Glasshape®

Digital Ceramic Printing on Glass

Complete certified glass solutions designed for your application

www.glasshape.com

Complete Architectural Glass Solutions

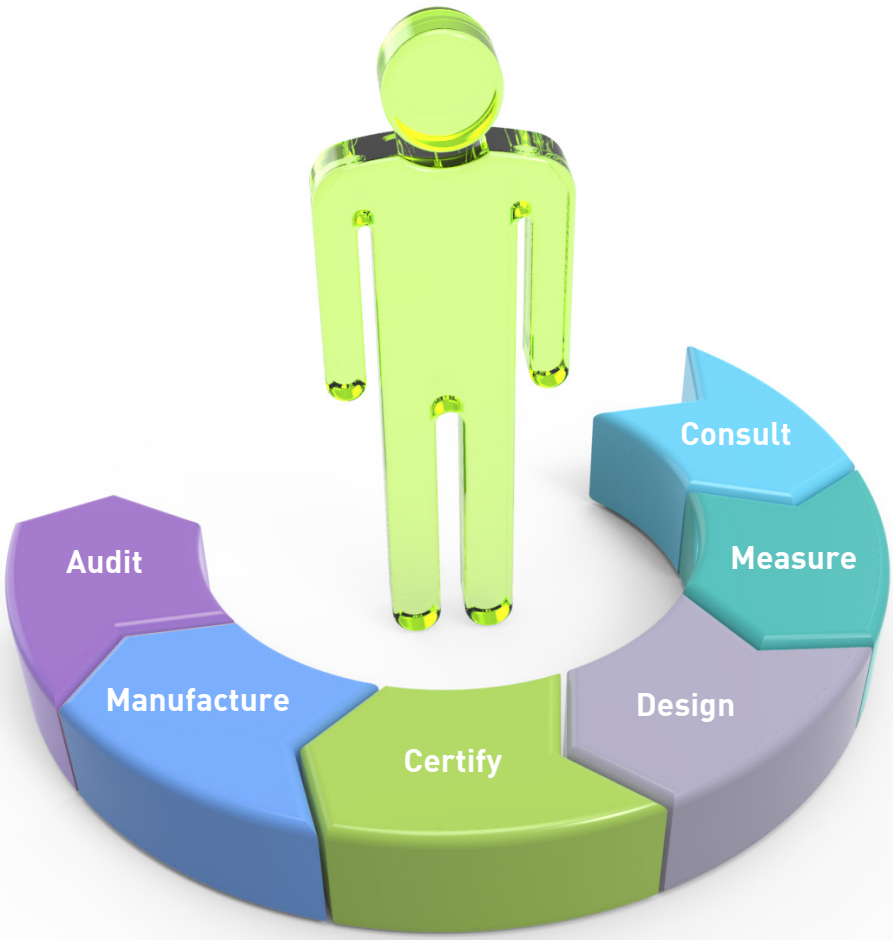
When it comes to glass, Glasshape® understand that quality, performance, durability and safety standards are paramount to designers, builders and owners of residential and commercial buildings.

Combining nearly 30 years of industry knowledge and technical capability Glasshape have developed unique proprietary manufacturing processes addressing the specific needs of the architectural sector and provide premium glass solutions.

At Glasshape, we take a customised approach. We work with clients to confirm their needs and establish the appropriate glass solutions. Our complete service includes consultation, digital measurement, CAD design, certification, and manufacturing. With the Glasshape tailored approach, clients are assured their glass solutions are effortlessly fulfilled.

With Glasshape the options are endless.

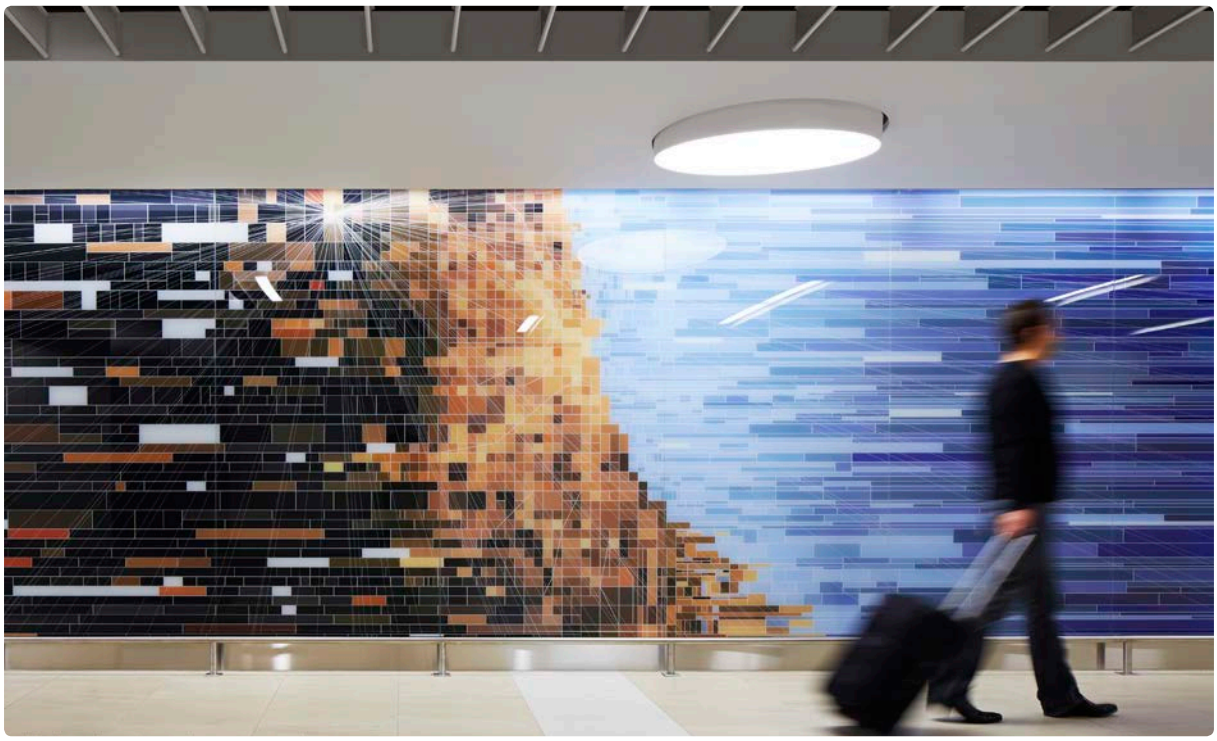
"Providing a Client centric approach, ensures worry free results."



