



AEROSPACE MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

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AMS 3634

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Revised

PLASTIC TUBING, ELECTRICAL INSULATION Polyolefin, Dual Wall, Semi-Rigid, Heat Shrinkable

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.
2. **FORM:** Dual wall semi-rigid tubing.
3. **APPLICATION:** 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 material is stable for continuous exposure at -55 C (-67 F) to 110 C (230 F).
4. **COMPOSITION:** The material shall be a thermally stabilized, modified polyolefin, selectively cross-linked by irradiation to provide a nonmeltable, shrinkable outer wall and an inner wall capable of melting and adhering to itself.
5. **TECHNICAL REQUIREMENTS:**
 - 5.1 **Color:** The tubing shall be furnished in the colors specified in Table II. Unless otherwise specified, the colors shall be in accordance with MIL-STD-104.
 - 5.2 **Properties:** The product shall conform to the requirements of 5.2.1 through 5.2.4 and shall be capable of meeting the requirements of 5.2.5 through 5.2.14. 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 in the expanded form (as supplied).

5.2.1 Tensile Strength, psi, min	1500	ASTM D638, Speed C (See Note 1)
5.2.2 Elongation, %, min	200	ASTM D638, Speed C (See Note 1)
5.2.3 Flow of Inner Wall	Pass	Note 2
5.2.4 Heat Shock	Pass	Note 3
5.2.5 Low Temperature Brittleness	Pass	Note 4
5.2.6 Heat Aging	Pass	Note 5
5.2.7 Corrosion	Pass	Note 6
5.2.8 Color Stability	Pass	Note 7
5.2.9 Solvent Resistance	Pass	Note 8
5.2.10 Fungus Resistance	Pass	Note 9
5.2.11 Specific Gravity, max	0.99	ASTM D792, Method A

5.2.12	Water Absorption in 24 hr, %, max	0.10	ASTM D570
5.2.13	Dielectric Withstand, v, min	2500	Note 10
5.2.14	Volume Resistivity, ohm-cm, min	10^{15}	ASTM D257

Note 1. Five specimens, each 4 in. in length, 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. Three specimens, each 6 in. in length, shall be conditioned for 3 min. in a mechanical convection oven which is at $200\text{ C} \pm 5$ ($392\text{ F} \pm 9$), with an air velocity of 100 - 200 ft per min. past the specimens. Within 5 sec after conditioning, 1/4 in. of one end shall be lightly pressed together with a pair of needle nose pliers. The specimens shall be removed from the pliers and cooled to room temperature. The specimens then shall be replaced for 5 min. in the mechanical convection oven at $200\text{ C} \pm 5$ ($392\text{ F} \pm 9$). After heating, the specimen shall be removed, cooled to room temperature, and examined to assure that there are no openings through the pressed portion.

Note 3. Three specimens, each 4 in. in length, shall be conditioned for 4 hr in a mechanical convection oven which is at $250\text{ C} \pm 5$ ($482\text{ F} \pm 9$), 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 visually examined. The outer wall of the tubing shall not drip, flow, or crack.

Note 4. The specimens shall be prepared and tested in accordance with ASTM D746, Procedure B. These specimens shall show no cracking at $-55\text{ C} \pm 2$ ($-67\text{ F} \pm 3.6$).

Note 5. Three specimens, each 6 in. in length, shall be conditioned on aluminum foil for 168 hr in a mechanical convection oven which is at $175\text{ C} \pm 3$ ($347\text{ F} \pm 5.4$), with an air velocity of 100 - 200 ft per min. past the specimens. After conditioning, the specimens shall be removed from the oven and cooled to room temperature. The specimens then shall be wrapped not less than 180 deg about the mandrel selected in accordance with Table 1. Any side cracking caused by flattening of the specimen on the mandrel shall be disregarded.

