DUPONT™ KAPTON® FPC

POLYIMIDE FILM

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-38479-11 (6/18).

CERTIFICATION

Kapton® FPC meets IPC 4202B requirements.

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)	33.5 (231)	34 (234)	34 (234)	33.5 (231)	ASTM D-882-91
Elongation	%	72	72	78	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
Shrinkage (30 min at 150°C)	%	0.03	0.03	0.03	0.03	IPC-TM-650
Method 2.2.4A						
Limiting Oxygen Index	%	37	43	46	45	ASTM D-2863-87
Electrical						
Dielectric Strength	kV/mil (kV/mm)	7.7 (303)	6.1 (240)	5.1 (201)	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

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Table 2 – Physical Properties of Kapton® FPC Film

Physical Property	Typical Value at 23°C (73°F)	Typical Value at 200°C (392°F)	Test Method
Yield Point at 3%, MPa (psi)	69 (10,000)	41 (6000)	ASTM D-882-91
Stress to produce 5% elonga- tion, MPa (psi)	90 (13,000)	62 (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 $\frac{\text{cal}}{\text{cm·sec·°C}}$	0.12 2.87×10^{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	Dm=<1	NBS smoke chamber	NFPA-258
Glass Transition Temperature (Tg)	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 Gage	Typical Value		Test Condition	Test Method
Dielectric Strength 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	V/m kV/mm 303 240 201 154	(V/mil) (7700) (6100) (5100) (3900)	60 Hz 1/4 in electrodes 500 v/sec rise	ASTM D-149-91
Dielectric Constant 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
Dissipation Factor 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
Volume Resistivity 25 µm (1 mil) 50 µm (2 mil) 75 µm (3 mil) 125 µm (5 mil)	Ω•cm[17] 1.5×10^{17} 1.5×10^{17} 1.4×10^{17} 1.0×10^{17}			ASTM D-257-91

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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

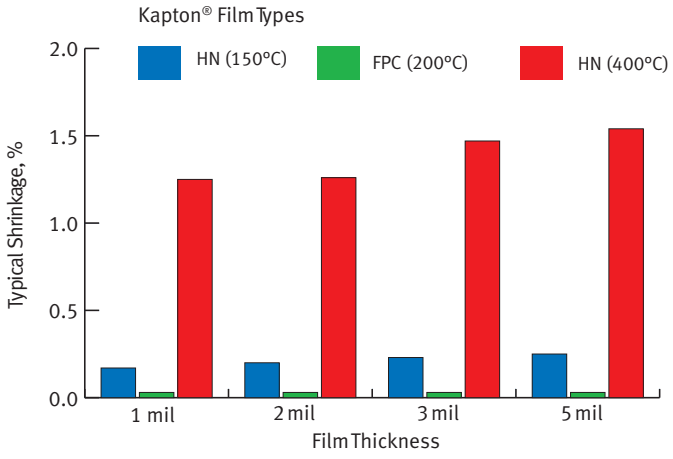

Table 5 – Thermal Coefficient of Expansion, Kapton® FPC Film, 25 µm (1 mil), Thermally Exposed

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

FOR MORE INFORMATION ON DUPONT™ KAPTON® POLYIMIDE FILMS, PLEASE CONTACT YOUR LOCAL REPRESENTATIVE, OR VISIT OUR SALES & SUPPORT WEBPAGE FOR ADDITIONAL REGIONAL CONTACT INFORMATION.

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K-15361 (6/18)