TapeCase Ltd.
150 Gaylord Street, Elk Grove Village, IL 60007
phone: (847) 299-7880
fax: (847) 299-7804
www. tapecase. com
sales@tapecase. com

DuPont Kapton Polyimide Film
Laminated with 3M 966 Adhesive

Product Description

Dupont Kapton Polyimide Film laminated with 3M 966 has been used successfully in applications at low and high temperatures. HN/966 film can be metallized, punched, or formed. It is the recommended choice for applications that require polyimide film with an excellent balance of properties over a wide range of temperatures.

Typical Physical Properties and Performance Characteristics

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Adhesion Peel: ASTM D-3330 (modified) (90 degree peel, 12"/min. [305 mm/min.] 2 mil aluminum)

Metal (Stainless Steel)

3M™ Adhesive Transfer	20 minute dwell		72 hr. dwell		Ultimate bond	
	oz./in.	N/100mm	oz./in.	N/100mm	oz./in.	N/100mm
Tape 966	53	58	78	85	145	159

High Surface Energy Plastic (ABS)

3M tape 966	44	48	54	59	40	44

Use on "Low Surface Energy Plastics" such as Polypropylene is not recommended. Consider other 3M™ Adhesive Transfer Tapes with 3M™ Adhesive 300, 300MP, 350 or 300LSE.

Adhesive Static Shear

Values for all 3M™ Adhesive 100 family of tapes on Stainless Steel (1 x 1 inch test samples)

Room temperature	2000 gms for 10,000 minutes
158°F (70°C)	1000 gms for 10,000 minutes
200°F (93°C)	1000 gms for 10,000 minutes
350°F (177°C)	500 gms for 10,000 minutes
450°F (232°C)	400 gms for 10,000 minutes

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Typical Physical Properties and Performance Characteristics *(continued)*

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Typical Liner Release Values: Liner release values may vary from lot to lot. Values stated are only typical or average values based on lots tested.

3M™ Adhesive Transfer	
Tape 966	39 gms/inch

Environmental Performance

The properties defined are based on the attachment of impervious faceplate materials (such as aluminum) to an aluminum test surface.

Bond Build-up: The bond strength of 3M™ Adhesive 100 increases as a function of time and temperature.

Humidity Resistance: High humidity has a minimal effect on adhesive performance. Bond strengths are generally higher after exposure for 7 days at 90°F (32°C) and 90% relative humidity.

U.V. Resistance: When properly applied, nameplates and decorative trim parts are not adversely affected by outdoor exposure.

Water Resistance: Immersion in water has no appreciable effect on the bond strength. After 100 hours in room temperature, the bond actually shows an increase in strength.

Temperature Cycling Resistance: Bond strength generally increases after cycling four times through: 4 hours at 158°F (70°C)
4 hours at -20°F (-29°C)
16 hours at room temperature

Chemical Resistance: When properly applied, nameplate and decorative trim parts will hold securely after exposure to numerous chemicals including gasoline, oil, Freon™ TF, sodium chloride solution, mild acids and alkalis.

Heat Resistance: The 3M adhesive 100 is usable for short periods (minutes, hours) at temperatures up to 450°F (232°C) and for longer periods (days, weeks) up to 300°F (149°C).

Low Temperature Service: -40°F (-40°C). Parts should be tested for low temperature shock service.

Features

- Excellent bond to metal and high surface energy plastics.
- Outstanding temperature and chemical resistance.
- Two adhesive thicknesses: 1 mil for thin profile labels and 2 mil for rougher surfaces.
- Low outgassing and low leachable chloride, important considerations for electronic and aerospace industries.
- Available on various liners for specialized processing:
  - 60# Densified Kraft for die-cutting metal nameplates
  - 55# Densified Kraft for rotary die-cutting specialty labels
  - 58# Polycoated Kraft for polycarbonate graphics
  - 86# Polycoated Kraft for polycarbonate end tabs and plastic nameplates on a common sheet

