

## **Quality Assessment and Complaints**

**Relates to Hammerglass® and float glass, including all business areas of Hammerglass AB**

Hammerglass® is a silicon oxide coated polymer product – 300 times stronger than glass. The surface coating provides UV resistance, chemical resistance and wear resistance. The Hammerglass sheets are flat and are available in the standard thicknesses 4, 6, 8, 10, 12 and 15 mm. Other thicknesses may be available. The sheets can be thermoformed, cold bent, laminated, edge polished and more.

The Hammerglass sheets are extruded by rolling plastic granules to the correct thickness and then allowing them to cool at room temperature. Black soot specks resulting from the heating process, dust particles, irregularities and rolling defects may occur but are usually sorted out in production control. Hammerglass AB has established permissible levels for the variation in material thickness and the size of black spots, and also for maximum distortion (diop-tre level). After extrusion the sheets are coated on both sides with a Hammerglass coating, and then further quality control is carried out. Despite this, defects in the sheets may still occur. The purpose of this document is to provide guidelines on how quality assessment of the products should be performed and how complaints are to be handled. These guidelines are based on the assessment of flat glass as described in EN 572 among other documents.

### **Marking and dimensions**

With the exception of projects such as noise barriers, bridges and roof solutions, where it is easy after project completion to determine from the project itself the date of installation, all Hammerglass screens/panes/panels are marked with the Hammerglass logotype, manufacturing number and protection class (if applicable) by means of laser engraving. This marking ensures traceability in the event of any guarantee issues, and facilitates supplier identification.

When specifying sheet size, external dimensions of the glass are to be indicated in millimetres in the form Width\*Height.

## **Assessment of defects**

### **Basis for assessment**

On assessment of Hammerglass® and float glass the viewing distance should be a minimum of 3 metres and the viewing angle should be 90 degrees to the glass. On assessment of glass roofs the intended viewing distance should apply. On assessment of noise barriers the viewing distance should be the distance that separates a person travelling on the road or railway from the barrier in question. Normal daylight conditions should obtain. That is to say there should not be any direct sunlight. Special lamps or lighting appliances which might amplify any defects must not be used.

Defects which have occurred after installation (scratches, coatings, splashes etc.) should not be assessed on the basis of these guidelines.

Since Hammerglass® has a coefficient of thermal expansion of 0.07 (the panes expand at a rate of 7 mm per metre from minus 20 °C to plus 40 °C), the dimensional tolerance has been set at 2%.

### **Visual quality**

Just as float glass, Hammerglass panes are divided into a middle zone – which is the main viewing field – and an edge zone. The edge zone normally consists of a 15 mm wide rim around the periphery of the glass.

### Point defects

Point defects are defects which have a core and a more or less indistinct rim, for example a soot flake or a dust particle. The maximum diameter or length of the core should be measured with an accuracy of 0.1 mm and assessed in accordance with the table.

Category	Point defect core (x)	Permitted number of defects in pane surface (A) 0 m <sup>2</sup> < A ≤ 5 m <sup>2</sup>	Permitted number of defects in pane surface (A) 5 m <sup>2</sup> < A ≤ 10 m <sup>2</sup>	Permitted number of defects in pane surface (A) 10 m <sup>2</sup> < A ≤ 20 m <sup>2</sup>
<b>A</b>	0 mm < x ≤ 0.5 mm	No restrictions	No restrictions	No restrictions
<b>B</b>	0.5 mm < x ≤ 1.0 mm	1	2	4
<b>C</b>	1.0 mm < x ≤ 3.0 mm	Must not occur	1	1
<b>D</b>	3.0 mm < x	Must not occur	Must not occur	Must not occur

The minimum permitted distance between defects according to category B is 500 mm.

### Surface defects

Scratches and marks which are not visible from a distance of 3 metres (possibly further in the case of a normal viewing distance for roofs and noise barriers) under diffuse daylight conditions should not be regarded as defects.

### Yellowing and discolouration

Solar UV radiation affects most materials to a greater or lesser degree. Hammerglass® surface treatment reduces UV radiation by 99.96%, which means that the Hammerglass sheets will not noticeably change colour during their first 10 years. Colour changes are specified in the yellowing index, where a change measured in accordance with EN 16153 should be no more than 10 delta within a 10-year period. The change in light transmittance in relation to the original value must not exceed 6% over a 10-year period, measured in accordance with EN 16153.

Replacement on discolouration in accordance with Hammerglass AB guarantee conditions is as shown in the table:

Time from purchase	Percentage based compensation
Up to 5 years	100%
6th year	75%
7th year	60%
8th year	45%
9th year	30%
10th year	15%

### Micro-cracks

The silicon oxide surface coating forms a glass-like surface with a degree of hardness considerably higher than that of the polymer sheet itself. The Hammerglass sheet varies in size on the basis of differences in temperatures, and the surface coating follows movements in the sheet. After a number of years micro-cracks may occur in the surface coating. This does not affect the service life of the sheet to any appreciable extent, nor does it accelerate yellowing of the sheets. Micro-cracks are a well-known phenomenon occurring in all forms of hard-coated polymer and are not regarded as a defect. One of the causes of micro-crack formation may be that the sheet is installed in such a way that it is unable to move with temperature variations. It is therefore important to follow the Hammerglass AB installation instructions.

