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EAD **090062-01-0404**

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European Assessment Document for

Kits for external wall claddings mechanically fixed

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Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD covers the assessment of kits for external wall claddings mechanically fixed (from now on “cladding kit” or “kit”).

The EAD is applicable to the cladding kits belonging to the families A to H indicated in Table 1.1.1 or a combination of these families. They consist of the following components[1]:

1. Cladding elements made of one fully body material (except TMCS[2]), see clause 1.1.1.
2. Cladding fixings for mechanically (not glued) fastening the cladding elements to the subframe or directly to the substrate, see clause 1.1.2.
3. Subframe (optional), see clause 1.1.3.
4. Thermal insulation layer (optional), see clause 1.1.4.
5. Other ancillary components (optional), see clause 1.1.5.

The cladding kits covered by this EAD always include the cladding elements. When the cladding elements are not provided by the manufacturer this EAD does not apply.

The cladding kits are non-load bearing construction elements. They do not contribute to the stability of the substrate on which they are installed. The cladding kits will normally contribute to durability of the works by providing enhanced protection from the effect of weathering. They are not intended to ensure airtightness of the building.

Cladding kits do not contain windows or door products.

This EAD is applicable to the following compositions of the kits:

- Complete kits (cladding elements, cladding fixings, subframe components and optionally, thermal insulation products and other ancillary components).
- Minimum kits (cladding elements and cladding fixings), when the minimum kit is not directly fastened to the substrate but it is intended to be fastened to the subframe, the other components of the external wall cladding systems (at least the subframe components) shall be available on the market and described in the ETA according to clauses 1.1.3 to 1.1.5 as part of the intended use of the kit, therefore, these components are part of the product assembly and are necessarily used within the product assessment process. This also applies for intermediate composition kits with components between minimum kits and complete kits.
- Cladding elements alone (without cladding fixings or subframe), in this case, the other components of the external wall cladding systems (at least the cladding fixings when the cladding elements are directly fastened to the substrate; or at least the cladding fixings and subframe components when the cladding elements are intended to be fastened to the subframe) shall be available on the market and described in the ETA according to clauses 1.1.2 to 1.1.5 as part of the intended use of the kit, therefore, these components are part of the product assembly and are necessarily used within the product assessment process.

Between the cladding elements and the thermal insulation layer or the substrate, there is an air space which is always drained and may be ventilated or not (see clause 1.3.10).

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1 Any kit component may be produced (manufactured) or not produced (purchased on the market or from a specific supplier) by the kit manufacturer.

2 TMCS = Thin Metal Composite Sheet.

Table 1.1.1 Description of the cladding kit families and their associated cladding fixings

Family of cladding kits	**Description of the cladding kits**	**Type of cladding fixings**
Family A (see Figures 1.1.1)	The cladding elements are mechanically fastened to the subframe or directly to the substrate by through visible punctual fixings.	Nails, screws, rivets or other similar punctual fixings.
Family B (see Figures 1.1.2)	The cladding elements are mechanically fastened to the subframe or directly to the substrate by special anchors placed in drilled holes or in undercut holes and anchored by mechanical interlock (at least 4 anchors by cladding element).	Group of components[3]: - undercut anchor[4] (fastener) - horizontal hook-rail (clamp) - horizontal supporting rail
Family C (see Figures 1.1.3)	The cladding elements are mechanically fastened to the subframe or directly to the substrate by punctual or linear fixings placed in the grooves or dowel holes of the cladding element.	Rail profiles, small rails, clips, clamps, pins or other similar punctual or linear fixings.
Family D (see Figures 1.1.4)	The cladding elements, integrated with adjacent elements by interlocking together at top and bottom with an overlap, are fixed to the subframe or directly to the substrate by mechanical punctual fixings positioned on the top edge and masked by the edge of the upper cladding elements.	Nails, screws, rivets or other similar punctual fixings.
Family E (see Figures 1.1.5)	The cladding elements are fixed to the subframe or directly to the substrate by punctual mechanical fixings positioned on the top edge and masked by the edge of the upper cladding element.	Nails, screws, rivets or other similar punctual fixings.
Family F (see Figures 1.1.6)	The cladding elements are mechanically fastened to the subframe or directly to the substrate by linear or by at least 4 metal punctual fixings.	Rail profiles, small rails, clips, clamps, pins or other similar punctual or linear fixings.
Family G (see Figures 1.1.7)	The cladding elements are suspended on the subframe or directly to the substrate by means of a hook-on arrangement with slotted fixings.	Hook/slot profiles and rails or other similar fixings.
Family H (see Figures 1.1.8)	The cladding elements are fixed to the subframe or directly to the substrate by punctual mechanical fixings that support both, the upper and lower cladding element where the top edge of the lower cladding element is masked by the bottom edge of the upper cladding element.	Small rails, clips, clamps, pins or other similar punctual fixings.

3 The minimum component to be defined as cladding fixing for family B kit is the undercut anchor.

4 Undercut anchors may be covered by the EAD 330030-00-0601.

Figures 1.1.1 to 1.1.8 are schematic representations of the families of cladding kits described in Table 1.1.1 (with and without subframe and thermal insulation layer). The components of the cladding kits are identified by the following legend.

Legend for the Figures 1.1.1 to 1.1.8:

① - Cladding element.	③ - Subframe.	⑤ - Anchor.
② - Cladding fixing.	④ - Substrate.	⑥ - Thermal insulation layer.

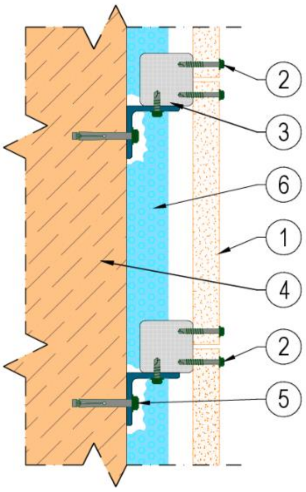

Figure 1.1.1a: Cladding kits family A with subframe and thermal insulation layer.

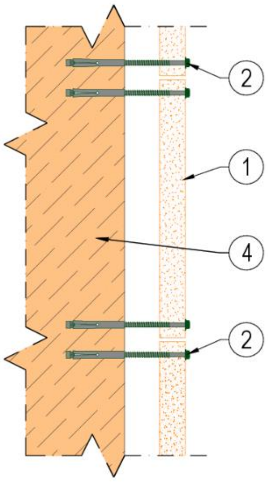

Figure 1.1.1b: Cladding kits family A without subframe and without thermal insulation layer.

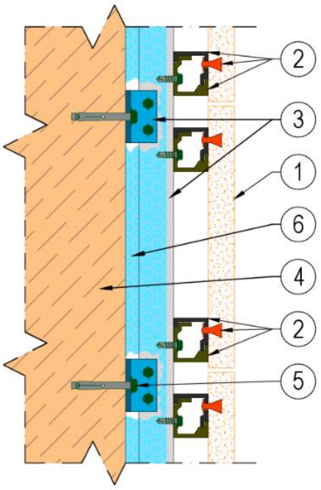

Figure 1.1.2a: Cladding kits family B with subframe and thermal insulation layer.

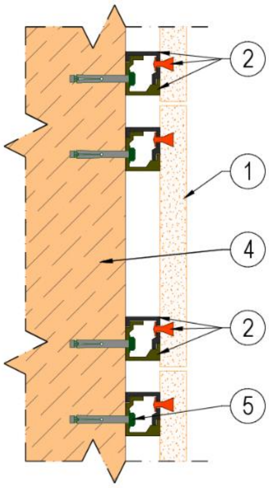

Figure 1.1.2b: Cladding kits family B without subframe and without thermal insulation layer.

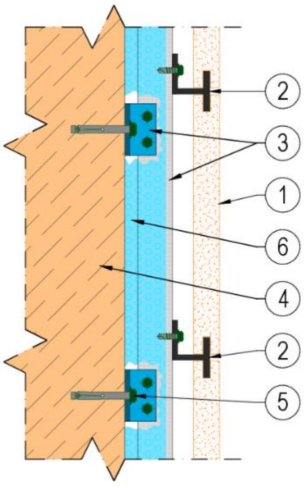

Figure 1.1.3a: Cladding kits family C with subframe and thermal insulation layer.

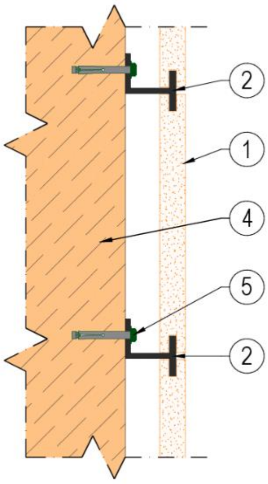

Figure 1.1.3b: Cladding kits family C without subframe and without thermal insulation layer.

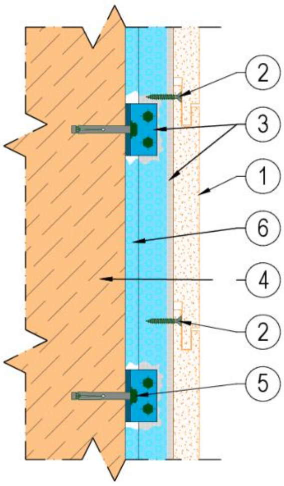

Figure 1.1.4a: Cladding kits family D with subframe and thermal insulation layer.

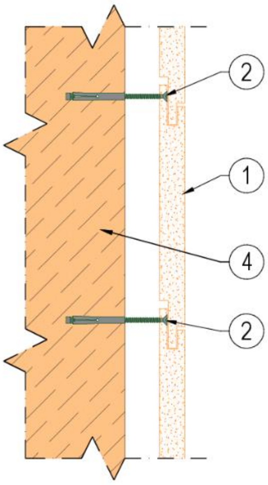

Figure 1.1.4b: Cladding kits family D without subframe and without thermal insulation layer.

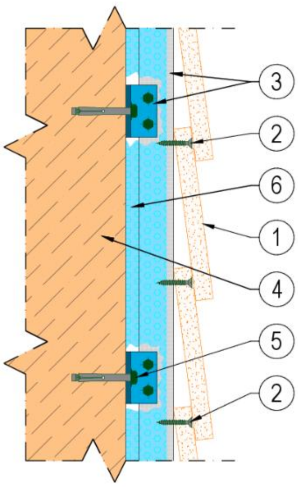

Figure 1.1.5a: Cladding kits family E with subframe and thermal insulation layer.

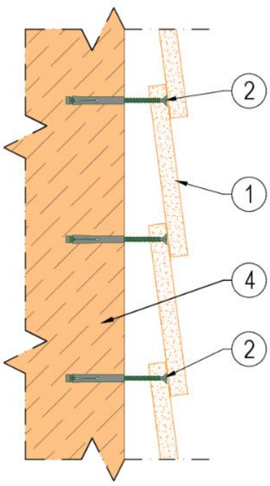

Figure 1.1.5b: Cladding kits family E without subframe and without thermal insulation layer.

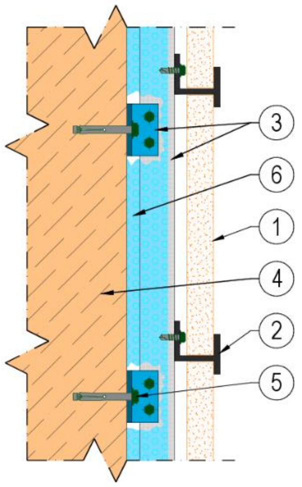

Figure 1.1.6a: Cladding kits family F with subframe and thermal insulation layer.

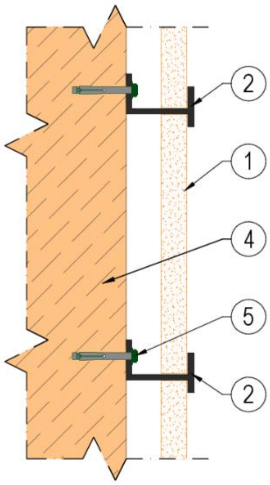

Figure 1.1.6b: Cladding kits family F without subframe and without thermal insulation layer.

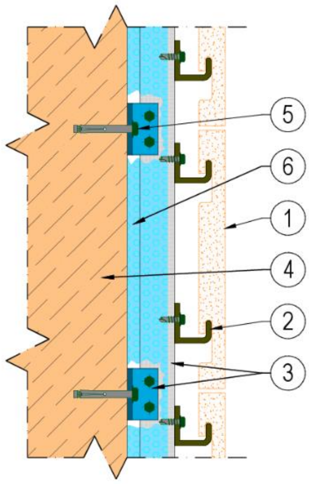

Figure 1.1.7a: Cladding kits family G with subframe and thermal insulation layer.

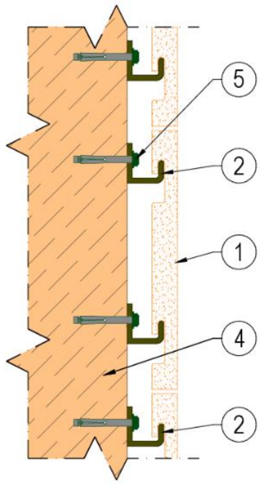

Figure 1.1.7b: Cladding kits family G without subframe and without thermal insulation layer.

