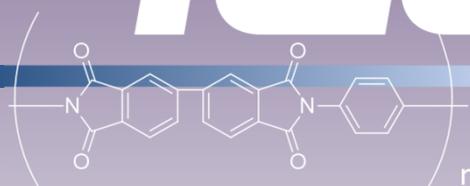


UBE



**UBE Polyimide Film
Exhibits Industry Leading
Heat Resistance**

UPILEX[®]



ユーピレックス[®]

Super-heat resistant polyimide film produced from UBE's exclusive "BPDA (Biphenyl tetracarboxylic dianhydride)" monomers.
This formulation is unique to UBE and exhibits outstanding dimensional stability, low water absorption and very high chemical resistance.

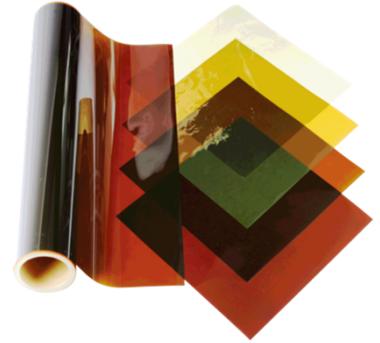
UBE Corporation

Advantages of "UPILEX®"

Heat-resistant and functional Polyimide film derived from BPDA

In addition to the excellent properties of general polyimide resins (heat resistance, high mechanical properties and excellent electrical insulating properties), UBE's polyimide film "UPILEX®" has various advantages unique to our formulation.

- High heat resistance---
"UPILEX®-S" can be used in high-temperature processes just below 500°C. This exceeds industry standard operating temperatures around 300°C.
- High mechanical properties---
Upilex has excellent wear resistance and toughness. This allows use of thinner films in applications where strength is critical.
- Chemical resistance---
It has excellent chemical resistance to organic solvents, gasoline, automotive oil, alkalis, acids etc..
- High-performance technology---
The industry leading surface uniformity and smoothness of "UPILEX®" improves performance and adds value to your application.



Grade lineup

UBE developed advanced film grades by customizing the base technology of the polyimide film surface, while maintaining the many advantages of the existing grade "UPILEX®-S". "UPILEX®" is used globally by many customers, who all demand the exceptional performance we deliver.

Base grade

UPILEX®-S

- **Mechanical properties:**
High tensile strength and modulus. Demonstrates outstanding mechanical characteristics through a wide temperature range.
- **Electrical properties:**
Excellent electrical characteristics over a wide range of temperatures and frequencies.

- **Thermal properties:**
Outstanding heat resistance. Excellent heat shrinkage and dimensional stability.
- **Environmental resistance:**
Low water absorption and hygroscopic expansion.
- **Chemical resistance:**
Insoluble in all organic solvents and resistant to chemicals (acids and alkalis etc.).
- **Smooth surface:**
Excellent surface smoothness allows fine pitch patterning.

Molding grade

UPILEX®-RN

- **Molding processability:**
Elongation over 100%. Excellent moldability for embossing due to better flexibility and lower modulus than "UPILEX®-S".
- **Environmental resistance:**
Molded articles have excellent heat resistance and chemical resistance, so they are used in insulation applications and in applications requiring environmental resistance.

Polyimide resin equivalent of UPILEX®-S

Function of the film surface

Enhanced thermal adhesion to metal

Surface thermal adhesion grade

UPILEX®-VT UPILEX®-NVT

As base films for laminated multilayer FPC and two-layer CCL, they have superior heat bonding characteristics and physical properties.

Enhanced adhesion of resin surface

Improved adhesion for sputtering, plating

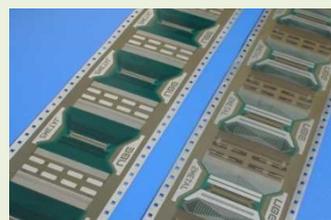
UPILEX®-SGA

It is suitable for sputtering or plating process and has superior mechanical properties. Dimensional stability and chemical resistance are equal to "UPILEX®-S".

