SPECIALIST GLASS PRODUCTS

PRODUCTION / TECHNICAL INFORMATION

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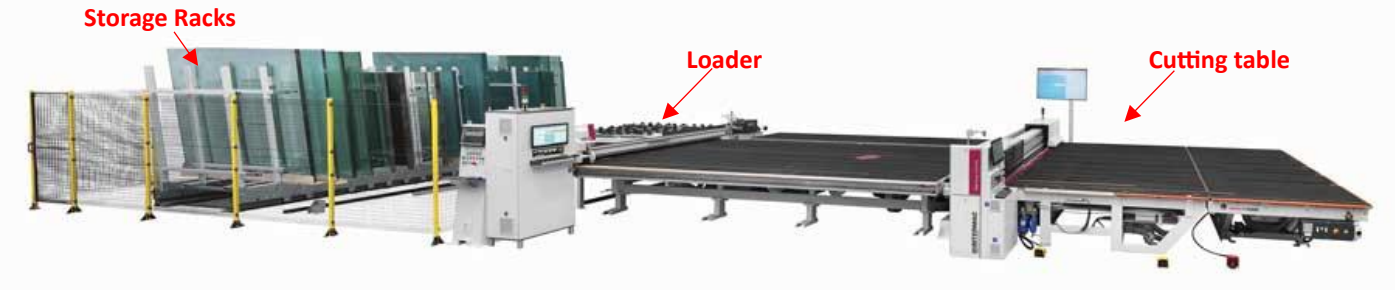
ALL DIMESNISONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED

CUTTING

We have 2 Intermac Genius cutting tables, both of which can cut monolithic glass from 2-25mm thick and one that is capable of cutting laminated glass in sheets up to 6000 x 3210.



The majority of stock is kept in the Movetro loader which has 44 storage racks.

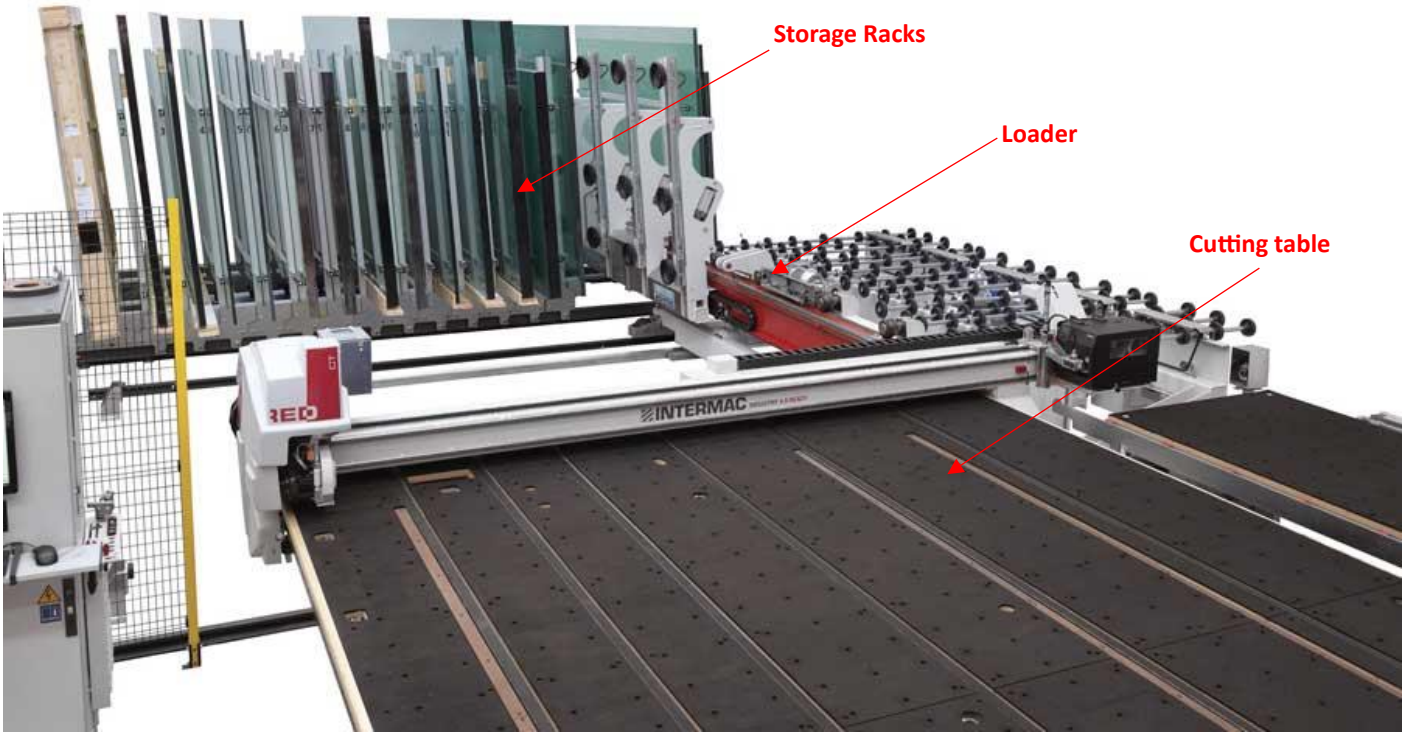
Jumbo packs of glass delivered via floatliners are craned straight into the racks and their position & substrate entered into the loaders database.

