

شركة واجهات للزجاج و الألمنيوم
Wajhat Glass & Aluminum Company



GLASS



Architectural
Building-Envelope Experts



Contents

Company Introduction	
Our Vision	
Our Mission	
Product Range	10
Warehouse & Storage Equipment	11
Cutting Line	13
List of machines	14
ArcGlass Production Flow	15
What is Glass?	16
Primary Float Glass	17
ArcLam Laminated Safety Glass	19
ArcTuff Fully Tempered (FT) Glass	30
Heat Soak Testing	37
Arc-HS Heat Strengthened Glass	38
ArcSeal Insulated Glass Units	41
Sentry Glass Structural Laminated Glass	55
Light, Solar & Thermal Insulation Performance	56
ArcDecor Profile	59

Company Introduction

ArcGlass is part of the renowned and highly reputed business group trading as Al harbi Holdings in a wide range of trading and manufacturing businesses operating across a diverse range of industries. ArcGlass was established in Riyadh, Saudi Arabia, in 2010 and has, through diligent investment and management, created one of the largest and best equipped integrated manufacturing facilities for production of architectural flat glass in the entire Middle East. The factory occupies an area of 12,000 m² and has an overall annual production capacity in excess of 500,000 m² of value-added high performance glass products.

The Management Team at ArcGlass have been briefed, from the beginning, to establish a quality and service-driven glass business, tailored to consistently meet the demands of an increasingly sophisticated market.

Investment in the best equipment and experienced personnel has enabled ArcGlass to enter the market with a range of high quality products and professional services that are second-to-none. Arc Glass currently has a workforce of over a hundred employees, all of whom are fully involved and focussed on the common aim of the business which is to set new standards of excellence throughout all departments and operations.



RXIDMTEK

Model 1500

MAIN
LOADER L1
FR B1
E B1



line number	1
rack number	104
number of plates	1
length [mm]	5100
width [mm]	3210
thickness [1/100mm]	600
glass mode	1
deposition mode	
arbitrary	<input type="checkbox"/>
directly	<input checked="" type="checkbox"/>
combing	<input type="checkbox"/>
TwinMode	<input type="checkbox"/>

OK
BYSTORE OFF / ON
SERVICE LOADER 1

Right side

Frame Manual

E M SEL SEL* +



Our Vision

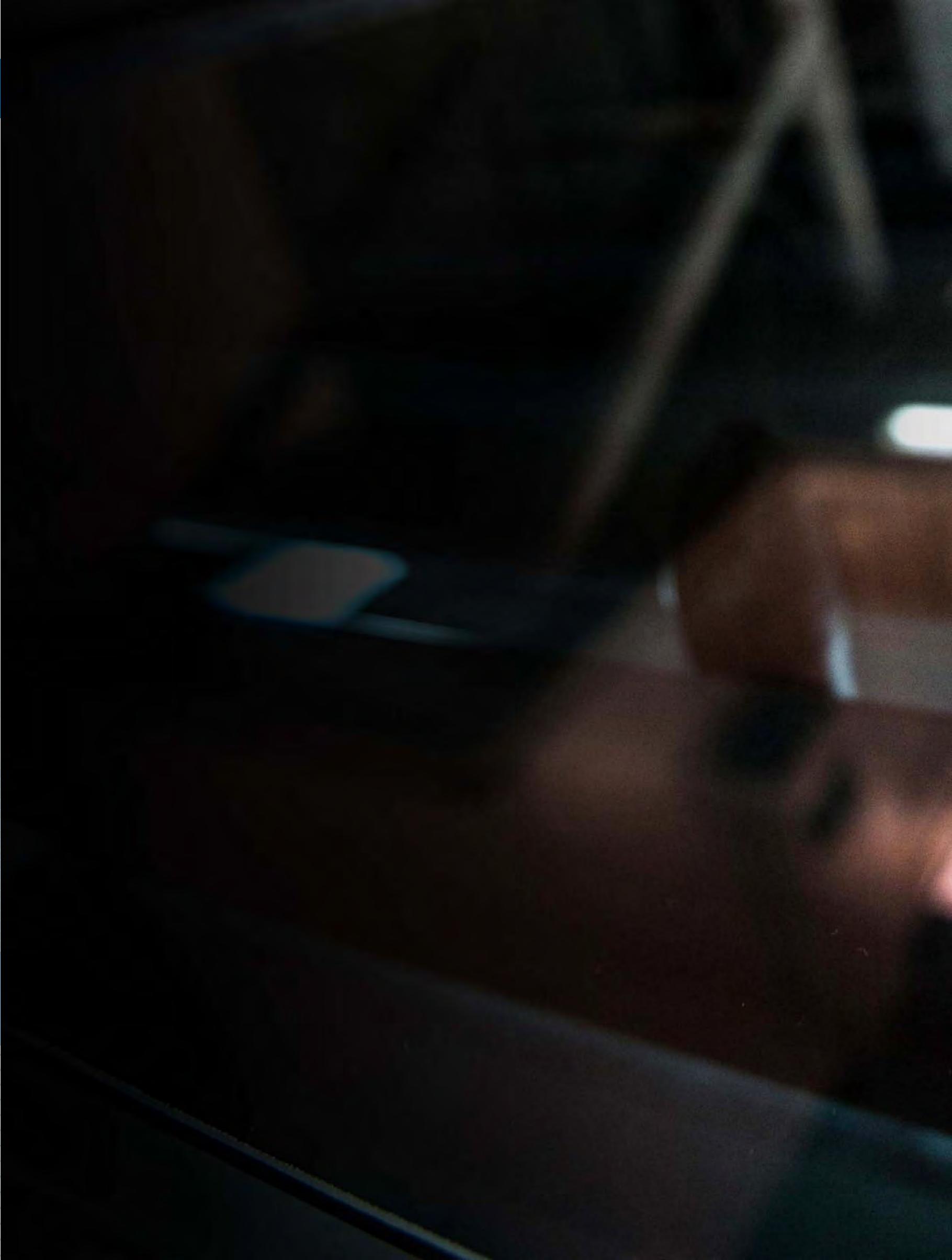
Our Vision is to establish ArcGlass as a market-leading supplier of superior quality architectural glazing products and services. This will be achieved by setting new bench-marks for product quality and technical expertise that others will find difficult to follow .

Our Mission

Our Mission is to utilize the most modern production equipment and technology in conjunction with efficient supply-chain management to provide our customers with a range of technologically-advanced products to meet their project specifications and construction schedules. We shall achieve our Mission-aim through:

- **Professionalism** : We are 100% committed to an on-going process of improvements to quality and service
- **Quality** : We shall endeavour to supply our customers with products of highest quality, greatest cost-benefit and most efficient delivery.
- **Dedication** : Our quality commitment is geared to meeting the needs of our customers in a competitive environment with the highest standards of product and service performance.
- **Satisfaction** : We will develop and uphold professional collaborative working relations between our Staff at all levels, and our Clients.





AG ArcGlass
BS EN 12603
HEAT STRENGTHENED GLASS

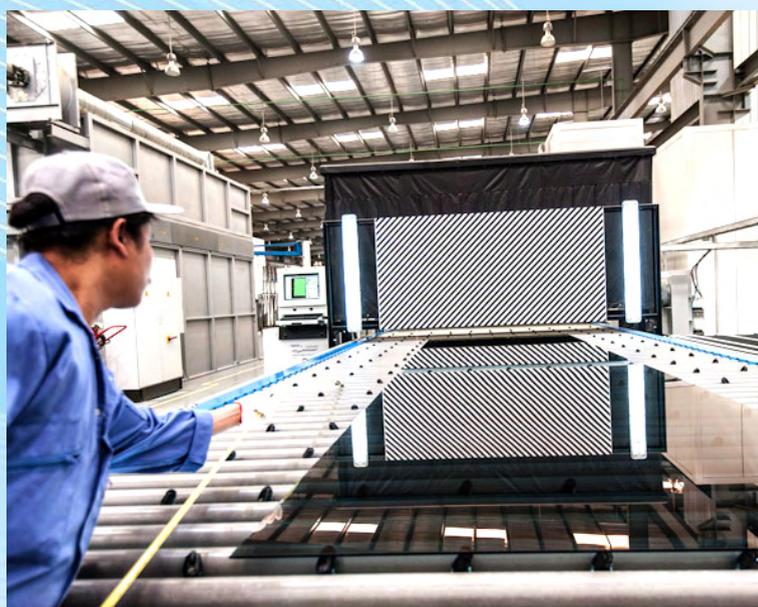
Product Range

Working within the framework of this Company's Philosophy and Culture, ArcGlass offers a Product-Range that has been developed to meet both the current as well as anticipated future requirements of a market which is becoming steadily more sophisticated and demanding.

ArcGlass have also established excellent working relationships and technical partnerships with a number of the world's leading glass manufacturers with the result that, as an independent glass processor, we are able to offer a range of architectural glass products with enhanced levels of performance and manufacturing quality that sets a new, and higher, benchmark for others to follow.

ArcGlass product range includes the following primary product categories which are subject to on-going development:

- ArcSeal Insulated Glass Units for solar control
- ArcSeal Insulated Glass Units for thermal insulation
- ArcTuff Tempered Glass
- Heat Soak Tested Tempered Glass
- Arc-HS Heat Strengthened Glass
- ArcLam Laminated Safety Glass
- ArcLam Laminated Security Glass
- ArcLam Laminated Blast-Resistant Glass
- ArcLam Laminated Bullet-Resistant Glass
- Glass for Frameless, Bolted Glazing Systems
- Glass for Skylights





Protected area for storage of stock glass



Storage Equipment





Fully Automated Glass section and cutting

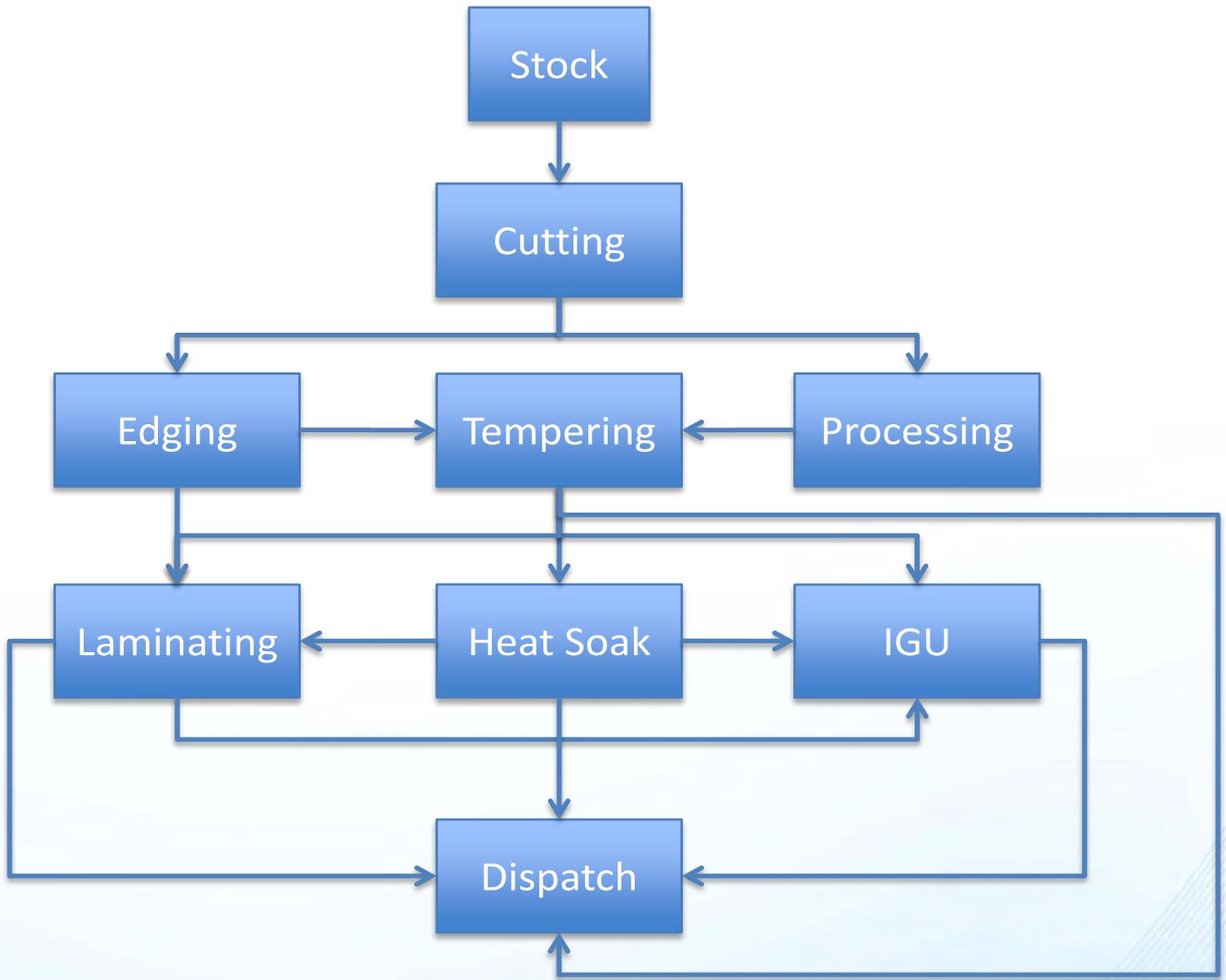


List of machines

Plant (List of Machines)

1. Automatic Arrising Station
2. Automatic Glass Cutting Station
3. Automatic PVB roll Feed Station
4. Automatic Sorting System
5. Automatic Sorting System (2)
6. Automatic Space Bender
7. Butyl Machine
8. Desiccant Filling Machine
9. Edge Deletion Robot
10. Glass Break Out Station
11. Glass Cutting Bridge
12. Glass Inspection & Assembly Station
13. Glass Plate Loading Gantry
14. Glass Plate Storage Area
15. Glass Plate Tilt and Transfer Table
16. Glass Processing Station
17. Glass Stock Rotating Station
18. Glass Tempering Furnace
19. Heat Soak Test Oven
20. Laminating Autoclave
21. Laminating Inspection and Assembly Station
22. Laminating Pre-nip and Oven Section
23. Laminating Suction and Transfer Section
24. Laminating Washing and Drying Section
25. Osprey Quality Monitoring System
26. Press with Argon Gas Filling
27. Rotating Table
28. Sealing Robot
29. Suction Lifter Frame
30. Washing and Drying Section
31. Washing and Drying Section (2)
32. X Breakout Station





What is Glass?