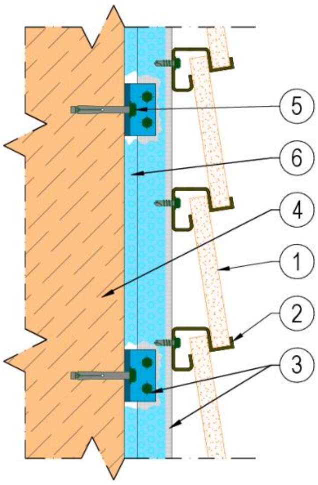

Figure 1.1.8a: Cladding kits family H with subframe and thermal insulation layer.

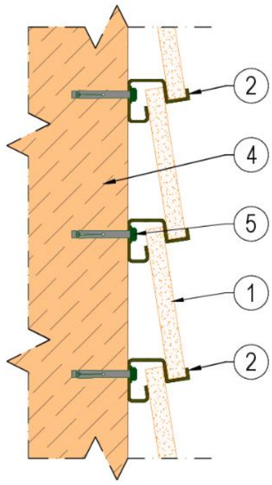

Figure 1.1.8b: Cladding kits family H without subframe and without thermal insulation layer.

The product is not fully covered by the following harmonised technical specification:

- Cladding elements harmonised technical standards (hEN) (see Table 1.1.1.1) because they do not cover kits, they only cover cladding elements alone and more generic intended uses (not the specific use for ventilated and non-ventilated façades).

- EAD 090001-00-0404[5] because it covers cladding kits where the cladding elements are made of prefabricated compressed mineral wool boards with thermo-setting synthetic binders mechanically fixed and also glued to a subframe. This EAD does not cover this type of cladding element material nor glued to the subframe.

- EAD 090019-00-0404 because it covers cladding kits where the cladding elements are made of composite panels made of board materials (expanded glass granulates) and renderings applied in situ. This EAD does not cover this type of composite cladding elements.

- EAD 090119-00-0404 because it covers cladding kits where the cladding elements are made of composite panels made of board materials (mineral boards) and renderings applied in situ. This EAD does not cover this type of composite cladding elements.

- EAD 090034-00-0404 because it only covers kits that do not contain the cladding elements. Kits covered by this EAD always include the cladding element.

- EAD 090058-00-0404 because it covers cladding kits where the cladding elements are made of composite metallic honeycomb panels and the cladding fixings and the subframe have a very specific composition different to the kit families given in Table 1.1.1. This EAD does not cover this type of composite cladding elements nor the specific cladding fixing and subframe.

- EAD 090097-00-0404 because it covers claddings kits where the cladding elements are glued to the subframe by means of an adhesive system. Mechanical cladding fixings may be considered as supplementary components. This EAD does not cover this way for fastening the cladding elements.

- EAD 090125-00-0404 because it covers cladding kits where the cladding element is a composite panel made of multilayer rigid materials. This EAD does not cover this type of composite cladding elements.

- EN 1090-1 because this harmonised standard does not apply to non-structural products (see FAQ number 31 on European Commission website https://ec.europa.eu/growth/sectors/construction/construction-products-regulation-cpr/frequently-asked-questions_en). Besides, the cladding elements are not included on this standard.

- EN 13830 because this harmonised standard covers curtain walling kits which are a very different product that is intended to be used as the external wall itself, not as coverings of the external walls.

Compared to the previous version of the EAD, the following changes are introduced:

- Extension of the scope by considering:
    - New cladding elements materials: agglomerated stone and wood-polymer composites (WPC) or natural fibre composites (NFC), (see Table 1.1.1.1).
- Extension of the intended use (see clause 1.2.1) by considering external ceilings and contact with ground.
- Improvements on the description for most of the assessment methods.
- Adding new essential characteristics and their respective assessment methods:
    - Seismic resistance.
    - Resistance to long term or permanent dead load (creep test) for external ceilings.

5 All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in chapter 4.

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.

The cladding elements are usually assembled according to a specific technical composition for fixings, joints and construction discontinuities, which forms part of the product description.

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 Cladding elements

Cladding elements are sheets, planks, tiles, brick slips, boards, panels, or cassettes made of the materials given in Table 1.1.1.1 for exterior use, that are installed by means of the cladding fixings directly, or through a subframe, to the external surface of the external walls, ceilings or cornices.

Cladding elements covered by this EAD are composed of one full body material, except the cladding elements made of Thin Metal Composite Sheets (TMCS).

The cladding elements may include grooves, dowel holes, drill or undercut holes, or may be in form of metal cassettes (TMCP[6]) depending on the kit family (see Figures 1.1.1 to 1.1.8).

Minimum data for describing the cladding elements are: type of material (in the case of natural stone, also name and petrographic designation), dimensions (where relevant, also grooves and dowel holes dimensions) and density or weight per square meter.

Table 1.1.1.1 Cladding elements materials and associated product technical specifications

Cladding element materials	Associated product technical specifications	
	Harmonised technical specifications	Others
Wood based	EN 13986; EN 14915	---
Metal	EN 14782; EN 14783	---
Natural stone (*)	EN 1469; EN 12057; EN 12326-1	---
Agglomerated stone	EN 15286	---
HPL laminates	EN 438-7	---
Fibre-cement	EN 12467; EN 492; EN 494	---
Concrete	EN 490; EN 14992	EN 15191
Terra cotta or ceramic	EN 1304; EN 14411	---
Plastic	EN 16153; EN 1013; EN 13245-2; EN 16240	---
Cement bonded board Cement bonded particle board	EAD 210024-00-0504	EN 634-1; EN 634-2
Thin Metallic Composite Sheets (TMCS)	EAD 210046-00-1201	---
Wood-polymer composites (WPC) or natural fibre composites (NFC)	---	EN 15534-5
(*) For cladding kits family B with undercut anchors (fasteners) covered by the EAD 330030-00-0601, see also the information given in Table 1.1 of EAD 330030-00-0601.		

6 TMCP = Thin Metal Composite Panel made of TMCS (Thin Metal Composite Sheets) cut, folded and assembled in form of cassette.

1.1.2 Cladding fixings

Cladding fixings are profiles, brackets, screws/anchors, nails, rivets, or any special fixing devices (see Table 1.1.1) used for fastening the cladding elements to the subframe or directly to the substrate.

Cladding fixings are made of metal materials (steel or aluminium alloy).

Minimum data for describing the cladding fixings are the geometric and physical parameters (such as cross-section shape and dimensions, weight, distance range between two cladding fixings, distance range to the cladding element borders) and material parameters (such as type of material, specific gravity, mechanical material properties). Exceptionally when justified for avoiding ambiguities, these data may be accompanied by adding the trade name of the component.

Cladding fixings may be fastened to the subframe (see clause 1.1.3) or directly to the substrate (see clause 1.3.2). See Figures 1.1.1a to 1.1.8a for cladding fixings fastened to the subframe and Figures 1.1.1b to 1.1.8b for cladding fixings fastened directly on the substrate.

When the cladding fixings are fastened directly to the substrate, the cladding kit may also optionally include the anchor (see clause 1.1.3).

1.1.3 Subframe (optional)

Subframe is the intermediate assembly located between the cladding elements and the substrate.

Subframe may or may not be part of the cladding kits. When the cladding fixings are fastened directly to the substrate, the subframe is never part of the cladding kits.

Depending on each specific kit composition the subframe may be composed of all these following components or only part of them:

- Vertical and/or horizontal profiles made of metal materials (steel or aluminium alloy) or wood for exterior use.
- Brackets made of metal materials (steel or aluminium alloy) for fastening the profiles to the substrate (e.g., external wall).

  Minimum data for describing the profiles and brackets are the geometric and physical parameters (such as cross-section shape and dimensions, weight, distance between profiles and between brackets) and material parameters (such as type of material, specific gravity, mechanical material properties). Exceptionally when justified for avoiding ambiguities, these data may be accompanied by adding the trade name of the component.
- Screws or rivets made of metal materials (steel or aluminium alloy) between the brackets and the profiles and between the cladding fixings and the profiles.
- Anchors (optional) between the subframe and the substrate or directly between the cladding fixings to the substrate.

  Minimum data for describing the screws, rivets and anchors are the geometric parameters (such as cross-section shape and dimensions) and material parameters (such as type of material, mechanical properties). Exceptionally when justified for avoiding ambiguities, these data may be accompanied by adding the trade name of the component.

1.1.4 Thermal insulation layer (optional)

Thermal insulation layer may or may not be part of the cladding kits. Thermal insulation layer covered by this EAD are thermal insulation products for buildings made of mineral wool (MW) according to EN 13162; expanded polystyrene (EPS) according to EN 13163; extruded polystyrene foam (XPS) according to EN 13164; rigid polyurethane foam (PU) according to EN 13165; phenolic foam (PF) according to EN 13166; cellular glass (CG) according to EN 13167; wood wool (WW) according to EN 13168; expanded perlite board (EPB) according to EN 13169; expanded cork (ICB) according to EN 13170; or wood fibre (WF) according to EN 13171.

Thermal insulation products are installed on the substrate by means of mechanically fixings and/or bonding materials that allow the thermal insulation products to keep their position on the substrate without any falling down or flatness losing.

Minimum data for describing the thermal insultation products are the type of material, dimensions and density or weight per square meter. Exceptionally when justified for avoiding ambiguities, these data may be accompanied by adding the trade name of the component.

1.1.5 Ancillary components (optional)

Ancillary components are:

- Breather membranes (see clause 1.3.8).
- Cavity barriers (see clause 1.3.9).
- Thermo-stop pads (see clause 1.3.13).
- Any other component used in the cladding kits (e.g., to form joints such as sealant, corner strips, etc.; or to achieve continuity such as mastic, joint-covers, gaskets, trims, etc.; or to keep the position of the cladding elements such as springs, groove protectors, etc.; or to improve performance at joints to control rain penetration such as baffles and flashings, etc.).

Minimum data for describing the ancillary components are the geometric parameters (such as shape and dimensions) and material parameters (such as type of material, mechanical properties). Exceptionally when justified for avoiding ambiguities, these data may be accompanied by adding the trade name of the component.

Since the EAD applies for mechanically fixed cladding kits, the influence of ancillary adhesives (which may be used e.g., to set correct position of components) on the mechanical resistance of the cladding kits are not considered(i.e., they are not used in the assessment of the mechanical resistance of the cladding kits). However, other influences (e.g., on cladding kit reaction to fire class) are considered in the relevant assessments (see clause 2.2).

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

1.2.1 Intended use(s)

This EAD covers the intended use of claddings kits as coverings of external walls (rainscreens):

- in ventilated façades, and/or
- in non-ventilated façades.

Besides, this EAD covers:

- Cladding kits which contain sloped surfaces / horizontal surfaces for the use in external ceilings, cornices, but not roofs.
- Cladding kits which contain cladding elements in contact with ground.

Cladding kits are mechanically fixed to external walls (vertical or sloped with respect to the vertical plane) or external ceilings or cornices (horizontal or sloped with respect to the horizontal plane) made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame in new or existing buildings (retrofit).

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 a working life of the cladding kits for the intended use of 25 years when installed in the works (provided that the cladding kits are subject to appropriate installation (see clause 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[7].

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

1.3.1 Cladding kits

A cladding kit is a specific kit composed of a cladding element, its cladding fixings and optionally a subframe, thermal insulation product and other ancillary components, and it is to be used as coverings of external walls, ceilings or cornices (not roofs).

1.3.2 Substrate

The term "substrate" refers to a wall, ceiling or cornice, which in itself already meets the necessary airtightness and mechanical strength requirements (resistance to static and dynamic loads), as well as a relevant watertightness and water vapour resistance. The substrate walls, ceilings or cornices, can be made of masonry (clay, any kind of concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame.

1.3.3 Subframe

See clause 1.1.3.

1.3.4 Cladding elements

See clause 1.1.1.

1.3.5 Cladding fixings

See clause 1.1.2.

1.3.6 Subframe fixings

Screws/anchors, nails, rivets, or any special fixing devices used to fasten the subframe components.

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7 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.

1.3.7 Ancillary components

See clause 1.1.5.

1.3.8 Breather membranes

Membrane placed in the cladding kits which contributes to the watertightness of the substrate. E.g., flexible sheets for waterproofing according to EN 13859-2.

1.3.9 Cavity barriers (compartmentation of air space)

Element placed in the air space to separate horizontally or vertically two compartments of air space (for fire or wind pressure purposes).

1.3.10 Air space

Space between the cladding elements and the thermal insulation layer or the substrate respectively.

1.3.11 Ventilated air space

A layer of air between the substrate or thermal insulation layer and cladding elements connected to the external environment permitting the dry-out of the water that may be found in this space due to condensations or rain penetration and the water vapour diffusion from the internal side of the substrate.

External wall claddings are considered as ventilated when the following criteria are fulfilled:

- The distance between the cladding elements and the thermal insulation layer or the substrate accordingly (ventilated air space) amounts to at least 20 mm. This air space may be reduced locally to 5 mm to 10 mm depending on the cladding elements and the subframe, provided that it does not affect the draining and/or ventilation function,
- Ventilation openings are envisaged, as a minimum, at the building base points and at the roof edges with cross-sections of at least 50 cm^2 per linear metre.

1.3.12 External wall cladding system

Constructive system that uses cladding elements for covering the external walls. The cladding kits may include all the components of the external wall cladding systems or only part of them.

