

# DuPont™ Pyralux® AP

## All-Polyimide Flexible Laminate

### A Family of High-Performance Adhesiveless Laminates for Flexible Printed Circuit Applications

#### Product Description

Pyralux® AP double-sided, copper-clad laminate is an all-polyimide composite of polyimide film bonded to copper foil. This material system is ideal for multilayer flex and rigid flex applications which require advanced material performance, temperature resistance, and high reliability.

Offered in a full range of dielectric thicknesses, Pyralux® AP provides designers, fabricators, and assemblers a versatile option for a wide variety of flexible circuit constructions.

- Low CTE for rigid flex multilayers
- Excellent thermal resistance
- Thin Cu-clads with superior handling
- Unique thick-core product for controlled impedance
- Excellent dielectric thickness tolerance/electrical performance
- High Cu-polyimide adhesion strength
- Full compatibility with PWB industry processes, IPC 4204/11 certified
- UL 94V-0, UL 796, 180°C (356°F) max. operating temperature

Table 1  
Pyralux® AP Product Offerings\*

Product Code	Dielectric Thickness, mil	Copper Thickness, $\mu\text{m}$ (oz/ft <sup>2</sup> )
AP 7163E**	1.0	9 (.25)
AP 7164E**	1.0	12 (.33)
AP 8515R	1.0	18 (0.5)
AP 9111R	1.0	35 (1.0)
AP 7156E**	2.0	9 (.25)
AP 7125E**	2.0	12 (.33)
AP8515E	1.0	18 (0.5)
AP 8525R	2.0	18 (0.5)
AP 9121R	2.0	35 (1.0)
AP 9222R	2.0	70 (2.0)
AP 8535R	3.0	18 (0.5)
AP 9131R	3.0	35 (1.0)
AP 9232R	3.0	70 (2.0)
AP 8545R	4.0	18 (0.5)
AP 9141R	4.0	35 (1.0)
AP 9242R	4.0	70 (2.0)
AP 8555R	5.0	18 (0.5)
AP 9151R	5.0	35 (1.0)
AP 9252R	5.0	70 (2.0)
AP 8565R	6.0	18 (0.5)
AP 9161R	6.0	35 (1.0)
AP 9262R	6.0	70 (2.0)

Add "R" to the end of the code to specify rolled-annealed copper foil (e.g., AP9121R). Add "E" to the end of the code to specify electro-deposited copper foil (e.g., AP9121E). If rolled-annealed double-treat copper foil is specified, add the letter "D" to the end of the product code (e.g., AP9121D).

\* Additional balanced/unbalanced copper constructions and dielectrics (>6 mil) are available through your DuPont Representative.

\*\* Available in ED copper only.



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Table 2  
Pyralux® AP Material Properties

Laminate Property	IPC TM-650 (* or other)	AP-9111 1 mil dielectric	AP-9121 2 mil dielectric	AP-9131-9161 3-6 mil dielectric
Adhesion to Cu (Peel Strength)	Method 2.4.9			
As fabricated, N/mm (lb/in)		1.6 (9)	>1.8 (10)	>1.8 (10)
After solder, N/mm (lb/in)		1.6 (9)	>1.8 (10)	>1.8 (10)
Solder Float at 288°C (550°F)	Method 2.4.13	Pass	Pass	Pass
Dimensional Stability	Method 2.2.4			
Method B, %		-.04 to -.08	-.04 to -.08	-.03 to -.06
Method C, %		-.05 to -.08	-.04 to -.07	-.03 to -.06
Dielectric Thickness Tolerance, %	Method 4.6.2	±10	±10	±10
UL Flammability Rating	*UL-94	V-0	V-0	V-0
Dielectric Constant*, 1 MHz	Method 2.5.5.3	3.4	3.4	3.4
Dissipation Factor*, 1 MHz	Method 2.5.5.3	0.003	0.002	0.002
Dielectric Strength, kV/mil	Method 2.5.6.1	6-7	6-7	6-7
Volume Resistivity, ohm-cm	Method 2.5.17.1	E16	E17	E17
Surface Resistance, ohms	Method 2.5.17.1	>E16	>E16	>E16
Moisture and Insulation Res., ohms	Method 2.6.3.2	E11	E11	E11
Moisture Absorption, %	Method 2.6.2	0.8	0.8	0.8
Tensile Strength, MPa (kpsi)	Method 2.4.19	>345 (>50)	>345 (>50)	>345 (>50)
Elongation, %	Method 2.4.19	>50	>50	>50
Initiation Tear Strength, g	Method 2.4.16	700-1000	900-1200	900-1200
Propagation Tear Strength, g	Method 2.4.17.1	>10	>20	>20
Chemical Resistance, min. %	Method 2.3.2	Pass, >95%	Pass, >95%	Pass, >95%
Solderability	*IPC-S-804, M. 1	Pass	Pass	Pass
Flexural Endurance, min. cycles	Method 2.4.3	6000	6000	6000
Glass Transition (T <sub>g</sub> ), C	—	220	220	220
Modulus, kpsi	—	700	700	700
In-Plane CTE (ppm/C) T<T <sub>g</sub>	—	25	25	25
In-Plane CTE (ppm/C) T>T <sub>g</sub>	—	40 (est.)	40 (est.)	40 (est.)