### Breakage

Hammerglass AB guarantees that the panes will not crack or break apart under the effect of weather or wind within a 10-year period from the date of installation. The precondition for this guarantee is that the panes should be installed in accordance with Hammerglass AB instructions, where account is taken of the fact that the panes must be allowed to move freely with temperature fluctuations and that any holes made in the panes should be in accordance with instructions.

## Assessment of glass panes

### Insulated glazing panel consisting of toughened glass

Toughened glass and thermally heat treated glass are float glass which has been heated to a high temperature and then rapid-cooled, with a view to giving the glass better impact strength and resistance to thermal changes, but also in order to form granular chunks if the pane breaks. Point defects and surface defects should be assessed as for float glass and Hammerglass®. Over and above these defects undulation, bulging and impressions resulting from the tempering furnace or from work tools may also occur. There are also industry-wide assessment principles applicable to such defects. Contact Hammerglass AB to obtain these specifications.

### Laminated glass

When two or more panes of float glass, toughened glass or Hammerglass® are bonded together, the result is strengthened glass solutions which are used for firearms protection, for example. When assessing defects in such glass, the number of panes should be taken into consideration. Here too, industry-wide assessment principles are applicable; contact Hammerglass AB for more information.

In general, however, it can be said that point defects measuring less than 0.5 mm across are permissible, whereas point defects in excess of 3 mm are not.

### Coated glass

Glazing material which is installed in order to improve U-value or g-value is referred to as coated glass. Defects may occur in the coating in the form of scratches, point defects or loss of coating. The viewing distance for defects is 3 metres and the maximum viewing angle is 30 degrees to the glass. These rules apply both to transmission and reflection. Defect types and assessment criteria are supplied by Hammerglass AB and based on industry-wide standards.

## Assessment of insulated glazing units

An insulated glazing unit is an assembly of two or more panes separated by an insulating gap conforming to a specified interval, where the edge of the unit has been sealed with butyl or a similar material. The gap between the glass panes is frequently filled with a gas in order to reduce heat transmission.

### Tolerance requirements and external appearance

An insulated glazing panel is permitted to vary by  $\pm 1.5$  mm in the case of double-pane configurations and by  $\pm 3$  mm in the case of triple-pane configurations. Hammerglass Insulate is an assembly of several different types of glazing material. It is natural that these create visual interference, particularly if a pane is viewed from a narrow angle. When assessed, an insulated glazing panel should always be viewed from an angle of 90 degrees to the panel and from a distance of 3 metres. Assessment should be made in normal daylight (not sunlight) and in the absence of humidity, whether inside or outside the panel. Artificial lighting or marking of defects in the glass to make them visible from a greater distance is not permitted on quality assessment. Furthermore it should be taken into account that the appearance of an insulated glazing panel may be perceived differently depending on the type of frame and glazing system.

If defects are detected in coated glass, the assessment of the defects should be made in accordance with EN 1096.

### Optical variations

An insulated glazing panel is tightly sealed and the volume of the gas contained within the glazing unit may change depending on, among other things, temperature, air pressure, solar radiation and so forth. The result may be that the panel assumes a convex or concave form which in itself can give rise to an optical phenomenon which is reminiscent of oil on water. The phenomenon is called the double-pane effect and is not a defect but rather proof that the unit is hermetically sealed.

### **Tints**

Normal glass has an almost clear coloration, whereas thicker panes tend towards a greenish tone. Tinted or coated glass also lends a tint to the insulated glazing panel. Optical phenomena with the exception of Newton rings are not normally grounds for complaint.

### **Newton rings**

If two panes of glass in an insulated glazing unit move in relation one to the other, there occurs something known as Newton rings, which is experienced as circular or ellipsoid rings, often in colours of the rainbow. Since the glass panes should not move in relation to each other, this defect does constitute a ground for complaint.

### **Specks and defects in insulated glazing panels**

Since the glazing unit consists of two or more panes, the number of permissible defects should be multiplied by the number of panes contained in the unit in order to establish the permissible quantity of defects.

### **Scratches**

Scratches which are not visible from a distance of 3 metres (or further, if a different viewing distance is in force) in normal, diffuse daylight do not constitute grounds for complaint.

### **Dirt between the panes**

The panes in an insulated glazing panel should be thoroughly cleaned and there should be no dirt particles, streaks or marks from suction pads. Irregularities which are not visible from a distance of 3 metres (or further, if a different viewing distance is in force) in normal, diffuse daylight are not to be regarded as defects.

### **Condensation**

Internal condensation on insulated glazing panels is not normal, but may occur in the peripheral zones of the panes. External condensation is simply a sign of the fact that the panel is well-insulated and is therefore not a ground for complaint. The phenomenon is not usual but may occur where there is a combination of high humidity, calm weather and a starlit sky. Condensation between the panes of an insulated glazing panel should not normally occur.