Glass

Is a versatile, durable material which is used in contemporary architecture to perform many functions in addition to its primary function of allowing light to enter the building. Modern Flat Glass has numerous applications in the fields of Architecture, Transport Vehicles, Solar Power, Domestic and Industrial Equipment. These many applications involve the visual, mechanical, structural, decorative and thermal properties of glass to provide protection of the "Built Environment" in terms of Safety, Security, Solar and Sound Control; in other words, to optimize indoor comfort-levels in every type of building or vehicle. Nevertheless, glass in its original condition is a fragile material which, if disturbed by undue forces of impact, wind-load or mechanical stress, will break into fragments which are potentially lethal. These potential risks can be substantially overcome by means of enhanced processing methods which provide additional strength and security to allow glass to reach its full potential in a safe and reliable manner. Nevertheless, glass shall not be used as a load-bearing element and all glass panes must be installed independently from each other.

ArcGlass provides a full range of professional services including design assistance, specification guidelines, product development and testing and assessment to cover all of these elements.



Composition of Commercial Quality Window Glass

SODA-LIME GLASS					
RAW MATERIAL (FRIT)				RECYCLED MATERIAL	
NATURAL	%	MANUFACTURED	%	BY-PRODUCT	%
Silica Si	72	Soda Ash Na_2CO_3	14	"Cullett"	17-20%
Limestone CaCO_3	9				
Dolomite $\text{CaMg}(\text{CO})_3$	4				
Others (minor additives and impurities including Iron Oxide $[\text{Fe}_2\text{O}_3]$)	1				
TOTAL	86		14		20

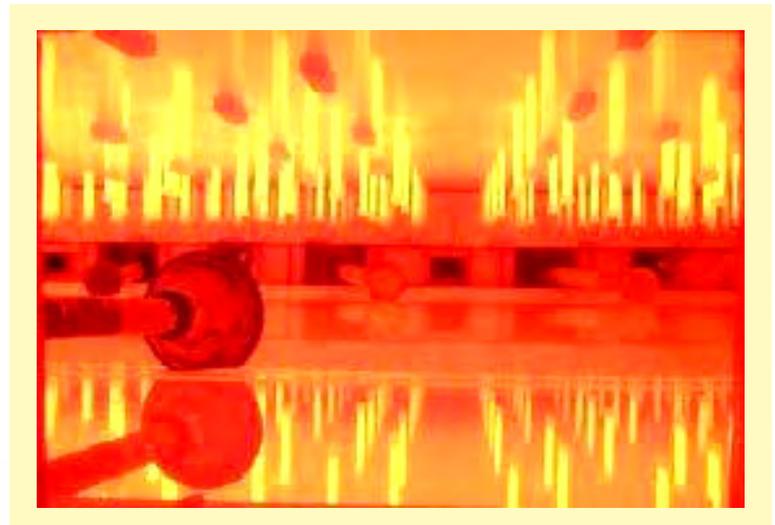
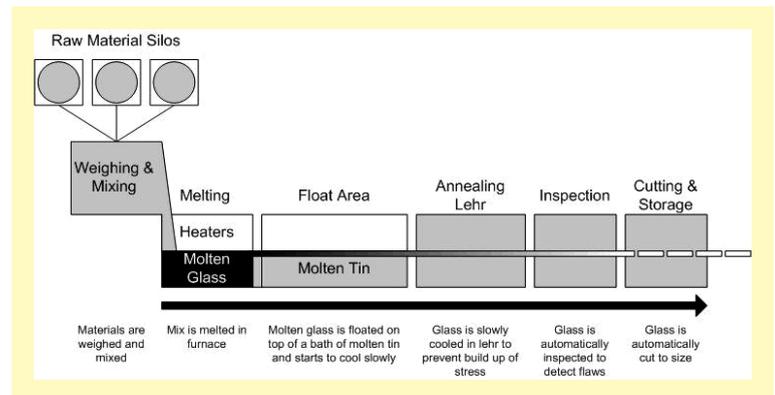
Float glass, commonly known as window glass, is the primary raw material for basic glazing applications and is also the universal substrate for all value-added architectural glass products.

Float glass is characterised by surfaces which are not only flat AND parallel (distortion-free) but also by it's "Fire-finish" which is created by natural forces of Gravity and Surface Tension whilst the liquid glass is supported o the surface of molten tin in an enclosed bath with a controlled atmosphere (no oxygen) during the floatation process. These float surfaces , top and bottom of the glass ribbon , have received no mechanical working. In other words, Float glass is a "non-machined" product.

Since float glass has been subjected to gradual cooling during the manufacturing process, it is supplied to ArcGlass in a "neutral-stress" condition known as Annealed Glass which allows it to be cut, drilled and edge-worked with total accuracy and without risk of breakage. However, broken annealed glass fragments are lethal and, thus, care must be taken in specifying annealed glass to ensure safety-in-use.

Availability

ArcGlass procures it's entire requirement for raw float glass and coated float glass from the most reliable and efficient manufacturers conforming to ISO 9001.2000, BS EN 572 and ASTM C 1036 international standards.



Primary Float Glass

Special Considerations for Large Finished Glass Sizes

Architects and designers typically desire glass panes to be as large as possible, keeping the amount of framing to a minimum. However, although the Glass Industry may have the physical capacity to produce very large panes of glass in various formats, this is not to say that such large sizes are always practical in terms of providing safe protection for the occupants of buildings.

The use of very large glass panes, including Fully Toughened and Laminated Glass, may create an uncomfortable feeling to persons in the immediate vicinity of such panes: this Visual Discomfort will be intensified when the pane is deflecting under wind-load even when structural calculations state that the pane is "Safe".

Although very large glass sizes up to 5100 x 3210mm are available from the primary Float Glass Manufacturers, these must be essentially considered as raw material for cutting down to more practical unit-sizes, and are rarely "fit-for-purpose" in structural openings in buildings.

Designers must therefore endeavour to work within the limitations of local / national glass-processing facilities, the capabilities of the contract-glazier to handle and install the unit, availability of specialised equipment to deliver the unit, and combinations of all these.

ArcGlass recommends that proposed "Over-size" glass configurations (Heat-Treated Glass, Insulated Glass Units, Laminated glass) must be reviewed at the design stage of the project so that potential difficulties can be identified to ensure practical manufacture, timely delivery and bottom-line profit.



ArcGlass employ the most up-to-date equipment for the mass-production of ArcLam Laminated Safety Glass in a multitude of combinations of glass and PVB interlayers to provide varying degrees of Safety, Security, Solar Control and Sound Control to meet the most stringent design specifications.

What is Laminated Glass ?

ArcLam Laminated glass is composed of two, or more, sheets of annealed or heat-treated (HS or FT) glass bonded together using PVB (Poly Vinyl Butyral) interlayers under conditions of considerable heat and pressure to create a “glass sandwich” having great properties of strength, safety and resistance to penetration. The superb quality of modern Poly Vinyl Butyral interlayers provides optical and light transmission properties almost as good as the glass itself, such that laminated and monolithic glass in the same elevation are indistinguishable.



"ArcLam" Laminated Safety Glass



The Glass lamination clean room where glass and interlayer materials are assembled





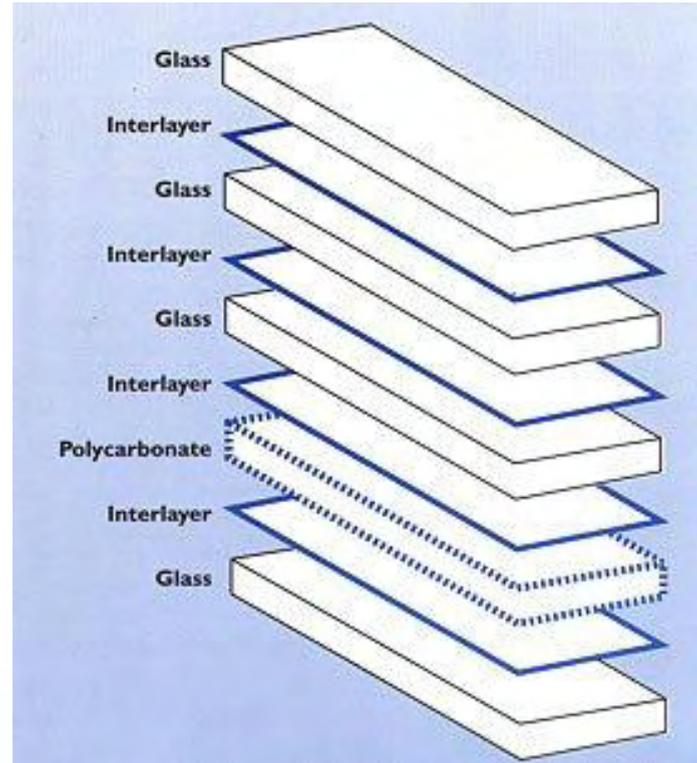
"ArcLam" Laminated Safety Glass

Safety and Security through Strength

The most significant feature of ArcLam laminated glass is that, when severely impacted (human or otherwise) the fragments will remain bonded to the PVB interlayer, minimising the risk of injury and also of flying glass. The broken laminated pane remains integral within the frame and will continue to perform its protective role until replacement glass can be sourced and installed.

Categories of ArcLam Laminated Glass

According to Customer's requirements, laminated glass can be constructed as a simple laminate (two sheets of glass + interlayer) or up to complex multi-laminated constructions using more than two glass-panes and more than one PVB interlayer. The ultimate multi-laminated glass combinations can be classified under various grades of bullet-resistant (anti-ballistic) glass, all available from ArcGlass Co.



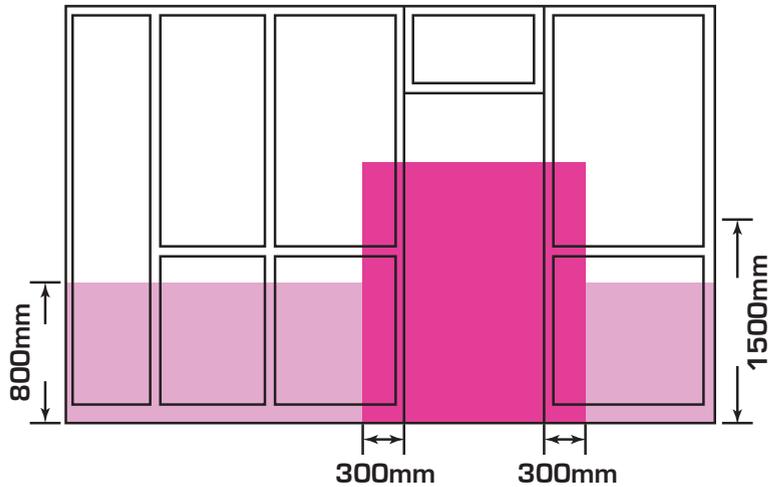
Safety & Security

Standard PVB thickness is 0.38mm (Normal Strength) and can be increased according to requirements for additional safety and security as follows :

1)	0.38mm PVB	: category NS (Normal Strength)	ANN only
2)	0.76mm PVB	: category HPR (High Penetration Resistance)	ANN only
3)	0.76mm Acoustic Grade PVB	: category HPR (Superior Noise Control)	ANN only
4)	1.14mm PVB	: category HI (High Impact)	ANN , HS & FT
5)	1.52mm PVB	: category HI (High Impact)	ANN , HS & FT
6)	Multi-Laminated	: category HD (Heavy Duty)	ANN , HS & FT
7)	Multi-Laminated	: category BRG (Bullet Resistant)	ANN , HS

ANN = Annealed Glass; HS = Heat-Strengthened Glass; FT = Fully Tempered Glass

Requirement for the Use of Safety Glass



- Doors
- Glazing adjacent to doors
- Low level glazing
- Safety glass is not a requirement here



Recommendations for Use

Standard	Category of Laminate	Purpose	Applications
12543 Part2	NS HPR	Where there is a risk of accidental human right	Any glazing located in a position where human impact is likely shall a) Break in such a way which is unlikely to cause injury or:- b) Resist the impact without breaking Suitable for safety / security risks in the home, banks, post offices petrol stations, wages offices, cash desks, shop windows etc.
BS EN 356	HI HD	"Anti-Bandit" Manual attack	As above
BS EN 1063	BRG	Armed attack	Screens in banks, post offices, petrol stations, wages offices, jewellery shops, museums, government offices & embassies
EN 13541	BR	Explosions	Shops, commercial offices, government buildings, embassies, refineries and chemical factories

"ArcLam" Laminated Safety Glass

Solar Control

ArcLam laminated glass can be designed in a wide variety of combinations to provide excellent properties of solar control, especially for all kinds of sloped glazing where protection from potential "fall-out" is required in addition to control of solar heat-gain.

ArcLam laminated glass can be manufactured with sputter-coated high performance glass with the coating on position # 2 of the laminate. Alternatively, the outer pane can be tinted and / or, the PVB interlayer itself can be tinted NOTE: Sputter-coated Low-E products cannot be laminated with the coating in Position# 2 (total loss of emissivity) or on position #4 (severe risk of corrosion).

When using solar control glass , tinted glass or tinted PVB, it will usually be necessary for the ArcLam laminated glass to be Heat-Strengthened for full 4-side support glazing systems, in order to avoid any risk of breakage due to thermally-induced stresses.

ArcLam laminated glass can also be produced in Fully Tempered condition for use in all kinds of frameless and bolted glass systems.

ArcLam laminated glass can be incorporated as one, or both, panes of an ArcSeal insulated Glass Unit to further enhance the solar, safety and security performance of the glazing.



UV (Ultra Violet) Protection

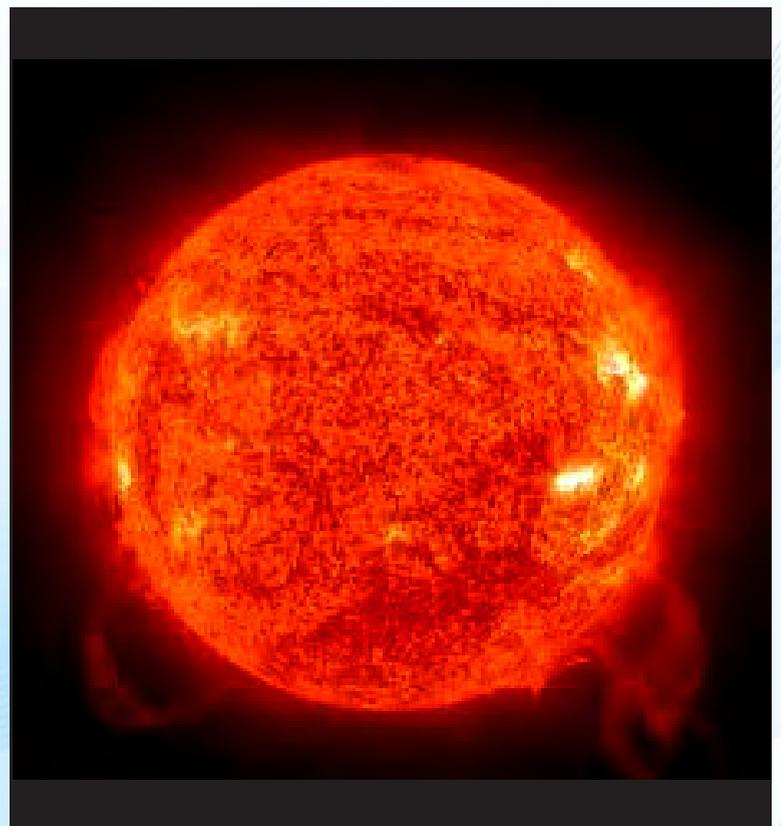
Ultra Violet Light occurs in the solar spectrum in a narrow waveband from 310 – 380nm (nanometers) and is a potentially harmful feature of solar radiation which can cause skin cancer as well as the fading and degradation of interior furnishings, display goods in shopfronts, and of painted surfaces. Relative depletion of the Ozone Layer in the upper atmosphere, substantially due to prolonged release of CFC refrigerant gas, has resulted in increased exposure levels of UV Light around the world.

