

The defects of door and window joinery are assessed with reference standards applicable to the products and its components. The reference standards include proprietary standards of product manufacturers.

## JOINERY

Before attempting any finishing work, inspect the windows and balcony doors to verify proper installation and operation with the following criteria:

- The maximum vertical and horizontal deviation for components up to 3000 mm long is 1.5 mm/m.
- The maximum diagonal length difference of the casement and the frame is 2 mm and 3 mm for components up to 2 m and 3 m long, respectively.
- The casement must open and close smoothly and without snagging.
- When open, the casement must not close or open further by itself.
- When closed, the casement must snugly and completely meet the frame to ensure seal.
- Frame deflection (deformation): 1.5 mm per 1 linear metre maximum for PVC windows, and:
  - Measure the deformation with the casement closed.
  - Do not add the deformation results. If the casement is deformed in one direction, the frame can be deformed in the opposite direction and the total deformation value shall not exceed the maximum limit specified above.
  - The in-plane deformation (concave or convex) must not cause the locking fixture to disengage.
  - No deformation must damage any window component, including ripping or failure of the locking fixture, failure of the weatherstrips, corrosion of locking fixtures, or damage to the frame (by chipping or nicking).
- The product deformation, including changes of shape or dimensions, must not significantly reduce the operating performance.

If any deviations are found, adjust the locking fixtures by readjusting the casement-to-frame alignment.

## ALUMINIUM PROFILES

The surface of the profiles should be finished by anodizing or polyester powder coating. Both treatment options provide anti-corrosive protection. The coating appearance is assessed within areas of interest important to the aesthetic quality and performance of the product. The areas of interest do not include the surfaces concealed by the closed casement, edges, deep or large recesses, or secondary surfaces.

Assess away from direct sunlight. All defects must be visible in the following assessment conditions: the viewing angle of the area of interest is approx. 60°, and:

- For external areas of interest: view from a distance of 5 m;
- For internal areas of interest: view from a distance of 3 m.

The coating within the area of interest must be free from scratches reaching the bare substrate. The area of interest shall not feature these defects: heavy roughness, streaks, runs, blisters, inclusions, pitting, flat tarnish, or porosity. The coating must be of uniform colour, glossy, and hiding the substrate well. The thermal break in composite profiles can be completely or partially coated.

## PVC PROFILES

The profile appearance is assessed within areas of interest important to the aesthetic quality and performance of the product. The areas of interest do not include the surfaces concealed by the closed casement, edges, deep or large recesses, or secondary surfaces.

The reference standards require assessment of the profile appearance from a viewing distance of 1 m or more. The external areas of interest must be viewed in diffused daylight. The internal areas of interest must be viewed in normal (diffused) artificial light with a viewing angle square to the area of interest (with a maximum variation within  $\pm 30^\circ$ ). Proceed with the assessment once evidence of operation is removed (this applies dirt from ventilation, debris, and cleaning effects).

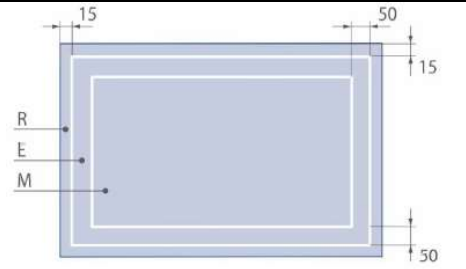
The area of interest shall not feature these defects: holes, blisters, indentation, surface irregularities, or deep scratches through the surface layer (down to the matrix). Defects include every evidence of peeling or loss of adhesion of the finish film.

**GLASS**

The IGUs must be assessed by viewing under transmitted light instead of reflected light (look through the glass and not on the glass surface) from a minimum distance of 3 m from the glass face and from the interior to the outside. The viewing angle should be as close to perpendicular to the glass as possible. There should be no evidence of defects on the glass. Perform this assessment in diffused daylight (with overcast sky) and without direct illumination by sunlight or artificial light sources. The viewing time is limited to 1 minute per 1 m<sup>2</sup>. The assessment of IGUs from the outside must be done under the installation conditions, and the minimum standard viewing distance is 3 m. The viewing angle should be as close to perpendicular to the glass as possible.

