



DuPont™ Kapton® FPC

POLYIMIDE FILM

Technical Data Sheet

DuPont™ Kapton® FPC polyimide film is treated on both sides and has the same excellent balance of physical, chemical and electrical properties over a wide temperature range offered by general purpose Kapton® HN. Kapton® FPC offers superior dimensional stability and adhesion, and is specifically designed for flex circuit manufacturers. Adhesion data for FPC can be referenced in the adhesion to Kapton® technical bulletin.

In applications where superior adhesion and low shrinkage are important, Kapton® FPC is the polyimide film of choice.

Applications

- Flexible printed circuits
- Automotive
- Computers
- Consumer products
- Telecommunications equipment
- Industrial instrumentation and controls
- Military applications
- Aerospace
- Electronic parts
- PCB stencils
- Screen printing
- Insulation tubing

Product Specifications

Kapton® FPC is manufactured, slit and packaged according to the product specifications listed in H-38487, Bulletin FC-97-6.

Certification

Kapton® FPC meets IPC 4202/1 requirements.



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Table 1
Typical Properties of Kapton® FPC at 23°C (73°F)

Property	Unit	1 mil 25µm	2 mil 50µm	3 mil 75µm	5 mil 125µm	Test Method
Physical						
Tensile Strength	kpsi (MPa)	34 (234)	34 (234)	34 (234)	34 (234)	ASTM D-882-91
Elongation	%	80	82	82	82	ASTM D-882-91
Tensile Modulus	kpsi (GPa)	400 (2.8)	400 (2.8)	400 (2.8)	400 (2.8)	ASTM D-882-91
Adhesion	pli (N/mm)	10 (1.8)	10 (1.8)	10 (1.8)	10 (1.8)	IPC-TM-650 Method 2.4.9*
Density	g/cc	1.42	1.42	1.42	1.42	ASTM D-1505-90
MIT Folding Endurance	cycles	285,000	55,000	6,000	3,000	ASTM D-2176-89
Tear Strength-propagating (Elmendorf), N		0.07	0.21	0.38	0.58	ASTM D-1922-89
Tear Strength, initial (Graves), N		7.2	16.3	26.3	46.9	ASTM D-1004-90
Thermal						
Flammability		94V0	94V0	94V0	94V0	UL-94
Dimensional Stability (30 min at 150°C)	%	0.03	0.03	0.03	0.03	IPC-TM-650 Method 2.2.4; Method A
Limiting Oxygen Index	%	37	43	46	45	ASTM D-2863-87
Electrical						
Dielectric Strength	kV/mil (kV/mm)	7.7 (303)	6.1 (240)	5.2 (205)	3.9 (154)	ASTM D-149-91
Dielectric Constant	1kHz	3.4	3.4	3.5	3.5	ASTM D-150-92
Dissipation Factor at 1 kHz		0.0018	0.0020	0.0020	0.0026	ASTM D-150-92

*Acrylic adhesive to 1 oz. copper

Table 2
Physical Properties of Kapton® FPC Film

Physical Property	Typical Value at		Test Method
	23°C (73°F)	200°C (392°F)	
Yield Point at 3%, MPa (psi)	69 (10,000)	41 (6000)	ASTM D-882-91
Stress to produce 5% elongation, MPa (psi)	90 (13,000)	61 (9000)	ASTM D-882-91
Impact Strength, N•cm•(ft lb)	78 (0.58)		DuPont Pneumatic Impact Test
Coefficient of Friction, kinetic (film-to-film)	0.48		ASTM D-1894-90
Coefficient of Friction, static (film-to-film)	0.63		ASTM D-1894-90
Refractive Index (sodium D line)	1.70		ASTM D-542-90
Poisson's Ratio	0.34		Avg. three samples Elongated at 5%, 7%, 10%
Low Temperature Flex Life	pass		IPC-TM 650, Method 2.6.18

Table 3
Thermal Properties of Kapton® FPC Film

Thermal Property	Typical Value	Test Condition	Test Method
Melting Point	None	None	ASTM E-794-85 (1989)
Thermal Coefficient of Linear Expansion	20 ppm/°C (11 ppm/°F)	-14 to 38°C (7 to 100°F)	ASTM D-696-91
Coefficient of Thermal Conductivity, W/m-K $\frac{\text{cal}}{\text{cm}\cdot\text{sec}\cdot\text{°C}}$	0.12 2.87 x 10 ⁴	296 K 23°C	ASTM F-433-77 (1987)
Specific Heat, J/g K (cal/g °C)	1.09 (0.261)		Differential calorimetry
Heat Sealability	not heat sealable		
Solder Float	pass		IPC-TM-650, method 2.4.13A
Smoke Generation	D _m < 1	NBS smoke chamber	NFPA-258
Glass Transition Temperature (T _g)	A second order transition occurs in Kapton® between 360°C(680°F) and 410°C(770°F) and is assumed to be the glass transition temperature. Different measurement techniques produce different results within the above temperature range.		