ArcLam laminated glass with clear PVB interlayers is virtually opaque to the entire UV waveband with transmission levels typically less than 2%, and frequently less than 1%, whereas standard 6.0mm clear float glass transmits 55% at 350nm.'

The use of pigmented tinted PVB will further improve the overall screening performance.

UV radiation protection of PVB does not diminish over long periods of severe exposure to the sun. Tests involving continuous exposure in full desert conditions have shown that protection levels of laminated glass remain unchanged.

Note: Although UV radiation is the primary cause of fading, other environmental factors such as excessive heat, high humidity levels, air-pollution and dust may also contribute to fading and surface degradation.



"ArcLam" Laminated Safety Glass

Sound Control

The PVB interlayer material in ArcLam laminated glass provides a superior level of acoustic insulation and a much better barrier to unwanted noise than either monolithic or non-laminated insulated glass units. ArcLam laminated glass is therefore highly effective in reducing noise transmission and can be used in all window and curtainwall designs.

Optimum PVB thickness is 0.76mm and is available as a normal standard PVB compound, or as Acoustic Grade PVB which, although slightly more costly, provides significant improvements of up to 3 dB on Transmission Losses (T/L's) across the entire audible frequency range, compared to normal PVB.

When designing for optimum acoustic insulation, all framing materials, tolerance joints, glazing gaskets, solid walls, floors and ceilings must have sound-reducing properties at least as good as the selected ArcLam glass type, and all openable windows must be completely airtight.

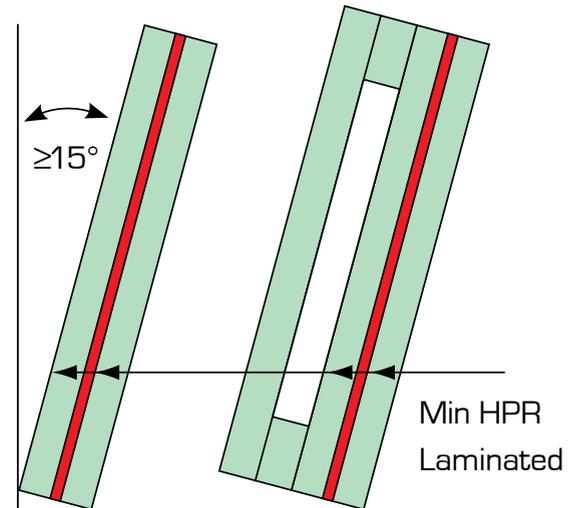
NOTE : Silicone sealants, where used with ArcLam laminated glass, must be of "neutral-curing" type. The use of "aci-toxy" [acid-curing] silicone sealants must be strictly avoided.



Sloped Glazing

Glass that slopes at an angle of 15 deg or more from the vertical plane is considered as "Sloped" glazing. Such glazing typically occurs in sloped walls, atriums, canopies and skylights. The possibility of breakage in sloped or overhead glazing creates a high risk situation where occupants of buildings may suffer injury or death from fall-out of broken glass. In addition, sloped and overhead glazing is subjected to wind-loads, hail storms, live loads and dead loads, often simultaneously: therefore, throughout the entire Gulf Region, there is strict adherence to current International Codes which require sloped glass (= > 15 deg from vertical) to comprise laminated glass and, in the case of double glazing, for the Inner Pane to be laminated.

Sloped laminated glass is subjected to the most severe solar exposure and associated thermal stresses. In many installations, this problem is safely overcome by Heat Strengthening the laminated pane so that, if broken, the large-plate fracture will ensure excellent adhesion between glass and PVB, thus substantially maintaining the integrity of the pane until such time as replacement glass can be installed. In the case of bolted glazing in sloped applications, the glass must be supplied in Fully Tempered condition, and ArcGlass strongly recommends that all tempered glass should be Heat Soak Tested in order to minimise the risk of spontaneous breakage due to presence of Nickel Sulphide inclusions in the central tensile zone of the pane.



Framing Systems

All framing systems must be designed, manufactured and installed as a "Total System" and to have impact and thermal-safety resistance at least equal to the ArcLam pane which is being installed at all the strength-levels denoted above.



"ArcLam" Laminated Safety Glass

Availability

TABLE 1		ArcLam NS LAMINATED SAFETY CLASS (mm)						
Glass/PVB	Max	Min	Condition	Substrates	Remarks	CTS	Stock	
6.38	33.1	3210 x 2440	250 mm x 400 mm	Annealed only	Clear / Clear	Maximum production sizes must not be assumed to be safe glazing sizes	✓	✓
8.38	44.1	3210 x 2440		Annealed only	Clear / Clear Green / Clear Grey / Clear Bronze / Clear Extra White / Extra White		✓	✓
10.38	55.1	3660 x 2440		Annealed only		For advice on "safe glazing" sizes, please consult ArcGlass Technical Department	✓	✓
12.38	66.1	3660 x 2440		Annealed only			✓	✓

Note: Also available in:
 White translucent (Opal) PVB where privacy or glaze control are required.
 Super Black and Super White opaque PVB
 CTS = Cut - to - size

TABLE 2		ArcLam HPR LAMINATED SAFETY CLASS (mm)						
Glass/PVB	Max	Min	Condition	Substrates	Remarks	CTS	Stock	
6.76	33.2	3210 x 2440	250 mm x 400 mm	Annealed only	Clear / Clear	Maximum production sizes must not be assumed to be safe glazing sizes	✓	✓
8.76	44.2	3210 x 2440		Annealed only	Clear / Clear Green / Clear Grey / Clear Bronze / Clear Extra White / Extra White		✓	✓
10.76	55.2	3660 x 2440		Annealed only		For advice on "safe glazing" sizes, please consult ArcGlass Technical Department	✓	✓
12.76	66.2	3660 x 2440		Annealed only			✓	✓

Note: Also available in:
 White translucent (Opal) PVB where privacy or glaze control are required.
 Super Black and Super White opaque PVB
 CTS = Cut - to - size

Availability

TABLE 3		ArcLam HI LAMINATED SAFETY CLASS (mm)						
Glass/PVB	Max	Min	Condition	Substrates	Remarks	CTS	Stock	
7.52	33.4	3210 x 2440	250 x 400 mm 500 x 500 mm HS/FT	Annealed only	Clear / Clear	Maximum production sizes must not be assumed to be "safe glazing" sizes For advice on "safe glazing" sizes, please consult ArcGlass Technical Department	✓	✓
9.52	44.4	3210 x 2440		Ann HS FT	Clear / Clear Green / Clear Grey / Clear Bronze / Clear Extra White / Extra White		✓	✓
11.52	55.4	3660 x 2440			✓		✓	
13.52	66.4	3660 x 2440			✓		✓	

Note: Also available in:
 White translucent (Opal) PVB where privacy or glaze control are required.
 Super Black and Super White opaque PVB
 CTS = Cut - to - size

TABLE 4		ArcLam HD LAMINATED SAFETY CLASS (mm)					
Glass/PVB	Max	Min	Condition	Mass kg/m ²	Substrates	Remarks	CTS
13.52	444.22	3210 x 2440	Annealed only	25	Clear / Clear Green / Clear Grey / Clear Bronze / Clear Extra White / Extra White	Maximum production sizes must not be assumed to be "safe glazing" sizes For advice on "safe glazing" sizes, please consult ArcGlass Technical Department	✓
15.52	644.22	3210 x 2440		40			
17.52	844.22	3210 x 2440		45			
19.52	666.22	3210 x 2000		50			
21.04	666.44	3210 x 2000		55			

Note: Also available in:
 White translucent (Opal) PVB where privacy or glaze control are required.
 Super Black and Super White opaque PVB
 CTS = Cut - to - size

TABLE 5		ArcLam BRG BULLET RESISTANT LAMINATED SAFETY CLASS (mm)				
Thickness	Weapon	BS EN 1063	Max. Size	Min	Mass kg/m ²	CTS
30.0	9 mm Hand Gun	BR2	3000 x 2000	250 x 400 mm	70	✓
38.0	.357" Magnum	BR3	3000 x 1500		97	
54.0	.44" Magnum	BR4	2400 x 1500		120	
58.0	5.56 mm M193	BR5	3660 x 2000		150	
72.0	7.62 mm High Power Military Rifle	BR6	1800 x 1500		190	

Note: ArcLam BRG is also available as glass-clad polycarbonate up to max. 2050 x 3000 mm.

"ArcTuff" Fully Tempered (FT) Glass

HEAT-TREATED GLASS ArcTuff Fully Tempered (FT) Glass & Arc-HS Heat-Strengthened Glass

ArcTuff is a thermally tempered glass product for use in all glazed openings where mandatory use of safety glass is required.

ArcTuff is produced on the most modern horizontal roller-type of furnace equipment and fully conforms to European Standards EN 12150 and EN 12600 as well as American Standards ASTM C 1048 and ANZI Z97 -1.

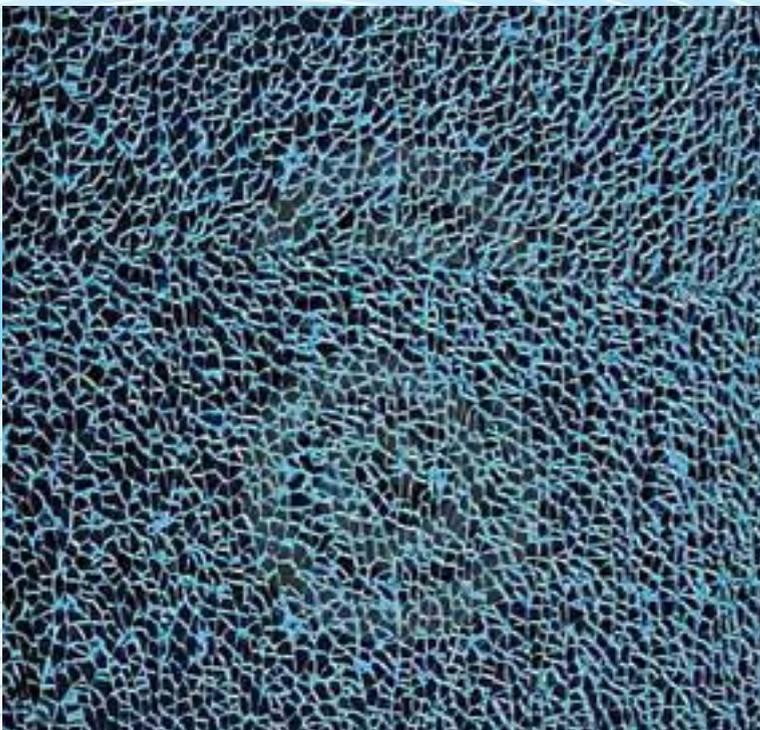
The tempering process involves the heating of annealed float glass to a temperature of around 650 deg C which causes the glass to become soft. To prevent soft glass from sagging between the supporting rollers, it is continuously oscillated backwards and forwards prior to proceeding into the quenching zone where it is rapidly cooled, top and bottom surfaces simultaneously, by high velocity cold air. The effect of shock-cooling is to induce perfectly balanced counteracting forces in the glass with an "envelope" of compressive surface stress acting inwards and a central zone in tension whose tensile energy is safely contained within the body of the pane.

The tempering process provides significantly increased resistance of Fully tempered (FT) to mechanical and thermal stresses up to 4 - 5 times the strength of annealed glass, and a safe working temperature range from minus 100 degC up to 280 degC . It can safely withstand a temperature difference of over 250 degC. ArcTuff Fully tempered (FT) glass is a perfectly elastic material which can absorb a considerable deflection when loaded and, on removal of a non-excessive load, will return to it's original flat condition even when frequently loaded.

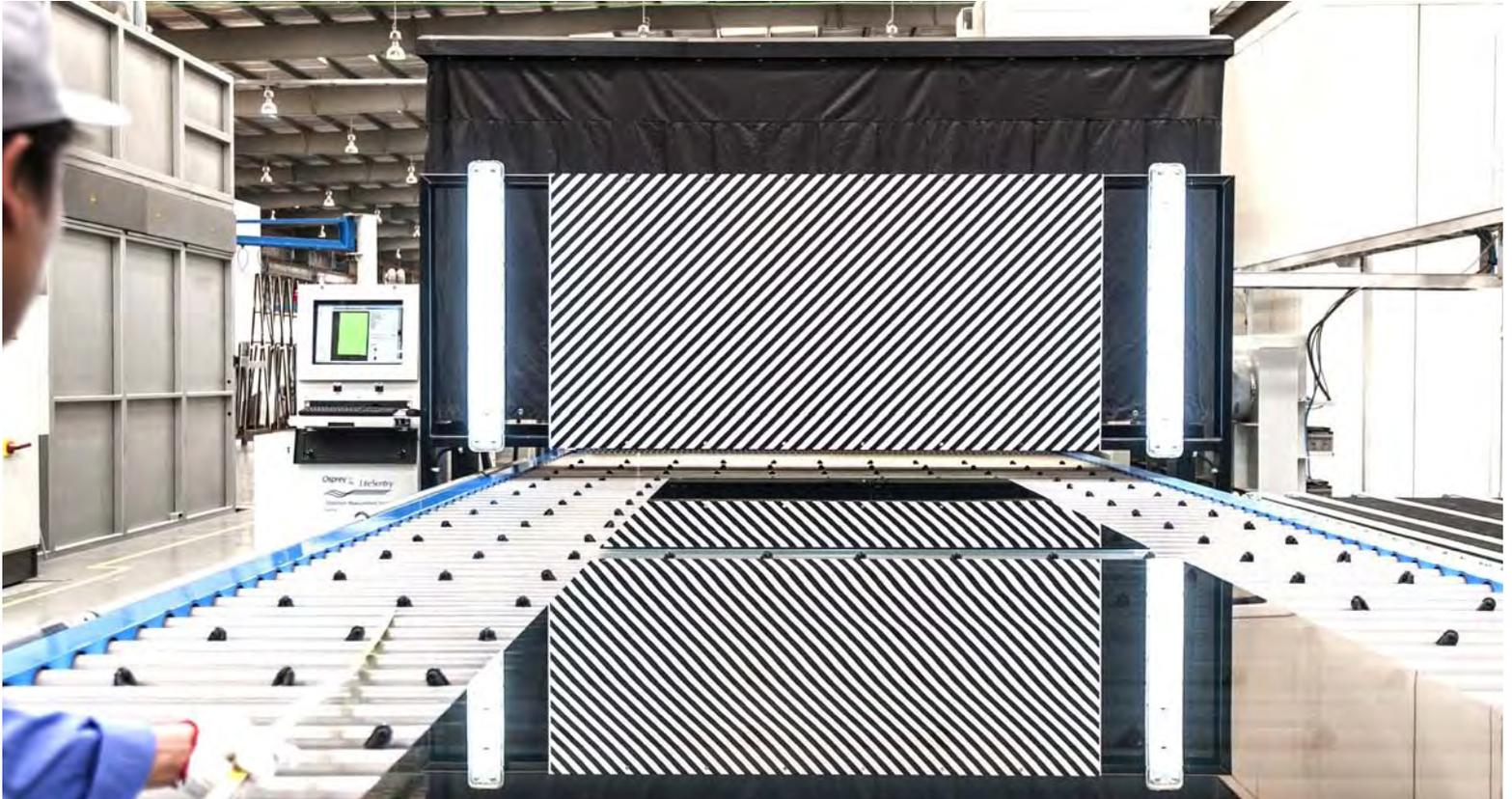
Breakage of ArcTuff FT glass will occur when the deflection exceeds the capacity of the compressive envelope to resist the tensile force in the central body of the pane. Alternatively, if hit by a sharp or very hard object on the surface or at the extreme edge of the glass, causing penetration to the tensile zone, the sudden explosive release of latent energy will cause total disintegration of the glass into small fragments with "dulled" edges which are non-injurious. This important feature of ArcTuff FT glass means that it is considered by all international safety standards, including EN 12600 and ANSI Z97-1, as a "true safety glass " for use in all glazing situations where impact-resistance and thermal safety are required.

