GIS | GLOBAL INKJET SYSTEMS

Inkjet Market & Technology Update
Coating & Decoration of Glass
- Flat, Container & Industrial -

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GlassPrint Conference

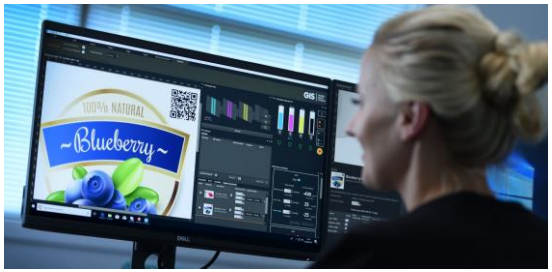
Düsseldorf 27-28 November 2019

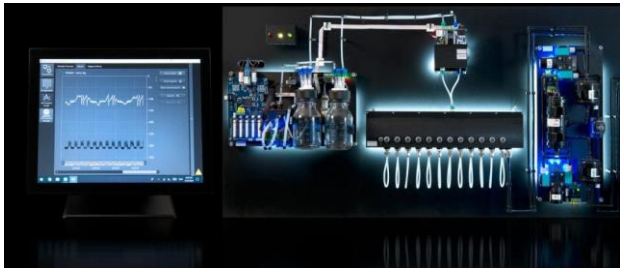
GLASSPrint2019 CONFERENCE

The GIS Inkjet EcoSystem

GLOBAL INKJET SYSTEMS

Complete image management from pixel to drop





We work with customers from R&D, Prototype Development - through to Production

Agenda

- **Update on markets & technology**
  - More market entrants – particularly in flat glass
  - Container – increasing adoption
  - What (potentially) lies ahead

Image source: Dip-Tech, AB InBev & Taylor Autoglass

Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 130+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

Some of the following slides contain images chosen to illustrate the range of inkjet print systems which are available in the market. The presence, or absence, of any manufacturer's products in these images does not in any way imply a commercial relationship between that manufacturer and GIS.

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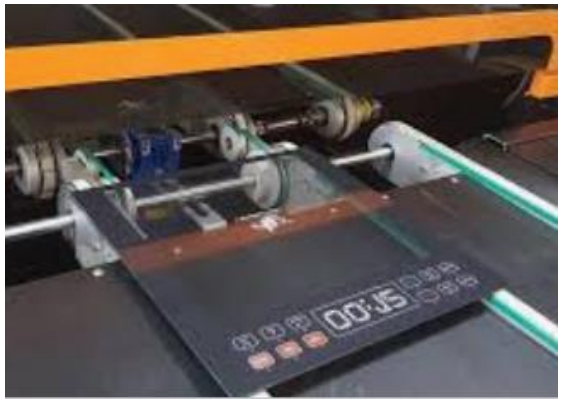
Flat Glass

Overview and Latest Market News

Flat Glass

- **Established**
  - Architectural
  - Décor
- **Developing**
  - Automotive
  - Appliance



- **News / developments from the last 12 months**

Image source: Dip-Tech and Tecglass

Tecglass

- **Vitro-JetF-Type Side Kinetix –** launched at Vitrum 2019
  - Heads move crosswise to the print carriage, lengthwise relative to the support table
  - 48 printheads

SINGLE PASS	printing at 360 dpi	up to 440 sqm/hour.
DOUBLE PASS	printing at 720 dpi	up to 230 sqm/hour.
4 PASS	printing at 1080 dpi	up to 120 sqm/hour.
6 PASS	printing at 1440 dpi	up to 85 sqm/hour.

https://www.youtube.com/watch?v=dH7YY99RA4k

Image source: Tecglass

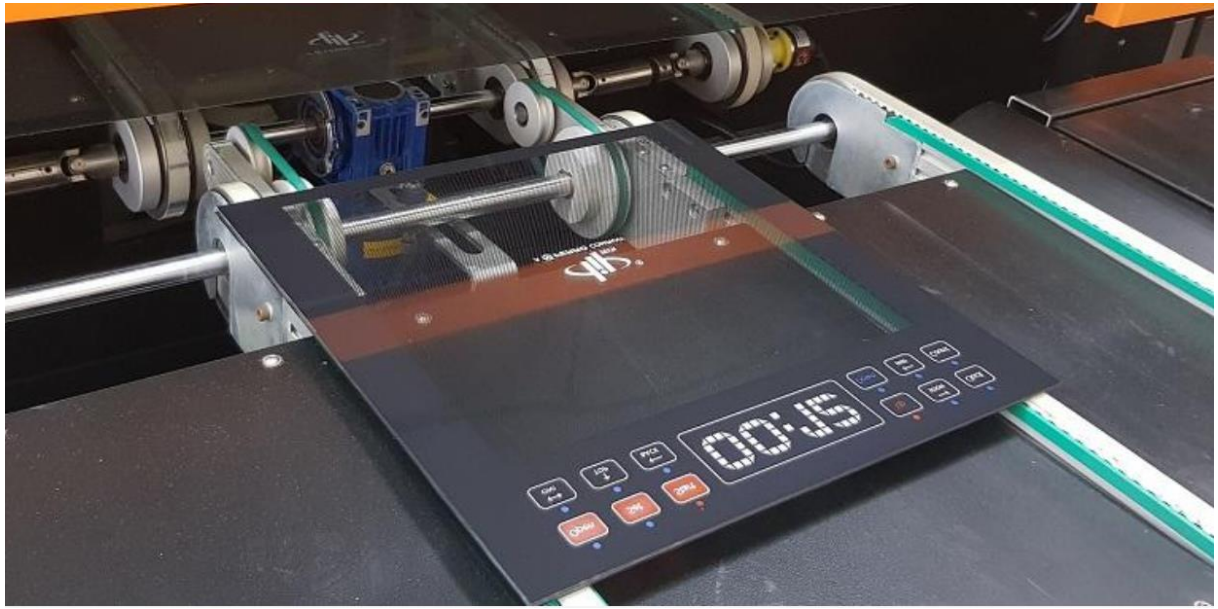
Tecglass

- **Vitro-Jet Single Pass Evolution with in-line Vitro Scan tool**
  - Up to 3.3m
  - 9m/sec
  - Up to 30 printheads (60,000 nozzles)
  - Rotation correction
  - Jetver Automotive inks

Image source: Tecglass

DipTech

- **Glasstec 2018 - introduced a new system for printing full colour home appliance panels using new Ferro Ultra-FIX inks**
  - Can produce the thick layers as well as the fine text and marks required for appliance panels
  - Dip-Tech patented technology



- **Vitrum 2019 – introduced gold and white gold inks – metalized highlights for architectural & design applications**

https://www.youtube.com/watch?v=P7xYYVKOWso

Image source: Dip-Tech

Dip-Tech

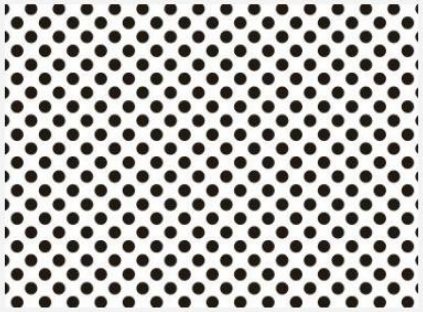
- **NEraD Plus** launched at Vitrum 2019

	NEra - D150	NEra - D300	NEra - D460	NEra - D Plus
Maximum glass size	Width 2800 / 3300 mm or Length: 2600 / 18000 (mm)			
# of Channels	6	12	12	12
Minimum glass size	400 x 400 / 800 x 800 (mm)			
Glass thickness	2-19 (mm)			

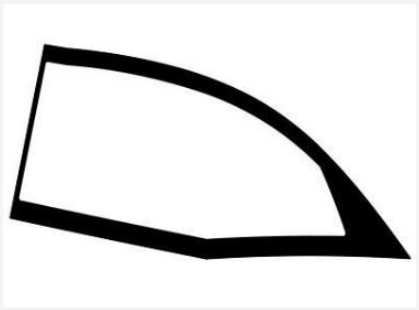
Image source: Dip-Tech

Dip-Tech

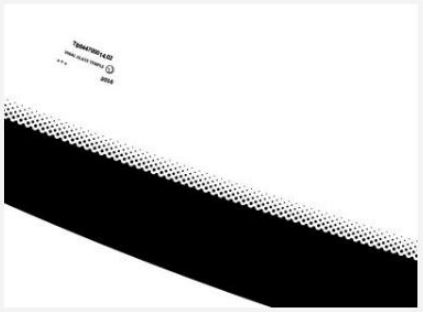
- **NEra V** – automotive glass
  - XY scanning system
  - Dynamic registration system – complex asymmetric glass panels



Single-color Dots & lines
Up to 1000 Sqm/hr



Single-color frames
Up to 380 Sqm/hr



Single-color Fine details and logo
Up to 120 Sqm/hr

		NEra - V300	NEra - V460	NEra - V Pluse
Maximum glass size	3300 x 2600 (mm)			
Minimum glass size	400 x 400 (mm)			
Glass thickness	2-19 (mm)			

Image source: Dip-Tech

Thieme

- **PW260 & SR450** with automatic registration recognition systems that let operators change parts on the fly – launched at Vitrum 2019

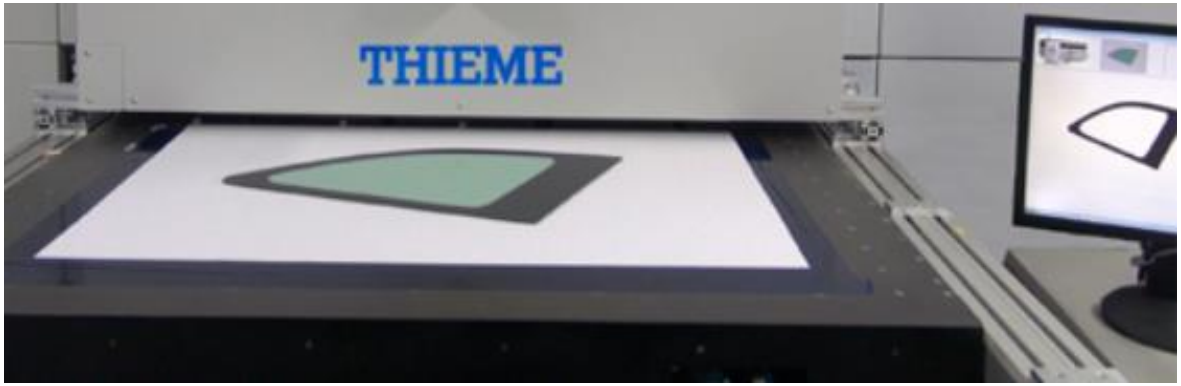
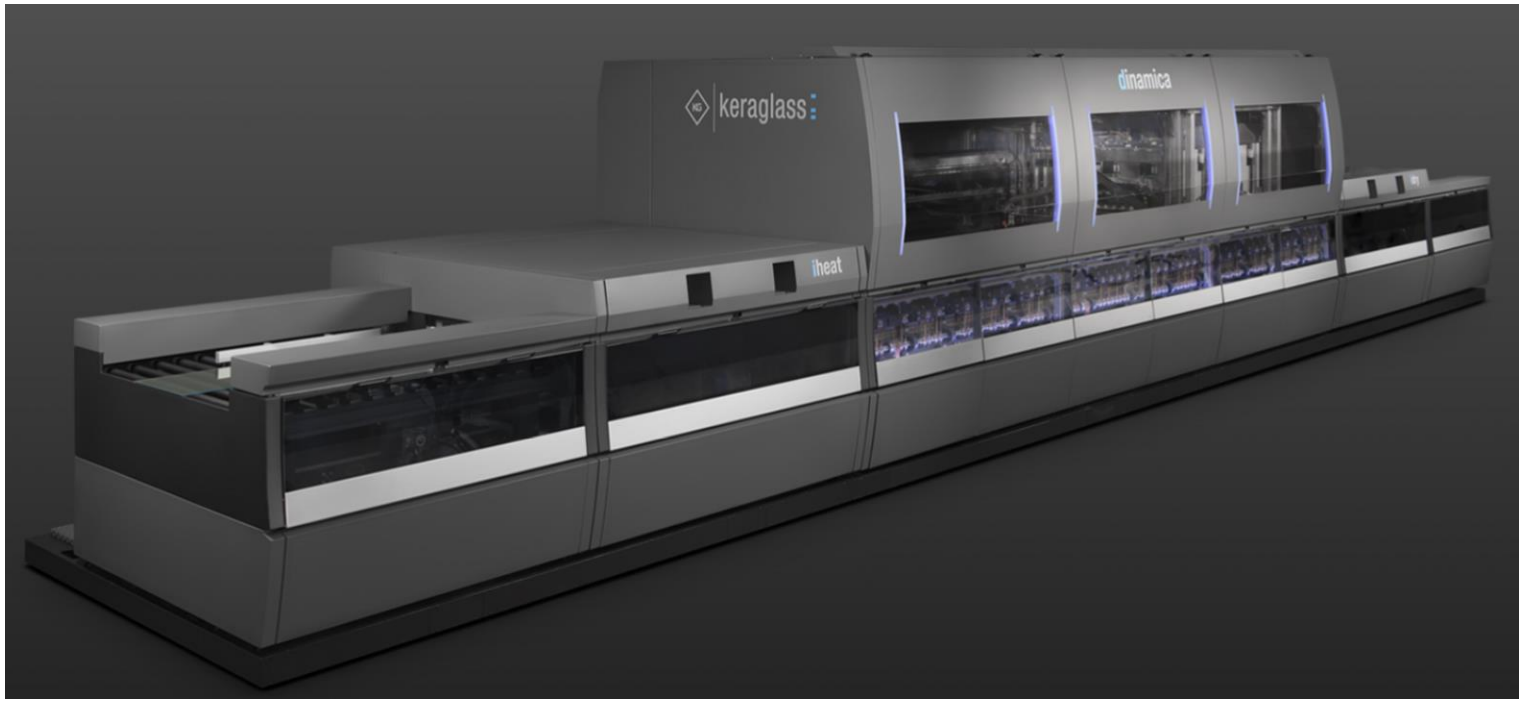


Image source: Thieme

Keraglass

- **Dinamica – launched at Vitrum 2019**
  - In line heating and drying
  - Single or multipass printing
  - 10-22 heads per bar (Xaar 2001)
  - Automotive & home appliance panels



https://www.youtube.com/watch?time_continue=131&v=osBmtKGL324

Image source: Keraglass

Tecnoferrari

- **Collaboration with Giardina Group – finishing & handling systems for glass industry – Vitrum 2019**
- **VivaJet single pass Series**
  - Print width up to: models (S) 910 mm, (M) 1190 mm, (L) 1470 mm
  - 360dpi

Image source: Tecnoferrari

System Ceramics

- **Creadigit – single pass**

Image source: System Ceramics

Rollmac & Gemata

- **Glassprint One – launched Oct 2018**
  - Gemata software & Caldera RIP
  - Certified for the use of TORRECID ceramic inks
  - 6-12 colours
  - Xaar 1003 printheads
  - XY scanning

Image source: Rollmac

		6 heads	12 heads	18 heads	24 heads
Type of heads		Xaar 1003 GS6S			
Type of print		Hexachrome			
Number of heads	[NR]	6	12	18	24
Band dimensions	[mm]	70,5	140	210	280
Minimum resolution	[dpi]	360			
Maximum resolution	[dpi]	1440			
Levels of grey	[NR]	8 dynamically chosen			
Dimensions of the droplet	[pl]	0 -6 -12 -18 – 24 – 30 – 36 - 42			
Number of rows of heads	[NR]	1	2	3	4
Print head translation speed	[mm/s]	400			
Productivity at 360 DPI	[m2/H]	115	230	445	460
Productivity at 1440 DPI	[m2/H]	28	56	84	112

https://www.youtube.com/watch?v=kZKFProtGbQ&feature=emb_logo

Cefla Finishing

- **J-Print Series**
  - Focus on interior glass applications

Image source: Cefla Finishing

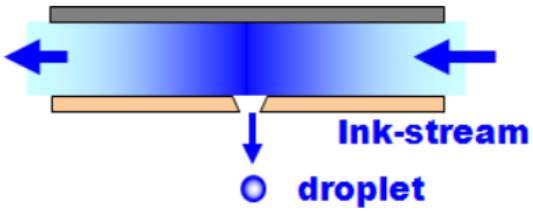
Example Printheads used in Flat Glass

- **TTEC**
  - CF1
  - CF3
- **Xaar**
  - 1003
  - 2001
- **Seiko**
  - RC1536
- **Fujifilm**
  - StarFire

Image source: TTEC, Xaar, Seiko, Fujifilm Dimatix

Recirculating Ink Supply

- **Recommended for heavily pigmented inks and challenging fluids**
  - Controls two pressure environments to generate a pressure differential across a printhead
  - Pressure difference can be adjusted to suit the printhead and fluid combination used
  - Allows thermal control of printhead (with in-line heater) and effective degassing
  - Allows effective priming of printhead
  - Gives increased reliability
  - System operation and fluid condition is more consistent and any environmental effects minimalised



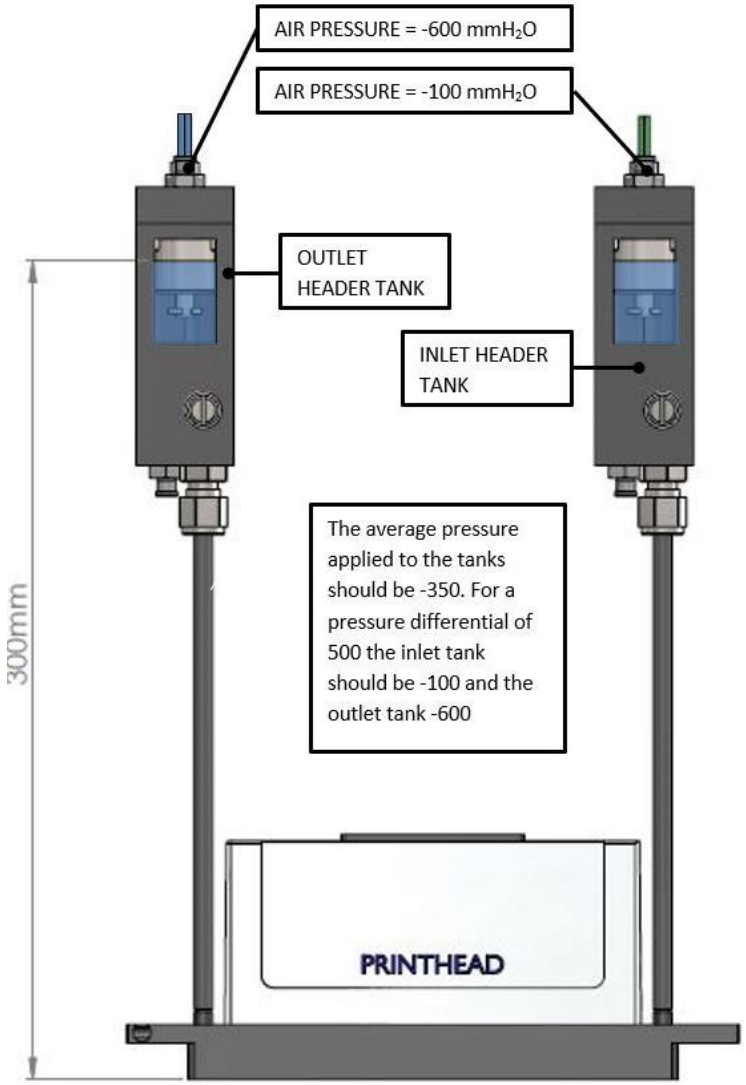


Image source: TTEC, GIS

Dynamic Registration

- **Key challenge is alignment & registration with the substrate**
- **Many different possible distortions can be solved by:-**
  - Mechanical (feeding)
  - Vision systems + software

Image source: Tecglass

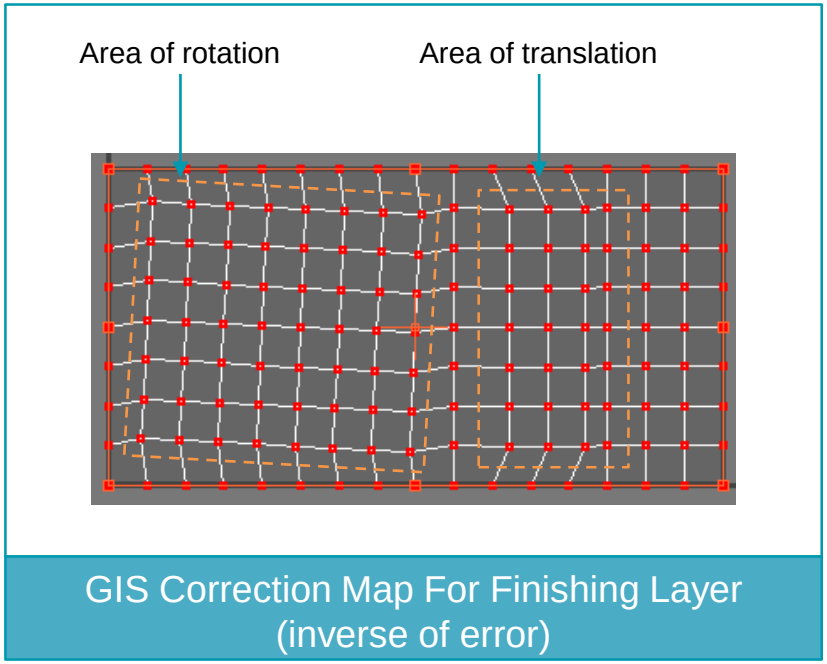
Dynamic Registration

Translation (X & Y)

- Product detect (X translation)
- Feeders or software offset (Y translation)

Rotation

- Feeders
- Vision system + fiducials + software



GIS Correction Map For Finishing Layer (inverse of error)

Mesh based correction accurately places finishing data in the desired location. Handles all translation, rotation, stretch, compression and skew as well as localized distortion correction

- General software conversion approach
- If you can measure the error – it can be corrected

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Hollow Glass

Bottles / Containers / Drinkware

Overview and Latest Market News

Cylinders, Cones & Tubs

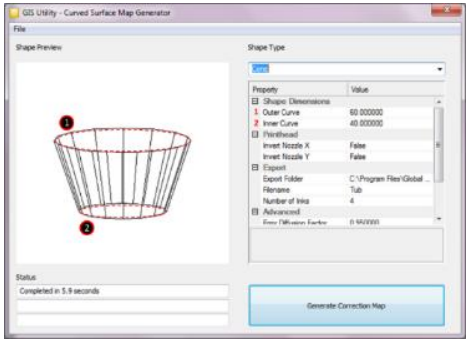
Cylinders well established/well understood technology

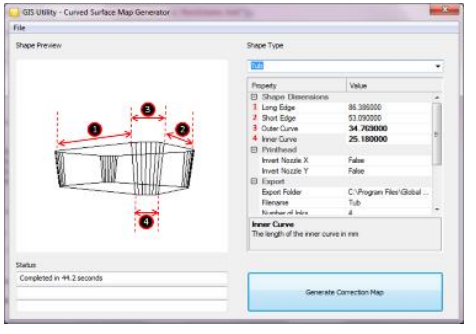
Cones or conical/tapered shapes

Software correction

For full wrapping

- Corrects nozzle alignment
- Provides density correction
- Ensures no dot gain issues
- Ensures no screening artefacts





Tubs

- Requires correction changes during the print
  - Often from pixel to pixel
  - Multi-dimensional nozzle, density and screener correction technology can be adjusted to each surface type and associated application process

Fermac

- **Linear series and Rotary series**

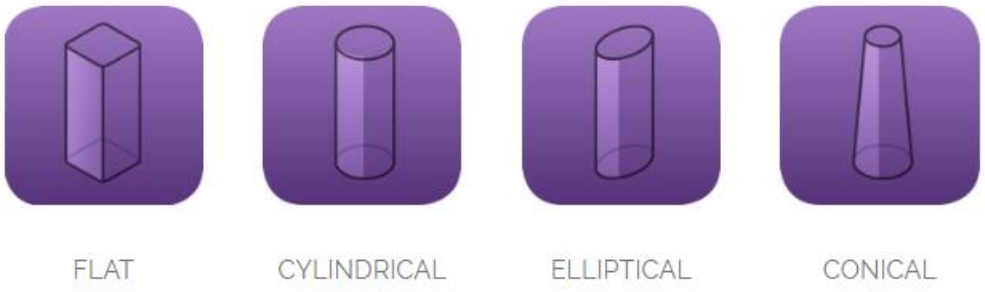


Image source: Fermac

https://www.youtube.com/watch?v=oVDUE_BHHlU

InkCups Now

- Helix DL Series
  - MagiCoat® glass primer to make glassware pieces more durable and resistant to wash cycles
  - Cyan, Light cyan, Magenta, Light magenta, Yellow, Black, White and Varnish. DL series ink is also FDA 21CFR compliant

Image source: InkCups Now

Koenig & Bauer Kammann

- **Range of screen & inkjet hybrid systems**
  - Round, oval, flat or angular - diameter up to 120mm - length 450mm. Max. print image height 220 mm
  - Adhesion promoter and a protective varnish

Image source: Kammann

Isimat

- **Indirect Digital Decoration (IDD) – launched at K-Show 2019** (plastics – but also for glass)
- Inkjet onto film – transfer process to container
- Hybrid technology system

Machines Dubuit

- Dec 2018: Announced distribution partnership with Engineered Printing Solutions (EPS) in the US

Image source: Machines Dubuit

Dekron (Krones – Till) – AB InBev

- Nov 2019: announced the introduction of “direct object printing” on its beer bottles. The technology is being developed in the brewer’s **Tattoo Alpha Plant** in Haasrode, in Leuven, Belgium.
- Previously tested the innovation on small batches to mark specific occasions – now opening up to broader mass market
- Decoration and tactile effects
- Launch in UK - part of limited-edition run of Beck’s Artist Series - nine bottle designs

- **Dekron DecoType**

http://whattheythink.com/articles/98337-beer-giant-ab-inbev-launches-trial-direct-object-printing-uk-market/

Image source: Krones and AB InBev

Other

Other Flat Glass Applications

- **Functional Coatings**
  - Mobile phones
  - Touch screens
- **Display**
  - LCD colour filters
  - OLED
    - Depositing light emitting layer
- **Printed Electronics / Touch Panels**
  - Conductives
  - Dielectrics
  - Encapsulation layers
- **Solar**
  - Organic solar cells (OPV)

- **Any opportunity / demand for complex shapes?**
  - Hollow glass?
  - Industrial?

Image source: company web sites

Complex Shapes

Image : GIS R&D lab

Complex Shapes

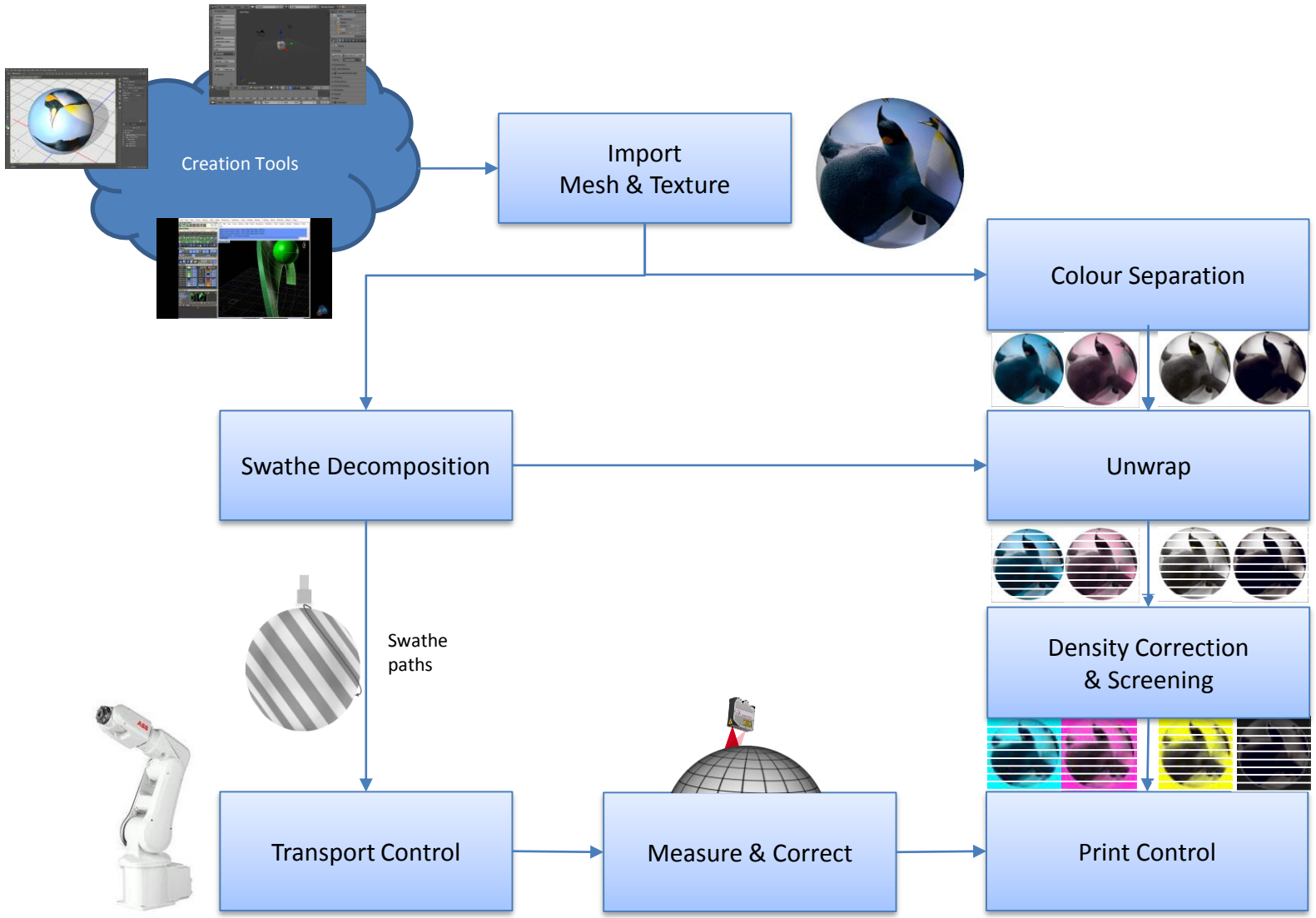
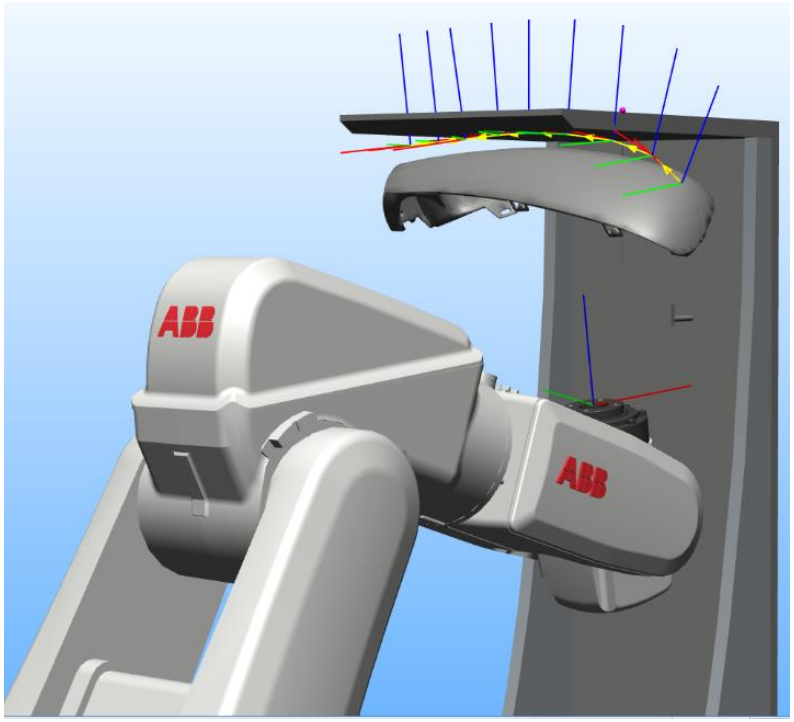
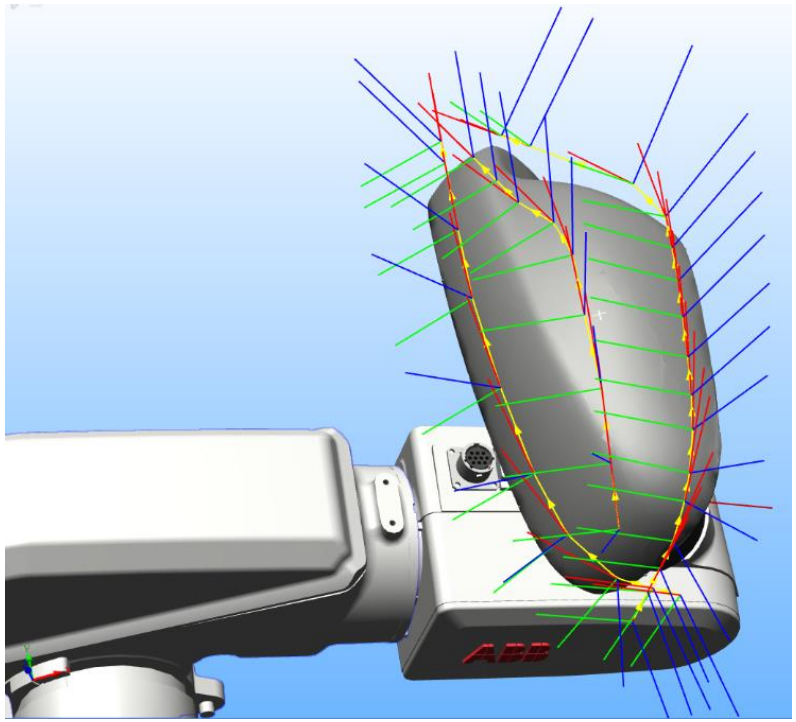


Image source : GIS

GIS Print Path Designer





Modelling in ABB RobotStudio

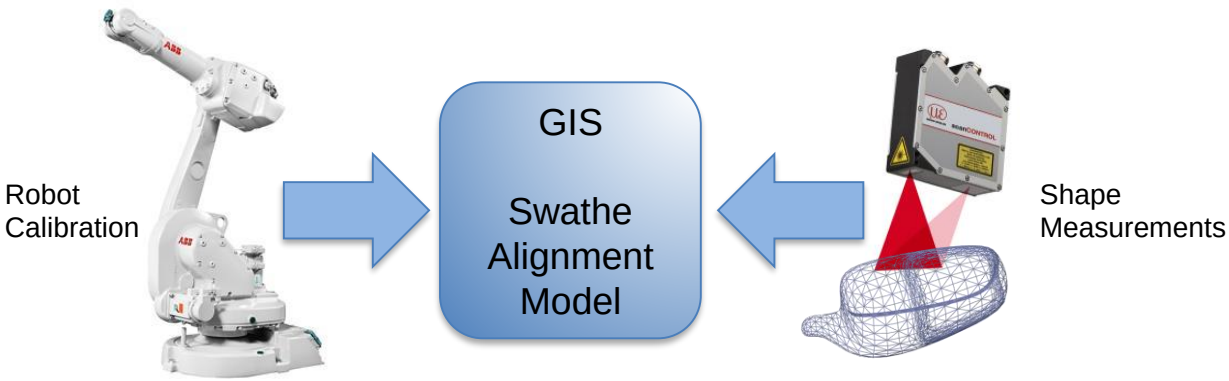


Image source : GIS

Full Object Coating – GIS Print Path Designer

Image source : GIS

Black Frit - Potential Application?

- **Reasons for the black frit**
  - Contact point between the glass and car frame - assists the adhesive to stick better to the glass
  - Help preserve the urethane sealant used to bond the glass to the frame
  - Help distribute temperature evenly to lessen optical distortion
    - Frit band heats up much faster than the windshield's glass, creating an optical distortion that makes either straight lines look curved or bowed inwards
    - The gradual black dots help lessen this phenomenon by dissipating the heat and spreading it out evenly
  - Aesthetic purposes. Halftone pattern allows a gradual decrease in size - transition much more subtle
- **Amount of black frit is increasing in designs**
  - Potential distortion problems in the firing process
- **Proposition to print on the formed glass….**

Image source: Adrianflux

Automotive Windshields

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Manufacturing Process

Step 1. Gather raw materials
Step 2. Melt raw materials
Step 3. Pour molten glass mixture onto tin ban
Step 4. Gradually cool glass as it is rolled through annealing lehr oven
Step 5. Cut glass
Step 6. Cut glass to windshield shape
Step 7. Apply black frit to glass (when flat) - typically using silk screen / inkjet
Step 8. Mold glass to shape adding curvature
- Potentially apply black frit with inkjet here in manufacturing process
- Additional decoration?

Step 9. Add PVB layer to glass and lay 2nd piece of glass on top
Step 10. Heat the three layers in over to bond
Step 11. Wash, label, pack and ship windshield

Summary

- **Flat glass**
  - Automotive & appliance applications growth
  - New inkjet introductions from glass industry players
  - Other inkjet vendors seeking new markets in glass
- **Container glass**
  - Adoption increasing
- **Complex shaped glass coating / printing**
  - Technology / software becoming available
  - New opportunities? New markets?
- **Importance of ink chemistry and software**

Image source: Glasstec

GIS – Company Overview

- Leading provider of technology solutions to industrial inkjet systems builders
- Supported printhead manufacturers
  - Fujifilm Dimatix, Konica Minolta, Kyocera, Ricoh, SII, Toshiba Tec, Xaar
- Founded November 2006
- Based in Cambridge, UK
  - Technical support in UK, China and Japan
- Employees 70
- Patent portfolio
- Supplier & partner to over 130 customers worldwide
- Huge range of applications

THE QUEEN'S AWARDS FOR ENTERPRISE

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