CAST ACRYLIC SHEETS & BLOCKS

oroglas®
casting for success

Technical Brochure

The best way to solve your technical issues

CONTENTS

Introduction

THE OROGLAS® BRAND NAME

Oroglas® is an Arkema registered trade name for PMMA (polymethylmethacrylate) products.

Oroglas® is available in:

- Cast sheets.
- Blocks

GENERAL PROPERTIES OF OROGLAS®

Brief summary of properties:

Oroglas® is a rigid, transparent, thermoplastic material.

Naturally colourless and exceptionally clear, it can also be tinted for an almost infinite range of colours. The light transmission and diffusion parameters can be varied on request.

It is inert to many corrosive chemicals and is the plastic material of choice for outdoor use (resistant to UV and general weathering).

A wide variety of industrial, craft and artistic processes can be used to machine and shape Oroglas® sheet.

THE RANGE

The products described in this technical brochure are referred to as:

- **Oroglas®**, for cast sheet.
- **Oroglas®**, for blocks.

Sheets and blocks are available in a wide range of formats, thicknesses, colours and surface finishes. Detailed information on the various combinations, as well as delivery conditions, are given in the Oroglas® Product Catalogue.

Sheets manufactured by Altuglas International meet the following standards:

Oroglas® CN: ISO 7823.1 - 2003.

APPLICATIONS

Oroglas® sheets are used in numerous applications:

- **Signs and signboards:** Illuminated panels, 3D lettering, indicator panels, etc.
- **POS advertising:** Display stands, testers, notice-boards, etc.
- **Interior design:** Shop-fitting, furniture, projection screens, glazing, etc.
- **Architectural fittings:** street furniture, safety fittings, acoustic screens, skylights, etc.
- **Industry:** Machine guards, dials, precision parts, etc.

Technical specification Oroglas®

TECHNICAL OF SPECIFICATIONS

Oroglas ® cast acrylic sheets complies with the international standard ISO 7823-1.

	TEST	UNIT	VALUES
MECHANICAL PROPERTIES:			
Tensile strength	ISO 527	MPa	76
Compressive strength	ISO 684	MPa	130
Flexural strength	ISO 178	MPa	130
Impact strength	ISO 179-1	kJ/m2	12
Modulus of elasticity	ISO 527	MPa	3300
Elongation at break	ISO 527	%	6
Indentation hardness (Rockwell scale M)	ISO 2039-1		100
THERMAL PROPERTIES:			
Vicat softening point (B50)	ISO 306	°C	115
Forming temperature		°C	130-190
Max continuous service temperature		°C	85
Coefficient of linear thermal expansion	EN 2155-1	mm/m/°C	0.065
Specific heat		kJ/kg/°C	1.32
Thermal conductivity	DIN 52 612	W/m/°C	0.17
Linear shrinkage after heating		%	< 2
ELECTRICAL PROPERTIES:			
Dielectric strength	DIN EN 60243-2	kV/mm	20-25
Volume resistivity	DIN IEC 167	ohm x cm	$>10^{15}$
Dielectric constant, 103 Hz	DIN 53 483		3.7
Dissipation factor, 50 Hz	DIN 53 483		0.06
OTHER PROPERTIES:			
Specific gravity	ISO 1183	g/cm^3	1.19
Water absorption (at 20°C in 24 hour)	ISO 62	%	0.30
Light transmission (clear sheet)	DIN 5036	%	92

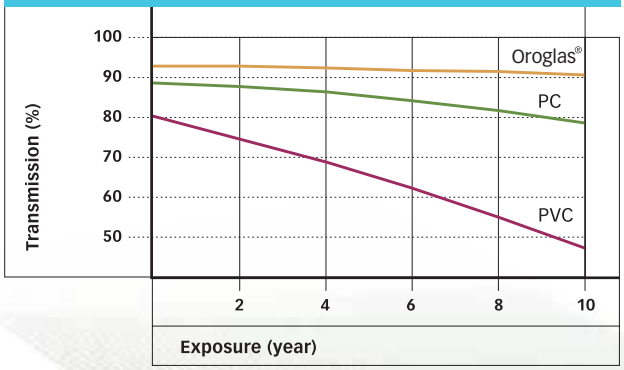
Properties of Oroglas®

RESISTANCE TO NATURAL AGEING

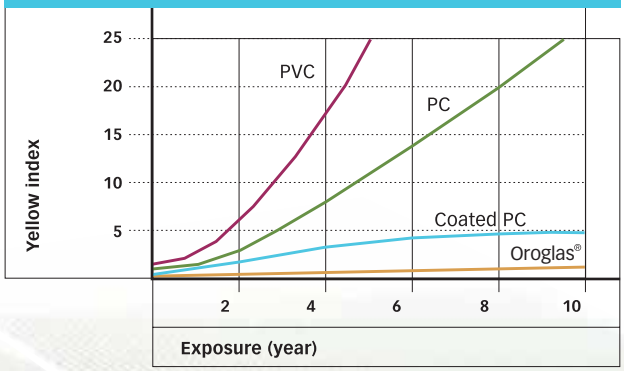
The values apply to a Central European climate

Oroglas® has an excellent resistance to natural ageing.

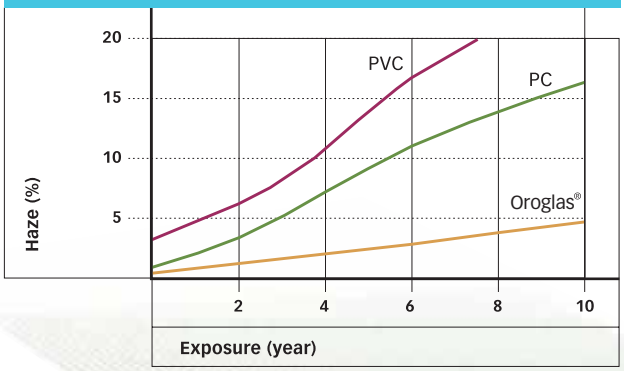
Variation in light transmission as a function of exposure to weathering.



Variation in the yellowness index as a function of exposure to weathering.



Variation in haze as a function of exposure to weathering.



