PLEXIGLAS®

PLEXIGLAS®
Film

PLEXIGLAS® Film 0F058 (Light Guide Film)

Thinner, Lighter, & More Energy-Efficient:
A Global Constant Trend

Do you remember how big and heavy your computer was 10 years ago? Now have a look at the tablet you carry. It's a handy device much thinner than a book, but loaded with information and equipped with an eye-catching display. Multi-cored CPU and a battery lasting for hours are all inside the compact hardware. This is one of the miracles brought along by global innovators creating trends to be thinner, lighter, and more energy-efficient.

Behind these trends is the continuous devotion of part suppliers, especially the display panel manufacturers. By seeking new materials and technology, our panel makers are trying hard to make products meet the global trends.

Thanks to its excellent optical properties (Table 1), PMMA (Polymethyl methacrylate) is the mainstream material of light guide panels (LGP) in back light units (BLU) and display modules.

Table 1 Optical properties of PMMA, PC and Glass

	PMMA	PC	Glass
Refractive Index	1.49	1.59	1.53
Abbe Number	59	30	59
Luminous transmittance [%]	92	87	91
Total Internal Reflection [°]	42	39	41
Optical Damping (lit.) [dB/km]	70-100	700	0.2

And with the demand for devices that have larger but slimmer displays, brighter effect and energy-efficiency, the leading position of PMMA is evermore solidified.

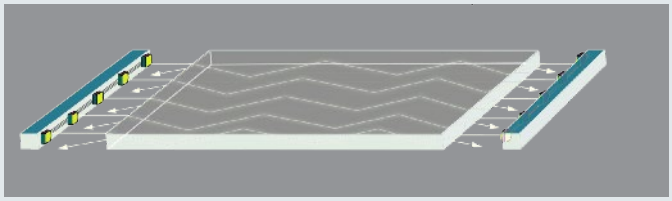
In 2009, a laptop LGP was 3 mm thick and only three years later it was half the size. For the popular tablet, the LGP is even thinner than 0.55 mm. The market keeps moving in this direction but, the existing LGP technology is reaching a limit.

A breakthrough in the industry turned to films, which allowed for even thinner and lighter panels.

Illuminate Your Application

At its purest, light is guided in PMMA over long distances though total internal reflection.

Operating principle:



The Light can exit the film via the surface by deflecting the light rays, e.g. by a surface pattern.

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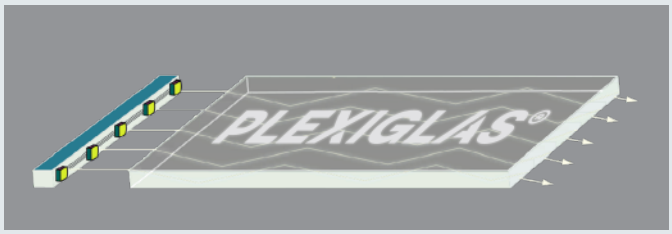
Operating principle:



Processing Advantages: A Productive Practice

Processing flexibility is an advantage for LGP manufacturers to build surface microstructure on PMMA sheets and film. Surface structuring technology is well known, and various methods could meet your specific demand.

Traditionally, surface structuring of PMMA allows for both chemical and physical processing. Chemical processing includes cast & cure and printing. Physical processing consists of hot embossing, injection molding, and melt calendering.

The hot embossing method is usually applied in processing surface structure on existing PMMA sheets and films. The sheets are at first heated above Tg (glass transition temperature), and then embossed using either hot press/stamp or embossing rolls/belts. Continuous production may be introduced with this method, while the precision of surface structure still has room for improvement.

Chemical processing with micro-structuring precision and high productivity are also available such as Ink Jet printing and laser printing. These methods create micro-lens on the surface of the film with uniformity and high luminance. This direct writing process provides design flexibility and saves time on development of new patterns.

These are some of the many existing technologies that could achieve the market demand of thinner LGP. Combined with PMMA film in a roll-to-roll (R2R) process, continuous production could be achieved, leading to increased production efficiency.

PLEXIGLAS® Film 0F058: A Better Choice

World-class LGP manufacturers and PMMA producers are cooperating to spread the use of optical PMMA film, accelerating the innovation downstream based on the film's excellent optical properties.

This development leads to a question: How to tell what is the best among the numerous products? Several criteria can help us.

Light transmission

The high light transmission of the PMMA film is the basis of a LGP. Thanks to its superior purity and outstanding production technology. PLEXIGLAS® Film 0F058 from Röhm GmbH easily reaches high light transmission, 92%, even higher than that of glass (91%). PLEXIGLAS® Film 0F058 provides a high gloss surface on both sides.

Haze

Nearly all the materials scatter light inside. Haze is the percentage of transmitted light that is scattered. Haze of PLEXIGLAS® Film 0F058 is 0.18%, meaning little light is lost in transmission.

True to its nature

The yellow index of PLEXIGLAS® Film 0F058 is 0.27, indicating little yellowness or blueness. This ensures the LGP pure and color stable.

Weathering resistance

PMMA is best among polymers for outdoor applications. Even, after extended time periods, PLEXIGLAS® Film 0F058 still maintains its high light transmission and shows no change in color compared to other plastics.

Optical quality

PMMA manufacturers must create an optical grade standard in order to ensure these properties are met. Therefore, the ability to manufacture the purist grade of the material will directly impact the effectiveness of the LGP.

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Reliability test

The film properties do not change after storage for 500 h at 85°C and 85% rel. humidity.

With side emitting micro LEDs becoming commercialized, PLEXIGLAS® Film 0F058 offers the thinnest LGF available in the market, providing a perfect match for light outcoupling and maximizing luminance.

Roll-to-Roll Solution

PLEXIGLAS® Film 0F058 offers a unique advantage for LGP fabricators: available in roll form (master rolls and slit to width rolls) and not just sheets. This enables customers to carry out roll-to-roll production, greatly enhancing the productivity, and consequently lowering total cost.

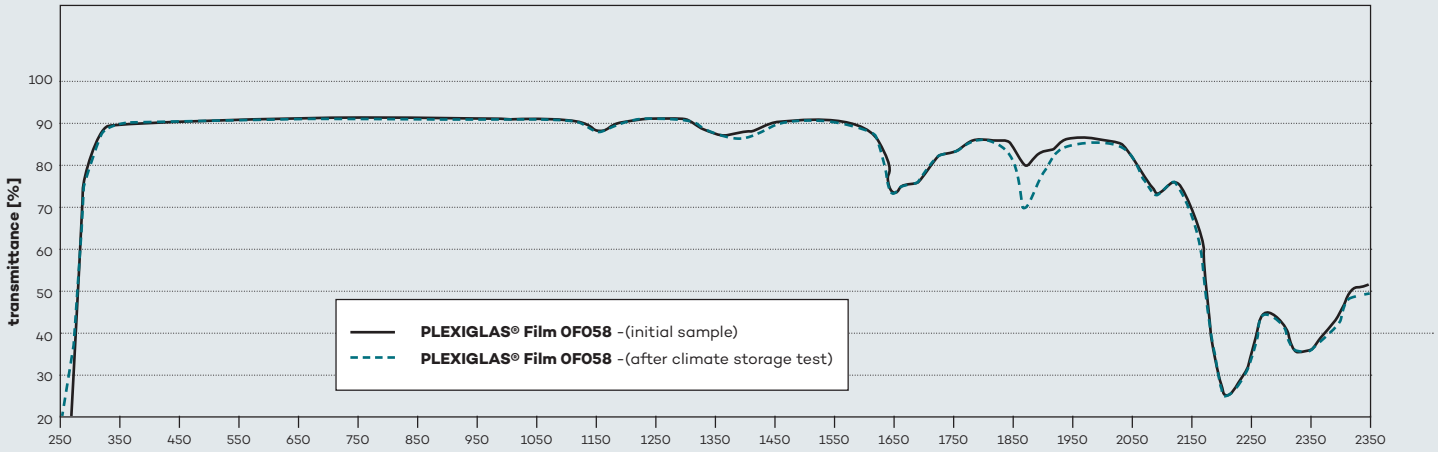
Technical data			
PLEXIGLAS® Film 0F058 Properties (film thickness 500µm)	**Unit**	**Standard**	**Values**
Luminous transmittance (D65/10°)	(%)	DIN EN ISO 11664	92.4
L (in transmittance, D65/10°)	-	DIN EN ISO 11664	97
a (in transmittance, D65/10°)	-	DIN EN ISO 11664	0
b (in transmittance, D65/10°)	-	DIN EN ISO 11664	0.1
Yellowness Index (D65/10°)	-	ISO 17223	0.27
Color coordinate x (in tranmittance, D65/10°)	-	DIN EN ISO 11664	0.314
Color coordinate y (in transmittance, D65/10°)	-	DIN EN ISO 11664	0.331
Haze	(%)	ASTM D1003	0.18
UV transmittance (280 – 380 nm)	(%)	DIN EN 410	91.3
Tensile yield stress (σ_y)	MPa	DIN EN ISO 527-3	-
Tensile strength (σ_m)	MPa	DIN EN ISO 527-3	88.2
Nominal tensile strain at break (ε_{tB})	(%)	DIN EN ISO 527-3	5.2
Glass transition temperature Tg (DSC)	°C	DIN EN ISO 11357	109
Refractive Index (23°C)	-	DIN EN ISO 489	1.49
Density	g/cm³	DIN EN ISO 1183	1.19
Max. water absorption (23°C)	(%)	DIN EN ISO 62	1.9
Surface tension (23°C)	(mN/m)	DIN ISO 8296	44-45

Table 2 Sales range of PLEXIGLAS® Film 0F058

	PLEXIGLAS® Film 0F058
Thickness, µm	200, 375, 500
Width, mm	1270
Roll length, m	500-1000

Cut to size rolls in optical quality for clean rooms are being offered.

Transmittance [%] as a function of the wavelenght [nm] before and after climate storage test @ 60°C / 90% rel. humidity



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