Base grade

UPILEX®-S

The standard grade of UBE polyimide "UPILEX®". Compared to other polyimide films, it has better surface smoothness and higher chemical resistance, greater stiffness and much higher heat resistance. Outgassing is very low, so it is easy to use.



Grades and Area factor of "UPILEX®-S"

Type	Grade	Thickness (μm)	Width* (mm)	Area factor (m ² /kg)
UPILEX®-S	12.5SN	12.5	508,514	54.4
	25S	25	508,514/1016,1028	27.2
	50S	50	508,514/1016,1028	13.6
	75S	75	508,514/1016,1028	9.1
	125S	125	508,514	5.4

*For custom widths, please contact us.

(1) Mechanical properties

"UPILEX®-S" delivers outstanding mechanical characteristics across a wide temperature range. It also demonstrates high tensile strength and modulus, and even features outstanding long-term heat resistance. Another exceptional feature of "UPILEX®-S" is its high resistance to hydrolysis, as demonstrated by its properties being virtually unaffected even when it is immersed in boiling water for long periods of time.

Property	Unit	Standard value								Measurement Method
		UPILEX -25S				UPILEX -50S	UPILEX -75S		UPILEX -125S	
		-269°C	-196°C	25°C	300°C	25°C	25°C	200°C	25°C	
Tensile strength	MPa	740	650	520	290	460	360	270	340	ASTM D882
Stress at 5% elongation	MPa	-	-	260	90	-	210	110	-	ASTM D882
Elongation	%	10	20	40	70	50	50	80	60	ASTM D882
Tensile modulus	GPa	-	-	9.1	3.7	9.3	6.9	3.8	7.6	ASTM D882
Tear strength-initiation [Graves]	N/mm	-	-	600	-	-	470	-	-	ASTM D1004
Tear strength-propagation [Elmendorf]	N	-	-	3.2	-	-	4.2	-	-	ASTM D1922
Folding endurance [MIT]	Cycles	-	-	>100,000	-	-	>12,000	-	-	ASTM D2176
Density	×10 ³ kg/m ³	-	-	1.47	-	1.47	1.47	-	1.47	ASTM D1505
Coefficient of kinetic friction (film-to-film)	-	-	-	0.4	-	-	0.4	-	-	ASTM D1894

(2) Electrical properties

"UPILEX®-S" exhibits excellent electrical characteristics over a wide range of temperatures and frequencies. Even at high temperatures, "UPILEX®-S" shows almost no deterioration in its electrical properties, unlike other plastic-type films. It also displays a low level of electrical insulation defects, making it an optimal choice for electrical and electronic uses that demand high reliability.

Property	Unit	Standard value				Measurement condition	Measurement Method
		UPILEX-25S		UPILEX-75S			
		25°C	200°C	25°C	200°C		
Dielectric strength	kV	6.8	6.8	11	11	60Hz	ASTM D149
Dielectric constant	-	3.5	3.3	3.3	3.2	1kHz	ASTM D150
		-	-	3.5	-	1MHz	ASTM D150
Dissipation factor	-	0.0013	0.0078	0.0038	0.0056	1kHz	ASTM D150
		-	-	0.0049	-	1MHz	ASTM D150
Volume resistivity	Ω·m	>10 ¹⁴	>10 ¹³	>10 ¹⁴	>10 ¹⁴	DC 100V	ASTM D257
Surface resistivity	Ω	>10 ¹⁷	10 ¹⁵	>10 ¹⁶	>10 ¹⁵	DC 100V	ASTM D257

(3) Thermal properties

“UPILEX®-S” boasts the highest heat resistance of any plastic film currently available. Its major features include a high starting temperature for thermal decomposition, smaller values for both heat shrinkage and thermal linear expansion coefficients, as well as flame resistance (UL94 VTM-0). Therefore, “UPILEX®-S” changes little in size even when heated. This makes it ideal for use in FPC and TAB-tape substrates composed of minute circuits.