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Working with Oroglas®

STORAGE OF SHEETS AND BLOCKS

SAFETY

Edges of sheets may be sharp. It is recommended that gloves be worn for protection during handling.

Sheets and blocks must be stored in a dry place. It is advisable to place a polyethylene cover over the stack when a sheet is removed, to reduce moisture absorption.

It is recommended that sheets and blocks of Oroglas® be stored horizontally on their original delivery pallets, and that the pallets be placed on horizontal storage shelves. It is strongly recommended that pallets should not be stacked, which carries the risk of creating internal tensions and spoiling the flatness of the sheets.

If a vertical storage method is adopted, it is preferable that Oroglas® sheets and blocks be leant against solid supports inclined at approximately 80°, to avoid any bending.

It is strongly recommanded to avoid storage longer than 6 months.

Flatness of the sheets could be altered if sheets are stored and/or transported in a humid environment.

PROTECTIVE FILM

Protective film

Oroglas® sheets are protected by polyethylene film. The top-face film carries the identification marks.
For Oroglas® blocks, the protective film is neutral.

It is strongly recommanded to avoid external storage. Protective film and adhesives could be damaged by UV emissions, which would make it difficult to remove the masking film.

Identification marks and traceability

Oroglas® sheets have at least two longitudinal markings, a few centimetres from the two edges. The markings indicate the name of the product, Oroglas® followed by the product code, colour code, thickness in millimetres and batch number.

This marking provides traceability for all our production batches.

When to remove the film

It is preferable to leave the protective film in position throughout machining, to keep the sheet surface in perfect condition.

Special precautions in respect of thermoforming:

The protective film must be removed before heating and thermoforming

- The film must be totally free from surface faults (holes, scoring, bubbles, etc), which could mark the part.
- The film must not touch the oven trays.

MACHINING

SAFETY

The various machining processes that are possible with Oroglas® sheets and blocks may result in ejection of large quantities of hard, sharp swarf. It is recommended that goggles be worn during such operations.

In terms of hardness, Oroglas® lies between wood and iron, and is quite close to aluminium or light alloys. It can be machined (cut, milled, turned or drilled) using machine tools for either wood or metal.

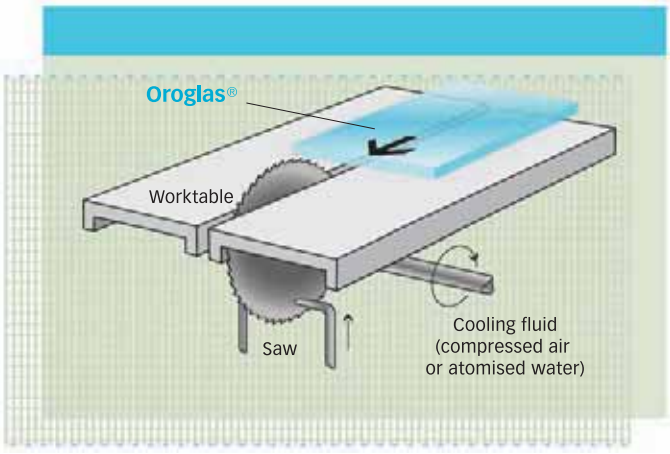
Recommendations for machining

Excessively fast machining causes local overheating, generating internal stresses which must subsequently be relieved by annealing. Otherwise, sooner or later, these stresses will cause fine surface crazing, which may spread under the effects of solvents or stress (for example, during bonding or painting).

The material will not overheat during machining if the following general guidelines are followed:

- Keep tools really sharp.
- Ensure efficient removal of swarf.
- Spray with water containing 2 % of cutting oil ("soluble" oil), or use a small jet of compressed air, or spray atomised water directly at the cutting position.

During machining, parts must be clamped properly to avoid any vibration. This recommendation is particularly important when the sheets are thin. Strong vibration may result in unattractive edges and broken corners.



CUTTING & OTHER MACHINING

When a sheet is being cut, the blade entry and exit stages are the most critical.

Oroglas® can be cut with very simple tools such as a hacksaw. However, this is not recommended: it is a long and delicate operation that cannot provide a very good finish.

A number of industrial cutting methods are suitable for Oroglas®.

Circular saws are normally used for straight cuts, with bandsaws or router cutters for other shapes. Other more sophisticated methods such as lasers or water jets give excellent results.

Oroglas® can be machined using numerous other processes such as drilling, turning, milling or sanding.

THERMOFORMING

Oroglas® is a very versatile, transparent thermoplastic. Parts with very complicated shapes can be created by thermoforming. Products obtained in this way retain all the original properties of the material: transparency, resistance to UV and mechanical strength, special surface aspects (Oroglas® Elegance, Oroglas® Granite).

Working with Oroglas®

STRAIGHT CUTTING

Cutting along a groove

SAFETY

Each time Oroglas® sheets or blocks are worked, it is strongly recommanded that gloves, protective glasses and sound protection be worn during operations.

This is not generally recommended, as the edges of the cut are irregular and require subsequent sanding. The technique can only be used for sheets with a thickness of 3 mm or less, over lengths of less than 400 mm.

The groove can be made using a cutter with a sickle-shaped blade. Repeat the grooving several times. Use the edge of a table to break along the groove.

Goggles and gloves must be worn for protection.

Bandsaw

This type of saw is generally used to cut curves. However, it can also be used for straight cuts on thick sheets.

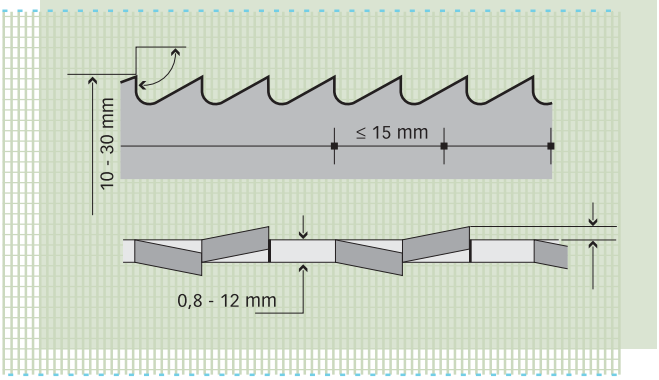
It never gives a clean edge and lengthy finishing operations are necessary if a polished edge is required.

