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Flexible Base Dielectrics for Use in Flexible Printed Circuitry

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A standard developed by IPC

Association Connecting Electronics Industries



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Flexible Base Dielectrics for Use in Flexible Printed Circuitry

Developed by the Flexible Circuits Base Materials Subcommittee (D-13)
of the Flexible Circuits Committee (D-10) of IPC

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Users of this publication are encouraged to participate in the
development of future revisions.

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Flexible Base Dielectrics for Use in Flexible Printed Circuitry

1 SCOPE

This standard establishes the classification system, the qualification and quality conformance requirements for flexible base dielectric materials to be used for the fabrication of flexible printed circuitry and flexible flat cable. This specification supersedes IPC-4202 which, in turn superseded IPC-FC-231C and the requirements herein meet or exceed the requirements for Class 3 in this superseded document. Note that conformance to Class 3 met or exceeded conformance to Classes 1 and 2. IPC-4202 no longer utilizes the 3-class system.

1.1 Classification System The system described in 1.1.1 through 1.1.2.4 identifies flexible base dielectrics.

1.1.1 Nonspecific Designation A nonspecific designation is intended for use by *designers* on master drawings to designate their material choice. At the end of this standard is a series of material specification sheets identified by specification sheet numbers. Each sheet outlines engineering and performance data for a flexible base dielectric, indicating base material type and method of reinforcement.

Example of nonspecific designation: *IPC-4202/1*, Where “1” refers to the specification sheet detailing unsupported polyimide flexible base dielectrics.

If further material specification details (such as dielectric thickness) are required, they should be highlighted in cross sectional views or notes on the master drawing.

1.1.2 Specific Designation The specific designation **should** be in the form shown in the following example, and is intended for use on material purchase orders by **fabricators** (see 6.1). The specific designation should not be used by designers on master drawings to indicate their material selection. Master drawings **shall** indicate the material design by designers on master drawings to indicate their material selection, as the designation is lengthy and requires fabricator level knowledge in making the detailed selections.

Example of specific designation:

IPC-4202/1 -E1E2

Where:

IPC-4202/1 – Nonspecific Designation (see 1.1.1), for unsupported polyimide flexible base dielectrics.

E – Base Dielectric Material Type Designation (see 1.1.2.1), specifying polyimide.

1 – Reinforcement Method Designation (see 1.1.2.2), specifying non-reinforced.

E – Reinforcement Type Designation (see 1.1.2.3), specifying non-reinforced.

2 – Base Dielectric Material Thickness Designation (see 1.1.2.4), specifying 50 μm [1970 μin] thickness.

1.1.2.1 Base Dielectric Material Type The type of dielectric material **shall** be designated per Table 1-1.

Table 1-1 Base Dielectric Type Designation

Designation	Base Dielectric Type
A	Polyvinylfluoride (PVF)
B	Polyethylene Terephthalate Polyester (PET)
C	Fluorinated Ethylene-Propylene Copolymer (FEP)
D	Polytetrafluorethylene (PTFE)
E	Polyimide
F	Aramid
G	Polyamide-imide
H	Epoxy
J	Polyetherimide
K	Polysulfone
L	Polyethylene Naphthalate (PEN)
M	Thermotropic Liquid Crystal Polymer

1.1.2.2 Reinforcement Method The reinforcement method **shall** be designated per Table 1-2.

Table 1-2 Reinforcement Method Designation

Designation	Reinforcement Method
1	Non-reinforced
2	Nonwoven reinforcement
3	Woven reinforcement
4	Combination woven and nonwoven reinforcement

1.1.2.3 Reinforcement Type The reinforcement type **shall** be designated per Table 1-3.

Table 1-3 Reinforcement Type Designation

Designation	Reinforcement Type
A	Glass
B	Polyester
C	Aramid
D	Cellulose
E	Film (non-reinforced)

Note: Combinations will use two letters separated by slash.

1.1.2.4 Base Dielectric Material Thickness The base material thickness **shall** be designated per Table 1-4.

Table 1-4 Nominal Dielectric Thickness Designation

Designator	Thickness*
1	25 µm [980 µin]
2	50 µm [1970 µin]
3	75 µm [2950 µin]
4	100 µm [3940 µin]
5	125 µm [4920 µin]
A	2.5 µm [100 µin]
B	5 µm [200 µin]
C	7.5 µm [300 µin]
D	10 µm [390 µin]
E	12.5 µm [490 µin]
F	15 µm [590 µin]
H	18 µm [710 µin]
J	20 µm [790 µin]
K	23 µm [910 µin]
L	38 µm [1500 µin]
X	Specified on purchase order

*See 3.6.4.

1.2 Qualification The flexible base dielectric materials that meet all the requirements of this standard **shall** be qualified products (see 4.8).

1.3 Quality Conformance This standard establishes a quality conformance system for the suppliers to demonstrate the continual conformance of a flexible base dielectric material to the quality requirements of the standard. See 4.9 for quality conformance inspection requirements.

1.4 Material Characteristics The flexible materials made to this standard use established requirements to enable the material to be applied in a broad range of applications. Materials made to this standard may have characteristics that provide specific enhanced performance. Both the user and supplier should review these enhancements. These enhancements may meet or exceed the specification requirements and will be as designated in the purchasing documentation, AABUS.

1.5 New Materials The flexible base dielectrics contained in this standard represent known materials. As new materials become available, they will be added to future revisions. Users and material developers are encouraged to supply information on new flexible materials using the blank specification sheet at end of this standard for review by the IPC Flexible Circuits Base Materials Subcommittee (D-13). Users who wish to invoke this standard for flexible materials not listed **shall** list a zero for the specification sheet number (i.e., IPC-4202/0).

