

# Working with Altuglas®

## THERMOFORMING

### HEATING METHOD

#### Heating times and temperatures

The temperature and heating time vary, depending on the type of Altuglas® sheet and heating method used.

#### SUMMARY TABLE OF HEATING CONDITIONS FOR SHEETS

Heating temperature		
	Altuglas® CN	Altuglas® EX
Minimum temperature (°C)	130	140
Maximum temperature (°C)	200	180
Recommended range (°C)	165-190	160-175

Heating times by type of equipment		
	Altuglas® CN	Altuglas® EX
Oven (min/mm)	3-4	2.5-3
<b>Infrared panels</b>		
1 panel (sec/mm)	40-50	35-45
2 panels (sec/mm)	25-30	20-25

#### Two main differences in response to heating

##### SHRINKAGE

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

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

With Altuglas® EX, the extrusion process causes variable shrinkage, depending on the thickness and length/width orientation of the sheets relative to the direction of extrusion.

##### In the extrusion direction:

- Maximum of 3 % for thicknesses  $\geq$  3 mm
- Maximum of 6 % for thicknesses  $\leq$  3 mm

##### In the transverse direction:

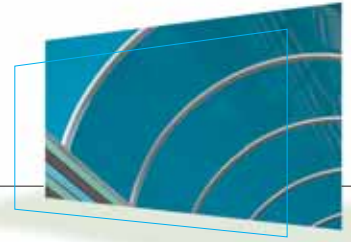
- Maximum of 1 %

These differences in shrinkage mean Altuglas® EX sheets must be clamped to a frame during the heating stage, to avoid distortion of their flat surfaces.

##### UNIFORM HEATING

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

Altuglas® EX must be heated very uniformly: any difference exceeding 5°C may lead to considerable internal stress.



## HEATING METHOD

### Other differences in response to heating, and precautions:

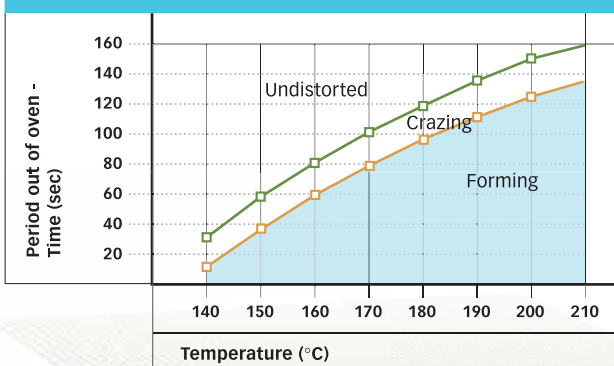
In a horizontal oven, Altuglas® EX tends to adhere to metal surfaces. It is therefore advisable to provide suitable protective coverings (fluorinated coatings, Teflon-coated fabric or fluorinated sprays) for metal surfaces such as the floor or sides of the oven.

Altuglas® EX sheet tends to creep. The elongation can cause tearing if the temperature exceeds 175°C or even 170°C, and if the heating is prolonged; this type of oven must not be used to heat large extruded sheets.

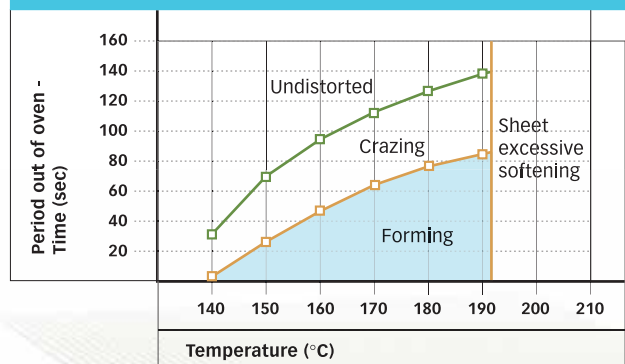
The heating time and temperature vary with the type of product, the temperature conditions and the complexity of the part being formed. The prime factor in the quality of the part is the time that elapses between removing the hot sheets from the oven (or switching off infrared heating) and forming. The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

These two diagrams also show 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. To test this phenomenon in a laboratory, dip test samples taken from the most elongated areas in 95 % ethanol for 10 minutes. The test pieces will crack or break if there is abnormal internal stress in the material.

3 mm Altuglas® CN forming range.



3 mm Altuglas® EX forming range.



## DIFFERENCES DUE TO THERMOFORMING

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

**Altuglas® EX**, on the other hand, can be thermoformed more easily where there are numerous details and sharp changes.

**Altuglas® Cast CIF** offers improved thermoforming capability relative to Altuglas® CN (better accuracy of shapes).

**Altuglas® EI Extruded Impact** has even better qualities: better accuracy of shapes and greater strength during mould-stripping, machining and subsequent handling.

## 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.

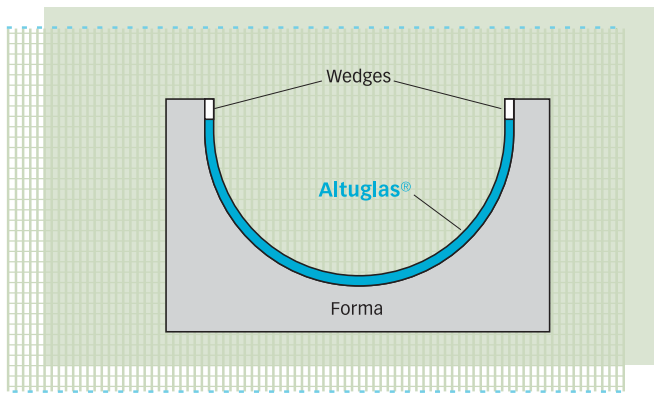
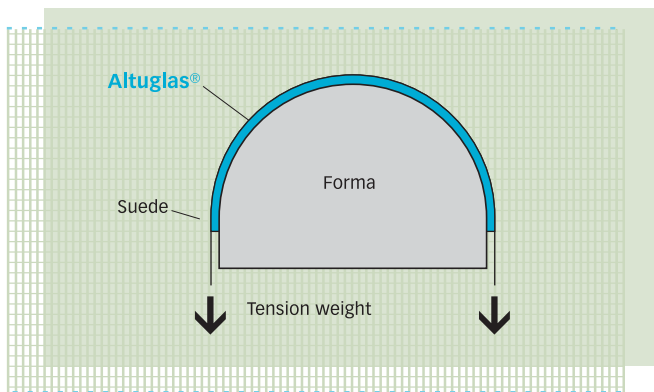
To minimize stresses during forming, it is advisable to heat (or better still regulate the temperature of) the dies and clamping frame at approximately 80°C for Altuglas® CN and 70°C for Altuglas® EX.

# Working with Altuglas®

## THERMOFORMING

### SIMPLE FORMING OF DEVELOPABLE SURFACES

Allows for known shrinkage, to make sure that the finished part is not smaller than required (note the difference between Altuglas® CN and EX). The heated sheet is simply placed over the shape and held in position with suede to avoid surface defects. Ensure gradual cooling, away from draughts.



### DETERMINING THICKNESS AFTER STRETCH THERMOFORMING

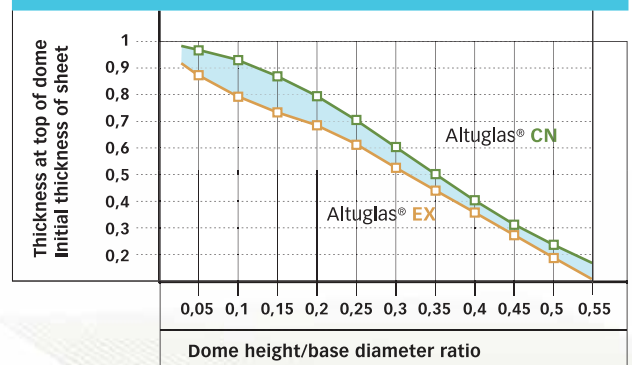
Unlike the forming process described above, one consequence of stretch thermoforming is that there are differences in thickness within the same piece.

The diagram below shows a cross-section of a dome produced by unrestrained vacuum- or blow-moulding. Due to stretching of the sheet, the final thickness at the top of the dome is considerably less than the initial thickness.

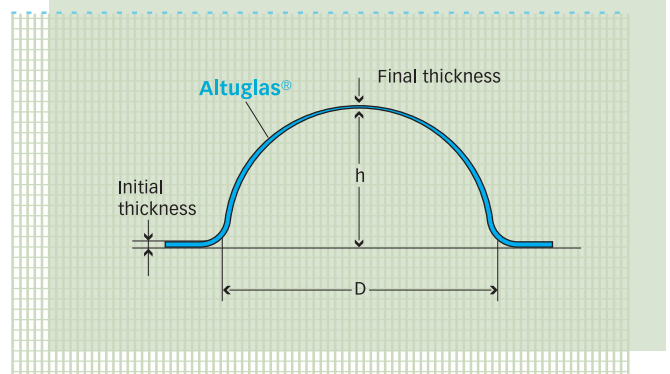
The curves below show the relation between reduction in thickness and degree of stretching for Altuglas® CN and EX. The reduction in thickness is shown as the ratio between final and initial thickness.

The degree of deformation is shown on the axes by the ratio between height and diameter. The curves, shown as a guide only, remain true for domes with a square base.

**Table showing Altuglas® elongation during unrestrained blow or vacuum moulding. Variations in thinning with deformation.**

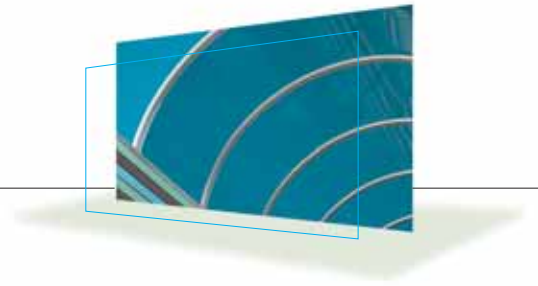


**Thinning at the top of a dome formed by unrestrained vacuum- or blow-moulding**



Stretching of Altuglas® sheet by unrestrained vacuum- or blow-moulding

Change in degree of thinning as a function of degree of deformation.



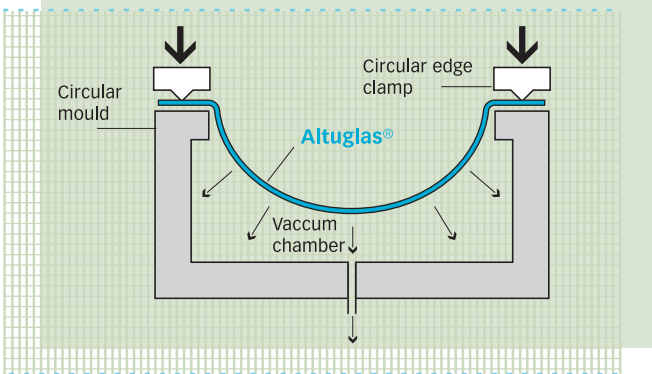
## THERMOFORMING BY UNRESTRAINED VACUUM-MOULDING

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.

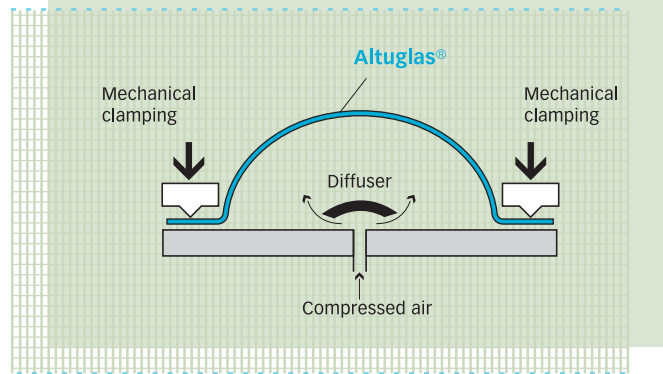
## THERMOFORMING BY UNRESTRAINED BLOW-MOULDING

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 Altuglas®. A seal is formed by locking the sheet against the plate, using a ring or frame and a clamp.

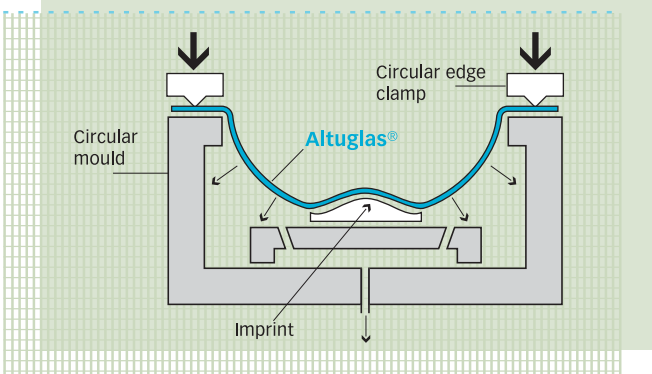
**Thermoforming by unrestrained vacuum-moulding.**



**Unrestrained blow-moulding with diffuser.**



**Thermoforming by unrestrained vacuum-moulding with a base imprint.**

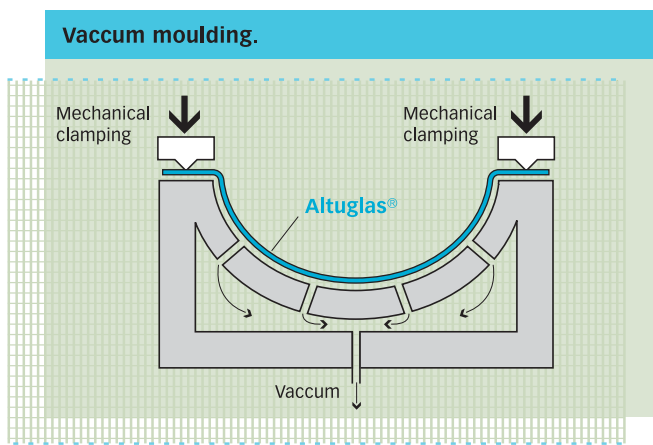


# Working with Altuglas®

## THERMOFORMING

### THERMOFORMING BY RESTRAINED VACUUM-MOULDING

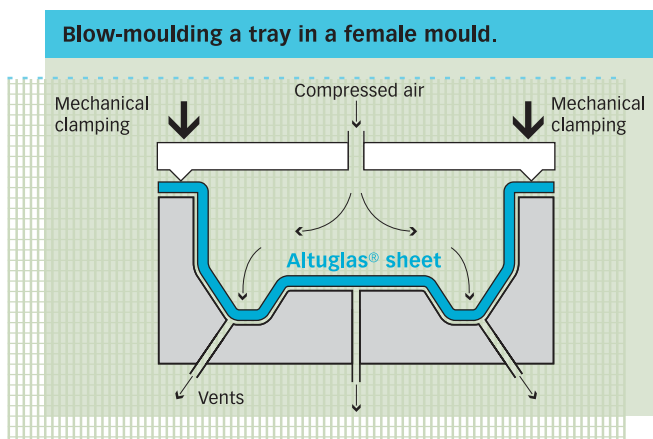
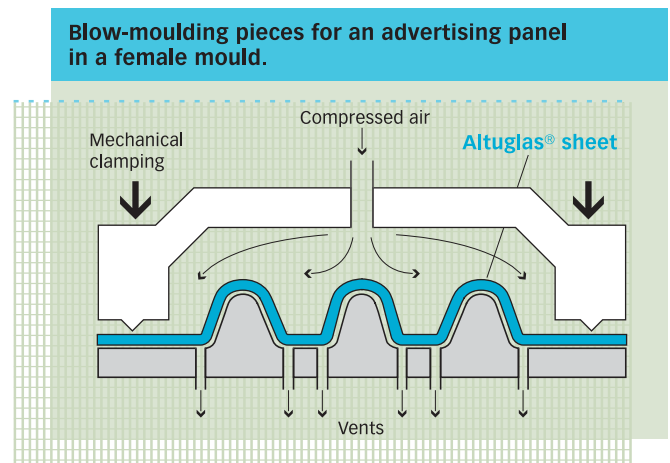
A concave mould is used, with the external shape of the required finished part. After heating, a sheet of Altuglas® is quickly fixed in an air-tight manner to the edge of the mould, using a ring and suitably shaped frame. Air is then pumped from the mould and the sheet takes up the shape.

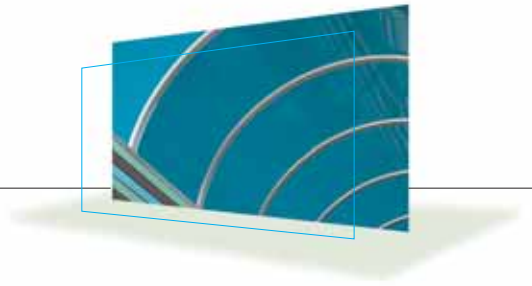


### THERMOFORMING BY RESTRAINED BLOW-MOULDING

The pressures involved mean the moulds must be very rigid, generally of metal, hardwood or epoxy resin. Vents must be provided at the extremities of the moulds, to allow air to escape.

The Altuglas® sheet must be tightly clamped to ensure good sealing and prevent slippage. The mould may be lightly lubricated, for example with paraffin wax or silicone-based oils, to obtain even drawing and facilitate mould-stripping.





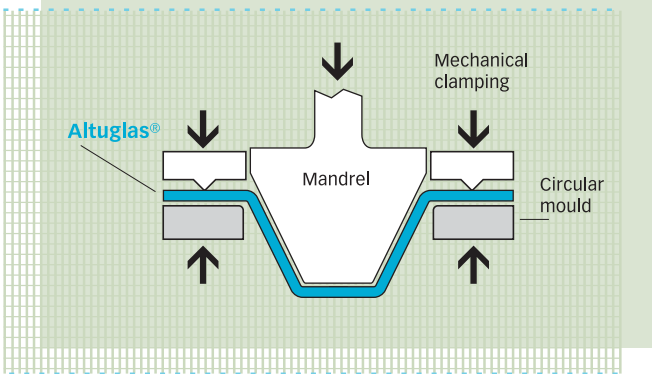
## THERMOFORMING BY PRESSING WITH A PUNCH

A punch shaped like the inside of the part is lowered to deform the hot Altuglas® at low pressure (see diagram 1: Forming by simple pressing).

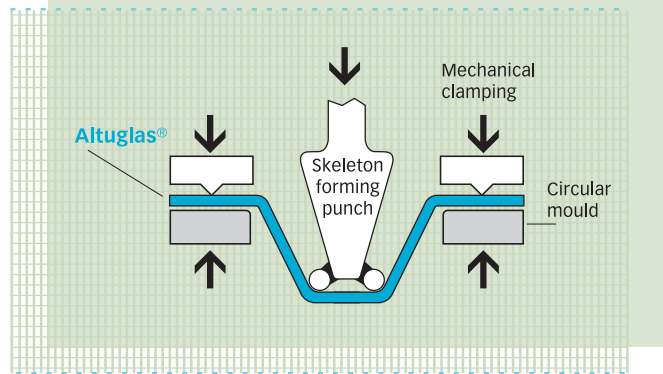
If required, a female mould section may still be used to form a die and accentuate the relief. This process, using a mould and punch, has the drawback of marking both faces of the part. It is rarely used, therefore (see diagram 2: Forming by pressing with a punch and die).

The punch need not be solid: it may be hollow, simply a frame representing the corners of the part to be formed. The remainder of the surface is then formed by contraction of the Altuglas® as it cools (see diagram 3: Forming by pressing with a skeleton punch).

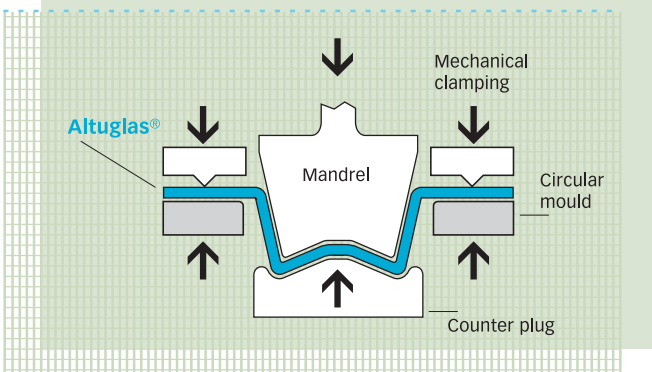
**Diag. 1: Forming by simple pressing.**



**Diag. 3: Forming by pressing with a skeleton punch.**



**Diag. 2: Forming by pressing with a punch and die.**



# Working with Altuglas®

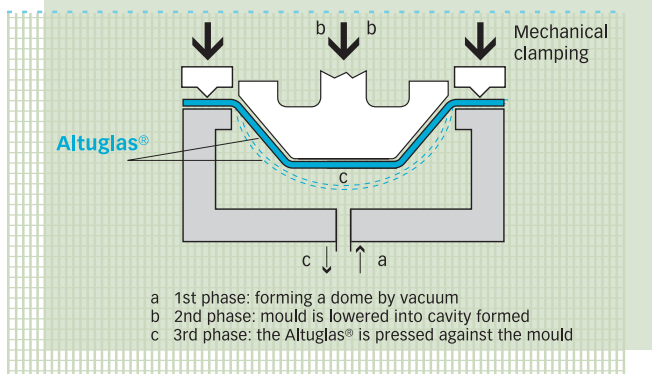
## THERMOFORMING

### COMBINED THERMOFORMING METHODS: BLOW/VACUUM-MOULDING AND PRESSING

#### Vacuum-drawing with elastic return against a plug (vacuum/snap-back)

This process is mainly used with Altuglas® CN, which has a memory effect. It consists of first drawing it into a vacuum tank, beyond the shape to be produced. A plug is then lowered into the vacuum-formed shape. The vacuum is released and the Altuglas® CN contracts elastically to fit the plug (see diagram 1: Forming by vacuum-drawing and moulding).

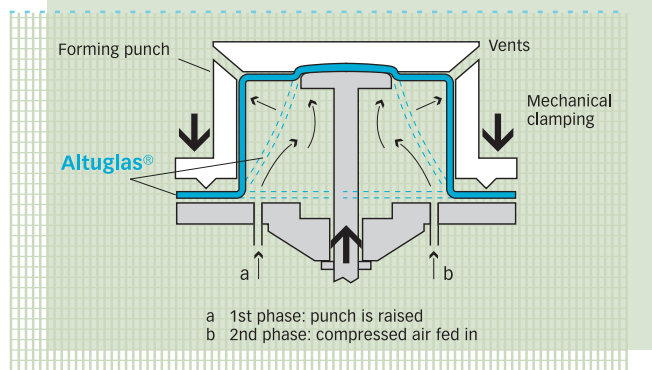
**Diag. 1: Forming by vacuum-drawing and moulding.**



#### Pressing and blow-moulding

A punch first presses the hot sheet to the bottom of the mould. It is then forced against the walls of the mould by air pressure (see diagram 2: Forming by pressing and blow-moulding).

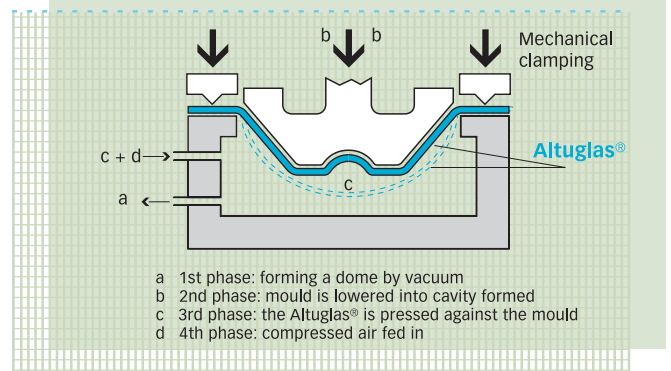
**Diag. 2: Forming by pressing and blow-moulding.**

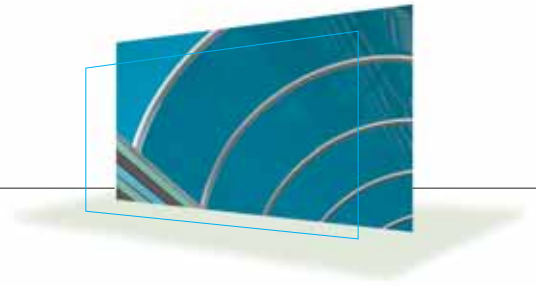


#### Vacuum-drawing and blow-moulding

The same tank is used first to apply a vacuum and then pressure. The vacuum is used to obtain maximum deformation, after which a plug is lowered into the vacuum-formed shape. The vacuum is then released and the sheet contracts elastically to fit the form of the plug. Finally, compressed air is used to force the sheet against all parts of the plug, including any cavities. Due to the elastic memory effect already mentioned, this process is mainly used with Altuglas® CN (see diagram 3: Forming by vacuum-drawing and blow-moulding).

**Diag. 3: Forming by vacuum-drawing and blow-moulding.**





## BENDING

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

The technique is to heat the Altuglas® 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

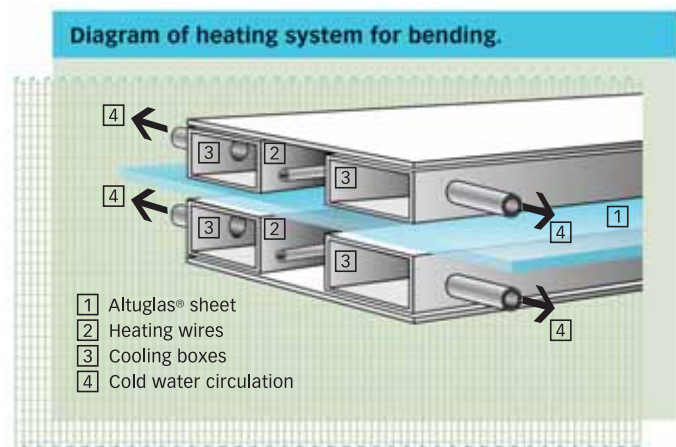
- Heat the material to a temperature at which bending can be carried out with the least possible force, as a guide 150° to 170°C. A single unit containing a heating wire and two water boxes is generally sufficient for sheets up to 5 mm thick. For thicker sheets, use two symmetrical systems, placed one 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:

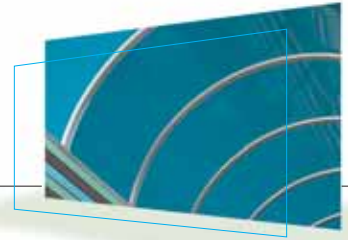
- Apply intense heating to the bend zone only.
- Use suitable heating units; the best can be adjusted to control the width of the zone to be heated. The zone adjacent to the heated zone must be kept at a temperature of about 70°C for extruded sheets and 80°C for cast sheets, to minimize stresses due 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 Altuglas®

## 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, especially with Altuglas® CN.
- 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, especially for Altuglas® EX.
- Heating above 190°C for Altuglas® CN and 170°C for Altuglas® EX.
- Too hot a 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.

Parts formed from Altuglas® EX must be annealed to relieve internal stress before any solvents, paints, printing inks or adhesive films are applied.

### 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. It is essential for extruded sheets. Internal stresses can cause crazing in contact with these products.

**Annealing times and temperatures**

For a given thickness, flat pieces produced from cast or extruded Altuglas® sheet require the same annealing time. Only the temperature changes:

- Altuglas® CN: 85°C
- Altuglas® EX: 75°C

The annealing time is given by the following formula:

$$\text{Annealing time (hours)} = 2 + [0.225 \times \text{thickness (mm)}].$$

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

- Altuglas® CN: 75°C
- Altuglas® EX: 65°C

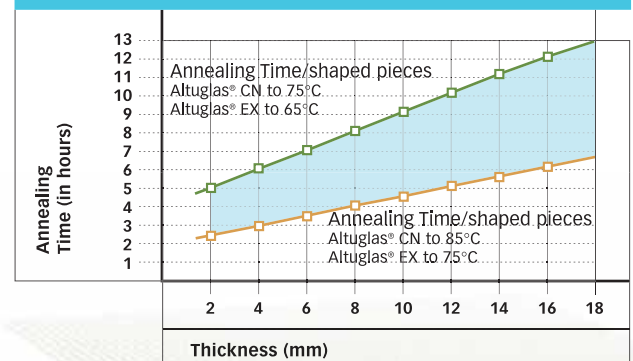
The annealing time for formed parts is given by the following formula:

$$\text{Annealing time (hours)} = 4 + [0.450 \times \text{thickness (in mm)}].$$

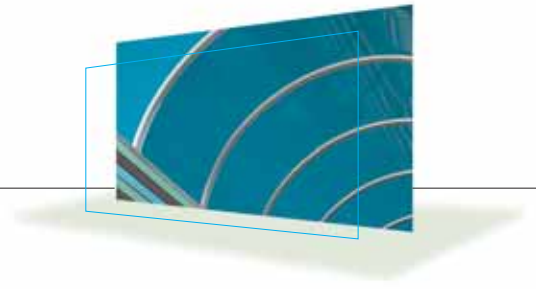
The graph of the two formulae, below, enables the annealing time for a given thickness to be read at a glance.

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.**



# Installation



## GENERAL INFORMATION

Altuglas®, either in the original flat sheets, or curved by cold or hot bending or thermoforming, is often mounted in a rigid frame. Regardless of whether it is affixed to a rigid frame or inserted in framing sections, certain basic precautions must be taken to avoid breakage or unwanted distortion in the long term. Detailed information is given in the Altuglas® "Architectural Manual".

### Incompatibility with other materials

Altuglas® must not be placed in contact with incompatible plastic materials such as plasticized P.V.C. or silicone sealing compounds containing acetic acid or acetates.

Recommended contact products are: Teflon®, Dutral®, EPDM rubber, neoprene, butyl, polyethylene (PE), polypropylene (PP) and neutral silicone. When the nature of the product is unknown, ask the supplier about its compatibility with Altuglas®.

## DIMENSIONAL VARIATION AND EXPANSION GAPS

Altuglas® has a coefficient of expansion roughly 10 times that of metals normally used for frames. Consequently, the sheet must be cut to dimensions which leave sufficient space for expansion. This applies just as much to the length and width of the sheet as to the diameters of fixing holes.

In addition, EPDM-type seals (compatible with Altuglas®) are frequently force-fitted between Altuglas® sheet and a rebate in the metal frame. In such an installation, ensure that there is sufficient elasticity to allow the Altuglas® to expand or contract freely. Moreover, with Altuglas® CN, allowance must be made for possible differences in thickness within a given sheet.

Finally, where the sheet is fixed by screws, the following guidelines are recommended:

- The drilling diameter should be substantially greater than the diameter of the screw thread.
- The hole must be protected from the screw threads by a plug made of compatible material (PE type).
- Soft insulating EPDM-type washers should be used when screwing.

## SELECTING THE SHEET THICKNESS

The Altuglas® sheet must be thick enough to stay rigid when exposed to forces such as wind pressure or snow that may be anticipated in the site area.

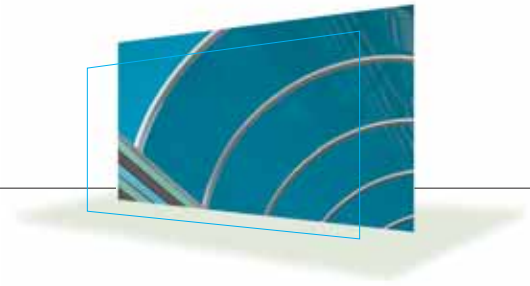
## COLD BENDING

Altuglas® CN, Altuglas® EX and Altuglas® EI sheets are ideally suited to cold bending. This allows them to be installed in curved rebates. However, the bends must not be sharper than a certain minimum curve radius, to avoid high permanent stress, which would eventually cause crazing or even breaks.

**The minimum bend radii (Rmin) are calculated as a function of sheet thickness. The coefficients given vary according to the type of sheet:**

Designation	Coefficient
Altuglas® CN Rmin (mm)	330 x thickness in mm
Altuglas® EX Rmin (mm)	330 x thickness in mm
Altuglas® EI 25 Rmin (mm)	220 x thickness in mm
Altuglas® EI 50 Rmin (mm)	200 x thickness in mm
Altuglas® EI 60 Rmin (mm)	180 x thickness in mm

# Assembly



## BONDING

Bonding is the creation of a PMMA joint between the parts being assembled. The glues are either a solution of PMMA in a solvent, most of which evaporates during curing, or polymerisation in situ to form PMMA. This second process effectively forms continuous Altuglas® between the adjacent parts.

In either case, the first step is to apply either the volatile solvent-based glues, or the monomer solvent for polymerizing glues, to both the faces to be bonded.

However, before any bonding, it is essential to apply an annealing heat-treatment, to relieve any internal stresses left by machining or forming.

It is also advisable, once the glue has dried and hardened at room temperature, to carry out another heat treatment for 2 to 5 hours at approx. 60°C, to improve the quality of the joint.

### Various types of glue

The specific composition and uses are set out in the Technical Data and Safety Data for each Altuglas® adhesive.

### Contact glues (Altuglas® Adhesive S)

These are solutions of generally small quantities of PMMA in a solvent, or may even be pure solvent. The setting time is the time required for the solvent to evaporate, but complete evaporation seldom occurs.

### Polymerizing glues (Altuglas® Adhesive P)

Catalysts are added to these fairly viscous solutions of polymethylmethacrylate and methylmethacrylate just before use, to polymerize the monomer. The material in the joint is therefore identical to Altuglas®. The setting time is the time required for the polymerization reaction to take place.

### Glue strength

Under ideal conditions, the strength of the joint, measured by a tensile test for example, is within the following range:

- **Contact glues:** 25 to 35 % of the strength of the original adjacent material.
- **Polymerizing glues:** 60 to 75 % of the strength of the original adjacent material.

## WELDING

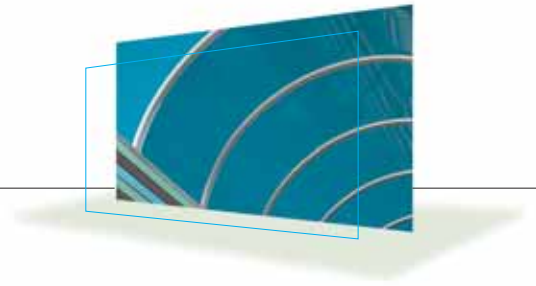
Welding involves placing the two parts to be joined in contact and then causing them to soften considerably in the contact area. Although many methods are available (hot gas, heating bars, induction, radiation, ultrasonics), this technique can only be applied to Altuglas® EX.

Another method is to use a filler rod and melt the material. It then becomes possible to weld Altuglas® CN.

However, the operation leaves high internal stress and an annealing heat-treatment is essential.

Under optimum conditions, the strength of the welded joints varies from 10 to 40 % of that of the original adjacent material.

# Decorative finishes



## DECORATIVE FINISHES

The most frequently used methods of decorating Altuglas® are screen-printing, hot transfer, paint spraying or application of coloured vinyl films. The method chosen will depend on various parameters:

- Economic factors (number of parts to be produced, investment cost).
- The shape of the part.
- The number of colours to be applied.
- The expected life, etc.

New technologies are offering new possibilities:

- Laser engraving in three dimensions.
- Illuminated panels with electronic programming of three-colour LEDs.

### Screenprinting

Screen-printing is generally known for its bright colours and long-term stability, and allows parts to be thermoformed after decoration. However, the surfaces must be perfectly flat. There are two types of screen-printing:

- Process using solvent-based inks.
- Process using inks that can be polymerised under UV.

The process using UV inks is increasingly used with Altuglas®. When used with Altuglas® sheets, this technology has certain advantages:

- New technical possibilities.
- Improved working conditions (absence of solvents).
- Faster production cycles.

The technology of UV inks is evolving rapidly. It is therefore preferable to contact the ink suppliers.

### Paint

Paint can be sprayed on to surfaces after forming and allows quicker drying.

### Adhesive films

Special care must be taken in preparing the surface and applying self-adhesive vinyl film. Subsequent thermoforming is not possible. The absence of gas loss from Altuglas® sheet ensures that the appearance and adhesion will be maintained in the long term. However, it is important to check first that the films are wholly compatible with Altuglas®.

### Illuminated decoration

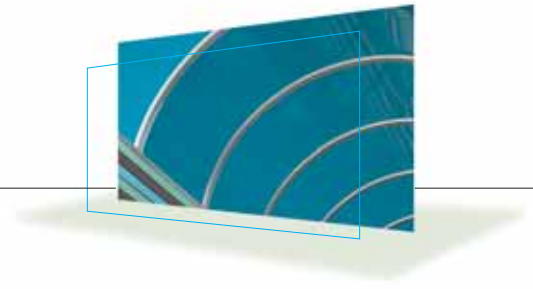
The light diffusion and transmission characteristics of Altuglas® make it the material of choice.

Speciality products such as Altuglas® Elit are designed for tangential illumination. Light comes from light source sources located around the edges. Altuglas® Elit diffuses this light evenly over the whole surface. This allows the construction of illuminated surfaces that are very compact. Altuglas® Elit sheets can be curved, thus allowing the creation of complex shapes.

Altuglas® Dual Satin allows optimum diffusion of light via its two matt surfaces, together with an almost infinite range of colours.

Combining new lighting technologies such as LEDs (light-emitting diodes) with Altuglas® sheets provides new design opportunities with a minimum of technical constraints.

# Finishing & Maintenance



## FINISHING

Before packing and wrapping pieces made of Altuglas® CN or EX, Altuglas® Cleaner 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 Altuglas® Polish and a soft cloth or polisher.

## MAINTENANCE AND CLEANING

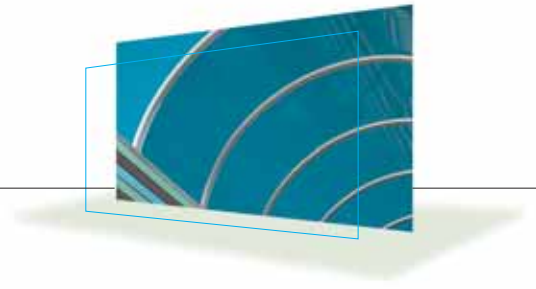
All the previous recommendations also apply to maintenance.