Table 4
Electrical Properties of Kapton® FPC Film at 23°C (73°F)

Property Film Gauge	Typical Value	Test Condition	Test Method
<u>Dielectric Strength</u> 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	<u>V/m kV/mm</u> <u>(V/mil)</u> 303 (7700) 240 (6100) 205 (5200) 154 (3900)	60 Hz 1/4 in electrodes 500 v/sec rise	ASTM D-149-91
<u>Dielectric Constant</u> 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	3.4 3.4 3.5 3.5	1 kHz	ASTM D-150-92
<u>Dissipation Factor</u> 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	0.0018 0.0020 0.0020 0.0026	1 kHz	ASTM D-150-92
<u>Volume Resistivity</u> 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	<u>Ω•cm</u> ₁₇ 1.5 x 10 ¹⁷ 1.5 x 10 ¹⁷ 1.4 x 10 ¹⁷ 1.0 x 10 ¹⁷		ASTM D-257-91

Dimensional Stability

The dimensional stability of Kapton® polyimide film depends on two factors—the normal coefficient of thermal expansion and the residual stresses placed in the film during manufacture. The latter causes Kapton® to shrink on its first exposure to elevated temperatures as indicated in the bar graph in **Figure 1**. Once the film has been exposed, the normal values for the thermal coefficient of linear expansion as shown in **Table 5** can be expected.

Figure 1. Residual Shrinkage vs. Exposure Temperature and Thickness, Kapton® HN and FPC Films

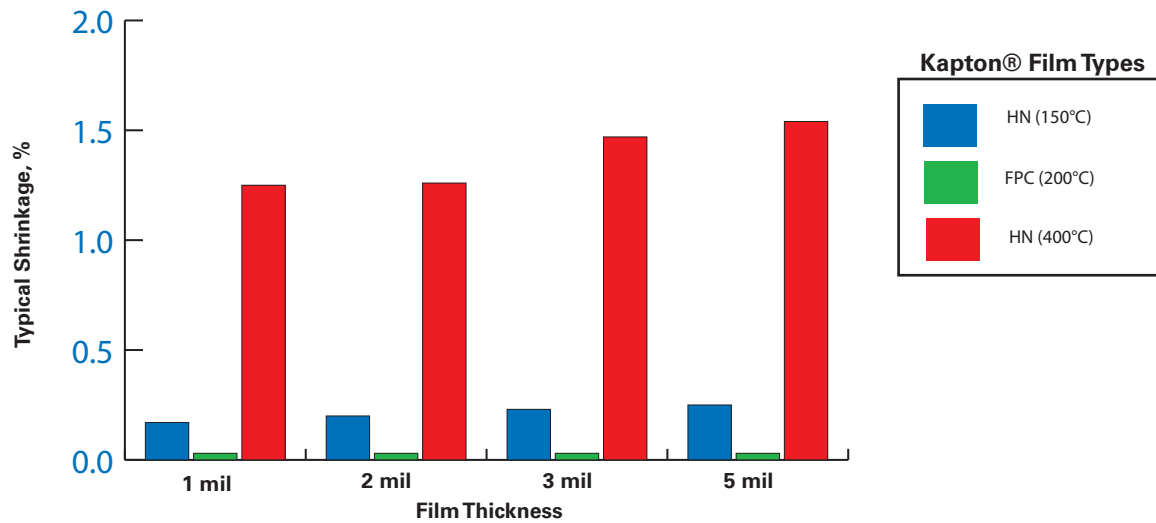


Table 5
Thermal Coefficient of Expansion,
Kapton® FPC Film, 25 μm (1 mil),
Thermally Exposed

Temperature Range, °C, (°F)	ppm/°C
30-100 (86-212)	17
100-200 (212-392)	32
200-300 (392-572)	40
300-400 (572-752)	44
30-400 (86-752)	34

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