TABLE I

Size	Diameter of Mandrel, Inch
1/8 to 1/4, incl	7/16
3/8 to 3/4, incl	1/2
300	1/2

Note 6. A specimen 1 in. in length (a 1/4 in. wide strip cut from sizes 1/2 and 3/4), shall be placed in the bottom of each of two clean 1/2 in. x 12 in. test tubes. A third test tube shall be used for control. A copper-glass mirror about 1/4 in. wide x 1 in. long shall be suspended 6 - 7 in. above the bottom of each tube by fine copper wire attached to a silicone rubber stopper wrapped in aluminum foil. The mirrors shall be vacuum-deposited copper, on one side only, with a thickness equal to $10\% \pm 5$ transmission of normal incident light of 5000 Angstroms. The coated mirrors shall be stored in vacuum and may be used for test only if no oxide film is present and the copper is not visibly damaged. The three test tubes shall be tightly sealed. The lower 2 in. of each tube shall be placed in an oven or oil bath at $121\text{ C} \pm 2$ ($250\text{ F} \pm 3.6$) for 16 hours. After cooling, the mirrors shall be examined in a good light against a white background. The copper shall not have been removed from a mirror leaving an area of transparency greater than 5% of the total area. Discoloration of the copper film shall not be considered corrosion.

- Note 7. Three specimens, each 4 in. in length, of each color shall be conditioned for 24 hr in a mechanical convection oven which is at $175\text{ C} \pm 3$ ($347\text{ F} \pm 5.4$), 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 determined to be within the limits of MIL-STD-104.
- Note 8. Tubing shall have tensile strength not lower than 1000 psi and shall withstand 2000 v for 1 min. after being immersed for 24 hr ± 2 at $23\text{ C} \pm 3$ ($73.4\text{ F} \pm 5.4$) in JP-4 Fuel, SAE phosphate ester test fluid No. 1, hydraulic oil, aviation gasoline 100/130, and water. The 2000 v shall be applied in accordance with the short-time test of ASTM D149 using a 500 v per sec rate of rise. Six specimens (a total of 30), each 6 in. in length, 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 strength 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 specimens are permissible. Three specimens, each 3 in. long, shall be used for each organism.
- Note 10. Five specimens, each 6 in. in length, shall be prepared in accordance with ASTM D876, sizes no. 20 to 1/2 in., inclusive. The required voltage then shall be applied in accordance with the short-time test of ASTM D149 using a 500 v per sec rate of rise. The specimens shall withstand 2500 v for 1 min.

5.3 Dimensions After Shrinkage:

- 5.3.1 Diametral: Three specimens, each 6 in. in length, shall be conditioned on mandrels having diameters equal to the maximum inside diameter of recovered tubing as specified in Table II, $+ 0.000$, $- 0.002$ in. or 2%, whichever is greater, for 10 min. in a mechanical convection oven which is at $200\text{ C} \pm 5$ ($392\text{ F} \pm 9$), 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 inspected for wall thickness in accordance with ASTM D876. Dimensions shall be in accordance with Table II. If air space is visible between the specimen and the mandrel, the specimen shall be removed from the mandrel and remeasured for inside diameter and wall thickness per ASTM D876.
- 5.3.2 Longitudinal: Three specimens, each 6 in. in length, shall be measured for length $\pm 1/32$ in. The specimen shall then be conditioned for 3 min. in a mechanical convection oven which is at $200\text{ C} \pm 5$ ($392\text{ F} \pm 9$), with an air velocity of 100 - 200 ft per min. past the specimens. After conditioning, the specimens shall be removed from the oven and cooled at room temperature for at least 30 sec and then remeasured in accordance with ASTM D876. 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 or 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 of 48 in., $+ 1$, $- 0$, and in the standard sizes, colors, and tolerances shown in Table II. Tolerances apply at 23 - 30 C ($73.4 - 86\text{ F}$).

TABLE II

Expanded (As Supplied)		Recovered Dimensions (After Heating)				
Color	Size	ID, Inch min	ID, Inch max	Nominal Total Wall Thickness Inch	Total Wall Thickness Tolerance, Inch plus and minus	Nominal Melttable Wall Inch
Brown	1/8	0.125	0.023	0.038	0.006	0.020
Gray	3/16	0.187	0.060	0.043	0.006	0.025
White	1/4	0.250	0.080	0.047	0.006	0.027
Red	3/8	0.375	0.135	0.050	0.007	0.030
Blue	1/2	0.500	0.195	0.055	0.007	0.035
Yellow	3/4	0.750	0.313	0.065	0.007	0.040
Blue	300	0.300	0.050	0.100	0.008	0.065

8. REPORTS:

- 8.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report stating that the product conforms to the requirements of this specification. This report shall include the purchase order number, material specification number, vendor's compound number, size, color, 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
1/8	200
3/16, 1/4, 3/8	100
1/2	48
3/4, 300	24

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