ArcTuff FT glass is manufactured in full compliance with current EN 12150 and ASTM C 1048 standards in terms of Tolerance, Squareness, Optical Distortion and Overall Bow.

Typical Tempered Glass Breakage Pattern



Tempering Line



High quality convection glass tempering technology with Osprey continuous optical quality monitoring. Every piece of tempered Glass is checked for quality.

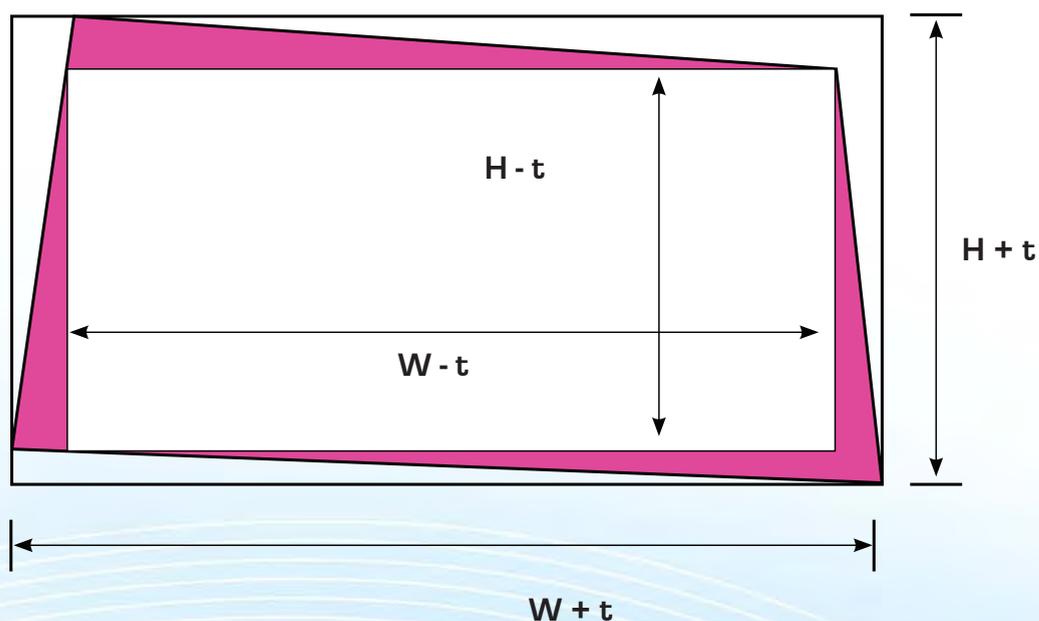


"ArcTuff" Fully Tempered (FT) Glass

HEAT-TREATED GLASS ArcTuff Fully Tempered (FT) Glass & Arc-HS Heat-Strengthened Glass

Tolerance & Squareness according to EN 12150

The nominal dimensions for Width & Height being given, the finished pane shall not be larger than a prescribed rectangle resulting from the nominal dimensions increased by Tolerance "t", or smaller than a prescribed rectangle reduced by the Tolerance "t". The sides of the prescribed rectangles are parallel to one another and these rectangles shall have a common center (see diagram below). The limits of squareness are also the prescribed rectangles. Tolerances are given in the following table.



Dimensional tolerances on 'W' and 'H' for rectangular ArcTuff FT Glass products according to EN 12150.

Dimensional tolerances on "W" & "H" for rectangular ArcTuff FT glass with standard arised edges according to EN 12150

Nominal Dimension of Longest Side mm	Tolerance "t" (mm)	
	Nominal Thickness (T ≤ 12mm)	Nominal Thickness (T > 12mm)
≤ 2000	t = ± 2.5	t = ± 3.0
2000 - 3000	t = ± 3.0	t = ± 4.0
> 3000	t = ± 4.0	t = ± 5.0

Availability

T mm	Max. mm
= < 12	2580 x 5400
> 12	up to 367 kg/pc



Edge-Working , Drilling of Holes & Formation of Cut-Outs

ArcTuff FT glass is available with a wide variety of edge-finishing, including bright polishing, which can greatly improve the standard tolerances shown above. For full details, including positioning of holes and cut-outs, please contact ArcGlass Technical Advisory Service Department.

Important note: All processing of edges, holes and cut-outs must be done prior to the tempering process. No further work can be done on the glass after completion of tempering.

Optical Distortion(Roller-Wave) and Bow Tolerances

Optical Distortion (Roller-Wave) & Bow Tolerances

Overall bow

Due to the rapid cooling [quenching] of the very hot glass during the tempering process , there will always be a variable risk that the final tempered (FT) product will not be perfectly flat. This "out-of-flatness" feature is known as "Bow" which will depend on a number of variable factors such as thickness, shape, size and aspect-ratio. Tempering Bow is maintained within Industry limits. Please refer to table shown below.

Edge Lift

Edge lift is a typical characteristic of heat-treated glass and is the result of a small area at the "leading edge" of the pane not being fully supported by the furnace-rollers during the heating stage. Edge Lift is maintained within recognized standards.

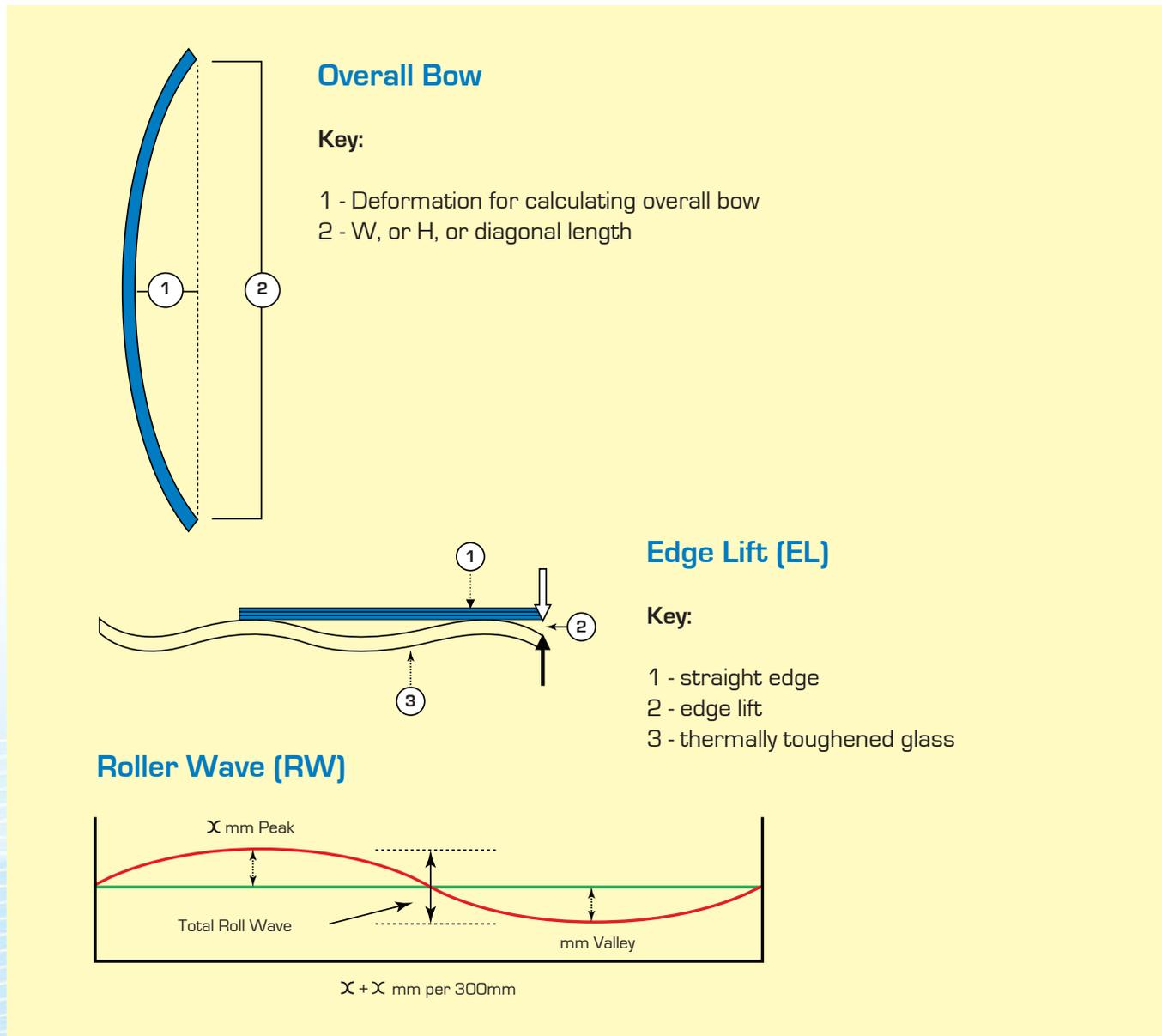
Roller Wave Distortion

The heating of the annealed [perfectly flat] glass up to 650 deg C causes it to become soft. gravitational forces allow the soft glass to sag between the support-rollers and this effect is controlled and minimised by oscillating the heated pane forwards and backwards throughout the entire tempering process. However, the inevitable result is that the FT glass will be optically less perfect than the annealed glass from which it was made. This effect is known as Roller wave Distortion and is controlled within the limits set by ASTM & EN Standards. The state-of-the-art tempering equipment installed at ArcGlassFactory ensures that ArcTuff FT glass is consistently produced within allowable limits.

Roller wave distortion is less evident in clear tempered glass, but becomes more noticeable when the glass is tinted and / or reflective. It may also be more noticeable in double glazed panes due to changes in barometric pressure and temperature acting on a fixed volume of air hermetically sealed between two glass lites and which may cause "dishing" or "bulging ".

When standing close to the glass, a perfect reflectance is often observed. However, the visible appearance of Roller Wave distortion becomes more noticeable as the Observer moves further away from the building.

Representation of overall bow, edge lift and roller wave



Roller Wave Distortion			EN 12150	
T mm	RW (x + x mm)	EL mm	Overall Bow	mm/m
4	= < 0.30	= < 0.40	= < 3.0	
5	= < 0.30	= < 0.40		
6	= < 0.30	= < 0.30		
8	= < 0.30	= < 0.30		
10	= < 0.30	= < 0.30		
12	= < 0.30	= < 0.30		
15	= < 0.30	= < 0.30		

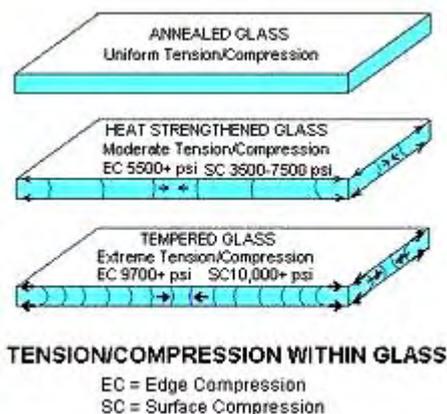
HEAT-TREATED GLASS ArcTuff Fully Tempered (FT) Glass & Arc-HS Heat-Strengthened Glass

Mock-Ups

All of the above features of ArcTuff Heat Treated glass should carefully evaluated in on-site mock-up frames prior to confirmation of specification and approval for production.

Summary or ArcTuff Fully Toughened (FT) Glass

Properties



- Is 4 - 5 times stronger than annealed glass of the same thickness and has greater resistance to thermally-induced stress than annealed glass. Surface compressive strength is in the range of 80N/mm² to 150N/mm²
- Toughened properties are stable within a temperature range from minus 100 degC up to 280 deg C and can with stand a temperature downshock of over 300 Centigrade degrees.
- Typically breaks into small cubical particles which can be handled safely.
- Suitable for use as a safety glass as defined by :
European Standard EN 12600 2002
British Standard BS 6206 and 6262
- Conforms to European Production Standard En 12150-1 and current American Standard ASTM C 1048

Applications

- FT glass cannot be cut, edge-worked or drilled after tempering. Any post tempering operations such as edge-grinding, cutting, sand-blasting etc may result in premature failure
- Edge-working: FT glass is normally supplied with standard arrised edges for general glazing purposes. Where glass edges are exposed, a variety of edge-finishes are available, including flat-ground, pencil-edge and bright polished on rectangular, shaped and complex-shaped glass lites.
- FT glass is a structural glass which can be used for frameless glass facades, frameless glass doors, structural glass balustrades and many types of furniture and oven and refrigerator appliances.
- FT glass can be used in any type of window or curtainwall system .
- FT glass is widely used in private and public transport vehicles.
- All types of clear, tinted, pyrolitic-coated and post temperable sputter-coated glass are available in FT condition
- FT Glass can be produced with silk-screened and digital printed ceramic frit designs.