Woodworking machines with a linear cutting speed of 15 to 25 m/sec can be used.

This type of blade does not allow really clean cutting and requires a large amount of finishing work. It is used mainly for cutting rough shapes prior to forming, or cutting around formed parts prior to finishing.

Any woodworking machinery with a linear speed of between 15 and 25 m/sec may be used.

Example of a steel bandsaw with set teeth.

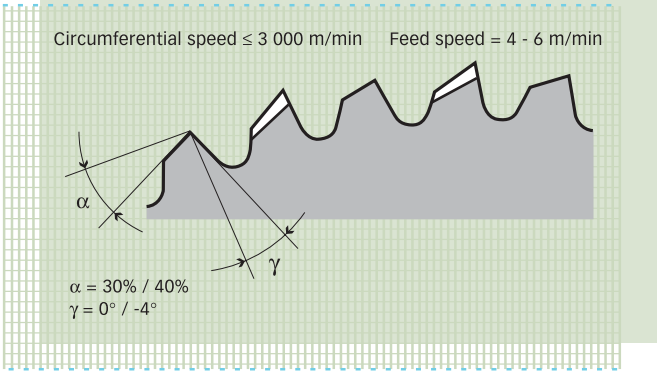


Jigsaw

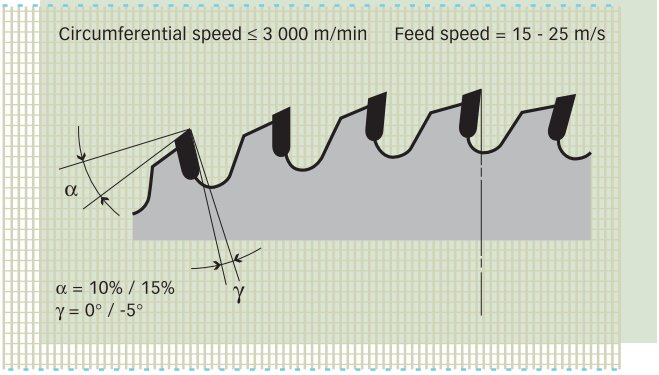
This method of cutting has little to recommend it, in view of the low quality of cut achieved.

Settings: medium cutting speed, with no swing. Medium advance speed. The saw must be in motion before cutting starts. Hold the base of the saw firmly against the sheet and minimise vibration of the sheet as far as possible.

Carbide-tipped blade with straight or set trapezoidal teeth (tooth pitch: 1cm).



HSS or SHSS blade with set teeth.



STRAIGHT CUTTING & CUTTING SHAPES

RECOMMENDED SPEED FOR DIFFERENT SAW DIAMETERS

Saw diameters (mm)	Rotation speed (rpm)
150	6400
200	4800
250	3800
300	3200
350	2800
400	2400

Circular saw

Circular saws give a straight, accurate cut. This is the most frequently used technique. When cut, Oroglas® sheets have a clean surface.

Two types of blade are usually used:

- Carbide-tipped blades are recommended for industrial use, for cutting piles of sheets.
- High-speed steel blades are usually used to cut single sheets.

The teeth are radial (the cutting edges are aligned with the centre) and are backed-off to form an angle of 45° at the tip.

The teeth are not set but the saw must have a rake of approx. 0.2 % on each face.

Pitch: 2 to 5 teeth per cm, depending on the Oroglas® being cut. Cooling by a jet of compressed air or water is recommended.

Milling

Milling can be used to obtain complex shapes with a clean, polished machine finish.

It is advisable to use plain cylindrical milling cutters with two or more cutting edges, preferably one-piece carbide-tipped. High speed or super-high speed steel tools will give indifferent quality results.

The rotation speed must be between 10,000 and 30,000 rpm, depending on the diameter and number of cutting edges used, and compressed air cooling may be helpful.

Milling can be used for several operations such as:

- Cutting through.
- Engraving.
- Finishing edges.

A polished finish can be obtained in a single operation if diamond-tipped tools are used.

Annealing is generally recommended.

Laser cutting

This process offers many advantages:

- It allows most shapes to be produced extremely accurately.
- It minimises off-cuts.
- It gives an excellent edge-finish, generally requiring little or no final polishing. Differences in quality of the cut will be seen, depending on the source and power of the laser, the speed of cut, as well as the thickness and pigmentation of the Oroglas®.

Laser cutting causes high internal stresses, which mean there must be no contact with solvents (adhesives, harsh cleaning products, etc). Annealing will reduce the risks of crazing (see page 25). However, it is inadvisable to use adhesives in conjunction with laser cutting.

Water-jet cutting

This process offers similar advantages to laser cutting, except for the edges which are not glossy in appearance. An additional advantage is that there are no internal stresses near the cut edge. Contact with solvents is permissible, including adhesives.

Working with Oroglas®

OTHER FORMS OF MACHINING

Drilling machines and bits

Drilling can be carried out with fixed or portable drilling machines, fitted with high speed, super-high speed or carbide-tipped steel drills for light metal, specially ground for Oroglas®.

"Drill File" conical bits may also be used.

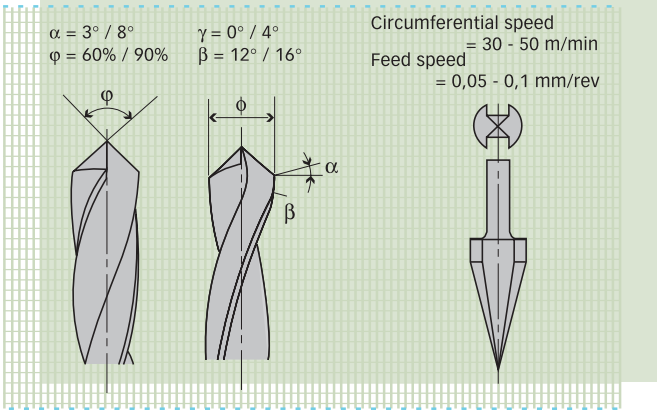
It is recommended that the edge of the drill be ground parallel to its centre line, to suit the special characteristics of Oroglas®.