VisionInk
CERAMIC PRINTED GLASS - BY GLASSHAPE

Overview

The VisionInk® digital ceramic glass printer is the most advanced and versatile glass printing machine available; ideal for both external and internal architectural and transportation glass applications. With VisionInk's image processing software, this high-tech printer goes far beyond the capabilities of traditional screen and UV glass printing; providing greater opportunity, flexibility, and quality in designing with glass. With thousands of possible colours, 720dpi resolution and the ability to control precisely the ink thickness, VisionInk provides unfettered scope of design.



Chicago O'Hare International Airport - Printed by Goldray Industries - Chicago, IL, USA

Sample (pre toughening) - VisionInk Clean Room, Glasshape - New Zealand

Why Choose VisionInk (vs. alternative methods of decorating glass)

With pinpoint accuracy up to 720dpi and inks, that once toughened (tempered), become a part of the glass itself, VisionInk represents the cutting edge of glass print technology and provides the most powerful resistance to scratching, UV light & weather deterioration and an easily maintained surface that withstands the test of time.

VisionInk removes all the limitations of screen printing:

- Print any design, from simple lines to detailed imagery
- Six spot colours combine to create an unrivalled colour palette; bespoke premixed colours can be created too
- Complete predictability, repeatability & durability
- Eliminate need for purchase, storage and maintenance of screens
- Extend black-out borders to include your brand/insignia in colour

Technology	Number of Colours	Producing Cycle	Design Content	Print Accuracy	Job Flexibility
Screen Printing	Up to 3	Long	Limited	Low	Low
Digital Ceramic Printing	No Limit	Short	No Limit	High	High

Inside the VisionInk Clean Room, Glasshape - New Zealand

Carmel Campus - Printed by Spiral Glass - Haifa, Israel

Glasshape

VisionInk
CERAMIC PRINTED GLASS - BY GLASSHAPE

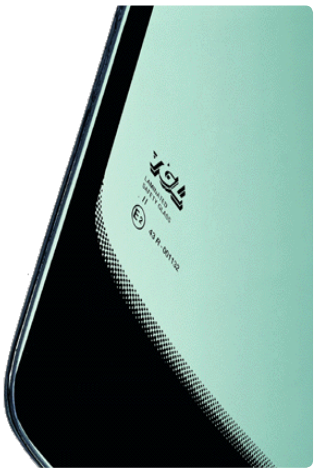
VisionInk combines the durability of ceramic inks with the versatility of digital printing

- Unrivalled durability (and can be delivered on a single layer of glass)
- Precision control of ink thickness for prediction & manipulation of Visible Light Transfer and Solar Heat Gain variables
- Surface can be cleaned as per normal glass with no impact on the graphic
- Perfectly suited to both interior and exterior applications, with 10yr warranty against fading

Technology	UV Resistant	Glass Systems	Transpar-ency	Scratch Resistance	Humidity Sensitivity	Cost	Finish
Interlayer	1-10 years	Double Layer	Limited	-	High	High	-
Organic Inks	1-10 years	Flexible	Limited	Low	Low	Low	High Quality
Decals	1-2years	-Post-	Limited	Very Low	Low	Low	Low
Ceramic Inks	10 years +	Flexible	Controlled	Very High	None	Low	Very High Quality

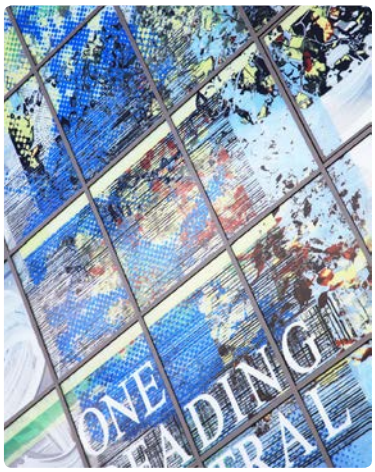
Debut 1997 → Multi Colour 2007 → Multi-Functional 2015

Less than two decades ago, digital printing first appeared in the glass industry with substantial limitations, Single spot colour (black) but with immediate application in the automotive sector



Advances in technology allowed for greater control of the inks and more colours. In 2007, a satellite image of the town of Eiserfeld, Germany was printed on the local Municipal Bank

The technology continues to advance, and can now tackle significant issues within construction and design, through versatile, durable inks and printing technologies



Poh Ming Tse Temple - GSC Glass Ltd - Singapore

Eco - Credentials (including SHG & VLT control)

SHG (Solar Heat Gain) & VLT (Visible Light Transfer) will always be a fundamental consideration for building design. VisionInk's printed glass allows you to control these variables, vastly extending the capabilities and applications of this remarkable substrate.

Solar Heat Gain & Visible Light Transfer

- Opacity, translucency & ink layer thickness can be precisely manipulated
- Control light diffusion & transmission
- SHG and VLT values of any design can be predicted allowing clients to calculate thermal and solar performance of the building envelope (even in planning stages)
- Using ink to deliver these goals vs. heavy building envelopes could deliver significant production and ongoing maintenance savings
- Ink printed onto the exterior surface mitigates reflected heat (available in black and white only)

Reduced bird collision

- Graphics can be designed to appear to birds as areas in which they cannot fly

Recyclable

- Printed glass can be handled and disposed of as any other type of glass

Non-toxic

- Inks are completely free of toxic heavy metals

Imitation of natural materials

- Photo realistic replication of scarce natural resources
- Not subject to the same risks of deterioration
- Access to otherwise restricted finishes (e.g. native timbers)

LEED, BREEAM - Environmental certification requirements

VisionInk significantly contributes to an overall positive rating under these programmes that measure a number of different variables including glass performance.