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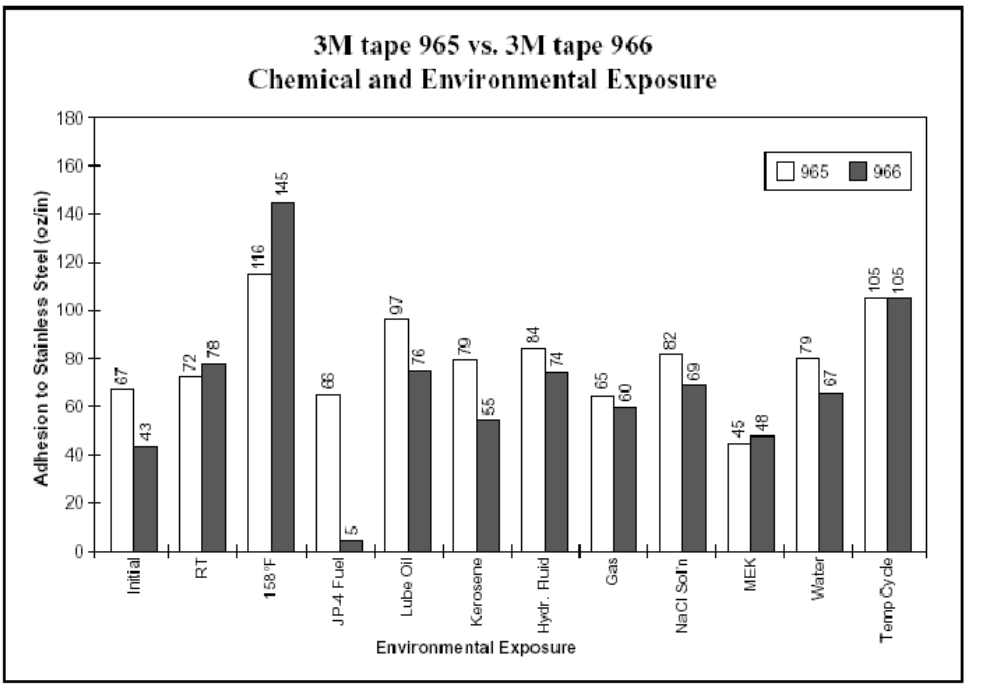
Chemical and Environmental Exposure

The 3M™ Adhesive 100 is well known in industry for environmental and chemical resistance. For many applications, any one of the products in this grouping will perform satisfactorily when exposed to different chemicals or temperatures. Jet fuels, however, are a challenge for pressure sensitive products. More specifically, the Aviation Turbine Fuel, Grade JP-4 (MIL H-T-5624), will attack many of the best adhesives within 72 hours. In response to the demands of this market and the corresponding military specification MIL-T-9906C, 3M™ Adhesive Transfer Tape 965 was developed as it differs slightly in chemistry from the rest of the 3M adhesive 100 family to provide the extra chemical resistance.

In addition to the added fuel resistance, 3M tape 965 retains all of the notable features of the adhesive 100: excellent adhesion to metals, good adhesion to high surface energy plastics, low outgassing, and excellent static shear values for room temperature and heated conditions. The chart below shows adhesion values (to stainless steel) of 3M™ Adhesive Transfer Tapes 965 and 966, with an emphasis on fuel and oil exposure. **The data represents representative or typical values and should not be used for specification purposes.**



Thermal and Electrical Properties for 3M tape 966

3M™ Adhesive Transfer Tape 966 was tested for the following properties; however, the results should be very similar for the other 3M™ Adhesive Transfer Tapes with 3M™ Adhesive 100.

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Thermal Conductivity (ASTM C518)	.103 BTU-ft/ft²-hr-°F (@105°F) .106 BTU-ft/ft²-hr-°F (@160°F) .108 BTU-ft/ft²-hr-°F (@214°F) .178 Watt/m-K (@41°C) .183 Watt/m-K (@71°C) .187 Watt/m-K (@101°C)
Coefficient of Thermal Expansion (ASTM-D696) **First heat (125-175°C)** **Second heat (25-175°C)**	 19.9 x 10^{-5} m/m/°C 58.4 x 10^{-5} m/m/°C
Insulation Resistance **(test voltage = 100 VDC, MIL-I-46058C)** **Before moisture resistance** **Cycle #4** **Cycle #10** **24 hr after moisture resistance**	 >1.0 x 10^{15} ohms 1.5 x 10^{11} ohms 9.4 x 10^{10} ohms 9.7 x 10^{12} ohms
Surface Resistance	>1.0 x 10^{15} ohms
Surface Resistivity	>5.6 x 10^{16} ohms
Volume Resistance	3.9 x 10^{11} ohms
Volume Resistivity (ASTM D257-92)	4.0 x 10^{15} ohm-cm
Dissipation Factor	0.025 (@1 kHz)
Dielectric Constant (ASTM D-150-92)	2.92 (@1 kHz)
Dielectric Strength (500 vac, rms. [60 Hz]/sec.) (ASTM D149-92)	1100 volts/mil

Application Ideas

Ideal tape application temperature range is 70°F to 100°F (21°C to 38°C) and application to surfaces at temperatures below 50°F (10°C) is not recommended for most pressure sensitive adhesives because the adhesive becomes too firm to adhere readily. However, once properly applied, low temperature holding is satisfactory. For more specific information, contact Customer Service at 1-800-223-7427.