When cutting a batch that has been optimised in the office or panels that have been dialled in on the table, a motorised carriage will move to the rack containing the correct substrate.

The loader with suction cups then moves in front of the required sheet and lifts it away from the pack, bringing it back and lowering it onto the cutting table.

The tables cutting head will then run along the sheet adding cut lines for each shape & trim using a wheel and applying the correct pressure for the thickness of glass being processed.

An operator will then breakout these cut lines and stack each piece onto metal trolleys.



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Edge Deletion

All soft coat glass must be edge deleted before being made into an IGU.

This is because the coating is susceptible to corrosion and must be removed around the outer edge so that the sealant is bonded to the actual substrate rather than the coating.

If this is not done the coating can deteriorate and moisture can cause the unit to fail.

Edge deletion is done on the cutting table using a grinding wheel.

STOCK

CLEAR	**STOCK SIZE**	**PLANITHERM TOTAL +**	
3MM	3210 x 2250	4MM	check availability
4MM	6000 x 3210	6MM	6000 x 3210
5MM	6000 x 3210	8MM	6000 x 3210
8MM	6000 x 3210	10MM	6000 x 3210
10MM	6000 x 3210	**SKN 175ii**	**STOCK SIZE**
12MM	6000 x 3210	4MM	check availability
15MM	6000 x 3210	6MM	6000 x 3210
19MM	6000 x 3210	8MM	6000 x 3210
LOW IRON		10MM	6000 x 3210
4MM	3210 x 2550	**PLANITHERM ONE**	
5MM	6000 x 3210	6MM	6000 x 3210
6MM	6000 x 3210	**LAMINATE**	
8MM	6000 x 3210	6.4MM	3210 x 2550
10MM	6000 x 3210	6.8MM	3210 x 2550
12MM	6000 x 3210	8.8MM ACOUSTIC	6000 x 3210
15MM	6000 x 3210	10.8MM ACOUSTIC	6000 x 3210
19MM	6000 x 3210	12.8MM ACOUSTIC	6000 x 3210
TINTS		**SPECIALS**	
4MM GREY	3210 x 2250	10MM DREAM	3210 x 2250
6MM GREY	6000 x 3210	4MM WHITE LACOBEL T	3210 x 2550
8MM GREY	6000 x 3210	6MM WHITE LACOBEL T	3210 x 2550
10MM GREY	6000 x 3210	6MM BLACK LACOBEL T	3210 x 2550
4MM BRONZE	3210 x 2250	6MM STOPSOL SUPERSILVER CLEAR	3210 x 2550
6MM BRONZE	6000 x 3210	6MM STOPSOL SUPERSILVER GREY	3210 x 2550
8MM BRONZE	6000 x 3210	4MM REEEDED	2140 x 1320
10MM BRONZE	6000 x 3210	4MM VISIOSUN	3210 x 2000
6MM GREEN	3210 x 2250	6MM VISIOSUN	3210 x 2000
MIRROR		8MM VISIOSUN	3300 x 2040
4MM SILVER	6000 x 3210	4MM OPTIVIEW	3210 x 2550
6MM SILVER	6000 x 3210	6MM OPTIVIEW	3210 x 2250
4MM GREY	check availability	8MM OPTIVIEW	3210 x 2550
6MM GREY	3210 x 2550		
4MM BRONZE	check availability		
6MM BRONZE	3210 x 2550		
6MM ANTIQUE(MORENA)	3210 X 2250		
6MM MIRRORPANE CHROME+	3300 x 2440		
6MM MIRRORPANE CHROME+	3210 x 2250		
6MM MIRRORVIEW 50/50	3210 x 2000		
6MM MIRRORVIEW 75/20	3210 x 2550		
SATIN			
4MM	3210 x 2250		
6MM	3210 x 2500		
8MM	6000 x 3210		
10MM	6000 x 3210		
'K' GLASS			
4MM	3210 X 2250		
6MM	6000 x 3210		

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SLE

The straight line edger (SLE) is used for grinding and polishing panels with straight edges. Glass is fed through the machine on a belt and 1 edge is machined at a time, the panel is then taken back to the start of the machine by an operator and a different edge put through, this is done until all edges of a panel are processed to the required finish.