GreenStar

Green Star Certification is a formal process during which a building, fitout, or precinct is awarded a rating by an independent panel of sustainable development experts through a documentation-based assessment.

Secrets the Vine Cancun - Printed by PVA Vitro - Cancun, Mexico

Graphics Limitations (almost none!)

VisionInk can replicate *any* image, design or pattern with brilliant accuracy, vibrant colours and sharp resolution. From simple lines to full colour photos, VisionInk allows architects, engineers and designers to explore new possibilities in modern and sustainable design in commercial, residential or civic contexts and beyond.

Complexity:	**Simple**	**Standard**	**Complex**
Example:	Geometric shapes	Photograph or image	Collage / illusions

Melinda Consortium - Printed by Veneto Vetro - Trento, Italy

Designing for Buildings

'Tiling' a design across multiple panels is easy with VisionInk. Our software can manipulate the image as required to allow for joins, frames, etc. as illustrated on page 8. If required, replacement panels with a perfect match in colour and positioning can be easily supplied.

Colour Matching

VisionInk uses 6 'spot' colours (blue, green, white, orange, red & black – BGWORK) to generate the hundreds of thousands of other colours possible with ceramic inks. This is a close match to the CMYK (cyan, magenta, yellow, black) 'Process' colour that paper based print methods use. Our software will convert any image file colour-mode to BGWORK but bright pinks are not possible to print – this is due to a lack of magenta in our colour mix (a magenta ceramic ink given current technology would need to be toxic (lead or cadmium based)). The best results come from converting an image file that is in RGB colour mode. Refer to Page 15 for more details.

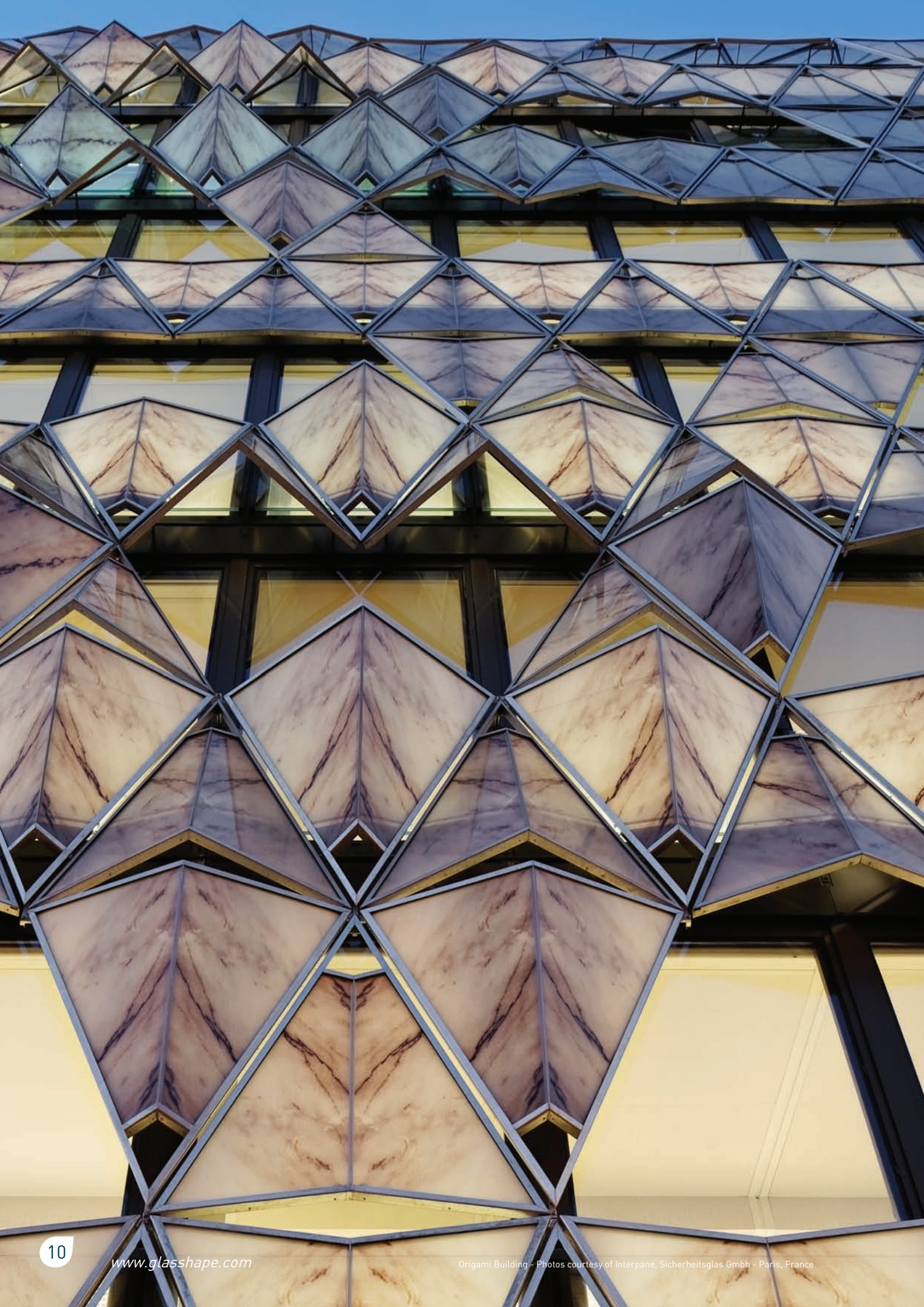
AFI MALL - Printed by AKMA - Afimall City, Moscow, Russia

Almatinskaya Station - Printed by Flachglas - Russia

Melinda Consortium - Printed by Veneto Vetro - Trento, Italy

Digital Processing

You can supply a final image file that Glasshape will convert to VisionInk colour mode, or engage our in-house design team to manipulate imagery to your specification – see the 'Graphics Application Guide' starting on page 13.