1.3.13 Thermo-stop pads

Non-metal pieces installed between the brackets base and the substrate for improving the punctual thermal transmittance.

1.3.14 Symbols

$\Delta d_{max,R,DS1,ip}$ [%] =	In-plane displacement relative to the representative damage state DS1 (see Table R.2.1).
$\Delta d_{max,R,DS2,ip}$ [%] =	In-plane displacement relative to the representative damage state DS2 (see Table R.2.1).
$\Delta d_{max,R,DS3,ip}$ [%] =	In-plane displacement relative to the representative damage state DS3 (see Table R.2.1).
ΔL [mm] =	Value of the displacement under loading in the bracket resistance test (see Figure L.4.1.1).

$\Delta L_{permanent}$ [mm] =	Value of the permanent deformation after unloading in the bracket resistance test (see Figure L.4.1.1).
ΔR_w [dB] =	Weighted improvement of the airborne sound insulation.
a [mm] =	Depth of the connexion profile-tool in the groove in the resistance of the grooved cladding element test. See Figure H.1.1.
a_{bord} [mm] =	Minimum distance of the cladding fixing at the border position to the border edge (vertical or horizontal) of the cladding element (see Figures I.1.1.2).
$a_{g,R,DS1,out}$ [m/s^2] =	Out-of-plane acceleration relative to the representative damage state DS1 (see Table R.2.1).
$a_{g,R,DS2,out}$ [m/s^2] =	Out-of-plane acceleration relative to the representative damage state DS2 (see Table R.2.1).
$a_{g,R,DS3,out}$ [m/s^2] =	Out-of-plane acceleration relative to the representative damage state DS3 (see Table R.2.1).
a_h [mm] =	Minimum distance of the cladding fixing at the corner position to the vertical border edge of the cladding element (see Figures I.1.1.2).
a_v [mm] =	Minimum distance of the cladding fixing at the corner position to the horizontal border edge of the cladding element (see Figures I.1.1.2).
b [mm] =	Depth of the free space in the groove in the resistance of the grooved cladding element test. See Figure H.1.1.
B_b [mm] =	Bracket base length.
b_{min} [mm] =	Minimum distance of the cladding fixing at the corner position to the corner vertice of the cladding element (see Figures I.2.1.2).
C and C_{tr} [dB] =	Spectrum adaptation terms of the airborne sound insulation.
$d_{20,C}$ [mm] =	Characteristic value of the displacement at 20ºC state for a series of test specimens, obtained according to equation (N.1).
$d_{80,C}$ [mm] =	Characteristic value of the displacement at 80ºC state for a series of test specimens, obtained according to equation (N.1).
$d_{ini,C}$ [mm] =	Characteristic value of the displacement at initial state for a series of test specimens, obtained according to equation (N.1).
$d_{20,m}$ [mm] =	Mean or average value of the displacement at 20ºC state for a series of tested specimens.
$d_{80,m}$ [mm] =	Mean or average value of the displacement at 80ºC state for a series of tested specimens.
d_{max} [mm] =	Maximum distance between two consecutive cladding fixings in one cladding element.
$d_{ini,m}$ [mm] =	Mean or average value of the displacement at initial state for a series of tested specimens.
d_{ring} [mm] =	General designation for the diameter for the ring in tests defined in clause I.1.
$d_{ring,lar}$ [mm] =	Large diameter for the ring in tests defined in clause I.1.
$d_{ring,med}$ [mm] =	Medium diameter for the ring in tests defined in clause I.1.
$d_{ring,min}$ [mm] =	Minimum diameter for the ring in tests defined in clause I.1.
e [mm] =	Cladding element tongue thickness in the resistance of the grooved cladding element test. See Figure H.1.1.
F [N] =	Applied load in the tests.
$F_{1,C}$ [N] =	Characteristic value of the load at 1 mm permanent deformation for a series of test specimens, obtained according to equation (N.1).
$F_{1d,C}$ [N] =	Characteristic value of the load at 1 mm displacement for a series of test specimens, obtained according to equation (N.1).

$F_{3d,C}$ [N] =	Characteristic value of the load at 3 mm displacement for a series of test specimens, obtained according to equation (N.1).
$F_{r,C}$ [N] =	Characteristic value of the load at 0,2% of the bracket wing length permanent deformation for a series of test specimens, obtained according to equation (N.1).
$F_{u,C}$ [N] =	Characteristic value of the ultimate load for a series of test specimens, obtained according to equation (N.1).
$F_{1,i}$ [N] =	Value of the load at 1 mm permanent deformation for each individual tested specimen.
$F_{corrected}$ [N] =	Corrected individual load value.
$F_{u,i}$ [N] =	Value of the ultimate load for each individual tested specimen.
$F_{1,m}$ [N] =	Mean or average value of the load at 1 mm permanent deformation for a series of tested specimens.
$F_{1d,m}$ [N] =	Mean or average value of the load at 1 mm displacement for a series of tested specimens.
$F_{3d,m}$ [N] =	Mean or average value of the load at 3 mm displacement for a series of tested specimens.
f_{max} [mm] =	Maximum displacement of the TMCP stated according to the MPII.
f_{cal} [mm] =	Displacement obtained by wind load resistance calculation.
f_{test} [mm] =	Maximum displacement obtained by wind load resistance testing.
F_{max} [N] =	Maximum load to be applied in the pulsating load test.
F_{min} [N] =	Minimum load to be applied in the pulsating load test.
$F_{r,m}$ [N] =	Mean or average value of the load at 0,2% of the bracket wing length permanent deformation for a series of tested specimens.
$F_{u,m}$ [N] =	Mean or average value of the ultimate load for a series of tested specimens.
F_{ref} [N] =	Applied load for reaching f_{max} of the TMCP.
F_{weight} [N] =	Constant weight load to be applied in the flexural stiffness test for TMCS.
H [mm] =	Drop height in the impact tests. See Figure G.4.3.
H1, H2, H3 =	Hard body impacts for 1 Joule, 3 Joules and 10 Joules respectively.
H_b [mm] =	Bracket height.
L [mm] =	Distance between two points. E.g., Length rope in the impact tests (Figure G.4.3), distance between the applied load in the creep test, .
L_b [mm] =	Width of the test specimen in the flexural stiffness test for TMCS.
L_h [mm] =	Dimension of the test specimen cladding element in horizontal direction.
Ls [mm] =	Span between two supporting points.
L_v [mm] =	Dimension of the test specimen cladding element in vertical direction.
L_w [mm] =	Bracket wing length.
MPII =	Manufacturer’s Product Installation Instructions.
n [--]	General designation for a number of elements.
p [mm] =	Cladding element groove depth in the resistance of the grooved cladding element test. See Figure H.1.1.
Q [kN/m^2] =	Maximum wind load (suction and/or pressure) resistance of the assembled kit.
Q_{ad} [N] =	Additional load (dead load) to be applied in the resistance to vertical load test.
Q_{cal} [kN/m^2] =	Wind load obtained by calculation.
Q_{test} [kN/m^2] =	Maximum wind load (suction and/or pressure) resistance obtained by testing.
Q_w [N] =	Weight of the cladding element specimen in the resistance to vertical load test.

R_C [N/mm²] =	Characteristic value of the bending strength for a series of test specimens, obtained according to equation (N.1).
R_m [N/mm²] =	Mean or average value of the bending strength for a series of tested specimens.
R_w [dB] =	Sound reduction index of the airborne sound insulation.
S1, S2, S3, S4 =	Soft body impacts for 10 Joules, 60 Joules, 100 Joules and 400 Joules respectively.
t [mm] =	Cladding element thickness in the resistance of the grooved cladding element test.
T_a [s] =	Out-of-plane fundamental vibration period.
X ; Y [hour] =	Interval of time in the creep test.
$W_{load,0h}$ [mm] =	Total initial displacement under load measured at the initial time X = 0 hours in the creep test.
$w_{load,2000h}$ [mm]=	Total displacement under load measured at the ending time X = 2000 hours in the creep test.
$w_{residual}$ [mm] =	Total residual displacement measured after removing of load (unloading) in the creep test.
$w_{load,Xh}$ [mm] =	Total displacement under load measured at each time X hours in the creep test.
$w_{unload,Yh}$ [mm] =	Total displacement under unload measured at each time Y hours in the creep test.
α, β, γ [º] =	Angle designations in several test specimen figures.
σ_e [MPa] =	Elastic limit of the metal faced skin sheets of the TMCS.
φ_{2000h} [-] =	Creep coefficient.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of kits for external wall claddings mechanically fixed is assessed in relation to the essential characteristics.

Table 2.1.1 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
2	Façade fire performance	2.2.2	Description / Class / Level (as relevant)
3	Propensity to undergo continuous smouldering	2.2.3	Description
Basic Works Requirement 3: Hygiene, health and the environment			
4	Watertightness of joints (protection against driving rain)	2.2.4	Description (for open joints) Level (for closed joints)
5	Water absorption	2.2.5	Level
6	Water vapour permeability (for non-ventilated façades)	2.2.6	Level
7	Drainability	2.2.7	Description
8	Content, emission and/or release of dangerous substances	2.2.8	Description
Basic Works Requirement 4: Safety and accessibility in use			
9	Wind load resistance	2.2.9	Level
10	Resistance to horizontal point loads	2.2.10	Description
11	Impact resistance	2.2.11	Description
12 to 15	Mechanical resistance (*). Cladding elements (see Table 2.1.2)	2.2.12.1 to 2.2.12.4	Level
16 to 21	Mechanical resistance (*). Connexion between the cladding elements and the cladding fixings (see Table 2.1.2)	2.2.12.5 to 2.2.12.10	Level
22 to 24	Mechanical resistance (*). Cladding fixings (see Table 2.1.2)	2.2.12.11 to 2.2.12.13	Level
25	Resistance of profiles (*)	2.2.12.14	Description
26	Tension/pull-out resistance of subframe fixings (*)	2.2.12.15	Level
27	Shear load resistance of subframe fixings (*)	2.2.12.16	Level
28	Brackets resistance (horizontal and vertical load) (*)	2.2.12.17	Level
29	Resistance to seismic loads. Out-of-plane fundamental vibration period	2.2.13.1	Level
30	Resistance to seismic loads. Out-of-plane acceleration	2.2.13.2	Level
31	Resistance to seismic loads. In-plane displacement	2.2.13.3	Level
Basic Works Requirement 5: Protection against noise			
32	Airborne sound insulation	2.2.14	Level
Basic Works Requirement 6: Energy economy and heat retention			
33	Thermal resistance	2.2.15	Level
Aspects of durability (**)			
34	Hygrothermal behaviour	2.2.16.1	Description
35	Behaviour after pulsating load	2.2.16.2	Level

Table 2.1.1 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
36	Freeze-thaw resistance	2.2.16.3	Level
37	Behaviour after immersion in water	2.2.16.4	Level
38	Dimensional stability by humidity	2.2.16.5.1	Level
39	Linear thermal expansion	2.2.16.5.2	Level
40	Chemical and biological resistance	2.2.16.6	Level
41	UV radiation resistance	2.2.16.7	Level
42	Corrosion	2.2.16.8	Description
43 to 55	Accelerated ageing behaviour of kits when the cladding element is made of thin metallic composite sheets/panels (TMCS/TMCP) (see Table 2.1.3)	2.2.16.9	Level

(*) Mechanical resistance of the kit is assessed by means of the mechanical characteristics of the relevant kit components and their connexions. See clause 2.2.12.
(**) Durability of the kit is assessed by means of relevant component durability, where relevant. See clause 2.2.16.

Table 2.1.2 Mechanical resistance of the components in relation with the applicable kit family as of the Table 1.1.1.

No	**Essential characteristic**	**Assessment method**	**Applicable to kit family** *(it is marked with X when is applicable)*							
			A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
12	Bending strength	2.2.12.1	X	X	X	X	X	X	X	X
13	Resistance of grooves	2.2.12.2	---	---	X	X	---	---	---	---
14	Resistance at dowel holes	2.2.12.3	---	---	X	---	---	---	---	---
15	Resistance to long term or permanent dead load (Creep test) (*)	2.2.12.4	X	X	X	X	X	X	X	X
16	Pull-through resistance	2.2.12.5	X	---	---	X	X	---	---	---
17	Pull-through resistance under shear loads	2.2.12.6	X	---	---	X	X	---	---	---
18	Axial tension resistance	2.2.12.7	---	X	---	---	---	---	---	---
19	Shear load resistance	2.2.12.8	---	X	---	---	---	---	---	---
20	Combined tension and shear load resistance (**)	2.2.12.9	X	X	---	X	X	---	---	---
21	Resistance of slot	2.2.12.10	---	---	---	---	---	---	X	---
22	Resistance to vertical load	2.2.12.11	---	---	X	---	---	X	---	X
23	Pull-through resistance of fixings from profile	2.2.12.12	---	X	X	---	---	X	---	X
24	Resistance of punctual cladding fixings	2.2.12.13	---	---	X	---	---	X	---	X

(*) Only relevant for cladding kits which contain horizontal or sloped surfaces for the use in external ceilings or cornices (not roofs).
(**) Only relevant for cladding kits which contain sloped surfaces for the use of external walls, ceilings, or cornices (not roofs).

