UPILEX®-RN

UPILEX-RN	-	High elongation polyimide film
UPILEX-S	-	High temperature polyimide film

UBE's UPILEX-RN film offers a unique property mix for many applications like:

Vacuum bagging film
Release film
Separation film
Flexible printed circuits
Heating film
Electrical isolation
Speaker cone

Summary

The very good physical, mechanical, electrical and chemical resistance properties are available over a wide temperature range, which has opened a wide application field for this type of film material.
UPILEX offers the best chemical resistance of all polyimide materials. It has no melting point and has the highest UL94 flammability rating VTM-0. The unique properties of UBE's UPILEX-RN and UPILEX-S polyimide films make these films ideal if high process temperatures and tensile strength are required.

UPILEX-RN polyimide films are the first choice polyimide film if high temperatures up to 400°C and higher, depending on the duration combined with good elongation properties are required. UPILEX-RN retains its physical properties even when exposed to chemicals.

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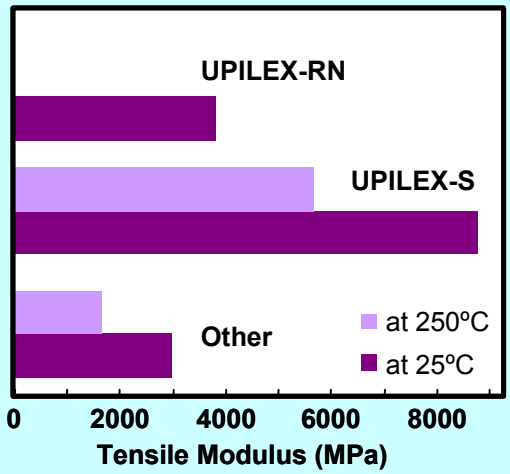
High tensile modulus

UPILEX®-RN and -S both have mechanical properties, which are considerably better than competitive products. In particular, UPILEX-S shows outstanding performance, with a tensile strength of 520 MPa, and a tensile modulus of 9121 MPa - more than twice of what was previously available. UPILEX-RN offers excellent elongation of 172% and a tensile strength of 402 MPa. In addition, there is very small degradation of these properties at high temperatures, enabling the use of these materials under extreme temperatures.



Superior dimensional stability

UPILEX-S and -RN have dimensional stability by far outperforming currently available products. Linear expansion, heat shrinkage and hygroscopic expansion are all extremely small.

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Mechanical Properties

UPILEX-RN offers:

- outstanding elongation properties
- very high tear strength
- very low out-gassing especially for water
- low heat shrinkage
- outstanding chemical resistance

Table-1: Mechanical Properties, Typical Values

Properties	Unit	UPILEX-RN				Test Method
		25µm	50µm	75µm	125µm	
Tensile Strength	MPa	402	373	379	349	ASTM D882
Elongation	%	172	142	153	138	ASTM D882
Tensile Modulus	MPa	3932	3491	3716	3658	ASTM D882
Initial Tear Strength [Graves]	N	344	647	929	1391	ASTM D1004
Density	g/cm^3	1.39				
Coefficient of Kinetic Friction (film-to-film)	–	0.4				

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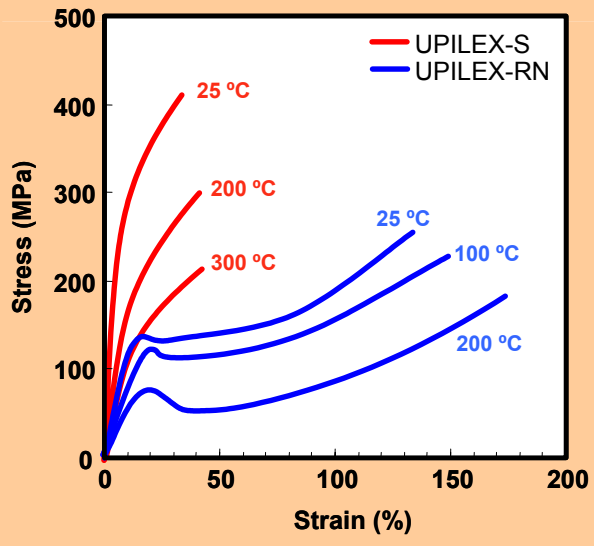
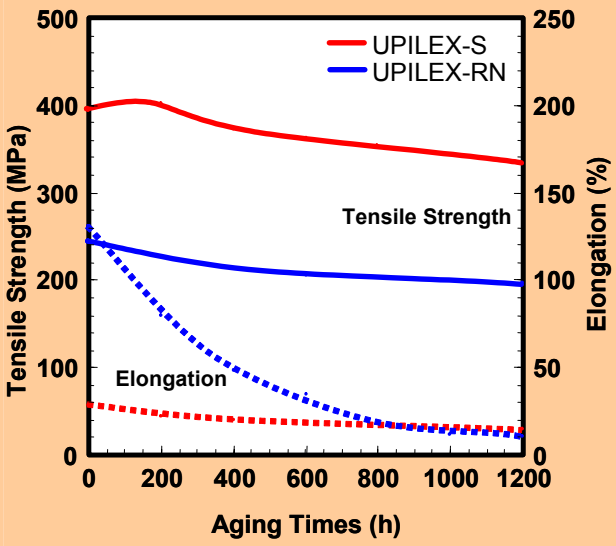
Thermal Properties

