

# VISUAL QUALITY OF INSULATING GLASS UNITS

Criteria for assessing deviations of the visual quality in Insulation Glass Units · English version July 2009

## The producer's responsibility

For claims in connection with punctures IGU s see "Glasindustriens Garantisikring 2008"

For approved claims based on the specifications in this publication the IGU producer shall, within one year of the original delivery date, supply free of charge, a replacement unit to the original delivery address.

The buyer is not entitled to compensation for installation cost for units with visual irregularities at the time of delivery. The above does not limit the buyer's rights under common Danish Law including the law of purchase.

## Claims

The buyer shall, immediately on receiving the units, examine them for visual irregularities and damage that may have been sustained during transportation from the factory to the buyers premises.

## Purity and quality of glass

Glass is an industrial product consisting mainly of lime, quarts and soda. The raw materials are thoroughly purified in the manufacturing process. In spite of this small impurities and minor scratches may from time to time occur on the inside surfaces of the finished IGU. See the table on page 4. Claims regarding impurities in the glass shall be assessed according to the

following methods, by which it shall be decided whether they are irrelevant and must be regarded as natural for the glass and therefore can not form basis for a claim or if they are so significant that they entitle the buyer to a replacement unit.

## Criteria for assessment

Units shall be viewed from the inside from a distance of 3 m. The viewing shall be done under diffused light conditions, not by artificial light or during direct sunlight. Visual irregularities and flaws that are not visible from this distance and under these conditions shall not be accepted as claims under the guarantee. When assessing reflections the distance of viewing from the outside shall be minimum 5 m.

Shadows, difference in colour nuances and distortions in reflections are deemed acceptable.

## Units with coated glass.

The coating on glass may contain Pinholes (small round area without coating) these form during the coating process.

The criteria for assessing pinholes are shown in the table on page 4.

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### Patterned- and wired glass

Irregularities of patterns are considered acceptable. Deviations in parallelism of the wires may occur in wired glass.

### Colour nuances in glass

Ordinary float glass used in IGUs is normally perceived as clear and colourless. It is actually green. The colour in the glass causes a reduction of the transmission of light. Two pieces of the same type of glass but of different thickness may therefore have different colour nuances. Coated or tinted glass may accentuate this effect.

The production of some types of coated or tinted glass may have ceased. They are therefore not available. The supplier or installer will be offer advice as to the best visual match of the existing glass. Because of the rapid development of new advanced types of glass it will at times prove difficult to match existing glass. In the case of coated or tinted glass produced by the same producer to the same specification but at different times, slight differences in colour may occur.

### Interference (Brewster Stripes)

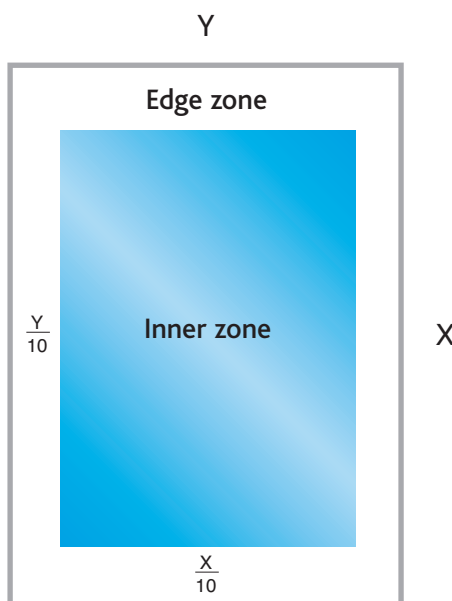
Brewster Stripes appear as irregular rainbow coloured stripes. They are usually only visible when looking through the glass at an oblique angle.

It is characteristic for Brewster Stripes that they "wander" when applying light pressure on the glass.

Brewster Stripes occur in units manufactured from float glass because of the extremely plane surfaces.

Light has a wavelength of between 0,00038 mm AND 0,00078 mm.

Daylight is composed of a number of different colours. This can be shown by sending light through a prism that breaks the light up into its spectral colours. When light pass through glass, any slight unevenness will mean that the light will have to travel a longer or shorter way. When these variations in distances coincide with the wavelengths of the various spectral colours the light is broken up and seen as blue, red and green.



