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Quality Guidelines

SICURTEC® special security glass with polycarbonate including SICURTEC® machine safety windows

1. Introduction

This document is valid for the entire SICURTEC® special security glass product family as well as SICURTEC® machine safety windows. SICURTEC® special security glass is a multi-layer laminate of soda-lime-silica glass with layers of plastic, particularly polycarbonate and polyurethane, each with type-specific material properties that can be optically different from other flat glass products.

SICURTEC® special security glass is in general subject to EN ISO 12543, EN ISO 1279 and EN ISO 14449. Permitted deviations from the relevant product standards are specified in this document. For special structures the basic standards of the employed glass types are applicable, e.g. coated glass EN 1096-1.

2. Applicability

This guideline is for the assessment of the quality features of SICURTEC® special security glass. The assessment is done on the basis of the inspection principles described in the following.

3. Inspection

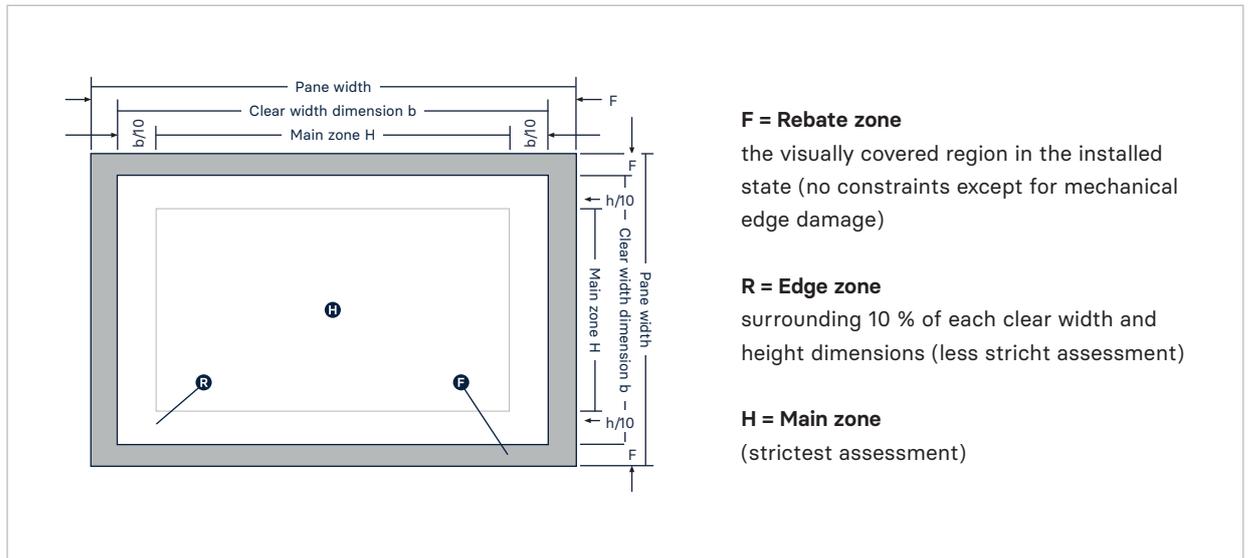
In general in the inspection the visual aspect of the glazing is decisive. In this the flaws must be not particularly conspicuous. Inspection of the glazed items should be done according to the table after section 6 from a distance of at least 2 m and with viewing angle that corresponds to the usual use of rooms. The inspection takes place in diffuse daylight (e.g. cloudy sky) without direct sunlight or artificial lighting. Glazing units within the rooms (internal glazing) should be inspected with normal (diffuse) lighting for the usage of the rooms, preferably viewed perpendicular to the surface. In this the flaws must be not particularly conspicuous. Flaws ≤ 0.5 mm are ignored. Disturbance areas (corona, glass flaws) must be no bigger than 3 mm.

4. Admissible States

In assessing certain features their specific properties need to be considered, e.g.