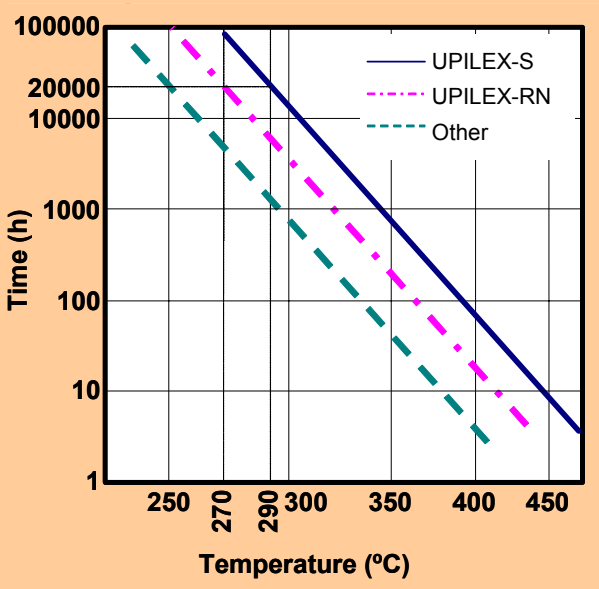
Tensile Strength-Stress Curves



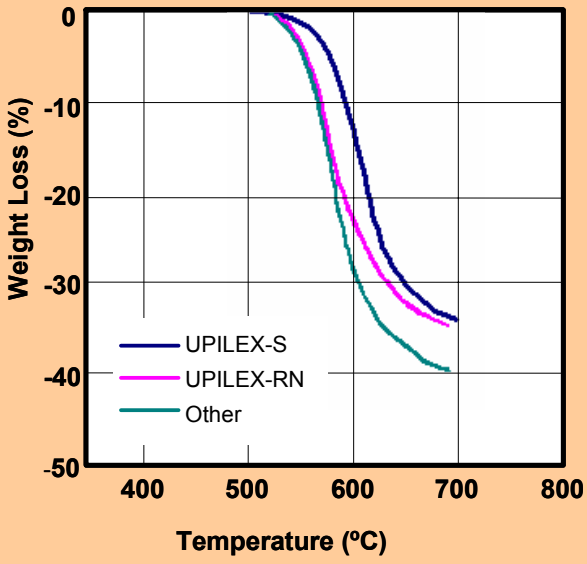
Tensile Strength and Elongation vs. Aging



Temperature to 50% Reduction in Tensile



Thermal Degradation Behavior



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Outstanding heat resistance

UPILEX –RN and –S have no melting point. The glass transition temperature for UPILEX-RN is 285°C. The film can be used at 400°C for several hours before loosing 50% of its tensile strength.

Both UPILEX-RN and -S withstand continuously (20.000h) temperatures of 270 °C and above. (Please see diagrams previous page)

Table-2: Thermal Properties, Typical Values

Properties	UPILEX-RN				Test Conditions
	25µm	50µm	75µm	125µm	
Heat shrinkage (%)	0.03	0.03	0.06	0.09	200°C, 2hr JIS C2318
Thermal Coefficient of Linear Expansion between 50–200°C (ppm /°K)	43	43	43	45	Values determined by minute linear expansion tester at 5°C/min. temperature increments
Melting Point (°C)	None				
Specific Heat (J/g/°K)	1.09				Differential Scanning Calorimeter
Temperature Index (°C)	270				Heat Treatment: 20000 h
Glass Transition Temperature (°C)	>285				
Flammability	UL94 V-0				UL94 File No.48133
Oxygen Index (%)	55				JIS K7201
Thermal Conductivity (W/m/°K)	0.24				Laser Flash Method

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Electrical properties

UPILEX-RN exhibits excellent electrical characteristics over a wide range of temperatures and frequencies. Even at high temperatures, UPILEX-RN shows remarkably slight deterioration in its electrical properties.