Method

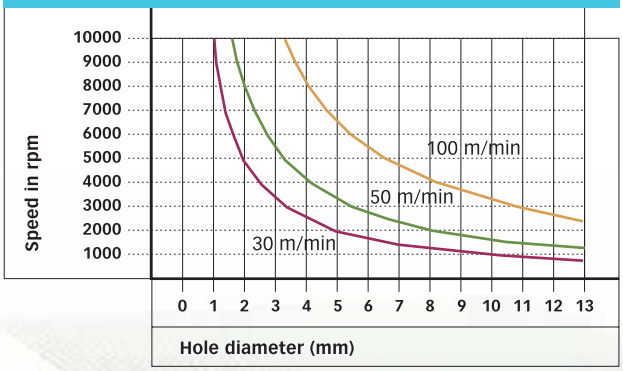
When drilling deep holes, the bit should be withdrawn frequently to help eject swarf and minimise heating that may damage the material. The use of carbide-tipped drills under lubrication is recommended, to obtain a high-grade finish on the sides of the holes.

HSS, SHSS or carbide-tipped drills.

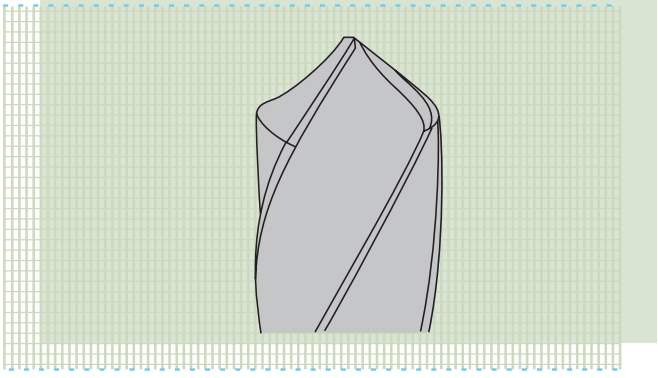
"Drill-File" conical bit.



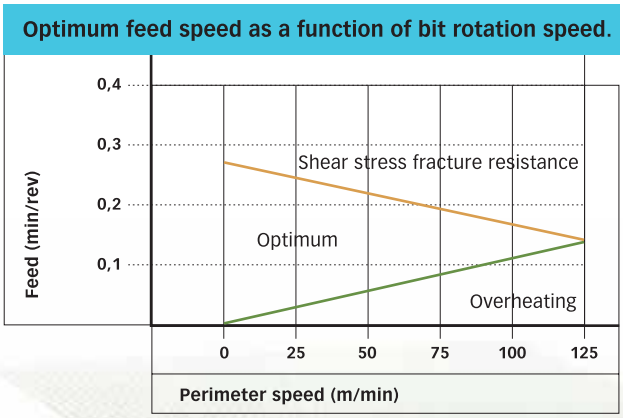
Bit rotation speed as a function of hole diameter.



A drill specially ground for Oroglas®.



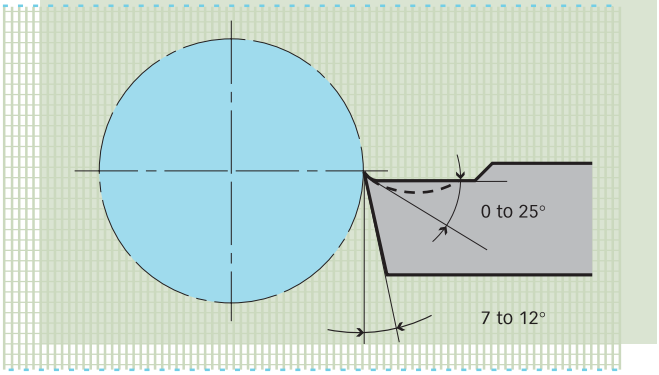
Optimum feed speed as a function of bit rotation speed.



Turning

Oroglas® can be turned in the same way as light metals, using ordinary tools, at the highest possible rotation speed and a low feed speed. In this case the material must be cooled by means of pure water, or a mixture of water and 2 % cutting oil.

A drill specially ground for Oroglas®.



Engraving

This can be carried out using a variety of processes:

- **Milling:** engraving by milling is generally carried out on digitally controlled machine-tools
- **Laser:** it is possible to engrave within a sheet, in 3 dimensions

Sanding

Sanding is required to finish the edges of coarsely cut sheet. Wet carborundum paper is used, either by hand or on a disc or belt sanding machine. For the latter, the recommended belt speed is 10 m/s. A water spray should preferably be applied during sanding, to minimise overheating of the material.

It is preferable to proceed in stages, using in turn:

- A coarse-grain abrasive paper (e.g. 60).
- A medium-grain abrasive paper (e.g. 220).
- A fine-grain abrasive paper (e.g. 500).

Sanding can be a very similar process to polishing, when the abrasives used are extremely fine.

It is preferable to use underwater sanding (simultaneous lubrication and cooling). The successive use of grain sizes 1500, 2400, 4000, 8000 and 12000 allows an almost perfect surface finish to be obtained. A final polishing operation with a Polishing product allows the original surface polish to be fully restored.

Working with Oroglas®

OTHER FORMS OF MACHINING

ABRASIVE POLISHING

After sanding, the material may be polished to restore its original surface gloss. This can be carried out by hand or using mechanical processes.

Machine polishing

Some edge-milling machines use diamond tools and give a polished finish directly. Edges can also be polished with a felt-belt polisher or a disc polisher, fitted with cotton or flannel buffs, using a polishing paste that is compatible with Oroglas®. Flat surfaces are polished using portable disc polishers, fitted with felt or sheepskin buffs soaked in a polish product.

Hand polishing

This carried out using non-woven suede cloth or felt, together with a polishing agent.

After polishing, a Cleaner product can be used to remove any finger or handling marks. This improves the gloss and reduces static somewhat, which slows down the accumulation of dust and reduces the frequency of cleaning.