Origami Building - Photos courtesy of Interpane, Sicherheitsglas Gmbh - Paris, France

Vision Ink
CERAMIC PRINTED GLASS - BY GLASSHAPE

Applications & Project Size

From small corporate insignia or residential splash-back to entire building façades or office fit-outs and point of sale solutions, VisionInk is a versatile design solution.

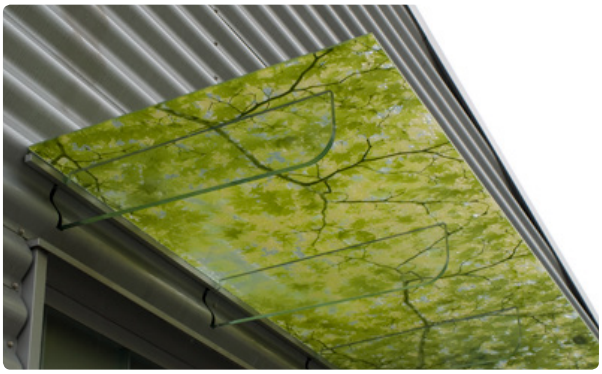
Small	Medium	Large
Splash Back	Restaurant Art	Entire Building

Private home - Printed by Rakla - Finland

Torremayor Hotel - Printed by Glasstech - Chile

Origami Building - Printed by Interpane Sicherheitsglas Gmbh - Paris, France

Residential	Commercial	Retail	Civic
Bathroom fit out	Internal Partition	POS/Display	Train Station

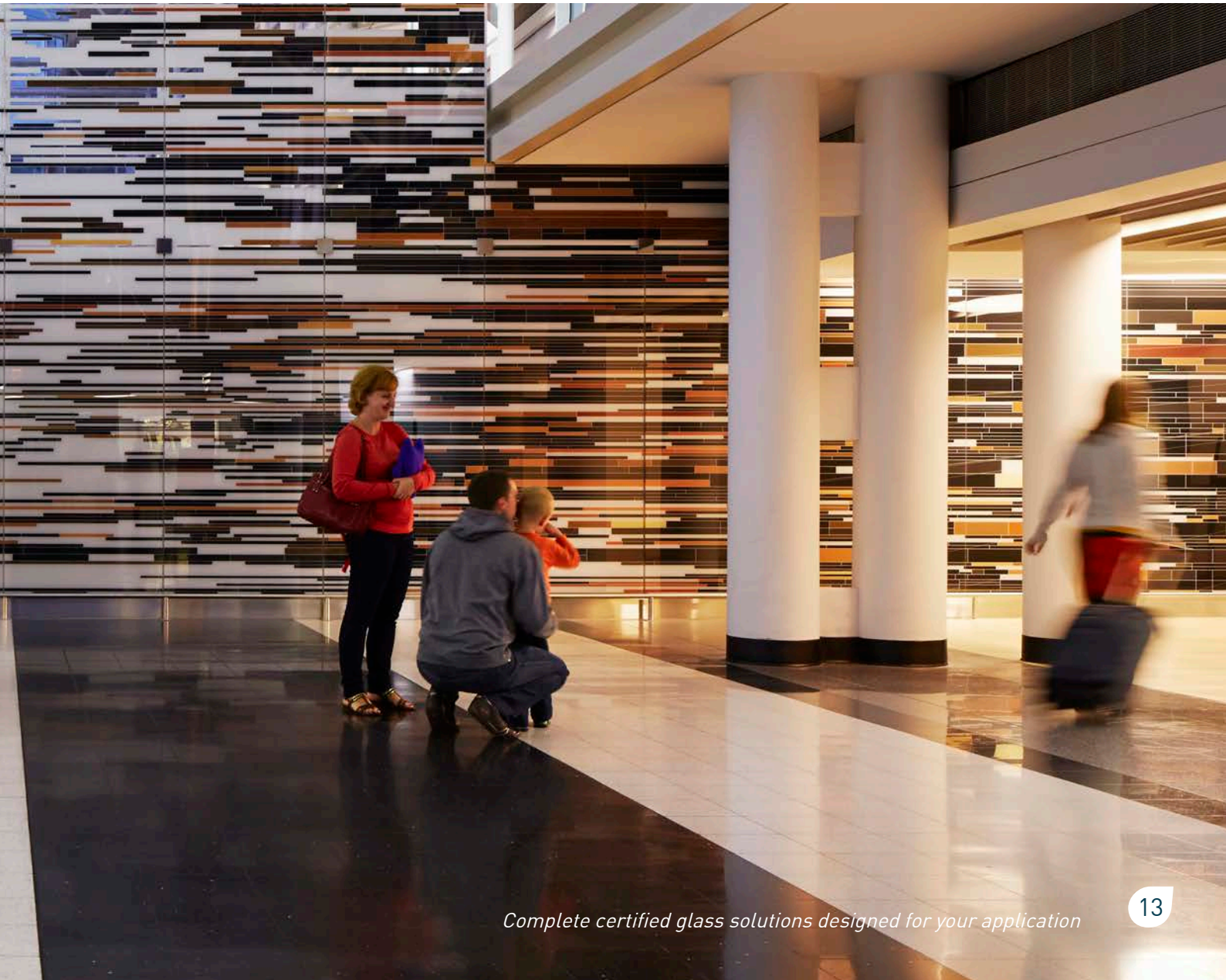


Helicopter Facade - Printed by Glasstech - Santiago, Chile

Applications & Project Size

Steve Hall (C) Hedrich Blessing Photography - Chicago O'Hare International Airport - Goldray Industries - Chicago, IL, USA

Graphic Application Guide



Rockheim Museum - Printed by Pir II - Norway

Ink Control

VisionInk has precision control of most print variables as illustrated below.

Opacity

Manipulate to change light transmission, varying degrees of privacy or visual impact or to accommodate smooth transition between colours or images.

'Spot' Colours

Our six standard spot colours are shown here. These can be premixed to make hundreds of other 'spot' colours and we have direct matches for many RAL references. NB: there are six ink stations on the printer, using a bespoke spot colour means sacrificing one of the standard colours. Our design team can advise the implications (if any) on a case by case basis.

