EUROPEAN ASSESSMENT DOCUMENT

EAD 090040-00-0404

March 2016

CANTILEVERED STRUCTURAL GLASS RAILING/BALUSTRADE

www.eota.eu

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

Cantilevered structural glass railing/balustrade is a kit and consists from:

- Continuous bearing base rail in which the glass element(s) is/are clamped. Base rail is fixed to the support structure directly or by means of various anchoring bracket-systems, which can be fastened from the top or from the side to suit different installation situations.
- Structural laminated safety glass according to EN 572-2[1], EN 12150-2, EN ISO 12543-1, EN ISO 12543-2 and EN 14449. Only one edge of the glass element is supported.
- Clamping system is a set of elements with which the glass-panes are embedded / clamped into a base rail.
- Handrail or glass edge protecting profile is mounted on the top edge of a balustrade.

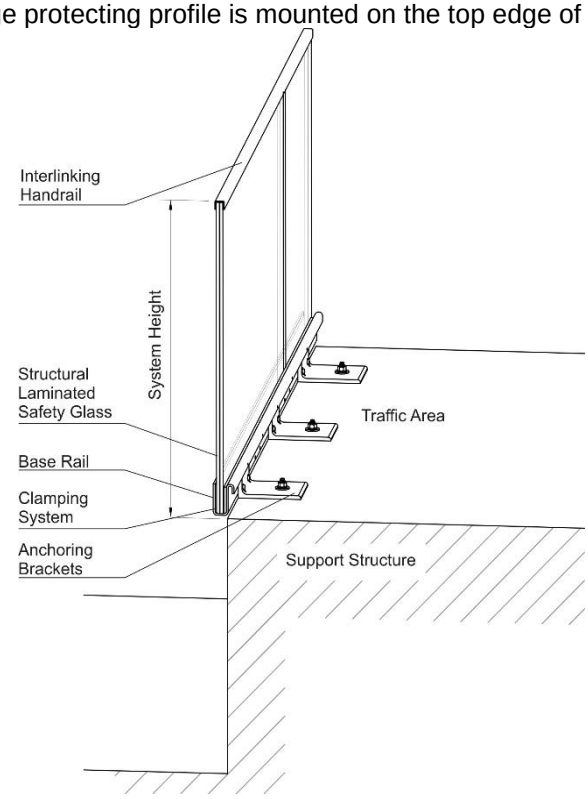


Figure 1: Drawing of Cantilevered structural glass railing/balustrade (example)

The kits are to be designed and erected in accordance with the ETA-holders' specifications.

Outside the scope of this EAD are:

- Kits incorporating filling elements of main material other than glass.

- Kits incorporating filling elements that are not exclusively cantilevered fixed.

- Cantilevered structural glass railing/balustrade that may be subject to imposed loads other than those detailed in this EAD, for example other traffic loads.

Connection anchoring elements with which the bearing profiles or brackets are connected to the building are out of the scope of this EAD. The information regarding the application of the connection elements shall be recorded in ETA.

1 All undated references to standards or to EAD in this EAD are to be understood as reference to the dated versions listed in clause 4.

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

1.1.1.1 Base-rail with (without) bracket system

Base rails are made of monolithic extruded aluminium profiles or of cold formed steel profile.

The base rail is fixed to the support structure directly or by means of various anchoring bracket-systems, which can be fastened from the top or from the side to suit different installation situations. Anchoring brackets may be as well incorporated in base rail to form one element.

Base rail profiles may have a line of bores for anchoring elements.

Anchoring elements (for example steel anchor bolts or screws) are not part of this EAD.

1.1.1.2 Clamping / adjusting system

1.1.1.2.1 Clamping shoe

is mounted along the bottom edge of glass panes and shall be made out of elastic material (e.g. EPDM or similar), to prevent excessive stresses and stress peaks of the glass edges.

1.1.1.2.2 Adjusting / support system

To avoid restraints and local stress peaks in glass and in order to sustain usability and the intended function through the working life of the construction product, the adjustment/support elements on both sides of glass panes must be continuous along the entire railing.

A support is considered as continuous if at least 80% of the lengths are homogenous supported and if the distance between neighbouring supports elements are less than 40 mm. No contact between glass and metal may occur.

1.1.1.3 Structural laminated safety glass

Multilayer safety glass (VSG) consists of at least two layers of

- float glass (soda lime silicate) glass according to EN 572-2 with breaking stress of minimum 45 N/mm²,
- heat strengthened (soda lime silicate) glass (TVG) according to EN 1863-1 and EN 1863-2 with breaking stress of minimum 70 N/mm² or
- thermally toughened (soda lime silicate) safety glass according to EN 12150-1 and EN 12150-2 with breaking stress of minimum 120 N/mm².