Mainly used for square/rectangular panels however certain shapes with straight edges can be processed on an SLE (triangles, rakes etc.) so long as the panel can stand safely on each edge.

We have 3 SLE's all with varying sizes and run speeds. The run speed of the machine is generally affected by the thickness of glass being processed, thicker glass = slower run speed.

The maximum panel size that can be processed on an SLE is **3600 x 3210**, the weight of the panel being processed cannot exceed **250kgs** due to the SWL of the crane used to rotate the panels.

Machinable thickness = **2-60**.

Minimum panel size = **60 x 100**

Softcoat panels with a protective film can be processed on the SLE such as SKN175ii & SN70/35. Hardcoat & satin products can also be processed on the SLE however it is imperative that these are cleaned around the edge & washed immediately after they are processed to avoid water marks/staining caused by standing water.

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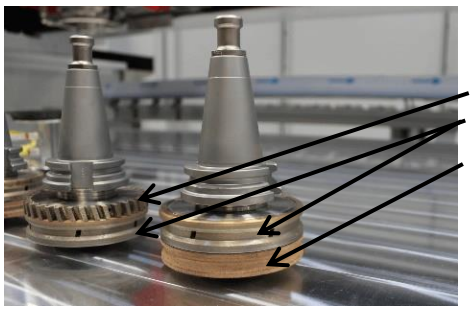
CNC

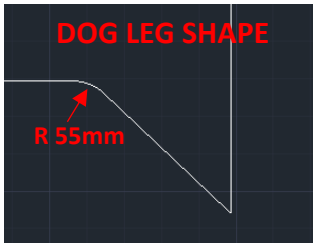
The CNC (computer numerical control) uses 4 different wheels to grind, refine and then polish the edges of the glass.



1. Segmented grinding wheel
2. Medium diamond
3. Fine Diamond
4. Polishing Wheel

Restrictions

We have 6 CNC's all with different capabilities and restrictions.
The maximum size of general CNC panels is **6000 x 2600** (Vertmax).
If the panel is over 4300 x 2350 it must be questioned with Production/Drawing.



The maximum size of panels with "dog legs" is 4300 x 2350.
"Dog legs" & diameters cannot be processed on the Vertmax and must be machined on a flatbed CNC.

The maximum diameter size is **2350** due to the size of the large Intermac CNC.
Panels that need to be CNC polished must be a minimum of 130 x 300 to allow suction cups to be placed underneath.

Cutouts

The minimum internal radius size on a cutout is 6mm however it needs to be at least half the thickness of the glass (19mm glass = 9.5mm radius) a minimum radius of 13mm is required for a polished finish.
For "dog legs" and any other internal radius on the edge of the panel the minimum size is 55mm.

The minimum internal cutout size / hole diameter is 32mm if a polished finish is required, 20mm for a ground finish.
Internal cutouts that are closer than 100mm to the edge of the panel need to be questioned with production.

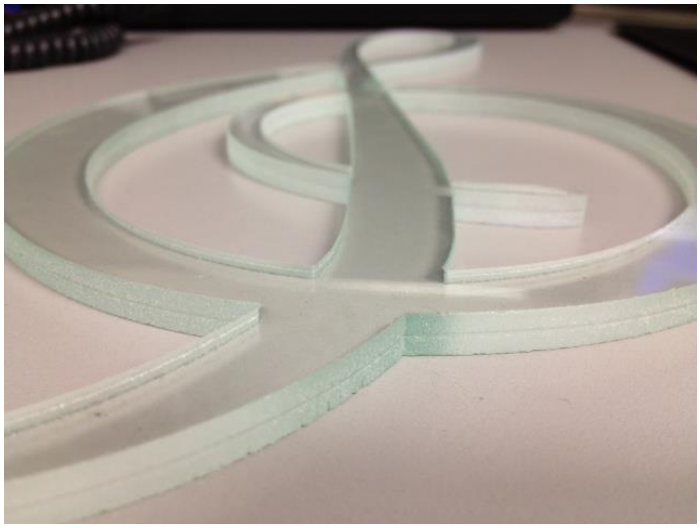
Vertmax

The Vertmax is a vertical CNC capable of machining & also drilling glass up to 6000 x 2600mm, the minimum size is 350 x 550.
All softcoat glass without a protective film (Climaguard, Planitherm etc.) is processed on the Vertmax to avoid any marks on the coated surface.
Glass to be made into an IGU is also processed on this machine to reduce the chances of watermarks from wet processing.

