

## EUROPEAN ASSESSMENT DOCUMENT

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# CANTILEVERED STRUCTURAL HORIZONTAL GLAZING (STRUCTURAL GLASS CANOPY/ROOF)

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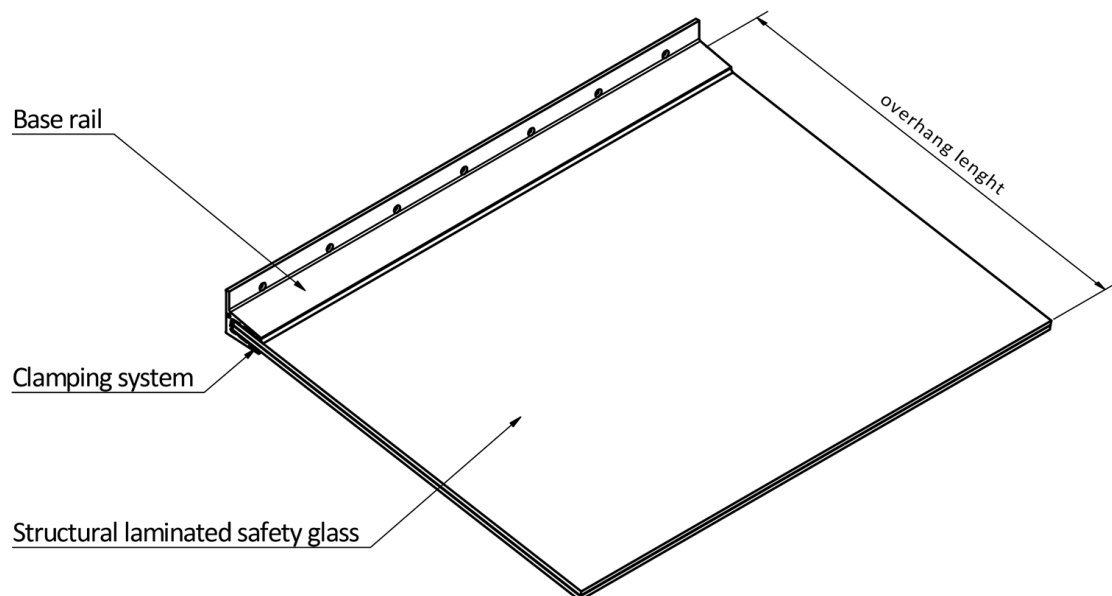
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## 1 SCOPE OF THE EAD

### 1.1 Description of the construction product

Cantilevered structural horizontal glazing (structural glass canopy / roof) is a kit<sup>1</sup> and consist from:

- Continuous bearing base rail in which the glass element(s) is/are clamped. Base rail is fixed to the building. Connection elements with which the bearing base rail is connected to the building are out of the scope of this EAD.
- Structural laminated safety glass according to EN ISO 12543-1, EN ISO 12543-2 and EN 14449. Only one edge of the glass element is supported. Each glass element is mechanically secured to restrict it's horizontal movement.
- Clamping system is a set of elements with which the glass-panes are imbedded / clamped into a base rail.



General drawing of the Cantilevered structural horizontal glazing is presented on Figure 1.

The kits are to be designed and erected in accordance with the ETA-holders specifications and comprise factory produced components as the parts of the kit supplied by the ETA-holder or by other manufacturers supplying to the specification of the ETA holder who has overall responsibility for the kit.

Outside the scope of this EAD are:

- Kits incorporating covering elements of main material other than glass.
- Kits incorporating covering elements that are not exclusively cantilevered fixed.
- Canopy / roof kits that may be subject to imposed loads other than those detailed in this EAD, for example pedestrian or other traffic.

<sup>1</sup> "Kit" means a construction product placed on the market by a single manufacturer as a set of at least two separate components that need to be put together to be incorporated in the construction works (Art 2 no 2 CPR).

- Kits incorporating provision for services, maintenance access (e.g. walkways, handrails and footholds) and safety (e.g. hooks and anchorages), ventilation of the building of which it forms the roof or part of the roof.
- Sliding, folding or otherwise opening roof kits.
- Canopy / roof kits that are intended to provide temporary protection to a building.
- Individual and continuous roof lights covered by hEN.

Connection elements with which the bearing profiles are connected to the building are out of the scope of this EAD. The manufacturer shall specify in the manufacturer's product installation instructions (MPII) general conditions and instructions regarding the applications of connection elements. The information regarding the application of the connection elements shall be recorded in ETA.

The product is not covered by a harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

### 1.1.1 Definition of product

The detailed specification, materials and dimensions of the product and product components must be defined in the MPII. Technical Assessment body (TAB) will record this information in the ETA within characterisation of product during the assessment of the product.

#### 1.1.1.1 Base-rail

Base rails are made of monolithic extruded aluminium profiles. The gap between two adjacent profiles interlinked with a single glass pane should not exceed 40 mm.

Base rail profiles have a line of bores for screws (bolts or studs).

Base rail can be fixed directly to the support structure (e.g. concrete or metal substructures) by means of various fixing or anchoring-systems.