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/mm², elongation on break > 300 % (or equivalent national assessment).

or

- polyvinyl butyral foil (PVB) according to EN 16613, with rupture strength > 20 N/mm², elongation on break > 250 %.

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

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.

1.1.1.4 Handrail

A handrail or glass edge protecting profile is mounted on the top edge of glazing. Handrails or edge protecting elements must be fixed to the glass (e.g., by means of applying the rubber fixing profiles between glass and handrail or appropriate elastic sealant.). All edges of the glass panes must be protected either through applying the handrail, glass edge protection profiles or if the seams (distance) between two neighbouring glass edges or between glass edges and end-poles, support construction or other contractions [G] do not exceed f ≤ 30 mm.

1.1.1.4.1 Continuous metallic handrail with interlinking, load distributing safety function

A continuous handrail with interlinking, load distributing function [A] may be necessary to provide a safety in case of a partial damage/failure of any arbitrary glass-pane within the balustrade. Handrails are made of metal (steel or aluminium). They can serve as load bearing core for other attached handrail profiles (e.g. out of wood or any other material); This attachment profiles are not to be considered as reinforcement to the load bearing handrail by assessment of the product. At each end of the Balustrade, a loadbearing connection [F] to the support structure or support elements [G] with sufficient load bearing capacity is applied. A handrail also serves as a glass edge protector.

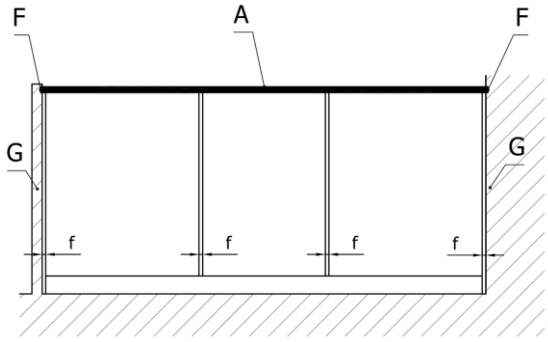


Figure 2: Continuous metallic handrail with interlinking

1.1.1.4.2 Edge protecting profile without load distributing safety function

Edge protecting profiles do not contribute in any means to the load bearing characteristics of the product. They serve only to protect the glass-pane edge-faces against damages with hard objects. The safety in case of a partial damage/failure glass-panes must still be ensured (e.g. with the sufficient load bearing capacity of the remaining glass layer).

- Interlinking edge protecting profile [B] is made of metal (steel or aluminium). It is mounted continuously along the upper edges, interlinking several glass-panes.

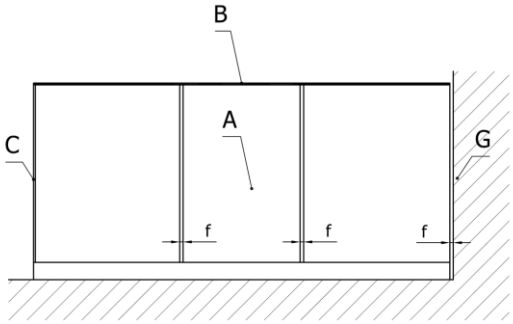


Figure 3: Interlinking edge protecting profile without load distributing safety function

- Not interlinking edge protection profiles [C] are mounted continuously along the horizontal edge of each glass-pane independently and can be made out of any suitable material with capability of protecting the glass-pane edges against hard body impacts. This edge protection profile is also used for vertical glass edges where applies.

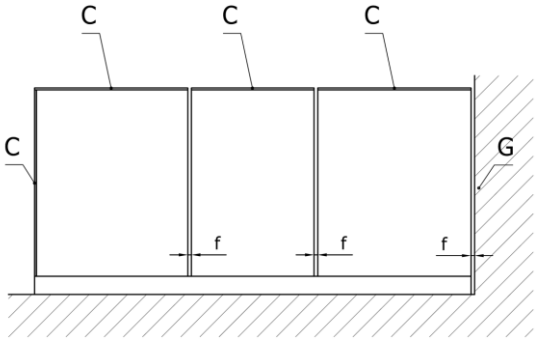


Figure 4: Not interlinking edge protecting profile without load distributing safety function

1.1.1.4.3 Point-fitted Handrails

- Load bearing point-fitted handrails [D] are attached to the glass-panes with point fitting elements [H]. In case the upper edges of the glass-panes are exposed, they must be protected with edge protection profiles [B] or [C] according to 1.1.1.4.2.