WATERJET

The waterjet is used for cutting/shaping of complex panels, it can also be used for holes & cutouts.

A mix of high pressure water and sand are used to cut through glass. This allows us to cut difficult shapes that wouldn't be possible on a tooled machine such as a CNC however the finish is left rough, not ground or polished but can be arrised after.



DRILL

The top drill uses a belt and rollers (similar to that of an SLE) to feed the glass into the machine. A sensor arm detects the front edge of the glass so that the machine knows exactly where to drill each hole on the panel used a CAD file sent from the office.

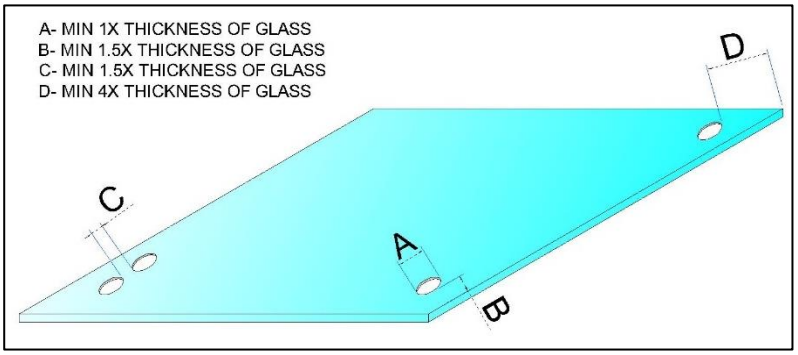
A tool carriage inside houses diamond bits of varying sizes.

When drilling, the machine will clamp the glass and drill part of the hole from face #1 and part from face #2 whilst cooling the bit with a constant flow of water. This minimises shelling around the hole that would be caused by drilling from only one side.

Every piece must have at least 1.5x the thickness of the glass between the hole and the edge of the panel to avoid the panel breaking in the toughener (this does not apply to float glass).

The maximum panel size for the top drill is 4200 x 2500 (larger panels can be drilled on Vertmax)

Max height of holes on a panel = 2400



Drill bits:

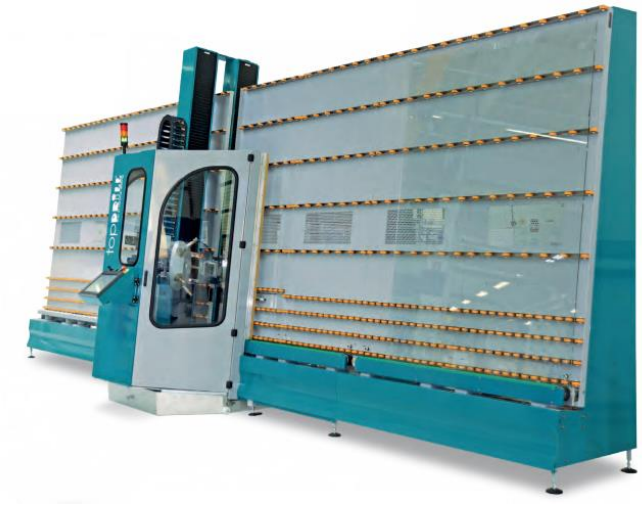
6-40mm

45mm

50mm

55mm

Any hole diameters not on the list above will need to be a CNC diameter cutout.



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TOUGHENING / HEAT STREGTHENING (FLAT)

Toughening

Toughening is a process in which float glass is heated up to a high temperature for some time followed by abrupt cooling using jets of cold air (Quenching). As a result of this process, the outside of the glass is forced into compression while the inside remains free to float for some time (creating tension on the inside). The higher the thermal expansion of the glass and the lower its thermal conductivity, the higher will be the level of residue stresses, and as a result of this, the stronger will be the resulting glass.

Glass can be toughened between 5-19mm thick and up to **6000 x 3210**.
4mm glass cannot exceed **3200** in length.

Each thickness is heated and cooled for a different length of time meaning glass gets grouped together for toughening.

Certain glass must be toughened on its own settings:

Soft coat glass
Toughenable mirrors

Heat Strengthening

Heat strengthening is a thermal process used to enhance the strength and durability of glass. This method involves subjecting the glass to a controlled heating and cooling cycle, which induces compressive stresses. The glass is cooled slowly to achieve a surface compression of around 6000 psi.

Heat-strengthened glass has outstanding thermal stability, its flatness and light transmission is close to that of annealed glass and much better than that of toughened glass.