'Process' Colours

By using the six spot colours and laying down dot combinations VisionInk images have the appearance of solid colour and high resolution when viewed at an appropriate distance. Hundreds of thousands of 'process' colours are possible, this illustrates just a tiny sample.

- Colour Mode: VisionInk prints in a unique 'colour mode', BGWORK (Blue, Green, White, Orange, Red, Black). Your files may be supplied in any colour mode but the best results are achieved when you supply us with a file in RGB colour mode. During conversion, some information changes or simply cannot be replicated, but our software makes allowances.
- We can achieve a 'visible' match in most cases, using a colour sample or the Pantone guide.

NB: bright pinks cannot be achieved with current ink technology, this is due to lack of magenta in our colour mix (a magenta ceramic ink given current technology would need to be toxic (lead or cadmium based)).

Micron Control

The thickness of the ink is controlled at a micron level to manipulate SHG, VLT, transparency and colour. Our design team can recommend the appropriate or required thickness for the best results.

Patterns & Coverage

Application of these (and other) patterns over an image during the processing stage is another tool we can use to manipulate ink coverage, influence SHG and VLT values, or deliver varying levels of visibility or privacy.

Sample 1 - VisionInk Samples

One Reading - Printed by Interpane - UK

Vector Graphics (as opposed to photographs or other 'pixel' images)

These files can be scaled to any size with absolutely no distortion or loss of resolution. They are regularly used to deliver against any combination of the following:

Decoration
Privacy
Light Control
Appearance of texture
Optical illusions
Graphic effect

Swatches

These are repeated patterns (some obviously repeated, others with the appearance of randomness). These seamlessly connect, and can be from our standard designs, custom generated designs, or client supplied designs.

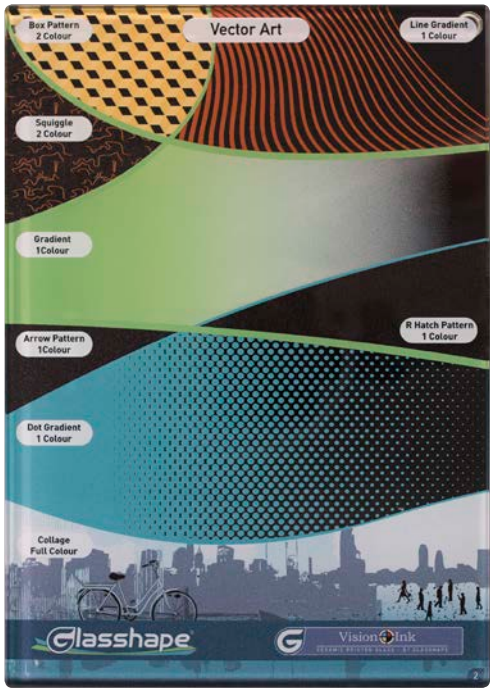
Gradients

Our sample illustrates some very simple gradient effects replicated on glass, these can also be applied to pixel images as a filter in the image processing stage.

Custom Designs

'Image Live Trace' is a process that will convert a pixel based image into a vector graphic meaning no loss of resolution when scaled (although the image will no longer appear as a photograph – as shown in "Collage Full Colour" at the bottom of our sample (bottom right)).

One Reading - Printed by Interpane - UK



Sample 2 - VisionInk Samples

Vector Graphics

Curved Sample of VisionInk - Glasshape - New Zealand

Photo Realism – Ultra Fine Detail Printing

Our 720dpi resolution near full colour printer produces photographic quality print in glass as illustrated here. We can combine vector graphics and text with a photograph as required. When viewed at an appropriate distance the appearance is virtually indistinguishable from the real thing, and adding a back light creates even more impact. Conversion to BGWORK colour mode influences final result and we will advise the recommended approach for Client Approval.

Pixel based images

Unlike vector graphics, pixel based images (including all photographs) lose resolution when scaled up. As a general rule, aim to supply the original high resolution image. We can always scale down and the original is the best file to scale up.

Material Replication

When viewed at an appropriate distance, the appearance is virtually indistinguishable from the real thing, but achieved on an easily maintained, durable and potentially weight saving substrate. Metallic colours are well replicated given the glossy nature of glass, although highly contrasting images deliver the effect best.

Image sourcing

- There are obvious advantages in sourcing a professionally shot image and we are happy to consult with any photographer ahead of the shoot to provide guidance.
- Stock imagery from libraries such as iStock and Getty may be used, appropriate licences must be purchased and we are happy to assist in this process.
- A client's own image can also be used.