New or revised specification sheets may become approved by the committee independent from revision of the standard. When this occurs, the new or revised specification sheet **shall** become part of the standard. Per 6.1, the specification sheet revision date **shall** be specified in the order.

2 APPLICABLE DOCUMENTS

The following documents of the issue currently in effect form a part of this standard to the extent specified herein.

2.1 IPC¹

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-TM-650 Test Methods Manual²

- 2.1.13 Inspection for Inclusions and Voids in Flexible Printed Wiring Materials
- 2.2.4 Dimensional Stability, Flexible Dielectric Materials
- 2.3.2 Chemical Resistance of Flexible Printed Wiring Materials
- 2.4.16 Initiation Tear Strength, Flexible Insulating Materials
- 2.4.17.1 Propagation Tear Strength, Flexible Insulating Material
- 2.4.19 Tensile Strength and Elongation, Flexible Printed Wiring Materials
- 2.5.5.3 Permittivity (Dielectric Constant) and Loss Tangent (Dissipation Factor) of Materials (Two Fluid Cell Method)
- 2.5.5.5 Stripline Test Method for Permittivity and Loss Tangent (Dielectric Constant and Dissipation Factor) at X-Band
- 2.5.5.9 Permittivity and Loss Tangent, Parallel Plate 1 MHz to 1.5 GHz
- 2.5.17 Volume Resistivity and Surface Resistance of Printed Wiring Materials
- 2.6.1 Fungus Resistance Printed Wiring Materials
- 2.6.2 Moisture Absorption, Flexible Printed Wiring

IPC-9191 General Requirements for Implementation of Statistical Process Control

2.2 American Society for Testing and Materials (ASTM)³

ASTM D-149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

1. www.ipc.org

2. Current and revised IPC Test Methods are available on the IPC Web site (www.ipc.org/html/testmethods.htm)

3. www.astm.org

ASTM D-374 Standard Test Methods for Thickness of Solid Electrical Insulation

ASTM D-2520 Standard Test Methods for Complex Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials at Microwave Frequencies and Temperatures to 1650 °C

2.3 Underwriters Laboratories Standards⁴

UL 94 Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 746B Polymeric Materials - Long Term Property Evaluations

2.4 NCSL International⁵

ANSI/NCSL Z 540.1 Calibration Laboratories and Measuring and Test Equipment - General Requirements

2.5 ISO⁶

ISO 10012-1 Quality Assurance Requirements For Measuring Equipment - Part 1: Metrological Confirmation System For Measuring Equipment

3 REQUIREMENTS

3.1 Terms and Definitions The definition of terms **shall** be in accordance with IPC-T-50.

3.2 Specification Sheets The individual item requirements **shall** be as specified herein and in accordance with the applicable specification sheets. Where there is no specification sheet available, the individual requirements **shall** be as specified in complimentary documents such as master drawings or ordering data sheets (see 6.1).

New or revised specification sheets may become approved by the committee independent from revision of the standard. When this occurs, the new or revised specification sheet **shall** become part of the standard, issued as an Amendment.

3.3 Conflict In the event of conflict, the following order of precedence **shall** apply:

1. Purchase order.
2. Master drawing (see 6.1D).
3. Specification sheets of this standard.
4. Other sections of this standard.
5. Applicable documents (see Section 2).

3.4 Materials Requirements The flexible base dielectrics **shall** be free from deleterious substances and formulated or prepared to meet the requirements of this standard.

3.4.1 Sheet Material Each sheet of flexible base dielectric material **shall** meet the requirements of 3.5 through 3.11.

3.4.2 Roll Material Each roll of flexible base dielectric material **shall** meet the requirements of 3.5 through 3.11. Defects are allowed such that the total of all defective areas **shall not** exceed 5% of the total roll area (roll length x roll width). Each defect area **shall** be defined in a 60 cm x 60 cm [23.6 in x 23.6 in] increment and suitably marked or flagged. Each defect area may contain single or multiple defects which are constrained within a square no larger than 30 cm x 30 cm [11.8 in x 11.8 in] centered within the defect area. If multiple defects are spaced such that they cannot be contained with a single 30 cm x 30 cm [11.8 in x 11.8 in] area, then more than one 60 cm x 60 cm [23.6 in x 23.6 in] defect area **shall** be marked or flagged on the roll or identified AABUS.

3.5 Visual Requirements When tested in accordance with the following paragraphs, the material **shall** meet the visual requirements specified in 3.5.1 through 3.5.5. Any defect within 6.5 mm [0.256 in] from the outside edges of the sheet or roll **shall** be disregarded.

The entire test specimen (sample unit per 4.9.2) **shall** be examined with normal or corrected 20/20 (also termed 6/6 or 1.0) vision for the requirements. If inclusions are seen, the worst appearing 50 mm x 50 mm [1.97 in x 1.97 in] area **shall** be examined with 10X magnification to determine the size of the inclusions. If no inclusions are seen with normal or corrected 20/20 (also termed 6/6 or 1.0) vision, the entire specimen **shall** be recorded as having no defects against the requirements of 3.5.3.

3.5.1 Marking Each material **shall** have a unique lot number traceable to all raw materials and processing parameters. Each package **shall** contain evidence of compliance.

3.5.2 Wrinkles, Creases, Streaks and Scratches The depth of scratches and height of streaks **shall** be measured with a surface profilometer capable of measuring to 4 µm [160 µin] (see IPC-TM-650, Method 2.4.15).

The material **shall** be free of wrinkles and creases. Streaks and scratches are addressed by the following: For material that is ≥12.5 microns nominal thickness, rejectable

4. www.ul.com

5. www.ncsli.org

6. www.iso.org