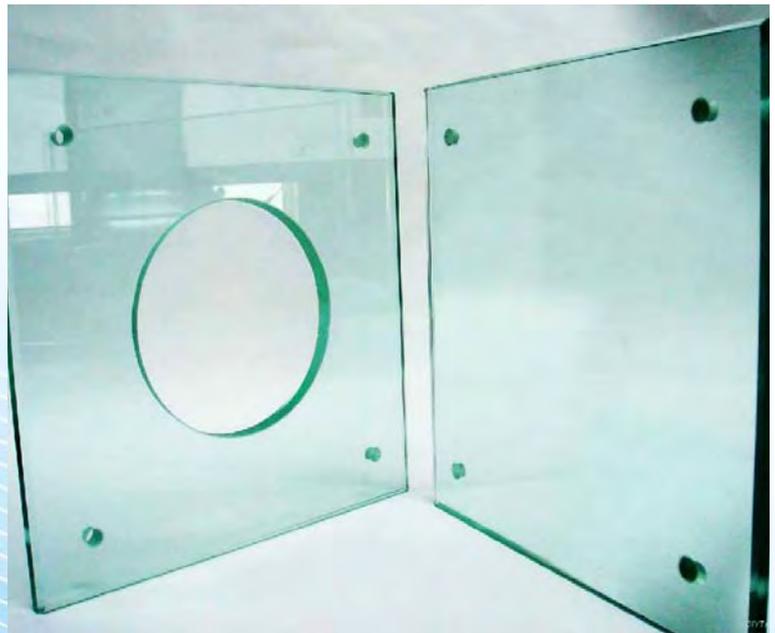
Ordering of ArcTuff FT Glass

FT Panes must be ordered, manufactured and installed with the “W” dimension parallel to the transom, in order to further decrease the overall visibility effect of Roller Wave distortion.

Strain Patterns

During the quenching process, it is occasionally possible for local variations in the compressive stress levels to occur in the glass surfaces. These variations are normally invisible but can become apparent as an anisotropic visual effect in certain lighting conditions, especially near to sun-down when polarization of light causes these stress-points to show up as a distinct dark mottled effect in the form of a pattern.

Strain Pattern is an anisotropic phenomenon which can occur in all heat-treated glasstypes and is recognised in ASTM Standard C 1058 “..... Heat Strengthened (HS) and Fully Tempered (FT) glass may contain a strain pattern (which is not normally visible) but may become visible under certain lighting conditions. It is a common characteristic of these kinds of glass and should not be mistaken as a discolouration or non-uniform colour. Anisotropic strain patterns are therefore not considered to be a defect in heat-treated glass.....”



Spontaneous Breakage of FT Glass

The production of float glass involves a highly sophisticated procedure for the blending and mixing of a number of natural raw materials to an extremely high degree of consistency. The volumes of material consumed are huge, considering that a typical Float Glass Line has a capacity in excess of 600 tons of glass per day.

In any such large scale operation, there will always be a very small risk of the occurrence of impurities in the raw materials and these are mostly removed from the glass during the melting and refining phases of the process.

However, from time-to-time, there is a possibility that small particles of Nickel may be present in the raw materials, and which can pass through the entire float process during which they react with sulphur in the melting fuel to form Nickel Sulphide (NiS). Nickel Sulphide passes into the finished float glass as very small "inclusions" which are not detected by normal on-line electronic QC equipment.

In annealed glass, NiS inclusions remain permanently dormant, but when the glass is fully tempered, any NiS inclusion located within the tensile zone will undergo a slow but progressive change (usually between 6 and 36 months from date of manufacture) to its crystalline structure, resulting in enlargement of up to 4% by volume.

This progressive enlargement can cause immense pressure up to 500 000 psi within the tempered pane and will certainly result in spontaneous breakage, typically with two "butterfly-wing" particles at the exact location of the NiS inclusion. At this time, the NiS inclusion may now be visible to the human eye. Note, however, that any NiS inclusion located in the outer Compression Zone of the FT glass will remain unchanged and will not present any danger to the future integrity of the FT pane.

Spontaneous breakage of FT glass due to NiS inclusions is not covered worldwide by any Manufacturer's Warranty and replacement is done at Client's expense.

Where FT glass has been used in areas which present difficult and dangerous access for replacement of spontaneous FT breakages, and where the cost of disruption and inconvenience greatly exceed the value of the glass itself. HEAT SOAK TESTING (HST) is a cost-effective process to ensure that FT glass is almost totally free of potentially dangerous NiS inclusions.

HST is an accelerated test to force the rapid growth of NiS inclusions (if any) in a large batch of FT glass in a controlled environment.

HST is carried out in a specially designed oven in which the FT glass is heated to 280 deg C and kept strictly at this temperature for a "Holding Time" of 2 hours in accordance with the parameters of EN 14179. Any spontaneous breakage occurring during the Heat Soak Test is replaced by the Manufacturer.

The cost of HST depends on the thickness of the tested FT glass. The volume of glass tested can be by agreed percentage of the total OR a random selection, OR 100% of the total at Client's discretion.

Note: however, that HST is not a Warranty and does not automatically insure that all harmful NiS inclusions have been detected. It is, nevertheless, a valuable reassurance that the glass is as safe as possible and that it can be expected to perform in a reliable manner (except for accidental breakage) throughout the life of the building.

ArcGlass conduct Heat Soak testing to EN 14179 using a top-of-the-range HST Oven with a daily capacity of 6 tons in panes up to 5000 x 2400 mm (subject to availability).



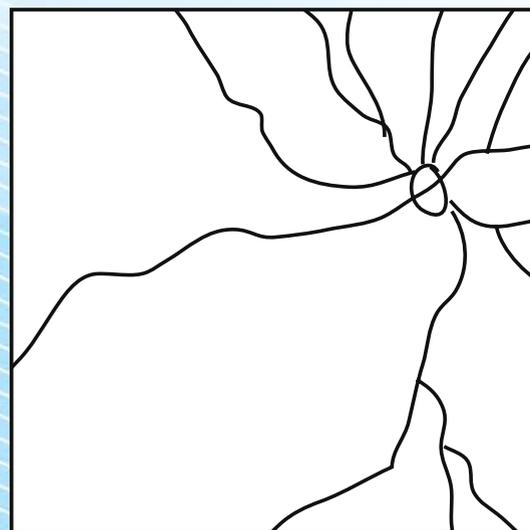
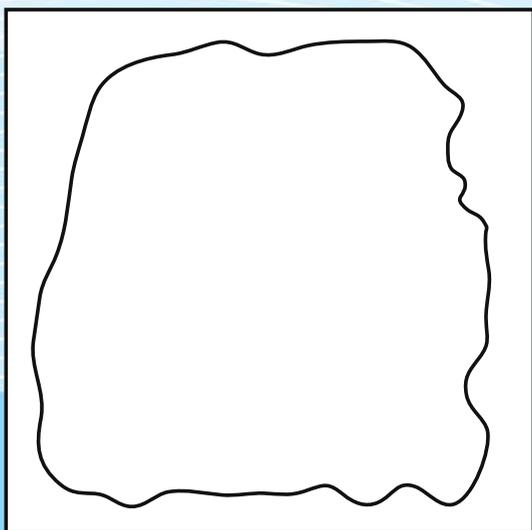
Arc-HS HEAT STRENGTHENED GLASS

In recent years there has been a strongly growing awareness that Heat-Strengthened (HS) glass provides many advantages compared to Fully Tempered glass when used in window and curtainwall applications where impact-safety is not a requirement. The absence of risk from spontaneous breakage, the better retention in the glazing system (if broken) and the improved surface quality are giving strong recognition to HS glass worldwide as a “first product of choice “ for façade glazing.

“Arc-HS” glass is a “semi-tempered” glass in which the hot glass is cooled similarly to FT glass, but for a longer period which results in much lower compressive stresses in the ‘external envelope’ of the glass and a much thinner, weaker tensile zone. As a result, Arc-HS glass does not have the impact resistance of FT glass and is therefore not a true safety glass. Fragmentation of HS glass is typically into large pieces which, however, tend to remain “in situ” especially when used in Insulated Glass Units where the perimeter silicone sealant holds the fragments in place.



Typical Heat-Strengthened Fracture Patterns



Arc-HS glass can be used only in areas where there is no legal requirement for the use of safety glass. Furthermore, Arc-HS glass is not a structural glass and must be supported on 4 sides. It cannot be used for bolted frameless glazing. Nevertheless, Arc-HS glass is suitable for a wide variety of architectural applications requiring sufficient strength to resist the stresses caused by absorption of solar energy and also to resist the forces of deflection under wind-load, dead-load (when used in laminated sloped glazing) etc.

Summary of Arc-HS Heat-Strengthened Glass

- Is 2 x times stronger than annealed glass of the same thickness.
Surface Compressive Stress is in the range of 25N/mm² – 52N/mm²
- Has much greater resistance to thermal stress than annealed glass and is “Thermally Safe “ for all curtainwall applications.
- Typically breaks edge-to-edge in large pieces with dulled edges.
- Is not a true safety glass
- Conforms to current versions of European Standard EN 1863 and American Standard ASTM C 1048.

Applications of Arc-HS Glass

- HS glass is not a structural glass and must be glazed on all 4 sides in conventional or structural silicone curtainwall systems.
- Not suitable for frameless bolted glazing systems.
- HS Glass can be the ideal choice for high rise buildings where added resistance to wind-load & thermal stress are required.
- HS Glass can be laminated (Arclam) with suitable number of PVB interlayers.
- HS Glass can be produced with silk-screened and digital-printed designs.
- All Clear, Tinted, Pyrolytic coated and Post Temperable sputter-coated glass, from 4.0mm – 10.0mm, can be produced in HS condition, subject to details shown below:

Availability

Substrate		Dimensional mm				
		4	5	6	8	10
Clear	T	4	5	6	8	10
	Max	2580 x 5400				
	Min	180 x 350				
Tinted	T	4	5	6	8	
	Max	2400 x 3600				
	Min	180 x 350				
Sputter-Coated Low-E and Solar Control Glass	T	4	5	6	8	
	Max	2400 x 3600				
	Min	180 x 350				

Safe Glazing Size

The above sizes refer to manufacturing limitations. The actual “Safe Glazing Size“ will depend on wind-load, dead load, whether single or double glazed, laminated or combined with annealed glass in sealed double glazing.

Comparison of Toughened & Heat Strengthened Glass

Charateristics	Toughened Glass	Heat Strengthened Glass
Surface Compressive Stress	80N/mm ² to 150N/mm ² but \geq 100N/mm ² for safety glazing quality.	25N/mm ² to 52N/mm ²
Mechanical Strength	\geq 4 times that of annealed glass. Can be used with bolted fixings.	\geq 2 times that of annealed glass.
Resistance to Thermal Stress	\geq 6 times that for annealed glass.	\geq 2 times that of annealed glass. Sufficient for most glazing applications
Maximum Operating Temperature	280°C Can withstand thermal down-shock of 200 Centigrade degrees.	150°C
Fracture Characteristics	Breaks into small, relatively harmless fragments. For safety glazing needs \geq 40 particles in 50mm square when tested to EN 12150.	Fracture similar to annealed glass. Should not be regarded as safety glass.
Optical Distortion	Some optical distortion may be expected within limits set by EN 12150.	Can be less than for tempered glass.
Bow	Some bow may be expected within limits set by EN 12150	Can be less than for tempered glass.
Thickness Available	4mm to 19mm	4mm to 8mm
Nickel Sulphide Inclusions	A very small proportion of panels contain critical Nickel Sulphide (NiS) inclusions. Most of these can be eliminated by heat soaking.	Not generally regarded as a source of fracture. Heat Soak Testing not applicable.

Glass is one of the fundamental materials of civilized life as we know it today. It provides us with daylight and perfect contact with the external environment and simultaneously protects us from changes in weather and climate, from unwanted noise in a busy world and safeguards our security against criminal, ballistic and explosive attack.

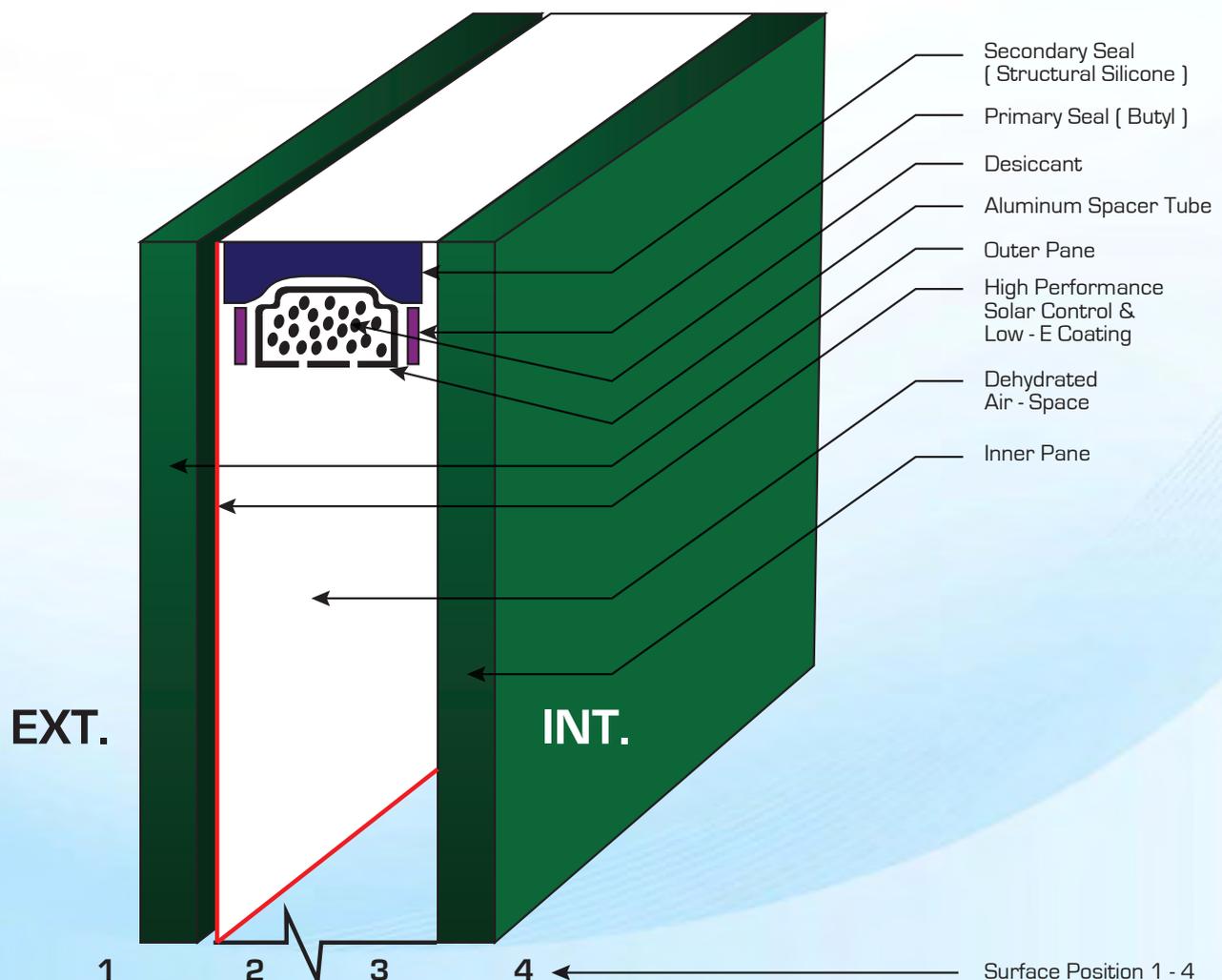
However, considering all the materials in the Building Envelope, glass is the weakest element not only in strength, but also in terms of its poor thermal conductance which can result in unacceptable heat-gain, or loss, depending on Season. These excessive transfers of heat into, and out of, the building can adversely affect the overall costs of air-conditioning or heating, with consequent reduction in the quality of indoor comfort-levels.