- ⊕ Combinations with coated glass elements EN 1096
- ⊕ Properties dependent on the material (esp. polycarbonate)
- ⊕ Colour deviations related to the manufacturer and the loading
- ⊕ Colour differences in patterned glass

For combinations with ESG (toughened safety glass), TVG (heat-strengthened glass), patterned glass or plastic sheets, the specific features of these products also apply. However the manufacturer reserves the right to have production-related deviations and modifications to the state of the art.



F = Rebate zone

the visually covered region in the installed state (no constraints except for mechanical edge damage)

R = Edge zone

surrounding 10 % of each clear width and height dimensions (less strict assessment)

H = Main zone

(strictest assessment)

4.1. SICURTEC®

Zone	Permissible:
Rebate zone F	<p>F = Rebate zone: the visually covered area when installed (excepting mechanical edge damage, no constraints)</p> <p>External shallow damage or cratering not affecting the strength of the glass and not exceeding the edge seal width. Interior cratering without loose fragments filled with sealant. Point and area residues and scratches without limit.</p>
Edge zone R	<p>The edge zone is 10% of the respective clear width and height dimension.</p> <p>Inclusions, bubbles, points, spots etc.:</p> <ul style="list-style-type: none"> ☉ Pane area ≤ 1 m.: max. 4 items, each < 3 mm Ø ☉ Pane area > 1 m.: max. 1 item < 3 mm Ø per surrounding m edge length <p>Residues (dot-like) in the space between panes (SBP):</p> <ul style="list-style-type: none"> ☉ Pane area ≤ 1 m.: max. 4 items, each < 3 mm Ø ☉ Pane area > 1 m.: max. 1 item < 3 mm Ø per surrounding m edge length <p>Residues (areas) in the SBP:</p> <ul style="list-style-type: none"> ☉ max. 1 item ≤ 3 cm² <p>Scratches: sum of separate lengths:</p> <ul style="list-style-type: none"> ☉ max. 90 mm – Each length: max. 30 mm <p>Hairline scratches: multiple not permitted</p>



Zone	Permissible:
Main view area H	<p>Inclusions, bubbles, points, spots etc.:</p> <ul style="list-style-type: none">☉ Pane area ≤ 1 m²: max. 2 items, each < 3 mm Ø☉ Pane area >1 / ≤ 2 m²: max. 3 items, each < 3 mm Ø☉ Pane area > 2 m²: max. 5 items, each < 3 mm Ø <p>Scratches: sum of separate lengths:</p> <ul style="list-style-type: none">☉ max. 60 mm - each length: max.20 mm <p>Hairline scratches: multiple not permitted</p>
R + H (edge zone + main view area)	<p>Max. no. of permitted items as in zone R</p> <p>Inclusions, bubbles, points, spots etc. from 0.5 to < 1.5 mm are permissible without area limit, except for accumulations. An accumulation is if there are at least 4 flaws less than 200 mm from each other. For three-layer laminated safety glass this reduces to 180 mm, to 150 mm for four-layer laminated safety glass and to 100 mm for laminated safety glass of five or more layers.</p>
In general	<p>Instructions:</p> <ul style="list-style-type: none">☉ Flaws ≤ 0.5 mm are ignored.☉ Disturbance areas (corona) must be no bigger than 3 mm.☉ For each intermediate layer the number of permitted items in zone R and H increases by 50% of the above values.☉ The result is always rounded up.☉ The manufacturing technology can result in unevenness (see section 5 tolerances).☉ With the use of polycarbonate, depending on the sun and light conditions, and on the viewing angle, a slight orange-peel effect can result.☉ Depending on the pane thickness and the number of intermediate layers used, the colour impression can be slightly influenced.☉ This effect can be considerably reduced by superstructures of clear glass.