Table 2.1.3 Accelerated ageing behaviour of cladding elements made of thin metallic composite sheets/panels (TMCS/TMCP)

No	Essential characteristic	Assessment method	Type of expression of product performance
43	Decay of delamination resistance by peel test (torque peel strength). After hygrothermal cycles	2.2.12.1.1 of EAD 210046-00-0404	Level
44	Decay of delamination resistance by peel test (torque peel strength). After immersion 6 h in boiling water at 90 ºC	2.2.12.2.1 of EAD 210046-00-0404	Level
45	Decay of delamination resistance by peel test (torque peel strength). After immersion in water 500 h at 20 ºC	2.2.12.3.1 of EAD 210046-00-0404	Level
46	Decay of delamination resistance by peel test (torque peel strength). After freeze-thaw cycles	2.2.12.4.1 of EAD 210046-00-0404	Level
47	Decay of delamination resistance by peel test (torque peel strength). After long term exposure to heat (2500 h at hot dry air 80 ºC)	2.2.12.5.1 of EAD 210046-00-0404	Level
48	Decay of flexural resistance (bending strength in four points test). After hygrothermal cycles	2.2.12.1.2 of EAD 210046-00-0404	Level
49	Decay of flexural resistance (bending strength in four points test). After immersion 6 h in boiling water at 90 ºC	2.2.12.2.2 of EAD 210046-00-0404	Level
50	Decay of flexural resistance (bending strength in four points test). After immersion in water 500 h at 20 ºC	2.2.12.3.2 of EAD 210046-00-0404	Level
51	Decay of flexural resistance (bending strength in four points test). After freeze-thaw cycles	2.2.12.4.2 of EAD 210046-00-0404	Level
52	Decay of flexural resistance (bending strength in four points test). After long term exposure to heat (2500 h at hot dry air 80 ºC)	2.2.12.5.2 of EAD 210046-00-0404	Level
53	Decay of flexural stiffness after short term exposure (1 h. +80 ºC)	2.2.16.9	Level
54	Decay of resistance of routed and returned edge after TPB test, flexural pulsating loads	2.2.16.9	Level
55	Decay of resistance of slot and its fixing device after pulsating loads	2.2.16.9	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.

If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant essential 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

Reaction to fire of the kits shall be assessed by considering the reaction to fire of the components (cladding elements, cladding fixings, subframe components, thermal insulation products, etc.), in order to be classified according to Commission Delegated Regulation (EU) 2016/364.

Where relevant (e.g., asymmetrically composed cladding elements, or relevant surfaces of the kit components of the rear side), reaction to fire of the rear side of the cladding kits shall also be assessed in order to be classified according to Commission Delegated Regulation (EU) 2016/364.

For the assessment of reaction to fire of the kits, one of the following options shall apply:

a) The kits shall be assessed based on the worst reaction to fire class of the kit components obtained according to a CWFT[8] Decision or tested using the method(s) relevant for the corresponding reaction to fire class according to EN 13501-1.

   Note: if option a) is followed, the field of application of the individual reaction to fire class of every kit component (i.e., the product and installation conditions for which the reaction to fire of the individual component is valid) shall completely match the end-use conditions of such a component when assembled into the kit.

b) If the option (a) leads to too onerous classification of the kits, or if classification for one or several components are missing, then the kits shall be tested, using the method(s) relevant for the corresponding reaction to fire class according to EN 13501-1 (reference method in case of dispute).

Criteria indicated in Annex B shall be taken into account. Associated mounting and fixing rules for the SBI test as well as for tests according to EN ISO 11925-2 shall be in accordance with Annex C.

The kits shall be classified according to the Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

The obtained reaction to fire classification according to Delegated Regulation (EU) 2016/364 in combination with EN 13501-1 covers both the application of the kits as vertically mounted external wall claddings as well as horizontal claddings beneath ceilings, provided that the assembly of the kits are identical for both cases. If not, separate testing with different test assemblies shall be considered.

When the thermal insulation products are part of the kits, the individual reaction to fire of the thermal insulation products shall be assessed, depending on the material, according to the thermal insulation product standards given in clause 1.1.4. The thermal insulation products shall be classified according to the Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

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[8] CWFT = Classified without Further Testing.

When subframe stud made of wood are part of the kits, the individual reaction to fire of these subframe studs shall be assessed according to a CWFT Decision or tested using the method(s) relevant for the corresponding reaction to fire class according to EN 13501-1. The subframe studs made of wood shall be classified according to the Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Components fulfilling the conditions as stated in clause B.6 shall be considered as small components without the need for testing and assessment of their reaction to fire performance, except where it is explicitly prescribed in Annexes B and C.

2.2.2 Façade fire performance

If the manufacturer intends to declare the façade fire performance of the product, in absence of a European assessment approach, the ETA shall state the results of the product assessment(s) according to the assessment method(s) required by the regulatory provisions of those countries, in which the manufacturer intends to make the product available on the market, according to the table given in Annex Q.

The facade fire performance shall be determined as requested at the place of application in order to demonstrate compliance with the relevant fire safety requirements and shall be stated in ETA.

2.2.3 Propensity to undergo continuous smouldering

This characteristic is only applicable for cladding kits completely or in parts consisting of components (see clause 1.1) made of mineral wool (MW), wood wool (WW), cork, wood-based boards/panels, wood fibres (WF) or made of any other vegetal or animal fibres or phenolic foam.

The assessment of the kits regarding propensity to undergo continuous smouldering is carried out by means of the assessment of the propensity to undergo continuous smouldering of the concerned kit components. It is considered representative of this essential characteristic for cladding kits.

Propensity to undergo continuous smouldering of concerned kit components shall be tested and assessed according to EN 16733.

The conditions and parameters which shall be taken into account within the tests as well as the extended application rules for the test results are specified in Annex P.

In accordance with EN 16733, clause 11, the ETA shall specify the following information:

Performance according to EN 16733, clause 11, of the kit components as given in its own DoP or after testing	**Description of the performance of the cladding kits regarding the characteristic Propensity to undergo continuous smouldering to be stated in the ETA**
The component does not show propensity to undergo continuous smouldering (NoS).	The cladding kits does not show propensity to undergo continuous smouldering.
The component shows propensity to undergo continuous smouldering (S).	The cladding kits shows propensity to undergo continuous smouldering.
Assessment of the propensity for continuous smouldering combustion is not possible (ANP).	Assessment of the propensity to undergo continuous smouldering is not possible

2.2.4 Watertightness of joints (protection against driving rain)

Cladding kits with open joints shall be described as “not watertight” .

Cladding kits with close joints contribute to the watertightness of the substrate. In this case, the watertightness of the cladding kits shall be assessed by testing according to EN 12865 Procedure A (see also Annex D). At least the worst case (maximum area of open joints, minimum thickness of the cladding element, maximum thickness joint between two cladding elements) shall be tested.

The limit level of pressure [in Pa] (just before water penetration) shall be stated in the ETA.

2.2.5 Water absorption

The assessment of the kits’ water absorption is carried out by means of the assessment of the water absorption of the relevant kit components (cladding elements and thermal insulation products) that are representative of this essential characteristic for cladding kits.

The water absorption of the cladding elements shall be assessed according to the test standards indicated in Table A.1 depending on the type of cladding element material.

When the thermal insulation products are part of the kit, water absorption of the thermal insulation products shall be assessed according to EN ISO 29767 for short-term water absorption by partial immersion, EN ISO 16535 for long-term water absorption by immersion or EN ISO 16536 for long-term water absorption by diffusion depending on the material of thermal insulation products (see clause 1.1.4).

The arithmetic average value and the maximum value shall be stated in the ETA according to the standards given above.

The values shall cover the range of density of the kit component material.

2.2.6 Water vapour permeability

This characteristic is only relevant when the cladding kits are used in non-ventilated façades.

The assessment of the kits’ water vapour permeability is carried out by means of the assessment of the water vapour permeability of the relevant kit components (cladding elements, thermal insulation products and breather membranes) that are representative of this essential characteristic for cladding kits.

Water vapour permeability of the following kit components shall be assessed:

- Cladding elements: according to EN ISO 12572, condition C (Table 1).
- Thermal insulation products (when it is part of the kit): according to EN 12086.
- Breather membrane (when it is part of the kit): according to EN ISO 12572, condition C (Table 1).

The values shall be stated in the ETA according to the standards given above.

As a simplified method, depending on the materials, tabulated values according to EN ISO 10456 may be stated in the ETA.

2.2.7 Drainability

The assessment of drainability is intended to determine whether water which penetrates in the air space or condensation water is drained out of the assembled cladding kits without accumulation or moisture damage or leakage into the substrate or the cladding kits.

This assessment shall be carried out by means of the analysis of available construction details of product assemblies, obtained from the Manufacturer’s Product Installation Instructions (MPII), aimed at detection of potential accumulation of water behind cladding kits.

The details of these assemblies, including descriptions of cladding fixings geometry and the connexions of the cladding kits with the base edges, openings (windows or doors), their geometry, etc., shall be stated in the ETA with notes explaining extended applicability of these descriptions.

2.2.8 Content, emission and/or release of dangerous substances

The performance of the kits regarding the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[9] after identifying the release scenarios taking into account the intended use(s) of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified intended release scenario for this product and intended use with respect to dangerous substances are:

S/W1: Product with direct contact to soil, ground- and surface water.

S/W2: Product with indirect contact to soil, ground- and surface water.

2.2.8.1 Leachable substances

For the intended use covered by the release scenario S/W1 and/or S/W2, the performance of the kits concerning leachable substances shall be assessed.

The dangerous substances assessment of the kit is carried out by means of the assessment of the most relevant kits components materials, which is the cladding element material.

<u>For cladding elements made of concrete and cement-based cladding elements</u>

A leaching test with subsequent eluate analysis shall take place, each in duplicate. Leaching tests of the cladding elements conducted according to CEN/TS 16637-2, but considering the steps below indicated for the leachant renewal. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area shall be (80 ± 10) l/m².

Specimens shall be prepared according to clause 8.2 of CEN/TS 16637-2.

The eluate is produced by a tank test according to CEN/TS 16637-2. The eluates taken after 6 hours, 1 day, 2 days and 6 hours, 4 days, 9 days, 16 days, 36 days and 64 days shall be analysed for following environmentally relevant parameters:

- aluminium, antimony, arsenic, barium, lead, cadmium, chromium (total), chromate (Cr VI), cyanide (total), cobalt, copper, molybdenum, nickel, mercury, thallium, vanadium, zinc,
- chloride (Cl-), sulphate (SO42-), fluoride (F-)
- TOC,
- pH-value, electrical conductivity, odour, colour, turbidity, and tendency to produce foam

The parameters shall be analysed using an appropriate equipment with a measurement range allowing the measurement of the substance concentration.

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9 The manufacturer may be asked to provide to the TAB the REACH related information which shall accompany the DoP (cf. Article 6(5) of Regulation (EU) No 305/2011).
The manufacturer may **<u>not</u>** be obliged by the EAD or the TAB to:
- provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS, taking into account the installation conditions of the construction product and the release scenarios resulting from there.

Any information provided by the manufacturer regarding the chemical composition of the products is not to be distributed to EOTA or to the TABs or beyond.

Measured concentration of the leaching test according to CEN/TS 16637-2 of these cladding elements shall be expressed per step for each parameter in µg/L and mg/m2. Additionally, the cumulatively released quantities shall be expressed for each parameter in mg/m2.

The used test methods for the analysis of the parameters shall be documented, including the equipment and its measurement range.

<u>For cladding elements materials other than concrete or cement-based cladding elements covered by CEN/TS 16637-2</u>

A leaching test with subsequent eluate analysis shall take place, each in duplicate. Leaching tests of the cladding element conducted according to CEN/TS 16637-2. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area shall be (80 ± 10) l/m².

Specimens shall be prepared according to clause 8.2 of CEN/TS 16637-2.

In eluates of "6” hours“ and "6” days", the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus according to EN ISO 6341.
- Toxicity test with algae according to EN ISO 15799.
- Luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.

For each biological test, EC20-values shall be determined for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16.

If the parameter TOC is higher than 10 mg/l, the following biological tests shall be conducted with the eluates of "6 hours" and/or "64 days" eluates:

- Biological degradation according to OECD Test Guideline 301 part A, B or E.

Determined toxicity in biological tests shall be expressed as EC20-values for each dilution ratio. Maximum determined biological degradability shall be expressed as "…% within …hours/days". The respective test methods for analysis shall be specified.

2.2.9 Wind load resistance

The wind load resistance (suction and/or pressure) of assembled cladding kits shall be assessed by structural calculations supplemented by testing.

Wind load resistance calculation (see clause E.3) shall be validated by testing according to clause E.1. Validation criteria are defined in clause E.2.

For this validation purpose, at least the worst case (the mechanically weakest case, see clause E.1.1.1) or the most representative case (according to the MPII) of the assembled cladding kits shall be tested.

For deciding the type of load to be applied in the test (suction and/or pressure), the specific configuration / composition of the cladding kit components (specially the cladding fixing and the type of cladding elements connexion) shall be considered. In case of doubt, it is recommended to carry out both tests: suction load and pressure load.

By confirming the results of the validated calculation, the wind load resistance calculation, input and output conditions (see clause E.3) shall be used for other configurations for the same cladding kits, i.e., for other dimensional range of the same kit components, other greater resistance of the same kit components, greater number of cladding fixings by cladding element area, lower span between the subframe profiles and lower span between the brackets.