\*See Page 6, Figures 6 and 7 for dielectric constant and loss tangent performance at higher frequencies

## Product Highlights and Applications

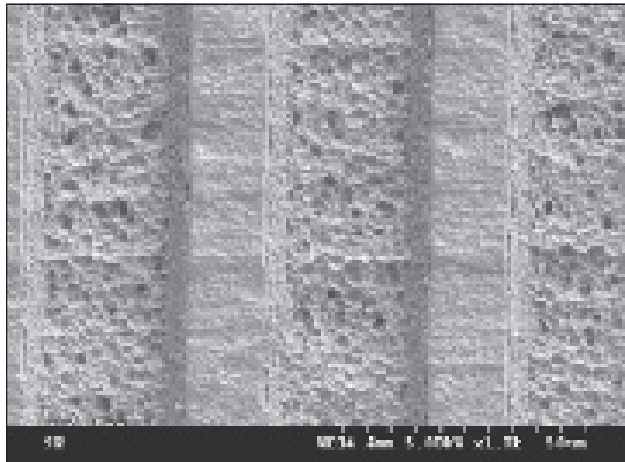
**1 mil  
Pyralux® AP**

AP-7163E\*  
AP-7164E  
AP-8515  
AP-9111

**2 mil  
Pyralux® AP**

AP-7156E\*  
AP-7125E  
AP-8525  
AP-9121

### *A Thin High-Performance Sheet Clad Laminate for High Density Flex Circuits*

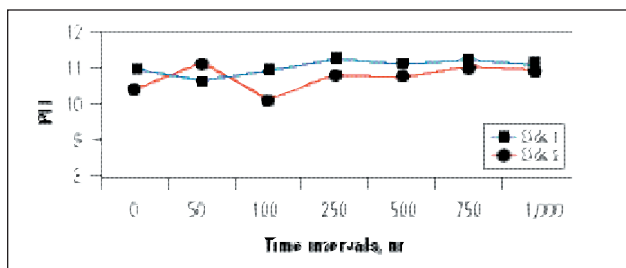


Double sided 1 mil Pyralux® AP was developed for high-reliability flexible circuit applications requiring thin dielectric profiles and superior performance offered by its all-polyimide construction. The high material modulus provides excellent handling characteristics in a thin adhesiveless laminate. All

1 mil Pyralux® AP constructions are UL rated and fully certified to IPC-4204/11. 1 mil Pyralux® AP features:

- 1.0 mil adhesiveless core dielectric with excellent thickness uniformity for consistent electrical performance
- High adhesion strengths and uniform performance profiles
- Excellent long-term thermal exposure performance (Figure 1) and harsh environment

Figure 1. 150°C (302°F) Continuous Temperature



### *The Flagship All-Polyimide Flexible Composite*

2 mil Pyralux® AP adhesiveless laminate is ideal for double sided, multilayer flex as well as rigid flex applications requiring advanced material performance and high reliability. All-polyimide constructions enable designers, fabricators, and assemblers to achieve higher density, premium performance flexible circuitry. 2 mil Pyralux® AP supports advanced circuit designs through its core polyimide chemistry strengths:

- Low thermal expansion coefficient for rigid flex fabrication and assembly
- Excellent thermal resistance to high-temperature assembly
- Good dimensional stability consistency
- Superior mechanical and electrical properties and compatibility with severe environment applications

2 mil Pyralux® AP is fully compatible with existing PCB processes and material handling systems. A double-treat RA copper offering provides the fabricator a unique construction to minimize surface preparation costs and increase overall final yields.

Typical 2 mil Pyralux® AP Material Properties:

