DuPont™ Kapton® HN

Polyimide Film

Description

DuPont™ Kapton® HN general-purpose film has been used successfully in applications at temperatures as low as -269°C (-452°F) and as high as 400°C (752°F). HN film can be laminated, metallized, punched, formed or adhesive coated. Kapton® HN is the recommended choice for applications that require an all-polyimide film with an excellent balance of properties over a wide range of temperatures.

Applications

- Mechanical parts
- Electronic parts
- Electrical Insulation
- Pressure sensitive tape
- Fiber optics cable
- Insulation blankets
- Insulation tubing
- Automotive diaphragms sensors and manifolds
- Etching
- Shims

Product Specifications

Kapton® HN is manufactured, slit and packaged according to the product specifications listed in H-38479 (6/18).

Certification

Kapton® HN meets ASTM D-5213 (type 1, item A) requirements.

Table 1 – Physical Properties of DuPont™ Kapton® HN at 23°C (73°F)

Property	Unit	.05 mil 12.7µm	1 mil 25µm	2 mil 50µm	3 mil 75µm	5 mil 125µm	Test Method
Ultimate Tensile Strength at 23°C, (73°F) at 200°C (392°F)	psi (MPa)	33,500 (231) 20,000 (138)	33,500 (231) 20,000 (138)	33,500 (231) 20,000 (138)	33,500 (231) 20,000 (138)	33,500 (231) 20,000 (138)	ASTM D-882-91, Method A*
Ultimate Elongation at 23°C, (73°F) at 200°C (392°F)	%	65 68	72 83	72 83	78 83	82 83	ASTM D-882-91, Method A
Tensile Modulus at 23°C, (73°F) at 200°C (392°F)	psi (GPa)	400,000 (2.76) 160,000 (1.10)	400,000 (2.76) 290,000 (2.0)	400,000 (2.76) 290,000 (2.0)	400,000 (2.76) 290,000 (2.0)	400,000 (2.76) 290,000 (2.0)	ASTM D-882-91, Method A
Density	g/cc	1.42	1.42	1.42	1.42	1.42	ASTM D-1505-90
MIT Folding Endurance	cycles	>285,000	285,000	55,000	6,000	5,000	ASTM D-2176-89
Tear Strength-propagating (Elmendorf), N (lbf)		NA	0.07 (0.02)	0.21 (0.02)	0.38 (0.02)	0.58 (0.02)	ASTM D-1922-89
Tear Strength, Initial (Graves), N (lbf)		3.5 (1.6)	7.2 (1.6)	16.3 (1.6)	26.3 (1.6)	46.9 (1.6)	ASTM D-1004-90
Yield Point at 3% at 23°C, (73°F) at 200°C (392°F)	MPa (psi)	69 (10,000) 41 (6,000)	69 (10,000) 41 (6,000)	69 (10,000) 41 (6,000)	69 (10,000) 41 (6,000)	69 (10,000) 41 (6,000)	ASTM D-882-91
Stress to produce 5% elong. at 23°C, (73°F) at 200°C (392°F)	MPa (psi)	90 (13,000) 62 (9,000)	90 (13,000) 62 (9,000)	90 (13,000) 62 (9,000)	90 (13,000) 62 (9,000)	90 (13,000) 62 (9,000)	ASTM D-882-92
Impact Strength at 23°C, (73°F)	N· cm· (ft lb)	78 (0.58)	78 (0.58)	78 (0.58)	78 (0.58)	78 (0.58)	DuPont Pneumatic Impact Test
Coefficient of Friction, kinetic (film-to-film)		0.48	0.48	0.48	0.48	0.48	ASTM D-1894-90
Coefficient of Friction, static (film-to-film)		0.63	0.63	0.63	0.63	0.63	ASTM D-1894-90
Refractive Index (sodium D line)		1.70	1.70	1.70	1.70	1.70	ASTM D-542-90
Poisson's Ratio		0.34	0.34	0.34	0.34	0.34	Avg. three samples, elongated at 5, 7, 10%
Low temperature flex life		pass	pass	pass	pass	pass	IPC-TM-650, Method 2.6.18

*Specimen size 25 x 150 mm (1.6 in); jaw separation 100 mm (4 in), jaw speed, 50mm/min (2 in/min). Ultimate refers to the tensile strength and elongation measured at break.