FLAME POLISHING

Using this technique, the machined edges of Oroglas® are exposed to a high-temperature flame over a restricted area. Passing the flame quickly over the area to be treated melts it, but does not burn it. As it cools, the melted material forms a perfectly smooth surface. If the machining has been carried out with tools that leave clean edges, the flame allows a polished, glossy surface to be obtained. Otherwise, the edge must first be sanded.

Flame polishing is a very fast technique, but requires certain precautions.

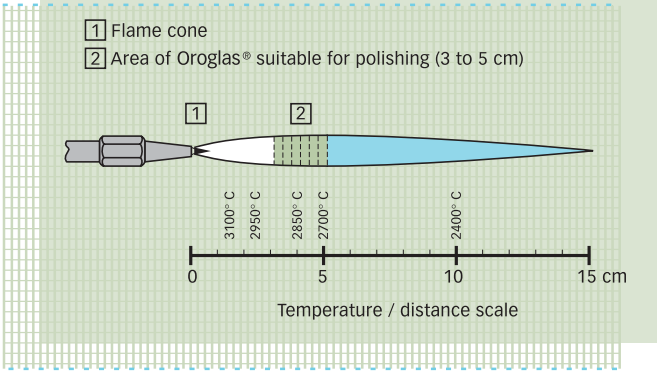
The surfaces being polished must be completely clean and free of any contamination. In particular, avoid touching the surface with fingers.

The technique is for use only with clear or transparent coloured parts. A test must be carried out before using it on diffusing or coloured sheets.

An oxyacetylene torch is often used, with a flame temperature between 2,700 and 2,900°C. The flame must be adjusted to contain excess oxygen (an oxidizing flame).

Lastly, this method causes very high stresses in the material, which must be relieved by annealing before painting, screen-printing or bonding.

Flame polishing with an oxyacetylene torch.



SAFETY

In some of the forming processes described below, hot sheet is stretched by vacuum or air pressure, with one face still exposed to the atmosphere. Although highly unlikely, the sudden failure of a sheet during forming could be dangerous for staff nearby. Guards must be provided to prevent the ejection of particles, which could be quite sharp.

PRELIMINARY INFORMATION

Thermoforming involves three steps: heating, forming and cooling.

When heated to a suitable temperature (depending on the specific type), Oroglas® becomes soft and rubbery. It can then be given a wide variety of shapes using suitable moulds. Cooling then restores its initial rigidity, while retaining the given shape.

Thermoforming and protective film

It is essential to remove the protective film before heating and thermoforming.

HEATING EQUIPMENT

Sheets may be heated using one of 2 industrial processes:

Circulating hot-air oven

This is the only acceptable heating method for parts requiring good optical properties. The temperature can be accurately controlled and Oroglas® sheets can be kept hot while awaiting thermoforming.

Infrared heating

This method of heating has low thermal inertia and warm-up time is therefore short.

- When used for thermoforming, it offers high productivity, automated operation and low labour costs. However, the investment is high.

- When used only for stoving (pre-heating), the cost is low but temperature control is more difficult and heating must be done in two stages for thicknesses ≥5 mm.

Working with Oroglas®

THERMOFORMING

HEATING METHOD

Heating times and temperatures

The heating time varies, depending on the type of Oroglas® sheet and heating method used.

SUMMARY TABLE OF HEATING CONDITIONS FOR SHEETS	
Heating temperature	**Oroglas ®**
Minimum temperature (°C)	130
Maximum temperature (°C)	200
Recommended range (°C)	165-190

Heating times by type of equipment	**Oroglas ®**
Oven (min/mm)	3-4
Infrared panels	
1 panel (sec/mm)	40-50
2 panels (sec/mm)	25-30

Two main differences in response to heating

SHRINKAGE

When heated for the first time, Oroglas® sheets shrink and allowance must be made for this in determining the dimensions of blanks.

Oroglas® is isotropic: it shrinks by a maximum of 2 % in all directions.

UNIFORM HEATING

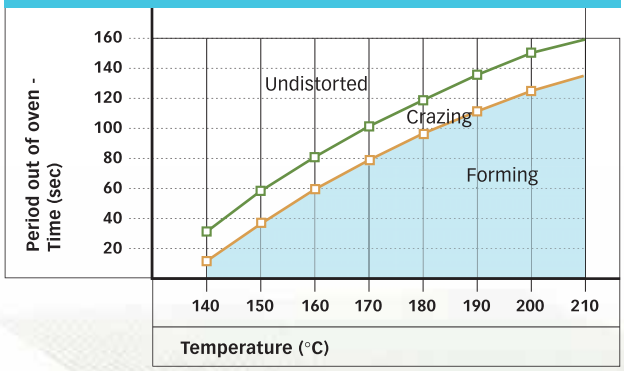
Oroglas® will withstand temperature differences of 10 to 15°C within a given sheet, without any effect on the final quality.

HEATING METHOD

The heating time and temperature vary with the type of product, the temperature conditions and the complexity of the part being formed. The prime factor in the quality of the part is the time that elapses between removing the hot sheets from the oven (or switching off infrared heating) and forming. The diagrams show the maximum waiting times before forming, in relation to heating temperature, for Oroglas® sheets.

This diagram also shows the zones in which forming becomes dangerous, or even impossible. There, crazing will result from high stresses in the material due to unsuitable temperature conditions.

3 mm Oroglas® forming range.



DIFFERENCES DUE TO THERMOFORMING

Even when heated to the maximum recommended temperature (190°-200°C), high pressure must be applied to Oroglas® to cause deformation. However, the pressure must be applied gradually: too sudden pressure could cause failure.

PRODUCTION OF MOULDS

Moulds, and where necessary dies, can be made from a range of materials such as wood, aluminium or steel, and reinforced or pre-stressed polyester or epoxy resins.