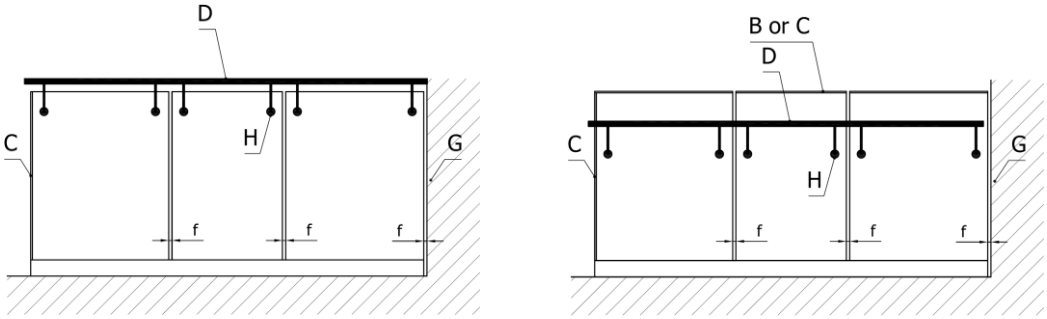


Figure 5: Point-fitted load bearing handrails

- Secondary / auxiliary handrail [E] without load bearing function is fixed on the glass-panes with point fitting elements [H]. No favourable effects on the load bearing capacity of the balustrade are to be taken into account by the system assessment. All additional unfavourable loads applied to the product components must be considered. If the secondary handrail is fitted between two glass-panes by means of clamping [I], each end of the secondary handrail must be connected [D] to support structure / elements [G] and a primary continuous handrail with interlinking, load distributing function [A] must be applied according to 1.1.1.4.1. Secondary handrails can be applied strictly according to the appropriate national provisions.

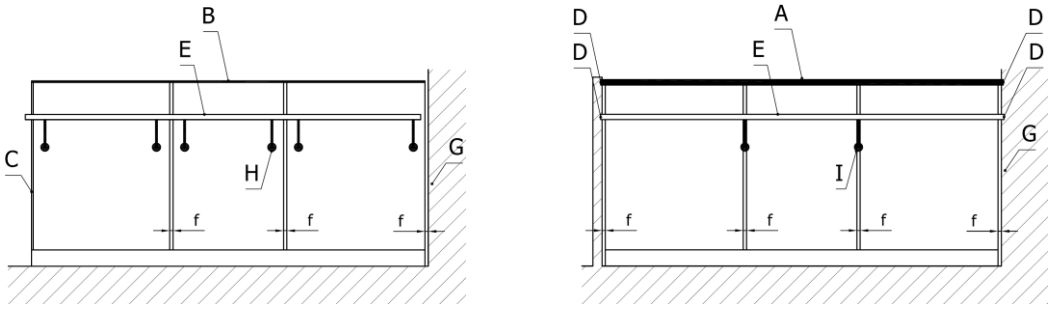


Figure 6: Point-fitted without load bearing handrails

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.

Cantilevered structural glass railing/balustrade with no handrail and/or no edge protection may be used as balustrade with safety function if this safety function is retained even when all glass layers of any glass-pane that have accessible edges are damaged/destroyed.

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

1.2.1 Intended use(s)

This EAD covers Cantilevered structural glass railing/balustrade. The system can be installed inside or outside buildings, where it can be exposed to adverse weather conditions. The product is intended to be used as a railing or balustrade for public and private purposes, on horizontal or sloped floors / staircases, as well as for other vertical glass structures, with or without a safety function. It provides a safety barrier and protection against falls from a height and must retain its original safety function in case of partial damage/failure of any arbitrary glass-pane within the balustrade, for example due to impact by a sharp object.

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 glass railing/balustrade for the intended use of 20 years (10 years for EPDM rubber) when installed in the works (provided that the Cantilevered structural glass railing/balustrade is subject to appropriate installation (see 1.1)). 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[2].

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.

2 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 referred to above.

1.3 Specific terms used in this EAD

1.3.1 Cantilevered structural glass railing/balustrade

Along (only) one edge clamped and provides a safety barrier and protection against falls from a height and must retain its original safety function in case of partial damage/failure.

1.3.2 Glass-pane

A glass element that may consist of at least two or more glass-layers laminated together with interlayers (e.g. polyvinyl-butyral-foil, ionomer-foil etc.).

1.3.3 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 or retain a residual load bearing capacity of the glass-pane in case of damage to one or more glass-layers.

1.3.4 Base rail

Base rail is a load bearing profile at the base of the glass-panes in which the glass-panes are clamped. It has the ability to conduct all the loads from the glass-panes to the support structure.

1.3.5 Anchoring brackets

Anchoring brackets is used as the support structure which can be fastened from the top or from the side of the base rail to suit different installation situations.

1.3.6 Protected edge faces

The glass railing must be constructed in a way to ensure that all glass edge-faces can be defined as protected. Glass edges are considered as protected if the seams (distance) between two neighbouring glass edges or between glass edges and end-poles, support construction or other contractions do not exceed 30 mm, or if the edges are in full of its length permanently protected by means of applying protecting profiles or handrails.