#### 1.1.1.2 Clamping / adjusting system

Clamping system consists of:

- front support band
- front support seal
- rear support band
- clamping bar
- adjusting system
- safety elements that prevent the pull-out of glass-pane

No contact between glass and metal may occur. For ensuring the durability of the product, no fixing of the glass-panes into the base rail by means of adhesion materials or grouting are allowed due to shrinking and possible chemical reactions with glass, lamination foil and other system

components as well as due to risk of inhomogeneous application of adhesion materials, sealants or grouts.

#### 1.1.1.2.1 Front support band

is made of EPDM rubber. Front support band is mounted along the whole length of the bottom front edge of the base rail and provides a continuous support to the clamped glass-pane.

#### 1.1.1.2.2 Front support seal

is made of EPDM rubber. Front support seal is mounted along the whole length of the upper front edge of the base rail and provides a continuous support to the clamped glass-pane under uplift loads.

#### 1.1.1.2.3 Rear support band

is made of POM or PA6 plastic. Rear support band is inserted into a socket of the base rail and supports the upper rear edge of the glass-pane.

#### 1.1.1.2.4 Clamping bar

is made of POM or PA6 plastic. The length of each bar is 30 to 60 mm. The distance between two adjacent bars should not exceed 200 mm. Every glass-pane must be clamped with at least 3 bars. The bars provide support to the clamped glass-pane under uplift loads. Instead of clamping bar the EPDM straps of the same length and thickness can be used.

#### 1.1.1.2.5 Adjusting system (Alternative)

Alternatively, an adjusting system can be used. It consists of:

- compensation inserts
- compensation straps (bands)
- adjusting grub-screws

The ETA applicant / manufacturer can decide to omit the adjusting system.

#### 1.1.1.2.6 Safety elements that prevent the pull-out of pane

Safety elements with function to prevent the pull-out of the glass-pane must provide mechanical safety against the pull-out of the glass-pane. Safety elements may exclusively fulfil only this one function (e.g. in case of down-folding of the damaged glass-pane).

Safety elements may not contribute to system load-bearing performance. They may not serve as base-rail reinforcements of any kind nor as connections or part of connection elements that may be stressed permanently (directly or indirectly) under external system loads (e.g. weight, wind or snow load). The connection elements must be revisable without dismounting the glass-panes. No contact between glass with harder materials (e.g. metal) may occur.

#### 1.1.1.3 Structural laminated safety glass

Multilayer safety glass (VSG) consist of two or three layers of

- heat strengthened (soda lime silicate) glass (TVG) according to EN 1863-1 and EN 1863-2 with breaking stress of minimum 70 N/mm<sup>2</sup>.

or

- thermally toughened (soda lime silicate) safety glass (ESG) according to EN 12150-1 and EN 12150-2 with breaking stress of minimum 120 N/mm<sup>2</sup>.

bonded with

- ionomer sheet (SGP) e.g. SentryGlas®5000 according to German technical approvals AbZ Z 70 3 143 and Z 70 3 170 (DIBt, Berlin), with rupture strength > 30 N/mm<sup>2</sup>, elongation on break > 300 % (or equivalent national assessment).

or

- polyvinyl butyral foil (PVB) according to prEN 16613:2013, with rupture strength > 20 N/mm<sup>2</sup>, elongation on break > 250 %.

Other applicable materials may be used for interlayer if verified that these properties are equivalent or better than the above stated and do not degrade the properties of other system components.

Glass edges are arrissed and polished according to EN 1863-1 and EN 12150-1.

Glass surfaces may be printed in following circumstances:

- The breaking stress/bearing capacity of glass in the clamping area (at least the clamping depth  $e + 40$  mm from the cantilevered glass edge) may not be reduced due to the printing.
- The breaking stress of the printed glass under printed surface outside the clamping area may not be less than 50% of the values of the unprinted glass stated above.
- Printed glass is to be used and applied strictly according to the appropriate national provisions. All regulations and documents regarding the printed glass as well as the instructions of the manufacturer must be followed. The ETA does not amend this in any way.

Only one layer of multilayer safety glass may have slots or bores for elements that prevents the pull-out of the glass-pane.

## 1.2 Information on the intended use(s) of the construction product

### 1.2.1 Intended use(s)

This EAD covers cantilevered structural glass canopy/roof or other horizontal glazing. Product is not walkable. The system can be installed inside or outside buildings, where it can be exposed to adverse weather conditions.

It consists either of single glass element or it can be consecutively, independently aligned to form a stripe of undefined length. Glass-panes may be inclined from  $-25^\circ$  to  $+25^\circ$  from horizontal level.

The product can be categorized into following use categories:

- use category A - cantilevered structural glass canopy,
- use category B - structural glass roof or
- use category C - other horizontal, not walkable, cantilever structural glazing.

The assessment deals with cantilevered structural glass glazing intended for use under the following boundary conditions, which are implicitly assumed throughout the rest of the document:

- As part of structures capable of giving adequate support to the glass-panes and possessing adequate possibilities for attaching the roof to the structure such that all loads can be properly transmitted to the load bearing structure of the building.
- An average ambient air temperature in the range from  $-15^\circ\text{C}$  to  $45^\circ$  or according to national assessment for individual system components if apply.
- Hard and soft body impacts as enumerated in this assessment.
- No accessibility to the glass-panes, even for maintenance and repair purposes.
- As the canopy of buildings where requirements with respect to hygiene, air quality, protection against lightning, condensation etc. are of the same nature and magnitude as in dwellings, offices, schools, shops, institutions, and places of assembly etc.

