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AEROSPACE MATERIAL SPECIFICATION

AMS 3582

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Revised

PLASTIC TUBING, ELECTRICAL INSULATION
Crosslinked Polyvinyl Chloride, Flexible, Heat Shrinkable
2 to 1 Shrink Ratio

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. FORM: Flexible tubing.

3. APPLICATION: Primarily for use as a flexible, electrical insulation tubing whose diameter can be reduced to a predetermined size by heating to a temperature of approximately 175 C (347 F). This material is stable for continuous exposure from -20 C (-4 F) to +105 C (+221 F).

4. COMPOSITION: The material shall be a crosslinked, thermally stabilized, flame-resistant, modified polyvinyl chloride.

5. TECHNICAL REQUIREMENTS:

5.1 Color: Shall be black, unless otherwise ordered.

5.2 Properties: The product shall conform to the requirements of 5.2.1 through 5.2.5 and shall be capable of meeting the requirements of 5.2.6 through 5.2.15. Tests shall be performed in accordance with the issue of specified ASTM methods listed in the latest issue of AMS 2350, insofar as practicable. Unless otherwise specified, tubing shall be tested after being shrunk by heating for 5 min. in a mechanical convection oven which is at 175 C ± 5 (347 F ± 9), with an air velocity of 100 - 200 ft per min. past the tubing, removed from the oven, and cooled to room temperature.

5.2.1	Tensile Strength, psi, min	2000	ASTM D638, Speed D (See Note 1)
5.2.2	Elongation, %, min	200	ASTM D638, Speed D (See Note 1)
5.2.3	Secant Modulus at 2% Strain, psi, min	1.5×10^4	ASTM D882 (See Note 2)
5.2.4	Heat Shock	Pass	Note 3
5.2.5	Flammability	Self-extinguishing within 15 sec	Note 4
5.2.6	Cold Impact	Pass	Note 5
5.2.7	Heat Aging	Pass	Note 6
5.2.8	Corrosion	Pass	Note 7
5.2.9	Solvent Resistance	Pass	Note 8
5.2.10	Fungus Resistance	Pass	Note 9
5.2.11	Restricted Shrinkage	Pass	Note 10
5.2.12	Specific Gravity, max	1.40	ASTM D792

5.2.13	Water Absorption in 24 hr, %, max	1.00	ASTM D570
5.2.14	Dielectric Strength, short time test, v per mil, min	400	ASTM D876
5.2.15	Volume Resistivity, ohm-cm, min	10^{11}	ASTM D257

Note 1. Five specimens, each 4 in. long, shall be tested, using 1 in. bench marks and 1 in. initial jaw separation. The specimens shall be full sections of tubing for sizes 1/4 and smaller and strip specimens not less than 1/4 in. wide cut longitudinally from sizes 3/8 and larger. No metal plugs are necessary when testing full sections of tubing. A specimen break at a bench mark or outside the gage length shall be cause for retest.

Note 2. Five specimens in the expanded form (as supplied), each 12 in. long, shall be tested. The specimens shall be full sections of tubing for sizes 1/4 and smaller and strip specimens not less than 1/2 in. wide cut longitudinally from sizes 3/8 and larger. No metal plugs are necessary when testing full sections of tubing. Initial strain rate shall be 0.1 in. per in. per minute.

Note 3. Three specimens in the expanded form (as supplied), each 6 in. long, shall be conditioned for 4 hr in a mechanical convection oven which is at 200 C ± 5 (392 F ± 9), with an air velocity of 100 - 200 ft per min. past the specimens. While in the oven and after removal from the oven, the specimens shall be examined. Tubing shall not drip, flow, or crack. Also, tubing shall be bent in 2 to 4 sec through 360 deg over a steel mandrel of the diameter shown in Table I. The tubing shall remain free from cracks except that any side cracking caused by flattening of the specimen on the mandrel shall be disregarded.

TABLE I

Size	Diameter of Mandrel, Inch
3/64 to 1/4, incl	5/16
3/8 to 1/2, incl	3/8
3/4 to 2 , incl	7/16

Note 4. Flammability shall be determined in accordance with ASTM D876 except that the bare steel wire used for supporting the specimens during the test shall be 0.020 in. in diameter for tubing sizes 1/16 and smaller. An 8 x 8 in. piece of tissue paper conforming to UU-T-450 shall be suspended taut and centered 9-1/2 in. below the test specimen, a minimum of 1/2 in. from the table top, in such a manner that any dripping particles will fall on the tissue paper. The specimen shall not flow and shall not drop flaming or glowing particles which will ignite the tissue paper. Flaming of the tissue paper shall be cause for rejection.

Note 5. Five specimens prepared in accordance with ASTM D876 and tested as specified in ASTM D746, Procedure B, shall show no cracking at -10 C ± 1 (14 F ± 1.8).

Note 6. Specimens shall be prepared as in Note 1 and shall be conditioned for 400 hr in a mechanical convection oven which is at 130 C ± 2 (266 F ± 3.6), with a maximum air velocity of 50 ft per min. past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for elongation. Specimens shall have elongation of not less than 130%.

