BUDVAR

windows more lasting than others

Evaluation of glass quality

The guide shows you how to properly perform a visual inspection of glass for possible quality defects. In addition, you will find answers to frequently asked questions before, during, and after glass installation.

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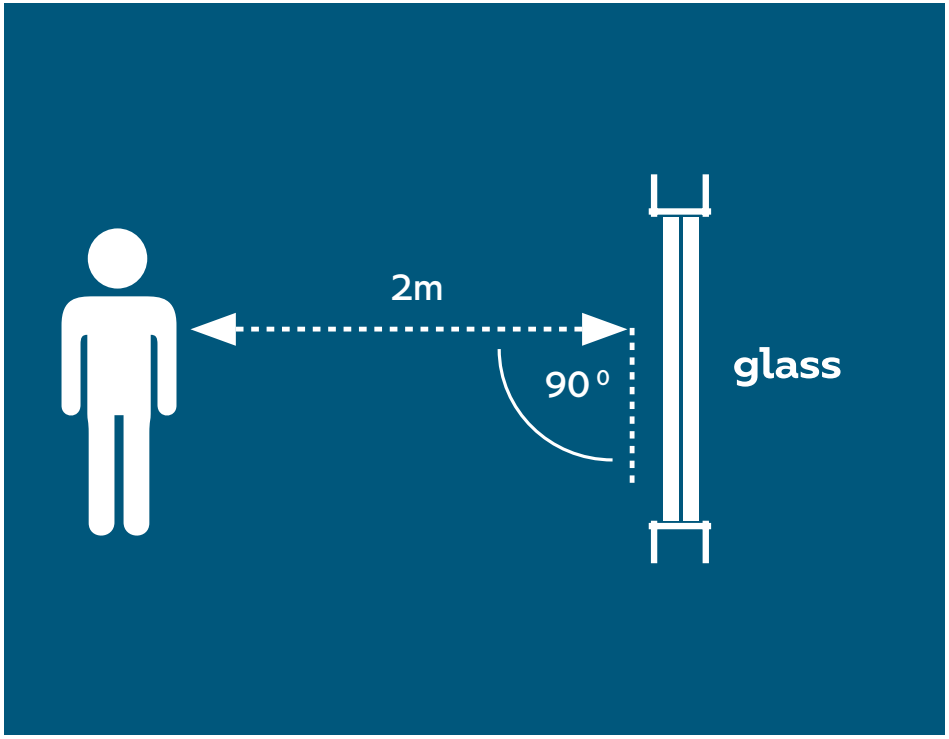
Visual inspection of the glass



- When conducting a visual inspection of glass, look through the glass, not at the glass.
- Any defects in the glazing should be noticed within 20 seconds. If the defect is not visible when looking through the glass at a certain distance, or if it is noticed after this time, then it is considered that such defect is not conspicuous or does not bother the onlooker.
- Do not use magnifying devices and sources of strong light (halogen lamps and flashlights) when conducting inspections.
- The inspection should not be done when the glazing is exposed to strong sunlight.
- All defects should be identified by standing at a distance of not less than 2 m from the glass, at an angle of 90° with the unaided eye.
- Defects should not be marked.

European Standard EN 1279:2018

If a defect is noticed, it should be measured with a suitable measuring device (millimeter scale/measure) and compared with the table of Quality Criteria for Composite Panes (EN:1279 standard).

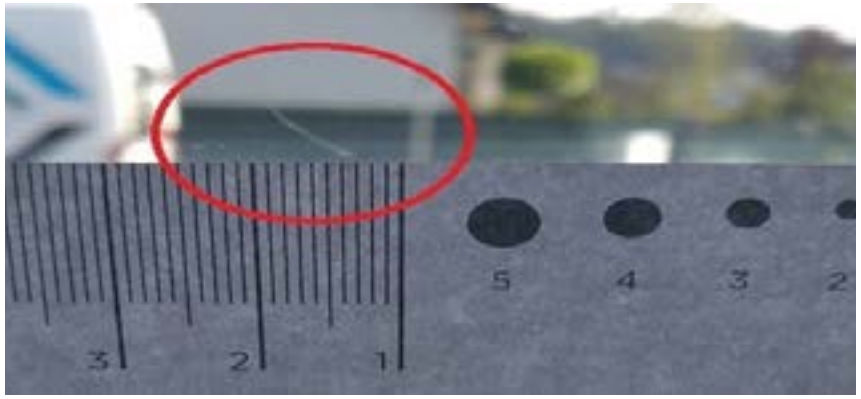
Photographing defects on glass

To be able to assess the root cause of the glass complaint reliably, each complaint notification should have photographic documentation of the defect with a gauge (millimeter interval) and an indication of the order number along with the item - preferably, it should be a description from the glazing frame of the advertised glass package.

Good photographic documentation is a guarantee of fast processing of the complaint.

How to photograph defects of glass?