For each assessed assembled cladding kit configuration (at least for the mechanically weakest configuration), the maximum wind load resistance “Q” in [kN/m²] shall be stated in the ETA. In addition, maximum wind load resistances obtained by testing shall also be stated in the ETA.

2.2.10 Resistance to horizontal point loads

This characteristic is only relevant for cladding kits that are known to be or are suspected of being sensitive to horizontal point loads (e.g., ladder bearing against it).

The resistance to horizontal points loads (e.g., one person standing on a ladder leaning against the cladding elements) shall be tested according to the method indicated in Annex F.

At least the worst case (the mechanically weakest case, i.e., lowest bending strength or modulus of elasticity and maximum distance between cladding fixings) of the assembled cladding kits shall be tested.

Description of any permanent deformation (visible deformation) on the tested kit components shall be stated in the ETA.

2.2.11 Impact resistance

The impact resistance shall be tested according to the method indicated in Annex G.

At least the worst case (the mechanically weakest case, see clause G.5) of the assembled cladding kits shall be tested.

Hard body and soft body impact resistance [in J] of each tested kit configuration shall be stated in the ETA.

Additionally, the degree of exposure according to the use categories defined in the Table G.2 in clause G.3 shall also be stated in the ETA.

2.2.12 Mechanical resistance

The assessment of the kits' mechanical resistance is carried out by means of the assessment of the mechanical resistance of the relevant kit components (cladding elements, cladding fixings and subframe components) and the connexions between them, which are representative of this essential characteristic for cladding kits.

The assessment depends on the applicable kit family (see Table 2.1.2) and the kit composition to be assessed (complete kit, minimum kit or cladding element alone assessed as a kit), see clause 1.1.

Mechanical essential characteristics are distributed in four groups:

a) Mechanical resistance of the cladding elements:

- Bending strength. See clause 2.2.12.1.
- Resistance of the grooves. See clause 2.2.12.2.
- Resistance of the dowel holes. See clause 2.2.12.3.
- Resistance to long term or permanent dead load (creep test). See clause 2.2.12.4.

b) Mechanical resistance of connexion between the cladding elements and the cladding fixings:

- Pull-through resistance. See clause 2.2.12.5.
- Pull-through resistance under shear loads. See clause 2.2.12.6.
- Axial tension resistance. See clause 2.2.12.7.
- Shear load resistance. See clause 2.2.12.8.
- Combined tension and shear load resistance. See clause 2.2.12.9.
- Resistance of slot. See clause 2.2.12.10.

c) Mechanical resistance of cladding fixings:

- Resistance to vertical load. See clause 2.2.12.11.
- Pull-through resistance of fixings from profile. See clause 2.2.12.12.
- Resistance of punctual cladding fixing. See clause 2.2.12.13.

d) Mechanical resistance of subframe components:

- Resistance of profiles. See clause 2.2.12.14.
- Tension/pull-out resistance of subframe fixings. See clause 2.2.12.15.
- Shear load resistance of subframe fixings. See clause 2.2.12.16.
- Bracket resistance (horizontal and vertical load). See clause 2.2.12.17.

2.2.12.1 Bending strength

The bending strength of the cladding elements shall be assessed according to the test standards indicated in Table A.1 depending on the cladding element materials.

For materials which are sensitive to temperature variations (e.g., plastics), the bending strength of the cladding elements shall also be tested after conditioning to high and low temperatures (max +80 ºC; min -20 ºC). For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

At least the worst case (the mechanically weakest case, i.e., weakest material and minimum thickness) shall be tested.

The arithmetic average value R_m [in N/mm^2] and the characteristic value R_C in [N/mm^2] according to equation (N.1) shall be stated in the ETA.

The values shall cover the range of density and thickness of the cladding elements.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Freeze-thaw resistance. See clause 2.2.16.3.
- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.2 Resistance of grooves

This characteristic is only relevant for kits family C & D (cladding elements with groove).

The grooved cladding element resistance shall be tested according to the method indicated in clause H.1.

At least the worst case (the mechanically weakest case, i.e., weakest material, minimum tongue thickness, and maximum groove depth, see Figure H.1.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Freeze-thaw resistance. See clause 2.2.16.3.
- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.3 Resistance at dowel holes

This characteristic is only relevant for kits family C when the cladding elements include dowel holes.

The resistance of the cladding elements at dowel holes shall be tested according EN 13364, as follows:.

- For cladding elements made of natural stone, EN 13364 is applicable by considering:
    - Technological tests (i.e., option b) in clauses 6.2.3, 6.2.4, 6.2.5, 6.2.6 & 7.1).
    - Depth of the hole given in clause 6.2.6 does not apply, it shall be the actual depth of the hole defined in the cladding kit according to the MPII.
    - Clause 7.3 does not apply. The dowels shall be placed according to the MPII.
- For cladding elements made of other materials different to natural stone, EN 13364 is applicable by considering:
    - Technological tests (i.e., option b) in clauses 6.2.3, 6.2.4, 6.2.5, 6.2.6 & 7.1).
    - Statements related to Type 0 cladding element specimens (i.e., without planes of anisotropy), see Figure 3 in EN 13364.
    - Depth of the hole given in clause 6.2.6 does not apply, it shall be the actual depth of the hole defined in the cladding kit according to the MPII.
    - Clause 7.3 does not apply. The dowels shall be placed according to the MPII.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Freeze-thaw resistance. See clause 2.2.16.3.
- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.4 Resistance to long term or permanent dead load (creep test)

This characteristic is only relevant for cladding kits which contain sloped surfaces / horizontal surfaces for the use in external ceilings, cornices, but not roofs.

Resistance of the cladding elements to long term or permanent dead load (creep test) shall be tested according to the method indicated in clause H.2.

The measured displacement [in mm], at initial loading ($w_{load,0h}$), at 2000 hours loading ($w_{load,2000h}$), at residual ($w_{residual}$), the creep coefficient φ_{2000h} [-], the applied load F [in N], and the span Ls [in mm] considered in the test according to clause H.2 shall be stated in the ETA.

2.2.12.5 Pull-through resistance

This characteristic is only relevant for kits family A, D & E (cladding elements which are pierced by punctual cladding fixings such as screws, rivets or nails).

The pull-through resistance shall be tested according to the method indicated in clause I.1.

At least the worst case (the mechanically weakest case, see clause I.1.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic $F_{u,C}$ [in N] value according to equation (N.1) shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Behaviour after pulsating load. See clause 2.2.16.2.
- Freeze-thaw resistance. See clause 2.2.16.3.

- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.6 Pull-through resistance under shear loads

This characteristic is only relevant for kits family A, D & E (cladding elements which are pierced by punctual cladding fixings such as screws, rivets or nails).

The pull-through resistance under shear loads shall be tested according to the method indicated in clause I.2.

At least the worst case (the mechanically weakest case, see clause I.2.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.7 Axial tension resistance

This characteristic is only relevant for kits family B (cladding elements which are fixed by special anchors placed in drill holes or in undercut holes and anchored by mechanical interlock).

When the undercut anchors are covered by the EAD 330030-00-0601, axial tension resistance shall be assessed according to clause 2.2.1 of EAD 330030-00-0601 provided that the criteria given in clause I.1 are met.

For other types of special anchors, axial tension resistance shall be tested according to the method indicated in clause I.1.

At least the worst case (the mechanically weakest case, see clause I.1.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Behaviour after pulsating load. See clause 2.2.16.2.
- Freeze-thaw resistance. See clause 2.2.16.3.
- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.8 Shear load resistance

This characteristic is only relevant for kits family B (cladding elements which are fixed by special anchors placed in drill holes or in undercut holes and anchored by mechanical interlock).

When the undercut anchors are covered by the EAD 330030-00-0601, shear load resistance shall be assessed according to clause 2.2.2 of EAD 330030-00-0601 provided that the criteria given in clause I.2 are met.

For other types of special anchors, shear resistance shall be tested according to the method indicated in clause I.2.

At least the worst case (the mechanically weakest case, see clause I.2.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.9 Combined tension and shear load resistance

This characteristic is only relevant for kits family B (cladding elements which are fixed by special anchors placed in drill holes or in undercut holes and anchored by mechanical interlock) and for kits family A, D & E which contain sloped surfaces for the use in external ceilings, cornices, but not roofs.

When the undercut anchors are covered by the EAD 330030-00-0601, combined tension and shear load resistance shall be assessed according to clause 2.2.3 of EAD 330030-00-0601 provided that the criteria given in clause I.3 are met.

For other types of special anchors, combined tension and shear load resistance shall be tested according to the method indicated in clause I.3.

At least the worst case (the mechanically weakest case, see clause I.1.1) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.10 Resistance of slot

This characteristic is only relevant for kits family G (cladding elements which are fixed by means of slots).

For TMCP cladding elements made of TMCS in form of cassette, the resistance of slot shall be tested according to the method indicated in clause I.4.

For other cladding elements materials, the resistance of slot shall be tested according to the method indicated in clause H.1.

At least the worst case (the mechanically weakest case, see clause I.4) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristics:

- Behaviour after pulsating load. See clause 2.2.16.2.
- Freeze-thaw resistance. See clause 2.2.16.3.
- Behaviour after immersion in water. See clause 2.2.16.4.

2.2.12.11 Resistance to vertical load

This characteristic is only relevant for kits family C & F.

Resistance to vertical load shall be tested according to clause J.1.

At least the worst case (the mechanically weakest case, see clause J.1) shall be tested.

Maximum displacement according to clause J.1 shall be stated in the ETA.

2.2.12.12 Pull-through resistance of fixings from profile

This characteristic is only relevant for kits family C & F (linear cladding fixings such as rail profiles). It is also relevant for the horizontal supporting rails of the cladding fixings in kits family B.

Fixing pull-through resistance shall be tested according to the method indicated in clause J.2.

At least the worst case (the mechanically weakest case, i.e., weakest material and minimum geometry) shall be tested.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.13 Resistance of punctual cladding fixings

This characteristic is only relevant for kits family C, F & H (punctual cladding fixings such as clips, small rails, pins, clamps, hangs and hooks).

Resistance of punctual cladding fixing to horizontal and vertical loads shall be tested according to the method indicated in clause J.3.

At least the worst case (the mechanically weakest case, i.e., weakest material and minimum geometry) shall be tested.

The arithmetic average value $F_{1,m}$, $F_{u,m}$ [in N] and the characteristic value $F_{1,C}$, $F_{u,C}$ [in N] according to equation (N.1) for both, horizontal and vertical load resistance shall be stated in the ETA.

The value and the assessment method of this characteristic is also to be used for the following durability characteristic:

- Behaviour after pulsating load. See clause 2.2.16.2.

2.2.12.14 Resistance of profiles

This characteristic is only relevant when the kits contain the subframe profile/stud (see clause 1.1).

Resistance of profiles/studs depend on both, the profile geometry and the material mechanical resistance properties obtained from the MPII based on following standards:

- For continuously hot-dip coated steels: EN 10346 and EN 1993-1-1 clause 3.2.6.
- For aluminium alloys: EN 755-2 and EN 1999-1-1 clauses 5.2.2 to 5.2.5.
- For stainless steel: EN 10088-1 and EN 1993-1-4 clauses 2.1.2 & 2.1.3.
- For wood studs: EN 1995-1-1 clause 2.3.2.

From the cross-section shape and dimensions of the profile obtained from the MPII, the Area, Moment of inertia and the Centre of Gravity of the cross-section, that are geometric characteristics related to the profile resistance, shall be calculated using Computer-aided design (CAD) software. The calculation tool shall be validated according to the Annex G of EN 1999-1-1 or Annex D of EN 1993-1-3.

For each profile geometry, the Area [in mm^2], the Moment of inertia [in mm^4] and the Centre of Gravity [in mm] of the cross-section shall be stated in the ETA.

2.2.12.15 Tension/pull-out resistance of subframe fixings

This characteristic is only relevant when the kits contain the subframe fixings (see clause 1.1).

For fixings between subframe components, the tension/pull-out resistance on the relevant subframe component (e.g., vertical profile or wood stud) shall be assessed according to the method indicated in clause K.1.

At least the worst case (the mechanically weakest case, i.e., weakest material and minimum geometry) shall be considered.

For anchors connecting the subframe to the substrate, tension / pull-out resistance shall be assessed according to the corresponding EAD (EAD 330747-00-0601, EAD 330284-00-0604 or EAD 330076-00-0604) depending on the type of anchor.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.16 Shear load resistance of subframe fixings

This characteristic is only relevant when the kits contain the subframe fixings (see clause 1.1).

For fixings between subframe components, the shear strength of the fixings between subframe components (e.g., between the vertical profile and the bracket) shall be assessed according to the method indicated in clause K.2.

At least the worst case (the mechanically weakest case, i.e., weakest material and minimum geometry) shall be considered.

For anchors connecting the subframe to the substrate, shear resistance shall be assessed according to the corresponding EAD (EAD 330747-00-0601, EAD 330284-00-0604 or EAD 330076-00-0604) depending on the type of anchor.

The arithmetic average value $F_{u,m}$ [in N] and the characteristic value $F_{u,C}$ [in N] according to equation (N.1) shall be stated in the ETA.

2.2.12.17 Bracket resistance (horizontal and vertical load)

This characteristic is only relevant when the kits contain the brackets (see clause 1.1).

The brackets load bearing capacity and deformation under loading (horizontal and vertical load) shall be tested according to the method indicated in Annex L.

At least the worst case (the mechanically weakest case) shall be tested (see clause L.1).

The arithmetic average values $F_{1,m}$, $F_{u,m}$ [in N] for horizontal load and $F_{r,m}$, $F_{1d,m}$, $F_{3d,m}$, $F_{u,m}$, [in N] for vertical load and the characteristic values $F_{1,C}$, $F_{u,C}$ [in N] for horizontal load and $F_{r,C}$, $F_{1d,C}$, $F_{3d,C}$, $F_{u,C}$, [in N] for vertical load according to equation (N.1) shall be stated in the ETA.

When possible, calculations through a numerical structural analysis (FEM[10]) at elastic state may be carried out provided that this calculation shall be validated by testing according to the method indicated in clause L.6. In this case no additional testing shall be necessary.

Values obtained by calculation are defined as an arithmetic average value and a characteristic value if the validation of the calculation has been obtained from mean and characteristic testing results, respectively.

2.2.13 Resistance to seismic loads

Resistance to seismic loads of the kits is assessed by means of the following properties:

- Out-of-plane fundamental vibration period, T_a, in seconds [s]. See clause 2.2.13.1.
- Out-of-plane acceleration relative to the representative damage states (DS1, DS2, DS3) defined in Table R.2.1, $a_{g,R,DS1,out}$, $a_{g,R,DS2,out}$, $a_{g,R,DS3,out}$, in meter per square second [m/s^2]. See clause 2.2.13.2.
- In-plane displacement relative to the representative damage states (DS1, DS2, DS3) defined in Table R.2.1, $\Delta d_{max,R,DS1,ip}$, $\Delta d_{max,R,DS2,ip}$, $\Delta d_{max,R,DS3,ip}$, in percentage [%]. See clause 2.2.13.3.

2.2.13.1 Out-of-plane fundamental vibration period

Cladding kit out-of-plane fundamental vibration period, T_a, shall be assessed by means of dynamic tests according to Annex R.

At least two representative cases, as defined in Table R.3.1 shall be tested.

Value of out-of-plane fundamental vibration period, T_a, in [s], obtained for the tested assembled cladding kit shall be stated in the ETA.

2.2.13.2 Out-of-plane acceleration

Cladding kit out-of-plane acceleration relative to the representative damage states (DS1, DS2, DS3) defined in Table R.2.1, $a_{g,R,DS1,out}$, $a_{g,R,DS2,out}$, $a_{g,R,DS3,out}$, shall be assessed by means of dynamic tests according to Annex R.

At least two representative cases, as defined in Table R.3.1 shall be tested. The results obtained on the two representative cases shall not be automatically extended to intermediate cases. A non-linear finite

[10] FEM = Finite Element Method.

element models (FEM) of the cladding kit, validated on the experimental results, shall be used in order to assess the seismic performances of non-tested cases.

Values of out-of-plane acceleration corresponding to the achievement of each defined damage states, $a_{g,R,DS1,out}$, $a_{g,R,DS2,out}$, $a_{g,R,DS3,out}$, in [m/s^2], recorded in the most unfavourable point of the cladding element closest to the geometric centre of the assembled kit shall be presented in the ETA.

Considering the cladding element closest to the geometric centre of the assembled kit subject to test, the most unfavourable point shall correspond to the centre of the free portion of such panel, i.e., the point farther from the panel-to-subframe connexions.

Some examples are reported in the Figure R.3.1.

2.2.13.3 In-plane displacement

Cladding kit in-plane displacement relative to the representative damage states (DS1, DS2, DS3) defined in Table R.2.1, $\Delta d_{max,R,DS1,ip}$, $\Delta d_{max,R,DS2,ip}$, $\Delta d_{max,R,DS3,ip}$, shall be assessed by means of in-plane displacement tests according to Annex R.

At least two representative cases, as defined in Table R.3.1 shall be tested. The results obtained on the two representative cases shall not be automatically extended to intermediate cases. A non-linear finite element models (FEM) of the cladding kit, validated on the experimental results, shall be used in order to assess the seismic performances of non-tested cases. .

Values of in-plane drift (the drift is the difference between the assembled cladding kit top and bottom displacement, divided by the height of the assembled cladding kit) corresponding to the achievement of each defined damage states, $\Delta d_{max,R,DS1,ip}$, $\Delta d_{max,R,DS2,ip}$, $\Delta d_{max,R,DS3,ip}$, in [%], obtained for the tested assembled cladding kit shall be stated in the ETA.

2.2.14 Airborne sound insulation

The improvement of airborne sound insulation shall be tested according to EN ISO 10140-1 Annex G.

At least the worst or more representative assembled cladding kits shall be tested. For the determination of the influence of the cladding kits on the sound insulation of the external wall, parameters such as the dynamic stiffness of the thermal insulation products, the mass/m^2 of the cladding elements and the type of anchors in the substrate shall be known.

The ratings of airborne sound insulation shall be undertaken according to EN ISO 717-1.

The weighted improvement ΔR_w, [in dB], the sound reduction index R_w [in dB] with and without the assembled cladding kit and the spectrum adaptation terms C and C_{tr}, [in dB] shall be stated in the ETA.

2.2.15 Thermal resistance

<u>In the case of non-ventilated façades:</u>

Thermal resistance (R-value) of the assembled cladding kits shall be calculated according to EN ISO 6946, using the thermal resistance of the kit components obtained from EN ISO 10456, or from testing according to EN 12667, EN 12939 or EN 12664 when the kit components materials correspond with the scope of standards. When this calculation is not possible, the thermal resistance shall be tested according to EN ISO 8990.

The assembled cladding kit thermal bridges shall be calculated according to EN ISO 10211. The possible influence of the thermos-stop pads in the point thermal transmittance of the brackets shall be considered in this calculation.

At least the worst or more representative assembled cladding kit shall be assessed.

Thermal resistance values [in (m^2·K)/W] for the assembled cladding kits shall be stated in the ETA.

In the case of ventilated façades when the cladding kits include the thermal insulation products:

Thermal resistance (R-value) of the kit is associated to the resistance of the thermal insulation products and it shall be assessed by testing according to EN 12667, EN 12939 or EN 12664 depending on the nature of the kit components materials.

Thermal resistance values [in (m^2·K)/W] or thermal conductivity value [in W/(m·K)] for the thermal insulation products shall be stated in the ETA.

In the case of ventilated façades when the cladding kit does not include the thermal insulation products:

This characteristic is not relevant.

2.2.16 Aspects of durability

The assessment of the durability of the kits is carried out by means of the assessment of the following characteristics which are representative of this essential characteristic for cladding kits:

- Hygrothermal behaviour. See clause 2.2.16.1.
- Behaviour after pulsating loads. See clause 2.2.16.2.
- Durability of kit components. See clauses 2.2.16.3 to 2.2.16.8. In particular, in case of kits when the cladding elements are made of TMCS/TMCP, clause 2.2.16.9 applies.

2.2.16.1 Hygrothermal behaviour

This characteristic is only relevant for cladding kits that are known to be or are suspected of being sensitive to hygrothermal variation.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Hygrothermal behaviour of the cladding kits shall be tested according to the method indicated in clause M.1.

Description on if any of the following defects, if any, occur during or at the end of the test programme shall be stated in the ETA:

- deterioration such as cracking or delamination of the cladding element that allows water penetration to the thermal insulation products or substrate;
- detachment of the cladding elements;
- permanent deformation.

2.2.16.2 Behaviour after pulsating load

This characteristic is only relevant for cladding kits that are known to be or are suspected of being sensitive to pulsating loads.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Cladding kit behaviour after pulsating loads shall be assessed by means of the following mechanical resistance tests before and after cycles, considering the corresponding family kit:

- Mechanical resistance of connexions between the cladding element and the cladding fixing:
  - Pull-through resistance. See clause 2.2.12.5.
  - Axial tension resistance. See clause 2.2.12.7.
  - Resistance of slot. See clause 2.2.12.10.

- Mechanical resistance of cladding fixings:
    - Resistance of punctual cladding fixing. See clause 2.2.12.13.

Pulsating load cycles shall be carried out according to the method indicated in clause M.2.

The number of test specimens shall be the same as those of the mechanical tests.

Test results shall be stated in the ETA according to the corresponding mechanical tests.

Ratio (division between the results after cycles and before cycles) shall also be stated in the ETA.

2.2.16.3 Freeze-thaw resistance

This characteristic is only relevant for cladding kits with components that are known or are suspected of being sensitive to freeze-thaw.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Cladding kit behaviour after freeze-thaw cycles shall be assessed by means of bending strength tests (see clause 2.2.12.1) before and after cycles.

Additionally, depending on the kit family (see Table 2.1.2), the behaviour after freeze-thaw cycles shall also be assessed by means of the following mechanical resistance tests before and after the freeze-thaw cycles:

- Mechanical resistance of connexions between the cladding element and the cladding fixing:
    - Pull-through resistance. See clause 2.2.12.5.
    - Axial tension resistance. See clause 2.2.12.7.
    - Resistance of slot. See clause 2.2.12.10.
- Mechanical resistance of the cladding element:
    - Resistance of grooved cladding element. See clause 2.2.12.2.
    - Resistance of the cladding element at dowel hole. See clause 2.2.12.3.

Freeze-thaw cycles shall be carried out according to the method indicated in clause M.3.

The number of test specimens shall be the same as those of the mechanical tests.

Test results shall be stated in the ETA according to the corresponding mechanical tests.

Ratio (division between the results after and before cycles) and the number of cycles applied shall also be stated in the ETA.

The values shall cover the range of density of the cladding element.

2.2.16.4 Behaviour after immersion in water

This characteristic is only relevant for cladding kits with components that are known to be or are suspected of being sensitive to water penetration.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Cladding kit behaviour after immersion in water shall be assessed by means of bending strength tests (see clause 2.2.12.1) before and after immersion in water.

Additionally, depending on the kit family (see Table 2.1.2), the behaviour after immersion in water shall also be assessed by means of the following mechanical tests before and after immersion in water:

- Mechanical resistance of connexions between the cladding element and the cladding fixing:

- Pull-through resistance. See clause 2.2.12.5..
- Axial tension resistance. See clause 2.2.12.7.
- Resistance of slot. See clause 2.2.12.10.

- Mechanical resistance of the cladding element:
  - Resistance of grooved cladding element. See clause 2.2.12.2.
  - Resistance of the cladding element at dowel hole. See clause 2.2.12.3.

Immersion in water shall be carried out according to the method indicated in clause M.4.

The number of test specimens shall be the same as those of the mechanical tests.

Test results shall be stated in the ETA according to the corresponding mechanical tests.

Ratio (division between the results after immersion and before immersion) shall also be stated in the ETA.

The values shall cover the range of density of the cladding element.

2.2.16.5 Dimensional stability

This characteristic is only relevant for cladding kits with components that are known to be or are suspected of being sensitive to changes in environmental relative humidity and/or temperature.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

2.2.16.5.1 <u>Dimensional stability by humidity</u>

The dimensional variations of the kit components associated with changes in relative humidity shall be assessed according to the following technical specifications:

- EN ISO 10545-10 for cladding elements made of terra cotta or ceramic.
- EN 12467 clause 5.4.3 for cladding elements made of fibre-cement and cement bonded boards.
- EN 318 for cladding elements or subframe components made of wood materials (wood-based or solid wood) or cladding elements made of other organic-based materials (agglomerated stone, HPL laminates, plastic, cement bonded particle boards, wood-polymer or natural fibre composites.
- EN 1170-7 for cladding elements made of inorganic materials (natural stone, fibre-cement, and concrete).

The maximum values in [mm/m] shall be stated in the ETA.

The values shall cover the range of density of the kit components.

2.2.16.5.2 <u>Linear thermal expansion</u>

The dimensional variations of the kit components associated with changes in temperature shall be assessed according to the following technical specifications:

- EN 14617-11 for cladding elements made of wood, agglomerated stone, wood, fibre-cement, plastic cement bonded board, cement bonded particle board, wood-polymer or natural fibre composites.
- EN 14581 for cladding elements made of natural stone.
- EN 438-2 clause 17, for cladding elements made of HPL laminates.
- EN 1770 for cladding elements made of concrete.
- EN ISO 10545-8 for cladding elements made of terra cotta or ceramic.

For cladding elements and subframe components made of steel and aluminium materials, values given in clause 3.2.6 of EN 1993-1-1 and clause 5.2.5 of EN 1999-1-1 shall be stated in the ETA.

The maximum values in [mm/m] shall be stated in the ETA.

The values shall cover the range of density of the kit components.

2.2.16.6 Chemical and biological resistance

This characteristic is only relevant for cladding kits with components that are known to be or are suspected of being sensitive to chemical and biological attack.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Chemical and biological resistance of the kit components shall be assessed according to the following technical specification:

- EN 335 for wood based cladding elements according to EN 13986 and wood based subframe components.
- EN 350 for solid wood cladding elements according to EN 14915 and solid wood subframe components.
- EN ISO 22479 for metal cladding elements according to EN 14783.
- EN 12326-1 clauses 5.8 to 5.10, for slate and stone cladding elements according to EN 12326-1.
- EN ISO 10545-13 for ceramic cladding elements according to EN 14411.
- EN 15534-1 clauses 8.4 to 8.6, for WPC or NFP cladding elements according to EN 15534-5.