How can the performance of window-glass be improved in order to create a product which is able to comply with all the parameters of sustainable architectural design as required by current Green Building Rating Systems now in wide use throughout our Region?

Principles of ArcSeal Double Glazing

ArcSeal IG Units employ the principle of a dead air-space trapped between two panes of glass, separated by a metal or thermoplastic spacer, usually 12, 16 or 20mm wide, and sealed around the perimeter by means of a “Dual-Seal” process to ensure that the dehydrated air in the inter-pane cavity is permanently isolated from ambient atmosphere. Spacer material is available in “Mill-Finish” (Silver), or Black-Painted finish which is especially favourable to structural-silicone curtainwall glazing where glass edges are fully exposed.

Diagram 1



ArcSeal Insulated Glass Units

ArcSeal IG Units employ a Primary Seal of PolyIsoButylene (PIB Butyl) applied to the glass-facing surfaces of the spacer-tube. PIB is an impervious material which ensures that entrapped air cannot escape from the cavity and also ensures that humid external air does not penetrate to the cavity. The inter-pane air is dehydrated by a molecular-sieve desiccant material contained within the spacer tube which has slotted "Breather" holes. By this means, the inter-pane air remains totally dry and will not allow formation of condensation on the inner glass surfaces, even in severe "Dew-Point" temperature / humidity conditions.

The entrapped air in the inter-pane cavity is not only totally dry but also "Dead" in the sense that the relatively narrow air-space does not easily permit convection (and heat-transfer) to take place. Thus the rate of heat transfer, in-out: out-in, is considerably reduced with consequent reductions in energy consumption required to maintain a stable indoor comfort level.

Further improvements in the performance of ArcSeal IG Units can be obtained by the addition of coated glass products (Solar-Control and / or Low-E) as well as tinted glass (often in combinations of all of these) to enhance the solar resistance (Solar Heat Gain Coefficient / g-value) and the thermal conductance (U-Value) of the product.

Diagram 2



NOTES:

- LT - Light Transmission
- SHGC - Solar Heat Gain Coefficient
- g - g - Value
- SC - Shading Coefficient
- Selectivity - Light/Solar Gain Ratio
- L - Light
- S - Solar
- G - Gain

Selectivity = LT/SHGC
 If = > 1.25 Glads is spectrally selective

Structural Contact Depth

Structural Contact Depth (SCD) of the structural silicone secondary seal is typically 6.4mm, and distance from edge-of-glass to sightline of the spacer-tube is nominally 12mm, but in the case of over-size units or units which are to be used in frameless bolted glazing systems, it may often be necessary to increase the SCD to accommodate additional shear-stresses as well higher center-of-glass deflection. For confirmation of non-standard SCD requirements, please refer to the Technical Advisory Service Department at ArcGlass.

Important Note:

In common with the entire Glass Processing Industry, both Nationally and Internationally, ArcGlass works to an internal specification for sightline tolerance, that-is-to-say placement of spacer-bars in relation to glass edge, of + - 3.0mm. This includes the sealant as well as the spacer itself. Furthermore, even with the most modern facilities, it is impossible to guarantee an absolutely straight and uniform application of PIB Primary Sealant onto the glass-facing surfaces of the spacer-bar. In addition, from time-to-time depending on ambient temperature, viscosity of the PIB sealant itself, normal variations in platen-pressure on the IG Line, it is possible for the PIB Primary sealant, a non-curing material, to migrate outwards and beyond the sightline of the spacer-bar. A PIB infringement of up to 3.0mm is allowed; however, this is NOT a defect, and will not compromise the integrity of the seal.

In high light-transmitting glasstypes, these common inconsistencies in the application of the PIB sealant cannot be concealed. There are no standards for the appearance of an IG Unit in our industry today and, as a result, inconsistencies as described above, are deemed to be acceptable provided that the integrity of the IG primary seal is not compromised. Therefore, considering these circumstances (which we do our best to control), due consideration must be given to increasing the frame edge-cover to mitigate against sealant and spacer visibility.

ArcGlass also strongly recommended the use of BLACK FINISH SPACERS, instead of silver mill-finish, as a further means to distract from any misalignment and / or migration of PIB sealant into the vision area within the tolerances described above.

Frame Performance

ArcSeal can supply silicone-sealed IG Units for all structural silicone curtainwall systems including Schuco (original Structural IG Spacer System), "Modified Schuco", U-Insert Systems and conventional "Carrier-Frame" systems. However, the efficiency of ArcSeal double glazing can be adversely affected by the quality and design of the framing system. Metal frames and fixing-brackets are capable of conducting large amounts of heat to the edges of the IG Unit in hot weather and, equally, of draining heat from the edges of the Units in cold weather. In each case, only the center of the glass will perform according to its measured thermal resistance (U-Value) with serious effects on its efficiency and cost-benefit to owners and occupants. For this reason, it is strongly recommended that metal framing systems should incorporate a thermal break in the design. Timber and UPVC frames offer optimum thermal resistance with minimum effect on the overall U-Value of the glass.

Edge-Deletion

Whereas it is normal practice to apply structural IG silicone directly to pyrolytic and sputtered solar control coatings without risk to the coating itself, sputtered Low-E glasstypes, with silver metal included in the "layer-stack", generally require to have the coating "deleted" around the edge in order to provide a clean, non-coated surface for structural bonding, and to avoid any risk of corrosion of the coating starting from the edge of the pane. The result is that, in all edge-deleted double glazing, the perimeter seals and spacer-tubes are visible. While ArcGlass takes special care to ensure accurate assembly of spacers and seals, it is generally not possible to achieve consistent straight alignment, nor to prevent some migration of PIB sealant into the sightline of the IG Unit. This feature is controlled within Industry Standards up to + - 3.0mm, and is not considered to be a defect provided that the integrity of the seals is maintained. The effect is mitigated by the use of black spacers for optimum appearance.

Cost-Benefit of ArcSeal Double Glazing

ArcSeal IG Units demonstrate the most up-to-date concept in the manufacture of Sealed Insulated Double Glazing. They are covered by ArcGlassStandard Product Warranty for a period of 10 years, but actual normal service life is conservatively expected to be in excess of 30 years, during which time the glass has made a contribution to energy-saving considerably in excess of original installation cost. ArcSeal IG Units enable Designers to comply with the most stringent requirements of Green Building Rating Systems in terms of Energy Consumption and Indoor Comfort and are an essential component of any modern building design. ArcSeal IG Units therefore provide significant first-cost and life-cycle benefits to Building Owners and Developers and greatly enhance the value of any property.

Availability of ArcSeal

ArcSeal SIG units are produced within the manufacturing limitations shown below:

AIR SPACE (mm)						NORMAL MAXIMUM SIZE (mm)
8	10	12	14	16	20	2500 x 4000 (Limits)

Size Limits for Production Units

Notes: The glazing given sizes in the following Table are maxima only, and are intended to ensure effective sealing of the unit. For particular applications, sizes must be governed by considerations of safety and centre-of-glass deflection under wind-load which shall be determined by the Project Design Team.

1	2	3	4	5	6	7	8
Glass Thickness (mm)	Cavity Width (mm)	Maximum Larger Dimension (mm)	Maximum Smaller Dimension Except for Squares (mm)	Maximum Area (m ²)	Maximum Square (mm)	Mass (kg/m ²)	Unit Thickness Tolerance
3	6 8 to 12	2110 2110	1000 1270	2.10 2.40	1000 1270	16	+ - 1.0mm
4	6 8 to 10 12 - 20	2420 2410 2440	1000 1300 1700	2.40 3.17 6.17	1000 1300 1300	21	
5	6 8 to 10 12 - 20	3000 3000 3000	1000 1500 1815	3.00 4.80 5.10	1000 1500 1750	26	
6	6 8 to 10 12 - 20	3600 3600 4000	1000 1750 2600	3.60 6.80 7.50	1000 1750 2250	31	
8 & 10	6 8 to 10 12 - 20	3600 3600 4000	2000 2250 2600	6.80 7.50 7.50	1500 2000 2250	51	+ - 1.5mm
12	12 - 20	3180	2100	6.80	2400	61	
Both Panes (Outer + Inner)							

Notes: For sizes upto 4000mm, Please submit enquiries for review and approval.

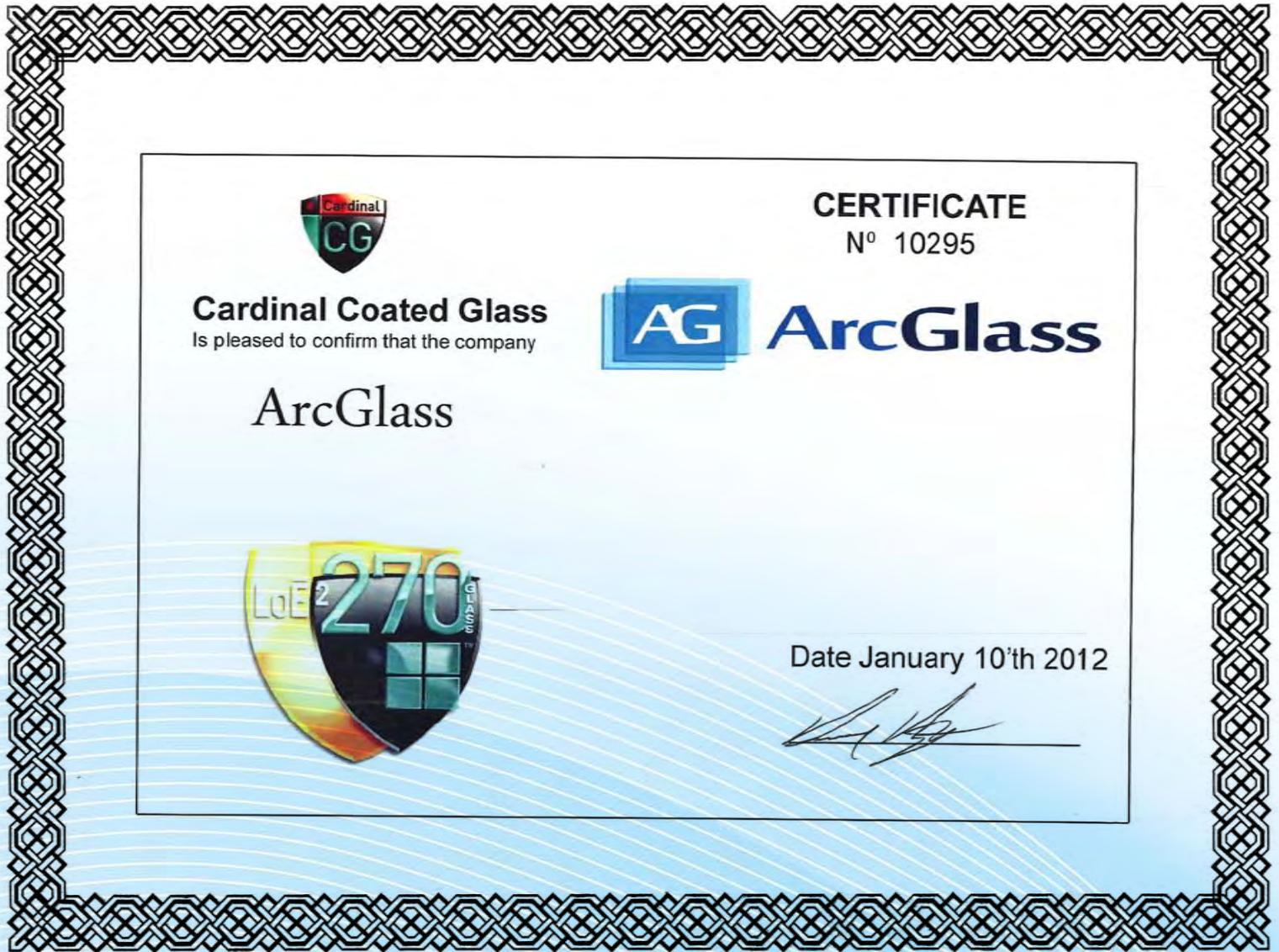
QA / QC and Warranty

ArcGlass employs well established QA / QC procedures in line with best international standards to ensure that ArcSeal SIG constructions are produced to a high standard using consumable materials only from suppliers of highest reputation and record in this field.

ArcSeal SIG Units are covered by ArcGlass Standard Product Warranty for up to 10 years from date of manufacture.



ArcGlass are found to confirm that they have been officially approved and certified by Cardinal Glass Industries, USA as competent processors of Cardinal 270, Cardinal 272 and Cardinal 366 spectrally-selective high performance Low-E glass combining optimum light transmission and solar control.





Cardinal Coated Glass
Is pleased to confirm that the company

ArcGlass



CERTIFICATE
N° 10293



Date January 10th 2012



Cardinal Coated Glass
Is pleased to confirm that the company

ArcGlass



CERTIFICATE
N° 10294



Date January 10'th 2012

Certificate N°: 12-10701



DuPont Glass Laminating Solutions
Is pleased to confirm that the company:

ArcGlass Glass Factory Inc

Has successfully passed the qualification process of SentryGlas® on September, 6th, 2012

*This certificate is valid until October 1st, 2013 as long as your manufacturing process for laminated safety glass remains unchanged.
Renewal is subject to validation of newly supplied laminates.*

Date: September 6th, 2012

For DuPont:

In performing this certification, DuPont International Operations S.a.r.l. does not assume or undertake to discharge any responsibility of the inspected company, which is the sole party responsible for the processing of its products in conformity with applicable laws, regulations, norms and the SentryGlas® laminating guidelines.



GUARDIAN INDUSTRIES

hereby certifies

ArcGlass Co

Dirab Road, Dirab, Riyadh, Kingdom of Saudi Arabia

has met the requirements of the Program to be certified as
SunGuard Select Processor

for Fully Tempered & Insulated Glass Unit fabrication of

SunGuard HP Products

It is the Sole responsibility of the processor to adequately inspect the coated glass before each step of fabrication and prior to installation. Failure to apply all professional standards, customary instructions and processing instructions will automatically void any warranty regarding Coated Products of Guardian. The processor has the full responsibility for the quality of the final product.