Property	Unit	Standard value				Measurement condition	Measurement Method
		UPILEX -25S	UPILEX -50S	UPILEX -75S	UPILEX -125S		
Thermal linear expansion coefficient (50-200°C)	ppm/°C	12	16	20	22	Rise rate of temperature 5°C/min	Fine linear dilatometer
Heat shrinkage	%	0.05	0.02	0.01	0.01	200°C, 2h	ASTM D1204
Melting point	°C	なし				-	-
Specific heat	kJ/(kg·K)	1.13				-	Differential scanning calorimeter
Heat life (Tensile strength)	°C	290				20,000h	Fixed temperature method
Flammability	-	V-0				-	UL94
Oxygen index	%	66				-	JIS K7201
Thermal conductivity	W/(m·K)	0.29				Thickness direction	Laser flash method

(4) Chemical-resistant properties

“UPILEX®-S” is insoluble in all organic solvents and is sufficiently resistant to virtually all chemicals, including inorganic acid and alkali solutions. This chemical resistance provides exceptional physical properties as well as superior dimensional stability when “UPILEX®-S” is exposed to chemicals.

As resistance to various automotive oils (engine oil, brake oil, gasoline, etc.) is strong, it is suitable for use in many automotive applications.



UPILEX General Polyimide

Property		Standard value (UPILEX-25S)			Measurement condition	Measurement Method	
		Strength retention (%)	Elongation retention (%)	Modulus retention (%)			
Chemical resistance	10% sodium hydroxide	80	60	95	25°C 5days Immersion	ASTM D882	
	Glacial acetic acid	100	95	100	110°C 5weeks Immersion		
	Water	PH=1.0	95	85	100		100°C 2weeks Immersion
		PH=4.2	95	85	100		100°C 2weeks Immersion
		PH=8.9	95	85	100		100°C 2weeks Immersion
		PH=10.0	95	85	100		100°C 4days Immersion
Water absorption		1.4%			23°C 24h Water Immersion	ASTM D570	
		0.8%			50°C RH60% Equilibrium		
Gas permeability	Water vapor	1.7×10 ⁻³ kg/m ² /25µm			38°C, RH90%, 24h	ASTM E96	
	Oxygen	0.8×10 ⁻⁶ m ³ /m ² /25µm			30°C, 1atm 24h	ASTM D1434	
	Carbon dioxide	1.2×10 ⁻³ m ³ /m ² /25µm			30°C, 1atm 24h	ASTM D1434	

(5) Comparison of film properties

■ ■ General properties of various heat-resistant films ■ ■

Property	Unit	UPILEX-25S	General Polyimide	Polyester	Polysulfone	Polytetra fluoroethylene
Density	×10 ³ kg/m ³	1.47	1.42	1.38-1.41	1.24-1.25	2.1-2.2
Tensile strength	MPa	520	170	140-250	60-70	10-30
Elongation	%	40	70	60-170	60-110	100-400
Tensile modulus	GPa	9.1	3.0	-	-	-
Tear strength-propagation [Elmendorf]	N	3.2	3.1	4.9-10.8	3.9-4.9	3.9
Chemical resistance	Organic solvents	Excellent	Excellent	Excellent	Excellent	Excellent
	Strong acids	Good	Good	Good	Excellent	Excellent
	Strong alkalis	Good	Poor	Good	Excellent	Excellent
Dielectric constant	-	3.5	3.5	3.2	3.1	2.1
Dissipation factor	-	0.0013	0.003	0.005	0.0008	0.0002