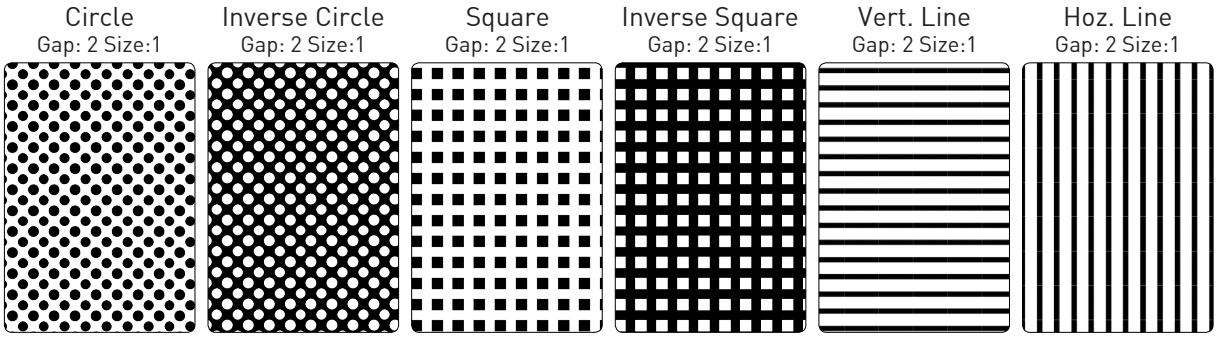
Sample 4 - VisionInk Samples

Double Vision

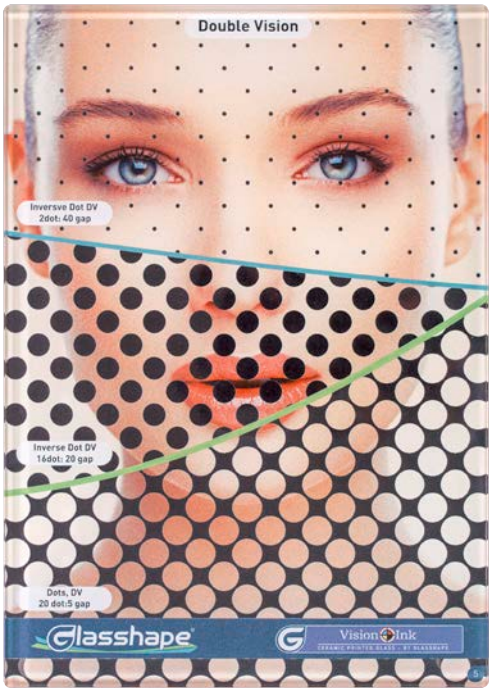
Our printing technology together with the transparent properties of glass mean we can print image 'two' directly on top of image 'one' resulting in different images viewed on each side of the glass. This can be useful in one-way glass applications or privacy control for example.

Dots & Gaps

Manipulation of dots and gaps allows us to deliver printed glass that appears as a crisp, vibrant, solid image from a distance and when viewed up close, allows visibility through to the other side.
Many different designs can be applied using this technique to deliver the desired result, just a few examples are shown here.

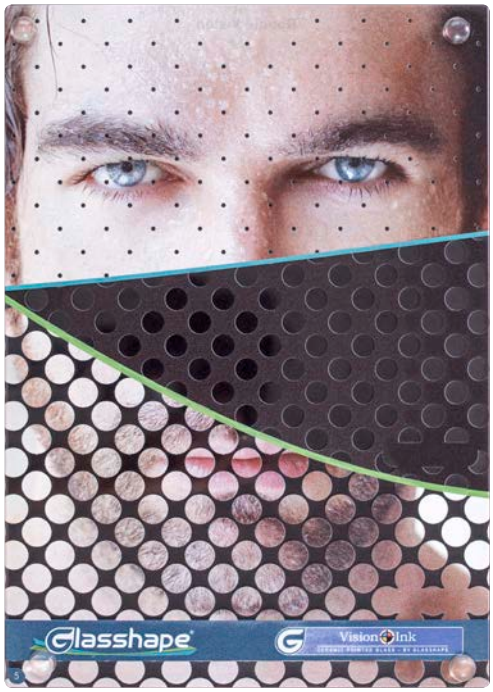


Front of Glass



Front of Sample 5 - VisionInk Samples

Back of Glass



Back of Sample 5 - VisionInk Samples

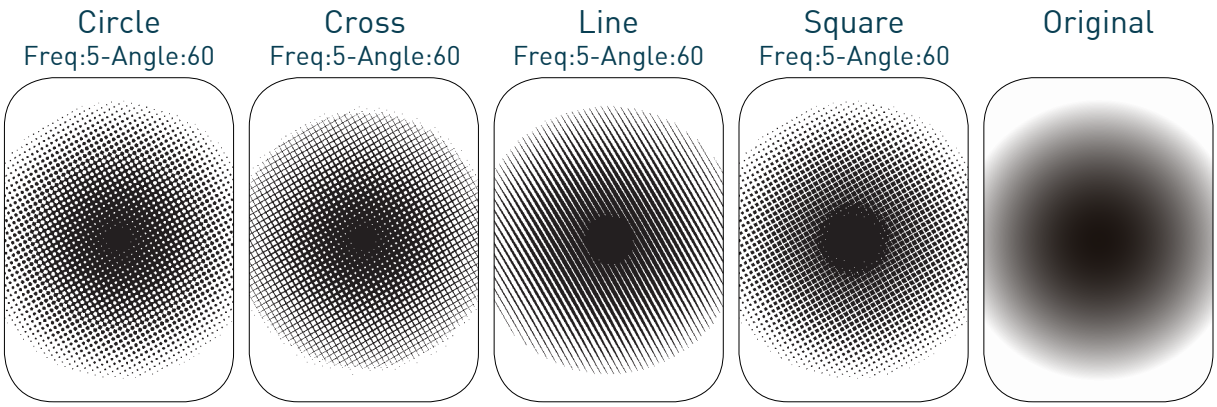
Deluxe Bathroom - Printed by South Bright Glass - China

Filters and Screens

AM Screening (as it is technically known) applies a 'filter' to an image, using the image information to guide the filter – the end result is a graphic that resembles the original image but has been manipulated to deliver either an aesthetic effect, functional benefit or both. This may be something you provide to us as finished art, or we develop for you.

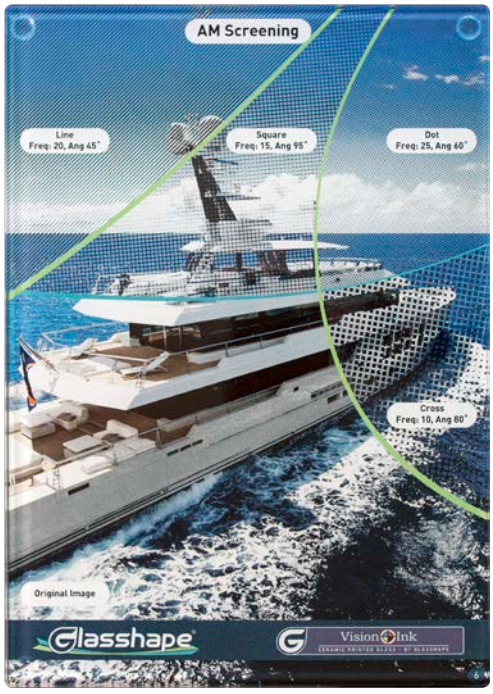
Variables

We can manipulate a number of variables including the type of shape, angle and frequency, examples of which are illustrated here.



Advantages & Applications

- The above variables impact the SHG and VLT properties of the glass and can be advised to clients.
- Allows 'see-through' print
    - "Horizon" viewing - lower frequency screen used.
    - "Interior/Street" viewing - High frequency screen used.



Sample 6 - VisionInk Samples

Water Art - Photo Manipulation detailing Slip Resistant Ink - Hope Island, Australia

Slip Resistant Ink

This is a specialty ink outside of our BGWORK standard spot colours. The patterns shown here are tested using the ANSI A137.1 Dynamic Co efficient of friction test.

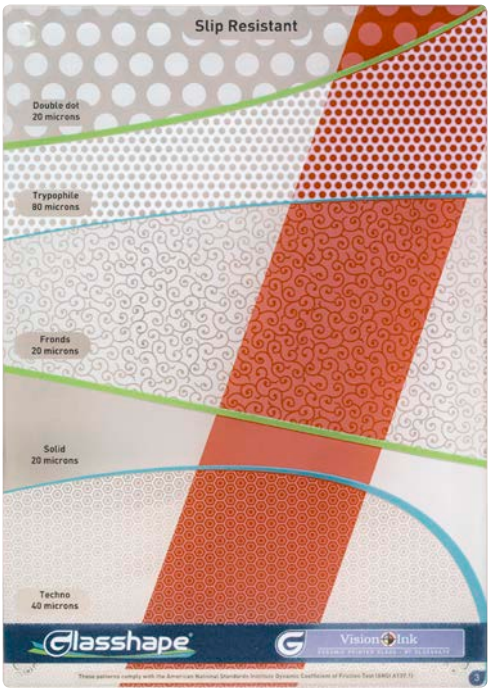
Certified to:

- AS4586 (Australia)
- AS/NZS 3661.1 (New Zealand)
- ANSI A131.1 (United States)

It is the combination of printed and non printed areas that create the best resistance. Any design featuring printed and non printed areas using this ink will provide a level of slip resistance although it will not necessarily be certified as such. We can test any bespoke design for certification as required.

As this ink is toughened into the glass, it offers unrivalled durability versus alternative non-slip solutions that typically wear off over time.

NB: we can print any spot or process colour under the slip resistant ink



Sample 3 - VisionInk Samples

Art Gallery - Printed by South Bright Glass - Guizhou, China

Technical Information

Graphic Requirements	
File Format:	EPS, PDF, JPEG, TIFF, AI, PSD, DWG, DXF, PNG
Image Resolution:	72-300dpi (depends on required viewing distance) range of 200-300 pixels per inch
Screening Control:	AM – Angle method 3-45 LPI FM – Digital screen appearance
File Preparation:	Standard graphic preparation via image and graphic applications such as Adobe Photoshop and Illustrator
Facade Panelling:	Implementation via DXF or DWG
Images in file:	Embedded images, or send as attached
Colour mode:	RGB colour mode preferred (CMYK is accepted)
Text in file:	Outline text within file
Variable Data:	Automatic panel customization: numbering, serial number, etc. (for tracking and easy installation on site)

Printer Capabilities	
Printer Technology:	DOD piezzo - Drop On Demand
Ink:	Digital Ceramic Ink
Print Resolution:	Up to 720 DPI
Print side of glass panel:	Print on one side only (opposite to tin side)
Print Surface:	Any side of flat laminates (including side 1, 2, 3 and 4) Only the concave side of curved glass Slip Resistance need to be applied to exposed glass (side 1)
Ink Appearance:	Glossy and matte
Transparency	Control via Ink thickness (%)
Full Colour Process:	Printing up to 6 colours simultaneously
Colour Match:	RAL/Pantone – Colour tables based on Digital Ceramic Ink colour gamut Images – Digital mixing process to produce colourful photo realistic images

Digital Site Measure

If you are looking for an accurate model of a curved panel for the design and development process, consider using Glasshape's in-house digital measuring service, giving you an accurate model to base your design on. This is especially useful if the design includes multiple irregular panels or digitising critical information for development.

Printer Specifications

Shown here to give you a technical understanding of our printer and the standards and limitations with which we operate.

VisionInk on flat or curved glass	
Glass Type:	Float glass, standard or tinted, toughened safety glass, heat strengthened
Glass Thickness	4-19mm (⅛ – ¾ in)
Glass Dimension:	Max 3900 x 2440mm (153 ½ x 96 in) - Min 400 x 50mm(15 ¾ x 2 in)
Glass Weight:	Max 1000kg / Max 2205 lbs

Ceramic Frit / Ink	
Digital Ceramic Ink:	Ceramic inks are lead and cadmium free glass enamels suitable for printing before toughening and laminating
Ink:	Based on glass frit and an inorganic pigment
UV Resistance:	ISO 11341:2004 (Accelerated radiation test)
Scratch Resistance:	(Braive Sclerometer) > 16 N
Firing Temperature Range:	590-690° C / 1094-1274°F
Surface Roughness:	(Time Technology TR200) Ra < 0.5 Rz < 3
Chemical and Weathering Durability:	The chemical durability of glass enamel is evaluated according to ASTM C724 - 91(2005) - Standard test method for acid resistance of ceramic decorations on architectural glass. Hydrochloric acid 2-3 (3.7% HCl, 5 min, 22°C ASTM C724-91) Acetic acid 1-2 (4% acetic acid, 15 min, 22°C ASTM C724-91) citric acid 1-2 (10% citric acid, 15 min, 22°C ASTM 724-91) Sulfuric acid 4 hr (0,1N H2SO4, 80°C, no change in color on glass side) Alkali resistance 1-2 (0,1N NaOH, 15 min, 22°C)

Office Building Murcia - Printed by Cristec - Murcia, Spain

How VisionInk Works

Our ceramic inks are a combination of pigment (green dots in this illustration), glass frit (light blue dots) and Ink solution. They have been optimised for this specific process. Once toughened (tempered) the ink and glass become one material. VisionInk digital ceramic inks are the result of extensive research into the interactions between ink and glass frit. The patented inks are optimized for printing on glass.

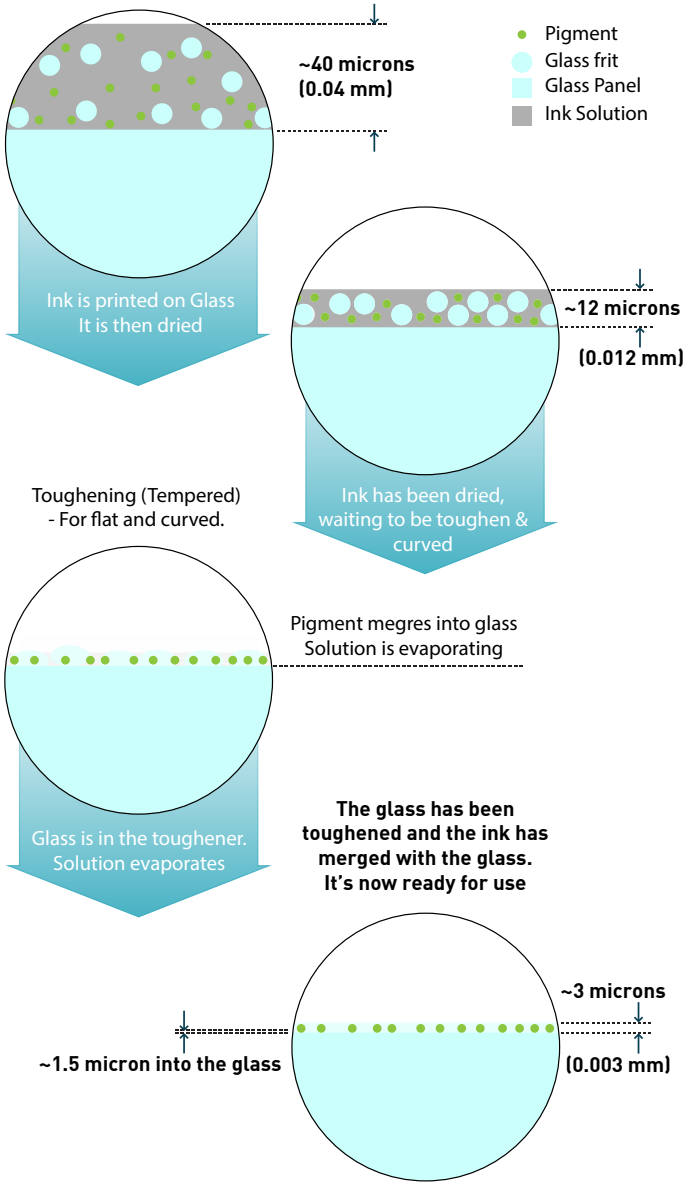
Illustration of a single ink droplet

Drying the Ink

- After printing, ink is dried for 10 minutes at 120 C with the in-line dryer
- 40 micron thick ink layer is reduced to 12 microns

Tempering and Firing the Dried Inks

- Firing converts the ink into a hard ceramic layer that is fused into the glass
- As temperatures rise, different chemical and organic processes occur within the glass
- VisionInk is compatible with DuraShield Laminates, Ezone coating, double glazing and Glasshape's signature glass curving.



Residential Stair Case - Atrium Homes - Australia

About Us

Glasshape® provide customised turnkey glass solutions offering a full range of certified specialist glass products. Our proven global success is backed by comprehensive warranties and validated by international accreditation.

Our service and specifically engineered glass solutions aim to exceed our clients design and performance requirements. We work with our clients to confirm their needs and establish the appropriate glass solutions. The Glasshape turnkey package from consultation through to installation is available to help ensure a worry-free and successful project is delivered every time.

Our full range of specialist products are tailored to suit industries operating in demanding conditions and requiring high performance standards. Industries include architectural, marine, machinery, transportation, storm, security and ballistic.

Glasshape has customers around the globe with Glasshape locations in New Zealand, Australia and USA.

Our Vision:

To become a world leader in the manufacture and supply of innovative, certified glass solutions tailored to meet the demanding requirements of highly specialised industries by differentiating on product quality, customer service and distribution excellence.

Our Mission:

Offer our customers a uniquely specialised glass solution that works for them every time.

Our Values:

- Treat customers, suppliers, and the community like we would our own family
- Tirelessly focus on brand, process improvement and delivery excellence by having a culture of continuous improvement
- Invest in the development of a great team, producing great products that completely satisfy the needs and desires of our diverse range of customers

Founded in 1986, Glasshape has mastered and refined the science of Curved and Bent Glass, Toughened Glass, Laminated Glass and Double Glazed Glass, with uncompromising quality and service. The Glasshape Group is one of Australasia's leading specialist processing, bending, toughening and laminating glass companies.

Glasshape is a successful company with double digit growth. We are a 100% customer focused company. To meet the increasing demand from architects, designers and their respective, highly discerning clients, Glasshape have a commitment to continuous innovation and technology investment. Our customers understand that with our expertise, their designs can be transformed into sensational glass realities.

New Zealand (Head Office)

65-67 Woodcocks Road, Warkworth,
P.O.Box 358, Warkworth 0910, Auckland
Freephone: 0800 883 336
Phone: +64 9 422 2565
Facsimile: +64 9 422 2566
info@glasshape.co.nz
www.glasshape.co.nz

Australia

Suite 16, Unit 8, M1 Business Centre
3972 Pacific Highway
Loganholme QLD 4129
Freephone: 1800 042 716
Brisbane: +61 7 3175 0501
Perth: +61 8 9468 2722
Sydney: +61 2 8011 1831
Melbourne: +61 3 9099 0200
Freefax: 1800 040 934
info@glasshape.com.au
www.glasshape.com.au

United States

P.O. Box 1654, Friday Harbor, WA 98250
Seattle: +1 206 538 5416
Facsimile: +1 206 735 7585
info@glasshape.com
www.glasshape.com

Vision Ink
CERAMIC PRINTED GLASS - BY GLASSHAPE

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TOUGHENED CURVED GLASS - BY GLASSHAPE

Dura Shield *Marine*®
MARINE GRADE GLASS - BY GLASSHAPE

Care Shield®
SECURE HEALTHCARE SAFETY GLASS - BY GLASSHAPE

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