Test results shall be stated in the ETA according to the corresponding technical specification listed above.

2.2.16.7 UV radiation resistance

This characteristic is only relevant for cladding kits with components that are known to be or are suspected of being sensitive to UV radiation such as polyester or other plastics.

For cladding elements made of TMCS/TMCP clause 2.2.16.9 applies.

Kit components behaviour after UV radiation ageing shall be assessed according to the following technical specification:

- EN 16153 clauses 5.3 & 5.4, for flat multiwall polycarbonate (PC) cladding elements.
- EN 1013 clause 5.5, for single skin profiled plastics cladding elements.
- EN 13245-1 clause 5.6, for PVC-U cladding elements according to EN 13245-2.
- EN 15534-1 clauses 8.1 & 8.2, for WPC or NFP cladding elements according to EN 15534-5.

Test results shall be stated in the ETA according to the corresponding standard listed above.

2.2.16.8 Corrosion

The assessment of the kits' corrosion is carried out by means of the assessment of the metal kit components corrosion representative of this essential characteristic for cladding kits.

By considering the corrosion protection of the metal components of the cladding kits obtained from the MPII based on following standards depending on the kit metal components and the possible additional measures of corrosion protection (e.g., EN ISO 12944-1 & EN 14879-2):

- For continuously hot-dip coated steels: EN 10346 clause 7.3.
- For aluminium alloys: EN 573-3 and EN 1999-1-1 Annex D.

- For stainless steels: EN 10088-4, tables 7, 10 & 11 and EN 10088-5, tables 8, 10 & 12.

The associated category of corrosivity of atmospheres, in function of the field of application and the material corrosion protection, shall be assessed and stated in the ETA according to EN ISO 9223.

In addition, description of any electrochemical incompatibility between the different metal components in contact, shall be also stated in the ETA.

2.2.16.9 Accelerated ageing behaviour of kits when the cladding element is made of thin metallic composite sheets/panels (TMCS/TMCP)

These characteristics are only relevant for kits when the cladding elements are made of TMCS/TMCP according to the EAD 210046-00-1201.

The following durability characteristics of the TMCS/TMCP shall be assessed and stated in the ETA according to clauses 2.2.12.1 to 2.2.12.5 of EAD 210046-00-0404.

- Decay of delamination resistance by peeling test (torque peel strength):
    - After hygrothermal cycles.
    - After immersion 6 h in boiling water at 90 ºC.
    - After immersion in water 500 h at 20 ºC.
    - After freeze-thaw cycles.
    - After long term exposure to heat (2500 h at hot dry air 80 ºC).
- Decay of flexural resistance (bending strength in four points test):
    - After hygrothermal cycles
    - After immersion 6 h in boiling water at 90 ºC
    - After immersion in water 500 h at 20 ºC
    - After freeze-thaw cycles
    - After long term exposure to heat (2500 h at hot dry air 80 ºC).

The following durability characteristics of the TMCS/TMCP shall be assessed and stated in the ETA according to the Annex O.

- Decay of flexural stiffness after short term exposure (1h +80ºC).
- Decay of resistance of routed and returned edge of TMCP after TPB test, flexural pulsating loads.
- Decay of resistance of slot and its fixing device after pull-out pulsating loads.

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 Commission Decision 2003/640/EC.

The applicable AVCP system is 2+ for any use except for uses subject to regulations on reaction to fire.

For uses subject to regulations on reaction to fire[11] the applicable AVCP systems regarding 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 3.2.1.

The manufacturer (regarding the components he buys from the market with DoP) shall take into account the Declaration of Performance issued by the manufacturer of that component. No retesting is necessary.

The actions to be undertaken by the manufacturer of the product for the different components of the kits are laid down in Tables 3.2.2 to 3.2.4 when the components are produced by the manufacturer himself and Table 3.2.5 when the components are not produced by the manufacturer himself but by its supplier under the specifications of the manufacturer.

11 Including propensity to undergo continuous smouldering, where relevant.

Table 3.2.1: Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Reaction to fire (i)				
	▪ Reaction to fire (for any classification)	Indirect tests as specified in Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5
	▪ Reaction to fire (for class A1)	Direct test according to EN ISO 1182	According to Control Plan	According to test method and Control Plan (v)	(iv)
	▪ Reaction to fire (for class A1 or A2)	Direct test according to EN ISO 1716	According to Control Plan	According to test method and Control Plan (v)	At least once each two years
	▪ Reaction to fire (for class A2 to D)	Direct test according to EN 13823 (ii)	According to Control Plan	According to test method and Control Plan (v)	(iv)
	▪ Reaction to fire (for class B to F)	Direct test according to EN ISO 11925-2	According to Control Plan	According to test method and Control Plan (v)	(iv)
2	When applicable, Propensity to undergo continuous smouldering	Direct control method based on relevant clause 2.2.3	According to Control Plan	One (v)	At least once each two years
		Indirect tests as specified in Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5	See Tables 3.2.2 to 3.2.5
3	Components <u>produced by the manufacturer himself</u>:				
	▪ Cladding elements	See Table 3.2.2	See Table 3.2.2	See Table 3.2.2	See Table 3.2.2
	▪ Cladding fixings and subframe components	See Table 3.2.3	See Table 3.2.3	See Table 3.2.3	See Table 3.2.3
	▪ Thermal insulation products	See Table 3.2.4	See Table 3.2.4	See Table 3.2.4	See Table 3.2.4
	▪ Ancillary components	According to Control Plan	According to Control Plan	According to Control Plan	According to Control Plan
4	Components not produced by the manufacturer himself (iii)	See Table 3.2.5	See Table 3.2.5	See Table 3.2.5	See Table 3.2.5

(i) Indirect tests shall be applied to all components independent from the source of their classification (Testing, Decision 96/603/EC as amended or any other applicable CWFT decision). Direct tests within the FPC shall only apply to those components where the classification is based on the prescribed tests for the corresponding class(es) according to Commission Delegated Regulation (EU) 2016/364 and EN 13501-1
(ii) If it is necessary to perform SBI tests within the FPC, t the test set-up that was classified as the worst case within the ETA procedure shall be tested.
(iii) Components produced by the supplier under the specifications of the manufacturer.
(iv) The tests shall always be carried out whenever the performance is not verified by means of indirect tests (see Tables 3.2.2 to Table 3.2.5) or, at least, once each five years when the indirect tests verify the performance. For this minimum frequency, the sufficient correlation between the foreseen system of indirect FPC measures and the direct tests shall be stated in the Control Plan. Otherwise, the minimum frequency of direct tests within the FPC shall be at least once per two years.
(v) The necessary number of specimens shall be detailed in the Control Plan depending on the test method and the class to be verified within the FPC. The tests shall be performed on randomly taken specimens from the production process.

Table 3.2.2: Control plan when the cladding element is produced by the manufacturer himself; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Incoming materials					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Checking of supplier certificates or supplier tests	Conformity with the order	---	Each delivery
Process					
2	When relevant, fire-retardant quantity (i)	Quantity measurement	According to Control Plan	---	Each batch
Finished component					
3	Geometry (form and dimensions) (i)	Depending on the material, according to the technical specifications defined in Table 1.1.1.1. Otherwise, measuring, visual check or Table 3.4.1 of clause 3.4	According to Control Plan	According to Control Plan	Daily(ii)
4	Density or mass per unit area or per unit (i)	Depending on the material, according to the technical specifications defined in Table 1.1.1.1. Otherwise, Table 3.4.1.1 of clause 3.4	According to Control Plan	According to Control Plan	Daily (ii)
5	Mechanical characteristics	Test or control based on relevant clauses in 2.2.12	According to Control Plan	According to Control Plan	According to Control Plan (ii)
		Direct test according to relevant clauses in 2.2.12	According to Control Plan	According to Control Plan	At least once each 5 years
6	PCS value (for class B to D) (i)	Test according to EN ISO 1716	According to Control Plan	According to Control Plan	Monthly (ii)
7	Organic content (i)	Ash content / loss on ignition according to clause 3.4.2. Otherwise, Thermogravimetry test based on EN ISO 11358-1	According to Control Plan	According to Control Plan	Once per batch (ii)

(i) Indirect characteristic related to reaction to fire and, when applicable, propensity to undergo continuous smouldering.

(ii) Deviations from the given cornerstones (higher or lower frequencies) shall be agreed between manufacturer and TAB and laid down in the Control Plan case by case depending on the type of production process, the variation in the volume produced and the production process control.

Table 3.2.3: Control plan when the <u>cladding fixings and/or subframe components</u> are produced by the manufacturer himself; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Incoming materials					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Checking of supplier certificates or supplier tests	Conformity with the order	---	Each delivery
2	Type of component material (i)	Checking of supplier certificates or supplier tests	Conformity with the order	---	Each delivery
Finished component					
3	Geometry (form and dimensions) (i)	Measuring and visual check	According to Control Plan	According to tests or control methods	Daily (ii)
4	Mechanical characteristics	Test or control based on relevant clauses 2.2.12.4 to 2.2.12.17	According to Control Plan	According to Control Plan	According to Control Plan (ii)
		Direct test according to 2.2.12.4 to 2.2.12.17	According to Control Plan	According to Control Plan	At least once each 5 years
5	When relevant, organic content (i)	Ash content / loss on ignition according to clause 3.4.2. Otherwise, Thermogravimetry test based on EN ISO 11358-1	According to Control Plan	According to Control Plan	Once per batch (ii)

(i) Indirect characteristic related to reaction to fire.
(ii) Deviations from the given cornerstones (higher or lower frequencies) shall be agreed between manufacturer and TAB and laid down in the Control Plan case by case depending on the type of production process, the variation in the volume produced and the production process control.

Table 3.2.4: Control plan when the thermal insulation products are produced by the manufacturer himself; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Incoming materials					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Checking of supplier certificates or supplier tests	Conformity with the order	---	Each delivery
Process					
2	When relevant, fire-retardant quantity (i)	Quantity measurement	According to Control Plan	---	Each batch
Finished component					
3	Depending on the thermal insulation material, according to the standards defined in clause 1.1.4	Depending on the thermal insulation material, according to the standards defined in clause 1.1.4	Depending on the thermal insulation material, according to the standards defined in clause 1.1.4	Depending on the thermal insulation material, according to the standards defined in clause 1.1.4	Depending on the thermal insulation material, according to the standards defined in clause 1.1.4
4	Organic content (i)	Ash content / loss on ignition according to clause 3.4.2. Otherwise, Thermogravimetry test based on EN ISO 11358-1	According to Control Plan	According to Control Plan	Depending on the material, according to the standards defined in clause 1.1.4or each batch, if applicable (ii)
(i) Indirect characteristic related to propensity to undergo continuous smouldering, when applicable. (ii) Deviations from the given cornerstones (higher or lower frequencies) shall be agreed between manufacturer and TAB and laid down in the Control Plan case by case depending on the type of production process, the variation in the volume produced and the production process control.					

Table 3.2.5: Control plan when the components are not produced by the manufacturer; cornerstones

No	Subject/type of control (ii)	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) **[including testing of samples taken at the factory in accordance with a prescribed test plan]**					
1	Components belonging to Case 1 (i)	(1)	Conformity with the order	Testing is not required	Each delivery
		(2)	According to Control Plan	Testing is not required	Each delivery
2	Components belonging to Case 2 (i):	(1)	Conformity with the order	Testing is not required	Each delivery
	▪ Characteristics declared in the Declaration of Performance (DoP) for the specific use within the kit.	(2)	According to Control Plan	Testing is not required	Each delivery
	▪ Characteristics not declared in DoP for the specific use within the kit.	(3)	According to Control Plan	According to Control Plan	According to Control Plan
3	Components belonging to Case 3 (i):	(1)	Conformity with the order	Testing is not required	Each delivery
		(3)	According to Control Plan	According to Control Plan	According to Control Plan

(1) Checking of delivery ticket and/or label on the package.
(2) Checking of technical data sheet and DoP or, when relevant: checking of supplier certificates or supplier tests or test or control according to Tables 3.2.1 to 3.2.4 above.
(3) Checking of supplier certificates or supplier tests or test or control according to Tables 3.2.1 to 3.2.4 above.

(i) Case 1: Component covered by a DoP for all characteristics needed for the specific use within the kit.
Case 2: If the component is a product covered by a DoP which, however, does not include all characteristics needed for the specific use within the kit or the characteristic is presented as NPD option for the component manufacturer.
Case 3: The component is not covered by a DoP.
(ii) Component characteristics are those defined in Tables 3.2.1 to 3.2.4 above.

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 the cladding kit are laid down in Table 3.3.1.

Table 3.3.1 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	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the cladding kit.	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	According to Control Plan
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the Control Plan.	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 3.2.1	According to Control Plan	According to Control Plan	Once per year

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire[12] 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 actions to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.3.2.