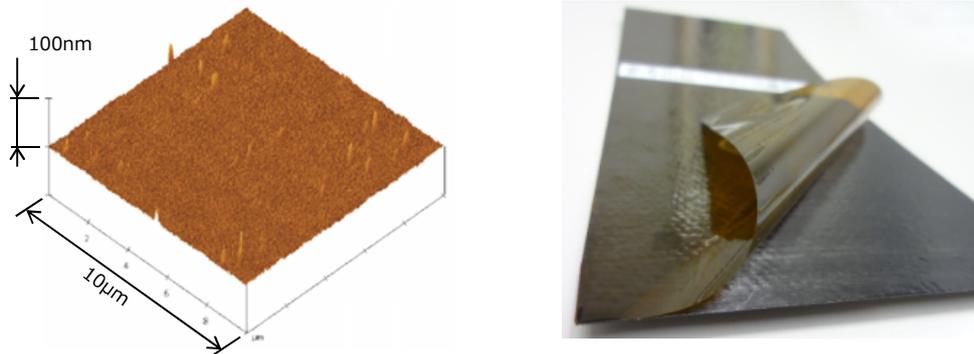
(6) Smooth surface

"UPILEX®-S" has an excellent smooth surface with low roughness. Therefore, it can also be suitably used as a film carrier base for other high heat resistance resins, cushioning materials or releasing materials.

■ ■ Surface flatness ■ ■

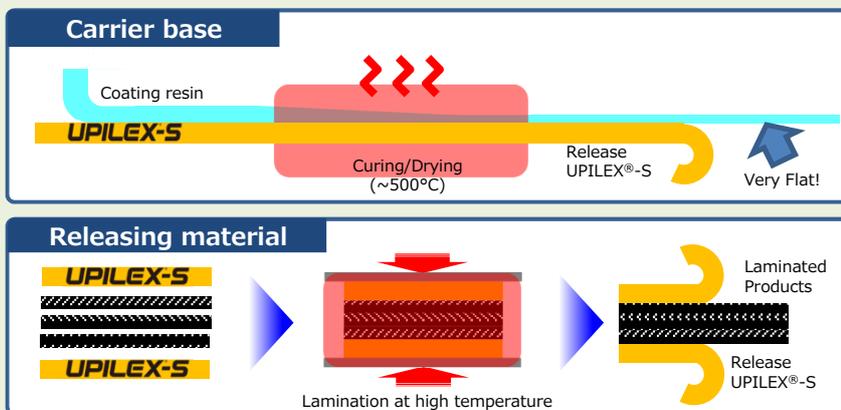
Surface Roughness	Unit	Standard value				General Polyimide	PET	Measurement method
		UPILEX -25S	UPILEX -50S	UPILEX -75S	UPILEX -125S			
Rms	nm	3.8	2.0	2.2	2.1	5.6	-	Scanning probe microscope (Scan area = 10mm x 10mm)
Ra	nm	2.1	1.2	1.3	1.1	3.2	22	
Rz	nm	64.9	60.3	57.8	51.5	100	-	

■ ■ AFM Image of "UPILEX®-50S" ■ ■

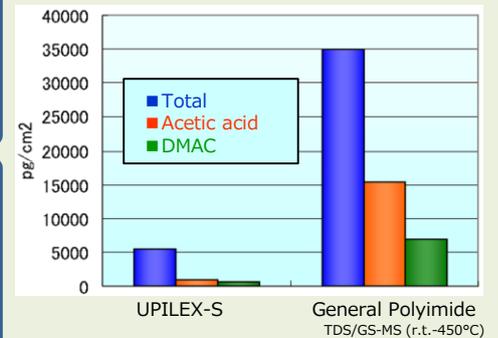


< Carrier base, Releasing material Application Examples >

Since outgassing is very low compared to general polyimide, it is the perfect film for many applications with vacuum and/or high-temperature processing. And, resin coats formed from a carrier base of "UPILEX®-S" have moderate adhesion strength to peel off later and offer a very smooth surface.