The following use conditions are outside the scope:

- Exceptionally severe use such as acts of vandalism.

### 1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account an assumed working life of the cantilevered structural glazed system for the intended use of 20 years (10 years for EPDM rubber) when installed in the works (provided that the cantilevered structural glazed system is subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works<sup>2</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

## 1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

### Cantilevered canopy

Along (only) one edge clamped protective roof like covering, clamped in a base rail mounted on a sub-construction or building on the height up to 3.5 m plus overhang length above trafficked area / floor of a walkway or door.

### Cantilevered roof

Along (only) one edge clamped protective roof like covering, clamped in a base rail mounted on a sub-construction or building on the height more than 3.5 m plus overhang length above trafficked area / floor.

### Overhang length

The distance from the back-side of the base rail, where it is connects to sub-construction or building to the front edge of the glass-pane.

### Structural glazing (in context of this document)

In large extent unsupported, self-bearing glass element(s) which have a significant influence to the static stability of a system.

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<sup>2</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life referred to above.



**Glass-pane**

A glass element that may consist of one or more glass-layers laminated together with interlayer(s).

**Glass-layer**

A monolithic glass element/sheet as part of the glass-pane.

**Interlayer**

One or more layers in the glass-pane which glued two glass-layers together. (e.g. polyvinyl-butyril-foil, ionomer-foil etc.).

**Multi-layer laminated safety glass** (in context of this document)

Glass-panes that consists of multiple glass-layers of the same or different types or thicknesses, glued together with interlayers, which prevent total disintegration of glass-pane in case of damage to one or more glass-layers.

**Base rail**

Bearing profile at the base of the glass-panes in which the glass-panes are clamped.

**Clamping system**

A set of elements with which the glass-panes are imbedded/clamped into a base rail.

**Residual load-bearing capacity**

Load-bearing capacity of fully damaged glass-pane.

**Imposed damage** (in context of this document)

Damage imposed deliberately during testing to a designated location to the glass-pane in order to simulate accidental occurrences under which the glass may break.

**Fracture line**

A continuous crack initiated through external or internal influence that physically separates one glass-layer into several pieces. Fracture line runs along the entire width or length of the glass-layer from one edge to another.

**Crack**

A local crack or short fissure initiated through external or internal influence that doesn't separate glass layer into multiple parts.

**Not-walkable glazing**

Glazing that is not designed to withstand the imposed loads and actions of traffic loads for example from pedestrian or other traffic.

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 1 shows how the performance of Cantilevered structural horizontal glazing is assessed in relation to the essential characteristics.

**Table 1 Essential characteristic of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

No	Essential characteristic	Assessment method	Type of expression of product performance
<b>Basic Works Requirement 1: Mechanical resistance and stability</b>			
1	Mechanical resistance and stability to snow and wind load to EN 1991	2.2.3	snow load (kN/m <sup>2</sup> ) wind load (kN/m <sup>2</sup> )
<b>Basic Works Requirement 2: Safety in case of fire</b>			
2	Reaction to fire	2.2.4	Class according to EN 13501-1
<b>Basic Works Requirement 4: Safety and accessibility in use</b>			
4	Resistance to the pull-out of pane	2.2.5	See 2.2.5
5	Soft body impact resistance	2.2.6	Category (table 3 of this EAD)
6	Hard body impact resistance	2.2.7	Pass/fail
7	Residual load capacity of the product	2.2.8	Category (table 4 of this EAD)

### 2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

#### 2.2.1 General provisions

Verification and assessment shall be performed on samples representative for the product. The performance established thru the assessment for each characteristic shall be representative for the dimensions and shape range of the product.

#### 2.2.2 Characterisation

Characterisation of products to be assessed shall be done in accordance with table 2.

**Table 2 Product characteristics, methods of verification and criteria used for checking the product identity**

No	Characteristic/Property	Verification method	Criteria
1	Dimensions of the base rail, positions of bores for screws	2.2.3.3	Consistency with the dimensions in MPII
2	Material characteristics of the base rail	2.2.3.4	See 2.2.3.4
3	Bending strength of glass-panes	2.2.3.5	Consistency with the values from MPII

No	Characteristic/Property	Verification method	Criteria
4	Properties of the interlayer	2.2.3.6	Consistency with the values from MPII
5	Clamping (adjusting) system	2.2.3.7	See 2.2.3.7

### 2.2.3 Mechanical resistance and stability to snow and wind load of the Cantilevered structural horizontal glazing

If and when Eurocodes are quoted in this EAD as the methods for the assessment of certain system characteristics, their application in this EAD, as well as in the subsequent ETAs issued according to this EAD, shall be in accordance with the principles laid down in the EC Guidance Paper L on the use of Eurocodes in harmonised European technical specifications.

The loadbearing capacities of the Cantilevered structural horizontal glazing system, including relevant connections/joints, shall be assessed to characteristic snow and wind loads and material strengths with the partial safety factors according to national regulations.

The assessment may be done by structural FEM calculation, or by testing or as combination of calculation assisted by testing.

