SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3648B

Issued JUL 1957
Revised JAN 1991
Reaffirmed MAR 2003

Superseding AMS 3648A

Tubing, Polychlorotrifluoroethylene (PCTFE) Unplasticized

FOREWORD

Changes in this reaffirm are format/editorial only.

1. SCOPE:

1.1 Form:

This specification covers a 100% homopolymer of polychlorotrifluoroethylene, (PCTFE) in the form of thin wall tubing.

1.2 Application:

Primarily for electrical and electronic applications requiring a chemically-inert tubing of the fluorocarbon family, having high dielectric strength and volume resistivity and being free from pinholes and electrical flaws, for use up to 165 °C (329 °F).

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 149 Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 374 Thickness of Solid Electrical Insulation

ASTM D 618 Conditioning Plastics and Electrical Insulating Materials for Testing
ASTM D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 876 Testing Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation
ASTM D 1430 Polychlorotrifluoroethylene (PCTFE) Plastics

2.2 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Shall be manufactured from virgin, unplasticized, 100% homopolymer polychlorotrifluoroethylene (PCTFE).

3.2 Color:

Shall be natural (unpigmented) and may vary from transparent to translucent.

3.3 Properties:

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

3.3.1	Tensile Strength at 23 °C ±1 (73 °F ± 2), minimum	4500 psi (31.0 MPa)	4.5.1
3.3.2	Elongation at 23 °C ± 1 (73 °F ± 2), minimum	100%	4.5.1
3.3.3	Insulation Resistance at 23 °C ± 1 (73 °F ± 2) and 500 volts DC, minimum	1.0×10^7 megohm per foot (3.05×10^7 megohm/m)	ASTM D 876

3.3.4	Penetration at 165 °C ± 1 (329 °F ± 2) [Start test at 100 °C (212 °F)]	None	ASTM D 876
3.3.5	Dielectric Strength at 23 °C ± 1 (73 °F ± 2), minimum	450 volts/mil (17,717 v/mm)	4.5.2
3.3.6	Heat Resistance (weight loss) at 165 °C ± 1 (329 °F ± 2), maximum	1.0%	ASTM D 876, Method B
3.3.7	Stress Relief (shrinkage) at 165 °C ± 1 (329 °F ± 2), maximum	1.0%	ASTM D 876
3.3.8	Specific Gravity at 23/23 °C (73/73 °F)	2.08 - 2.18	ASTM D 792, Method A
3.3.9	Zero Strength Time at 250 °C ± 2 (482 °F ± 4), minimum	100 seconds	ASTM D 1430

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:

The following sizes are standard and the following tolerances apply; measurements shall be made at 20 to 30°C (68 to 86 °F) in accordance with ASTM D 374, Method C:

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of tubing shall supply all samples for vendor's test and shall be responsible for performing all required tests. 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: Test for tensile strength (3.3.1), elongation (3.3.2), dielectric strength (3.3.5), specific gravity (3.3.8), zero strength time (3.3.9), and sizes and tolerances (3.5) are acceptance tests and shall be performed on each lot.

TABLE I

Inside Diameter, Inches Nominal	Inside Diameter, Inches Minimum	Inside Diameter, Inches Maximum	Wall Thickness, Inch Nominal	Wall Thickness Inch Tolerance, plus and minus
0.023	0.020	0.027	0.008	0.002
0.026	0.023	0.030	0.008	0.002
0.028	0.025	0.032	0.008	0.002
0.032	0.029	0.036	0.008	0.002
0.036	0.032	0.040	0.008	0.002
0.040	0.036	0.044	0.008	0.002
0.044	0.040	0.049	0.008	0.002
0.049	0.045	0.054	0.009	0.002
0.056	0.051	0.061	0.009	0.002
0.062	0.057	0.067	0.009	0.002
0.069	0.064	0.074	0.009	0.002
0.077	0.072	0.082	0.009	0.002
0.086	0.081	0.091	0.010	0.002
0.096	0.091	0.101	0.010	0.002
0.107	0.102	0.112	0.010	0.002
0.119	0.114	0.124	0.010	0.002
0.134	0.128	0.141	0.010	0.002
0.151	0.144	0.158	0.011	0.002
0.170	0.162	0.178	0.011	0.002
0.191	0.182	0.198	0.011	0.002
0.214	0.204	0.224	0.011	0.002
0.239	0.229	0.249	0.011	0.002
0.268	0.258	0.278	0.012	0.002
0.300	0.289	0.311	0.012	0.002
0.323	0.313	0.334	0.012	0.002
0.336	0.325	0.347	0.013	0.002
0.387	0.375	0.399	0.015	0.002
0.451	0.438	0.464	0.018	0.003
0.515	0.500	0.530	0.020	0.003
0.643	0.625	0.662	0.025	0.003
0.772	0.750	0.795	0.030	0.004
0.901	0.875	0.927	0.035	0.004
1.030	1.000	1.060	0.035	0.004
1.287	1.250	1.325	0.040	0.005

TABLE I (SI)

Inside Diameter, Millimeters Nominal	Inside Diameter, Millimeters Minimum	Inside Diameter, Millimeters Maximum	Wall Thickness, Millimeter Nominal	Wall Thickness, Millimeter Tolerance, plus and minus
0.58	0.51	0.69	0.20	0.05
0.66	0.58	0.76	0.20	0.05
0.71	0.64	0.81	0.20	0.05
0.81	0.74	0.91	0.20	0.05
0.91	0.81	1.02	0.20	0.05
1.02	0.91	1.12	0.20	0.05
1.12	1.02	1.24	0.20	0.05
1.24	1.14	1.37	0.23	0.05
1.42	1.30	1.55	0.23	0.05
1.57	1.45	1.70	0.23	0.05
1.75	1.63	1.88	0.23	0.05
1.96	1.83	2.08	0.23	0.05
2.18	2.06	2.31	0.25	0.05
2.44	2.31	2.57	0.25	0.05
2.72	2.59	2.84	0.25	0.05
3.02	2.90	3.15	0.25	0.05
3.40	3.25	3.58	0.25	0.05
3.84	3.66	4.01	0.28	0.05
4.32	4.11	4.52	0.28	0.05
4.85	4.62	5.03	0.28	0.05
5.44	5.18	5.69	0.28	0.05
6.07	5.82	6.32	0.28	0.05
6.81	6.55	7.06	0.30	0.05
7.62	7.34	7.90	0.30	0.05
8.20	7.95	8.48	0.30	0.05
8.53	8.26	8.81	0.33	0.05
9.83	9.52	10.13	0.38	0.05
11.46	11.13	11.79	0.46	0.08
13.08	12.70	13.46	0.51	0.08
16.33	15.88	16.81	0.64	0.08
19.61	19.05	20.19	0.76	0.10
22.89	22.22	23.55	0.89	0.10
26.16	25.40	26.92	0.89	0.10
32.69	31.75	33.66	1.02	0.13

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the tubing to a purchaser, when a change in ingredients and/or processing 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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

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 A lot shall be all tubing produced in a single production run from the same batch of raw material and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 pounds (227 kg). A lot may be packaged in smaller quantities and delivered under the basic lot approval provided lot identification is maintained.

4.3.1.2 When a statistical sampling plan has 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 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 ingredients and/or processing and, when requested, sample tubing. Production tubing made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Tensile Strength and Elongation: Shall be determined in accordance with ASTM D 876 except use a jaw separation rate of 1.0 inch (25 mm) per minute.