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 glass railing/balustrade is assessed in relation to the essential characteristics.

Table 1 Essential characteristics 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
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 4: Safety and accessibility in use			
2	Mechanical resistance and stability of the Cantilevered structural glass railing/balustrade	2.2.2	Level
3	Hard body impact resistance	2.2.3	Level
4	Soft body impact resistance	2.2.4	Level

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

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

Testing will be limited only to the essential characteristics which the manufacturer intends to declare. If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

2.2.1 Reaction to fire of the Cantilevered structural glass railing/balustrade

The Cantilevered structural glass railing/balustrade shall be tested according to the method(s) referred to in EN 13501-1 and relevant for the corresponding reaction to fire class. The product shall be classified according to the Commission Delegated Regulation (EU) No 2016/364.

The reaction to fire of the Cantilevered structural glass railing/balustrade made of materials according to EC decision 96/603/EC as amended may be classified without testing.

2.2.2 Mechanical resistance and stability of the Cantilevered structural glass railing/balustrade

The assessment of the product shall be undertaken by structural calculations supplemented by testing according to Annex A and shall, when relevant, include resistance against disproportionate collapse (system deformation).

2.2.2.1 Calibration of the calculation

The calculation method shall be calibrated by testing according to annex A.

The calibration criteria are the displacements at designated measurement points. The deviation of the calculated displacement shall not exceed 15% of the displacement determined by tests on the same configuration. The calibration shall be made in a way that the results of the calculation remain statically on the safe side.

2.2.2.2 Calculation of mechanical resistance and stability

By confirming the results of the calibrated calculation, the calculation method, input and output conditions may be used for other kit configuration. The results of the calibrated calculation as well as the results of calculation of other configurations (given explicitly if applicable or empirically) shall be stated in the ETA.

By the calculation of mechanical resistance and stability all relevant kit components that contribute to the load bearing capacity, load transitions as well as to the load itself shall be simulated/represented through the calculation models that define the components in all relevant physical properties (e.g., cross-section, thickness, material properties etc.). It is recommended that the calculation is performed through a numerical structural analysis (FEM).

Applicable materials and its properties shall be stated in the ETA.

The calculation model shall include all relevant kit components. All relevant contacts between individual kit components shall be appropriately defined and included into the calculation model either by calculation model that includes all kit components or by calculating individual components taking into account the interaction/load-transition between kit components in which case the mechanical resistance of the kit is defined by the level of the weakest component.

Mechanical resistance of the assembly kit shall be defined by the mechanical resistance of at least following kit components:

- of the Base Rail profiles including supporting Brackets if applicable.
- of the Glass-panes.
- of the load beating Handrails.

All weakenings like bores; cut-outs etc. shall be included in the calculation model if applicable.

All discontinuous contacts between kit components especially between glass-panes and the components of the clamping system that causes localized stress in glass shall be modeled in a way that represents the most unfavorable configuration that can occur under normal assembly situation.

Other product configuration shall be determined by explicit static calculation on a confirmed calibrated model for each configuration, or alternatively through empiric method based on the results of confirmed calibrated static calculations of kit components.

2.2.2.2.1 Mechanical resistance of the kit regarding the base rail

Mechanical resistance of the base rail including supporting brackets if applicable shall be obtained according to section A.2 of the Annex A and stated in ETA as the linear momentum along lower edge of the inset glass-pane in [Nmm/mm] separately for each load direction.

2.2.2.2.2 Mechanical resistance of the kit regarding the glass-pane

Mechanical resistance of glass-panes shall be obtained according to the section A.3 of the Annex A.

By the calculation of the kit, two states of integrity shall be examined:

- Mechanical resistance with the intact glass-pane persistent and transient design situation,
- Residual mechanical resistance of the partially damaged glass-pane (accidental design situation).

For glass-panes covered by a harmonized technical specification the mechanical resistance (bending strength) may also be determined from harmonized technical specifications.

In case the mechanical resistance of glass (bending strength) is to be determined by tests it shall be done according to EN 1288-3. The mechanical resistance of glass by the kit with the intact glass-pane and the residual mechanical resistance of the glass by the kit with the partially damaged glass-pane shall be stated in the ETA. Following partial safety factors γ_M shall be used to determine the design value of mechanical resistance:

$$R_d = R / \gamma_M$$

For mechanical resistance (intact laminated glass-pane):

R – bending strength of a laminated glass-pane in MPa or N/mm²

- γ_M = 1,36 – partial safety factor for heat strengthened or thermally toughened glass
- γ_M = 2,36 – partial safety factor for float glass

For residual mechanical resistance (one layer of the glass-pane damaged):

R – bending strength of a single glass-layer in MPa or N/mm²

- γ_M = 1,5 – partial safety factor for heat strengthened or thermally toughened glass
- γ_M = 2,6 – partial safety factor for float glass

By the mechanical resistance of the intact laminated glass-pane the influence of the inter-layer (foil) shall be determined to cover the level of bonding from 0 to 100% (at least the influence by 0% and by 100% bonding shall be determined). This shall be varied by modifying the elasticity of the inter-layer static model (bonding stiffness may only be applied according to the used bonding material specifications, its application guideline/regulation or technical specification (hEN, EAD, EN, ISO etc.) regarding various bonding materials if applicable. The influence on the mechanical resistance by various level of bonding shall be stated in ETA.