#### 2.2.3.1 Assessment by calculation

The assessment of the system (glass panes, base rail and anchoring bolts) by **calculation** can be undertaken by means of structural FEM calculation with validated computer programs and known material properties of all used components. Applicable materials and its properties should be stated in a corresponding ETA.

#### 2.2.3.2 Assessment by testing

The assessment **of system by testing** shall be done according a test procedure described in annex A of this EAD.

The testing shall be carried out on sample cantilevered structural horizontal glazing, representative of those to be supplied and/or erected in practice (normally in width of 1 m). The selection of the sample or samples needs careful consideration to ensure that it is fully representative. Normally, the sample(s) shall be taken from production and be fabricated in strict accordance with the manufacturer's drawings, specification and installation instructions.

Load is carried out either as uniformly distributed loads (e.g. by vacuum or air bag) or as evenly distributed point loads (e.g. sandbags or individual weights). Maximal declared nominal load is specified by the manufacturer. Maximal declared nominal load defines the allowable combined characteristic values of snow and wind loads assessed and calculated according to EN 1990 and EN 1991 and its respective national provisions.

Maximal nominal<sup>3</sup> load in kN/m<sup>2</sup> perpendicular to the Cantilevered Structural horizontal glazing surface depends of:

- the length of glazing (overhang length),
- thickness and type of glass-pane and
- type of base rail.

All Cantilevered Structural horizontal glazing data (length of glass pane-overhang length, thickness of glass, distance between anchoring elements, as well as width of the glass panes if relevant), and its reference to the snow and wind loads should be given in an ETA. A sufficient

<sup>3</sup>

Maximal nominal load is to be compared with the combination of characteristic snow and wind loads. Characteristic values of snow and wind loads as well as the combination of these two loads are to be assessed and calculated according to EN 1990 and EN 1991 and its respective national provisions

data to adequately design connection elements (anchoring bolts, screws, load transition to the support structure etc.) should also be given in ETA.

#### 2.2.3.3 Dimensions of the base rail, positions of bores for screws

Dimensions of base rail and positions of bores for screws shall to be determined by measuring using a calibrated device capable of achieving an accuracy of  $\pm 1\%$  of the measurement. Measurements may be performed by and during the TAB's assessment. The results of measurements shall be recorded.

#### 2.2.3.4 Material characteristics of the base rail

Base rail shall comply with EN 573-3. The corrosion resistance shall be in accordance with requirements of the Member State. The characteristic of material must be declared in the MPII. The manufacturer shall provide TAB information of base rail material's characteristics (supplier's certificate of compliance (EN 10204 Designation 2.1 or higher)) and TAB can eventually check characteristics of base rail.

#### 2.2.3.5 Bending strength of glass-panes

The characteristics bending strength is performed according to EN 1288-3. Testing the fracture pattern shall be carried out according to EN 12150 (thermally toughened soda lime silicate safety glass - ESG) or EN 1863 (heat strengthened soda lime silicate glass - TVG). The regulations of the respective Member state in which "Cantilevered structural horizontal glazing" is used shall be observed. The characteristic bending strength of the glass pane must be higher than declared in the MPII. Evaluation of the fracture pattern of the panes is done according EN 12150 (ESG) or EN 1863 (TVG).

The manufacturer shall provide TAB the information of glass panes characteristics and TAB can eventually check characteristics of glass pane.

#### 2.2.3.6 Properties of the interlayer

Tear strength and elongation at rupture of the interlayer made of PVB or ionomer sheet (e.g. SGP) shall be determined according EN ISO 527-3 with a test speed of 50 mm/min at 23 °C. The characteristics tear strength and elongation at rupture of the interlayer must be greater than declared in the MPII.

The manufacturer shall provide TAB the information of the interlayer characteristics.

#### 2.2.3.7 Properties of material of clamping (adjusting system) and safety element (EPDM, POM)

Clamping system (adjusting system) and safety element is made from EPDM or thermoplast (like POM). All elements for adjusting system have to be of material according to relevant standard. The quality of material must be declared in the MPII.

The manufacturer shall provide TAB the information of these characteristics.

### 2.2.4 Reaction to fire of the Cantilevered structural horizontal glazing

If necessary elements of cantilevered structural horizontal glazing shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1.

Note: In some Member States, the classification of cantilevered structural horizontal glazing according to EN 13501-1 might not be sufficient for the use as the cantilevered structural horizontal glazing.

The cantilevered structural horizontal glazing shall be classified according to EN 13501-1.

Note: In some Member States, the classification of cantilevered structural horizontal glazing according to EN 13501-1 might not be sufficient for the use as the cantilevered structural horizontal glazing.

### 2.2.5 Resistance to pull-out of the glass-pane

Safety elements prevent the pull-out of glass-pane and shall be tested with a pull-out test on the system assembly. During the tests the accidental loads that may stress the safety elements must be simulated. Test should be done according annex B.

The pull-out capacity of the system is determined according to the ultimate pull-out load. The pull-out capacity  $F_{EU}$  (see annex B) of glass pane shall be greater than self-weight of the maximal glass pane multiplied by 1.5 (safety factor 1.5 is specified as a product of safety factor for dead load  $\gamma_G$  and material safety factor  $\gamma_M$  according EN 1990).

### 2.2.6 Soft body impact resistance

The resistance to vertical impact by a soft body on horizontal assembly of cantilever horizontal structural glazing should be executed by the drop of a soft body with mass of 50 kg according to EOTA TR001: "Determination of impact resistance of panels and panel assemblies".

The test shall be carried out on least favourable arrangement assembly; in case of repeated impacts, every consequent test shall be carried out at about the same point of impact. The point of impact should yield the least favourable result (the largest length of glass pane) for the assembly under examination.

The cantilever horizontal structural glazing with least favourable width and maximum overhang length of glass-pane shall be mounted in accordance with the MPII, so that the test assembly corresponds as much as possible with the end-use conditions. In this test, the soft body impactor is dropped from a height (h), so that the total impact energy is equal to  $E = 9,81 \times h \times m$ . The height (h) is measured between the designated point of impact and the height of release of the soft body impactor (barycentre).

When tested according the paragraphs above, and according to their resistance to impact load of soft body, cantilever horizontal structural glazing kits are categorized as described in Table 3. The category shall be stated in an ETA.

**Table 3: Large soft body impact load categories**

Category	Impact Energy Vertical impact [J]
SB 1200	1200
SB 800	800
SB 600	600
SB 300	300
SB A*	A
SB 0	No requirement
* The value of A can be selected to meet specific requirements	

A successful test is achieved if neither the bag can pass through the specimen. In the case of multi-layered panes this refers to penetration of all layers of the pane. If damage of the outer layers occurs, this must be considered in relation to its effect on durability and residual load capacity of the canopy.

### 2.2.7 Hard body impact resistance

The hard body impact load with the 4.11 kg steel ball represents the action from heavy non-deformable objects such as tools or equipment which by accident hit the cantilever horizontal structural glazing when being used, during maintenance of the roof or adjacent structures. The

test shall consist of series of drops with heights from 1 m consequently alternating the impact area near the base rail and near the front unsupported glass-edge / corner.

When tested according the paragraphs above no penetration shall be acceptable. In the case of multi-layered panes this refers to penetration of all layers of the pane. If penetration (damage) of the outer layers occurs, this must be considered in relation to its effect on durability and residual load capacity of the canopy and to the safety of the occupants standing underneath.

### 2.2.8 Residual load capacity of the canopy

In order to assess the risk of unsafe breakage of a brittle structural element such as glass, a determination of a residual load-bearing capacity in case of accidental destruction shall be evaluated by testing.

The testing shall be carried out on sample kits, representative of those to be supplied and/or erected in practice. The selection of the sample or samples needs careful consideration to ensure that it is fully representative.

Several groups of specimens may need to be tested to gain information about the full range of options available for a given system, for example, changes to member size throughout the range or changes of the location and method of imposed damage.

The tests shall be carried out under constant dead-load of min. 0,5 kN/m<sup>2</sup>. The dead-load shall be distributed as uniformly as possible to the entire surface of the glass-panes of the cantilever horizontal structural glazing system. After the load is imposed to the glass-pane, all glass layers of glass-pane shall be force-damaged to a degree, where a global impact of the damage can be determined. Imposing the damage itself is not part of the test evaluation; therefore no explicit impact energy requirements are to be given.

The glass-panes shall be damaged by impacts alternating the following methods to ensure that the most unsafe damage is achieved. (During tests all methods shall be used for imposing the initial damage at least once. The methods that do not provide the sufficient damage described may be omitted from further testing):

- a Imposed damage of low intensity to the layers of the glass-pane, beginning by the topmost layer, and consequently moving to lower glass-layers.
- b Imposed damage of low intensity to the layers of the glass-pane, beginning by the bottommost layer, and consequently moving to upper glass-layers.
- c Instantly imposed damage of high intensity to all layers of the glass-pane
- d Imposed damage of high intensity to the upper surface of the glass-pane
- e Imposed damage of high intensity to the lower surface of the glass-pane

As an imposed damage the impact of the hard body with 4,11 kg steel ball from tests under this clause can be used for method d) if the sufficient damage structure complies with the criteria stated under this clause.

Following tools for imposing damage shall be used:

- a hammer (m=650 g) and a punch-tool – for imposing precise low intensity damages to the edges;
- a hammer (m=5 kg) – for imposing high intensity damage to the edge or surface;
- a steel ball (m=4,11 kg designed according to DIN 5401) – for imposing high intensity damage to the surface.

The location of the impact area of the imposed damage shall be alternated as follows (all locations shall be considered):

- on the unsupported front edge
- on the side edge near the unsupported front edge
- on the side edge near the clamping area

### Determination of sufficient damage

The imposed damage shall be determined as sufficient (global), if the influence of the damage affects the entire glass-layer so that all edges of the glass-layer indicate damaged. This shall be assessed by observing the break-pattern of each glass-layer. All following conditions must be met:

- At least one fracture line shall flow continuously from one edge to another;
- At least one fracture line shall be observed on each edge of the glass-layer;
- All glass-layers must meet the conditions from above stated conditions.

Only fracture lines that go through the entire thickness of the glass-layer continuously along the whole of its length shall be included in this observation. Cracks alone are not qualified as a global damage.

If the global damage cannot be determined, following steps shall be taken:

- a series of up to five subsequent procedures with the same method on the same location shall be carried out. The intensity may be increased;
- another method of imposed damage described above shall be used;
- another location for implying imposed damage shall be used:

The objective is to determine the residual load-bearing capacity of assembled cantilevered canopy/roof, constructed from the kit under constant dead-load (accidental load). As a result of assessed residual load-bearing capacity tests the risk for the occupants can be categorized. Determination of the overall resistance will depend on the method of assessment adopted from this chapter. The performance of the kit/system or a component may govern.

All of the following criteria/cases shall be assessed:

#### a) residual load-bearing capacity of the safety glass-panes

##### [c1] failing characteristics

Directly after imposed destruction of all glass layers, the speed of the down-folding of the damaged glass-panes shall be observed in relation to its effect on the safety of the persons standing underneath, if relevant. The risk for persons should be no greater as commonly accepted.

As criteria for assessment the following rule shall be verified. The tolerable process of down-folding of the damaged glass-pane must occur in long enough time to allow rational persons standing underneath the damaged canopy/roof, to acknowledge the imminent danger and to retreat from the endangered area in time and in safe manner. Area of imminent danger is space underneath the canopy/roof that can be breached by the down-folded damaged glass-pane. If the lower edge of hypothetically fully down-folded glass-pane remains more than 3,5 m above the trafficked area / floor, it is not necessary to consider it as the area of imminent danger.

##### [c2] stability of damaged glass-pane

The damaged/destroyed glass-pane must remain embedded (clamped) into the base rail for at least 24 h after the last imposed damage. The largest piece(s) of debris which fell of the broken element within 24 hours after the last imposed damage described in this chapter shall be documented, evaluated and compared by EN 12150 (ESG) or EN 1863 (TVG).

**Table 4: Residual load capacity categories**

Category	Description	For use in	Performance	
			criteria [c1]	criteria [c2]
RL 0	Cantilevered horizontal glazing	only over not accessible areas*	not passed	not passed
RL 1	Cantilevered roof	mounted on a sub-construction or building more than 3,5 m plus overhang length above the accessible area	not passed	passed
RL 2	Cantilevered canopy	no limitations	passed	passed

\* this can be circumstantially overridden by condition not covered by this document or ETAs.

b) load-bearing capacity of the base rail (bearing profiles)

Base rail must remain fixed in its original position for at least 24 h after the last imposed damage to the glass-pane.



### 3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

#### 3.1 System(s) of assessment and verification of constancy of performance

For the products covered by this EAD the applicable European legal act is: Decision 2003/656/EC of the European Commission<sup>4</sup>.

The system to be applied is 1.

#### 3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 5.

**Table 5 Control plan for the manufacturer; corner stones**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Factory production control (FPC) including testing of samples taken at the factory in accordance with a prescribed test plan</b>					
1	Dimensions of base rail	2.2.3.3	Drawings in the ETA	3/each type of base rail	Each delivery
2	Material characteristic of base rail	2.2.3.4	According MPII and ETA	Documents of supplier	Each delivery
3	Length of base rail, position of bores for screws	Laid down in control plan	Drawings in the ETA		1/10 base rail
4	Characteristics of laminated glass pane	2.2.3.5 2.2.3.6	According MPII and ETA	Documents of supplier	Each delivery
5	Dimensions of laminated glass pane	Laid down in control plan	According MPII and ETA		Each glass pane at delivery
6	Properties of material of clamping system (EPDM, POM)	2.2.3.7	According MPII and ETA	Documents of supplier	Each delivery
7	Dimensions of elements of clamping system	Laid down in control plan	Drawings in the ETA		Each delivery

#### 3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for Cantilevered Structural horizontal glazing are laid down in Table 6.

<sup>4</sup> Official Journal of the European Communities/Union L 231 of 17. 09. 2003.

**Table 6 Control plan for the notified body; corner stones**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b>					
1	The Notified Body shall ascertain that in accordance with the control plan, the manufacturing plant of the manufacturer, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the cantilevered structural horizontal glazing according the European Technical Assessment.				-
<b>Continuous surveillance, assessment and evaluation of factory production control</b>					
1	It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan.				once a year

## 4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

**EN 1990** Eurocode: Basis of structural design

**EN 1991-1-1** Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings

**EN 13501-1** Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

**EN 1288-3** Glass in building - Determination of the bending strength of glass - Part 3: Test with specimen supported at two points (four point bending)

**EN ISO 868** Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)

**EN 1863-1** Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description

**EN 1863-2** Glass in building - Heat strengthened soda lime silicate glass - Part 2: Evaluation of conformity/Product standard

**EN 12150-1** Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description

**EN 12150-2** Glass in building - Thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard

**EN ISO 12543-1** Glass in building - Laminated glass and laminated safety glass - Part 1: Definitions and description of component parts

**EN ISO 12543-2** Glass in building - Laminated glass and laminated safety glass - Part 2: Laminated safety glass

**EN 14449** Glass in building - Laminated glass and laminated safety glass - Evaluation of conformity/Product standard

**EN 14963** Roof coverings - Continuous rooflights of plastics with or without upstands - Classification, requirements and test methods

**EN 12600** Glass in building - Pendulum test - Impact test method and classification for flat glass

**EN 573-3** Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition and form of products

**EOTA TR001** Determination of impact resistance of panels and panel assemblies, EOTA, February 2003

**ETAG 016** Self-supporting composite lightweight panels, Part 2: Specific aspects relating to Self-supporting Composite Lightweight Panels for use in roofs, EOTA, November 2003

**DIN 18008-1** Glass in Building – Design and construction rules – Part 1: Terms and general bases

**DIN 18008-2** Glass in Building – Design and construction rules – Part 2: Linearly supported glazings

**DIN 18008-4** Glass in Building – Design and construction rules – Part 4: Additional requirements for barrier glazing

**Überkopfverglasungen im Rahmen von Zustimmungen im Einzelfall, Merkblatt G1**  
Regierungspräsidium Tübingen Landestelle für Bautechnik, Fassung 24.03.2009

## ANNEX A: VERIFICATION OF SYSTEM BY TESTING

### A.1. Testing scheme for testing to vertical uniform load

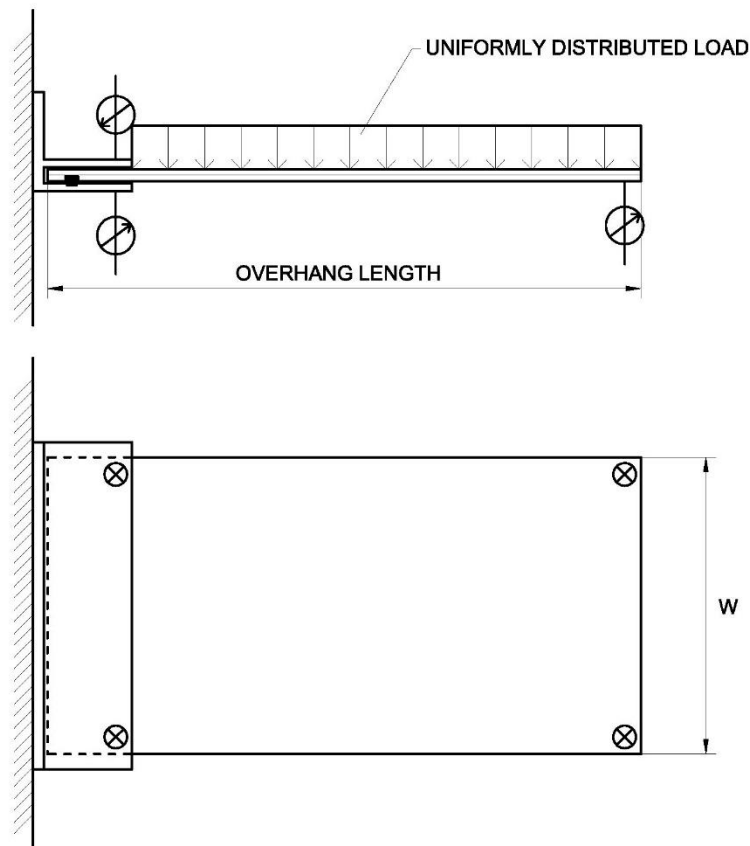


Figure A.1: Test apparatus

### A.2. Test specimen and number of tests

The test specimens for determination of load bearing capacity should be conditioning in normal room condition. The testing shall be carried out on sample cantilevered structural horizontal glazing, representative of those to be supplied and/or erected in practice (normally width of specimen of 1 m and maximal overhang length). Minimum 2 specimens should be tested.

### A.3. Test apparatus

The test apparatus shall be mounted in accordance with the schematic presentation in Figure A.1 and with the detailed specifications as set out below, or equivalent.

The apparatus shall be capable of continuously recording the specimen displacements to the nearest  $\pm 0.03$  mm.

### A.4. Test procedures

Load is carried out with an uniform load of a pre-weighted bags filled with steel balls of the maximum diameter of 1 mm distributed evenly over the entire surface of the pane. Load is applied up to the level of maximal declared nominal load in first stage and maximal declared nominal load multiplied by relevant safety factors in the second stage. Maximal declared nominal load is specified by the manufacturer. Maximal declared nominal load defines the allowable combined

characteristic values of snow and wind loads assessed and calculated according to EN 1990 and EN 1991 and its respective national provisions.

During all stages of loading and unloading (as well as one hour after unloading) the displacements should be measured at an estimated measurement points and the condition of the test specimens should be monitored.

#### **A.5. Evaluation of the test results**

At the level of the second stage of load there should not be any visible damage in the glass pane and the base rail in the each tested sample.

#### **A.6. Test report**

The test report shall include at least the following information:

- reference to this EAD, Annex A
- the name of the testing laboratory
- the name of the ETA-Applicant (and manufacturer of the product, if different)
- date of the test
- description of the test instruments
- identification of the product tested (designation, dimensions and any relevant identification characteristic)
- identification of the sample(-s) tested (dimensions, shape, etc.) and reference to its marking (if any)
- description of conditioning and preparation of the sample (if any)
- the rate of applying the load
- description of test conditions (temperature and RH)
- test load attained during the tests together with the corresponding displacements at all measurement positions;
- evaluation of the test result according A.5;
- specification of the mechanical fastener, their quantity and positioning;
- description of the method of loading the specimen and of measuring the panel deformations;
- type and position of any failure, including failures.