5. Tolerances

5.1. Measurement and edge offset

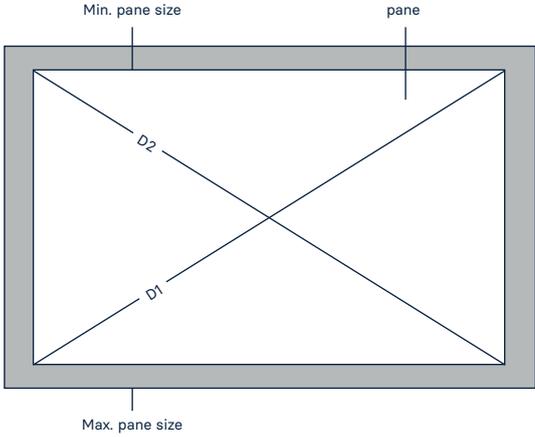
Nominal dimension

< 1000 mm	±4,0 mm
≥ 1000 mm und < 2000 mm	±5,0 mm
≥ 2000 mm	±6,0 mm

For reasons of the production technology the individual panes can shift.
The tolerance is within the deviation of the table stated above.



5.2. Rectangularity



A nominally rectangular pane must be contained within a rectangle with sides having the permitted maximum and minimum dimensions.

Applicable: $D1 - D2 = \max. 2\text{mm}$

The rectangularity is checked in the measurement of the diagonals D1 and D2. The absolute difference must be at most 2 mm.

5.3. General distortion

Straightness relative to the glass edge length (general distortion)

**Intruder-resistant products
to EN 356 + EN 1627 ff.:**



Measuring rod
 $h1 = 3 \text{ mm/m}$ Measuring rod

**Bullet- and explosion-resistant products
to EN 1063 or DIN EN 13541:**



Measuring rod
 $h1 = 5 \text{ mm/m}$ Measuring rod



5.4. Element thickness

Element thickness	Mono	ISO
< 26 mm	+/- 2,0 mm	+/- 2,5 mm
> 26 < 40 mm	+/- 3,0 mm	+/- 3,5 mm
> 40 mm	+/- 4,0 mm	+/- 4,5 mm

6. Assessing the visible area of the insulating glass edge seal

Production-related features in insulating glass on glass and spacer frames can be recognisable in the visible area of the edge seal and therefore outside the clear glass area. These features can become visible if, through manufacturing conditions, the insulating glass edge seal is not covered on one or more sides. The permissible deviations from parallelism of the spacer frame(s) to the straight glass edge or to further spacers (e.g. for triple thermal insulating glass) are, in total, 4 mm for a boundary edge length of 2.5 m; for greater edge lengths 6 mm in total. For two-pane insulating glass, the tolerance of the spacer up to a boundary edge length of 3.5 m is 4 mm, and 6 mm for greater edge lengths. If, for constructional reasons, the edge seal of the insulating glass is not covered, typical features of the edge seal can become visible that are not within the guideline and need to be agreed in the individual case. Special frame designs and implementation of the insulating glass edge seal require matching to the glazing system in use.

7. General instructions

The guideline provides an assessment standard for the visual quality of glass in the building industry. In the assessment of an installed glass product it is assumed that, in addition to the visual quality, the features of the glass product in fulfilling its functions are taken into account.

The values of the properties of glass products such as sound-insulating, thermal-insulating and light-transmission values that are stated for the corresponding function, relate to test panes according to the corresponding applicable test standard. For other pane formats, combinations and the installation process and external influences can affect the stated values and visual impressions.

7.1. Physically determined features

The assessment of the visual quality does not include a series of unavoidable physical phenomena that can be noticeable in the clear glass area, such as:

- ⊗ Interference phenomena
- ⊗ Insulating glass effect
- ⊗ Anisotropies
- ⊗ Condensation on the exterior surfaces of the panes (water condensation formation)
- ⊗ Wettability of glass surfaces

7.1.1. Explanation of terms

7.1.1.1. Interference phenomena

In insulating glass made from float glass, interference in the form of spectral colours can occur. Optical interference is a phenomenon from the superposition of two or more light waves that meet at a point. They become apparent through coloured zones of greater or lesser strength that change with pressure on the pane. This physical effect is increased by the plane parallelism of the glass surfaces. This plane parallelism provides a distortion-free view. Interference phenomena appear randomly and cannot be influenced.



7.1.1.2. Insulating glass effect

Insulating glass has an air-gas volume enclosed by the edge seal, with a state determined mainly by the barometric pressure, the altitude of the factory above standard zero (normal null, NN) and the air temperature at the time and place of manufacture. In the installation of insulating glass at other altitudes, with temperature changes and variations of the barometric air pressure (high and low pressure), concave or convex arching will occur in the individual panes and consequently optical distortions. Multiple reflections can also occur on glass surfaces, with differing intensities. These mirror images can be more clearly recognised if, for example, the background of the glazing is dark. This phenomenon results from the laws of physics. As a result of the thermal pre-stressing process, chemical and mechanical changes to the surface condition can occur, such as formation of dots and roller marks.

7.1.1.3. Anisotropies

Anisotropies are a physical effect in heat-treated glass resulting from the internal stress distribution. Occurrence of dark-coloured rings or bands under polarised light and/or viewing through polarised glasses is possible, depending on the viewing angle.

Polarised light is present in normal daylight. The extent of the polarisation depends on the weather and the position of the sun. The double refraction is more noticeable with a shallow angle of view or also with glass panes forming a corner.

7.1.1.4. Condensation on the exterior surfaces of panes (dew formation)

Condensate (dew) can form on the external glass surfaces when the glass surface is colder than the neighbouring air (e.g. misted car windows). The formation of condensate on the exterior surfaces of a glass pane is determined by the Ug value, the air humidity, the air flow and the inside and outside temperatures. Condensate formation on the room-side surface is promoted when air circulation is hindered, e.g. with deep reveals, curtains, flower pots, flower boxes, blinds and with unfavourable arrangement of radiators, inadequate ventilation or similar.

For insulating glass with a high level of thermal insulation, condensation can form temporarily on the glass side exposed to the weather if the external relative humidity of the air is high and the air temperature is higher than the temperature of the glass surface.

7.1.1.5. Wettability of glass surfaces

The wettability of the glass surfaces can vary depending on, for example, marks from rollers, fingers, labels, paper grain, vacuum suckers, sealant residues, silicone components, smoothing agents, lubricants or environmental influences. When the glass surfaces are damp because of condensation, rain or water from cleaning, the differing wettability can become visible.



7.2. Visual properties of glass products

7.2.1. Intrinsic colour

All materials used in glass products have intrinsic colours resulting from the raw materials that can become more evident with increasing thickness. For functional reasons, coated glass is used. Coated glass also has an intrinsic colour.

This intrinsic colour can be recognisable in various ways when looking at and/or through the glass. Variations of the colour impression are possible and unavoidable because of the iron-oxide content, the coating and changes in glass thicknesses and pane structure.

7.2.2. Colour differences and coatings

Objective assessment of the colour difference with coatings requires measurement or testing of the colour difference under conditions accurately defined beforehand (glass type, colour, light type). Such an assessment cannot be a topic of this guideline. (Further information can be found in the pamphlet „Farbgleichheit transparenter Gläser im Bauwesen“ (Colour equality of transparent glass in building) of the VFF (German window trade association).)

7.3. Exterior surface damage

If exterior surfaces are subject to mechanical or chemical damage recognised after the glazing is done, the cause must be determined. Such flaws can also be judged as in section 3.

Otherwise the following standards and guidelines apply (among others):

- ⦿ Technical directives for the glazier trade
- ⦿ VOB/C ATV DIN 18 361 „Glazing work“
- ⦿ Product standards for the glass products concerned
- ⦿ Conditions of use for SICURTEC® glass
- ⦿ Pamphlet about glass cleaning issued by the Bundesverband Flachglas e.V. (Federal Flat Glass Association), and others
- ⦿ The elements should be padded so that the load is spread over the whole element.

8. Designation

SICURTEC® products and glazing are permanently marked with sandblasting. Multiple markings are possible.

The attack side, in particular for asymmetrical structures, is marked with a label.