Table 2 – Thermal Properties of DuPont™ Kapton® HN 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 (cal/sec-cm-°C)	0.20 (4.8 x 10^{-4})	296 K (23°C)	ASTM D5470
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
Shrinkage, % 30 min at 150°C 120 min at 400°C	 0.17 1.25		IPC-TM-650 Method 2.2.4A; ASTM D-5214-91
Limiting Oxygen Index, %	37–45		ASTM D-2863-87
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 3 – Typical Electrical Properties of DuPont™ Kapton® HN Film at 23°C (73°F), 50% RH

Property Film Gage	Typical Value		Test Condition	Test Method
Dielectric Strength	**V/m kV/mm**	**(V/mil)**		
12.7 µm (0.5 mil)	315	(8000)	60 Hz 1/4 in electrodes 500 V/sec rise	ASTM D-149-91
25 µm (1 mil)	303	(7700)		
50 µm (2 mil)	240	(6100)		
75 µm (3 mil)	201	(5100)		
125 µm (5 mil)	154	(3900)		
Dielectric Constant				
12.7 µm (0.5 mil)	3.4		1 kHz	ASTM D-150-92
25 µm (1 mil)	3.4			
50 µm (2 mil)	3.4			
75 µm (3 mil)	3.5			
125 µm (5 mil)	3.5			
Dissipation Factor				
12.7 µm (0.5 mil)	0.0016		1 kHz	ASTM D-150-92
25 µm (1 mil)	0.0018			
50 µm (2 mil)	0.0020			
75 µm (3 mil)	0.0020			
125 µm (5 mil)	0.0026			
Volume Resistivity	Ω•cm[17]			
12.7 µm (0.5 mil)	1.5 x 10^{17}			ASTM D-257-91
25 µm (1 mil)	1.5 x 10^{17}			
50 µm (2 mil)	1.5 x 10^{17}			
75 µm (3 mil)	1.4 x 10^{17}			
125 µm (5 mil)	1.0 x 10^{17}			

Dimensional Stability

The dimensional stability of DuPont™ 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 of the thermal coefficient of linear expansion as shown in **Table 4** can be expected.

Figure 1. Residual Shrinkage vs. Exposure Temperature and Thickness, DuPont™ Kapton® HN

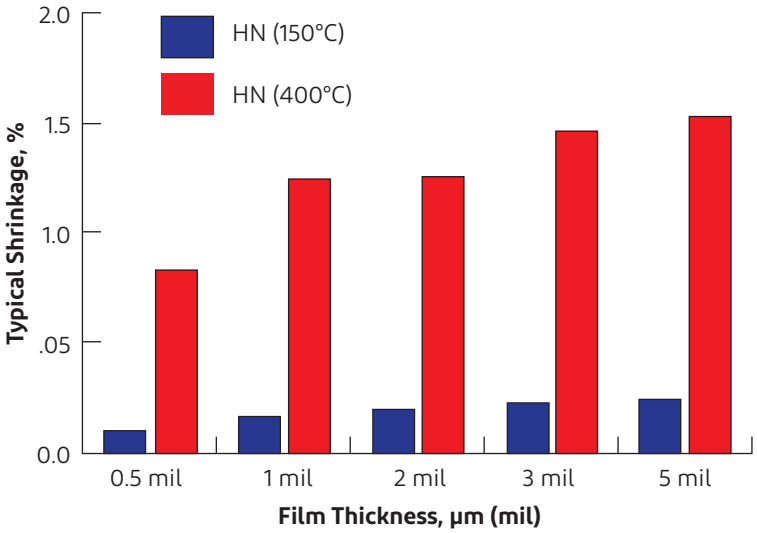


Table 4 – Thermal Coefficient of Expansion, DuPont™ Kapton® HN Film, 25 µm (1 mil), Thermally Exposed

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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