Table-3: Electrical Properties (Typical Values)

Properties	Unit	UPILEX-RN				Test conditions	Test Method
		25μm	50μm	75μm	125μm		
Dielectric Strength	kV	6.5	12.0	13.8	15.6	50Hz	ASTM D149
Dielectric Constant	–	3.2	3.2	3.4	3.5	10^3 Hz	ASTM D150
Dissipation Factor	–	0.0018	0.0017	0.0023	0.0018	10^3 Hz	ASTM D150
Volume Resistivity	Ω cm	$4.3*10^{16}$	$6.7*10^{16}$	$5.3*10^{16}$	$5.9*10^{16}$	DC100V	ASTM D257

Chemical-Resistance Properties

UPILEX-RN is insoluble in all organic solvents and is sufficiently resistant to virtually any chemicals, including inorganic acid and alkali solution and so forth. UPILEX-RN retains its physical properties and superior dimensional stability even when exposed to chemicals.

Table-4-1: Chemical Prosperities: water absorption and gas permeability (Typical Values)

Properties		UPILEX-25RN	Test Conditions	Test Method
Water Absorption		1.4%	Immersion 24 h in H_2O @ 23°C	ASTM D570
Gas Permeability	Water Vapor	$1.7g/m^2$	24 h @ 38°C, 90%RH	ASTM E96
	Oxygen	$100\ ml/m^2$	24 h @ 30°C, 1 bar	ASTM D1434
	Nitrogen	$30\ ml/m^2$		
	Carbon Dioxide	$115\ ml/m^2$		
	Helium	$2200\ ml/m^2$		

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Table-4-2: Chemical Resistant Prosperities (typical values for UPILEX-25RN)						
Resistance to		(%)			Test Conditions	Test Method
		Strength Retained	Elongation Retained	Modulus Retained		
10% NaOH		85	80	105	Immersion @ 25°C for 5 days	ASTM D882
Glatial Acetic Acid CH_3COOH		110	105	115	Immersion @ 110°C for 5 weeks	
P-Cresol		55	140	50	Immersion @ 200°C for 3 weeks	
H_2O	PH = 1.0	100	90	110	Immersion @ 100°C for 2 weeks	
	PH = 4.2	100	85	115	Immersion @ 100°C for 2 weeks	
	PH = 8.9	100	90	115	Immersion @ 100°C for 2 weeks	
	PH = 10.0	100	95	115	Immersion @ 100°C for 4 days	

Environmental Resistance

UPILEX-RN features low water absorption and hygroscopic expansion. Another advantage of UPILEX-RN is its low absorption/desorption speeds and superior weather resistance.

Table-5: Dimensional Stability: when immersed in various chemical solutions and solvents (typical values for UPILEX-RN)									
Chemicals	Immersion Conditions	Dimensional Stability (%)							
		25 RN		50 RN		75 RN		125 RN	
		MD	TD	MD	TD	MD	TD	MD	TD
Ferric Chloride (37%)	23°C, 10 min.	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Cupric Chloride (37%)	23°C, 10 min.	+0.00	-0.00	+0.00	-0.00	+0.00	+0.00	+0.00	+0.00
5%NaOH	60°C, 10 min.	+0.00	-0.00	+0.00	-0.00	+0.00	+0.00	+0.01	+0.01
	60°C, 30 min.	-0.00	-0.02	-0.00	-0.01	+0.00	-0.00	+0.01	-0.01
2N-Hydrochloric Acid	23°C, 10 min.	-0.00	-0.00	-0.00	-0.00	-0.00	+0.00	-0.00	+0.00
2N-NaOH	23°C, 10 min.	+0.00	+0.00	+0.00	+0.00	-0.00	+0.00	+0.01	+0.01
Isopropanol	23°C, 10 min.	+0.00	+0.01	+0.00	+0.00	+0.00	+0.00	+0.00	+0.00
Toluene	23°C, 10 min.	+0.01	+0.01	+0.01	+0.01	+0.01	+0.00	+0.00	+0.00
Methyl Ethyl Ketone	23°C, 10 min.	+0.01	+0.01	+0.00	+0.01	+0.00	-0.00	+0.00	-0.00
Methyl Chloride/Trichloroethane	23°C, 10 min.	-0.00	+0.01	-0.00	+0.01	+0.00	-0.00	-0.00	-0.00

*MD=Machine Direction, TD=Transverse Direction

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Available grades of UPILEX-RN

Table-6: UPILEX-RN Grades and Area Factors			
Grade	Thickness (µm)	Width (mm)	Area Factor (m^2/kg)
UPILEX-25 RN	25	508 / 1016	28,8
UPILEX-50 RN	50	508 / 1016	14,4
UPILEX-75 RN	75	508 / 1016	9,6
UPILEX-125 RN	125	508 / 1016	5,8

For other width or grades, please contact the sales office.

Version: 031105

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