

G-Leaf™

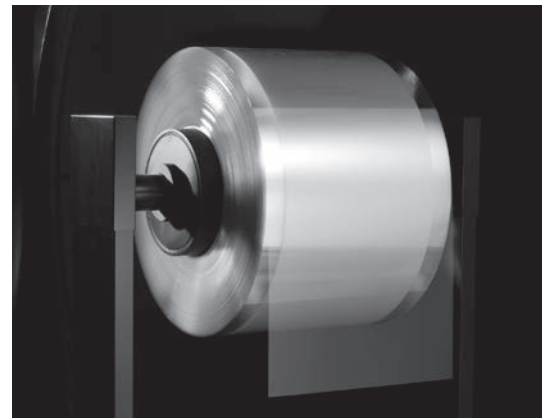
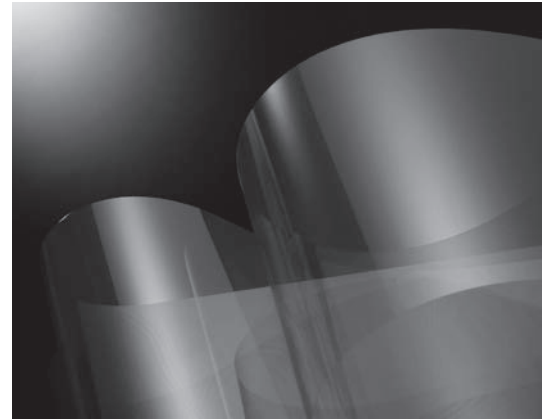


Glass Substrate

Ultra-thin glass G-Leaf™, which is under 0.2mm (200µm) thick, is a superior material formed by overflow technology. G-Leaf™ maintains the advantageous functions and reliability of glass in a film state and can therefore be applied using the roll-to-roll process. G-Leaf™ is a next-generation material that holds excellent potential for applications such as electronics, energy-related products, medical-use products, and lighting.

Features

- Excellent properties of glass
  - Optical properties
  - Weather resistance
  - Heat resistance
  - Gas barrier properties
  - Electrical insulation
  - Chemical durability
- Properties of overflow technology
  - Surface flatness
  - Surface smoothness
- Features unique to thin sheet forming
  - Flexibility
  - Workability
  - Lightweight
- Environmentally friendly glass that does not contain As or Sb

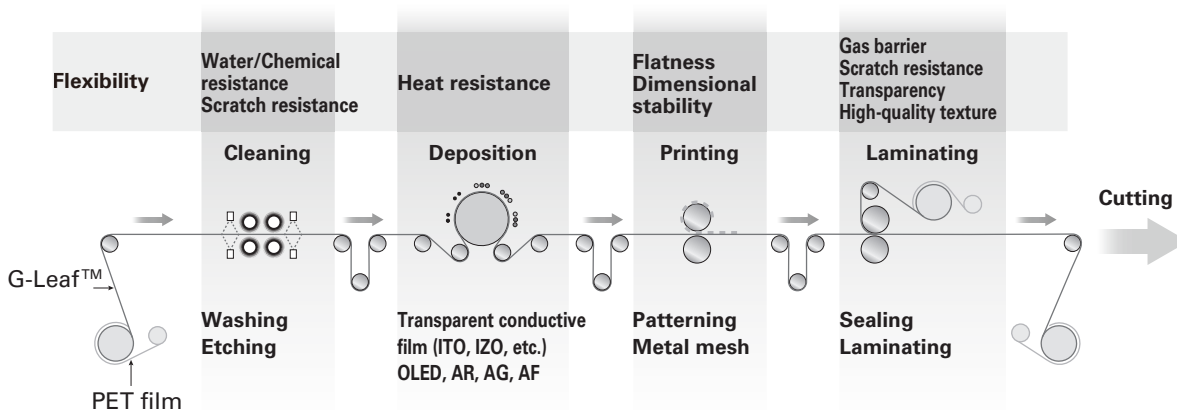


Rolled-up form

G-Leaf™ allows for the reduction of energy and environmental burdens at all stages of its production, from raw materials to delivery.

Roll-to-Roll manufacturing process for flexible devices using G-Leaf™

G-Leaf™, with both its glass features and flexibility, makes it possible to manufacture high-quality flexible devices with the high-productivity roll-to-roll process.



Applications

- Flexible solar cell
- Flexible display
- Flexible lighting
- Touch sensor
- Electronic paper
- Thin film battery

## Thermal Properties

With its high heat resistance, low thermal expansion, and low thermal shrinkage, G-Leaf™ offers superior thermal dimensional stability.

