



# DUPONT™ PYRALUX® FR COPPER-CLAD LAMINATES

## FLEXIBLE COMPOSITES

### PRODUCT DESCRIPTION

DuPont™ 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 sheet adhesive 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 Conformance is available with every batch. Complete material and manufacturing records for each lot, with samples of finished product, are retained for reference purposes. 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. Copper-Clad Product Codes**

Product Code*	Copper	Adhesive	Kapton®	IPC
	oz/ft <sup>2</sup> (g/m <sup>2</sup> )	mil (µm)	mil (µm)	Certification**
FR9110R	1 (305)	1 (25)	1 (25)	Yes
FR9120R	1 (305)	1 (25)	2 (51)	Yes
FR9130R	1 (305)	1 (25)	3 (76)	Yes
FR9150R	1 (305)	1 (25)	5 (127)	Yes
FR9210R	2 (610)	1 (25)	1 (25)	Yes
FR9220R	2 (610)	1 (25)	2 (51)	Yes
FR7012R	1/2 (153)	1/2 (13)	1/2 (13)	No
FR7002R	1 (305)	1/2 (13)	1/2 (13)	No
FR7062R	1/2 (153)	1/2 (13)	1 (25)	No
FR7011R	1 (305)	1/2 (13)	1 (25)	Yes
FR7008R	2 (610)	1/2 (13)	1 (25)	Yes
FR7092R	1 (305)	1/2 (13)	2 (51)	Yes
FR7004R	1/2 (153)	1 (25)	1/2 (13)	No
FR7037R	1 (305)	1 (25)	1/2 (13)	No
FR7038R	2 (610)	1 (25)	1/2 (13)	No
FR8510R	1/2 (153)	1 (25)	1 (25)	Yes
FR7031R	3/4 (229)	1 (25)	1 (25)	Yes
FR8520R	1/2 (153)	1 (25)	2 (51)	Yes
FR7019R	3/4 (229)	1 (25)	2 (51)	Yes
FR7097R	1 (305)	2 (51)	1 (25)	Yes

\*Add "R" to the end of the code to specify rolled-annealed copper (e.g. FR9210R). Add "E" to the end of the code to specify electro-deposited copper (e.g. FR9210E). If rolled-annealed, double-treated copper is specified, add the letter "D" to the end of the product code (e.g. FR9210D).

\*\*Certified to IPC-4204/1: "Flexible Metal-Clad Dielectrics for use in Fabrication of Flexible Printed Wiring."

# DUPONT™ PYRALUX® FR COPPER-CLAD LAMINATES

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

Product Code*	Copper	Adhesive	Kapton®	IPC
	oz/ft <sup>2</sup> (g/m <sup>2</sup> )	mil (μm)	mil (μm)	Certification**
FR9111R	1 (305)	1 (25)	1 (25)	Yes
FR9121R	1 (305)	1 (25)	2 (51)	Yes
FR9131R	1 (305)	1 (25)	3 (76)	Yes
FR9151R	1 (305)	1 (25)	5 (127)	Yes
FR9212R	2 (610)	1 (25)	1 (25)	Yes
FR9222R	2 (610)	1 (25)	2 (51)	Yes
FR7022R	1/2 (153)	1/2 (13)	1/2 (13)	No
FR7014R	1/2 (153)	1/2 (13)	1 (25)	No
FR7010R	1 (305)	1/2 (13)	1 (25)	Yes
FR7041R	2 (610)	1/2 (13)	1 (25)	Yes
FR7091R	1/2 (153)	1/2 (13)	2 (51)	Yes
FR7093R	1 (305)	1/2 (13)	2 (51)	Yes
FR7058R	2 (610)	1/2 (13)	2 (51)	Yes
FR7003R	2 (610)	1/2 (13)	3 (76)	No
FR7017R	1/2 (153)	1 (25)	1/2 (13)	No
FR7039R	1 (305)	1 (25)	1/2 (13)	No
FR7040R	2 (610)	1 (25)	1/2 (13)	No
FR8515R	1/2 (153)	1 (25)	1 (25)	Yes
FR8525R	1/2 (153)	1 (25)	2 (51)	Yes
FR7090R	2 (610)	2 (51)	2 (51)	Yes
FR7071R	1 (305)	1/2 (13)	1/2 (13)	Yes

\*Add “R” to the end of the code to specify rolled-annealed copper (e.g. FR9210R). Add “E” to the end of the code to specify electro-deposited copper (e.g. FR9210E). If rolled-annealed, double-treated copper is specified, add the letter “D” to the end of the product code (e.g. FR9210D).

\*\*Certified to IPC-4204/1: “Flexible Metal-Clad Dielectrics for use in Fabrication of Flexible Printed Wiring.”

**Table 3. Pyralux® Copper-Clad Properties**

Property	Typical Coverlay Value	Test Method
Flammability	VTM-0	UL94
Meets UL746E Direct Support Requirements	Yes	UL746E
UL Max Operating Temperature	105 °C (221 °F)	UL 746F
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% -0.10%	IPC-TM-650, No. 2.2.4 Method B IPC-TM-650, No. 2.2.4 Method C
Dielectric Constance (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

The values in Table 3 represent a typical 1 oz. RA copper foil, 1 mil adhesive and 1 mil Kapton® construction.

## PROCESSING

Laminating conditions for DuPont™ 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® LF. Refer to publication “Pyralux® Flexible Composites Technical Manual” for further processing details.

## STORAGE CONDITIONS AND WARRANTY

Pyralux® FR flexible laminates should be stored in the original packaging at temperatures of 4–29°C (40–85°F) and below 70% humidity. The product should not be frozen and should be kept dry, clean and well-protected. Subject to compliance with the foregoing handling and storage recommendations, DuPont’s warranties, as provided in the DuPont Standard Conditions of Sale, shall remain in effect for a period of two years following the date of shipment.



## DUPONT™ PYRALUX® FR COPPER-CLAD LAMINATES

### 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.

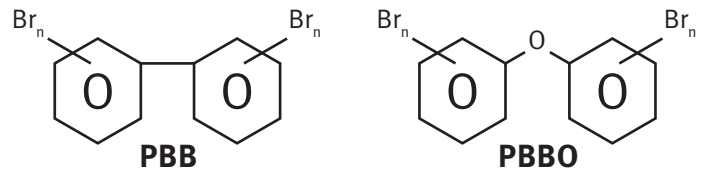
Although DuPont is not aware of anyone developing contact dermatitis when using Pyralux® FR products, some individuals may be more sensitive than others. Anyone handling Pyralux® FR products should wash their hands with soap before eating, smoking, or using restroom facilities. Gloves, finger cots, and 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-50102-5 H-73233-9 (7/15)