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

AEROSPACE MATERIAL SPECIFICATION

AMS 3583A
Superseding AMS 3583

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PLASTIC TUBING, ELECTRICAL INSULATION
Crosslinked Polyvinyl Chloride, Semi-Rigid
Heat Shrinkable
2 to 1 Shrink Ratio

1. SCOPE:

1.1 Form: This specification covers a crosslinked polyvinyl chloride plastic in the form of semi-rigid, thin-wall, heat-shrinkable tubing.

1.2 Application: Primarily for use as a semi-rigid, electrical insulation tubing whose diameter can be reduced to a predetermined size by heating to 175°C (345°F) or higher. This tubing is stable for continuous exposure from -20°C (-5°F) to +105°C (+220°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 D471 - Rubber Property - Effect of Liquids
ASTM D2671 - Testing Heat-Shrinkable Tubing for Electrical Use
ASTM G21 - Resistance of Synthetic Polymeric Materials to Fungi

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

2.3.1 Federal Specifications:

UU-T-450 - Tissue, Facial

2.3.2 Military Specifications:

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-A-8243 - Anti-Icing and Deicing-Defrosting Fluid

2.3.3 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a crosslinked, thermally-stabilized, flame-resistant, modified polyvinyl chloride.

Ø 3.2 Color: Shall be black conforming to MIL-STD-104, unless otherwise ordered.

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

3.3.1 Recovered Tubing: The following requirements apply to tubing after being shrunk by heating to Ø 175°C ± 5 (347°F ± 9) in a convection-current air oven with an air velocity of 100 - 200 ft per min. (0.5 - 1.0 m/sec) past the tubing, holding at heat for not less than 3 min., removing from the oven, and conditioning for not less than 4 hr at 23°C ± 2 (73°F ± 4) and 45% - 55% relative humidity.

3.3.1.1	Tensile Strength, min Ø Jaw separation rate 20 in. per min. (8.5 mm/sec)	3000 psi (20.7 MPa)	
3.3.1.2	Elongation, min	150%	
3.3.1.3	Secant Modulus at 2% Strain, min	70,000 psi (483 MPa)	
Ø 3.3.1.4	Dielectric Strength, min	400 V/mil (15,750 V/mm)	4.5.1
3.3.1.5	Volume Resistivity, min	10^{11} ohm-cm	
Ø 3.3.1.6	Flammability (Burning Time), max	15 sec	4.5.2
Ø 3.3.1.7	Fungus Resistance	Rating of 1 or less	ASTM G21
Ø 3.3.1.8	Brittleness Temperature	-10°C ± 1 (14°F ± 2)	
Ø 3.3.1.9	Heat Aging, 400 hr ± 2 at 130°C ± 2 (266°F ± 4)		
3.3.1.9.1	Elongation, min	75%	
Ø 3.3.1.10	Corrosion, Method B, After 168 hr ± 2 at 135°C ± 2 (275°F ± 4)	Pass	
Ø 3.3.1.11	Solvent Resistance		4.5.3
3.3.1.11.1	Tensile Strength, min	2600 psi (17.9 MPa)	
3.3.1.11.2	Dielectric Strength, min	300 V/mil (11,810 V/mm)	
Ø 3.3.1.12	Dimensional Change on Heating		

3.3.1.12.1 Diametral	In accordance with Table I	
3.3.1.12.2 Longitudinal, max	+1%, -10%	

3.3.2 Expanded Tubing: The following requirements apply to tubing in the expanded (as-received) condition. Heating for the tests of 3.3.2.1 and 3.3.2.2, shall be performed in an oven as specified in 3.3.1.

Ø 3.3.2.1 Heat Shock at 200°C ± 5 (392°F ± 9)	No dripping, flowing, or cracking	
3.3.2.1.1 Bending After Heat Shock	No cracks	4.5.4
Ø 3.3.2.2 Restricted Shrinkage, Procedure C After 30 min. ± 1 at 175°C ± 5 (347°F ± 9)	No cracks; withstand 2000 V for 1 min.	
Ø 3.3.2.3 Specific Gravity, max	1.40	
Ø 3.3.2.4 Water Absorption, max 24 hr ± 0.25 at 25°C ± 2 (77°F ± 4)	1.00%	

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 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.

3.6 Standard Sizes and Tolerances: Tubing shall be supplied in lengths of 48 in., +1, -0 (1219 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 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 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 (3.3.1.1), elongation (3.3.1.2), secant modulus (3.3.1.3), flammability (3.3.1.6), dimensional change on heating (3.3.1.12), heat shock (3.3.2.1), and size 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 dielectric strength (3.3.1.4), volume resistivity (3.3.1.5), fungus resistance (3.3.1.7), brittleness temperature (3.3.1.8), heat aging (3.3.1.9), corrosion (3.3.1.10), solvent resistance (3.3.1.11), restricted shrinkage (3.3.2.2), specific gravity (3.3.2.3), water absorption (3.3.2.4), 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 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification tests and shall be performed on the initial shipment of tubing 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.

4.2.3.1 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: Shall be in accordance with ASTM D2671 and the following; a lot shall be not more than 100,000 ft (30,480 m) of 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.

4.3.1 Acceptance Tests: Not less than 16 ft (4.88 m) of tubing from each lot.

4.3.1.1 When a statistical sampling plan and acceptance quality level (AQL) for the tubing 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 Periodic Tests: Not less than 50 ft (15.3 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	3/64 - 1/4, incl
1/2	3/8 - 1/2, incl

4.3.3 Qualification 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. 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 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 tubing. Tubing made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

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

4.5.2 Flammability: Shall be determined in accordance with ASTM D2671, except that the bare steel wire used for support of the specimens during the test shall be 0.020 in. (0.51 mm) in diameter for size 1/16 and smaller. An 8-in. (203-mm) square piece of tissue paper conforming to UU-T-450 shall be suspended taut and centered 9-1/2 in. (242 mm) below the test specimen, a minimum of 1/2 in. (13 mm) from the table top, in such a manner that any dripping particles will fall on the tissue paper. The specimen shall neither flow nor drop flaming or glowing particles which will ignite the tissue paper. Flaming of the tissue paper shall be cause for rejection.

4.5.3 Solvent 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, MIL-H-5606 hydraulic oil, ASTM Fuel B (See ASTM D471), salt water (5% salt), and MIL-A-8243 anti-icing fluid.