■ ■ Outgassing when heated ■ ■



■ ■ Adhesion strength between "UPILEX®-S" and film products ■ ■

Coated/Laminated Resin		180° Peel Strength (N/10mm)	Sample preparation (Carrier = UPILEX-25S)
Grade	Thickness (µm)		
Nitto Denko 31B	34	3.0	Laminate 31B and UPILEX-S at room temperature
	34	5.2	Laminate 31B and UPILEX-S at room temperature And leave it for 20h at 70°C
Nichiban LP24	42	2.1	Laminate LP24 and UPILEX-S at room temperature
	42	3.8	Laminate LP24 and UPILEX-S at room temperature And leave it for 20h at 70°C
Epoxy Resin	38	1.2 ¹⁾	Coating Epoxy resin on UPILEX-S and curing 1) peel off at an angle of 90°
Epoxy Prepreg	91	1.0	Laminate epoxy prepreg and UPILEX-S
UPILEX®-25VT	25	0.08	Laminate UPILEX-25VT and UPILEX-S at 320°C
UPIA®-ST (U-Varnish-S)	26	1.1	Coating UPIA®-ST(U-Varnish-S) on UPILEX-S And curing at max 400°C

Molding grade

UPILEX®-RN

“UPILEX®-RN” has many excellent physical characteristics, including molding process-ability and environmental resistance. Therefore “UPILEX®-RN” can be used in embossing, speaker diaphragms, aerospace applications, etc..

- “UPILEX®-RN” has excellent tolerance not only to acids and organic solvents, but also to alkalis.
- “UPILEX®-RN” has excellent heat resistance ,electrical properties, and radiation resistance.
- Since it has excellent elongation through heating and pressing, it is easy to make solid components using drawing process. Molded articles have excellent strength characteristics.
- “UPILEX®-RN” can form an excellent insulating layer by ribbon winding to a conductor such as a coil, due to it’s low modulus and high flexibility compared to “UPILEX®-S”.



Grades and Area factor of “UPILEX®-RN”

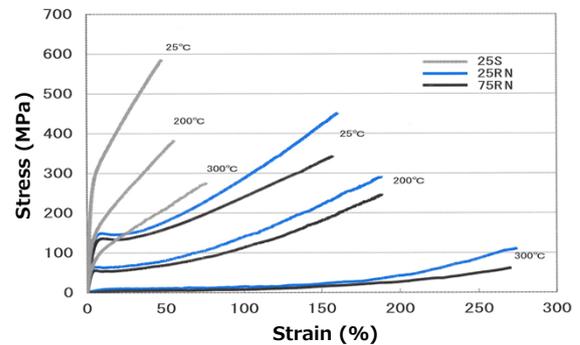
Type	Grade	Thickness (μm)	Width* (mm)	Area factor (m ² /kg)
UPILEX®-RN	25RN	25	508	28.8
	50RN	50	508	14.4
	75RN	75	508	9.6
	125RN	125	508	5.8

*For custom widths, please contact us

(1) Mechanical properties

Property	Unit	Standard value		Measurement Method
		UPILEX-25RN	UPILEX-75RN	
Tensile strength	MPa	390	380	ASTM D882
Elongation	%	160	150	ASTM D882
Tensile modulus	GPa	3.9	3.9	ASTM D882
Density	×10 ³ kg/m ³	1.39	1.39	ASTM D-1505-03

Stress-Strain Curve of “UPILEX®-RN”



(2) Electrical properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25RN	UPILEX-75RN		
Dielectric strength	kV	7.1	13.9	60Hz	ASTM D149
Dielectric constant	-	3.4	3.5	1MHz	ASTM D150
Dissipation factor	-	0.007	0.007	1MHz	ASTM D150
Volume resistivity	Ω·m	>10 ¹⁴	>10 ¹⁴	DC 100V	ASTM D257
Surface resistivity	Ω	>10 ¹⁵	>10 ¹⁶	DC 100V	ASTM D257

(3) Thermal properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25RN	UPILEX-75RN		
Heat life (Tensile strength)	°C	270	270	20,000h	Fixed temperature method
Flammability	-	V-0	V-0	-	UL94

(4) Chemical property

Property	Unit	Standard value		Measurement Method
		UPILEX-25RN	UPILEX-75RN	
Water Absorption	%	1.4	1.7	ASTM D570

Surface thermal adhesion grade

UPILEX®-VT UPILEX®-NVT



“UPILEX®-VT” and “UPILEX®-NVT” are heat bonding polyimide films having heat fusing layers on both side of the film, created by the polyimide resin equivalent of “UPILEX®-S”.

