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AEROSPACE MATERIAL SPECIFICATION



AMS 3598D

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Superseding AMS 3598C

Submitted for recognition as an American National Standard

PLASTIC SHEET, COPPER FACED, GTN Glass Fabric Reinforced Polytetrafluoroethylene

1. SCOPE:

1.1 Form:

This specification covers polytetrafluoroethylene-impregnated glass laminates in the form of sheet clad on one or both sides with electrolytically deposited copper foil.

1.2 Application:

This sheet has been used typically in etched, printed circuits for electrical and electronic equipment where continuous operating temperature will not exceed 205 °C (401 °F), but usage is not limited to such applications.

1.3 Classification:

This specification covers two classes of copper-clad polytetrafluoroethylene/glass laminates; the class supplied and the weight of the copper foil, shall be as specified on the drawing or purchase order:

- Class 1: Copper clad on one face
- Class 2: Copper clad on both faces

1.4 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.

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AMS 3598D

SAE

AMS 3598D

2. APPLICABLE DOCUMENTS:

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

2.1 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 149	Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 150	A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials
ASTM D 229	Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D 495	High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D 570	Water Absorption of Plastics
ASTM D 618	Conditioning Plastics and Electrical Insulating Materials for Testing
ASTM D 709	Laminated Thermosetting Materials
ASTM D 790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 790M	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials (Metric)

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-C-81302	Cleaning Compound, Solvent, Trichlorotrifluoroethane
MIL-STD-2073-1	DOD Materiel, Procedures for Development and Application of Packaging Requirements

2.3 The Institute for Interconnecting and Packaging Electronic Circuits (IPC) Publications:

Available from IPC, 7380 North Lincoln Avenue, Lincolnwood, IL 60646.

IPC-CF-150	Copper Foil for Printed Wiring Applications
IPC-S-804	Solderability Test Methods for Printed Wiring Boards

3. TECHNICAL REQUIREMENTS:**3.1 Material and Fabrication:**

Sheets shall be constructed of laminations of glass cloth thoroughly impregnated with a polytetrafluoroethylene resin and sintered. Face sheets of copper may be applied to one or both faces during the original sintering of the laminate or in subsequent operation.

AMS 3598D

SAE

AMS 3598D

3.1.1 Color: Shall be natural.

3.1.2 Copper Faces: Shall be IPC-CF-150, Class 1, electrolytically-deposited copper foil.

3.1.3 Designations: Sheet shall be designated according to the following numbering system:
(R)

Material, GTN

Copper foil weight, ounces per square foot (kg/m^2)

Base laminate (without metal cladding) thickness, inch (mm)

Tolerance class, N for normal or C for close

Number of sides laminated with copper foil

Example: GTN1-0.125N-2 (GTN0.3-3.18N-2)

GTN = Glass fabric with polytetrafluoroethylene resin, natural color

1 = One ounce per square foot (0.3 kg/m^2) copper, 0.0014 inch (0.036 mm) thick

0.125 = Nominal base laminate thickness without cladding of 0.125 inch (3.18 mm)

N = Normal thickness tolerance

2 = Copper foil on two sides

3.2 Properties:

Sheet shall conform to the requirements in Table 1, Table 2, Table 3, and Table 4; tests shall be performed on the sheet supplied and in accordance with the specified test methods, insofar as practicable. Specimens shall be conditioned in accordance with ASTM D 618, Procedure A, prior to being tested. For specimens requiring removal of copper faces before testing (See 4.5.1), the conditioning shall follow removal of the copper. Where requirements vary with thickness, use the value for the next lower specified thickness for thicknesses not specified.

3.2.1 Dielectric strength, perpendicular to laminations (when specified), short time test, shall be as shown in Table 1, determined in accordance with ASTM D 149.

