

Decorative Glass and UV Print Tolerances

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This standard forms part of the CAworks Commercial Terms & Conditions (Clause 12) and replaces the earlier Google Docs edition.

1. Purpose & scope

1.1 This document defines the dimensional, visual and colour tolerances applicable to all decorative and UV-printed glass products supplied and/or installed by CAworks Designer Glass & Steel Works L.L.C (“CAworks”), unless stricter tolerances are explicitly agreed in the project specifications.

1.2 The purpose is to clarify what constitutes an acceptable product versus a defect that may be rejected by the client at sign-offs and certifications.

1.3 Stricter standards can be specified additionally and agreed in writing.

2. Normative & reference standards

The following standards and industry documents are used as the basis for these tolerances (latest editions as amended):

- EN / GSO EN 12150-1 – Glass in building – Thermally toughened soda lime silicate safety glass – Part 1: Definitions and description, tolerances, flatness, edgework, fragmentation, mechanical characteristics.
- EN ISO 12543 – Glass in building – Laminated glass and laminated safety glass – dimensional tolerances.
- EN 1279-1, Annex F – Glass in building – Insulating glass units – Optical and visual quality (viewing rules, defect zones).

- Manufacturer quality guidelines and tolerance manuals for toughened and printed glass (Pilkington, Sedak, Semco, AGC, Guardian, etc.), covering dimensional tolerances, roller-wave/bow, and defect classification.
- Industry “visual quality” guides applying a 2–3 m viewing distance and diffused lighting for inspection.

Where there is any conflict, this CAworks document governs the commercial interpretation between CAworks and its client.

3. Definitions

3.1 Visible area

The area of glass visible in normal use after installation, excluding portions permanently covered by frames, channels, fixings, or construction elements.

3.2 Main zone (M)

The central part of the visible area, excluding the perimeter edge zone.

3.3 Edge zone (E)

A 15 mm wide band around the perimeter of the visible area (or 0.5% of glass length, whichever is greater), where slightly higher levels of defects and printing irregularities are acceptable.

3.4 Normal viewing position

Standing at ≥ 2.0 m from the glass, looking perpendicularly ($\pm 30^\circ$) to the surface, under bright diffuse light (daylight or evenly distributed artificial light) and without direct spotlights pointed at the glass.

3.5 ΔE (Delta E)

A standard numerical measure of colour difference between two samples in CIE $L^*a^*b^*$ colour space.

4. Inspection conditions

4.1 All visual and colour assessments must be conducted:

- from normal viewing position (≥ 3 m);
- with the glass in its final installed orientation;
- under diffuse, non-critical lighting – no spotlights or grazing light used solely to search for defects.

4.2 Inspection closer than 2 m, using raking light, flashlights, or magnification is not a valid basis for rejecting the glass.

4.3 Minor imperfections that are not visible from normal viewing position are not considered defects.

5. Dimensional tolerances – glass

Unless otherwise agreed, dimensional tolerances follow EN / GSO EN 12150-1, EN ISO 12543 and typical processor tolerances used for toughened and laminated glass.

5.1 Thickness

- Nominal glass thickness as per project design (e.g. 6 mm toughened, 10 mm laminated).
- Thickness tolerance in line with EN 572 / EN 12150 (typically ± 0.2 – 0.3 mm for 6 mm float/toughened glass; larger tolerances for thicker glass).

Deviations within those standard thickness tolerances are not claimable.

5.2 Length & width (rectangular panes)

Unless stricter factory tolerances are stated on the CAworks shop drawings or supplier documentation, the following apply:

Pane dimension	Tolerance
Up to 2000 mm	± 2.0 – 2.5 mm
2000–3000 mm	± 3.0 mm
Over 3000 mm	± 3.0 – 4.0 mm

These values are consistent with common manufacturer guidelines for toughened/laminated glass.

5.3 Squareness & diagonal

- Diagonal difference and out-of-squareness are acceptable within the limits allowed by EN 12150 / EN ISO 12543 and typical processor tables (usually a few millimetres depending on size).

Glass is not defective if it fits within the designed framing/channel system and dimensional deviations remain within these standard tolerances.

5.4 Flatness / bow / roller wave

- Overall bow (curvature) up to 3 mm per metre (minimum 2 mm) is considered acceptable for flat toughened glass. Where glass is fixed at edges (e.g. walk-on glass, ceilings), glass bow is not limited.
- Roller-wave distortion typical of toughened glass is not a defect if within EN 12150-1 and manufacturer limits and not visually disturbing from normal viewing position.

6. UV print – position & geometry tolerances

6.1 Print position (registration)

For partial or patterned UV printing relative to a reference edge:

Panel longest side	Positional tolerance
≤ 2000 mm	± 4 mm
> 2000 mm	± 6 mm

Claims based solely on misalignment within these tolerances are not accepted.

6.2 Printing-free edge & edge zone

- A printing-free edge zone of 10–15 mm around the perimeter of the glass is permitted.
- Minor density variation, small dots, or paint build-up in the edge zone are acceptable provided they are not clearly visible in normal viewing and do not affect function.

Requests for “zero border” must be explicitly agreed and may require separate tolerances.

7. UV print – visual quality & defects

The following applies to decorative / UV-printed surfaces observed from normal viewing position.

7.1 Pinholes & point defects (dust spots)

Main zone (M):

Defect size (diameter)	Acceptance
≤ 0.5 mm	Allowed without limitation
0.5–1.0 mm	Allowed if isolated and not clustered
1.0–2.0 mm	Maximum 2 per m ² , with a total of 4 per pane
> 2.0 mm	Normally not acceptable and may be claimable

Edge zone (E): a slightly higher number of defects is acceptable if not visually dominant.

7.2 Scratches & line defects

- Very fine “hairline” scratches not visible from 3 m are not defects.
- In the main zone, up to 3 fine scratches ≤ 25 mm each (and not concentrated in one area) are acceptable.
- Deep scratches clearly visible at 2 m, or clusters of scratches, may be rejected.

These thresholds are aligned with typical manufacturer criteria for printed and coated glass.

7.3 Banding, mottle and density variation

- Minor variations in ink density, banding, or mottle inherent to digital / sprayed printing processes are acceptable if:
 - they are not obvious at normal viewing position; and
 - they do not alter the intended artistic effect in a material way.
- Slight differences in gloss level or reflectivity depending on viewing angle are not considered defects.

8. Colour tolerances (ΔE)

8.1 Colour matching is measured against the approved CAworks sample or digital colour reference using ΔE (CIE L*a*b*). Typical interpretation:

ΔE	Interpretation
≤ 3.0	Barely perceptible; considered an excellent match
3.0–4.0	Visible on close comparison but acceptable in normal interior use
5.0–6.0	Clearly visible; still commercially acceptable for many architectural applications, especially across different lighting conditions and substrates

8.2 Unless stricter values are agreed, CAworks applies:

- Within a single production batch for a project:
 - target $\Delta E \leq 3.0$ to the master sample;
 - values ≤ 4.0 are considered commercially acceptable.
- Between different batches / later replacements:
 - target $\Delta E \leq 3.0$;
 - differences ≤ 5.0 are acceptable where panels are not directly adjacent or are separated by joints / frames.

8.3 Rejections based solely on perceived colour variation under spotlights, coloured lighting, or non-standard conditions will be assessed using measured ΔE and standard viewing conditions.

9. Glass characteristics not considered defects

The following phenomena are inherent to glass and toughening and are not grounds for claim:

- Slight optical distortion / roller wave within EN 12150 limits.
- Anisotropy / iridescent “zebra” patterns visible in polarised light.
- Minor inclusions or bubbles within the limits defined by EN and manufacturer standards.
- Slight colour shifts due to glass type (low iron vs clear), thickness or viewing angle.

10. Rejection rules

10.1 A defect can result in rejection only if:

- it is visible from normal viewing position under standard lighting; and
- it exceeds the tolerances defined in Sections 5–8; and

- it is not caused by misuse, damage, external impact, building movement, other trades or cleaning chemicals (as per CAworks Warranty Exclusions).

10.2 The following are not claimable:

- Deviations in dimensions, flatness or squareness within the tolerances of this document.
- UV print misalignment, small pinholes or scratches within the defined thresholds.
- Colour differences measured within the ΔE limits in Section 8.
- Defects only visible under:
 - distance < 2 m;
 - direct spot / grazing light;
 - oblique or extreme viewing angles;
 - magnification or special optical devices.

10.3 CAworks reserves the right to verify alleged defects by site inspection, measurement and reference to applicable standards. Where no defect is found, inspection and any remedial works may be charged at CAworks' standard rates.

11. Relationship to CAworks warranty and terms

11.1 This Quality & Tolerances Standard forms an integral part of the CAworks Commercial Terms & Conditions and Warranty.

11.2 For the purpose of the Warranty, a product is considered “free from manufacturing defect” if it complies with:

- this Tolerances Standard; and
- the approved shop drawings and samples.

11.3 Any deviations within these tolerances shall not be grounds for rejection, discount or replacement.