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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3654B
Superseding AMS 3654A

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TUBING, ELECTRICAL INSULATION
Light Wall, Extruded Polytetrafluoroethylene (PTFE)

1. SCOPE:

1.1 Form: This specification covers extruded polytetrafluoroethylene (PTFE) in the form of flexible tubing.

1.2 Application: Primarily for electrical insulating sheath up to 260°C (500°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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 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 D876 - Testing Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation
ASTM D1675 - Testing Polytetrafluoroethylene Tubing

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-104 - Limit for Electrical Insulation Color
MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be flexible tubing made from extruded virgin polytetrafluoroethylene, free from contamination and from foreign, reground, and scrap material.

3.2 Color: Unless otherwise specified, tubing shall be natural in color, ranging from colorless translucent to semi-opaque white. When ordered in colors, the colors shall be in accordance with MIL-STD-104 or as agreed upon by purchaser and vendor.

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

3.3.1	Tensile strength at 200% elongation	2,500 - 6,000 psi (17 - 41 MPa)	ASTM D876 Temperature: 25°C ± 1 (77°F ± 2)
3.3.2	Elongation, min	200%	ASTM D876 Temperature: 25°C ± 1 (77°F ± 2)
3.3.3	Dielectric Breakdown Voltage, average, min		ASTM D876 Temperature: 25°C ± 1 (77°F ± 2)

Nominal Wall Thickness		
Inch	Millimetre	
0.006	0.15	8,000 v
0.008	0.20	10,000 v
0.010	0.25	11,000 v
0.012	0.30	12,000 v
0.015 - 0.020	0.38 - 0.51	14,000 v

3.3.4	Strain Relief (shrinkage), max	1.0%	ASTM D1675 Temperature: 300°C ± 3 (570°F ± 5)
3.3.5	Volatile Loss, max	0.05%	ASTM D1675 Temperature: 300°C ± 3 (570°F ± 5)
3.3.6	Specific Gravity	2.14 - 2.21	ASTM D1675
3.3.7	Mandrel Bend (dielectric breakdown reduction), max	25%	ASTM D1675

3.4 Quality: Tubing, 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 tubing.

3.5 Sizes and Tolerances: Shall be as shown in Table I; tolerances apply at 20° - 30°C (68° - 86°F), measured in accordance with ASTM D1675.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of tubing 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 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

Requirement	Paragraph Reference
Tensile Strength	3.3.1
Elongation	3.3.2
Dielectric Breakdown Voltage	3.3.3
Specific Gravity	3.3.6

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 prior to or on the initial shipment of tubing to a purchaser, when a change in material, processing, or both 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 tubing 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 When suitable test specimens cannot be cut from the tubing, a separate flat strip test sample shall be supplied upon request. This strip shall be prepared from tubing 1 in. ± 0.063 (25 mm ± 1.60) in OD by 0.075 in. ± 0.008 (1.90 mm ± 0.20) in wall thickness, mechanically slit and flattened into a strip while being extruded, and cured in the same manner as production tubing.

4.3.1.2 A lot shall be all tubing from the same batch of compound processed in one continuous run and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 lb (225 kg). A lot may be packaged in small quantities under the basic lot approval provided lot identification is maintained.

4.3.1.3 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 4.5 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 tubing shall be approved by purchaser before tubing for production use is supplied, unless such approval be waived by purchaser. Results of tests on production tubing 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 tubing which are essentially the same as those used on the approved sample tubing. If necessary to make any change 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, processing, or both and, when requested, sample tubing. Production tubing made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Reports:

4.5.1 The vendor of tubing shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the tubing conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3654B, vendor's material designation, lot number, and quantity.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3654B, contractor or other direct supplier of tubing, supplier's material designation, part number, and quantity. When tubing for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of tubing to determine conformance to the requirements of this specification, and shall include in the report either a statement that the tubing conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the tubing 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 tubing represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each package shall be permanently and legibly marked with not less than AMS 3654B, size, color, quantity, purchase order number, manufacturer's identification, and date of manufacture.

5.2 Packaging:

5.2.1 Packaging shall be accomplished in such a manner as will ensure that the tubing, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any other normal hazard. Standard packages shall contain quantities as agreed upon by purchaser and vendor.

5.2.1.1 Packaging of special sizes and lengths shall be as agreed upon by purchaser and vendor.

5.2.2 Packages of tubing shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the tubing to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.3 For direct U. S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 and 5.2.2 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Tubing not conforming to this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.3 For direct U. S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size and color of tubing desired
Quantity of tubing desired
Applicable level of packaging (See 5.2.3)

8.4 Tubing meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 9330.