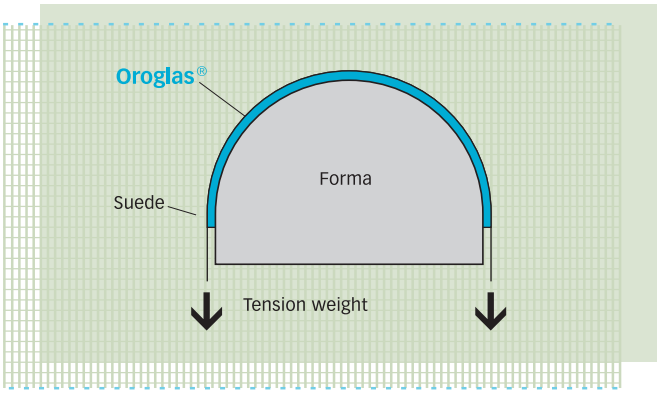
To minimize stresses during forming, it is advisable to heat (or better still regulate the temperature of) the dies and clamping frame at approximately 80°C for Oroglas®.

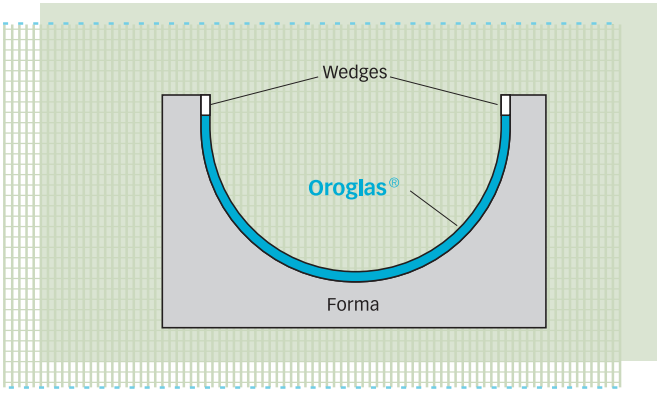
Working with Oroglas®

THERMOFORMING

SIMPLE FORMING OF DEVELOPABLE SURFACES

Allows for known shrinkage, to make sure that the finished part is not smaller than required. The heated sheet is simply placed over the shape and held in position with suedette to avoid surface defects. Ensure gradual cooling, away from draughts.

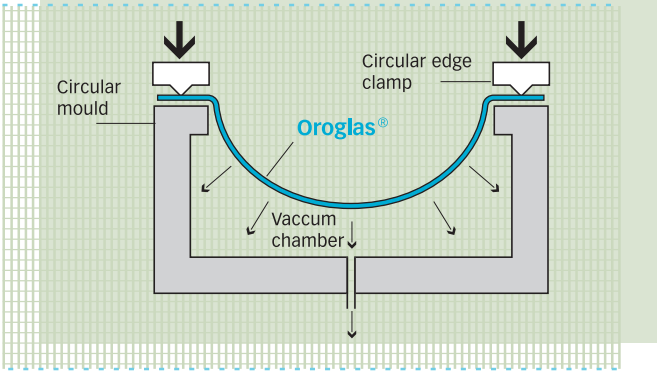




THERMOFORMING BY UNRESTRAINED VACUUM-MOULDING

For perfectly symmetrical forms similar to a spherical or ovoid dome, the mould need only be a frame or a perforated disk, placed on a vacuum tank. The curved part is not then exposed to any contact or friction and there is no risk of marking. When combined with certain "tricks of the trade", this technique can be used to produce complex forms such as those described below.

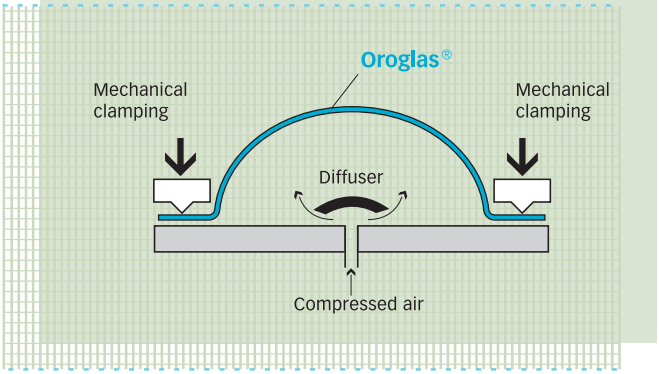
Thermoforming by unrestrained vaccum-moulding.



THERMOFORMING BY UNRESTRAINED BLOW-MOULDING

This very simple system consists of a plate with a compressed air inlet, protected by a diffuser to avoid blasting cold air on to the hot Oroglas®. A seal is formed by locking the sheet against the plate, using a ring or frame and a clamp.

Unrestrained blow-moulding with diffuser.



Working with Oroglas®

THERMOFORMING

BENDING

If the part to be produced requires only straightforward bends between flat surfaces, it is preferable not to heat the entire sheet or block, to ensure that the excellent flatness remains unaffected.

The technique is to heat the Oroglas® locally along the length of the bender, using one or more straight electrical heating elements.

The heating element may, for example, be a nickel/chromium wire held taut by a spring or counterweight and heated by a low voltage supply (24 or 48 volts).

Recommended procedure

- Heat the material to a temperature at which bending can be carried out with the least possible force, as a guide 150° to 170°C. A single unit containing a heating wire and two water boxes is generally sufficient for sheets up to 5 mm thick. For thicker sheets, use two symmetrical systems, placed one on each side of the sheet.
- Heat a zone that is at least as wide as the sheet is thick. The width of the zone for a right-angle bend is roughly 5 times the thickness.
- Machine a V-groove for acute bend angles and thick sheet.

Precautions

A number of precautions must be taken to limit stress in the bend zone:

- Apply intense heating to the bend zone only.
- Use suitable heating units; the best can be adjusted to control the width of the zone to be heated. The zone adjacent to the heated zone must be kept at a temperature of about 80°C for cast sheets, to minimize stresses due to temperature differences.
- Avoid excessive thermal shock when bending the material, specifically by using wooden guides.

Despite these precautions, bending leaves high internal stresses. Once again, the product must be annealed before being placed in contact with solvents or used in demanding conditions.

Working with Oroglas®

THERMOFORMING – GUIDELINES AND AVOIDING ERRORS

AVOIDING ERRORS

Certain basic processing errors must be avoided to obtain the best results:

The part may crack or tear if:

- A part is too hot or too cold.
- Drawing is done too quickly.
- The mould is too cold, or has angles that are too sharp.
- The air jet is too forceful or poorly diffused.