Heat-strengthened glass is widely used with laminated glass for additional strength, such as in overhead and sloped glazing.

Toughened vs heat strengthened

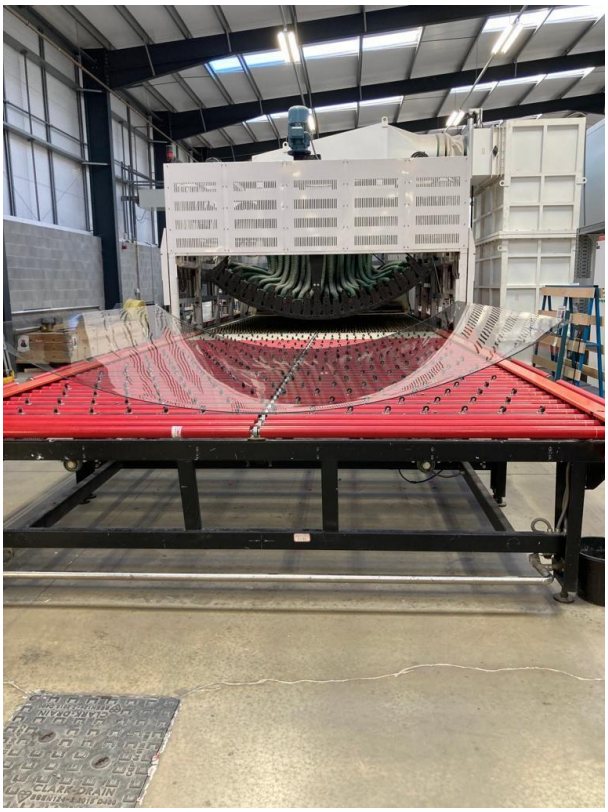
The differences between the two are as follows:

- With toughened glass, the cooling process is accelerated to create higher surface compression (the dimension of force or energy per unit area) and/or edge compression in the glass. It is the air-quench temperature, volume and other variables that create a surface compression of at least 10,000 psi. This is the process that makes the glass four to five times stronger and safer than annealed glass. As a result, toughened glass is less likely to experience a thermal break.
- With heat-strengthened glass, the cooling process is slower, which means the compression strength is lower (at least 6000 psi). In the end, heat-strengthened glass is approximately twice as strong as annealed glass.

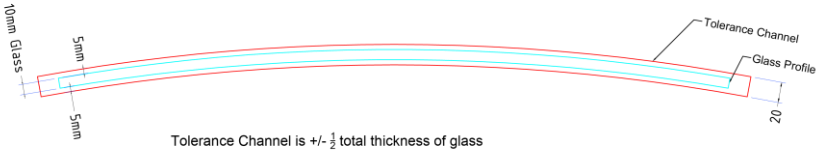
TOUGHENING (BEND)

TOUGHENED BEND PARAMETERS					
TOUGHENER	**MINIMUM GIRTH**	**MAXIMUM GIRTH**	**MINIMUM RADIUS**	**MINIMUM HEIGHT**	**MAXIMUM HEIGHT**
SMALL	300	1100	4-10mm 450 12mm 550	150	3200
MEDIUM	300	2500	5-10mm 880 12mm 1000 15mm 2000 19mm 2000	150	3200
LARGE	300	3200	5-10mm 1500 12mm 1500 15mm 2000 19mm 2000	350	5000

For bends close to the above parameters or over 90° please refer to production department.



BEND TOLERANCE



Tolerance Channel is +/- ½ total thickness of glass

10mm Glass = 20mm tolerance channel
13.5mm (6mm clear/1.5mm laminate/6mm clear) = 25.5mm tolerance channel
21.5mm (10mm clear/1.5mm laminate/10mm clear) = 41.5mm tolerance channel

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HEAT SOAK

Heat soaking is a process in which toughened glass is subjected to a temperature of 280°C for 2 hours in a heat-soaking oven. This will cause the panel to break if any nickel sulphide inclusions are found.

It is estimated that up to 95% of nickel sulphide-contaminated panes of glass are usually destroyed by this process, reducing the chance of on-site spontaneous breakage.