By residual mechanical resistance the influence of interlinking handrail shall be taken into account. The proportion of the load-bearing capacity spread between the remaining glass-layer of the damaged glass-pane and adjacent intact glass-pane(s) connected with the interlinking handrail is to be determined through static calculation and is defined by the base-rail clamping stiffness, stiffens of the adjacent glass-panes and the width ratio between two adjacent glass-panes. Alternatively, only two extremes may be examined instead:

- Remaining glass-layer of the damaged glass-pane takes over the entire load,
- Handrail and adjacent glass-panes take over the entire load.

Mechanical resistance of the interlinking, load distributing handrail and/or interlinking edge protection profiles depends on the mechanical resistance and/or residual mechanical resistance of glass-panes and shall be stated in ETA

Note: For some Member States additional tests or calculations for the mechanical resistance, stability and/or serviceability of the structural glass railing may apply.

2.2.3 Hard body impact load – 1 kg steel ball on edge protector

The hard body impact load with the 1 kg steel ball to the unprotected glass edges or to the edge protector represents the action from heavy no deformable objects, such as pieces of furniture or equipment, accidentally hitting the edges of barrier when being moved. Whereas the edge protector may be damaged, the structural integrity of the barrier glazing as well as its safety function must not be compromised in the process.

Impact points are to be set unfavourably along the upper glazing edge (at least one impact ≤ 30 mm away from the glass corner and one in the middle of the upper glass edge). Only one impact at the same point is necessary.

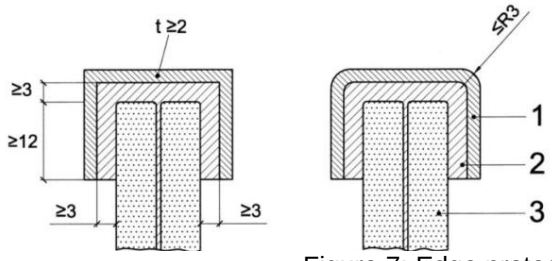
For railings without handrail and / or edge protection, each hard body impact test is to be carried out unfavourably so that all accessible glass edge faces are hit with the impact body.

Minimum 2 x 20 J (Nm) stroke will be done to the upper edge of the glazing (to the edge protector).

In the product without continuous interlinking metallic profile, test will be done by hard body impact minimum 1 x 20 J to the exposed edge(es) of the glazing (or to the edge protector).

No hard body impact test is needed if kit:

- has metallic handrail profile according to Fig.7 with thickness ≥ 2 mm, glass inset of at least 12 mm and a permanent elastic sealant between glass and metal with thickness ≥ 3 mm or
- has the handrail from a bent profile with the bending radius ≤ 3 mm.



1. Handrail profile
2. Elastic sealant
3. Glass

Figure 7: Edge protection

The maximum energy of the impact under which:

- the structural integrity of the barrier glazing as well as its safety function is not compromised and
- there are no glass pieces falling out of the glass pane that could endanger the traffic areas

shall be stated in ETA.

After the hard body impact tests, the soft body impact resistance testing (clause 2.2.4) is to be carried out.

If at any time during the hard body impact testing any damage of the protected glass pane is observed, the soft body impact test is to be carried out immediately with the impact point of the soft body set in the designated testing area as close as possible to the impact point of the hard body or to the origin of the damage. Edge protector, if present, may be damaged.

2.2.4 Soft body impact resistance of the assembled system

The soft body impact resistance shall be tested on the assembled system, mounted according to manufacturer manual instructions. These tests represent the action from a person accidentally crashing against the balustrade. Glass railing with a safety function of protecting against falls from a height must have sufficient resistance / residual carrying capacity against dynamic loads to prevent the crashing person to break through the railing.

Testing the Cantilevered structural glass railing/balustrade shall be carried out with impactor described in EN 12600 (twin tires). Minimal impact energy is 350 J (Nm) (equivalent drop height of 700 mm). Impact energy for testing the single glass-pane elements without interlinking handrail or interlinking metallic edge protection profile is 450 J (equivalent drop height of 900 mm)

As a rule, two glass panes with each variation of construction type are tested. At least one pendulum stroke must be carried out at each fixed impact point.