The following tables specify the maximum defects for IGUs and the defects typical of IGU bonding.

Area of interest

|        |   |  |
|--------|---|--|
| Zone R | The 15 mm wide area, usually concealed by the frame or corresponding to the edge weatherstrip for non-framed edges. |  <p>IGU area of interest</p> |
| Zone E | The 50 mm wide area along the exposed surface.  |  |
| Zone M | The main zone of interest   |  |

Maximum spot defects (applicable to single IGUs made of two monolithic glass panes).

| Zone of assessment | Defect size [ø, mm] (w/o the 'halo') | Glass pane surface, S [m <sup>2</sup> ]      |  |           |                       |
|--------------------|--------------------------------------|--|--|-----------|-----------------------|
|                    |                                      | S ≤ 1  | 1 < S ≤ 2                                    | 2 < S ≤ 3 | S > 3                 |
| R                  | Every dimensions                     | Unlimited                                    |  |           |                       |
| E                  | ø ≤ 1                                | Less than 3 is acceptable per every ø 200 mm |  |           |                       |
|                    | 1 < ø ≤ 3                            | 4  | 1 per each linear metre of the glass outline |           |                       |
|                    | ø > 3                                | Unacceptable                                 |  |           |                       |
| M                  | ø ≤ 1                                | Less than 3 is acceptable per every ø 200 mm |  |           |                       |
|                    | 1 < ø ≤ 2                            | 2  | 3  | 5         | 5 +2 / m <sup>2</sup> |
|                    | ø > 2                                | Unacceptable                                 |  |           |                       |

The 'halo' is an area of localised optical distortion, usually around a spot defect within the glass.

Maximum impurities (applicable to single IGUs made of two monolithic glass panes).

| Zone of interest | Defect size [ø, mm]<br>Defect type | Glass pane surface, S [m <sup>2</sup> ]         |  |
|------------------|------------------------------------|---|--|
|                  |                                    | S ≤ 1   | S > 1  |
| R                | Every dimensions                   | Unlimited                                       |  |
| E                | Spots, ø ≤ 1                       | Unlimited                                       |  |
|                  | Spots 1 < ø ≤ 3                    | 4   | 1 per each linear metre of the glass outline |
|                  | Stain, ø ≤ 17                      | 1   |  |
|                  | Spots, ø > 3<br>I stain > ø 17     | Max. 1  |  |
| M                | ø ≤ 1                              | No more than 3 is acceptable per every ø 200 mm |  |
|                  | Spots 1 < ø ≤ 3                    | No more than 2 is acceptable per every ø 200 mm |  |
|                  | Spots, ø > 3<br>I stain > ø 17     | Unacceptable                                    |  |

Maximum linear defects (applicable to single IGUs made of two monolithic glass panes).

| Zone of interest | Individual length (mm) | Total length (mm) |
|------------------|------------------------|-------------------|
| R                | Unlimited              |                   |
| E                | ≤ 30                   | ≤ 90              |
| M                | ≤ 15                   | ≤ 45              |

Visual assessment criteria for other IGUs

The foregoing tables should not be applied for the assessment of any IGU at least one component of which is made of textured rolled glass, armoured glass, textured armoured glass, plain drawn glass, or refractory drawn glass.

The visual quality of heat-tempered safety glass, annealed or not, and heat-toughened glass within an IGU or a laminated glass pane which belongs to an IGU shall conform to the applicable reference standard of the product. For heat-treated float glass, the overall convexity along the whole glass edge must not exceed 3 mm / 1000 mm of the glass edge. Higher convexity values may be present in square glass or rectangular glass close to square form (with the maximum ratio of 1:1.5) and in single glass panes less than 6 mm thick.

The maximum acceptable number of defects for IGUs not made from two monolithic glass panes

The maximum acceptable number of defects specified for single IGUs made of two monolithic glass panes is increased by 25% for every additional glass pane (this applies to multi-chamber IGUs and laminated glass layers). Round up the maximum acceptable number of defects.

