements shown in Table 1; tests shall be performed on the extrusions 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), min	5500 psi (37.9 MPa)	4.5.1
3.3.2	Elongation at 23 °C ± 1 (73 °F ± 2), min	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 two drops of wetting agent to the water
3.3.4 (R)	Dielectric Strength, applicable only to Type 1 extrusions, Short Time Test, min (59.1 kV/mm)	1500 volts per mil	4.5.2

3.4 Quality:

Extrusions, 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 extrusions.

3.5 Tolerances:

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

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3.5.1 Rods: As shown in Table 2.

TABLE 2A - Rod Tolerances, Inch/Pound Units

Nominal Diameter Inches	Tolerance, Inch plus only
Up to 0.250, incl	0.006
Over 0.250 to 0.500, incl	0.009
Over 0.500 to 0.750, incl	0.012
Over 0.750 to 1.000, incl	0.015
Over 1.000 to 1.250, incl	0.018
Over 1.250 to 1.500, incl	0.021
Over 1.500 to 1.750, incl	0.024
Over 1.750 to 2.000, incl	0.027
Over 2.000 to 2.250, incl	0.030
Over 2.250 to 2.500, incl	0.033
Over 2.500	As agreed upon by purchaser and supplier

TABLE 2B - Rod Tolerances, SI Units

Nominal Diameter mm	Tolerance, mm plus only
Up to 6.35, incl	0.15
Over 6.35 to 12.70, incl	0.23
Over 12.70 to 19.05, incl	0.30
Over 19.05 to 25.40, incl	0.38
Over 25.40 to 31.75, incl	0.46
Over 31.75 to 38.10, incl	0.53
Over 38.10 to 44.45, incl	0.61
Over 44.45 to 50.80, incl	0.68
Over 50.80 to 57.15, incl	0.76
Over 57.15 to 63.50, incl	0.84
Over 63.50	As agreed upon by purchaser and supplier

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3.5.2 Tubes: As shown in Table 3.

TABLE 3A - Tube Tolerances, Inch/Pound Units

Nominal OD or ID Inches	ID Tolerance Inch minus only	OD Tolerance Inch plus only
Over 0.187 to 2.000, incl	0.062	0.062

TABLE 3B - Tube Tolerances, SI Units

Nominal OD or ID mm	ID Tolerance mm minus only	OD Tolerance mm plus only
Over 4.75 to 50.80, incl	1.57	1.57

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3.5.3 Shapes: As agreed upon by purchaser and supplier.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R) The manufacturer of extrusions 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 extrusions 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 extrusions 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 extrusions 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 extrusions 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
(R) 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 extrusions shall be approved by purchaser before extrusions for production use are supplied, unless such approval be waived by purchaser. Results of tests on production extrusions shall be essentially equivalent to those of the approved sample.

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production extrusions 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 extrusions. Production extrusions 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 a testing speed of 2 inches per minute (0.85 mm/s) and measuring elongation over a 2-inch (50.8-mm) gage length. The test specimen for rod, and for shapes where size permits, shall conform to Figure 1 of this specification except that rods 0.250 inch (6.35 mm) and under in nominal diameter may be tested in full cross-section.

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4.5.2 Dielectric Strength: Shall be determined in accordance with ASTM D 149 on specimens 0.040 inch ± 0.001 (1.02 mm ± 0.03) thick. The test shall be conducted under oil using 0.062-inch (1.57-mm) diameter corrosion-resistant steel electrodes with rounded edges. If flash-over is a problem on small diameter rod or on shapes, specimens shall be prepared by drilling holes from opposite ends of a piece of the extrusion, leaving a web 0.040 inch ± 0.001 (1.02 mm ± 0.03) thick in the middle of the specimen. Electrodes shall be the same as used for the wafer specimen and shall be inserted in the holes in the specimen.

4.6 Reports:

The supplier of extrusions 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 3533B, type, manufacturer's compound number, form and 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 extrusions 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 extrusions represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

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

5.1.1.1 A lot of extrusions may be packaged in small quantities and delivered
(R) under the basic lot approval provided lot identification is maintained.

5.1.2 Each package shall be permanently and legibly marked with not less than the following information:

ETHYLENE TETRAFLUOROETHYLENE (ETFE) EXTRUSIONS
AMS 3533B
TYPE _____
SIZE OR PART NUMBER _____
LOT NUMBER _____
PURCHASE ORDER NUMBER _____
QUANTITY _____
MANUFACTURER'S IDENTIFICATION _____

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