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### Double glass effect

An IGU is a sealed unit and usually contains gas. The state of the contained gas is governed by the atmospheric pressure and the prevailing temperature at the time and place of production.

When installing the IGU at a different altitude and when exposed to variations in temperature and atmospheric pressure (high or low) the glass sheets will bow forming either concave or convex surfaces, resulting in visual distortions.

“Double glass effect” (distortions) can therefore appear with varying degrees on the surfaces of the IGU s.

If the IGU is seen against a dark background or if the glass is coated the “Double glass effect” may be exaggerated. This is a physical phenomenon that applies to all IGU s.

### Anisotropies

Anisotropies are physical effects in heat treated glass caused by differences in internal stresses in the glass.

Anisotropies may, depending on the angle of viewing appear as dark rings or stripes, when seen in polarizing light or through polarizing glass.

Polarizing light is present in normal daylight. The degree and strength of the polarizing light depends on the weather, the height of the sun and the direction of its rays.

The phenomenon is most noticeable when the glass is viewed at a flat angle or when two glass surfaces form an angle in relation to each other.

### Condensation on outer surfaces

INTERNALLY: Condensation may occur on the outer glass surface on the room side. In the case of a heated room this may be caused by high humidity or a poorly insulation IGU.

Modern IGU s insulate better. Resulting in a higher temperature on the surface on the room side. This reduces condensation.

EXTERNAL: Modern IGU s have, because of their better insulation characteristics, a lower temperature on the external surface. This may from time to time result in condensation on its external surface. This condensation is largely governed by weather conditions.

### Marks on glass surfaces

Condensation on the outer glass surfaces may temporarily reveal imprints from rollers, fingers, labels, suction cups, remnants from sealants and release agents or others production related markings.

### Oxidisation and tarnishing

Oxidisation appears as a greyish surface and is a chemical reaction caused by incorrect storage in a humid environment.

In concrete constructions leaching of alkaline materials may cause a chemical reaction on the glass surfaces.

## Permitted visual irregularities in glass:

	<b>Standard IGU</b>	<b>IGU with coated glass</b>
<b>Rebate zone</b>	External damage to edges or "shelling" Internal "shelling" filled with sealant Production remnants and unlimited scratches.	
<b>Perimeter zone</b>	<b>Bubbles, points, spots etc.</b> Glass area < 1 m <sup>2</sup> max no. 4 at < 3 mm. Ø Glass area > 1 m <sup>2</sup> max. no.1 at < 3mm. Ø Per linear meter length of perimeter. <b>Scratches.</b> Max 30 mm. x 2 mm. per individual scratch Total accumulated length max. 90 mm Hair line scratches permitted unlimited but not accumulated.	<b>Pinholes:</b> Ø 1 mm. – 1,5 mm. no. 5/200 mm. Ø > 1,5 mm. not permitted
<b>Inner zone</b>	<b>Bubbles, points, spots etc.</b> Glass area < 1 m <sup>2</sup> max no. 2 at < 2mm. Ø Glass area > 1 m <sup>2</sup> and < 2 m <sup>2</sup> max no. 3 at < 2 mm. Ø Glass area > 2 m <sup>2</sup> max no. 5 at < 2 mm. Ø <b>Scratches including hail line scratches</b> As for the perimeter zone.	<b>Pinholes:</b> Ø 1 mm. – 1,5 mm. no. 2 per m <sup>2</sup> Ø > 1,5 mm. not permitted
	<b>Laminated glass</b>	<b>Coated/laminated glass</b>
<b>Perimeter- and inner zone</b>	1. The permitted visual defects in the perimeter zone is increased by 50 % per extra layer of glass. 2. Cast laminated glass may show some waving caused during production.	<b>As for coated glass</b>
	<b>Tempered glass</b>	<b>Coated/tempered glass</b>
<b>Perimeter and inner zone</b>	According to DS/EN 12150	<b>As for coated glass.</b>
<b>Spacer bars.</b>	Claims in connection with spacer bars is not dealt with in this document. Butyl from the inner seal may show max 2 mm. beyond the inner edge of the spacer bar.	