Max size **6000 x 2330**

CHECK WITH PRODUCTION IF CLOSE TO MAXIMUM SIZE

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ANNEALED BENDS

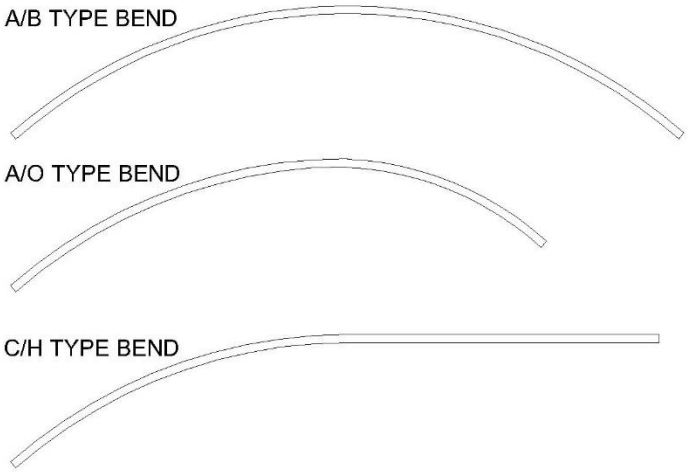
Annealed glass is glass that has been heated when flat to allow it to become malleable to shape around into or around a mould.
The flat glass is placed across 2 poles along the height and then heated to approx 600^{o}c before being cooled down in a controlled way (annealed). This can be polished, cut and laminated etc. It is not as strong as toughened, but when laminated it is more suitable for certain applications, particularly where security is required.
It can be used in single or double glazed applications where safety is not a high priority.

We have a gas oven with 4 bays and an electric oven with 2 giving us the flexibility to build multiple moulds even whilst the oven is firing.
We typically fire the gas oven twice a day and the electric oven once.

The maximum sizes are below, this is the size of the flat glass that can fit in the oven , when looking at a job that is close to these sizes the over material required on the glass needs to be considered and checked with production.

Electric Oven – 3700 x 2400

Gas Oven – 3000 x 2100



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LAMINATING

Laminated glass is a type of safety glass that holds together when shattered. In the event of breaking, it is held in place by a thin polymer interlayer, typically of polyvinyl butyral (PVB), ethylene-vinyl acetate (EVA), Ionoplast polymers (SGP) or cast in place (CIP) liquid resin, between its two or more layers of glass. The interlayer, made through heat and pressure, keeps the layers of glass bonded together even when broken. The thermoset EVA offers a complete bonding (cross-linking) with the material whether it is glass, polycarbonate, or other types of products.

Maximum Sizes:

MAX SIZES	PVB	EVA	SGP	CIP
FLAT	5000 x 2200	5900 x 2500	5900 x 2200	6000 x 3200
CURVED	5000 x 2000	5000 x 2000	5000 x 2000	5000 x 3200

Polyvinyl Butryl (PVB) is one of the most popular and commonly used interlayers within the architectural, automotive and transport sectors. PVB is popular due to its relative high durability, predictable mechanical behaviour, and ease of manufacture. Many different grades of PVB exist, having been modified to achieve a range of structural properties, impact resistance and acoustic performance. The laminated panel is first assembled by placing PVB interlayers between two or more pieces of glass within a clean room. This 'sandwich' of different materials is initially de-aired and stuck together using a vacuum or series of rollers before the laminate is placed within an oven and subjected to approximately 10 bars of pressure and heated to approximately 130°C to produce the final laminated product.

SentryGlas® or SGP was originally developed to improve the performance of glazing when subject to debris strikes resulting from hurricanes. Compared to PVB interlayers, SentryGlas® interlayer is tougher, 100 times stiffer and performs better over a wider temperature range. The material also bonds well to some metals which can be an advantage when designing bespoke glass structures. SentryGlas® is intended for use in structural glass applications; for example, large unsupported sections of feature glass and glass stairs, floors and beams. SentryGlas® interlayers are typically processed in the same way as the PVB interlayer i.e. using an autoclave or vacuum oven.

Ethylene-vinyl acetate (EVA) has high adhesion levels that can further increase the edge stability of the interlayer which increases the resistance to delamination and therefore the durability of the product. Similar to PVB, EVA is supplied on a roll in varying thicknesses and can be layered to achieve the required thickness/performance. The glass and interlayers are placed in a vacuum bag and heated to approximately 120^{o}C to create the laminated product. Due to the use of a vacuum bag, a hot box chamber is sometimes used instead of an autoclave. EVA interlayers are known to rupture or tear and may not always be suitable for security applications or where they are required to support fractured glass for long periods of time. Due to the properties of this material, EVA interlayers may not be as suitable as PVB or SentryGlas® interlayers for structural applications. EVA laminates have been shown to perform much worse than PVB under blast loading.

Poured resin (CIP) This lamination process involves the creation of a cavity between two or more panes of glass using a clear tape around the perimeter of the glass. A liquid resin is subsequently poured into the cavity and is cured using UV light. Poured resin interlayers are now used to laminate cast, patterned glass and curved glass which is difficult to laminate using sheet interlayers like PVB. Annealed bends are most often laminated using CIP as other forms of laminating using a vacuum can cause the annealed bends to crack under pressure.

