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

AEROSPACE MATERIAL SPECIFICATION

AMS 3658A
Superseding AMS 3658
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POLYTETRAFLUOROETHYLENE EXTRUSIONS
Premium Strength, Stress-Relieved, Radiographically Inspected

1. SCOPE:

1.1 Form: This specification covers one grade of polytetrafluoroethylene resin in the form of extruded rods, tubes, and shapes.

1.2 Application: Primarily for mechanical parts, such as seals, back-up rings, and bearings, requiring chemical inertness and dimensional stability at temperatures up to 260°C (500°F) and higher mechanical and electrical properties than AMS 3656.

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 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: The product shall be extruded from polytetrafluoroethylene powder without admixture of fillers, pigments, or adulterants, and shall be sintered and stress-relieved.

3.2 Color: Shall be opaque white. Minor discolorations or contamination shall not in themselves be unacceptable.

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

Printed in U.S.A.

3.3.1 Tensile Strength at 23°C ± 1 (73.4°F ± 1.8), min — 4.5.1

3.3.1.1 Rods and Shapes

Nominal Diameter or Distance Between Parallel Sides		
Inches	(Millimetres)	
Up to 0.500, excl	(Up to 12.70, excl)	1800 psi (12.4 MPa)
0.500 to 1.500, incl	(12.70 to 38.10, incl)	1900 psi (13.1 MPa)
Over 1.500	(Over 38.10)	2000 psi (13.8 MPa)

3.3.1.2 Tubes, All Sizes — 1800 psi (12.4 MPa)

3.3.2 Elongation at 23°C ± 1 (73.4°F ± 1.8), min — 4.5.1

3.3.2.1 Rods and Shapes

Nominal Diameter or Distance Between Parallel Sides		
Inches	(Millimetres)	
Up to 0.500, excl	(Up to 12.70, excl)	150%
0.500 to 1.500, incl	(12.70 to 38.10, incl)	175%
Over 1.500	(Over 38.10)	200%

3.3.2.2 Tubes, All Sizes — 150%

3.3.3 Specific Gravity at 23°/23°C (73.4°/73.4°F) — ASTM D792 Add 2 drops of wetting agent to the water

3.3.3.1 Rods and Shapes

Nominal Diameter or Distance Between Parallel Sides		
Inches	(Millimetres)	
Up to 0.500, excl	(Up to 12.70, excl)	2.14 - 2.19
0.500 to 1.500, incl	(12.70 to 38.10, incl)	2.15 - 2.20
Over 1.500	(Over 38.10)	2.15 - 2.20

3.3.3.2 Tubes, All Sizes — 2.14 - 2.19

3.3.4 Dielectric Strength, Short Time Test, min — 4.5.2

3.3.4.1 Rods and Shapes

Nominal Diameter or Distance Between Parallel Sides		
Inches	(Millimetres)	
Up to 0.500, excl	(Up to 12.70, excl)	700 V per mil (27,560 V/mm)
0.500 to 1.500, incl	(12.70 to 38.10, incl)	750 V per mil (29,530 V/mm)
Over 1.500	(Over 38.10)	800 V per mil (31,500 V/mm)

3.3.4.2 Tubes, All Sizes — 700 V per mil (27,560 V/mm)

3.3.5 Dimensional Stability: Rods and shapes up to 1.500 in. (38.10 mm), incl, in nominal diameter or distance between parallel sides and all tubes shall not change in length by more than 1.5% and in diameter or distance between parallel sides by more than 0.5%, determined as in 4.5.3. Dimensional stability of rods and shapes over 1.500 in. (38.10 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.4 Quality: The product 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.

3.4.1 The product shall be radiographically inspected. Radiographic procedures and standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Unless otherwise specified, the following tolerances apply at 23° - 30° C (73.4° - 86° F):

3.5.1 Rods and Shapes:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tolerance, Inch plus only
Up to 0.250, incl	0.008
Over 0.250 to 0.500, incl	0.016
Over 0.500 to 0.750, incl	0.020
Over 0.750 to 1.000, incl	0.024
Over 1.000 to 1.250, incl	0.030
Over 1.250 to 1.500, incl	0.038
Over 1.500 to 1.750, incl	0.046
Over 1.750 to 2.000, incl	0.052
Over 2.000 to 2.250, incl	0.068
Over 2.250 to 2.500, incl	0.076

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tolerance, Millimetres plus only
Up to 6.35, incl	0.20
Over 6.35 to 12.70, incl	0.41
Over 12.70 to 19.05, incl	0.51
Over 19.05 to 25.40, incl	0.61
Over 25.40 to 31.75, incl	0.76
Over 31.75 to 38.10, incl	0.97
Over 38.10 to 44.45, incl	1.17
Over 44.45 to 50.80, incl	1.32
Over 50.80 to 57.15, incl	1.73
Over 57.15 to 63.50, incl	1.93

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance control tests.

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

4.3 Sampling: Sufficient material shall be taken from each lot to perform all required tests in triplicate; a lot shall be all product produced in a single production run from the same batch of raw material and presented for vendor's inspection at one time.

4.4 Approval:

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

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production material which are essentially the same as those used on the approved sample material. 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 material. Production material 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. (51 mm) per min. and measuring elongation over a 2 in. (50.8 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 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 (1.02 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 product, leaving a web 0.040 in. ± 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.

4.5.3 Dimensional Stability: Cut specimens from the product, each 1.000 in. ± 0.005 or 25.00 mm ± 0.13 in length, and measure their length and their diameter or distance between parallel sides at midlength to the nearest 0.001 in. or 0.02 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 290° C ± 3 (554° F ± 5.4). The heating medium may be either oil or air. Hold the specimens at 290° C ± 3 (554° F ± 5.4) for 120 min. ± 5. Lower the temperature at a rate not greater than 30 C (54 F) deg per hr to approximately 23° C (73° F). Measure the length and diameter of the specimens to the nearest 0.001 in. or 0.02 mm at the same points as used for the original measurements. Calculate the changes in dimensions by the following equation and average the results for each dimension:

$$D = \frac{L_n - L_i}{L_i} \times 100$$

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

4.6 Reports:

4.6.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the tensile strength, elongation, specific gravity, and dielectric strength requirements and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, vendor's compound number, form and 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, material specification number and its revision letter, contractor or other direct supplier of material, supplier's compound number, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, 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 product 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 product 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 product, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any normal hazard.