Test specimens must be stored for at least 12 hours at a temperature 15 °C to 25 °C before testing. The tests are to be carried out at 15 °C to 25 °C.

Note: For some Member States additional/different requirements about impact resistance characteristics may apply.

The pendulum impact test is performed on 3 to 4 locations within the area, which is defined in Figure 8. It is to consider that the impact body centre of gravity must align with the edges of this impact area. The distance of the impact points from the unsupported vertical edges is ≥ 100 mm and ≥ 250 mm from the supported edges (e.g., upper edge). The distance from the floor is ≥ 500 mm. If the floor level doesn't align with the lower supported edge of the glass pane, the distance from the floor is still relevant.

The location of impact points must be chosen so that maximal stresses in glass are achieved (e.g., near the base-rail, near the handrail, on the unsupported vertical edges of the glass, in the centre of glass etc.).

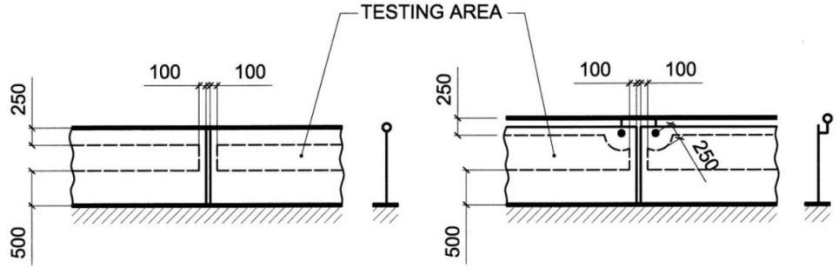


Figure 8: Testing area for pendulum testing

At least one pendulum stroke must be carried out at each fixed impact point. After each impact, the whole structure is inspected for potential permanent deformation or damage to the connections (e.g. screws, welds).

If the glass elements remain intact, but the damage or greater residual deformation of the construction occurs, the initial state of the test set-up must be restored before further testing.

If the glass elements are damaged, but doesn't fall out of the base rail, sufficient remaining loading capacity, preserved in glass elements, damaged by the impact tests, is to be tested immediately after damage occurs with an additional impact with reduced impact energy of 50 J (equivalent drop height is 100 mm). This additional impact must hit the same place where the initial impact caused structural damage.

The maximum energy of the impact under which:

- the test impactor doesn´t perforate the glass pane or
- the glass pane isn't pulled out of its base,
- no cracks and openings in the laminated safety glass with voids larger than 76 mm occurs and
- no glass pieces that could endanger the traffic areas may fall out of the glass pane,

shall be stated in ETA.

Note: For some Member States additional requirements for different characteristics may apply (e.g., necessity of mechanical securing of the individual Cantilevered structural glass railing/balustrade).

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 2019/1764/EC[3].

The applicable system is 4.

For uses subjects to regulations on reactions to fire the applicable AVCP systems regrading reaction to fire are 1, or 3, or 4 depending on the conditions defined in the said Decision.

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 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) including testing of samples taken at the factory in accordance with a prescribed test plan					
1	Dimensions of base rail	gauge	Control plan	3/each type of base rail	Each delivery
2	Material characteristic of base rail	certificate 3.1 according EN 10204		1	Each delivery
3	Length of base rail, position of bores for screws	gauge		1/10 base rail	1/10 base rail
4	Characteristics of laminated glass pane	Documents of supplier		Documents of supplier	Each delivery
5	Dimensions of laminated glass pane	gauge		Each glass pane at delivery	Each glass pane at delivery
6	Properties of material of clamping system (EPDM, POM)	certificate 3.1 according EN 10204		Documents of supplier	Each delivery
7	Dimensions of elements of clamping system	gauge		3/each part of clamping system	Each delivery
8	Properties of material for handrail	certificate 3.1 according EN 10204		Documents of supplier	Each delivery
9	Dimensions of handrail	gauge		3/each type of handrail	Each delivery

3 Official Journal of the European Communities/Union L 270 of 24.10.2019.

3.3 Tasks of the notified body

The intervention of the notified body for reaction to fire under AVCP system 1 is only necessary for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the tasks to be undertaken by the Notified Body under AVCP system 1 are laid down in Table 3.

Table 3 Control plan for the Notified Body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 are fulfilled for reaction to fire, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the productio n or a new line
Continuous surveillance, assessment and evaluation of factory production control					
2	Where the intervention of the Notified Body is necessary only because the conditions for the applicability of system 1 in the Decisions regarding reaction to fire are fulfilled, the notified body will consider especially the clearly identifiable stage in the production process which results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 2	According to Control plan	According to Control plan	1/year

4 REFERENCE DOCUMENTS

EN 1990:2002/A1:2005/AC:2010 Eurocode: Basis of structural design

EN 1991-1-1:2002/AC:2009 Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings

EN 1991-1-4:2005/A1:2010 Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions

EN 13501-1:2018 Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 1288-3:2001 Glass in building - Determination of the bending strength of glass - Part 3: Test with specimen supported at two points (four point bending)

EN 10204:2004 Metallic products - Types of inspection documents

EN 572-2:2012 Glass in building - Basic soda lime silicate glass products - Part 2: Float glass

EN 1863-1:2011 Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description

EN 1863-2:2004 Glass in building - Heat strengthened soda lime silicate glass - Part 2: Evaluation of conformity/Product standard

EN 12150-1:2015+A1:2019 Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description

EN 12150-2:2004 Glass in building - Thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard

EN ISO 12543-1:2012 Glass in building - Laminated glass and laminated safety glass - Part 1: Definitions and description of component parts

EN ISO 12543-2:2012 Glass in building - Laminated glass and laminated safety glass - Part 2: Laminated safety glass

EN 16613:2019 Laminated glass and laminated safety glass - Determination of interlayer mechanical properties resisting steels for general purposes

EN 14449:2005/AC:2005 Glass in building - Laminated glass and laminated safety glass - Evaluation of conformity/Product standard

EN 12600:2002 Glass in building - Pendulum test - Impact test method and classification for flat glass

ANNEX A: Testing for mechanical resistance

A.1. Testing scheme for testing to horizontal load

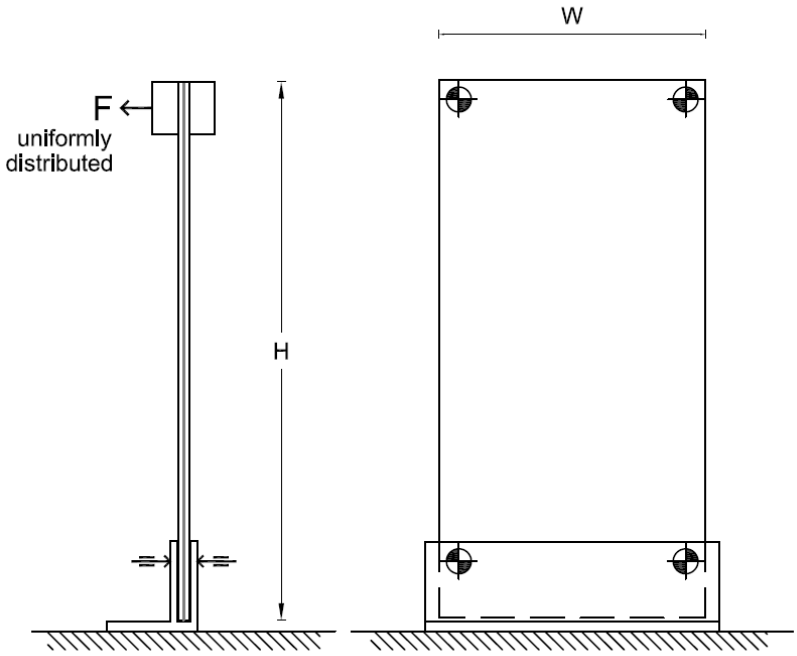


Figure A.1: Test apparatus

A.2. Test of the mechanic resistance of the base-rail (and support brackets if applicable)

A.2.1 Test specimen and number of tests

The width of the representative test specimen W is to be determined by the raster of individual kit components so that the validity of the results can be extended to any arbitrary length. Normally the smallest system length and/or the length determined by the maximal support distance is to be tested.

The test specimen shall include at least base-rail (and support brackets where applicable), all the components of the clamping system and the glass-pane element. Glass-pane may be replaced with a metallic plate, so that the test results for the base-rail are not impeded by the lesser resistance of the glass-pane.

The test shall be performed on specimens with the smallest system high H, so the combination of the bending moment and transverse load is the most unfavourable. By testing with larger heights, the relation between momentum and transverse load may be calculated and adopted by the results.

Base rail shall be fixed on a stiff test betting in a way that represents the most unfavourable fixing configuration. The stiffest possible fixing(s) is to be chosen, so the lesser stiffness of the fixing doesn't obstruct the results.

The specimens shall be conditioned at a temperature of (23 ± 1) for at least 24 h. The test is performed at 23 ± 2ºC, 50 ± 5 % RH.

A.2.2 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.

Additionally, the strain shall be measured with the strain gauges at the predetermined critical control-points (e.g. on sides of the base-rail and in fixing areas/ areas with bores)

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

At least following measurement points shall be set:

- Four measuring points on base-rail: two measuring points on each upper base-rail edge on both sides of the specimen.
- measuring points on top of the glass-pane or plate.

The rate of applying the load of 10 - 50 mm/min (measured on the top of the specimen).

