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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3532B

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Submitted for recognition as an American National Standard

Superseding AMS 3532A

ETHYLENE TETRAFLUOROETHYLENE (ETFE) MOLDED SHEET
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 sheet.

1.2 Application:

This sheet has 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 operations 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:

Sheet covered by this specification is 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.

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 Sheet 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:

Sheet shall conform to requirements shown in Table 1 and 3.3.5; tests shall be performed on the sheet 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 sheet, Short Time Test, min	1200 volts per mil (47.2 kV/mm)	4.5.2

3.3.5 Dimensional Stability: Sheet 2.000 inch (50.80 mm) and under in nominal thickness shall not change in length, width, or thickness by more than 0.5%, determined as in 4.5.3. Dimensional stability of sheet over 2.000 inches (50.80 mm) in nominal thickness shall be as agreed upon by purchaser and supplier.

3.4 Quality:

Sheet, 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 sheet.

3.5 Tolerances:

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

3.5.1 Thickness: As shown in Table 2.

TABLE 2A - Thickness Tolerances, Inch/Pound Units

Nominal Thickness (T) Inches	Tolerance Inch plus	Tolerance Inch minus
0.0312 to 0.0625, incl	0.015	0.005
Over 0.0625 to 0.0938, incl	0.020	0.005
Over 0.0938 to 0.125, incl	0.016	0.008
Over 0.125 to 0.1563, incl	0.018	0.009
Over 0.1563 to 0.1875, incl	0.022	0.011
Over 0.1875 to 0.250, incl	0.030	0.015
Over 0.250 to 0.375, incl	0.038	0.019
Over 0.375 to 0.500, incl	0.046	0.022
Over 0.500 to 0.625, incl	0.054	0.027
Over 0.625 to 0.750, incl	0.070	0.035
Over 0.750 to 1.000, incl	0.087	0.043
Over 1.000 to 1.250, incl	0.102	0.051
Over 1.250 to 1.500, incl	0.118	0.059
Over 1.500 to 1.750, incl	0.134	0.067
Over 1.750 to 2.000, incl	0.150	0.075
Over 2.000	0.10T	0.10T

TABLE 2B - Thickness Tolerance, SI Units

Nominal Thickness (T) mm	Tolerance mm plus	Tolerance mm minus
0.79 to 1.59, incl	0.38	0.13
Over 1.59 to 2.38, incl	0.51	0.13
Over 2.38 to 3.18, incl	0.41	0.20
Over 3.18 to 3.97, incl	0.46	0.23
Over 3.97 to 4.76, incl	0.56	0.28
Over 4.76 to 6.35, incl	0.76	0.38
Over 6.35 to 9.52, incl	0.96	0.48
Over 9.52 to 12.70, incl	1.17	0.56
Over 12.70 to 15.88, incl	1.37	0.68
Over 15.88 to 19.05, incl	1.78	0.89
Over 19.05 to 25.40, incl	2.21	1.09
Over 25.40 to 31.75, incl	2.59	1.30
Over 31.75 to 38.10, incl	3.00	1.50
Over 38.10 to 44.45, incl	3.40	1.70
Over 44.45 to 50.80, incl	3.81	1.90
Over 50.80	0.10T	0.10T

3.5.2 Width and Length: Shall not vary more than +0.250 inch (+6.35 mm), -0.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

The manufacturer of sheet shall supply all samples 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 sheet conforms to the requirements of this specification.

4.2 Classification of Tests:

Tests for all technical requirements are acceptance tests and preproduction tests and shall be performed prior to or on the initial shipment of sheet 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 sheet 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 sheet 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) manufacturer, 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 manufacturer.

4.4 Approval:

4.4.1 Sample sheet shall be approved by purchaser before sheet for production use is supplied, unless such approval be waived by purchaser. Results of tests on production sheet 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 sheet 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 sheet. Production sheet 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). Sheet over 0.062 to 0.625 inch (1.57 to 15.88 mm), exclusive, in nominal thickness shall be machined to 0.062 inch ± 0.010 (1.57 mm ± 0.25) thick before cutting specimens. From sheet 0.625 inch (15.88 mm) and over in nominal thickness, a slice somewhat thicker than 0.062 inch (1.57 mm) shall be cut in a plane parallel to, and not less than 0.5 inch (13 mm) from, the plane of one end of the sheet; this slice shall be machined on both faces to 0.062 inch ± 0.010 (1.57 mm ± 0.25) thick and the specimens cut from the machined slice. In all cases of specimens reduced to specified thickness by machining, tool marks shall be removed by light sanding in a longitudinal direction.

4.5.2 Dielectric Strength: Shall be determined in accordance with ASTM D 149 on specimens 0.060 inch ± 0.010 (1.52 mm ± 0.25) thick. Tests shall be conducted under oil using electrodes of corrosion-resistant steel, nominally 0.25 inch (6.35 mm) in diameter with 0.031 inch (0.79 mm) radius at the edges.

4.5.3 Dimensional Stability: Cut specimens from the product with both a length and width of 1.000 inch ± 0.005 (25.40 mm ± 0.13). Measure length, width, and thickness 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 (75 °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 °F ± 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, width, and thickness 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: