ASIA POLY INDUSTRIAL

Fabrication Guide

for A-Cast® cast acrylic

This fabrication guide has been produced as an aide memoire to fabricators and installers of A-Cast® cell cast acrylic.

Every endeavour has been made to ensure that the information contained herein is accurate and reliable and is given in good faith as indicative of the product, for the guidance of users. Values quoted for processing or properties of the material are results of tests on representative samples and do not constitute a specification. The processing and performance characteristics of A-Cast® acrylic will depend on the user, tools and equipment, temperature and applied stress. Users are advised to confirm the suitability of the material for their own particular purpose and using their own tests.

No warranty in respect to the fitness of the product for any particular purpose is given and any implied warranty, whether statutory or otherwise, is excluded, except to the extent that exclusion is prevented by law.

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Introduction

The ability to be readily fabricated, formed and cemented lends A-Cast® to many applications.

A-Cast® cast acrylic is a product that has become synonymous with clarity, colours and choice. The fabrication behaviour of the material and wide range of colours, surfaces and finishes enable designers to quickly realise their creative ideas.

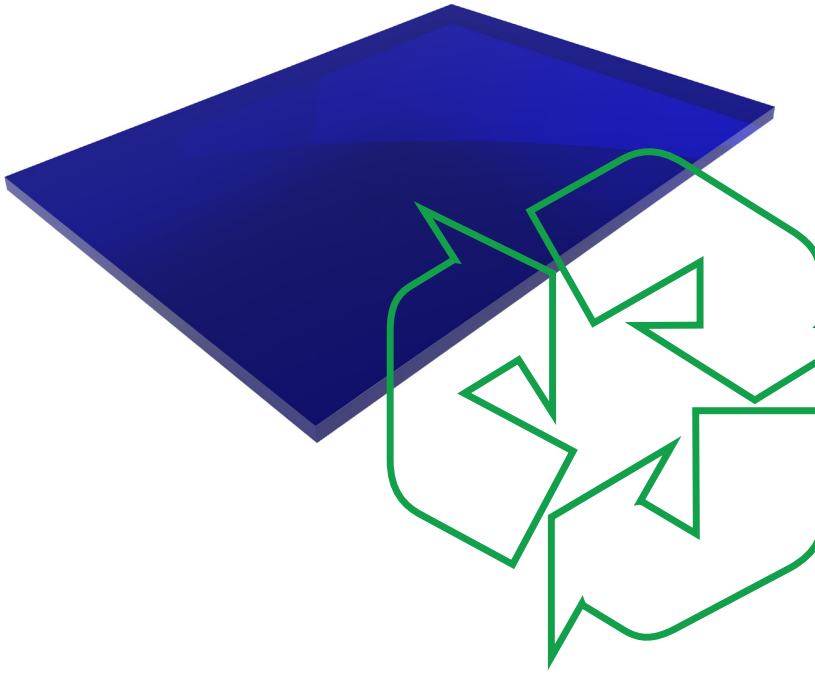
The benefits of A-Cast® cast acrylic are based upon the properties of the product and the manufacturing method – made in a batch process as opposed to extrusion which is a continuous production process. The manufacturing method means that small quantities can be produced, giving flexibility in both colour range and surface finish, with the ability to offer colour matching and speciality products in relatively low quantities.

The cell cast process has benefited over the years from the application of engineering technology to increase process control and repeatability from one production batch to the next and Asia Poly have taken full advantage, although the basic casting process is essentially the same as that which was invented many years ago.

The benefits of A-Cast® cell cast acrylic from its inherent physical properties include:

- Clear gloss sheet with a light transmission and optical clarity higher than glass at 92%.
- Half the weight of glass with four times the strength so less liable to breakage.
- High flexural modulus with the ability to accomodate large spans.
- Resistance to weathering means the material is suitable for indoor and outdoor applications.
- Excellent surface hardness for abrasion resistance.
- Good chemical resistance so durable and easily cleaned.
- Wide colour range and different effects.
- Thermoplastic material so can be recycled into other products and itself.

These physical properties of the A-Cast® product, including the ability to be readily fabricated, formed and cemented, lend it to many different applications including both functional and aesthetic uses.



Safety First

When working with A-Cast®, all standard health and safety precautions should be taken.

Because health and safety is so important there are rules and laws which require us not to put ourselves or others in danger. When working with A-Cast® cast acrylic sheets all standard health and safety precautions should be taken, including the use of any necessary Personal Protective Equipment (PPE).

Managing health and safety is no different from managing any other aspect of a business. Risks in the workplace can be assessed and sensible measures put in place to control them.

Operators involved in the fabrication of A-Cast® acrylic are required at all times, to observe the health and safety policies of their respective employer.

In turn, operators should be adequately trained on the use of all work equipment, including machinery and tools, which should be maintained in a safe working condition.

Operators should also familiarise themselves with the location of emergency stops and ensure that machine safety guards are in position before operating any equipment.

Flammability

A-Cast® cast acrylic is a combustible thermoplastic and will ignite and burn if placed in contact with an open flame or any other source of ignition. Being combustible, if the source of the flame is removed, the acrylic will continue to burn and eventually melt.

When storing or working with A-Cast®, users should be aware of the flammability of the material and take all necessary precautions.

A Material Safety Data Sheet (MSDS) is available on request from Asia Poly or to download, visit www.asiapoly.com.my/downloads.

Storage and handling

The surface protection film can be left in place while working on the product unless otherwise specified.

Surface protection film

A-Cast® cast acrylic sheets are supplied with a surface protection film to prevent damage to the sheet in both transit and storage.

The surface protection film can also be left in place while working on the product and can be used for marking out to aid fabrication.

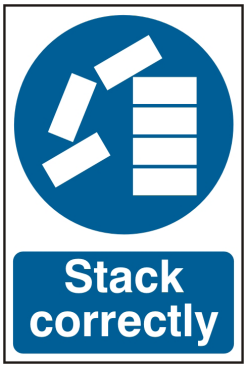
This surface protection film is typically pressure-sensitive, polyethylene or paper, dependent upon the market supplied.

Storage

Even though A-Cast® is suitable for use in many different environments, the sheets must always be stored indoors, in a dry environment at a temperature around 20°C.

Sheets are typically supplied on pallets and can remain, stored flat but care should be taken when removing and replacing sheets so as not to introduce dirt or debris between the stack.

If stored in racks, the racking supports should also be set at a suitable distance to prevent overhang, where the pallet bows, which could cause warpage.



A-Cast® may also be stored vertically where sheets can lean at around a 10º angle, in racks with adequate support and protection on the floor to prevent damage to one edge of the sheet.

Handling

A-Cast® sheets should always be handled with care, especially when handling wide area sheets and large thicknesses.

When removing A-Cast® sheets from a stack, to prevent damage, the sheet should never be dragged but lifted clear which will typically require more than one person to do this.

Preparation and visual consistency

Different materials and finishes along with different light sources can make colours appear different.

Removal of the protection film can create a static charge which will attract dust to the A-Cast® sheet. However, the surface of the sheet can then be cleaned with fresh water or using a mild detergent and blotted dry with a chamois leather or soft, 100% cotton cloth.

Visual Consistency

When working with colours, all thermoplastic sheets may vary from batch to batch and even between sheets while remaining within industry standard tolerances.

This manufacturing tolerance and other environmental effects on colour should always be considered during fabrication and for subsequent installation.

How light affects colour perception

The appearance of a surface colour is defined by the product of the spectral reflectance curve of the material and the spectral emittance curve of the light source shining on it.

As a result, different materials and surface finishes in combination with different light sources, whether artifical or natural, can make colours appear different. In the same way, the colour of two samples can appear the same under one light but different under another - known as a metameric failure or more accurately, an illuminant metameric failure.

Most types of fluorescent lights produce an irregular or peaky spectral emittance curve, so that two materials under fluorescent light might not match, even though they are a metameric match to an incandescent white light source with a nearly flat or smooth emittance curve.

How surface affects colour perception

When light reflects off an object, an element of the light reflects at an equal but opposite angle. This is known as specularly reflected light and is reflected as if by a mirror. The light that is not specularly reflected but is reflected in many different directions is known as diffuse reflectance.

For objects with glossy surfaces as with general purpose A-Cast® sheet, the specularly reflected light is relatively strong and the diffused light is weaker. On matt surfaces, the specular component is weak and the diffused light is stronger.

People only view diffused light and ignore spectral reflectance. However, when looking at a glossy object, the colour appears different because the mirror-like reflectance from the light source is added to the colour of the object.

How size affects colour perception

Other metameric failures include a geometric metameric failure which can occur when two samples match when viewed from one angle, but then fail to match when viewed from a different angle. This kind of failure is especially common in metallic or pearlescent finishes.

Sawing

Circular saws, band saws, jig saws and fret saws as well as specialist beam saws and wall saws are all suitable.

Preparation

The surface protection film can be left in place while working on the A-Cast® sheet and can be used for marking out to guide the saw blade. When marking out, always remember to leave compensation for the blade kerf - ***the largest width of the saw tooth***.

Prior to processing any significant quantity of sheets, trial cuts should be made to evaluate the blade, cutting speeds and feeds.

The A-Cast® sheet should also be properly secured for safety and to prevent vibration which may otherwise affect the quality of cut.

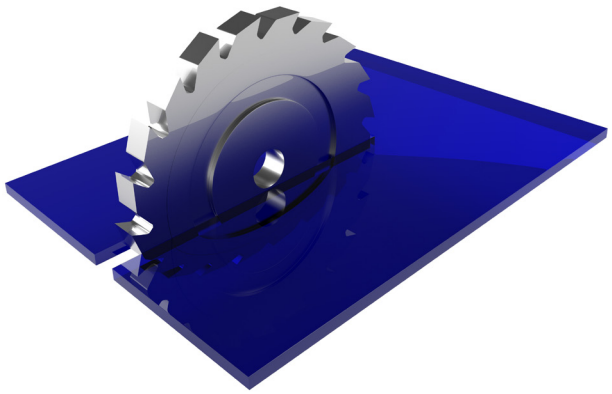
Hand Saws

For single or small quantities, where the edge of the sheet will subsequently, be polished, A-Cast® can be cut by hand using a fine toothed hacksaw or fret saw. For all other work, including thicker gauge sheet, portable powered saws or specialist beam saws and wall saws should be used.

Powered Saws

A-Cast® cast acrylic allows for a very forgiving saw blade cut that is less likely to chip or melt when compared to extruded acrylic. The material can be easily sawn using a circular saw, engineered with extremely hard carbide tips. To prevent chipping of the material, the carbide tips should be ground to a triple chip geometry. Along with band saws, the circular saw can be particularly useful for cutting straight lines while jig saws are more suited for cut-outs or shapes.

Large amounts of product can be cut automatically when specialist horizontal beam saws, machines with a blade that power cuts from under the material, such as those by Schelling and others are used.



The same is true of vertical wall saws such as Holzma and Striebig where the blade is mounted above the sheet.

All powered saws require a blade design and selection to maintain smooth, chipless cutting, since acrylics are moderately heat sensitive. Selection should also consider heat generation and reducing the buildup of localised stresses which can then lead to crazing.

While fewer teeth would typically reduce cutting friction and overheating, the maximum number of teeth is required to reduce or eliminate chipping, which is especially important on thinner sheets.

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Scribe breaking

A-Cast® sheet, up to 4mm, may be cut in a straight line by scribing the surface of the sheet several times.

Scribing the sheet

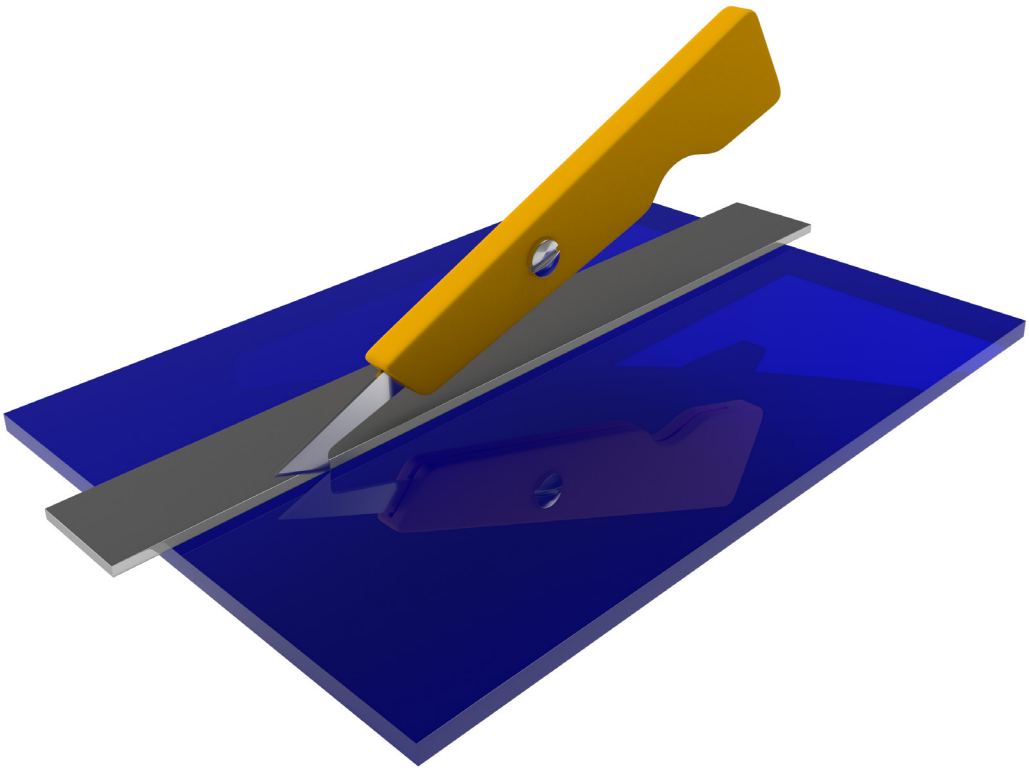
A-Cast® sheet may be cut in a straight line from top to bottom, by scoring the surface of the sheet several times using a scriber or blade, guided along a rule or straight edge.

Splitting the sheet

Once the sheet has been weakened along this line, it should then be placed with the scribed line facing upwards and positioned just over the edge of a bench. With one hand used to support the sheet, the palm of the other hand should then be used to apply downward pressure over the other side of the line in one swift and sharp movement. If both sides of the sheet are required, then the user must also react quickly to get a grip of the overhanging piece.

This technique used on A-Cast® sheet, up to a thickness of 4mm, should be sufficient to split the sheet along the line and produce a clean break.

Scibe breaking should only be used on small lengths of acrylic and some practise may be required to master the technique. Therefore, it is advisable to make a first attempt using some scrap or off-cut material.



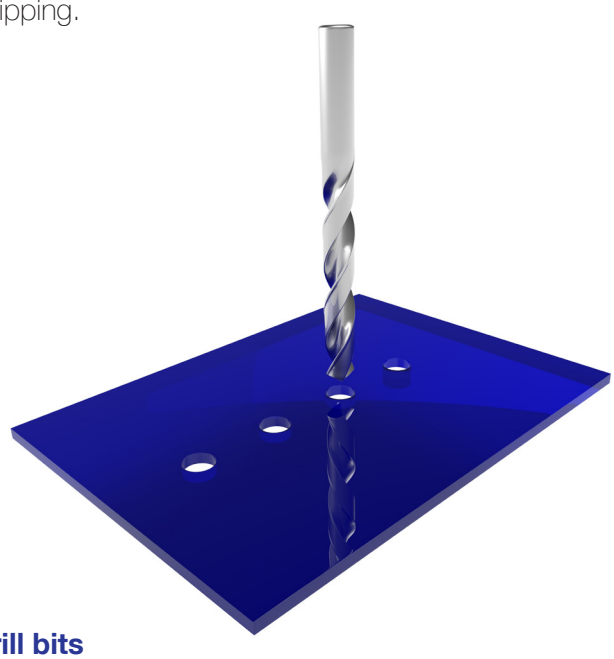
Drilling, screwing and tapping

Conventional twist drills and hole-saws for use with wood are suitable for drilling A-Cast®

Drilling

A-Cast® sheet can be drilled using power tools such as portable drills as well as drill presses and multi-spindle drill machines. Feed rates should be kept slow when entering and exiting the work piece.

When drilling, the work piece should be clamped in place and backed with plywood or similar to continue into solid material as it penetrates the bottom surface and thus, reduce the possibility of chipping.



Drill bits

Drill bits specifically designed for plastics will always work best. However, conventional HSS twist drills can be used if reground to give a tip angle of 60-90° and a flat cutting edge with a rake angle of 0-4°.

Drill speeds

The following table offers a start point to determine the optimum drill speed but it is for the user to determine the speed required, taking into consideration the sheet thickness and depth of hole.

Drill Diameter		Drill Speed (RPM)
Inches	mm	
1/8”	3.0mm	3,500
3/16”	4.5mm	2,500
1/4”	6.0mm	1,800
3/8”	9.5mm	1,200
1/2”	12.7mm	900
5/8”	16.0mm	700
3/4”	19.0mm	600
1”	25.4mm	450

Typically, if there is melting of the acrylic, drill speed should be lowered and should be raised if chipping occurs.

Cooling

Care must be taken to moderate the heat generated during drilling, which may distort or crack the sheet. Water or compressed air can be used. The drill should also be removed periodically to clear swarf.

Screwing and tapping

Standard taps and dies can be used to cut threads in acrylic with coarse threads the preferred option.

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Laser cutting

A-Cast® can be laser cut into simple or complex shapes producing an edge similar to that of a polished finish.

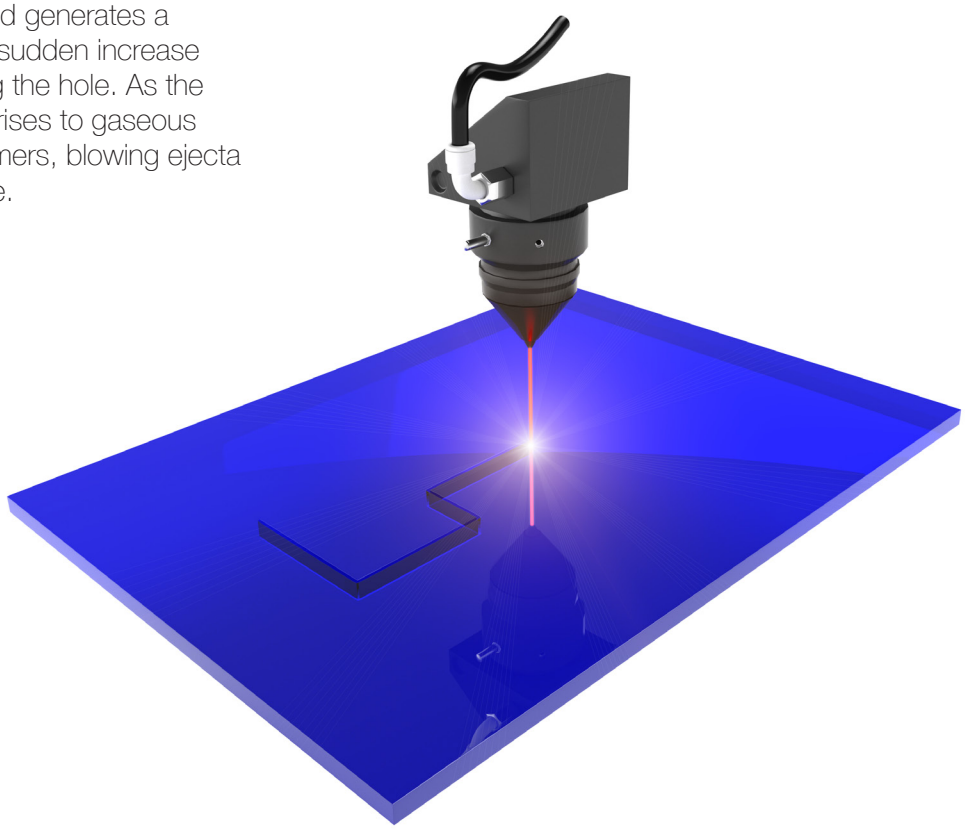
Laser cutting can be used to produce complex, accurate shapes with extremely fine, practically radius-free inner contours and is typically used for industrial manufacturing applications. However, with no tooling requirement, the process is suited to the development of prototypes and one-offs and for this reason it has gained popularity in schools, small businesses and by hobbyists.

Vaporisation cutting

Laser cutting works where the focused beam heats the surface of the cast acrylic and generates a keyhole. The keyhole leads to a sudden increase in absorptivity, quickly deepening the hole. As the hole deepens, the material vaporises to gaseous compounds, including its monomers, blowing ejecta out and further enlarging the hole.

With minimal kerf widths, laser cutting results in less waste than with other mechanical cutting methods and a very clean, high quality cut is made with no additional machining required.

However, the laser cutting does introduce high internal stresses along the cut edge, which on exposure to solvents may produce stress crazing. Annealing the cast acrylic sheet is therefore a pre-requisite post-processing step when intending to cement laser cut parts together.



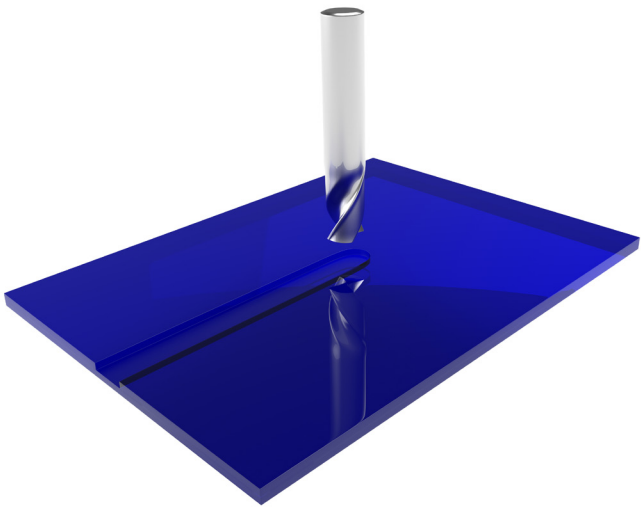
Routing and engraving

Routing A-Cast® can be performed dry but compressed air is to be used to clear swarf and keep the cutter cool.

Routing

Routing is arguably the most important fabrication process for acrylics which machine effectively in hand fed as well as CNC routing machines.

With CNC routing, the tool, feed and speed of the router needs to be set to achieve the optimum balance between edge finish and productivity.



The tendency of acrylics to craze can inhibit their ability to be machined at high speeds, especially during cutter entry, as router bits do not have a centering point similar to drills due to the requirement for flat bottom cutting. Excessive spindle speeds may also melt the acrylic or result in a poor finish.

Depth of cut is also critical to ensure a consistent edge finish with a maximum of twice the cutter diameter per depth of cut a good rule of thumb.

With all the right parameters, both quality and output will be optimised.

Engraving

Engraving A-Cast® cast acrylic sheet creates a frosty opal finish which not only delivers contrast between the original and engraved surface, but also creates a great effect when the engraved panel is edge lit with LED's.

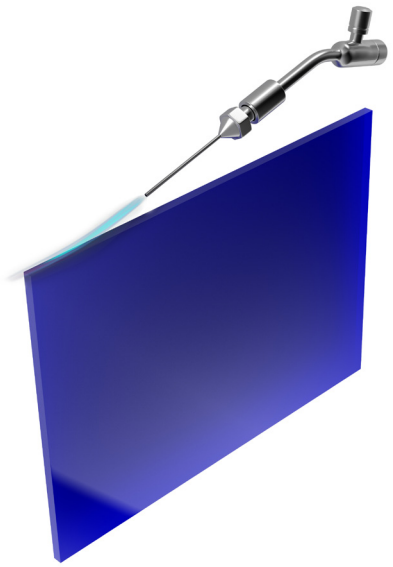
A common technique when engraving onto cast acrylic is to reverse engrave onto the reverse side of the sheet. This not only gives a high quality finish but protects the engraving from being tampered with from the front.

Flame and diamond polishing

Polishing can be used to produce a polished straight edge with rounded or sharp, 90° corners.

Flame polishing

It is important to remove the protective masking from the material's edge when flame polishing. Specialist equipment or an oxygen-hydrogen welding torch can produce a completely polished edge with rounded corners.

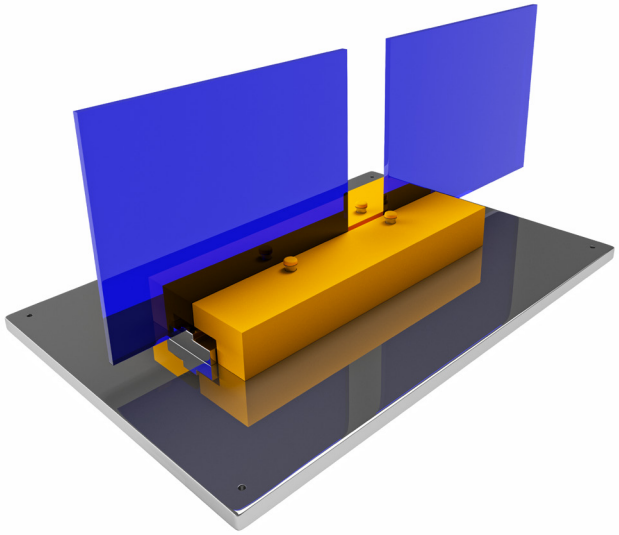


The torch should be held at a slight angle and the flame drawn along the edge of the sheet. If the first pass does not produce a completely polished edge, the piece can be allowed to cool and then a second pass performed.

When flame polishing, the sudden and excessive, localised heating will induce stress in to the sheet. To reduce the stress and prevent the possibility of crazing, the part should then be annealed, especially if the part is to be cemented.

Diamond polishing

Diamond polishing removes saw marks and produces a clear, polished edge with sharp, 90° corners in a single pass over a diamond cutter operating at approximately 25,000 RPM.



Diamond polishing produces excellent results with very little stress in the work, which is particularly useful if the work is to be cemented in any way.

Other

Unlike glass, fine scratches may be buffed out of the surface of cast acrylic sheet by applying a plastic scratch remover such as Vuplex®. For deep scratches, the surface of the A-Cast® sheet can be sanded using light pressure while rinsing regularly with clean, fresh water. The gloss finish can then be restored by polishing.

Thermoforming and line bending

Thermoforming depends on conditions including sheet thickness, mould design, depth of draw and process.

Thermoforming is typically used for relatively low, annual production quantities and has lower tooling costs and faster product development times than competing plastic technologies such as injection moulding.

Heating

To thermoform A-Cast® cast acrylic sheet, the entire sheet must first be heated uniformly to a temperature around 170°C, albeit temperature and time are dependent upon a number of factors. These would include sheet thickness, mould design, depth of drawer and the subsequent process to be utilised.

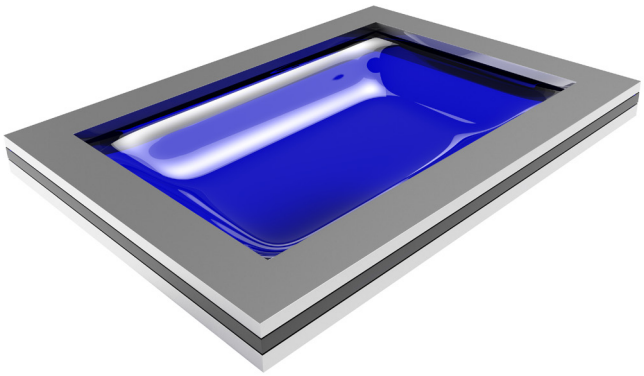
Heating time would also depend on the heating method, conditions within the oven and the panel-to-heater distance with an air circulation oven the ideal and recommended method.

Before forming, the sheet's temperature must also be higher than the desired temperature to allow for cooling that will occur prior to the start of forming.

These variables which affect heating are too many to predict and best determined by trial and error.

Forming

The heating temperature must be carefully controlled within the forming range, as excessively high temperatures may cause sheet degradation and excessively low temperatures may cause stress and crazing.



Cast acrylic then requires a thermoforming process that can deliver greater force in order to achieve the desired results such as forming using a mould and air pressure or press forming using matched male and female moulds, both to achieve good part definition.

Cooling

After the sheet has been formed it should then be cooled slowly and uniformly to minimise the buildup of stress. Parts should remain on the mould until cooled to 60-70ºC. Removing earlier, the part may distort and if fully cooled, the part may contract on to the mould and crack.

Post-Processing

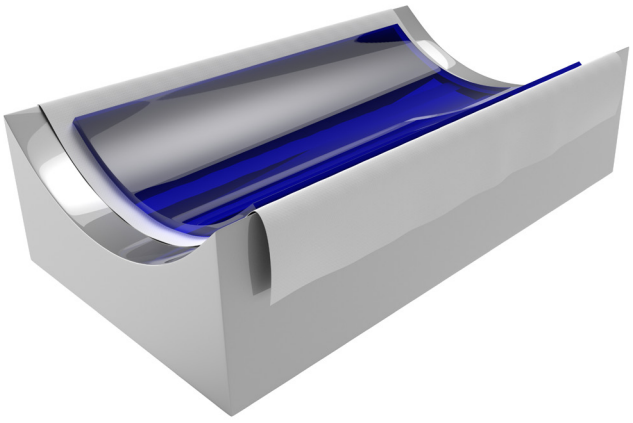
Parts are often hand-worked after forming for trimming to shape or secondary drilling, cutting or finishing is required, dependent upon the product.

A-Cast® sheets, softened along a line by a strip heater, can be bent and then clamped in place to cool.

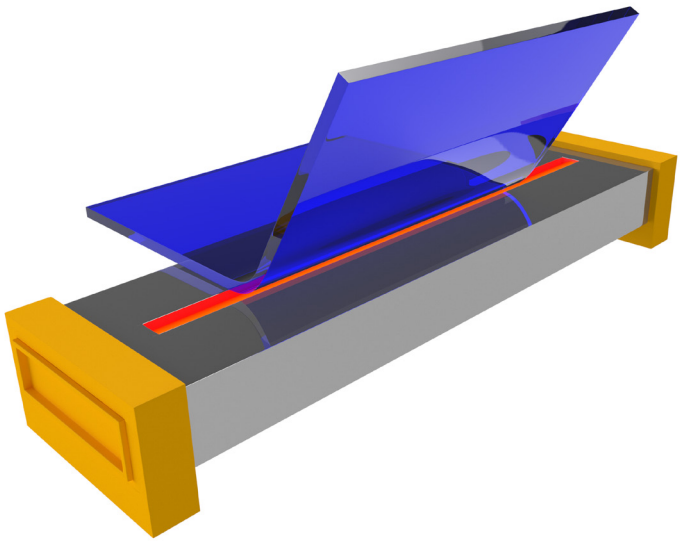
Drape forming

Drape forming refers to a single curvature thermoforming technique which uses gravity and very little force. The A-Cast® sheet is heated and then placed over a mandrel mould, lined with cloth or felt, to take up the form of the mould and prevent the pre-heated sheet being marked.

The mould form may be either positive (male) or a negative (female) mould.



Localised stress is generated by the process which is caused by the shrinkage and contraction of the heated areas as the sheet cools. This will inevitably, lead to a weaker edge. To ensure a right angle bend with minimum stress, the alternative process to line bending would be to heat the entire sheet and subsequently, drape form the bend over a mould.



Line bending

A-Cast® sheets can be softened along a line by a strip heater, on one or two sides dependent upon thickness. After strip heating, the A-Cast® cast acrylic sheet needs to be bent with the heated surface to the outside and then held or clamped in place while it cools.

Shrinkage

Original dimensions won't change in fabrication operations not requiring heat but cast acrylic sheet would tend to shrink slightly, around 2% in both directions, after being heated to thermoforming temperatures and then subsequently, cooled.

Cementing

A-Cast® can be joined using specialist acrylic cements that offer good mechanical strength, durability and clarity.

Surface protection film

Acrylics are not glued, they are chemically welded using a special cement applied with a brush, hypo-solvent applicator or syringe. Acrylic cements are a free-flowing (capillary), solvent-type bonding agent.

Since acrylic cements soften surfaces and welds them together they produce strong, optically clear joints.

Loading of adhesive joints

As with all joints, the application of stress will lead to poor performance. Different types of load are imparted on adhesive joints depending on the joint geometry and the direction of loading. These are classified as tensile, shear, cleavage or peel.

In general shear loading is more desirable than either tensile, cleavage or peel.

Tensile loading results in high concentrations of shear stress in the adhesive at the edges of the joint and the loading is difficult to apply uniformly, resulting in higher concentrations of stress on one side of the joint.

Cleavage and peel loading results in concentrations of tensile stress though the adhesive layer at the edge of the joint making it susceptible to failure.

However, shear loading primarily results in shear deformations of the adhesive and the stresses are less concentrated at the edges of the joint than for the other types of loading making the adhesive less susceptible to failure. It is therefore important to protect against these loads through careful joint design.

Joint design

The choice of joint type will obviously depend on the nature of the structure that is to be created but where possible, it is also necessary to:

- maximise shear and compression forces.
- minimise peel and cleavage forces.
- optimise the area over which the load is distributed.

The strength of a joint is a complex function of the stress concentrations set up by the load.

In a simple lap joint there are two sorts of stress, shear and peel. The shear stress varies along the length of the joint with concentrations at the ends. The peel stress acts at right angles to the lap joint and is at a maximum at the joint ends. The peel stress tends to distort the joint and consequently weakens it. In most joints, the stresses can be more evenly distributed, resulting in joints of greater strength.

Cleaning and maintenance

The surface of the sheet can be cleaned simply with fresh water or using a mild detergent.

Removal of the protection film can create a static charge which will attract dust to the A-Cast® sheet. However, the surface of the sheet can then be cleaned with fresh water or using a mild detergent, blotted dry with a chamois leather or soft, 100% cotton cloth. Synthetic materials should never be used and the sheet surface should not be rubbed dry which can cause scratches.

This would also be the recommended method for all general purpose cleaning of A-Cast® sheet or fabricated items. The use of any solvents or ammonia based cleaning products is not recommended. However, proprietary cleaning products that are suitable include VuPlex® which cleans using safe ingredients that won't damage the surface and can repair minor scratches in the product surface.

VuPlex®

While some cleaners use abrasives to remove dirt and scratches, VuPlex® works contrary to this by penetrating dirt and grime, while adding a fine coating of wax that leaves the surface protected.

The coating also acts as a barrier against water and moisture while reducing static build-up which may otherwise attract dust and other abrasive materials.

Chemical resistance

A-Cast® chemical resistance tests are based on a temperature of 23°C with stress-free material.

Chemical Resistance

Paint		Arsenic acid	R	Ethyl alcohol, to 15%	R
Acrylic paints and lacquers	LR	Battery acid	R	Ethyl alcohol, 15-30%	LR
Aromatic-free hydrocarbons	R	Benzaldehyde	NR	Ethyl alcohol, absolute	NR
Nitrocellulose	NR	Benzene	NR	Ethyl bromide	NR
Oil paints, pure	R	Bromine	NR	Ethyl butyrate	NR
Thinners, general	NR	Butanol	LR	Ethylene bromide	NR
Chemical process baths		Butyl lactate	NR	Ferric chloride	R
Electroplating baths	R	Butyric acid, to 5%	R	Ferrous chloride	R
Photographic baths	R	Calcium chloride	R	Ferrous sulphate	R
Building materials		Calcium hypochlorite	R	Formic acid, to 2%	R
Bituminous emulsion	NR	Carbon disulfide	NR	Formic acid, to 40%	LR
Cement	R	Carbon tetrachloride	NR	Glycerol	R
Hot bitumen	LR	Chlorinated hydrocarbons	NR	Glycol	R
Mortar	R	Chlorine, liquid	NR	Heptane	R
Plaster of paris	R	Chlorine, water	LR	Hexane	R
Red lead	R	Chloroethyl acetate	NR	Hydrochloric acid	R
Chemicals and solvents		Chlorophenol	NR	Hydrofluoric acid, to 20%	R
Acetic acid, glacial	NR	Chromic acid	LR	Hydrogen peroxide, to 40%	R
Acetic acid, to 25%	LR	Citric acid, to 20%	R	Hydrogen peroxide, over 40%	LR
Acetic acid, 5% (vinegar)	R	Copper sulphate	R	Iodine	R
Alum	R	Cresol	NR	Isopropyl alcohol, to 50%	LR
Aluminium chloride	R	Cyclohexane	R	Lactic acid, to 80%	LR
Aluminium oxalate	R	Diacetone alcohol	NR	Magnesium chloride	R
Aluminium sulphate	R	Diamyl phthalate	LR	Magnesium sulphate	R
Ammonia, aqueous solution	R	Dibutyl phthalate	NR	Manganese sulphate	R
Ammonium sulphate	R	Diethylene glycol	R	Mercury	R
Amyl acetate	NR	Dioxane	NR	Methanol, absolute	NR
Aniline	NR	Ether	NR	Methanol, to 15%	LR
Arsenic	R	Ethyl acetate	NR	Methyl ethyl ketone	NR
Methylated spirits	NR	Tartaric acid, to 50%	R	Ice cream	R

Chemical Resistance

Milk of lime	R	Thionyl chloride	NR	Marinades	R
Monobromonaphthalene	R	Toluene	NR	Meat and fish	R
Motor fuel, benzene-free	R	Triethylamine	R	Salt, pepper, cinnamon, onions	R
Motor fuel, with benzene	NR	Trichloroacetic acid	NR	Vinegar	R
Nickel sulphate	R	Tricresyl phosphate	R	Beer, wine, spirits to 30%	R
Nitric acid, to 20%	R	Turpentine	LR	Coffee, tea, chocolate	R
Nitric acid, 20-70%	LR	Turpentine substitute	LR	Fruit juices, milk	R
Nitric acid, over 70%	NR	Urea, to 20%	R	Water, mineral water, soda	R
Oxalic acid	R	Xylene	NR	**Gases and vapours**	
Paraffin	LR	Zinc sulphate, aqueous	LR	Ammonia	R
Perchloroethylene	NR	Zinc sulphate, solid	R	Bromine vapour, dry	LR
Petroleum ether	R	**Disinfectant**		Carbon dioxide	R
Phenols	NR	Aqueous hypochlorite solution	R	Carbon monoxide	R
Phosphoric acid, to 10%	R	Bleaching powder, to 5%	R	Chloride vapour, dry	LR
Phosphorus trichloride	NR	Carbolic acid	NR	Exhaust gases, incl HCl	R
Phosphorus	NR	Hydrogen peroxide, to 40%	R	Exhaust gases, incl HF	R
Picric acid, 1% in water	R	Hydrogen peroxide, over 40%	LR	Exhaust gases, incl sulphuric acid	R
Potassium dichromate	R	Lugol solution	R	Hydrogen sulphide	R
Potassium carbonate	R	Mercuric chloride	R	Methane	R
Potassium chloride	R	Surgical spirit	NR	Nitric oxide	R
Potassium cyanide	R	Tincture of iodine, 5%	NR	Oxygen	R
Potassium hydroxide	R	**Greases, oils and waxes**		Ozone	R
Potassium nitrate	R	Animal	R	Sulphur dioxide, dry	R
Potassium permanganate	R	Mineral	R	Natural Gas, Butane	R
Silicon tetrachloride	NR	Silicone oil	LR	**Cleaning agents**	
Silver nitrate	R	Vegetable	LR	Also refer chemicals & solvents	
Sodium bisulphite	R	**Plastics**		Alcohol,to 30%	R
Sodium carbonate	R	Foams	R	Alcohol, absolute	NR
Sodium chlorate	R	Foams, containing plasticizer	NR	Petrol, pure	R
Sodium chloride	R	Polyamide	R	Petrol mixture, with benzene	NR
Sodium hydroxide	R	Polyethylene	R	Soap solution	R
Sodium hypochlorite	R	PVC	R	Soda solution	R
Sodium sulphate	R	PVC, plasticized	NR	Solvent stain removers	NR
Sodium sulphide	R	Rubber	R	Trichloroethylene	NR
Stearic acid	R	Rubber, containing plasticizer	NR	**Pest control agents**	
Sulphur	R	**Foodstuffs and beverages**		Aqueous solutions of pesticides	LR
Sulphur dioxide, liquid	NR	Aniseed, bay, nutmeg	R	**Other**	
Sulphuric acid, to 30%	R	Cloves	NR	Nail polish, nail polish remover	NR
Sulphurous acid, conc.	LR	Coffee beans, unflavoured	R	Sea water	R
Sulphurous acid, to 5%	R	Coffee beans, flavoured	LR	Soaps	R
Sulphuryl chloride	R	Honey, pure	R	Sprays	LR

Typical physical properties

Values quoted are results of tests on representative samples and do not constitute a specification.

	Item	Test method and conditions	Unit	Test result
General	Specific gravity	JIS K-7112	-	1.19
	Water absorption rate (24 hrs)	JIS K-7209 / ISO 62	Wt %	0.3 / 0.2
	Vicat softening point	ISO 306 (4)	°C	Min Ca 110
	Relative density	ISO 1183	-	1.19
Mechanical	Tensile strength	JIS K-7113 / ISO 527 (1)	MPa	79 / 75
	Tensile elongation	JIS K-7113 / ISO 527 (1)	%	2 ~ 7 / 4
	Flexural strength	JIS K-7203 / ISO 178 (2)	MPa	118 / 116
	Flexural modulus	JIS K-7203 / ISO 178 (2)	MPa	3200 / 3210
	Izod impact strength (notched)	JIS K-7110	KJ/m^2	2
	Charpy impact strength (unnotched)	JIS K-7111 / ISO 179 (3)	KJ/m^2	17 / 12
	Internal strain	ASTM D-638-67T	% - ¼"	<1
	Rockwell hardness	ASTM D-2240	D scale	90
	Pencil hardness	JIS D-0202	-	2 ~ 3H
	Specific surface resistance	JIS K-6911	-	$>10^{16}$
Optical	Total light transmittance	JIS K-7105 / ASTM D-1003	%	93 / 92
	Haze	JIS K-7105	%	0.5
	Refractive index (ηD^{20})	JIS K-7105 / ISO 489/A	-	1.49
Thermal	Heat conductivity	(20°C)	W/m.k	0.19
	Specific heat capacity	JIS K-7123	KJ / kg. K	1.47
	Deflection temperature under load	JIS K-7207	°C	100
	Maximum continuous use temperature	-	°C	80
	Flammability	ASTM D-635	IN/MIN	1.1
	Linear expansion coefficient	JIS K-7197	K^{-1}	7×10^{-5}

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