Step 1 | Apply the linear gauge to the glass, with the top edge below the defect



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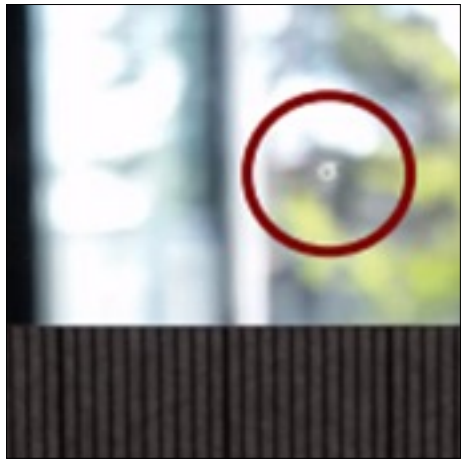
Step 2 | Bring the smartphone to a distance of about 10 cm from the glass and try to take a picture of the flaw

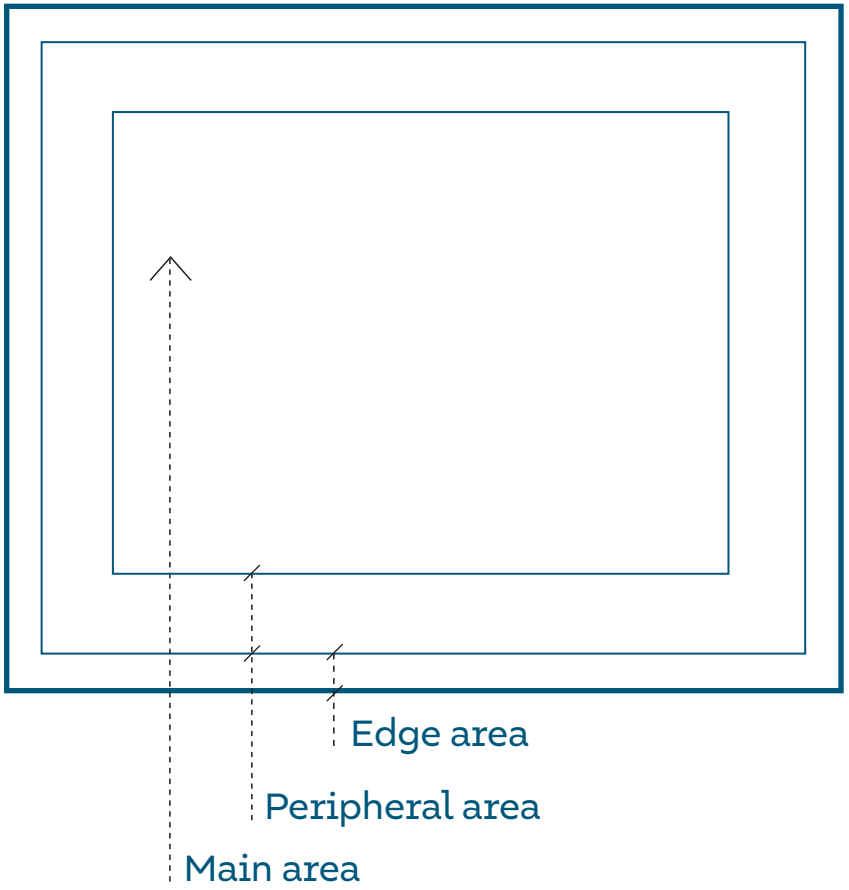


If the photo fails (it's blurry and smudged), leave the Smartphone in the same position and click your finger on the screen to catch the focus.

If there are still difficulties in obtaining focus, smoothly move the smartphone closer and further away from the surface of the glass 5-20 cm, watching the screen and take a picture when the focus is best.

Not every apparent defect qualifies for a claim

According to the Quality Criteria for insulating glass units, a certain type of defect is allowed inside the package as long as its size is acceptable. If the defect is visible from a distance of two meters and more, the size of the defect should be compared with the table that includes acceptable and unacceptable defect sizes.



Edge area
15 mm from the edge of the glass (it is usually covered by the window frame)

Peripheral area
50 mm from the edge

Main area
central area of the glass

Next to it, we show the areas of the glazing package, based on which the location of the defect in the glazing package can be determined.

If the defect is not visible when looking through the glass at a certain distance, it is considered that such a defect does not disturb the image and does not affect its properties, i.e., transparency, thermal and acoustic insulation.

Classification of defects in insulating glass units

does not constitute a defect of the glass

glass defect

Image reflection

Double-glazing units consist of more than one sheet of glass, so the onlooker may notice multiple reflections. This effect will be stronger in triple-glazing units. It does not constitute a defect in the glazing.

Concavity / convexity of insulating glass units

The hermetically sealed space between the panes of glass contains a fixed volume of air or gas dictated by the values of atmospheric temperature and pressure prevailing at the time of assembly. Once the glazing is installed, changes in external temperature and pressure will increase or decrease the volume of air or gas in the space between the panes, which in turn will cause the glass sheet to bend, visible as a distorted reflection image. This distortion indicates that the glass has been properly insulated and does not indicate a defect in the glass. In the case of the installation of insulating glass units above an altitude of 1,700 meters above sea level or with a relative altitude difference between the production site and the installation site of more than 500 meters, it is recommended that pressure compensation be performed to reduce the effect of concave/convexity of the insulating glass units and reduce the risk of glass breaking.