By this certificate GUARDIAN is not granting any warranty regarding the processor's continuing capability to adequately process GUARDIAN's products

Valid Until : January 24, 2013

Vivek Buch, Technical Services Executive, Guardian RAK



SAINT-GOBAIN GLASS

Is pleased to confirm that the company

ARC Glass
Riyadh, KSA



has successfully passed a Saint-Gobain Glass inspection on the heat treatment and insulating glass process qualifying it for the processing of :

SGG COOL-LITE® KT

This processor's site has been visited on **15 Sep 2012**

This certificate is valid until **15 Sep 2013** so long as your manufacturing process remains as it is on the date of the inspection.

After such date, its renewal is subject to a new inspection.

In performing this certification, Saint-Gobain Glass does not assume or undertake to discharge any responsibility of the inspected company, which is the sole party responsible for the processing of its products in conformity with applicable laws, regulations, norms and the Guidelines for Use of Coated Glass of Saint-Gobain Glass

CERTIFICATE

N° **1123803**

DATE

October 12th, 2012

For Saint-Gobain Glass :





الإمارات للزجاج
Emirates Glass

January 10, 2012

To Whom It May Concern

At

ArcGlass

Dear Sirs,

Further to the recent success of the trials made in your factory, we are now pleased to confirm your company as a...

Certified Processor of Emicool Post Temperable Glass Products

...and we are further pleased to enclose our ***CP Certificate*** in recognition of the competence which you have shown in all procedures to achieve this success.

We are proud to be associated with you in the onward development of the Emicool-T range of high performance glass and look forward to a long, and mutually beneficial, interaction between our companies.

Best regards,

Ahmed Baker
Product Manager



Paid-Up Share Capital Dhs. 35,425,000
الإمارات للزجاج ذ.م.م. - دبي ٢٩٧٦٩ - هاتف: ٢٩٧٦٩٠ / ٧٠٩٤٧٠٠ - فاكس: ٢٩٧٦٩٠ / ٧٠٩٤٧٠٠ - بريد إلكتروني: emiglass@emirates.net.ae
Emirates Glass LLC P.O. BOX 29769, DUBAI, U.A.E. TEL: (+971-4) 3471515 / 7094700 FAX: (+971-4) 3471440
E-mail: emiglass@emirates.net.ae





الامارات للزجاج
Emirates Glass

This is to certify that

ArcGlass

*have successfully demonstrated competence at every stage of handling & processing
of the following Emicool Post - Temperable glass product(s):*

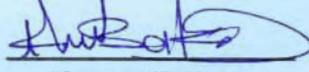
Emicool Sun - Multifunctional Low-E Glass



Reference : ArcGlass_multi

Date : January 10, 2012

Validity : 1 year

Issued by : 
Ahmed Baker
Product Manager



الإمارات للزجاج
Emirates Glass

This is to certify that

ArcGlass

*have successfully demonstrated competence at every stage of handling & processing
of the following Emicool Post - Temperable glass product(s):*

Emicool Sun - Solar Control Glass



Reference : ArcGlass_Solar

Date : January 10, 2012

Validity : 1 year

Issued by : 
Ahmed Baker
Product Manager

ArcGlass are proud to have been approved by Du Pont Co as certified processors of their advanced SentryGlas structural interlayer material to provide a laminated glass product with enhanced performance in Stiffness, Strength and Security.

Stronger and more rigid than conventional PVB Laminated Glass, SentryGlas interlayers create a safety glass that protects against the biggest storms, larger impacts and more powerful blasts.

SentryGlas interlayers are a structural component within the glass and allow the use of thinner glass panes without any loss of strength and rigidity.

SentryGlas is up to 100 times stiffer and 5 times stronger than conventional PVB laminated glass. Laminated glass made with SentryGlas acts like an engineered component with low mechanical stress under loads and provides outstanding post-breakage resistance to creep and collapse. SentryGlas laminated glass gives ultimate protection and security even in the event of breakage, and can continue to perform safely until replacement glass can be produced and installed.

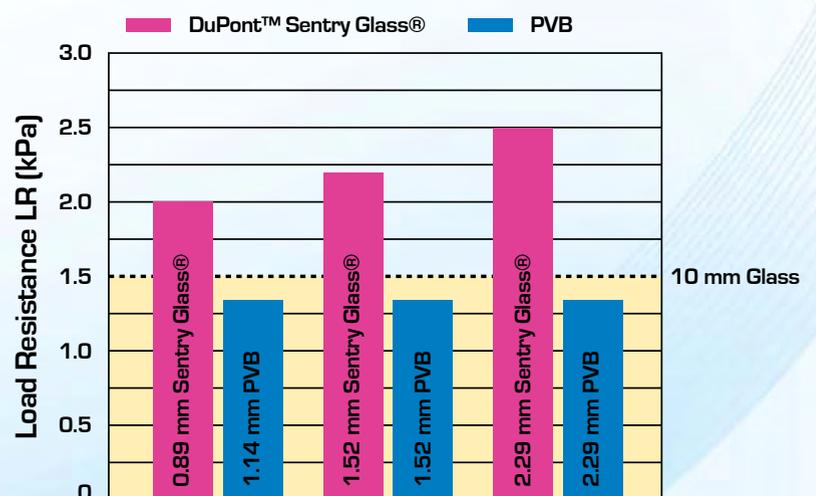
Furthermore, when installed in any situation where glass edges are exposed, or in any situation where where the glass edges are in prolonged contact with water, the superb edge-stability of SentryGlas is another major benefit compared to normal laminated glass.

The superb clarity and transparency of SentryGlas interlayer-material means that optimum levels of light transmission are maintained even when using normal commercial quality float glass.

When used with Low-Iron (Extra-White) float glass, the result is a glass laminate of ultimate clarity and transparency .

DuPont SentryGlas interlayers have been tested and accepted for use in hundreds of impact-resistant glazing systems, meeting some of the toughest building codes in the world.

Experienced glass laminators, such as ArcGlass, working with professional façade system specialists, such as Sister Company Wajhat Aluminium & Glass, are able to meet the most stringent requirements of modern architectural design and construction for Safety, Security, Solar and Sound control, using SentryGlas advanced interlayers.



5 mm glass | Interlayer | 5 mm glass
 1200 x 360 mm (two sides simple supported)
 (ASTM E1300, "short" term load 50° C)

Sentry Glass® makes glass stronger, helping increase load resistance and reduce deflections compared with same-thickness glass using PVB.

Definition of Terms

1. Solar Spectrum

The three main components of Solar Radiation striking the Earth’s surface comprise :

- Ultra Violet Light (UV) 4%
- Visible Light (VL) 16%
- Infra Red Radiation (IR) 70%

which represents the distribution of the majority of solar radiation known as the SOLAR SPECTRUM, within a waveband from 300nm to 2500nm.

Distribution of Solar Radiation

Description	%	Waveband (nm)	
Exotic radiation	2.5	= < 100 nm	X-Rays, etc.
Ultra-Violet (UV – C, B, A.)	12	100 – 380 nm	Ultra Short Wave
Visible Light (VL)	17	380 – 780 nm	Short Wave
Infra-Red (IR)	68	780 – 1200 nm 1220 – 2500 nm	Near IR Far IR Long Wave

Overall Spectrum of Solar Radiation according to European Standard EN 410

Ultra-Violet Light (UV)

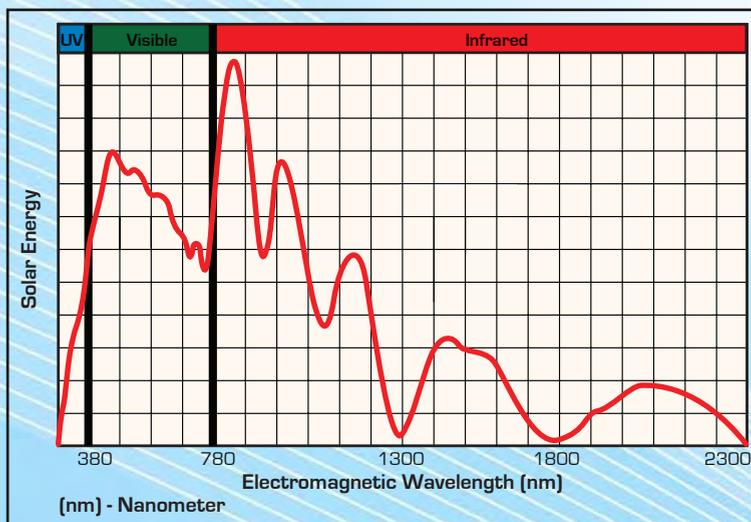
Is a potentially harmful short-wave type of solar radiation which is invisible and is partially screened by the Ozone Layer in the upper atmosphere. It is responsible for fading of paint and fabrics and can cause skin cancer in humans if severely exposed to sunlight for prolonged periods.

Visible Light (VL)

Human vision is a reaction between the eye and the brain stimulated by Visible Light, or daylight, in the electromagnetic spectrum within the waveband from 380–780 nm and creates the sensation of sight.

Infra-red (IR)

Is the long-wave portion of the Solar Spectrum and is also invisible. IR can be sub-divided into Near IR from around 780 – 1000 nm and the Far IR from around 1000 – 2500 nm. Although accounting for the majority of solar radiation reaching the earth’s surface, IR radiation does not cause substantial solar heat-gain in buildings, via the glazing.



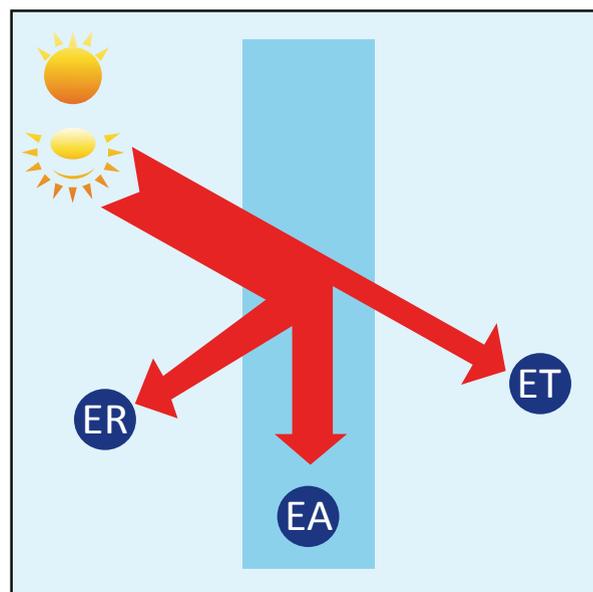
Spectrophotometric Characteristics of Glass

When solar radiation strikes window-glass , it is partially :

- Reflected
- Absorbed
- Transmitted (Direct and re-radiated)

When the various percentages for R-A-T for a multitude of glass types are added together, the result is always 100% (Total Incident Light).

Spectrophotometric measurements are done in accordance with European Standard EN 410 for Air-masses 1.0, 1.5, and 2.0, and also in accordance with American Standard NFRC 200/300 conditions at Air mass 1.5, corresponding to a Solar Altitude of 42 deg. Tests are set up so that the solar strike is perpendicular to the glass surface.



$$ER + EA + ET = 100\%$$

Light Transmittance (Tv)

Light Reflectance Rv(out) & Rv(in)

Tv is the percentage of light transmitted through the glass compared to the total quantity of light which reaches the glass at an angle of 90 deg.

Rv(in) is the percentage of light reflected to the Interior

Rv(out) is the percentage of light reflected back to the Exterior.

Tv, Rv(in) and Rv(out) will vary according to thickness of glass, tint, and characteristics of any applied coating. Even clear glass, which has an inherent green tint visible at the edges will, have variable LT Characteristics depending on the thickness.

$Tv + Rvin + Rvout$ is always =100% and the difference is due to the quantity of light absorbed in the body of the glass.

Total Tv minus (Actual Tv + Rvin + Rvout) = LA (Light Asorbed).

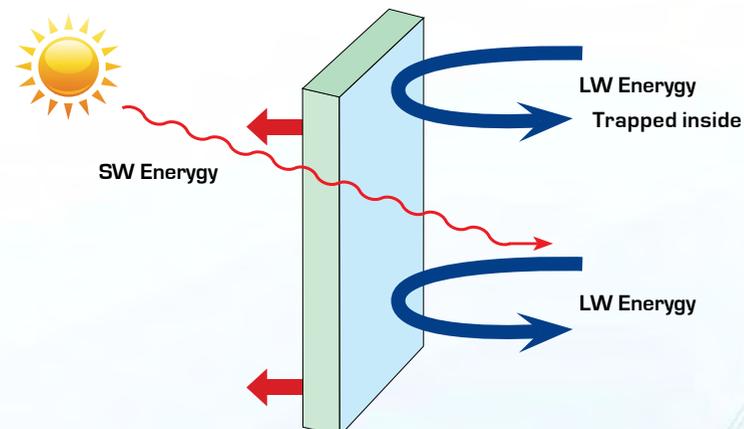
Solar Heat Gain Coefficient (SHGC)

Boundary conditions according to American ASHRAE / NFRC 200/300

SHGC is the Total Energy Transmission of incident solar radiation which enters a room by a combination of directly-transmitted heat PLUS re-radiation of heat from the warm inner surface of the glass.

SHGC is expressed as a Decimal number to represent a percentage of total solar energy striking the glass. The lower the number, the better the solar resistance of the glass.

The Green House Effect



SHGC can be converted to SHADING COEFFICIENT by a factor of 0.87.

For example, SHGC = 0.52 **OR** SC = 0.60

Therefore:
 $SC = 0.52 / 0.87$
 $= 0.60$

Therefore:
 $SHGC = 0.60 \times 0.87$
 $= 0.52$

Solar Factor (SF) or g-Value (g)

Boundary conditions according to European Standard EN 410. SF is now known throughout the EU as " g-Value " and is the European equivalent of SHGC.

Values for g and SHGC can only be compared at Air Mass = 1.5 (solar altitude = 42 deg)

Relative Heat Gain (RHG)

RHG is a good indicator of the constant flow of heat into a building when the glazing is fully exposed to the sun.