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 Altuglas®.

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

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

There are three categories of Altuglas® 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 Altuglas® CN and EX to various fluids at room temperature, for various periods of up to 1 year or more.

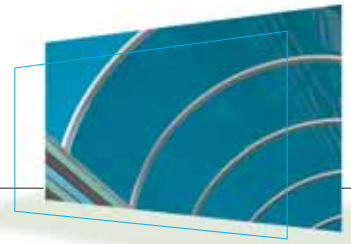
The tests were only carried out on colourless sheets. The results are considered satisfactory if the test pieces show no obvious changes such as swelling, dissolved areas, crazing, splitting or embrittlement. Slight discolouration may occur without being considered a flaw.

# Chemical resistance

REACTION OF ALTUGLAS TO VARIOUS CORROSIVE SUBSTANCES							
	%	ALTUGLAS CN	ALTUGLAS EX		%	ALTUGLAS CN	ALTUGLAS EX
<b>ACIDS</b>							
Acetic Acid	10	NA	LA	Lactic Acid	20	NA	NA
Acetic Acid	100	SA	SA	Nitric Acid	10	NA	
Butyric Acid	Concentr.	SA	SA	Nitric Acid	Concentr.	SA	
Chromic Acid	10	NA		Oxalic Acid	Saturated	NA	NA
Chromic Acid	Saturated	SA	SA	Paracetic Acid		SA	SA
Citric Acid	Saturated	NA	NA	Phosphoric Acid	10	NA	NA
Formic Acid	10	NA	NA	Phosphoric Acid	95	SA	SA
Formic Acid <small>concent</small>	90	SA	SA	Sulfuric Acid	10	NA	NA
Hydrochloric Acid	10	NA	NA	Sulfuric Acid	30	LA	LA
Hydrofluoric Acid	Concentr.	NA		Sulfuric Acid	90	SA	SA
Hydrofluoric Acid		SA	SA	Tartaric Acid	Saturated	NA	NA
<b>ALCOHOLS</b>							
Amyl Alcohols	Pure	SA	SA	Methyl Alcohol	10	NA	NA
Benzyl Alcohol	Pure	SA	SA	Methyl Alcohol	50	LA	LA
Butyl Alcohol	Pure	SA	SA	Methyl Alcohol	Pure	SA	SA
Ethyl Alcohol	30	LA	SA	Propyl Alcohol	10	LA	LA
Ethyl Alcohol <small>Anhydrous</small>	Pure	SA	SA	Propyl Alcohol	50	SA	SA
Ethyl Alcohol <small>Br.contact</small>	10	NA	NA				
<b>BASES</b>							
Caustic Potash	10	NA	LA	Caustic Soda	50	SA	SA
Caustic Potash	50	SA	SA	Sodium Carbonate	Saturated	NA	NA
Caustic Soda	10	NA	LA				
<b>GASES</b>							
Acetylene		NA	NA	Ozone		NA	NA
Butane		NA	NA	Propane		NA	NA
Carbonic Gases		NA	NA	Sulphur Dioxide		NA	NA
Hydrogen		NA	NA	Sulphuric Anhydride		SA	SA
Oxygen		NA	NA				
<b>OILS AND GREASY PRODUCTS</b>							
Butyl Stearate		NA		Mineral Oils		NA	NA
Coconut Oil		NA	LA	Parafin		NA	NA
Lanoline		NA	NA	Sodium Oleate		NA	LA
Lockeed Oil		SA	SA				
<b>FOOD PRODUCTS</b>							
Fruits Juices		NA	NA	Vinegar		NA	NA
Milk		NA	NA	Wine		NA	NA
Olive Oil		NA	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 incur the liability of Altuglas International, especially in case of infringement of the rights of a third party.



## REACTION OF ALTUGLAS TO VARIOUS CORROSIVE SUBSTANCES

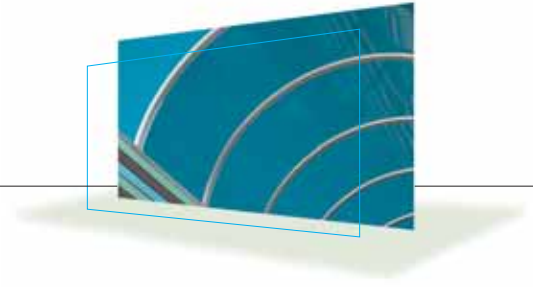
	%	ALTUGLAS CN	ALTUGLAS EX		%	ALTUGLAS CN	ALTUGLAS EX
<b>PHENOLS</b>							
Cresol		SA	SA	Phenol		SA	SA
Metacresol		SA	SA				
<b>DISINFECTANTS AND CLEANING AGENTS</b>							
Ammonia Solution	Density 0,88	NA	NA	Hydrogen Peroxide	40 volumes	NA	NA
Ammonium Solution	Concentr.	SA	SA	Hydrogen Peroxide	90 volumes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

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# Guarantee

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## GUARANTEE

Clear Altuglas® CN and EX sheets of any thickness retain virtually all their characteristics after 10 years exposure to weathering.

The Altuglas® 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).





**Altuglas International**

6, cours Michelet · Cedex 52  
F-92064 Paris La Défense 10  
Tel +33 (0)1 49 00 80 80 / 89 72  
Fax +33 (0)1 49 00 89 71  
[www.altuglasint.com](http://www.altuglasint.com)  
[www.altumax.com](http://www.altumax.com)