LAMINATING (HOAF OVEN)

HOAF OVEN

The Hoaf oven is capable of laminating glass using many different interlayers including PVB, EVA & SGP.

Max size (Metal Frame) 5000x2000mm
Max size (Metal Table) 3800x1450mm
Top rack 5000x1600mm overhanging.

METAL TABLES

The metal tables can be used for all flat & curved panels under the maximum size and with a depth of less than 80mm.

Panels larger than the maximum size of the tables can either go on the top of the stack slightly overhanging or on the metal frame which will also be used for bends with a depth greater than 80mm (if not on top of stack).

METAL FRAME

Printed interlayers must be in a separate oven on an individual program.

When laminating using the Hoaf oven glass is taped and wrapped in disposable vacuum bags inside of the climate room before being pressurised and heated for between 6 – 9 hours depending on the mix of glass & interlayers within the fire.

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LAMINATING (TEMA OVEN)

The Tema oven is used primarily for laminating EVA.

SGP is only laminated in the Tema oven when large quantities are required as SGP cannot be mixed with other interlayers in this oven due to the program restrictions.

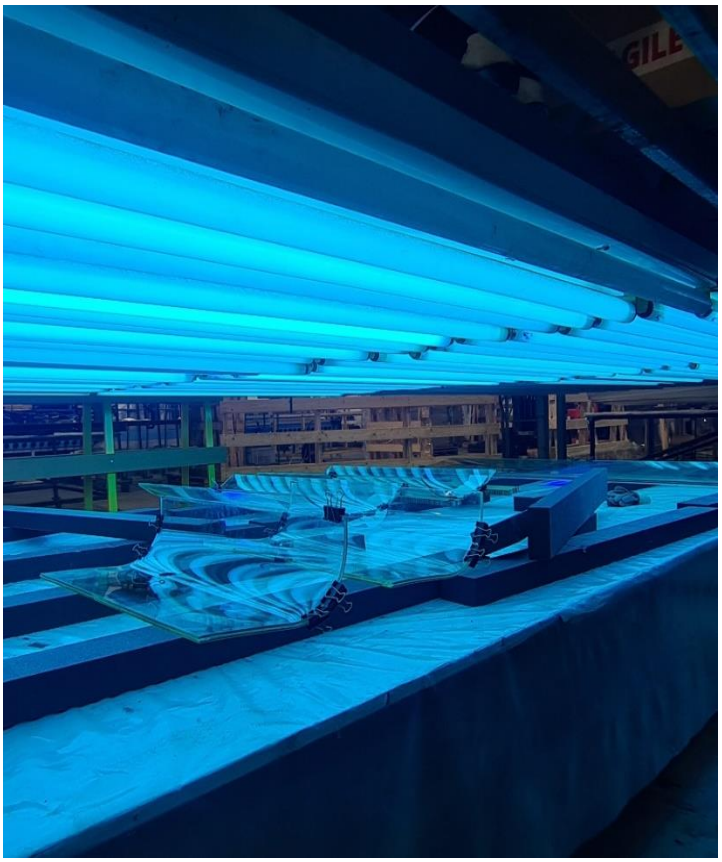
Bed size **5900 x 2900mm**

The metal tables can be used for all flat panels under the maximum size.

Each bed is 5900 x 2900 and 2 are used for each fire, the oven is fired 3 times per day producing approx **90m²** of laminated glass a day.

The Tema oven uses a large silicon blanket that closes over the full table rather than the disposable bags, this speeds up the building process and is more cost effective.

LAMINATING (RESIN/C.I.P)



The large layout of the resin lights allows for a panel up to 6000 x 3210 to be laminated however panels close to this size need to be checked with production first.

The panels are cleaned thoroughly before a clear 3M tape is applied around the perimeter of the bottom piece. The tape can vary in thickness to create a thicker interlayer. The second panel/lid is then placed on top before the Uvekol S15 resin is pumped into the cavity.

Once the resin has spread evenly all the bubbles are removed and the panel is cured underneath UV lights for approx 30 minutes but can vary depending on size.

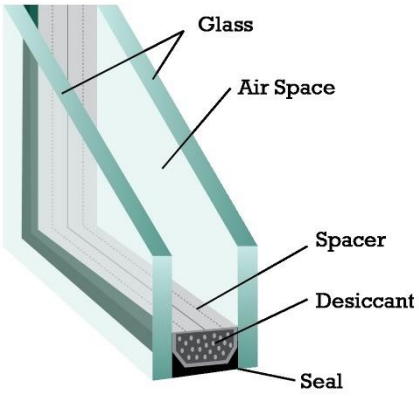
DOUBLE GLAZING

Double glazing works by creating an air gap that insulates against heat transfer between two different temperature zones (inside and outside).

