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EXTRUDED PMMA MIRROR – TECHNICAL MANUAL

The extruded PMMA mirror sheet provides very high optical and mechanical characteristics and good weather resistance. It can be used to obtain reflecting objects of different shapes through different processes, such as cutting, hot air and mould thermoforming, milling, etc.. This sheet offers solutions to both indoor and outdoor applications. It's available in silver and in a wide range of colours.

Composition / information on ingredients

Product description:

Polymethylmethacrylate (PMMA) sheets with protection film
Aluminium (< 5 g/m²)
Stabilized water-based compound

Hazardous ingredients:

None

Hazards identification

No labeling requirement in accordance to EU Directives.

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Technical information

SILVER MIRROR POLYMETHYLMETHACRYLATE SHEET

STANDARD SPECIFICATIONS

	CODE	UNIT	VALUE
PHYSICAL PROPERTIES			
Density	ISO 1183	g/cm³	1,19
MECHANICAL PROPERTIES			
Tensile strenght to breakage	ISO527	MPa	83
Elongation to breakage	ISO527	%	5
Elasticity moduls in traction	ISO527	MPa	3.200
Resistance to flexion	ISO178	MPa	120
Rockwell hardness, M/R scale			92
Ball pressure hardness	ISO 2039	MPa	185
THERMAL PROPERTIES			
Maximum Service temperature		°C	80
Softening temperature		°C	110
Coefficient of linear thermal expansion	ISO 75-2		7

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Product range

2050 x 3050 mm - Thickness range: from 1.5 mm to 6 mm
2050 x 1010 mm - Thickness range: from 8 mm to 10 mm
2050 x 1250 mm - Thickness range: from 10 mm to 15 mm
1220 x 2440 mm - Thickness range: from 1.5 mm to 6 mm

Thickness tolerances

1.8 mm up to 2.7 mm ± 10%
2.8 mm up to 11,9 mm ± 5%
12,0 mm up to 15 mm ± 4%

Cut-to-size tolerances

-0 / + 1.0 mm

User guide

Storing and handling

The originally packed plastic sheets should neither be stored outside nor be exposed to great variations of weather and/or temperature. When storing under conditions with substantial variation of temperature and humidity, flat shape distortion (corrugation) of the sheet can happen. It is recommended to store the sheets stacked and in horizontal position.
Polyethylene film protects sheets against dirt, mechanical load and scratches. It is recommended to leave the protective PE film in place until final processing. PE protective film is not designed for long-term open-air, sun and high temperature exposure/protection. It has only moderate UV - and heat-resistance.

If sheet is stored outside, without protection, the protective foil should be removed after four weeks time, as there is a risk of brightness loss and difficult

removal of the degraded PE film. This could lead to sheet surface damage.
If sheet is stored inside under usual and constant conditions, it is recommended to remove the film 6 months after its application.
If material is stored in a cold place it needs to be tempered to ambient temperature before using (thermoforming, machining…).
Depending on storage and climatic conditions, plastic sheets absorb moisture. Although humidity absorption has no practical influence on the physical properties, it may interfere during further processing of the sheets at higher temperatures e.g. during bending, or heating before thermoforming. Therefore, according to the intended use, the sheets may have to be pre-dried.
It is recommended to store the sheet under constant temperature and humidity conditions on a plane support. Critical are mainly spring and autumn.

Cleaning

Protection film removal will induce a build-up of the electrostatic charge on the sheet surface. This electrostatic charge attracts airborne dust, and other fine particles. Therefore, prior to further processing, it is recommended to clean the sheet by antistatic treatment (e.g. blowing by ionised compressed air or cleaning by hand with a cloth wetted with suitable antistatic agents).
This is particularly important prior to thermoforming process, as dust or dirt particles will cause imprints on the moulded surface.
Plain water will suffice for top-side cleaning and care of the sheets. In case of excessive dirt, clean with warm water and a weakly alkaline, non-abrasive cleaning agent.
The sheets should be dried with a soft cloth or with chamois leather. Dry scrubbing of the surface will cause scratches and possible damage.

Drying

As with most plastics, extruded PMMA mirror sheets absorb moisture during storage.

Whilst processing at higher temperatures, this can produce bubbles; therefore, pre-drying below softening point temperature is advisable. Normally pre-drying of sheets with high moisture contents in an oven with air circulation, 24 hours at 60-70°C for these sheets will suffice or min. 1-2 hours per mm of thickness.
To achieve good drying results, air circulation between the sheets must be ensured; the protection foil must be removed before drying.
They must be cooled down slowly to avoid repeated induction of moisture or internal stress due to cooling down too fast after drying. The maximum cooling speed after drying has to be less than 15°C per hour; the maximum oven temperature from which the sheet may be removed is 60°C.
Preliminary tests are recommended.
In general, extruded PMMA mirror sheets need not be pre-dried prior to thermoforming, provided that the material has been adequately stored and the foil is undamaged.

Dimensional change

There are substantial orientation forces involved in the extrusion process to form the sheet from the molten polymer. A part of these forces remains “frozen” in the sheet. When the sheet is to be heated e.g. before thermoforming, this stress became apparent in shrinkage of the sheet. The shrinkage is always higher in parallel to the extrusion direction. Longitudinal shrinkage is always higher in thin sheets and lower in thick sheets. Such dimensional change has to be taken into consideration when cutting sheets to be thermoformed.
As the shrinkage value depends on both heating temperature and heating time, preliminary tests are advisable.