Example 1. To determine the maximum acceptable number of defects in a double IGU made from three monolithic glass panes, multiply the maximum acceptable numbers of defects from the tables above by 1.25.

Example 2. To determine the maximum acceptable number of defects in a single IGU made from two laminated glass panes, with each made from 2 glass panes, multiply the maximum acceptable numbers of defects from the tables above by 1.5.

Definition of defects

Spot defects: hemi to fully spherical distortions of visual transparency seen while looking through the glass. They might include inclusions of solids or gas, or spot defects in a coating or laminated glass.

Impurity: any material in the form of a spot or a stain on the glass surface.

Linear defect: defects which can be present on or in the glass and form deposits, stains, or scratches, and where one of the dimensions of the defect is longer than the other or the defect occupies an elongated surface area.

Physical characteristics to be ignored in assessment

Colour integrity: given the possible levels of iron oxide in glass, the coating deposition process, the coating itself, and/or variations in glass thickness or the IGU/laminate bonding structure, perceived differences in glass colour may appear.

IGU colour difference: IGUs which feature coated glass may exhibit variations of tone of the same colour. This phenomenon can be amplified when viewed at an angle. The possible root causes of colour differences include slight colour variations of the substrate under the coating and small variations of the coating thickness. An objective assessment of colour difference can be performed with the test method specified in ISO 11479-2.

Interference: in float IGUs, interference may result in spectral colours. An optical interference is caused by superposition of two or more light wave bands at the same location. This phenomenon is perceived as variation in the intensity of the spectral colours which vary with the pressure applied to the glass. This physical phenomenon is amplified by the parallelism of the glass surfaces. Interference may appear at random and cannot be avoided.

Specific barometric pressure effects: an IGU contains a sealed volume of atmospheric air or another gas. The containment is formed by the IGU edge seals. The gas volume generally depends on the altitude (the height above sea level), barometric pressure, and air temperature at the time and location of production. If the IGU is installed at an elevation or the temperature and/or barometric pressure is different from the production values, it will be exposed to bending which result in optical distortion. This effect can be prevented by equalizing the internal pressure of the IGU with a dedicated device to a level which will ensure proper performance at the installation location. Contact us for the specifics.

Multiple reflection (ghosting): the surface of an IGU may show multiple reflections, each of different intensity (a.k.a. ghosting). These reflections are visible particularly well if the background behind the IGU viewed through is dark. This phenomenon is a physical property of all insulated glazing units.

Anisotropy (irization): IGUs with heat-treated glass components may reveal a visual phenomenon called anisotropy, ref. EN 12150-1 and EN 1863-1.

Condensation of the external IGU surface: external glass surfaces may develop condensation if the glass surface is colder than the ambient air. The intensity of condensation on external glass surface depends on the U-value, relative humidity, air movement, and indoor and outdoor temperatures. If the relative humidity is high and the glass surface temperature falls below the ambient temperature, humidity condenses on the glass surface.

Glass surface wettability: the appearance of glass surfaces may vary with the effect of processing rollers, finger marks, labels, handling suction cups, residues of sealants and silicone compounds, residues from smoothing agents and lubricants, ambient exposure, and more. This may become evident when the glass surface is wet with condensation, rain, or wash water.

Cracking of glass: glass is a hard, brittle, amorphous, homogeneous solid. It has negligible internal stresses, which makes it easy to process and cut. Glass cracks under thermal or mechanical stress from external sources. The glass cracked by these phenomena after delivery to the customer cannot be claimed on warranty. The resistance of glass to cracking from thermal or mechanical stress can be improved by tempering or thermal strain hardening. This applies especially to high-impact glass.

## **COLOUR, TEXTURE, AND GLOSS**

These characteristics cannot be assessed for compliance with sample decks. Sample decks are indicative only and represent a small portion of the material which will coat the profiles. Moreover, most samples are not applied on the actual production substrates. When replacing or repairing components or parts thereof, differences in gloss level and colour may result in comparison to the components or parts pre-existing or already delivered, and exposed to outdoor elements for certain time.