High quality flexible circuits without an adhesive layer are obtained, by heating and pressing “UPILEX®-VT” or “UPILEX®-NVT” with metal (Cu, SUS, Al) foil.

In addition, they are also available for bonding films comprised of metal, ceramic and other materials.

- Flexible circuits without adhesive are produced.
- This offers high tensile strength and tear strength.
- Offering the same low water absorption, low dimensional change and high heat resistance as “UPILEX®-S”, with the addition of laminate workability in the heat press.



■ Grades and Area factor of “UPILEX®-VT, NVT” ■

Type	Grade	Thickness (μm)	Width* (mm)	Area factor (m ² /kg)
UPILEX®-VT	12.5VT	13	510, 520	57.1
	20VT	20	510, 520	35.1
	25VT	25	510, 520	28.0
	50VT	50	510, 520	13.9
UPILEX®-NVT	12.5NVT	13	510, 520	55.1
	20NVT	20	510, 520	35.5
	25NVT	25	510, 520	28.4
	50NVT	50	510, 520	14.0

*For custom widths, please contact us.

(1) Mechanical properties

Property	Unit	Standard value		Measurement Method
		UPILEX-25VT	UPILEX-50VT	
Tensile strength	MPa	530	540	ASTM D882
Tear strength	N/mm	3.0	4.3	IPC-TM-650 2.4.17.1
Elongation	%	90	90	ASTM D882
Tensile modulus	GPa	7.5	7.6	ASTM D882
Density	×10 ³ kg/m ³	1.43	1.44	ASTM D-1505-03

(2) Electrical properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25VT	UPILEX-50VT		
Dielectric strength	kV	7.2	10.5	60Hz	ASTM D149
Dielectric constant	-	3.2	3.3	1GHz	Triplate-Line Resonator
		3.2	3.3	10GHz	Triplate-Line Resonator
Dissipation factor	-	0.005	0.004	1GHz	Triplate-Line Resonator
		0.007	0.007	10GHz	Triplate-Line Resonator
Volume resistivity	Ω·m	>10 ¹⁴	>10 ¹⁴	DC 100V	ASTM D257
Surface resistivity	Ω	>10 ¹⁵	>10 ¹⁵	DC 100V	ASTM D257

(3) Thermal properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25VT	UPILEX-50VT		
Thermal linear expansion coefficient (50-300°C)	ppm/°C	20	20	-	Fine linear dilatometer
Heat shrinkage	%	0.31	0.35	300°C, 2h	JIS C2318
Thermal decomposition temp. at 5% weight loss	°C	584	582	In Air	TG-DTA
Flammability	-	V-0	V-0	-	UL94

(4) Chemical properties

Property	Unit	Standard value		Measurement Method
		UPILEX-25VT	UPILEX-50VT	
Water absorption	%	1.1	1.4	ASTM D570
Moisture Absorption	ppm/%RH	14	13	UBE method

Improved adhesion for sputtering, plating

UPILEX®-SGA



“UPILEX®-SGA” is a polyimide film having improved adhesion properties created by a special process to both sides of the “UPILEX®-S”. It is suitable for sputtering or plating processes because of high surface adhesion. It offers a flexible base for high-performance electronic circuits. In addition, it can also be used as an adhesive tape base material for LOC packaging.

