



ERBA ISOLANTI srl

Via Liguria n. 34/31 - 20068 Peschiera Borromeo (MI)
telef. 02/5530.3089 - fax 02/5530.3127

DATA: 24 Lug.01	PEN Films KALADEX 2000 for electrical insulation	Codice KX
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		Gruppo B



Kaladex® is DuPont's trademark for its range of biaxially oriented polyethylene naphthalate (PEN) films, introduced on a fully commercial basis in 1992. With its distinct polymer chemistry this new product range has been developed specifically to meet your need for cost-effective films with a performance between that of polyethylene terephthalate (PET) films such as DuPont's Melinex® and Mylar® and polyamide films such as DuPont's Kapton®. **Kaladex®** PEN films offer you:

- **New and expanded market opportunities** – in applications with technical requirements at or beyond the limits of PET performance and where it is uneconomical to use currently available materials.
- **Reduced manufacturing costs** – with reduced wastage, increased production yields or better throughput in critical applications.
- **Reduced material costs** – by replacing overspecified materials in current use.

Kaladex® PEN films are particularly suited to a wide range of applications in areas such as:

- Electrical insulation, where **Kaladex®** offers RTI's suitable for Class F applications.
- Labels
- Electronic applications such as flexible printed circuits, membrane touch switches, flexible heaters etc.
- General industrial and graphics applications such as belts, diaphragms, transfer tapes etc
- Packaging

Made by a similar stenter process to Melinex® and Mylar® PET films, **Kaladex®** is biaxially oriented and heat set. Films in the range thus offer many of the benefits familiar to users of PET – ease of handleability, processing and printing, excellent optical properties etc – together with enhanced performance in terms of:

- Higher glass transition temperature (Tg) of 120°C, vs 78°C for PET films
- Superior long term temperature ageing performance – exceeds Class F (155°C) continuous use temperature
- Better dimensional stability at elevated temperatures, in terms of lower shrinkages and better retention of mechanical properties
- 25% higher stiffness (Young's modulus) than PET
- Improved water hydrolysis resistance towards water, steam and alkalis
- Better retention of mechanical properties on UV exposure/weathering
- Very low levels of extractable oligomers

These performance characteristics in combination with DuPont's leading expertise in polymer science and film pretreatment technology provide the basis for a highly attractive product range. **Kaladex®** PEN films are currently qualified in a number of wide-ranging applications and DuPont is working closely with customers to develop further opportunities. Samples of the current **Kaladex®** grade range are available for testing and evaluation, and further grades will follow as the market demands.

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Property	Test Method	Units	Value
General			
Film Thickness		microns	75
Area Yield		sq.m/kg	9.80
Density		g/cc	1.36
Mechanical			MD/TD*
Tensile strength	ASTM D 882-88	MPa	200/200
Elongation to Break	ASTM D 882-88	%	60/60
F5 (force to elongate 5% of gauge length)	ASTM D 882 (50% strain rate)	MPa	135/135
Young's Module	ASTM D 882-88	MPa	5000/5000
Tear Initiation Resistance	ASTM D 1004	kg	5.0/5.0
Tear Propagation Resistance	ASTM D 1938	kg	0.045/0.045
Slip (coefficient of static friction)	ASTM D 1894-78 (modified to DuPont method)		0.27
Hydrolysis Resistance	Retention of tensile strength on immersion in water at 90°C for 1680 hours	%	90/90
Optical			
Haze	ASTM D 1003-77 (Gardner Hazemeter)	%	25
Total Luminous Transmission (TLT)	ASTM D 1003-77 (Gardner Hazemeter)	%	84
Electrical			
Volume Resistivity	ASTM D 257-83 (100 V d.c. at 25°C and 1000s)	log Ohm m	16
Surface Resistivity	ASTM D 257-83 (500 V d.c. at 20°C and 54% r.h.)	log Ohm/sq	15
Breakdown Voltage	ASTM D 149-81 (0.25 inch electrodes in dry air at 25°C)	kV	15.5

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Property	Test Methods	Unit	Value		
Electrical (continued)					
Permittivity	ASTM D 150-81				
23°C, 50 Hz				3.24	
23°C, 1 kHz				3.22	
23°C, 10 kHz				3.20	
50°C, 50 Hz				3.27	
100°C, 50 Hz				3.29	
150°C, 50 Hz				3.40	
Dissipation factor:	ASTM D 150-81				
23°C, 50 Hz				--	0.0034
23°C, 1 kHz				--	0.0042
23°C, 10 kHz				--	0.0048
50°C, 50 Hz				--	0.0048
100°C, 50 Hz				--	0.0055
150°C, 50 Hz				--	0.0125
Thermal					
Melting Point (Peak)		°C	262		
Glass Transition Temperature (Tg)	DSC	°C	120		
Coefficient of Thermal Expansion (between 10 and 40°C)		1/K (cm/cm°C)	20x10 ⁻⁶ /21x10 ⁻⁶		
Continuous Use Temperature	UL746B				
	Mechanical w/o Impact ^x	°C	160		
	Electrical ^x	°C	180		
Shrinkage 190°C, 5 mins		%	0.8/0.8		
Flammability	UL94 ^x		VTM-2		

* MD Machine direction
 * TD Transverse direction
 x File No. E151234

The foregoing data have been obtained using standard test procedures on defined specimens. The results should therefore only be regarded as a general guide to material properties and not as design data.