Visual and color distortion of tempered glass

Tempered glass may show some visual and color distortion, more accentuated in the reflection of images than double-glazing units. This does not indicate changes in the physical properties of the glass and does not indicate a defect.
The refraction of light on the glass can cause small transient rainbow effects, which occur due to the parallel alignment of high-quality flat glass panes with respect to each other and due to the different orientation of tempered glass. Glazing technology is constantly evolving, so newly manufactured glass installed next to packages of older glass may diverge and may not match perfectly. This is not a defect of the glass.

The low-emissivity coating of the glass can cause temporary visual effects. Under certain lighting conditions, the coating can look like a transparent film or cause a haze effect on the glass surface. When light-colored objects, such as curtains, are placed adjacent to the glass, they may appear slightly darker than they actually are. Differences in the construction of adjacent glass assemblies can also cause visual effects that are acceptable.

When laminated glass is used, the so-called Moire Effect, or waviness of laminated glass, may be revealed, which is not a disadvantage of such insulating glass units.

Example of tempered glass marking

Tempered Glass Designation

Individual panes of glass having a safety product certification may have a marking corresponding to the product on the surface or edge of the glass. These markings will not all be in the same corner of the glass and will not overlap in an insulating glass unit, and this is not a defect in the glass.

Roll imprint at thermally strengthened glass

In the process of thermal strengthening, glass is laid on heated rolls in a furnace, which may result in the appearance of small imprints on the surface of the glass, and these may be more pronounced in thicker packages. These are not qualified as a defect in the glass.

Waviness from rolls when glass is hardened

The rolls of the curing furnace can cause slight irregularities in the surface of the glass, where the maximum deformation, rippling can be 0.3 mm / 300 mm.

Milky area

Under certain lighting conditions and from certain angles, some coatings or laminated products can cause a phenomenon called haze, which is a blurred, sort of dusty appearance, which is not a defect in the glass.

Anisotropy

Insulating glass units having thermally reinforced and tempered glass in their structure may be characterized by the occurrence of a phenomenon called anisotropy. This is a stress pattern occurring in the glass concerning specific opalescence effects, resembling with their shape geometric figures or shadows, which can appear at a certain insolation, especially in the presence of polarized light. This phenomenon is described in EN12150-1, EN1836-1.

It does not qualify as a defect in the glass.

Color differences

Color differences that may occur between adjacent insulating glass units are acceptable, as long as they meet ISO 11479-2 criteria for measuring and evaluating the color of coated glass used in building facades.

Deformation of the muntins

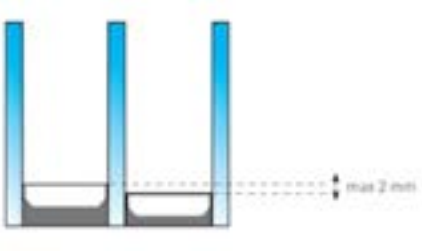
Under the influence of weather conditions, muntins can sometimes distort from a straight line, can appear discolored, or can tap against the glass. None of the above is a defect in the glass. These phenomena increase as the dimensions of the glazing unit increase. When the temperature returns to normal, the muntins will return to their original alignment. Any visible discoloration of the muntins is usually caused by the use of coated glass. The clattering of the slats against the glass may be noticeable under certain conditions during which the insulating glass unit is exposed to external vibrations, such as strong gusts of wind. The use of so-called bumpers is intended to protect the glass from damage, not to eliminate vibrations. Glazing bars and muntins are installed with a position tolerance of +/- 2 mm in relation to the inner edge of the spacer. In the case of model glazing with curves or glazing manufactured according to a template, the muntin deviation from the dimensions can increase up to 10 mm.

When using muntins in two chambers of a double-glazed unit, the dimensional tolerance of the muntin division is ± 4 mm. When making slanted muntin bars due to the manual method of manufacture, the deviation can be ± 5 mm.

Offset spacers

The tolerance of manufacture and application of spacers relative to each other for double glazing is ± 2mm. Shaping of spacer frames for model panes is carried out manually - permissible deformations of the frame are greater than for rectangular panes. Possible additional deformations during the shaping of the frames and during their application increase the tolerance of distance frame displacement relative to each other in this type of double-glazed panes to ±5 mm relative to each other.

Offset frames - rectangular panes of glass

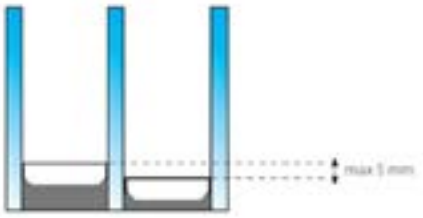


✓ Max 2 mm

✗ > 2 mm

Look at the surfaces of the frames, not the sealant.
Verify perpendicular to the glass, not at an angle.

Offset of frames - model windows



✓ Max 5 mm

✗ > 5 mm

Look at the surfaces of the frames, not the sealant.
Verify perpendicular to the glass, not at an angle.