A.2.3 Test procedures

Load shall be applied uniformly along the upper edge of the glass-pane or plate. If a point load is applied, a stiff beam shall be used to distribute the point load evenly.

Test shall be performed in both directions on separate specimens.

Minimum 2 specimens of each configuration shall be tested.

Each test shall be performed in two steps, by continuously applying load at the top of the specimen.

- Preload to the predetermined initial load – to settle the system components.
- Load to the predetermined design load*, and unload to the initial load after 30 minutes.
- Load to the break point after 30 minutes.

(* the predetermined design load shall be determined by the static calculation to predict the offset yield-point reduced with the material safety factor of the base-rail profile e.g. γ_M =1,1)

During all stages of loading and unloading the displacements shall be measured at an estimated measurement points (see figure A1) and the condition of the test specimens shall be monitored.

A.2.4 Evaluation of the test results

From the relation between the applied force and deformation from which the stress-strain diagram is to be determined.

The yield strength shall be determined out of the stress-strain diagrams. An offset yield point is arbitrarily defined with the offset value of 0,2% plastic strain.

The mechanical resistance R is the calculated linear momentum along lower edge of the inset glass-pane in Nmm/mm for each configuration and load direction. R results from the applied force F on top of the specimen at the point of offset yield point with the glass-pane H high and W long at which the offset yield strength of the base rail (and/or support brackets if applicable) is reached:

$$R = F H / W$$

The results of the tests shall be analysed by a statistical analysis at 5% fractile according to EN 1990.

A.3 Test of the glass-pane

A.3.1 Test specimen and number of tests

The dimensions of the representative test specimen (W, H) is to be determined by the raster of individual kit components so that the validity of the results can be extended to any arbitrary length. Normally the smallest system length and/or the length determined by the maximal support distance and maximal system hight is to be tested.

The test specimen shall include at least base-rail (and support brackets where applicable), all the components of the clamping system and the glass-pane element.

Base rail shall be fixed on a stiff test betting in a way that represents the most unfavourable fixing configuration. The stiffest possible fixing(s) is to be chosen, so the lesser stiffness of the fixing doesn't obstruct the results.

The specimens shall be conditioned at a temperature of (23 ± 1) for at least 24 h. The test is performed at 23 ± 2ºC, 50 ± 5 % RH.

A.3.2 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.

Additionally, the strain shall be measured with the strain gauges at the predetermined critical control-points (e.g. on glass surfaces just above the clamping area).

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

At least following measurement points shall be set:

- Four measuring points on base-rail: two measuring points on each upper base-rail edge on both sides of the specimen.
- measuring points on top of the glass-pane or plate.

The rate of applying the load of 10 - 50 mm/min (measured on the top of the specimen).

A.3.4 Test procedures

Load shall be applied uniformly along the upper edge of the glass-pane or plate. If a point load is applied, a stiff beam shall be used to distribute the point load evenly.

Test shall be performed in both directions on separate specimens.

Minimum 2 specimens of each configuration shall be tested.

Each test shall be performed in two steps, by continuously applying load at the top of the specimen.

- Preload to the predetermined initial load – to settle the system components
- Load to the predetermined nominal load*, and unload to the initial load after 30 minutes.
- Load to the break point after 30 minutes.

(* the predetermined nominal load shall be determined by the static calculation to predict the design value of the bending strength of the glass if applicable.)

By excessive deformation (more than H/10) or plastic deformation of the profile the test shall be terminated before the break point of the glass.

During all stages of loading and unloading the displacements shall be measured at an estimated measurement points and the condition of the test specimens should be monitored.

A.3.5 Evaluation of the test results

The result of the tests shall be the relation between the applied force and deformation/displacement.

The mechanical resistance R is the calculated ultimate bending stress of the glass-pane in MPa for each glass type, configuration and load direction. R results from the applied force F on top of the specimen at the break point of glass-pane and shall be calculated out of the data recorded by the strain-gauges.

The results of the tests shall be analysed by a statistical analysis at 5% fractile according to EN 1990.

The test data provide only the results with undefined (probably maximal) level of bonding stiffness between glass layers. Therefore, the range of bonding stiffness shall be determined through calibrated static calculation using the test data to adjust mechanical resistance. The range of bonding stress shall be stated in ETA (e.g. by stating dimensionless reduction factors).

If tests don't provide the data for determination of the mechanic stability R of the glass-pane (e.g. no glass damage can be achieved under normal test conditions), the tests predominantly provide the data for the calibration of the calculation model of stiffness of the clamping as well as to the bonding between glass layers.

A.4 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.2.4;
- specification of the mechanical fastener, their quantity and positioning;
- description of the method of loading the specimen and of measuring the pane deformations;
- type and position of any failure, including failures.