### **Warranty**

5 years' full insulating glass warranty.

## **Special provisions relating to Hammerglass Automotive**

### **Driver's cab**

For the cab side screens the same assessment criteria as given above apply. For the windscreen, where special regard must be given to the driver's need for good visibility, the dioptré value of the screen should not exceed 0.07, and the viewing distance for point defects and surface defects should be 1 metre (instead of 3 metres).

## **Special provisions relating to Hammerglass Infrastructure**

### **Noise barriers**

In those cases where Hammerglass AB is responsible for the installation of entire noise barriers, quality assessment may also be carried out in relation to steel and wooden components contained in the structure, and to the installation itself. Reference should in general be made to the rules laid down in AB 04. As regards tolerance requirements for installation of the barrier, posts are allowed to vary by a 10 mm individual distance in depth direction. The panels may vary by 20 mm in height direction and may have an individual variation in inclination of 2 degrees.

## Breakage and damage

### Transport damage

If, during transportation, damage occurs to Hammerglass panes or if glass contained in an insulated glazing unit breaks, the damage is covered by the carrier's insurance and should if possible be reported to the carrier when the consignment arrives. If the damage is first discovered on installation, it should be immediately reported to Hammerglass AB, so that the forwarding agent can be given the opportunity to inspect both the packaging and the damage.

### Over damage

If a glass pane breaks after the glass has been installed, Hammerglass AB is not normally responsible for the damage. The glass may have been damaged during installation or affected in various ways by person or property. If there is uncertainty surrounding the cause of the breakage, please contact Hammerglass AB for an inspection in situ.

## Complaints handling

### Complaints

General provisions for delivery of Hammerglass® are regulated by ABM 07.

(Planglas [Float Glass] 2009, section 8 Complaints/replaces AMB 07, section 19):

'A defect shall be complained of within a reasonable time after it has been noticed or ought to have been noticed. In the case of defects which ought not to have been noticed by the Buyer during the latter's reception inspection, a complaint shall only be regarded as having been made at the correct time if...

**a)** ... it has been made within a reasonable time after receipt from the Buyer's orderer and...

**b)** ... the latter has complained within a reasonable time after the defect has been noticed or ought to have been noticed.

The complaint shall in all circumstances be made prior to installation of the delivered goods, if the defect would have been noticeable during any one of the inspections specified in Planglas [Float Glass] 2009, section 6. If a complaint has not been made in accordance with this section, the Buyer shall be deemed to have forfeited his right to complain of the defect in question.'

### Liability

(Planglas [Float Glass] 2009, section 9 Liability/supplements ABM 07, section 20):

'The Seller's liability for defects in delivered goods shall be assessed on the basis of the condition of the goods on delivery. If inspection in accordance with these provisions does not take place, then the Buyer thereby forfeits his right to complain of any defects or damage which ought to have been discovered on such inspection. It rests with the Buyer, should he wish to complain of a defect, to prove not only that the defect existed on handover but also that it ought not to have been discovered on inspection. If inspection has not taken place in accordance with these provisions, then the Buyer does not have the right to claim that the provision of any guarantee by the Seller should imply that the burden of proof in relation to defects would thereby have transferred to the Seller.'

(ABM 07, section 20):

'The period of liability is ten years calculated from the handover of the goods and it begins with a guarantee period of five years.

(ABM 07, section 20):

'The Seller is liable for defects that appear and are reported during the period of liability. For defects that appear after the expiry of the guarantee period, however, the Seller is liable only if the defect is substantial and is shown to be due to negligence on the part of the Seller.'

(ABM 07, section 20):

'If during the guarantee period the Seller is of the opinion that he is not liable for a reported defect, it is up to him to show that the goods are in accordance with the contract or to show probability that the reported defect is due to a circumstance on the Buyer's side.'

**Quality complaints**

Hammerglass AB will provide a new screen/pane/insulated glazing panel and will refund the agreed cost of replacement of the screen/pane/panel in those cases where the screen/pane/panel is deemed to exhibit quality defects or, in the case of an approved guarantee claim, is in accordance with the assessment principles described above.

**Notification of complaint**

Notification of a complaint should normally be made to the Seller who has supplied the screen/pane/panel. The latter should in turn respond by quickly contacting Hammerglass AB for further handling of the complaint. A complaint should contain indication of the following:

- The address at which the goods concerned may be inspected, the relevant contact person and contact details
- Hammerglass AB marking number (introduced by the letters HG)
- The number of units affected and the dimensions of each unit
- The reason for the complaint, supplemented please by photos or a drawing
- The original order date and order number

**Inspection**

Hammerglass AB shall decide whether inspection in situ is necessary. In certain cases the cost of this inspection may be debited, if for example it ought to have been manifest that the damage concerned does not constitute a ground for complaint, or if it is not in fact a Hammerglass product which has been installed.