The liner used for 3M™ Adhesive Transfer Tapes 9461P, 9461PC and 9462P is not intended to provide premium release characteristics. Testing is urged for applications where liner release is critical. These products are not recommended for use with non-transferable facestocks such as 3M™ Label Material 8070, 8071 or 8074 because of the potential for liner caused pre-destruct.

3M™ Adhesive Transfer Tape 965 has been specially modified to provide outstanding performance for fuel line identification labels, bar code labels for harsh environments and specially performance-engineered labels for automotive, aerospace and industrial markets. It also meets MIL-T-9906C specification requirements.

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

Property	Unit	1 mil 25µm	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(139)	33,500(231) 20,000(139)	ASTM D-882-91, Method A*
Ultimate Elongation at 23°C, (73°F) at 200°C (392°F)	%	72 83	82 83	ASTM D-882-91, Method A
Tensile Modulus at 23°C, (73°F) at 200°C (392°F)	psi (GPa)	370,000 (2.5) 290,000 (2.0)	370,000 (2.5) 290,000 (2.0)	ASTM D-882-91, Method A
Density	g/cc	1.42	1.42	ASTM D-1505-90
MIT Folding Endurance	cycles	285,000	5,000	ASTM D-2176-89
Tear Strength-propagating (Elmendorf), N (lbf)		0.07 (0.02)	0.58 (0.02)	ASTM D-1922-89
Tear Strength, Initial (Graves), N (lbf)		7.2 (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 (6000)	69 (10,000) 41 (6000)	ASTM D-882-91
Stress to produce 5% elong. at 23°C, (73°F) at 200°C (392°F)	MPa (psi)	90 (13,000) 61 (9000)	90 (13,000) 61 (9000)	ASTM D-882-92
Impact Strength at 23°C, (73°F)	N•cm•(ft lb)	78 (0.58)	78 (0.58)	DuPont Pneumatic Impact Test
Coefficient of Friction, kinetic (film-to-film)		0.48	0.48	ASTM D-1894-90
Coefficient of Friction, static (film-to-film)		0.63	0.63	ASTM D-1894-90
Refractive Index (sodium D line)		1.70	1.70	ASTM D-542-90
Poisson's Ratio		0.34	0.34	Avg. three samples, Elongated at 5, 7, 10%
Low temperature flex life		pass	pass	IPC-TM-650, Method 2.6.18

Table 2
Thermal Properties of 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 $\frac{cal}{cm•sec•°C}$	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	D_s=<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 (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.		

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Table 3
Typical Electrical Properties of 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)	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)	205	(5200)		
125 µm (5 mil)	154	(3900)		
Dielectric Constant			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			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	•cm			ASTM D-257-91
25 µm (1 mil)	1.5×10^{17}			
50 µm (2 mil)	1.5×10^{17}			
75 µm (3 mil)	1.4×10^{17}			
125 µm (5 mil)	1.0×10^{17}			

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

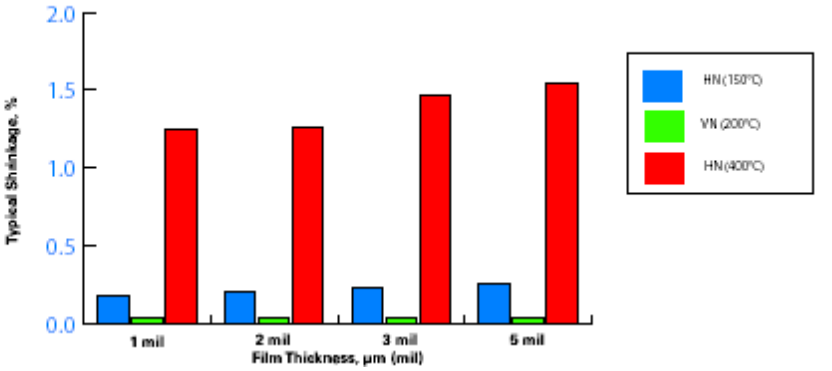

Table 4
Thermal Coefficient of Expansion, Kapton® HN Film, 25 µm (1 mil), Thermally Exposed

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

NOTE:
1. *When applying pressure sensitive adhesive films to any surface, be sure that the surface is free from oil or other surface contaminates such as powder, dust or release agents. Adhesive performance should be carefully checked when used on substrates containing plasticizers..*
2. *The above values are "Typical Values" which have a nominal range about them and are not intended for specification purposes.*