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Point and line defects

Such defects include blisters (gas inclusions), pebbles, and "grains." They are subject to evaluation regarding the number of defects and their size. Note that a defect that is not visible under inspection conditions from a distance of 2 m is not a defect.

Point defects – spherical or semi-spherical disorders visible when looking through glass.
It can be a defect in the form of a solid inclusion, gas inclusion, lack of coating or a defect in laminated glass.

Internal impurities – material present on the surface of the glass having the form of a point defect or "muntins" inside the glassing.

Stains/streaks– a defect larger than a point defect or internal dirt, typically of irregular shape and texture, such as a fingerprint.

Linear defect – a defect when one dimension is predominant over other dimensions, e.g., a crack.

Defects smaller than 0.5 mm are not considered during the Visual Evaluation of the IGU. Other residues from the manufacturing process should be considered as a point/linear defect, e.g., glass filings. Flaws on the outside of the insulating glass unit, which may arise after delivery of the insulating glass unit, do not qualify for a claim. Superficial scratches are scratches that can be felt under the fingernail.

Air bubbles | Size of acceptable defects

Main area

Bubbles up to 2 mm

Number of pieces acceptable depending on the size of the glass in m^2*

Peripheral area

Bubbles up to 3 mm

Number of pieces acceptable depending on the size of the glass in m^2*

*Measure the core of the bubble, without the areola.

Internal impurities | Size of acceptable defects

Edge area and main are

Impurities up to 3 mm

Acceptable in the amount of 2 pieces in an area of 20 cm

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Impurities on frames | Size of acceptable defects

Edge area

Spot impurities
up to 3 mm

Glass grains that do not occur in clusters - max 4 pcs. at a length of 20 cm

grains = spheres ☑

☒

☑

Scratches, internal linear defects | Size of acceptable defects

Main area

Single scratch up to 15 mm

Total scratch length up to 45 mm

Peripheral area

Single scratch up to 30 mm

Total scratch length up to 90 mm

An external scratch felt under the fingernail does not qualify for a complaint.
Hairline scratches (thin as a hair) are not subject to complaint.

How to read assessment criteria

ACCEPTABLE INTERNAL IMPURITIES AND STREAKS			
Glass size s (m^2)			
Area	Defect size (Without envelopment) (Ø Mm)	S ≤ 1	S > 1
Edge area	All sizes	No limits	No limits
Peripheral area	Stain Ø ≤ 1	No limits	No limits
	Stain 1< Ø ≤ 3	4	1 per meter of glazing circumference
	Stains / streak Ø ≤ 17	1	
	Impurities Ø > 3 / Spots Ø > 17	Unacceptable	
Main area	Stain Ø ≤ 1	Acceptable if less than 3 pieces in an area Ø ≤ 20 cm	
	Stain 1< Ø ≤ 3	Acceptable if less than 3 pieces in an area Ø ≤ 20 cm	
	Impurities Ø > 3 / Spots Ø > 17	Unacceptable	

GLASS SIZE (SURFACE AREA in M^2)

NUMBER OF ACCEPTABLE DEFECTS IN RELATION TO THEIR SIZE AND LOCATION/AREA OF OCCURRENCE

GLASS AREA

DEFECT SIZE

EN 1279-1:2018

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ACCEPTABLE POINT DEFECTS + BUBBLES

Glass size s (m^2)					
Area	Defect size (Without envelopment) (Ø mm)	S ≤ 1	1 < S ≤ 2	2 < s ≤ 3	S > 3
Edge area	All sizes	No limits			
Peripheral area	Ø ≤ 1	Acceptable if less than 3 pieces on a surface Ø ≤ 20 cm			
	1< Ø ≤ 3	4	1 per meter of glazing circumference		
	Ø > 3	Unacceptable			
Main area	Ø ≤ 1	Acceptable if less than 3 pieces in an area Ø ≤ 20 cm			
	1 < Ø ≤ 2	2	3	5	5 +2/m^2
	Ø > 2	Unacceptable			

PERMISSIBLE INTERNAL IMPURITIES STAIN AND STREAKS

Glass size s (m^2)			
Area	Defect size (Without envelop-ment) (Ø mm)	S ≤ 1	S > 1
Edge area	All sizes	No limits	
Peripheral area	Stain Ø ≤ 1	No limits	
	Stain 1 < Ø ≤ 3	4	1 per meter of glazing circumference
	Stain/streak Ø ≤ 17	1	
	Impurities Ø > 3 / Spots Ø > 17	Unacceptable	
Main area	Stain Ø ≤ 1	Acceptable if less than 3 pieces in an area Ø ≤ 20 cm	
	Stain 1 < Ø ≤ 3	Acceptable if less than 3 pieces on a surface Ø ≤ 20 cm	
	Impurities Ø > 3 / Spots Ø > 17	Unacceptable	