Sheet thickness	Shrinkage parallel to xt	Shrinkage perpendicular to xt
1,8 mm up to 2,7 mm	Max. 10%	Max. 2%
2,8 mm up to 3,4 mm	Max. 4%	Max. 2%
3,5 mm up to 15 mm	Max. 3%	Max. 2%

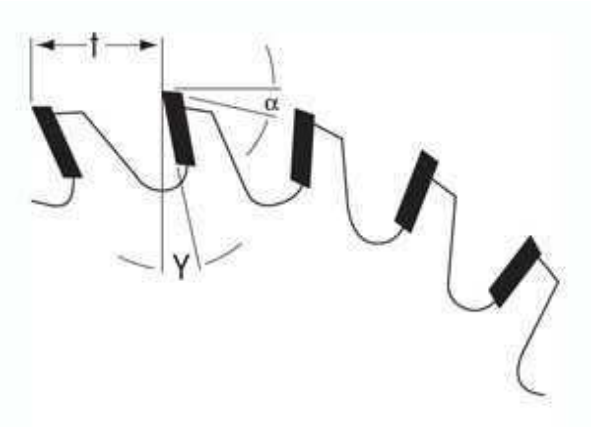
Thermal linear change

Like all materials, extruded PMMA mirror is subject to linear change at variable temperatures. Plastics show higher linear change than metals, and this must be taken into account when mounting sheets into frames. Attention must be paid to the elongation clearance in order to avoid damage during material usage.
These sheets absorb moisture during storage and application. Beyond the thermal linear change, the content of moisture can effect an additional dimensional change up to 0.5%.
Variation and differences in moisture content between interior and outside surface of a sheet (e.g. swimming-pool glazing, terrarium, greenhouse, winter garden) effect different elongation between the sheet surfaces. This difference can cause curvature of the mounted sheet. This curvature can be avoided by choosing an applicable higher thickness of sheet, in order to get inherent stability or use enough “cold bending”. Preliminary tests are recommended.

Machining

Extruded PMMA mirror sheets can be worked with most tools used for metals. Both cutting speed and forward feed should be such that the material doesn’t melt.

Sawing



Circular saws, band saws and jig saws can easily be used to work extruded PMMA mirror sheets . The use of new and well sharpened tools is recommended.
It is very important to employ an efficient saw dust extraction system to remove saw dust and chips generated by the saw blade. The sheets must be adequately fixed to avoid saw chattering or vibrating.

	Band saw	Circular saw
Clearance angle α	30-40º	15-20º
Rake angle γ	0-8º	0-5º
Cutting speed	1000-3000 m/min.	3000 m/min.
Circular pitch t	3-8 mm	10-20 mm

Drilling

Commercial quality twist drills for metal can be used. The point angle should be adapted to about 60º - 90º. Best drilling capacity is achieved with a cutting speed of 25-80 m/min and a feed rate of 0.1- 0.2 mm p.r. Recommended is to adjust cutting rim for plastics material.
When drilling thin sheets, it is advisable to fix them on a solid, flat support to avoid brittle breaks of the lower edge of the drilled hole.

Milling

Universal, profile, spindle moulding and hand milling cutters at cutting speeds up to 4500 m/min can be used for milling these sheets.
Small tool diameters require the application of one or two-edged milling cutters. They offer perfect removal of chips, high cutting speed and an excellent milling pattern.
When using one-edged milling cutters, the clamping chuck must be carefully tightened to avoid component marks on the sheet.

Laser cutting

Extruded PMMA mirror sheets are easy to cut with a CO2 - laser. Brilliant edges of cut can be achieved but this can vary depending on type, thickness and surface treatment. The laser operating efficiency should amount to 300 – 1000 W. Inert gas rinsing and extraction of monomer vapours must be ensured.
Preliminary tests are essential in order to determine exact positioning in each case.
Inclined edges of cut, not being square to the sheet surface, will result from increasing material thicknesses.

Polishing

Prior to hand-operated polishing, the sheet must be ground. Hand-operated grinding requires the use of 80-600-grit abrasive paper as well as several grinding work cycles from rough-grind up to finish-grind. Mechanical grinding should be done with belt grinders and a belt speed of 5 - 10 m/s. High surface temperatures can be avoided by lightly pressing on the work piece.

Jointing

The joint faces must be cleaned prior to bonding.
The components to be bonded should be tempered to release stresses prior to bonding in order to avoid potential stress cracking (crazing) due to the reaction with the glue; this applies especially to components having been machined by metal-cutting tools or cut by laser.
It is possible to use an acrylic or polyurethane glue, without solvents. Our technical service department will provide you with information on appropriate products.
Preliminary tests are recommended.

Forming

The heating time depends on the equipment employed and will rise considerably according to increased material thickness, however, it must not exceed the temperature of 110-120°C. in order to avoid the opacification of the mirror.
Due to the memory effect, the exact angle specifications must be determined by preliminary tests.
Preliminary tests are essential to determine the sheets behaviour in each individual case.
It is not possible to thermoform the anti – scratch mirror.
Preliminary tests are essential to determine the sheets behaviour in each individual case.

Concluding remarks

For more details on further processing methods, please contact our technical customer service.

NOTE:
Our technical recommendations are without legal obligation.
The information given in this brochure is based on our knowledge and experience to date. It does not release the user from the obligation of carrying out their own tests and trials, in view of the many factors that may affect processing and application; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose.
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