Note 7. A specimen of each color of tubing, 6 in. long, shall be slid over a straight, clean, unplated, uninsulated, solid copper conductor. For sizes 1/4 and smaller, a single copper conductor shall be used; for sizes 3/8 and larger, several copper conductors shall be used, each conductor AWG 18 or smaller. The specimens on horizontally suspended conductors shall be conditioned for 168 hr in an oven which is at 136 C ± 2 (276.8 F ± 3.6), with an air velocity of 100 - 200 ft per min. past the specimens. The specimens shall then be removed from the oven, cooled to room temperature and conditioned for 4 hr at 23 C ± 1 (73.4 F ± 1.8) at a relative humidity of 48 - 52%. The tubing shall then be slit open and the copper shall be examined for pitting and blackening. The tubing shall be considered non-corrosive only if the copper is not pitted or blackened. Darkening of the copper due to normal air oxidation shall be disregarded.

Note 8. Tubing shall have tensile strength not lower than 1800 psi and dielectric strength not lower than 300 v per mil after being immersed for 24 hr ± 2 at 23 C ± 3 (73.4 F ± 5.4) in JP-4 fuel, hydraulic oil, aviation gasoline 100/130, salt water (5% salt), and anti-icing fluid. Six specimens (a total of 30), each 6 in. long, shall be immersed in each of the fluids. The volume of the fluid shall be not less than 20 times that of the specimens. After immersion, the specimens shall be lightly wiped, air dried for 30 - 60 min. at room temperature, and subjected to the tensile strength and dielectric tests; three of each group of six specimens shall be tested for tensile strength and the other three for dielectric strength.

Note 9. Fungus resistance shall be determined in accordance with ASTM D1924 except that the incubation period shall be 28 days and the test organisms shall be Aspergillus niger, Aspergillus flavus, Penicillium luteum, and Trichoderma T-1. At the end of the incubation period, not more than traces of growth on the specimen are permissible. Three specimens, each 3 in. long, shall be used for each organism.

Note 10. A specimen in the expanded form (as supplied) shall be shrunk onto a clean metallic mandrel of the configuration and size shown in Fig. 1. The tubing on the mandrel then shall be conditioned for 30 min., in an oven which is at 175 C ± 5 (347 F ± 9), with an air velocity of 100 - 200 ft per min. past the specimen. After conditioning, the tubing shall be visually examined and then shall be subjected to the following voltage withstand test. The tubing shall snugly fit the mandrel and shall not be cracked. The test potential shall be applied between the mandrel and a metal foil electrode wrapped around the largest diameter of the tubing in accordance with ASTM D876. The test potential then shall be applied in accordance with the short-time test of ASTM D149 using 500 v per sec rate of rise. The specimen shall withstand 2000 v for 1 minute.

5.3 Dimensions After Shrinkage:

5.3.1 Diametral: Three specimens in the expanded form (as supplied), each 6 in. long, shall be measured for length and inside diameter. The specimens shall be conditioned for 5 min. in a mechanical convection oven which is at 175 C ± 5 (347 F ± 9), with an air velocity of 100 - 200 ft per min. past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and then remeasured. Longer heating at such temperature shall cause no additional shrinkage. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with Table II. Measurements shall be made in accordance with ASTM D876.

5.3.2 Longitudinal: In reaching its recovered dimensions, the tubing shall not exhibit a longitudinal change greater than +1%, -10%, computed as follows:

$$\% \text{ change} = \frac{\text{Length after heating} - \text{Length before heating}}{\text{Length before heating}} \times 100$$

5.4 Marking: Prior to and after shrinkage, tubing shall be capable of having numbers or characters printed on it with conventional tubing marking techniques.

6. QUALITY: The product shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from imperfections detrimental to fabrication, appearance, or performance of parts.

7. STANDARD SIZES AND TOLERANCES: Unless otherwise specified, tubing shall be supplied in lengths shown in 9.1 and in the standard sizes and tolerances shown in Table II. Tolerances apply at 23 - 30 C (73.4 - 86 F).

TABLE II

Expanded (As Supplied)		Recovered Dimensions (After Heating)		
Size	ID, Inches min	ID, Inch max	Nominal Wall Thickness, Inch	Wall Thickness Tolerance, Inch plus and minus
3/64	0.046	0.023	0.020	0.003
1/16	0.063	0.031	0.020	0.003
3/32	0.093	0.046	0.020	0.003
1/8	0.125	0.062	0.025	0.003
3/16	0.187	0.093	0.025	0.003
1/4	0.250	0.125	0.025	0.003
3/8	0.375	0.187	0.030	0.005
1/2	0.500	0.250	0.030	0.005
3/4	0.750	0.375	0.035	0.005
1	1.000	0.500	0.040	0.005
1-1/2	1.500	0.750	0.045	0.006
2	2.000	1.000	0.050	0.007

8. REPORTS:

8.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report showing the results of tests made on the product to determine conformance to the requirements of 5.2.1 through 5.2.5 and a statement that the product conforms to all other requirements of this specification. This report shall include the purchase order number, material specification number, vendor's compound number, size, color if other than black, and quantity.

8.2 Unless otherwise specified, 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, 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.

9. PACKAGING:

9.1 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. Unless otherwise specified, standard packages shall contain the following quantities:

Size	Quantity, ft
3/64, 1/16	500
3/32, 1/8, 3/16, 1/4, 3/8	200
1/2, 3/4, 1, 1-1/2	100
2	50

9.2 Each package shall be permanently and legibly marked with the AMS number, size, color if other than black, quantity, purchase order number, manufacturer's identification, and date of manufacture.