EN 1279-1:2018

AREA	ACCEPTABLE DEFECTS INSIDE THE PACKAGE IN CASE OF FLOAT GLASS AND COATED GLASS
Edge	External damages to glass edges and chippings, that do not affect the strength of the glass and do not extend beyond the width of the insulating glass seal (EN1279-1:2018 F.6).
	Internal chipping with no loose chips filled with sealant/butyl.
	Spot, internal impurities, and scratches of the surface.
Scratches and linear defects	Hairline cracks (width ≤ 0.2 mm), normally invisible at visual inspection conditions, are acceptable if they do not occur in clusters. • A cluster is more than 3 defects in a circle with a diameter of 20 cm. • Scratches and linear defects of 0.2 mm to 1 mm are subject to assessment. • Scratches with a more than 1 mm thickness are classified as point defects. • Central area - a single scratch / linear defect is allowed up to a maximum of 15 mm; the total length of scratches / linear defects is up to 45 mm. • Edge area - a single scratch / linear defect is allowed up to a maximum of 30 mm; the total length of scratches / linear defects is up to 90 mm.
Spacer frames and muntins	Typically, these defects are located in the edge area defined by EN1279:2018 (covered by the window frame) Butyl outflows allowed up to a maximum of 5 mm - not affecting the function of the insulating glass unit, including waviness of butyl, i.e., unevenly applied butyl. Spot impurities on the frames and visible parts of the muntins are allowed up to a maximum of 3 mm. Molecular sieve grains are treated as spot impurities. They cannot occur in clusters. A sieve cluster is more than 4 pieces in a 20 cm long element. Single scratches on the aluminum frame are acceptable. Other types of defects on the frames, such as scratches, dirt, stains, fingerprints, roll marks, and smudges on the spacer, invisible from a distance of 2 m under the inspection conditions provided by EN1279, are acceptable.

Condensation of water

External condensation on the side of the room or outside the building can be identified because it can be wiped off, for example, with a dry cloth.

- INDOORS from the inside it is caused by warm, moist air close to the building. This indicates a problem in the construction of the building itself and the need for better air ventilation since water condensed on the surface of the glass here is a symptom, not a defect.

- IN the space between the panes of glass indicates that the insulating glass unit has lost its airtightness; this is a defect in the insulating glass unit.

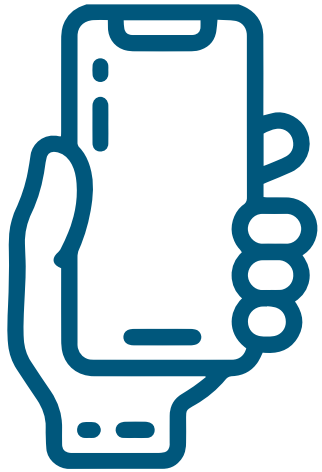
- On the outside is a positive indicator of the thermal insulation of the glass and does not constitute a defect in the insulating glass unit.

- The condensation pattern formed on the surface of the glass due to condensation of water and moisture is known as a "condensation pattern" or suction cup mark. It is not a defect in the glass and is formed due to microscopic silicone deposits on the surface of the glass, which break down over time. When a new insulating glass unit is installed near an old glass unit, the glass surfaces in these units will be different ages so that condensation can form different patterns on them.

Condensation of water – recording the occurrence

If you notice condensation on the glass, record a video as you wipe the glass with your hand, checking whether the water is on the surface of the glass or inside.

If the water is inside the package, file a complaint and attach the recorded video.



Variations in package thickness and dimensions

Glazing Thickness Tolerance EN1279-1:2018

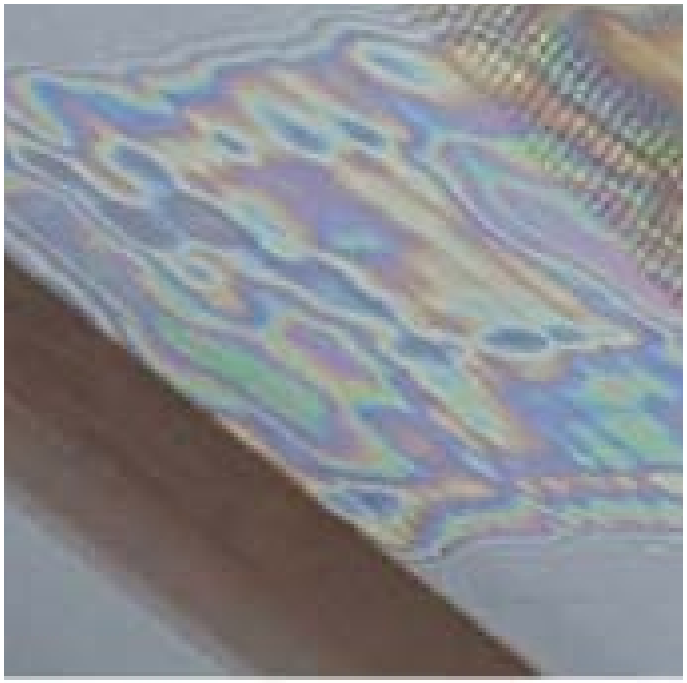
Product type	Thickness tolerances
2-pane package (annealed float glass)	± 1,0 mm
2-pane package with at least one heat-treated or laminated glass pane	± 1,5 mm
3-pane package (annealed float glass)	± 1,4 mm (annealed float glass)
3-pane package with at least one heat-treated or laminated glass pane	+ 2,8 mm / -1,4 mm

Glazing Dimensional Tolerance EN1279-1:2018
According to EN1279-1:2018 section 6.3.2.

