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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3634B
Superseding AMS 3634A

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PLASTIC TUBING, ELECTRICAL INSULATION
Polyolefin, Selectively Crosslinked, Encapsulating
Semi-Rigid, Heat-Shrinkable

1. SCOPE:

1.1 Form: This specification covers an irradiated, selectively crosslinked, thermally-stabilized, modified-polyolefin plastic in the form of semi-rigid, dual-wall, heat-shrinkable tubing.

1.2 Applications: Primarily for use as a semi-rigid, electrical insulation tubing whose diameter can be reduced to a predetermined size by heating to temperatures higher than 135°C (275°F). Tubing is not flame-retardant and will burn slowly. This tubing is stable for continuous exposure from -55°C (-67°F) to +110°C (+230°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 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 D471 - Rubber Property - Effect of Liquids
ASTM D2671 - Testing Heat Shrinkable Tubing for Electrical Use
ASTM G21 - Determining Resistance of Synthetic Polymeric Materials to Fungi

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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 Specifications:

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missiles and Ordnance
MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5

2.3.2 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a thermally-stabilized, modified-polyolefin plastic, selectively cross-linked by irradiation to provide a non-meltable, shrinkable, outer wall and an inner wall capable of melting and adhering to itself.

3.2 Color: Shall be black, unless otherwise ordered.

3.3 Properties: Tubing shall conform to the following requirements; reported values shall be the average of all specimens tested for each requirement. Except as otherwise specified, tests shall be performed in accordance with ASTM D2671 insofar as practicable. Tubing shall be tested in the expanded form (as supplied), unless otherwise specified.

3.3.1	Tensile Strength, min Jaw separation rate 2 in. per min. (0.85 mm/s)	1500 psi (10.3 MPa)	
3.3.2	Elongation, min	200%	
3.3.3 Ø	Flow and Sealing of Inner Wall	Pass	4.5.1
3.3.4	Heat Shock, 4 hr ± 0.2 at 250°C ± 5 (482°F ± 9)	No dripping, flowing, or cracking of outer wall	
3.3.5	Low-Temperature Flexibility, Procedure B 4 hr ± 0.25 at -55°C ± 2 (-65°F ± 4)	No Failure	

3.3.6 Heat Aging, 168 hr ± 2 at 175°C ± 3 (345°F ± 5)	No dripping, flowing, or cracking of outer wall	4.5.2
3.3.7 Corrosion, Procedure A, After 16 hr ± 0.25 at 120°C ± 3 (250°F ± 5)	Area of transparency not more than 5% of total area	
3.3.8 Fluid Resistance		4.5.3
3.3.8.1 Tensile Strength, min	1000 psi (6.90 MPa)	
3.3.8.2 Dielectric Strength, min	400 V per mil (15,750 V/mm)	4.5.4
3.3.9 Fungus Resistance	Rating of 1 or less	ASTM G21
3.3.10 Specific Gravity, max	0.99	
3.3.11 Water Absorption, max 24 hr ± 0.25 at 25°C ± 2 (77°F ± 4)	0.10%	
3.3.12 Dielectric Strength, min (short time test)	500 V per mil (19,700 V/mm)	4.5.4
3.3.13 Volume Resistivity, min	10^{15} ohm-cm	
3.3.14 Dimensions and Dimensional Change on Heating ø		4.5.5
3.3.14.1 Dimensions and Diametral ø	In accordance with Table I	
3.3.14.2 Longitudinal, max	-10%, +1%	4.5.5.1

3.4 Marking: Tubing, prior to and after shrinkage, shall be suitable for having numbers or characters printed on it with conventional tube marking techniques.

3.5 Quality: Tubing, as received by purchaser, shall be uniform in quality and ø condition, smooth, and free from foreign materials and from internal and external imperfections detrimental to usage of the tubing.

3.6 Standard Sizes and Tolerances: Tubing shall be supplied in lengths of 48 in., +1, -0 (1200 mm, +25, -0) and in the standard sizes and to the tolerances shown in Table I, unless otherwise specified. Tolerances apply at 23° - 30°C (73° - 86°F). Measurements shall be made in accordance with ASTM D2671.

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 4.6. 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 requirements for tensile strength (3.3.1), elongation (3.3.2), flow and sealing of inner wall (3.3.3), heat shock (3.3.4), dimensional change on heating (3.3.14), and sizes and tolerances (3.6) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for low-temperature flexibility (3.3.5), heat aging (3.3.6), corrosion (3.3.7), fluid resistance (3.3.8), fungus resistance (3.3.9), specific gravity (3.3.10), water absorption (3.3.11), dielectric strength (3.3.12), volume resistivity (3.3.13), and marking (3.4) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 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 or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.3.1 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 in accordance with ASTM D2671 and the following; a lot shall be all tubing of the same size from the same production run presented for vendor's inspection at one time. The number of specimens for each test shall be as specified in the applicable test procedure or, if not specified therein, not less than three. A lot may be packaged in small quantities under the basic lot approval as long as lot identification is maintained.

