



DuPont Electronic Materials

Flexible Circuit Materials

# Pyralux® FR™ Copper-Clad Laminates

Flexible Composites

## Description

Pyralux® FR™ copper-clad laminate is a composite of DuPont Kapton® polyimide film with copper foil on one or both sides, bonded together with a proprietary, flame-retardant, C-staged acrylic adhesive. Pyralux® FR™ flexible composites are recommended for use in single-sided, double-sided, multilayer, and rigid-flex circuits that require flame retardancy. All copper-clad laminates are available with rolled, annealed copper or electro-deposited copper. In addition, both types are available with double-treated copper (nodules of electro-deposited copper on both sides of the copper foil). Double-treated copper, if used, eliminates surface preparation steps prior to resist or coverlay lamination.

## Construction

Copper-clad laminates are available in a variety of film thicknesses and copper weights. **Tables 1** and **2** list typical constructions.

The product code must be used when ordering copper-clad laminates from DuPont.

## Packaging

Pyralux® FR™ copper-clad laminates are supplied in 24 in (610 mm) by 36 in (914 mm) sheets. There is a minimum of four sheets and a maximum of 25 sheets per pack.

## Typical Data

Each manufactured lot, except the laminate constructions noted in **Tables 1** and **2**, is certified to IPC specifications and tested according to IPC Test Method TM-650. See **Table 3**.

A Certificate of Compliance (COC) is available with every batch. Complete material and manufacturing records for each lot, with samples of finished laminate, are retained for reference purpose. The roll labels contain the lot number, DuPont order number, customer order number, IPC specification, customer specification, and customer part number; save these labels for reference in case of inquiries.

**Table 1**  
Single-Sided Copper-Clad Product Codes

Product Code*	Copper oz/ft <sup>2</sup> (g/m <sup>2</sup> )	Adhesive mil (μm)	Kapton® mil (μm)	IPC Cert.†
FR9110	1 (305)	1 (25)	1 (25)	Yes
FR9120	1 (305)	1 (25)	2 (51)	Yes
FR9130	1 (305)	1 (25)	3 (76)	Yes
FR9150	1 (305)	1 (25)	5 (127)	Yes
FR9210	2 (610)	1 (25)	1 (25)	Yes
FR9220	2 (610)	1 (25)	2 (51)	Yes
FR7012	1/2 (153)	1/2 (13)	1/2 (13)	No
FR7002	1 (305)	1/2 (13)	1/2 (13)	No
FR7062	1/2 (153)	1/2 (13)	1 (25)	No
FR7011	1 (305)	1/2 (13)	1 (25)	Yes
FR7008	2 (610)	1/2 (13)	1 (25)	Yes
FR7092	1 (305)	1/2 (13)	2 (51)	Yes
FR7004	1/2 (153)	1 (25)	1/2 (13)	No
FR7037	1 (305)	1 (25)	1/2 (13)	No
FR7038	2 (610)	1 (25)	1/2 (13)	No
FR8510	1/2 (153)	1 (25)	1 (25)	Yes
FR7031	3/4 (229)	1 (25)	1 (25)	Yes
FR8520	1/2 (153)	1 (25)	2 (51)	Yes
FR7019	3/4 (229)	1 (25)	2 (51)	Yes
FR7097	1 (305)	2 (51)	1 (25)	Yes

\*Add "E" to the end of the code to specify electro-deposited copper (e.g., FR9210E).

If double-treated copper is specified, add the letter "D" to the end of the product code (e.g., FR9120D or FR9210ED).

† Certified to IPC-FC-241C/1: "Flexible Metal-Clad Dielectrics for use in Fabrication of Flexible Printed Wiring."

**Table 2**  
**Double-Sided Copper-Clad Product Codes**

Product Code*	Copper oz/ft <sup>2</sup> (g/m <sup>2</sup> )	Adhesive mil (μm)	Kapton® mil (μm)	IPC Certified†
FR9111	1 (305)	1 (25)	1 (25)	Yes
FR9121	1 (305)	1 (25)	2 (51)	Yes
FR9131	1 (305)	1 (25)	3 (76)	Yes
FR9151	1 (305)	1 (25)	5 (127)	Yes
FR9212	2 (610)	1 (25)	1 (25)	Yes
FR9222	2 (610)	1 (25)	2 (51)	Yes
FR7022	½ (153)	½ (13)	½ (13)	No
FR7014	½ (153)	½ (13)	1 (25)	Yes
FR7010	1 (305)	½ (13)	1 (25)	Yes
FR7041	2 (610)	½ (13)	1 (25)	Yes
FR7091	½ (153)	½ (13)	2 (51)	Yes
FR7093	1 (305)	½ (13)	2 (51)	Yes
FR7058	2 (610)	½ (13)	2 (51)	Yes
FR7003	2 (610)	½ (13)	3 (76)	No
FR7017	½ (153)	1 (25)	½ (13)	No
FR7039	1 (305)	1 (25)	½ (13)	No
FR7040	2 (610)	1 (25)	½ (13)	No
FR8515	½ (153)	1 (25)	1 (25)	Yes
FR8525	½ (153)	1 (25)	2 (51)	Yes
FR7090	2 (610)	2 (51)	2 (51)	Yes
FR7071	1 (305)	½ (13)	½ (13)	Yes

\*Add "E" to the end of the code to specify electro-deposited copper (e.g., FR9210E).

