AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 3533

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Revised

ETHYLENE TETRAFLUOROETHYLENE 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: Primarily for parts such as seals, insulators, back-up rings, valve liners, and bearings requiring good mechanical, chemical, electrical, environmental (including radiation resistance), and elevated-temperature properties. 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. It is capable of continuous operation up to 150°C (300°F) and, depending on exposure time, load, and environment, can be used intermittently up to 200°C (390°F).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D149 - Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
ASTM D638 - Tensile Properties of Plastics
ASTM D792 - Specific Gravity and Density of Plastics by Displacement

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be extruded from ethylene tetrafluoroethylene 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 so specified by purchaser.

3.2 Color: Shall be translucent white. Minor discoloration will be acceptable.

3.3 Properties: Extrusions shall conform to the following requirements; tests shall be performed on the extrusions supplied and in accordance with specified test methods, insofar as practicable:

3.3.1	Tensile Strength at 23°C ± 1 (73°F ± 2, min	5500 psi (38 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 - 1.73	ASTM D792; add 2 drops of wetting agent to the water
3.3.4	Dielectric Strength, Short Time Test, min	1500 V per mil (59,060 V/mm)	4.5.2

3.4 Quality: Extrusions shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from internal and external imperfections detrimental to fabrication, appearance, or performance of parts.

3.5 Tolerances: Unless otherwise specified, the following tolerances apply at 23° - 30°C (73° - 86°F):

3.5.1 Rods:

TABLE I

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 vendor

TABLE I (SI)

Nominal Diameter Millimetres	Tolerance, Millimetres 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	0.69
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 vendor

3.5.2 Tubes:

TABLE II

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 II (SI)

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

3.5.3 Shapes: As agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of extrusions shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform such confirmatory testing as he deems necessary to ensure that the extrusions conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the initial shipment of extrusions to a purchaser, when a change in material or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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, the contracting officer, or the request for procurement.

4.3 Sampling: 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 tests 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 vendor's inspection at one time but shall not exceed 200 lb (90 kg).

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6.1 shall state that such plan was used.

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

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. Results of tests on production extrusions shall be essentially equivalent to those of the approved sample extrusions.

4.4.2 Vendor 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 extrusions. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material and 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 D638 using a testing speed of 2 in. (50 mm) per min. and measuring elongation over a 2 in. (50 mm) gage length. The test specimen for rod, and for shapes where size permits, shall conform to Fig. 1 of this specification except that rods 0.250 in. (6.35 mm) and under in nominal diameter may be tested in full cross-section.

4.5.2 Dielectric Strength: Shall be determined in accordance with ASTM D149 on specimens 0.040 in. ± 0.001 (1.00 mm ± 0.03) thick. The test shall be conducted under oil using 0.062-in. (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 in. ± 0.001 (1.00 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:

4.6.1 The vendor of extrusions shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, AMS 3533, vendor's compound number, size or part number, and quantity.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 3533, contractor or other direct supplier of extrusions, supplier's compound number, part number, and quantity. When extrusions for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of extrusions to determine conformance to the requirements of this specification, and shall include in the report a statement that the extrusions conform, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.7. Resampling and Retesting: 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 and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 Packaging shall be accomplished in such a manner as 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.