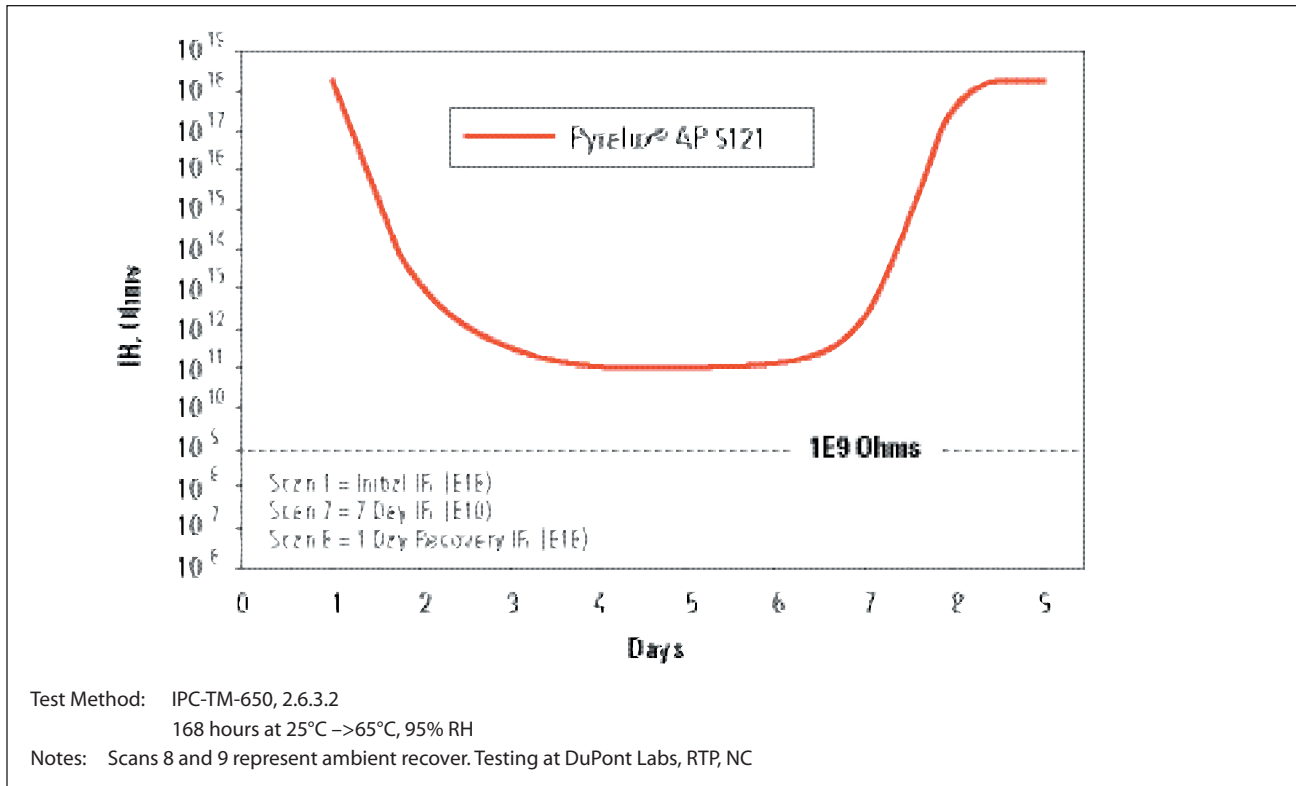
Table 3  
288°C (550°F) Solder Float Performance

Pyralux® AP Solder Float Resistance	Conditions	Results
Thermal Stress, Solder Shock	10 layer circuit similar to 50884C 100 mil centers, 288°C (550°F) 10-second dwell time	Pass  No blisters, delamination, solder wicking

Test Method: IPC-TM-650, 2.4.13

\* See Table 1. Additional copper/metal constructions available on request.

Figure 2. Moisture and Insulation Resistance



## Chemical Resistance

Table 4  
Chemical Absorption

Weight Change (%)	Weight Change (%)		Weight Change	
	24 hr Immersion		24 hr Immersion	
	Pyralux <sup>®</sup> AP (polyimide)	Pyralux <sup>®</sup> LF (acrylic)	Pyralux <sup>®</sup> AP (polyimide)	Pyralux <sup>®</sup> LF (acrylic)
2 N Sulfuric Acid	0.95	3.44	KOH (1.5%, 55°C)	(9.42) (51.85)
Isopropanol (IPA)	0.79	7.77	Permanganate	0.25 (46.50)
Methyl Ethyl Ketone (MEK)	0.42	39.45	Para-formaldehyde	0.59 4.57
Cupric Chloride Etchant	0.65	6.41	EDTA (E-less plating)	0.62 5.01

Test Method: IPC-TM-650, 2.6.2

Notes: All chemical immersions are 24 hours followed by roll drying. Values in parentheses indicate weight loss after immersion. Other values represent weight gain.

Table 5  
Automotive Fluids Resistance

Immersion Fluid	% Retention of Original Peel Strength	Weight % Change After Immersion	Immersion Fluid	% Retention of Original Peel Strength	Weight % Change After Immersion
Anti-Freeze	95	1.8	Transmission Fluid	100	0.7
Detergent Solution	96	3.5	Unleaded Gasoline	99	2.8
Motor Oil (10W30)	102	0.6	Diesel Fuel	100	2.3
Brake Fluid	102	0.7	Sour Gasoline	100	1.6

Test Method: IPC-TM-650, 2.4.9 (peel strength)

Note: Sample data based on 2-minute immersions, 100 cycles. Test construction: AP-9121