Single-chamber glass and two-chamber	Tolerance of Length and Width of the glazing package	Tolerance of Length and Width of the glazing package
All glazing packages with a glass thickness of less than 6 mm, and width or height of the glazing package below 2000 mm	±2	≤2
All glazing packages in which the glass thickness ranges from 6 mm to 12 mm or width or the height of the glazing package is between 2000 and 3500 mm	±3	≤3
Glazing of the width or hight from 3500 mm to 5000 mm and the thickest pane has a thickness in excess of 12 mm	±4	≤4
Glazing of the width or height above 5000 mm or in which the thickest pane has the thickness in excess of 12 mm	±5	≤5

For model glass, the dimensional tolerance is ± 5mm.

Newton rings



An optical phenomenon on insulating glass units involving the appearance of colored circles in the shape of rings. Rings - interference bars - are formed when light passes through, through thin layers near the contact of convex and flat surfaces separated by a substance with a different refractive index than the contacting layers.

Butyl outflows

Thermal outflows
(around the perimeter of the glass):

- occur due to natural changes in the concavity/ convexity of the glass,
- most often they appear in windows installed on the south side.

Even materials
not in direct contact with the glass can cause interactions by migrating vapors, for example.

Cracks in glass

Thermal cracks

Thermal cracks are caused by thermal stress in the case of sudden changes in the temperature of the glass. The risk of these cracks increases in installations where there is a lot of partial shading, where the glass is part of the support (e.g., posters, furniture), where curtains are used, films are applied, and where heaters or air conditioners are aimed directly at the glass. Thermal cracking can also occur when glass delivered on racks is exposed to strong sunlight. Glass on a rack, without frames, must not be stored in direct sunlight. The rack should be stored in a dry, ventilated and shaded place (under a roof), without exposing the glass to temperature variation and weather conditions. The glass is secured with straps only for transportation. After unloading, the securing straps should be loosened.

Characteristic signs of thermal cracking:

- the direction of the crack at right angles from the edge deep into the surface of the glass,
- the crack goes at right angles through the thickness of the glass,
- the course of a thermal crack always follows the path of least resistance - thermal cracks can change direction many times.

Cracked glass and scratches on the outer surface of the glass that may arise off-site are not subject to warranty and complaint.

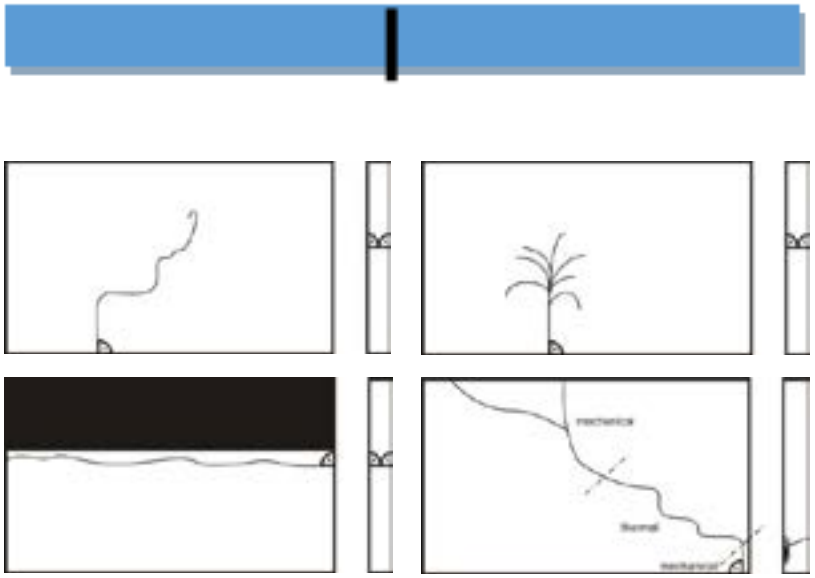
If the temperature distribution in a material is not homogeneous, it causes thermally induced tensions. Areas of glass that are heated by sunlight or other heat sources begin to expand.

In contrast, the currently unheated surfaces are colder and subjected to tensile stress. If the tensile strength point is exceeded in this situation, cracking occurs. In addition, this phenomenon can be exacerbated in buildings that are not heated, such as those under construction.

In the case of thermal cracks in double glazing, due to the structure of the double glazing unit, the highest temperature is obtained by the inner pane and it is the one that most often cracks. The outer panes are cooled by air, so to speak.

In the case of inner glass - when the center of the glass will have a temperature of 90 degrees and the edge of the glass of which a small part is exposed to the "environment" only 20 degrees - thermal stresses - resulting from the thermal expansion of the glass will cause it to break.

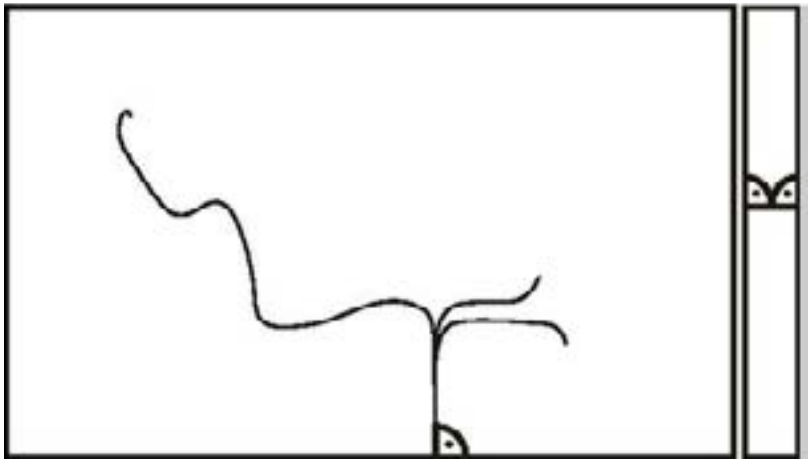
thermal cracks (edge view)

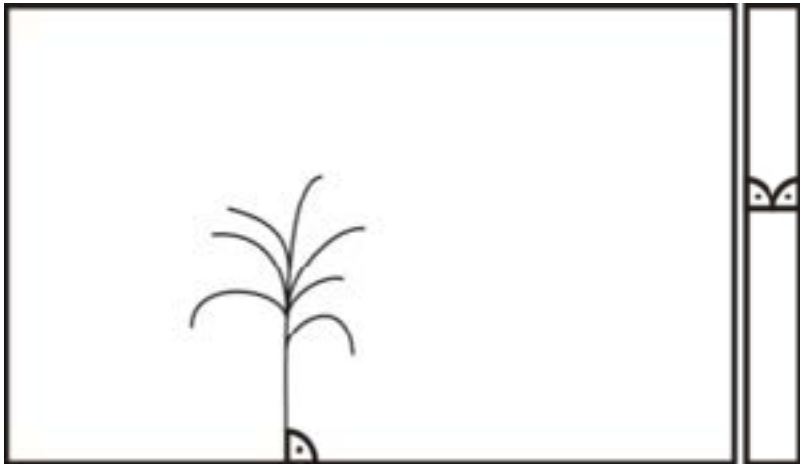


right angle

change of direction of the crack

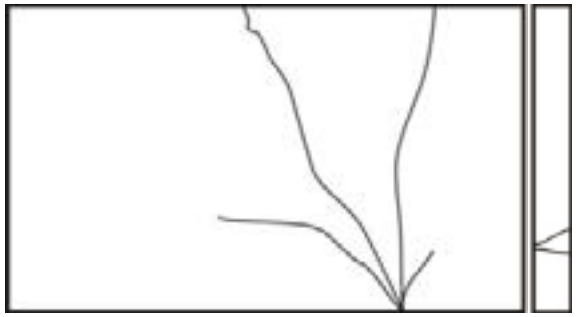
Thermal cracks



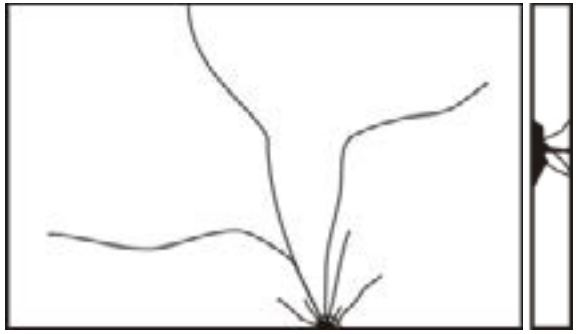


Mechanical cracks

mechnical cracks (edge view)



Mechanical cracks



Glass defects / edge impact

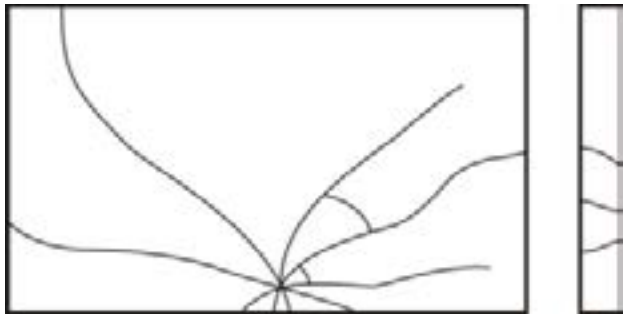
Mechanical cracks formed on installed glass can occur due to excessive differences in air pressure, temperature, and altitude between the place of production and the place of installation, as well as due to the impact on the glass, for example, stone.

Signs characteristic of a mechanical crack
(caused, for example, by bending stress):

- a crack from the edge deep into the surface of the glass may or may not run at right angles,
- the crack through the thickness of the glass does not follow a right angle,
- a crack formed when the glass is bent does not always run along the path of least resistance.

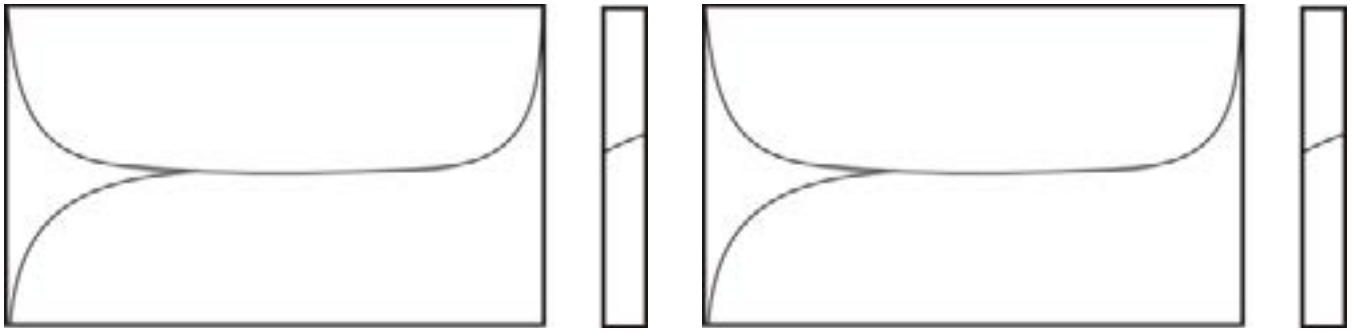
Mechanical cracks

Chipping

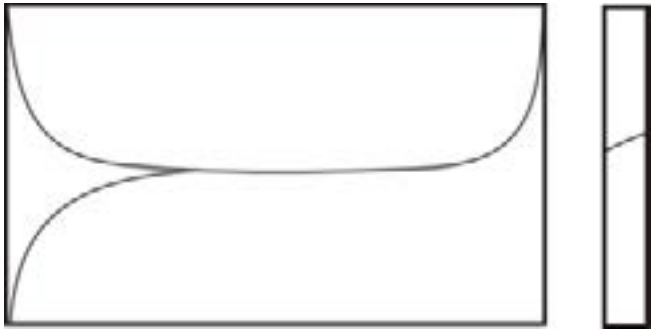


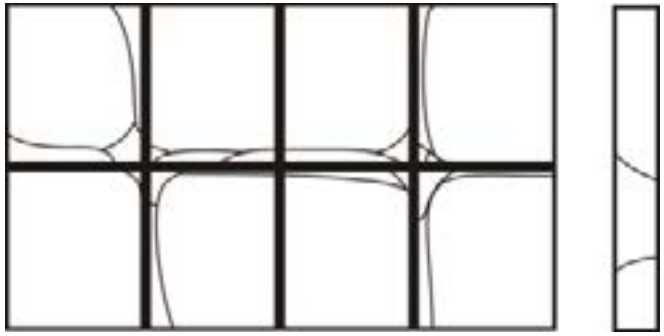
Impact

Cracks caused by the weather
(e.g., wind and mismatched glass or lack of pressure compensation)



Cracks in windows with muntins due to weather conditions





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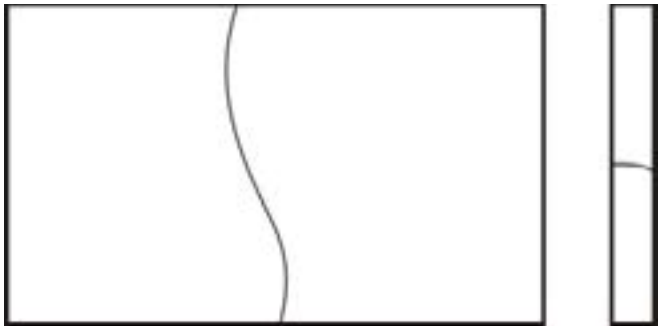
Cracks caused in transport



Spontaneous cracking of tempered glass

A naturally occurring stain present in any glass is nickel sulfide contamination.

It is harmless if the annealed glass is used. Nickel sulfide in glass is extremely rare, but in some cases, it can lead to the spontaneous cracking of tempered glass during use.

To reduce the risk of such cracking, it is recommended that tempered glass undergos an additional HST process that checks the glass for nickel sulfide.

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Recommended ways to clean glass

Use a gentle, non-abrasive glass cleaner. Distribute the solution evenly on the glass with a sprayer, clean brush, cleaner or non-abrasive sponge. Then wipe the cleaning solution off the surface of the glass using circular motions and applying light pressure.

Rinse the glass with plenty of clean water and remove all the cleaner from the glass surface. Then dry the glass surface with a clean, lint-free cleaning cloth or window squeegee.

Be careful not to get abrasive particles between the glass cleaning materials. If there are still "residues" on the glass, the above steps should be repeated.

Do not use abrasive cleaners, scouring pads or other sharp materials to clean the glass and areas around the frames.

BUDVAR

windows more lasting than others

GLASSOLUTIONS

SAINT-GOBAIN

Sources:

Glassolutions | General Conditions of Sale
- October 2021 edition

Glassolutions | Quality criteria for insulating glass units