† If double-treated copper is specified, add the letter "D" to the end of the product code (e.g., FR9120D or FR9210ED).

† Certified to IPC-FC-241C/1: "Flexible Metal-Clad Dielectrics for use in Fabrication of Flexible Printed Wiring."

**Table 3**  
**Pyralux® FR™ Copper-Clad Properties**

Property	Typical Copper-Clad Value	Test Method
Flammability	VTM-0	UL94
Meets UL796 Direct Support Requirements	Yes	UL796
Peel Strength	—	IPC-TM-650, No. 2.4.9
After lamination	2.1 N/mm (12 lb/in)	Method B
After soldering	1.9 N/mm (11 lb/in)	Method D
Solder Float Resistance 10 sec at 288°C (550°F)	Pass	IPC-TM-650, No. 2.4.13 Method B
Thickness Tolerance	±10%	IPC-TM-650, No. 4.6.2
Dimensional Stability	-0.10%	IPC-TM-650, No. 2.2.4
	-0.10%	Method B
		Method C
Dielectric Constant (at 1 MHz)	3.5	IPC-TM-650, No. 2.5.5.3
Dissipation Factor (at 1 MHz)	0.02	IPC-TM-650, No. 2.5.5.3
Dielectric Strength	137 kV/mm (3500 V/mil)	ASTM D-149
Insulation Resistance (at ambient)	10 <sup>6</sup> megohms	IPC-TM-650, No. 2.6.3.2
Volume Resistivity (at ambient)	10 <sup>9</sup> megohm-cm	ASTM D-257
Surface Resistance (at ambient)	10 <sup>7</sup> megohms	ASTM D-257

## Processing

Laminating conditions for Pyralux® flexible composites are typically in the following ranges:

Part Temperature: 182–199°C (360–390°F)  
Pressure: 14–28 kg/cm<sup>2</sup> (200–400 psi)  
Time: 1–2 hours, at temperature

Pyralux® FR™ can be processed like Pyralux® FR. Refer to publication “Pyralux® Flexible Composites Technical Manual” for further processing details.

## Storage

Pyralux® flexible composites will retain their original properties for a minimum of one year when stored in the original packaging at temperatures of 4–29°C (40–85°F) and below 70% humidity. The products do not need refrigeration and should not be frozen. Keep the material clean and well protected.

Copper-clad laminates should not be automatically discarded if storage conditions have deviated from these limits. We recommend that material which has been stored outside of these conditions be examined in a practical test before being committed to production.

## Safe Handling

Pyralux® FR™ coverlay, sheet adhesive, and bond ply contain a B-staged adhesive. Since B-staged adhesive contains trace quantities (parts per million) of unreacted monomers, operators should take care to minimize contact.

Pyralux® FR™ copper-clad laminates contain fully cured (C-staged) adhesive.

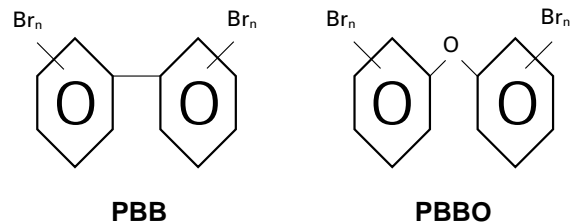
Although DuPont is not aware of anyone developing contact dermatitis when using Pyralux® FR™ products, some individuals may be more sensitive than others. Anyone handling Pyralux® FR™ copper-clad laminates should wash their hands with soap before eating, smoking, or using restroom facilities. Gloves, finger cots, and finger pads should be changed daily. Clothes should be washed frequently.

The unreacted acrylic monomer in the adhesive may impart a mild odor when the release film or paper is removed. We recommend that areas where B-staged materials are used, as well as lay-up and lamination areas, be well ventilated with a fresh air supply.

Pyralux® adhesive is cured during lamination. The curing reaction does not produce any vapors, although impurities may volatilize. When drilling or routing parts made with Pyralux® FR™ flexible composites, provide adequate vacuum around the drill head to minimize worker exposure to adhesive dust.

Thin copper-clad laminates can have sharp metal edges. People handling these materials should be cautioned and provided with suitable gloves to prevent cuts.

Pyralux® FR™ flexible composites DO NOT contain polybrominated biphenyls (PBBs), polybrominated biphenyl oxides (PBBOs), or polybrominated diphenyl ethers (PBDEs).



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**Caution:** Do not use in medical applications involving permanent implantation in the human body. For other medical applications, see "DuPont Medical Caution Statement," H-50102.



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