4.3.1 For Acceptance Tests: Not less than 16 ft (5 m) of tubing from each lot.

4.3.1.1 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 Periodic Tests: Not less than 50 ft (18 m) of tubing of each size or size range. Certain representative sizes may be used to demonstrate conformance of a range of sizes as follows:

Representative Size	Range of Sizes
1/4	1/8 - 1/4, incl
1	300 - 1, incl

4.3.3 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 or processing, or both, and, when requested, sample tubing. Tubing made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Flow and Sealing of Inner Wall: Three specimens, each approximately 6 in. (150 mm) long, shall be conditioned for 3 min. ± 0.2 in a mechanical convection oven which is at 200°C ± 5 (392°F ± 9) with an air velocity of 100 - 200 ft per min. (510 - 1015 mm/s) past the specimens. Within 5 sec after conditioning, approximately 1/4 in. (6.5 mm) of one end shall be lightly pressed together with needle nose pliers. The specimens shall be removed from the pliers and cooled to room temperature. The specimens shall be replaced for 5 min. ± 0.2 in the mechanical convection oven at 200°C ± 5 (392°F ± 9). After heating, the specimens shall be removed, cooled to room temperature, and examined to ensure that there are no openings through the pressed portion.

4.5.2 Heat Aging: Three specimens, approximately 6 in., (150 mm) long, shall be conditioned on aluminum foil for 168 hr ± 2 in an oven which is at 175°C ± 2 (347°F ± 4). After conditioning, the specimens shall be removed from the oven, cooled to 23°C ± 3 (73°F ± 5), and bent through 180 deg over a mandrel selected in accordance with Table II. The specimens shall be examined visually for evidence of dripping, flowing, or cracking of the outer wall. Any side cracking caused by flattening of the specimen on the mandrel shall not constitute failure.

TABLE II

Size	Mandrel Diameter	
	Inch	(Millimetres)
1/8 to 1/4, incl	7/16	(11.0)
300 to 3/4, incl	1/2	(12.5)
1	9/16	(14.0)

4.5.3 Fluid Resistance: Shall be determined in accordance with ASTM D2671 on specimens immersed for 24 hr ± 2 at 23°C ± 3 (73°F ± 5) in MIL-T-5624 JP-4 fuel, SAE phosphate ester test fluid No. 1A (See 8.2), MIL-H-5606 hydraulic oil, ASTM Fuel B (See ASTM D471), and water.

4.5.4 Dielectric Strength: Shall be determined by dividing the dielectric breakdown voltage, determined in accordance with ASTM D2671, by the wall thickness measured adjacent to the point of electrical rupture.

4.5.5 Dimensions and Dimensional Change on Heating and Diametral Change: Three 6 in. (150 mm) specimens of tubing shall be measured for inside diameter in accordance with ASTM D2671. The specimens then shall be placed on mandrels and conditioned for 10 min. in an oven which is at 200°C ± 3 (392°F ± 5). The diameter of the mandrels shall equal the maximum inside diameter of the recovered tubing as specified in Table I, plus 0.000, minus 0.002 in. or 2%, whichever is greater. After conditioning, the specimens, while still on the mandrels, shall be removed from the oven, cooled for at least 30 sec in water at less than 35°C (95°F), and inspected for wall thickness in accordance with ASTM D2671. If air space is visible between the specimen and the mandrel, the specimen shall be removed from the mandrel, measured for inside diameter and inspected for wall thickness in accordance with ASTM D2671.

4.5.5.1 Longitudinal Change: Three 6 in. (150 mm) specimens of tubing shall be measured for length to an accuracy of ±1/32 in. (0.8 mm). The specimens shall be conditioned on aluminum foil for 3 min. in an oven which is at 200°C ± 3 (392°F ± 5). After conditioning, the specimens shall be removed from the oven, cooled to 23°C ± 3 (73°F ± 5), and remeasured. The longitudinal change shall be calculated as follows:

$$\% \text{ Change} = \frac{\text{Length after Heating} - \text{Length before Heating}}{\text{Length before Heating}} \times 100$$

4.6 Reports:

4.6.1 The vendor of tubing shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and, when performed, to the periodic 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 3634B, vendor's compound number, lot number, size, 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 3634B, contractor or other direct supplier of tubing, supplier's compound number, 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.

4.7 Resampling and Retesting: If the average of the results of the specimens Ø tested for any requirement fails to meet the specified value, disposition of the tubing may be based on the results of testing three additional specimens for each original specimen failing to meet the specified average requirement. Failure of the average of the original specimens plus the retest specimens to meet any specified requirement 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 3634B, size, 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 each contain the following quantities:

Size	Quantity
1/8, 3/16, 1/4, 3/8	1000 ft (300 m)
1/2	500 ft (150 m)
3/4, 300	400 ft (120 m)
1	200 ft (60 m)