Two panes of glass are sealed into a unit (IGU) separated by a spacer bar.

The space between the panes creates an air gap that slows down thermal transfer (hot or cold) by conduction – it doesn't 'trap heat' but it slows down the movement of heat to reduce heat loss.

Because air can't circulate in the narrow gap between the panes, air convection is slowed down and this also reduces heat transfer.



Standard sightline = 14mm

Units over 3210mm must be an aluminium spacer bar with minimum 19mm sightline

The maximum size of a unit is restricted by previous processes such as edging/toughening/laminating as well as overall weight. Refer to production on oversize units.

PLANITHERM® TOTAL+

PLANITHERM® TOTAL+ is a high performance low-emissivity (Low-E) glass. With its optimised balance of low emissivity and high solar gain, PLANITHERM® TOTAL+ is one of the most energy efficient low-E glass products available.

PLANITHERM TOTAL+

U - value
1.2 W/m²K

Light Transmittance
79%

Light Reflectance
13%

Solar Factor
71%

(4(16)4 unit with 90% argon gas filling)

COOL-LITE SKN 175 (II)

COOL-LITE® SKN 175 (II) is a highly selective, solar control glass with leading aesthetics.

With a low solar factor SKN 175 (II) is great at reducing the warmth from the sun, known as solar gain.

COOL-LITE SKN 175 (II)

U – VALUE
1.0 W/M²K

LIGHT TANSMITTANCE
70%

Light Reflectance
14%

Solar factor
35%

(6(16)4 unit with 90% argon gas filling)

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PAINTING

Panels can be painted to any standard RAL code and also matched to certain other brands such as Pantone, Farrow & Ball.

Any colours that are not a standard RAL need to be checked with production.

The glass is masked fully on the unpainted face, masking is only applied to the painted face if a band/border is required.

The panels are meticulously cleaned inside the booth before being sprayed and left to cook at 80^{o}c for 1 hour (this can vary depending on thickness of glass and number of panels in the spray booth).

Maximum panel size 6000 x 2400

SANDBLASTING

The sandblaster uses 120 grade alumina shot that is blasted through high pressure nozzles to etch onto the surface of the glass.
This can either be a full face etch or with a masking applied to create different designs/effects.

The nozzles oscillate vertically whilst the glass is fed through the machine via a constantly moving track.
The maximum panel size that will fit on the sandblaster is 4300mm x 1900mm, the maximum thickness is 40mm.

DESPATCH

Frame Dimensions	SWL
W 1200 x H 1450 x L 980	1000 KGS
W 1200 x H 1850 x L 980	1000 KGS
W 2100 x H 1450 x L 980	1400 KGS
W 2100 x H 1850 x L 980	1400 KGS
W 3100 x H 1450 x L 980	1500 KGS
W 3100 x H 2100 x L 980	1500 KGS
METAL FRAMES W 2300 x H 2170 x 1200	**2000 KGS**
METAL FRAMES W 2750 x H 2500 x 1200	**2000 KGS**

VEHICLE TYPE	MAX LOAD	LOAD DIMENSIONS
BOX VAN (x3)	1 TONNE	MAX LENGTH 4.6M MAX HEIGHT 1.7M
BOX VAN WITH SMALL SIDE RACK	1 TONNE – INCLUDING ANYTHING LOADED ON SIDE RACK – 350KG CAN BE CARRIED ON SIDE RACK	MAX LENGTH (IN VAN) 3.4M MAX HEIGHT (IN VAN) 1.7M MAX LENGTH (ON RACK) 3.6M MAX HEIGHT (ON RACK) 2.55M
3.5T FLAT BED	1.5 TONNE	MAX LENGTH 4.5M MAX HEIGHT 3.21M
7.2T BOX VAN WITH LARGE SIDE RACK	3.75 TONNE – INCLUDING ANYTHING LOADED ON SIDE RACK – 750KG CAN BE CARRIED ON SIDE RACK	MAX LENGTH (IN VAN) 4.6M MAX HEIGHT (IN VAN) 1.7M MAX LENGTH (ON RACK) 4.7M MAX HEIGHT (ON RACK) 3.2M
7.2T FLAT BED	4.2 TONNE	MAX LENGTH 6M MAX HEIGHT 3.21M
CURTAIN SIDER (x3)	3.9 TONNE	MAX LENGTH 6M MAX HEIGHT 2.3M

ALL DIMESNISONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED