Technical information

Assessment of the visual quality of digital and screen printing

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Area of application

The Technical Information applies to the assessment of the visual quality of digitally or screen-printed glass panes in relation to which ceramic inks are applied to the entire surface or parts thereof and are baked on during the manufacturing process to form semi-tempered glass or toughened/single-pane safety glass.
The guideline applies to all products manufactured at the facilities of GLASSOLUTIONS
The tolerances and allowable discrepancies specified in the guideline apply, in particular, where no special agreements have been made between customers and GLASSOLUTIONS for the products to be manufactured (drawings, technical delivery specifications, etc.).
In the case of insulated glass, the panes are to be assessed in relation to the specified features and characteristics.

Procedures

In the **screen-printing method**, ink is printed onto the surface of the glass by way of a close-meshed screen with a squeegee, whereby the thickness of the ink application can be influenced slightly by the thread diameter and the mesh size. The ink application is opaque or transparent depending on the colour chosen, but in any case thinner than when using the rolling or pouring technique. Typical of the production process are, depending on the colour, light stripes both in and across the direction of printing.

In the **digital printing method**, the motif is created with the help of an image processing program. Ink is printed directly onto the glass surface with a plotter, whereby the thickness of the ink application can vary. The ink application is opaque or transparent depending on the colour chosen, but in any case thinner than when using the rolling, pouring or screen-printing technique. Maximum print resolution is 720 dpi.

Typical of the production process are light stripes, especially on the ink surface in the direction of printing, which can, of course, be visible against backlighting in the case of light-coloured inks.

The print edges are exactly straight in the direction of printing and slightly serrated across the direction of printing. In the case of dotted, perforated and text motifs, the print edges display serration, though this can only be recognised very close up. The digital printing process is particularly suitable for complex multi coloured grid designs or images, less so for large or full-format prints. Skips/blemishes of up to 3 mm can occur, especially in the case of light-coloured inks. This has to be taken into account for the respective installation situation (background).

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The following applies to both procedures:

Where media (sealants, panel adhesives, insulation, etc.) are applied directly to the ink side, these will show through in the case of light-coloured inks and grid motifs.

If digitally or screen-printed glass panes are used for transparent areas, this must be clarified in advance and be verified by way of sampling.

The printing is extensively scratch-proof and acid-resistant to a limited degree; resistance to light and adhesion correspond to the consistency and durability of the ceramic vitrifiable colours.

Test specifications

The printed glass is to be assessed from the non-printed side in relation to faults and colour. If specific installation instructions exist, this must be noted in the order.
Inspections are carried out in differing daylight conditions without direct sunshine or backlight from a distance of around 3 metres in refection.

In the case of glass panes ordered for transparent use, the examination of both sides is carried out under the test conditions described above. However, this application must be clarified in advance with GLASSOLUTIONS and stated in the order.

Product characteristics

- **Edge processing in screen printing**
  According to the normal test criteria of DIN 1249-11
  The following applies to finely ground or polished edges:

  - Printing with a gap to the chamfer:
    A minimum gap of 2 mm from the ink layer to the chamfer is permitted. Printing up to the chamfer is also possible. Tolerances depend on the size of the glass panes. The precise tolerances are defined under **Quality characteristics**.

- **Edge processing in digital printing**
  According to the normal test criteria of DIN 1249-11
  The following applies to finely ground or polished edges:

  - Printing with a gap to the chamfer:
    A minimum gap of 2 mm from the ink layer to the chamfer is permitted. Printing up to the chamfer is also possible. Non-parallelism is also permissible. Tolerances depend on the size of the glass panes. The precise tolerances are defined under **Quality characteristics**.

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- **Surface and glass characteristics**
  Building glass: according to the guidelines for assessment of the visual quality of toughened glass (ESG/TVG) monolithic or of the visual quality of enamelled and screen-printed glass).

- **Printing**
  Printing is carried out in such a way as to guarantee a faultless overall optical impression. Water marks, light areas, colour blurring, ink splashes and clouding are not permissible in the field of vision of the glass pane. In digital printing, the smallest ink splashes can be found in the immediate vicinity of the print edges. These are caused by the printing process and are only visible very close up. Production-related geometric tolerances in the print design, especially in the event of fine dots, perforations, lines, etc., can give rise to a change in the overall look of the image in this regard depending on the degree of printing. This is not a reason for complaint and is to be taken into account in case of replacement deliveries or repeat orders.

- **Non-slip printing**
  Special provisions have to be observed for non-slip printing with regard to application (see our Technical Information TI 006 – Treatment and cleaning of glass with non-slip printing).

- **Colour reproduction**
  Printing is carried out on float glass as standard.
  The colours are assessed through the glass (colour at position 2). The colours can display a different shade or degree of gloss from the printed side.
  We do not recommend the selection of colours solely from the colour chart of a colour system as the coloured pane can leave behind a somewhat different colour impression on account of the intrinsic colour of the glass and the reflection on the surface of the glass. Colour deviations in the range of $\Delta E \leq 5$ cannot be ruled out by virtue of fluctuations in the production of inks or of pigments and raw materials of the glass, as well as in the baking process. This must be taken into account for repeat orders, in particular. In addition, colour reproduction depends on the thickness and type of the glass.
  To improve colour consistency for differing glass thicknesses, glass low in iron oxide (iron oxide content approx. 0.02%) should be preferred for certain colours ($\Delta E \leq 4$**).**
  Slight production-related pattern or colour shifts are possible in the case of textured or coloured glass.

- **Weather resistance**
  The resistance of the printed glass to weather is influenced by environmental conditions. Depending on rain intensity and air contamination through aggressive substances such as SO_2, NO_x ("acid rain") and flue dust, glass and glass enamel surfaces can become unsightly after just a few months (loss of gloss of the ink surface, ink deposits, etc.). In fundamental terms, we do not recommend the application of enamel printing on the side exposed to the weather.

  In the case of glass panes that can be walked/stepped on, the surface can also be damaged by other influences:

  - Dust, stones or abrasion. These cause a higher degree of wear, scratches and soiling of the surface (e.g. rust stains).
  - Liquids, such as rainwater, oils, beverages. These cause surface corrosion and soiled patches or, in the event of longer reaction times, peeling of the enamel, especially where individual areas are covered by materials and the liquids dry only slowly beneath these.

  In principle, the visual assessment of the colour is carried out – as described above – through the glass (colour at position 2). With very transparent colours, slight scratches, water drainage traces or soiling can become visible on the printing.

- **Storage**
  Printed glass panes are prone to corrosion, especially when stacked with spacers in conditions of prolonged moisture. The glass panes must therefore be protected against moisture during transportation and storage.

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Quality characteristics

Visual quality is assessed at a distance of 3 m. If no faults or defects can be detected from that distance, no assessment is carried out. Complaints may not be overly emphasised in the assessment.

Punctiform characteristics	Ø < 0.5 mm	are not assessed
	Ø 0.5 – 1.0 mm	max. of 3 per m² with a gap of ≥ 100 mm
	Ø 1.0 – 2.0 mm	max. of 2 per pane
Baked-on foreign bodies (fluff, hairs, etc.)	permissible up to a length of 10 mm (max. width 0.5 mm)	
Seamed edges	all screen-printing faults are permissible 3 mm around the circumference.	
Polished/finely ground edges	the edge region must be visually clean for completely printed or edge-printed glass panes. Ink drips/runs are not permissible.	
Textures in print	Linear textures are permissible.	

Tolerance for the design layer (screen-printing)

Print size ≤ 200cm	Edges seamed	± 2.5 mm
	other edge processing	± 2.0 mm
Print size ≥ 200 cm	Edges seamed	± 4.0 mm
	other edge processing	± 3.0 mm
Non-parallelism	non-parallelism is permissible up to 2 mm for all edge machining.	

Tolerance for the design layer (digital printing)

Print size ≤ 200 cm	Edges seamed	± 2.0 mm
	other edge processing	± 1.0 mm
Print size ≥ 200 cm	Edges seamed	± 3.0 mm
	other edge processing	± 2.0 mm

Non-parallelism	non-parallelism is permissible up to 2 mm for all edge machining.

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Design geometry tolerances

Screen printing	Dots, squares, lines, etc.	0/+ 0.2 mm
Digital printing		0/+ 0.1 mm
Boreholes	In the event of boreholes, a 2 mm gap between the edge of the printing and the edge of the boreholes is permissible.	
Printing general	The contours of the printing must end cleanly. Sharp serration is not permissible. Strong scattering, strong squeegee traces, blurring, etc. are not permissible.	
Multiple printing (screen printing)	In the case of multiple printing, sampling must be carried out (normally ± 2 mm offset tolerance)	
Multiple printing (screen printing)	In the case of multiple printing, sampling must be carried out (normally ± 0.8 mm offset tolerance)	
Stamping	The stamping described above is carried out on the printed side as standard.	

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On publication of this Technical Information, all earlier editions shall cease to be valid.

The information set out above, especially suggestions for the processing and use of our products, is based on our findings and experience. Liability cannot be established from this information or from any verbal consultation, unless intent or gross negligence is proved on our part.

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