## ANNEX B: PULL OUT TESTING OF GLASS PANE

### B.1. Testing scheme for pull-out

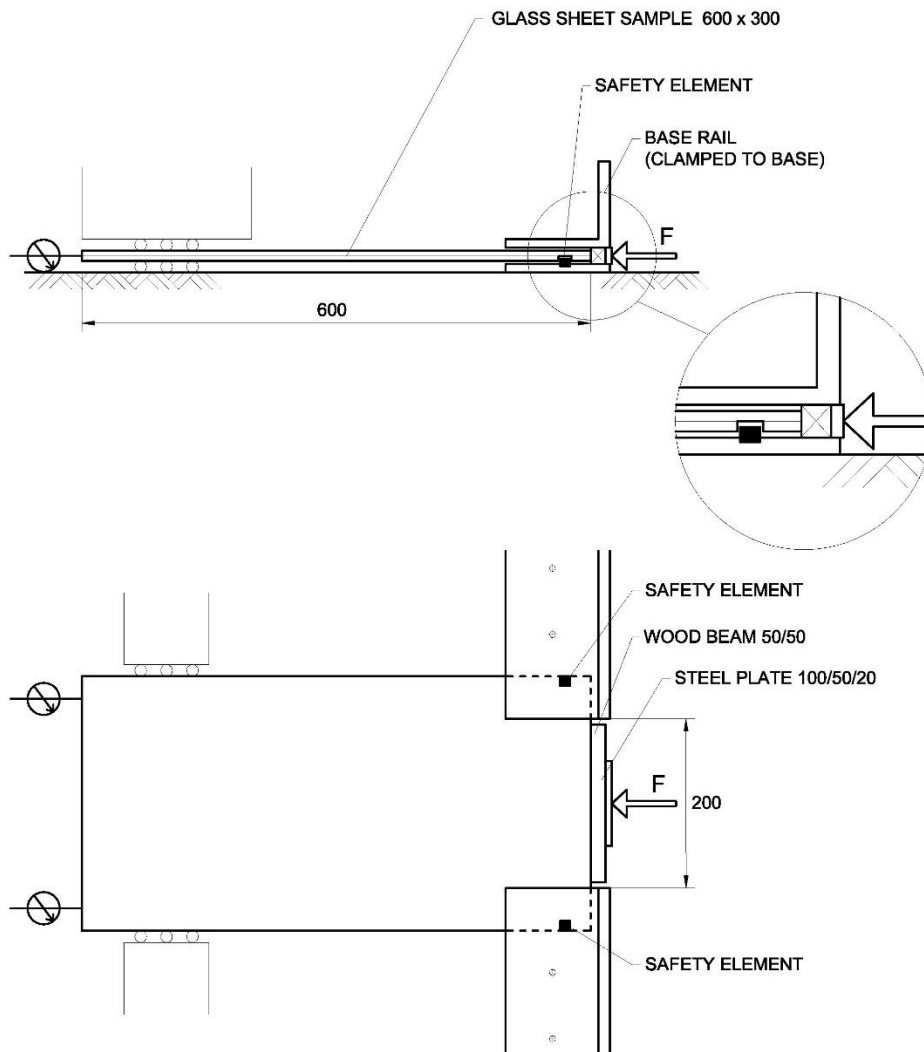


Figure B.1: Test apparatus

### B.2. Test specimen and number of tests

The test specimens for determination of pull out resistance should be conditioning in normal room condition. The test specimen size is 500-600 × 300 mm. More than one different thickness of laminated glass pane should be tested to confirm performance and the behaviour of elements (if system includes more than one type of laminated glass pane). Each specimen is protected to pull out with two safety elements.

For each thickness of laminated glass minimum 3 specimens should be tested.

### B.3. Test apparatus

The test apparatus shall be in accordance with the schematic presentation in Figure B.1 and with the detailed specifications as set out below, or equivalent.

The apparatus shall be capable of continuously recording the loads  $F$  with an accuracy of  $\pm 1\%$  of the load applied. The specimen displacements shall be measured to the nearest  $\pm 0.03$  mm.

### B.4. Test procedures

The horizontal load  $F$  shall be applied in width/2 as shown in Figure B.1. Speed of loading shall be approx. 1 kN/min. Load is applied until the failure of the specimen and the glass can be completely pulled out of it's bedding in the direction of the load  $F$ .

#### **B.5. Evaluation of the test results**

The expected ultimate pull-out load  $F_{EU}$  is determined by a statistical analysis at 5% fractile according to EN 1990 and on the basis of the measured pull-out forces of specimens of the same thickness of the glass pane.

#### **B.6. Test report**

The test report shall include at least the following information:

- reference to this EAD, Annex A
- the name of the testing laboratory
- the name of the ETA-Applicant (and manufacturer of the product, if different)
- date of the test
- description of the test instruments
- identification of the product tested (designation, dimensions and any relevant identification characteristic)
- identification of the sample(-s) tested (dimensions, shape, etc.) and reference to its marking (if any)
- description of conditioning and preparation of the sample (if any)
- the rate of applying the load
- description of test conditions (temperature and RH)
- test load  $F$  attained during the tests together with the corresponding displacements at all measurement positions;
- evaluation of the test result according B.5;
- specification of the mechanical fastener, their quantity and positioning;
- description of the method of loading the specimen and of measuring the panel deformations;
- type and position of any failure, including failures.