- In sputtering or plating, a flexible base for electronic circuits that does not use any adhesives can be obtained.
- Peel strength is high, surface smoothness is very high.
- Superior mechanical property, with low water absorption, excellent dimensional stability and high heat resistance comparable to “UPILEX®-S”.



■ ■ Grades and Area factor of “UPILEX®-SGA” ■ ■

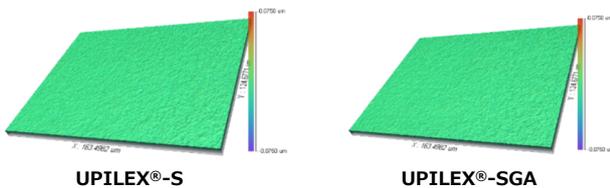
Type	Grade	Thickness (μm)	Width* (mm)	Area factor (m ² /kg)
UPILEX®-SGA	25SGA	25	508	27.2
	50SGA	50	508	13.6

*For custom widths, please contact us

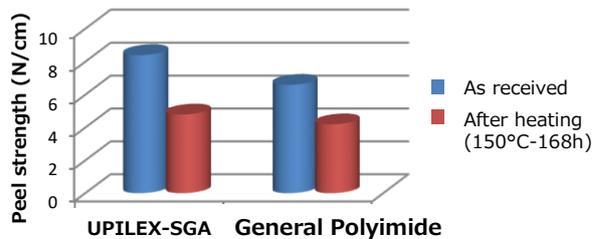
(1) Mechanical properties

Property	Unit	Standard value		Measurement Method
		UPILEX-25SGA	UPILEX-50SGA	
Tensile strength	MPa	490	490	ASTM D882
Elongation	%	40	45	ASTM D882
Tensile modulus	GPa	10	9.7	ASTM D882
Density	×10 ³ kg/m ³	1.47	1.47	ASTM D-1505

■ ■ Surface morphology of “UPILEX®” ■ ■



■ ■ Peel strength of “UPILEX®-SGA” ■ ■



(2) Electrical properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25SGA	UPILEX-50SGA		
Dielectric strength	kV	6.4	10.6	60Hz	ASTM D149
Dielectric constant	-	3.4	-	1GHz	IPC-TM650 2.5.5.9
Dissipation factor	-	0.003	-	1GHz	IPC-TM650 2.5.5.9
Volume resistivity	Ω·m	>10 ¹⁴	>10 ¹⁴	DC 100V	ASTM D257
Surface resistivity	Ω	>10 ¹⁶	>10 ¹⁶	DC 100V	ASTM D257

(3) Thermal properties

Property	Unit	Standard value		Measurement condition	Measurement Method
		UPILEX-25SGA	UPILEX-50SGA		
Thermal linear expansion coefficient (50-200°C)	ppm/°C	13	14	-	Fine linear dilatometer
Heat shrinkage	%	0.06	0.06	200°C, 2h	ASTM D1204

(4) Chemical property

Property	Unit	Standard value		Measurement Method
		UPILEX-25SGA	UPILEX-50SGA	
Water absorption	%	1.2	1.4	ASTM D570

Packing and handling precautions

(1) Packing example



(2) Handling precautions

- When handling "UPILEX®" at high temperatures attention should be paid to ventilation. This is because DMAC, which "UPILEX®" contains traces of, produces carbon monoxide at temperatures over 300°C and at high temperatures, in excess of 500°C, "UPILEX®" generates pyrolytic products. Ventilation should be adequate to ensure that concentrations of DMAC and carbon monoxide are kept to safe levels (10ppm and 100ppm). In addition, breathing safety equipment, such as organic gasmasks, should be used to prevent the inhalation of fumes.
- Please refer to Safety Data Sheet (SDS) before use.

(3) Content Statement

The content provided is based on materials, data and information currently available and no guarantee is given with regard to content, physical properties or hazardous and harmful effects. Furthermore, handling precautions relate to normal handling. In unique situations requiring special handling, please use safety measures appropriate for the application and process.



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