Optical distortion may occur due to:

- Defects in the surface of the mould.
- Contact between the sheet and mould at high temperature, before forming.
- Heating above 190°C.
- Too hot mould.
- A poorly diffused jet of air.

PRECAUTIONS DURING COOLING

To retain the required form without distortion, the part must be left in the mould until it has cooled to around 70°C.

Cooling must be as long and uniform as possible, to minimise residual internal stress.

ANNEALING

Stress-relieving of machined and formed parts

If the parts have not been properly machined or have been thermoformed under unsuitable conditions, it is preferable that they be annealed in an air circulation oven before contact with solvents, adhesives, ink or paint. This operation is designed to relieve internal stresses caused by machining or forming. Internal stresses can cause crazing in contact with these products.

Annealing times and temperatures

For a given thickness, flat pieces produced from cast Oroglas® sheet require a certain annealing time. The temperature:

- **Oroglas®** : 85°C for flat panels

The annealing time is given by the following formula:

Annealing time (hours) = 2 + [0.225 x thickness (mm)].

When annealing bent or thermoformed parts, the temperatures must be reduced by 10°C to avoid unwanted distortion:

- **Oroglas®** : 75°C for thermoformed parts

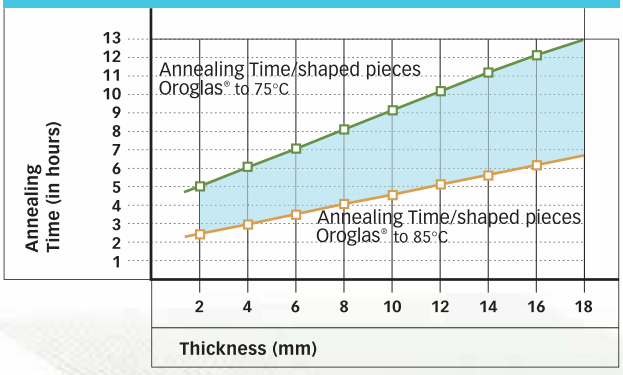
The annealing time for formed parts is given by the following formula:

Annealing time (hours) = 4 + [0.450 x thickness (in mm)].

The graph of the two formulae, below, enables the annealing time for a given thickness to be read at a glance.

It is important to allow the parts to cool naturally in the oven, to avoid fresh stresses due to thermal shock.

Annealing time as a function of temperature for various sheet thicknesses.



Finishing & Maintenance

FINISHING

Before packing and wrapping pieces made of Oroglas® a Cleaner product can be applied to remove finger and handling marks. This improves the shine and reduces static, which slows down the accumulation of dust.

However, if the parts have accidental scratch marks, they should first be polished using polishing product and a soft cloth or polisher.

MAINTENANCE AND CLEANING

All the previous recommendations also apply to maintenance.

In many cases, cleaning only amounts to washing with clean water and a soft cloth, chamois leather or sponge.

Never rub the dry surface of Oroglas®.

The use of solvents such as methylated spirits, turpentine, White Spirit® or window cleaning products is to be discouraged.

Resistance to chemicals

RESISTANCE TO CHEMICALS

Oroglas® provides good resistance to water, alkalis and aqueous solutions of inorganic salts. However, Oroglas® is attacked by certain dilute acids, such as hydrocyanic and hydrofluoric acids, and concentrated sulphuric, nitric or chromic acids.

There are three categories of Oroglas® solvents:

- Highly active solvents: chlorinated hydrocarbons.
- Moderately active solvents: aromatics, aldehydes, ketones and esters (acetates).
- Slow solvents: alcohols.

The following table indicates the resistance of Oroglas® to various fluids at room temperature, for various periods of up to 1 year or more.

The tests were only carried out on colourless sheets. The results are considered satisfactory if the test pieces show no obvious changes such as swelling, dissolved areas, crazing, splitting or embrittlement. Slight discolouration may occur without being considered a flaw.

Chemical resistance

REACTION OF OROGLAS® TO VARIOUS CORROSIVE SUBSTANCES

	%	OROGLAS®		%	OROGLAS®
ACIDS					
Acetic Acid	10	NA	Lactic Acid	20	NA
Acetic Acid	100	SA	Nitric Acid	10	NA
Butyric Acid	Concentr.	SA	Nitric Acid	Concentr.	SA
Chromic Acid	10	NA	Oxalic Acid	Saturated	NA
Chromic Acid	Saturated	SA	Paracetic Acid		SA
Citric Acid	Saturated	NA	Phosphoric Acid	10	NA
Formic Acid	10	NA	Phosphoric Acid	95	SA
Formic Acid concent	90	SA	Sulfuric Acid	10	NA
Hydrochloric Acid	10	NA	Sulfuric Acid	30	LA
Hydrofluoric Acid	Concentr.	NA	Sulfuric Acid	90	SA
Hydrofluoric Acid		SA	Tartaric Acid	Saturated	NA
ALCOHOLS					
Amyl Alcohols	Pure	SA	Methyl Alcohol	10	NA
Benzyl Alcohol	Pure	SA	Methyl Alcohol	50	LA
Butyl Alcohol	Pure	SA	Methyl Alcohol	Pure	SA
Ethyl Alcohol	30	LA	Propyl Alcohol	10	LA
Ethyl Alcohol Anhydrous	Pure	SA	Propyl Alcohol	50	SA
Ethyl Alcohol Br.contact	10	NA			
BASES					
Caustic Potash	10	NA	Caustic Soda	50	SA
Caustic Potash	50	SA	Sodium Carbonate	Saturated	NA
Caustic Soda	10	NA			
GASES					
Acetylene		NA	Ozone		NA
Butane		NA	Propane		NA
Carbonic Gases		NA	Sulphur Dioxide		NA
Hydrogen		NA	Sulphuric Anhydride		SA
Oxygen		NA			
OILS AND GREASY PRODUCTS					
Butyl Stearate		NA	Mineral Oils		NA
Coconut Oil		NA	Parafin		NA
Lanoline		NA	Sodium Oleate		NA
Lockeed Oil		SA			
FOOD PRODUCTS					
Fruits Juices		NA	Vinegar		NA
Milk		NA	Wine		NA
Olive Oil		NA			

NA - No Attack
LA - Limited Attack
SA - Severe Attack

WARRANTY: The information given in this literature is based on the findings of our research and experience. It is intended as a general guide to the use of our products and must not be considered as a binding specification. In no way does this information incurs the liability of Altuglas International, especially in case of infringement of the rights of a third party.

