Thermal Breakage in Glass

Translation prepared by

Unik Funkis
Vinduer & Døre

DVV Warranty

Thermal stresses in glass arise due to uneven heat exposure and typically occur after the elements have been installed. These stresses are caused by conditions beyond the control of the window manufacturer.

Thermal breakage in glass is not covered by the DVV warranty for windows and exterior doors unless it can be proven that the breakage is due to a defect in the supplied element.

What is thermal breakage in glass?

If an insulated glass unit is exposed to uneven heat, it will cause tensile stress in the glass. If these tensile stresses exceed the glass's natural tensile strength, the glass will crack.

The risk of thermal breakage should always be assessed for specific applications and locations of windows and doors. This risk can be reduced through structural measures or by choosing glass that is either heat-strengthened or tempered.

Critical temperature differences often occur with blinds, sunshades, colored or coated glass, shadows cast by surrounding buildings or vegetation, applied window films, poor or uneven ventilation around the glass

Characteristics of thermal breakage: The breakage lines are few and run as smooth, clean fractures from the edge of the glass perpendicularly toward the center.

Critical temperature differences:

Thermal breakage occurs when the temperature difference between the central area of the glass and the edge exceeds a certain critical limit, which depends on the type and quality of the glass:

- **Wired, rolled, or laminated glass**: 20–30°C
- **Float glass**: 40–50°C
- **Heat-strengthened glass**: 60–70°C
- **Tempered glass**: 80–100°C

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Central area temperature

The temperature in the central area of the glass depends on several factors, the most significant of which are mentioned in more detail below:

Orientation
Glass facing south or west is more exposed to sunlight than glass facing north.

Tilt
Glass absorbs the most heat when sunlight strikes it at a perpendicular angle. If sunlight hits the glass at an angle, part of the radiation is reflected. The most critical angle of incidence ranges from 30–50° depending on orientation.

Heat absorption
Colored glass absorbs more sunlight than clear glass causing it to become warmer. Similarly, low-emissivity coated glass (energy glass) also has a higher absorption coefficient than clear glass.

Air movement around the glass
Air movement on both the inner and outer sides of the glass contributes to cooling. On windless days, the glass will reach a higher temperature.

Sunshades
Blinds installed on the inside or within a double-glazed unit reflect sunlight, which causes parts of the glass to heat more. Reduced air circulation further amplifies the heating effect. The choice of colors and the distance between the blind and the glass are important factors.

Number of glass layers
Multi-layered glass (e.g., triple-glazed units) tends to trap heat due to stagnant air between the layers. The middle pane in a triple-glazed unit is especially vulnerable. Standard energy glass should not be used as the middle layer.

Applied window films or decorations
Films or decorative elements applied to the glass can increase the temperature or cause uneven heating, as the film absorbs more sunlight than the glass itself.

Edge temperature

The temperature of the edge of the glass depends on several factors, including:

Heat conduction from the glass edge

If the frame has high thermal conductivity and lacks insulation between the frame and the wall, it can cause the glass edge to cool. This is especially true when the wall is made of materials with high

thermal conductivity and heat capacity, such as brick or concrete. Dark-colored frames also increase the risk of thermal breakage.

Shadow effects

Sharp shadows extending more than 100 mm from the edge can create temperature differences and thermal stresses in the glass. Shadows may come from awnings, vegetation, deep window recesses, roof overhangs, or neighboring buildings.

Solutions

- **Structural design**:
  When placing windows and doors, assess whether the glass may be exposed to critical temperature variations, including shadow effects from external shading, neighboring buildings, etc.
- **Glass edge quality**:
  Thermal breakage starts at the weakest point of the glass edge, so the edges must be smooth, sharp, and free of damage.
- **Frame insulation**:
  Insulation between the frame and the wall recess helps reduce edge cooling.
- **Heat-strengthened or tempered glass**:
  It is possible to calculate temperature gradients across the glass due to sunlight and shadow effects, which helps assess the risk of thermal breakage. Parameters in these calculations include orientation, tilt, glass size, absorption capacity, frame dimensions, wall protrusions, and shading (e.g., curtains).

If calculations show a risk of critical heat exposure, consider using tempered glass, which can withstand temperature differences of up to 300°C.

In summary

The risk of thermal breakage is highest for:

- South- and west-facing glass panes
- Glass tilted at an angle of 30–50° from horizontal
- Colored glass
- Low-emissivity coated glass
- Sunshades (blinds) and similar elements
- Applied films or stickers
- Triple-glazed units
- Facade and spandrel glass

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Important points:

- Glass edges must be free from damage.
- Insulation between the frame and wall is essential.
- Heat-strengthened or tempered glass should be used in critical constructions.
- Facade and spandrel glass should always be tempered.

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