TABLE 1A - Minimum Dielectric Strength, Inch/Pound Units

Base Laminate Thickness Inch	Dielectric Strength Volts/mil
Up to 0.032, incl	800
Over 0.032 to 0.046, incl	740
Over 0.046 to 0.062, incl	700
Over 0.062 to 0.093, incl	640
Over 0.093 to 0.125, incl	600
Over 0.125 to 0.156, incl	560
Over 0.156 to 0.187, incl	540
Over 0.187 to 0.250, incl	500

AMS 3598D

SAE

AMS 3598D

TABLE 1B - Dielectric Strength, SI Units

Base Laminate Thickness Millimeters	Dielectric Strength kV/mm
Up to 0.81, incl	31.5
Over 0.81 to 1.17, incl	29.1
Over 1.17 to 1.57, incl	27.6
Over 1.57 to 2.36, incl	25.2
Over 2.36 to 3.18, incl	23.6
Over 3.18 to 3.96, incl	22.0
Over 3.96 to 4.75, incl	21.3
Over 4.75 to 6.35, incl	19.7

TABLE 2 - Properties

Property	Requirement	Test Method
3.2.2 Dielectric Strength, parallel to laminations, Stepwise Test, min (Applicable only to base laminate thickness of 0.020 inch (0.51 mm) and above.		ASTM D 229
3.2.2.1	32 kV/inch (1.26 kV/mm)	
3.2.2.2 After 48 hours immersion in distilled water at 50 °C ± 2 (122 °F ± 4)	10 kV/inch (0.39 kV/mm)	
3.2.3 Permittivity at 1 MHz, max	2.9	ASTM D 150
3.2.4 Power Factor at 1 MHz, max	0.0006	ASTM D 150
3.2.5 Arc Resistance, min	150 seconds	ASTM D 495
3.2.6 Insulation Resistance, min	100 Megohms	4.5.2
3.2.7 Flexural Strength, flatwise, min		ASTM D 790 or ASTM D 790M
3.2.7.1 Lengthwise	13.0 ksi (89.6 MPa)	
3.2.7.2 Crosswise	11.0 ksi (75.8 MPa)	

AMS 3598D

SAE

AMS 3598D

TABLE 2 - Properties (Continued)

	Property	Requirement	Test Method
3.2.8	Compressive Strength flatwise, min	19.0 ksi (131 MPa)	ASTM D 229
3.2.9	Solder Bath Resistance	No softening, splitting, blistering, or delamination	4.5.3
3.2.10	Solvent Resistance	No softening, blistering, or lifting of base laminate and residual surface adhesive	4.5.4
3.2.11	Heat Resistance	No blistering	4.5.5
3.2.12 (R)	Copper Porosity	No more than three resin spots spaced not less than 1 inch (25 mm) apart for each 18 x 18 inch (457 x 457 mm) square area. No resin spot with an included area larger than a 0.015 inch (0.38 mm) diameter circle	4.5.6

3.2.13 Peel strength, as received and after solder bath resistance, shall be as shown in Table 3, determined in accordance with 4.5.7.

TABLE 3A - Minimum Peel Strength, Inch/Pound Units

Nominal Foil Weight oz/ft ²	Nominal Foil Thickness Inch	Peel Strength Pounds Force per Inch Width
1.00	0.0014	4
2.00	0.0028	5

AMS 3598D

SAE

AMS 3598D

TABLE 3B - Minimum Peel Strength, SI Units

Nominal Foil Weight kg/m ²	Nominal Foil Thickness mm	Peel Strength Newtons per Meter Width
0.31	0.036	701
0.61	0.071	876

3.2.14 Water absorption in 24 hours, for base laminate thickness shall be as shown in Table 4; determined in accordance with ASTM D 570.

TABLE 4 - Maximum Water Absorption

Base Laminate Thickness Inch	Base Laminate Thickness mm	Weight Gain %
Up to 0.032, incl	Up to 0.81, incl	0.25
Over 0.032 to 0.062, incl	Over 0.81 to 1.57, incl	0.15
Over 0.062 to 0.250, incl	Over 1.57 to 6.35, incl	0.10

3.2.15 Solderability: When laminates are tested as specified in 4.5.8, the metal clad surfaces shall wet (R) when soldered; dewetting shall not exceed 5% of the surface of specimen.

3.3 Quality:

Sheet, as received by purchaser, shall be uniform in quality and condition and free from blisters, cracks, holes, cuts, wrinkles, delamination, unbonded areas, corrosion, excess bonding material, and other imperfections detrimental to usage of the sheet. Discoloration of the copper faces shall not be considered objectionable. The bonded copper faces shall be of such smoothness not to reveal visible evidence of the underlying glass fabric weave.

3.4 Tolerances:

3.4.1 Length and Width: Shall not vary more than +1.0 inch (+25 mm), -0, from length and width ordered except where test specimens have been removed.

3.4.2 Copper Weight and Thickness:

3.4.2.1 Copper face standard weight tolerances shall be as shown in Table 5.
(R)