REACTION OF OROGLAS® TO VARIOUS CORROSIVE SUBSTANCES

	%	OROGLAS®		%	OROGLAS®
PHENOLS					
Cresol		SA	Phenol		SA
Metacresol		SA			
DISINFECTANTS AND CLEANING AGENTS					
Ammonia Solution	Density 0,88	NA	Hydrogen Peroxide	40 volumes	NA
Ammonium Solution	Concentr.	SA	Hydrogen Peroxide	90 volumes	SA
Bleach	10° Chlorine	NA	Mercurochrome		NA
Bleach	48° Chlorine	SA	Tincture of Iodine		SA
Formaldehyde	40	NA			
MINERAL SALTS IN SOLUTION					
Alun (Saturated Solution)		NA	Mercuric	10	SA
Ammonium Chloride	Saturated	NA	Potassium Bichromate	10	NA
Ammonium Nitrate		NA	Potassium Chloride	Saturated	
Calcium Chloride	Saturated	NA	Potassium Iodide		NA
Calcium Hypochloride		NA	Potassium Permanganate	10	NA
Chlorine Water	2	LA	Sea Water		NA
Copper Sulphate		SA	Sodium Bichromate	10	NA
Ferric Chloride	10		Sodium Bisulphate	10	NA
Iron Perchloride		SA	Sodium Chloride		NA
Iron Sulphate		NA	Sodium Metaphosphate		NA
SOLVENTS AND MISCELLANEOUS					
Acetal Dehyde	100	SA	Ethylene Glycol		NA
Acetic Anhydride		LA	Ethylene Sulphate		SA
Acetone		SA	Freon		SA
Aniline		SA	Gasoil		LA
Benzene		SA	Glycerine		NA
Benzaldehide		SA	Mercury		NA
Butyl Acetate		SA	Methylene Chloride		SA
Butyl Phthalate		LA	Methylethylketone		SA
Carbon Disulphide		SA	Naphtalene		LA
Chloroform		SA	Nonyl Phthalate		LA
Cyclohexane		SA	Petrol Standard		LA
Dichloroethane		SA	Petrol Super 100 Oct.		SA
Diethyl Chloride		SA	Pyraline		SA
Diethylene Glycol		NA	Turpentine		NA
Dioctyl Phthalate		LA	Toluene		SA
Dioxane		NA	Trichlorethane		SA
Ethylamine		SA	Trichlorethylene		SA
Ethyl Acetate		SA	Tricresyl Phosphate		SA
Ethyl Chloride		SA	Xylene		SA
Ethyl Ether		SA	White Spirit (< 3% Aromatics)		NA

NA - No Attack
LA - Limited Attack
SA - Severe Attack

Guarantee

GUARANTEE

Oroglas® sheets of any thickness retain virtually all their characteristics after 10 years exposure to weathering.

The Oroglas® guarantee covers light transmission, rigidity and tensile strength.

The exact terms of the guarantee are given in the "Ten-year guarantee" sheet.

Technical information contained in the present brochure is given following our own laboratory tests.

Technical specifications for our products are given as a guide and are subject to modification.

We accept no liability in respect of the description of our products or their fitness for any particular purpose or for any loss or damage caused (whether direct or consequential).

TEN YEAR GUARANTEE ON OROGLAS® CAST SHEETS

Altuglas International guarantees that its Oroglas® cast sheets of any thickness up to 20 mm, retain virtually all their characteristics after 10 years exposure to weather. This guarantee covers light transmission, rigidity and tensile strength.

1.1 RETENTION OF LIGHT TRANSMISSION

Measurements are based on the ASTM D1003 Standard. They are taken on 2-mm. thick samples whose surfaces have been thoroughly cleaner and re-polished. The light transmission coefficient values have been taken initially and after a 10-year period as follows:

OROGLAS® 800 000 – minimum guaranteed on delivery: 90%

OROGLAS® 800 000 - minimum guaranteed after a 10-year period: 88%

1.2 RETENTION OF RIGIDITY

The elasticity deflection module is measured in accordance with the ISO 178 standard on 1 to 4 mm parallel-faced samples that have been conditioned at 23° C and at 50% relative humidity.

OROGLAS® 800 000 – minimum guaranteed on delivery: 3000 MPa

OROGLAS® 800 000 – minimum guaranteed after a 10-year period: 2800 MPa

1.3 RETENTION OF TENSILE STRENGTH

The tensile strength at break is measured on 1 to 4 mm parallel-faced samples in accordance with the ISO 527 standard 23°C and at 50% relative humidity

OROGLAS® 800 000 – minimum guaranteed on delivery: 65 Mpa

OROGLAS® 800 000 – minimum guaranteed after a 10-year period: 60 MPa

2. GUARANTEE CONDITIONS

Oroglas® cast sheets should be stored, handled, transported, machined and installed in accordance with the manufacturer's instructions.

Fastening and sealing sheets together should be carried out in such a matter so as not to have any negative impact on the sheets.

The sheets should not be exposed to the harmful effects of chemical agents.

Please refer to our Technical Brochure for details of finishing operations and chemical resistance.

3. GUARANTEE PERIOD

This 10-year guarantee takes effect from the date on which the materiel is received by the customer.

4. APPLICATION OF THE GUARANTEE

This guarantee applies if damage occurs within the conditions started above and if that damage is notified to the stockist within the guarantee period.

This guarantee is limited to the free replacement of Oroglas® cast sheets only.

5. GENERAL NOTES

5.1– For Oroglas® "neutral" or "transparent colours" cast sheets, the retention of rigidity and tensile strength are guaranteed in accordance with paragraphs 1-2 and 1-3 above. However, light transmission and colour are not covered within this guarantee.

5.2– All guaranteed values are measured on machined samples taken from a parallel-faced material. The values cannot be measured precisely on products whose edges are not straight.

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