Strain point	°C	650
Annealing point	°C	705
Softening point	°C	940
Coefficient of thermal expansion	30-380°C	$\times 10^{-7}/K$ 38

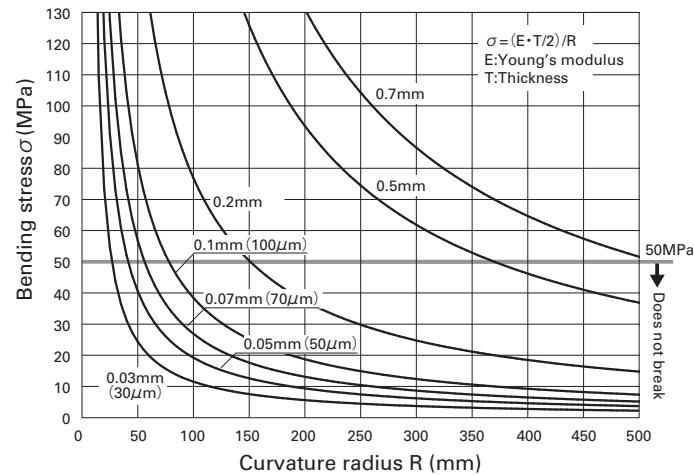
## Mechanical Properties

G-Leaf™ is characterized by high elasticity and high hardness.

Density	$\times 10^3 kg/m^3$	2.46
Young's modulus	GPa	73
Poisson's ratio		0.2
Vickers hardness	Hv	600

## Flexibility

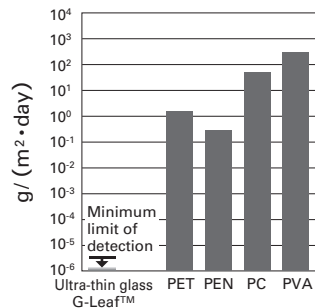
G-Leaf™ is also available in rolled-up forms.



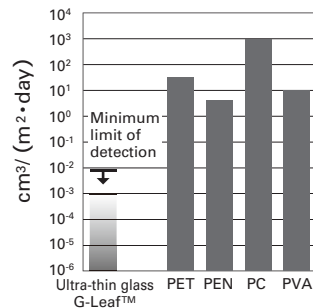
\* Glass breakage depends on defects located on edges and/or surfaces of glass substrates. In the above figure, 50MPa is considered to be the boundary between "broken" and "not broken" conditions.

## Gas Barrier Properties

Water vapor permeation rate



Oxygen transmittance rate



\* Both the water vapor permeation rate and oxygen transmittance rate are lower than minimum limit of detection.

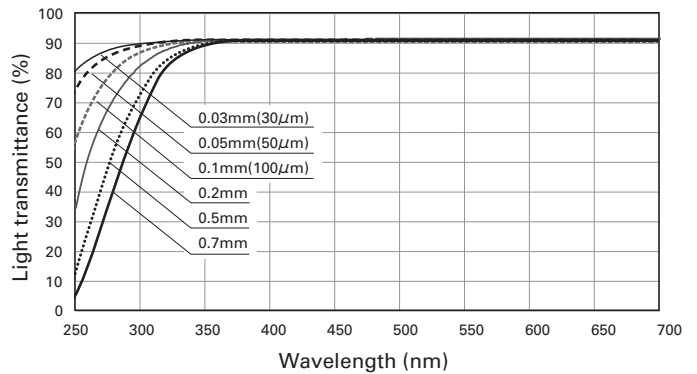
## Electrical Properties

Volume resistivity $\log \rho$	350°C	$\Omega \cdot cm$	12.0
Dielectric constant	1MHz, 25°C		5.3
$\tan \delta$	1MHz, 25°C		0.001

## Optical Properties

G-Leaf™ has high light transmittance.

Light transmittance	$\lambda = 550nm$	%	92
Refractive index ( $n_d$ )	$\lambda = 587.6nm$		1.52



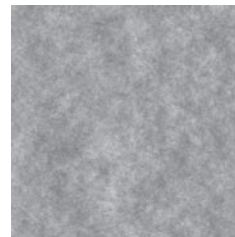
## Chemical Properties

G-Leaf™ has high chemical durability. It is an ecological material and does not contain any substances that impose burdens on the environment.

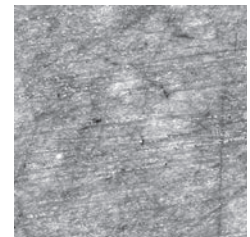
Chemical durability	10% HCl (80°C-60min)	No visual change
	63 BHF (20°C-3min)	No visual change
Alkali content	wt %	0.1 max.
As, Sb content	wt %	less than 0.1

## Surface Quality (AFM Image)

Formed by overflow technology, the product has an extremely smooth and flat surface.



G-Leaf™  
Non-polished surface formed by overflow technology  
 $R_a = 0.2nm$



Polished surface  
 $R_a = 0.5nm$

## Dimensions

Thickness		Tolerance
Center		
0.2mm (200 $\mu m$ )		$\pm 10\%$
0.1mm (100 $\mu m$ )		
0.07mm (70 $\mu m$ )		
0.05mm (50 $\mu m$ )		
0.03mm (30 $\mu m$ )		

Both rolled-up forms and sheets are available. Please consult us regarding thickness, size, and shape. Laminated adhesive film with G-Leaf™ is available in order to facilitate its handling.