RHG represents the sum of solar energy transmitted (SHGC) PLUS conducted heat gain (U-Value) and is determined according to standard boundary conditions shown below :

RHG	Solar	+	Conducted
	SHGC x 230		Summer "U" x 14

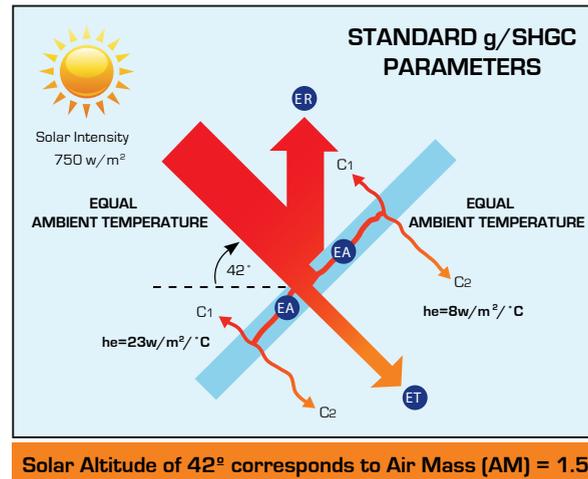
Solar Intensity = 230 Btu/Hr/Sqft/degF

Outdoor / Indoor temperature difference = 14degF

Summer U-Value from Manufacturer's Data Sheet

SHGC from Manufacturer's Data Sheet.

Obtain Metric RHG (W/m2): multiply by 3.154



U-Value

U-Value measures the flow of heat through a glass pane from a warm air-mass to a cool air-mass by means of conduction, convection and radiation, and can be described as Heat-Gain or Heat-Loss depending on ambient weather conditions, and whether the building is air-conditioned or heated. It is assumed that the glass is shaded (no sun).

ASHRAE NFRC 100 U-Values are calculated according to the following boundary conditions:

U-Value (center-of-pane) Btu/Hr/Sqft/degF or W/m2K

Environmental Conditions	ASHRAE Standard NFRC 100	
	Summer Daytime "U"	Winter Nighttime "U"
Outdoor Temperature	°F	89
	°C	32
Indoor Temperature	°F	75
	°C	24
Wind Velocity	mph	6
	kph	10
Solar Intensity	Btu/Hr/ft²	248
	w/m2	788
		no sun

The flow of heat through a shaded window can be reduced by means of a dead air-space (insulated Glass Unit) and a Low-Emissivity (Low-E) coating, or a combination of both.

Glass Type	U - Value (w/w²k)
6mm Single	5.70
Standard 24mm Single Unit 6 x 12 x 6mm (Both Panes Clear)	3.10
Standard 30mm Single Unit 6 x 16 x 6mm (w/ SS20 Solar Control #2)	2.60
Standard 28mm Single Unit 6 x 16 x 6mm (w/ Cardinal 266 clear Low-E #2)	1.40

Introduction

Screen printed glass (ArcDecor) is one of the decorative products from within the ArcGlass Decorative Glass range. It is ideal for use in partitions, roof glazing and external walls where a combination of aesthetic and functional needs are required.

The major benefits are:

- Control of solar heat and light transmission
- Privacy
- Flexibility of designs – standard or commissioned
- Available in ArcGlass single, double or triple glazed and laminated options
- Available in a range of colours
- No colour fading

Flat glass size Maximum 2600 x 5200mm
 Maximum print coverage 2600 x 5200mm
 Minimum size 400 x 700mm

Designs

ArcGlass Decor offer a range of standard designs as listed below. However, the inherent nature of the product encourages the use of bespoke designs. All bespoke designs should be submitted for discussion prior to placing an order to ensure that all design, colour and cost implications have been fully considered. A non-standard design can be provided if :

- Minimum distance apart and width of lines is 3mm
- Minimum diameter of dot or hole is 2mm
- Minimum distance between dots or holes is 1.5mm

Colours

WHITE ceramic ink is the most commonly used colour, though there are two other standard colours available:

BLACK and DIFFUSED (simulated Acid Etch).

For non-standard colour availability, please contact ArcGlass. The range is limited to one colour per glass.

Screens

In order to maintain a consistent appearance, each glass size requires its own screen. Because of this, a minimum order level of 20 panes per size is normally required. However, smaller quantities can be ordered at increased costs.

The screens must be paid for by the clients as part of the contract and after completion of the contract screens will be kept for a period of twelve months and then offered to the client before disposal, thus it may be beneficial to order spare panes.

Performance

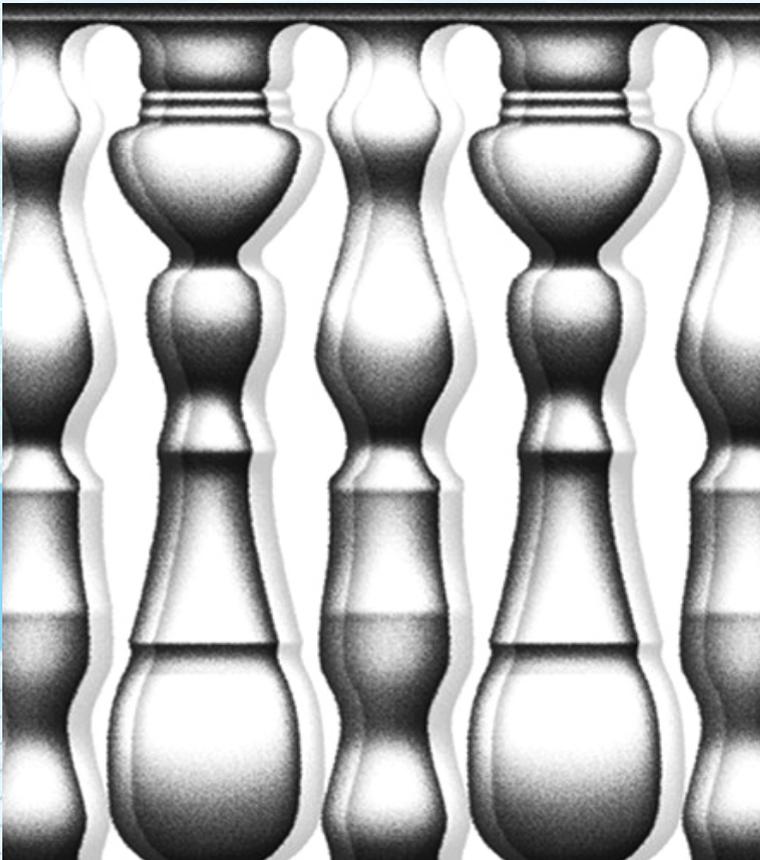
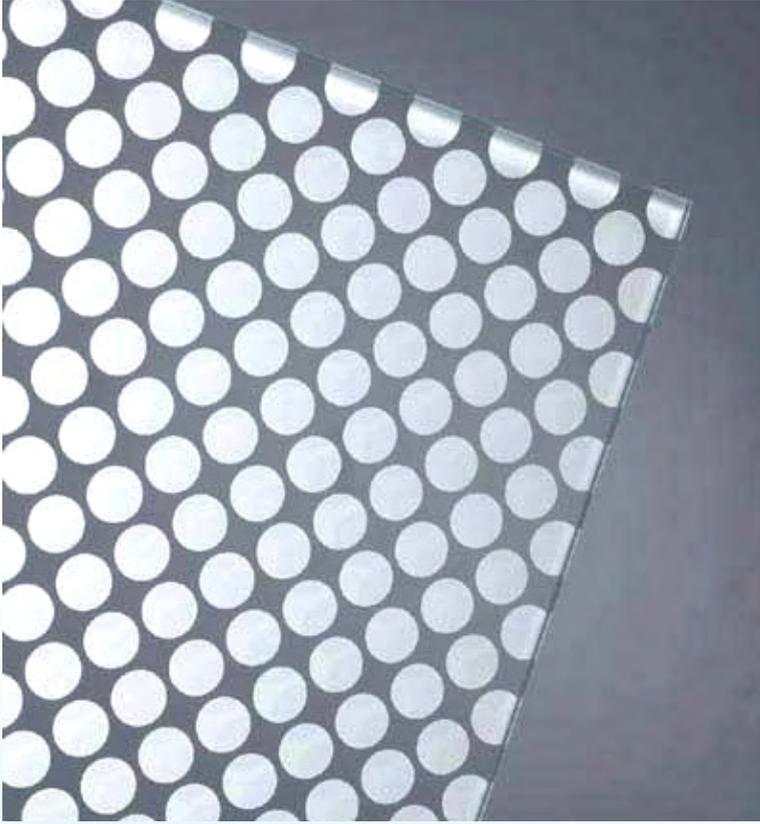
The use of screen printed glass gives both aesthetic and technical control of heat and light transmission. By increasing the ceramic coverage on the glass, the shading coefficient of clear and body tinted glasses is reduced, thus allowing greater flexibility of choice and design.

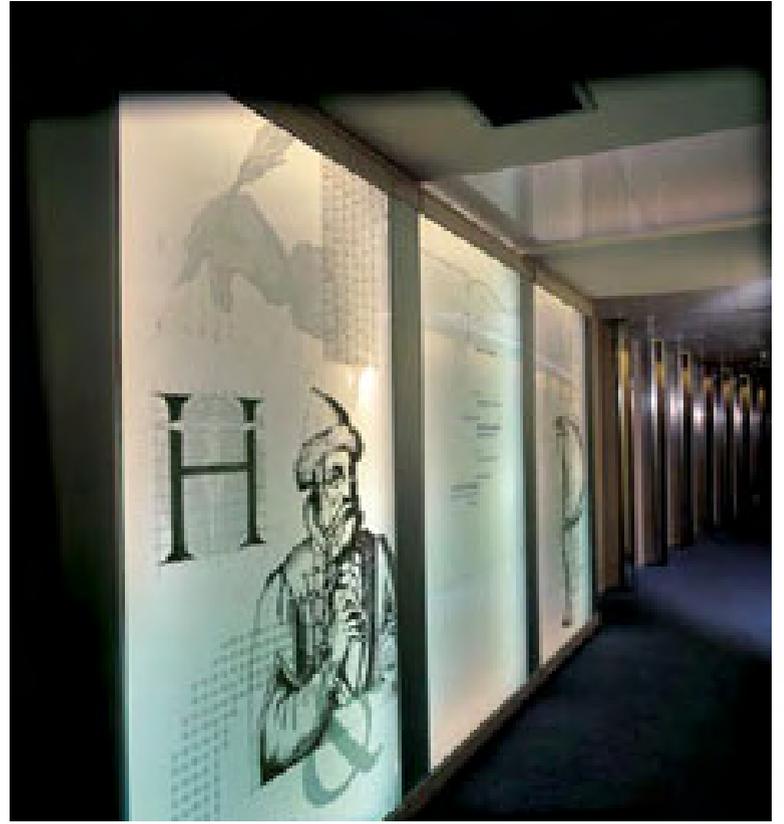
Performance data for screen printed glass is available on request.

System Information



Screen Printed Glass from the ArcGlass Decorative Glass Range





Visions

Introduction

Digital Printing on Pvb, ArcDecor "Visions" is one of the decorative products from within the ArcGlass Decorative Glass range. It is ideal for use in partitions, roof glazing and external walls where a combination of aesthetic and functional needs are required.

The major benefits are:

- Control of solar heat and light transmission
- Privacy
- Flexibility of designs – standard or commissioned
- Available in ArcLam laminated options
- Available in a range of colours
- Outstanding UV Stability

Maximum print coverage 2600 x 5000mm

Minimum size 250 x 400mm

Designs

ArcDecor "Visions" offer a range of high quality Digital Images printed onto Pvb (Polyvinyl Butyral Film) and then laminated between two pieces of glass to give stunning images, with our expertise we can offer any quality image of your choice and imagination to suit a wide range of applications from Shower screens up to external façades using Safety Inks which are corresponding to EN 12543.

Colors

6 Color option CMYK -LC,LM (Cyan, Magenta, Yellow, Black, Light Cyan, Light Magenta or white).

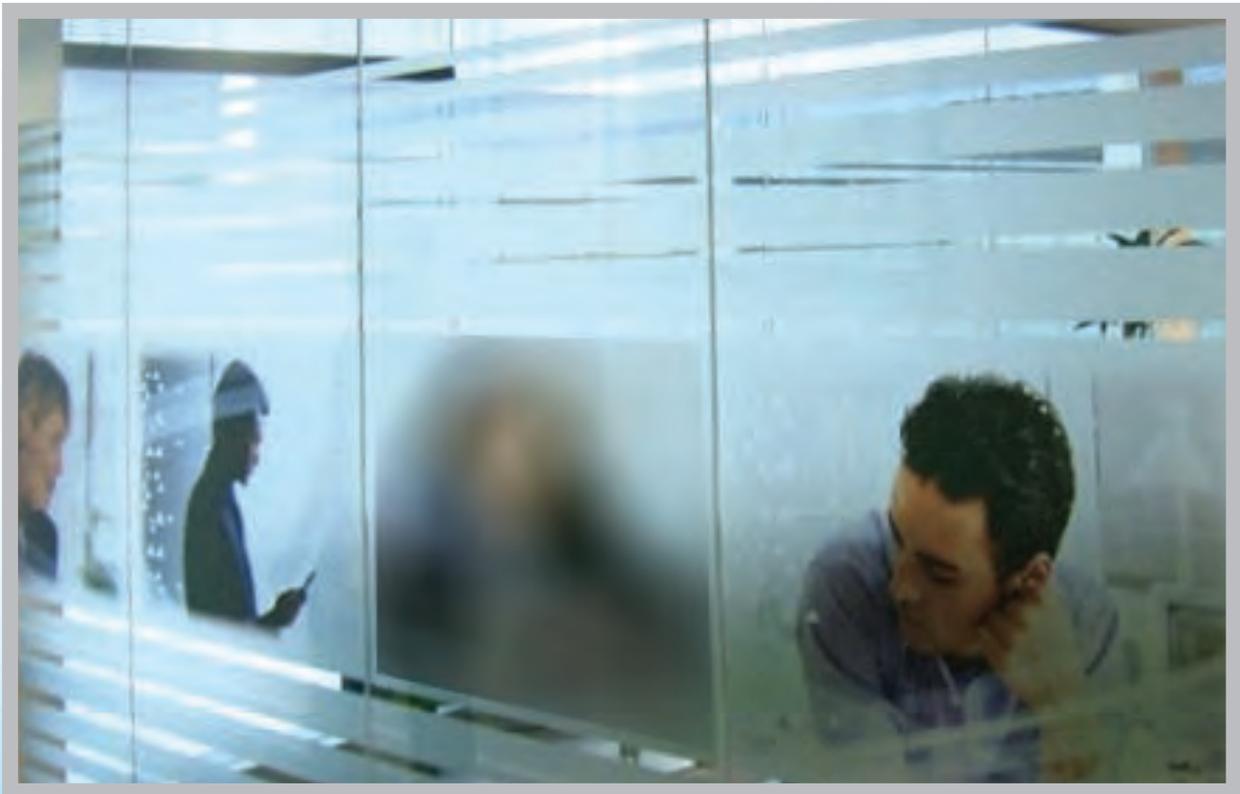
Resolution 600 x 1100 dpi.

System Information



Digital Printing on PVB from the ArcGlass Decorative Glass Range







www.wajhat.com.sa

Contact Details:

P.O. Box 2553, Riyadh 11476 Saudi Arabia

Tel.: +966 1 4405900

Fax: +966 1 4405901