12 Including propensity to undergo continuous smouldering, where relevant.

Table 3.3.2 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 carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire-retardants					
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	As defined in the Control Plan agreed between the TAB and the manufacturer	As defined in the Control Plan agreed between the TAB and the manufacturer	When starting the production, after starting a new production line or after modifications of the production process
Continuous surveillance, assessment and evaluation of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire-retardants					
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 3.2.1	As defined in the Control Plan agreed between the TAB and the manufacturer	As defined in the Control Plan agreed between the TAB and the manufacturer	Once per year

3.4 Special methods of control and testing used for the assessment and verification of constancy of performance

3.4.1 Dimension and density of the cladding element

Table 3.4.1.1 Cladding element special methods of testing by materials

Cladding element material	**Test methods**	
	Dimensions	**Specific mass or density**
Wood based	EN 325; EN 1309-1	EN 323
Metal	EN 10143; EN 485-4; EN 14782 clauses 4.2 & 4.7; EN 14783 clauses 4.2 & 4.5	EN 10346 clause 7.3; EN 1396 clause 4.3
Natural stone	EN 13373	EN 1936
Agglomerated stone	Annex A of EN 15286	EN 14617-1
HPL laminates	EN 438-6 clause 5.3	Method A EN ISO 1183-1
Fibre-cement	EN 12467 clause 5.3; EN 492 clause 5.2; EN 494 clause 5.2; EN 13369 clause 4.3.1	EN 12467 clause 5.4.2; EN 492 clause 5.3.2; EN 494 clause 5.3.2; EN 1170-6
Concrete	EN 491 clauses 5.2 & 5.3; EN 13369 clause 4.3.1	EN 491 clause 5.5
Terra cotta or ceramic	EN ISO 10545-2	EN ISO 10545-3
Plastic	EN 16153 clause 4.2; EN 1013 clause 5.2	EN 16153 clause 4.2; EN 1013 clause 5.2; EN ISO 1183-1 Method A; EN ISO 10352
Cement bonded particle board	EN 325; EN 1309-1	EN 323
Thin Metallic Composite Sheets/Panels (TMCS/TMCP)	EN 485-3; EN 485-4; EN ISO 1923	Calculation based on dimension and mass; EN ISO 845; EN 1602
Wood-polymer composites (WPC) or natural fibre composites (NFC)	EN 15534-1 clause 6.6	EN 15534-1 clause 6.2

3.4.2 Ash content or Loss on ignition

For products which are inorganic, i.e., products containing a low percentage of organic compounds and for thermal insulation products as well, the test method shall be based on EN 13820.

For products which are organic, the test method shall be based on EN ISO 3451-1.

4 REFERENCE DOCUMENTS

EAD 090001-00-0404	Pre-fabricated compressed mineral wool boards with organic or inorganic finish and with specified fastening system.
EAD 090019-00-0404	Kits for ventilated external wall claddings of lightweight boards on subframe with rendering applied in situ with or without thermal insulation.
EAD 090034-00-0404	Kit composed by subframe and fixings for fastening cladding and external wall elements.
EAD 090058-00-0404	Ventilated external wall cladding kit comprising a metallic honeycomb panel and its associated fixings.
EAD 090097-00-0404	Kits for external wall claddings glued to the subframe.
EAD 090119-00-0404	Kits for external wall cladding of mineral boards with renderings applied in situ.
EAD 090125-00-0404	Kits for external wall claddings with multilayer composite rigid cladding elements.
EAD 210024-00-0504	Cement-bonded boards.
EAD 210046-00-1201	Thin metal composite sheet.
EAD 330030-00-0601	Fastener of external wall claddings.
EAD 330076-00-0604	Metal injection anchors for use in masonry.
EAD 330284-00-0604	Plastic anchors for redundant non-structural systems in concrete and masonry.
EAD 330747-00-0601	Metal Anchors for Use in Concrete. Part 6 : Anchors for multiple use for non-structural applications.
EN 10088-1:2014	Stainless steels - Part 1: List of stainless steels.
EN 10088-4:2009	Stainless steels – Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes.
EN 10088-5:2009	Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes.
EN 1013:2012+A1:2014	Light transmitting single skin profiled plastics sheets for internal and external roofs, walls and ceilings – Requirements and test methods.
EN 10143:2006	Continuously hot-dip coated steel sheet and strip – Tolerances on dimensions and shape.
EN 10346:2015	Continuously hot-dip coated steel flat products for cold forming – Technical delivery conditions.
EN 1090-1:2009+A1:2011	Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components.
EN 1170-4:1997	Precast concrete products. Test method for glass-fibre reinforced cement. Part 4: Measuring bending strength, "simplified bending test" method.
EN 1170-6:1997	Precast concrete products. Test method for glass-fibre reinforced cement. Part 6: Determination of the absorption of water by immersion and determination of the dry density.
EN 1170-7:1997	Precast concrete products. Test method for glass-fibre reinforced cement. Part 7: Measurement of extremes of dimensional variations due to moisture content.
EN 12057:2004	Natural stone products – Modular tiles – Requirements.
EN 12086:2013	Thermal insulating products for building applications – Determination of water vapour transmission properties.
EN 12326-1:2014	Slate and stone for discontinuous roofing and external cladding – Part 1: Specifications for slate and carbonate slate.
EN 12372:2022	Natural stone test methods – Determination of flexural strength under concentrated load.
EN 12467:2012+A2:2018	Fibre-cement flat sheets – Product specification and test methods.
EN 12664:2001	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance.
EN 12667:2001	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance.
EN 12865:2001	Hygrothermal performance of building components and building elements – Determination of the resistance of external wall systems to driving rain under pulsating air pressure.
EN 12939:2000	Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance.

EN 1304:2005	Clay roofing tiles and fittings – Product definitions and specifications.
EN 1309-1:1997	Round and sawn timber. Method of measurement of dimensions. Part 1: Sawn timber.
EN 13162:2012+A1:2015	Thermal insulation products for buildings – Factory made mineral wool (MW) products – Specification
EN 13163:2012+A1:2015	Thermal insulation products for buildings – Factory made expanded polystyrene (EPS) products – Specification.
EN 13164:2012+A1:2015	Thermal insulation products for buildings – Factory made extruded polystyrene foam (XPS) products – Specification.
EN 13165:2012+A2:2016	Thermal insulation products for buildings – Factory made rigid polyurethane foam (PU) products – Specification.
EN 13166:2012+A2:2016	Thermal insulation products for buildings – Factory made phenolic foam (PF) products – Specification.
EN 13167:2012+A1:2015	Thermal insulation products for buildings – Factory made cellular glass (CG) products – Specification.
EN 13168:2012+A1:2015	Thermal insulation products for buildings – Factory made wood wool (WW) products – Specification.
EN 13169:2012+A1:2015	Thermal insulation products for buildings – Factory made expanded perlite board (EPB) products - Specification.
EN 13170:2012+A1:2015	Thermal insulation products for buildings – Factory made products of expanded cork (ICB) - Specification.
EN 13171:2012+A1:2015	Thermal insulation products for buildings – Factory made wood fibre (WF) products – Specification.
EN 13238:2010	Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates.
EN 13245-1:2010	Plastics - Unplasticized poly(vinyl chloride) (PVC-U) profiles for building applications - Part 1: Designation of PVC-U profiles.
EN 13245-2:2008 EN 13245-2:2008/AC:2009	Plastics – Unplasticized poly (vinyl chloride) (PVC-U) profiles for building applications – Part 2: PVC-U profiles and PVC-UE profiles for internal and external wall and ceiling finishes.
EN 13364:2001	Natural stone test methods. Determination of the breaking load at dowel hole.
EN 13369:2018	Common rules for precast concrete products.
EN 13373:2020	Natural stone test methods – Determination of geometric characteristics on units.
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests.
EN 13820:2003	Thermal insulating materials for building applications – Determination of organic content.
EN 13823:2020+A1:2022	Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item.
EN 13830: 2003	Curtain walling – Product standard.
EN 13859-2:2010	Flexible sheets for waterproofing – Definitions and characteristics of underlays – Part 2: Underlays for walls.
EN 1396:2015	Aluminium and aluminium alloys – Coil coated sheet and strip for general applications – Specifications.
EN 13986:2004+A1:2015	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking.
EN 14411:2012	Ceramic tiles – Definitions, classification, characteristics, evaluation of conformity and marking.
EN 14581:2004	Natural stone test methods - Determination of linear thermal expansion coefficient.
EN 14617-1:2013	Agglomerated stone – Test methods – Part 1: Determination of apparent density and water absorption
EN 14617-11:2005	Agglomerated stone – Test methods – Part 11: Determination of linear thermal expansion coefficient.
EN 14617-2:2016	Agglomerated stone – Test methods – Part 2: Determination of flexural strength (bending).
EN 1469:2015	Natural stone products – Slabs for cladding – Requirements.
EN 14782:2006	Self-supporting metal sheet for roofing, external cladding and internal lining – Product specification and requirements.

EN 14783:2013	Fully supported metal sheet and strip for roofing, external cladding and internal lining – Product specification and requirements.
EN 14879-2:2006	Organic coating systems and linings for protection of industrial apparatus and plants against corrosion caused by aggressive media - Part 2: Coatings on metallic components.
EN 14915:2013	Solid wood panelling and cladding – Characteristics, evaluation of conformity and marking.
EN 14992:2007+A1:2012	Precast concrete products – Wall elements.
EN 15191:2009	Precast concrete products – Classification of glass-fibre reinforced concrete performance.
EN 15286:2013	Agglomerated stone – Slabs and tiles for wall finishes (internal and external).
EN 15534-1:2014+A1:2017	Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) - Part 1: Test methods for characterisation of compounds and products.
EN 15534-5:2014	Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) - Part 5: Specifications for cladding profiles and tiles.
EN 15715:2019	Thermal insulation products - Instructions for mounting and fixing for reaction to fire testing - Factory made products.
EN 1602:2013	Thermal insulating products for building applications – Determination of the apparent density.
EN 16153:2013+A1:2015	Light transmitting flat multiwall polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings – Requirements and test methods.
EN 16240:2013	Light transmitting flat solid polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings – Requirements and test methods.
EN 16733:2016	Reaction to fire tests for building products – Determination of a building product's propensity to undergo continuous smouldering.
EN 1770:1998	Products and systems for the protection and repair of concrete structures - Test methods - Determination of the coefficient of thermal expansion.
EN 1925:1999	Natural stone test methods. Determination of water absorption coefficient by capillarity.
EN 1936:2006	Natural stone test methods – Determination of real density and apparent density, and of total and open porosity.
EN 1990:2023	Eurocode – Basis of structural and geotechnical design.
EN 1993-1-1:2022	Eurocode 3 - Design of steel structures – Part 1-1: General rules and rules for buildings.
EN 1993-1-3:2006 EN 1993-1-3:2006/AC:2009	Eurocode 3 - Design of steel structures – Part 1-3: Supplementary rules for cold-formed members and sheeting.
EN 1993-1-4:2006 EN 1993-1-4:2006/A1:2015 EN 1993-1-4:2006/A2:2020	Eurocode 3: Design of steel structures – Part 1-4: General rules – Supplementary rules for stainless steel.
EN 1993-1-8:2005 EN 1993-1-8:2005/AC:2009	Eurocode 3: Design of steel structures – Part 1-8: Design of joints.
EN 1995-1-1:2004 EN 1995-1-1:2004/AC:2006 EN 1995-1-1:2004/A1:2008 EN 1995-1-1:2004/A2:2014	Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings.
EN 1998-1:2004 EN 1998-1:2004/AC:2009 EN 1998-1:2004/A1:2013	Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings.
EN 1999-1-1:2023	Eurocode 9: Design of aluminium structures – Part 1-1: General structural rules.
EN 310:1993	Wood-based panels. Determination of modulus of elasticity in bending and of bending strength.
EN 318:2002	Wood based panels – Determination of dimensional changes associated with changes in relative humidity.
EN 323:1993	Wood-based panels. Determination of density.
EN 325:2012	Wood-based panels – Determination of dimensions of test pieces.
EN 335:2013	Durability of wood and wood-based products – Use classes: definitions, application to solid wood and wood-based products.

EN 350:2016	Durability of wood and wood-based products – Testing and classification of the durability to biological agents of wood and wood-based materials.
EN 438-2:2016+A1:2018	High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 2: Determination of properties.
EN 438-6:2016	High-pressure decorative laminates (HPL) – Sheets based on thermosetting resins (Usually called Laminates) – Part 6: Classification and specifications for Exterior-grade Compact laminates of thickness 2 mm and greater.
EN 438-7:2005	High-pressure decorative laminates (HPL) – Sheets based on thermosetting resins (Usually called Laminates) – Part 7: Compact laminate and HPL composite panels for internal and external wall and ceiling finishes.
EN 485-2:2016+A1:2018	Aluminium and aluminium alloys – Sheet, strip and plate – Part 2: Mechanical properties.
EN 485-3:2003	Aluminium and aluminium alloys – Sheet, strip and plate – Part 3: Tolerances on dimensions and form for hot-rolled products.
EN 485-4:1993	Aluminium and aluminium alloys. Sheets, strip and plate. Part 4: Tolerances on shape and dimensions for cold-rolled products.
EN 490:2011+A1:2017	Concrete roofing tiles and fittings for roof covering and wall cladding – Product specifications.
EN 491:2011	Concrete roofing tiles and fittings for roof covering and wall cladding – Test methods.
EN 492:2012+A2:2018	Fibre-cement slates and fittings – Product specification and test methods.
EN 494:2012+A1:2015	Fibre-cement profiled sheets and fittings – Product specification and test methods.
EN 538:1994	Clay roofing tiles for discontinuous laying – Flexural strength test.
EN 573-3:2019+A1:2022	Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition and form of products.
EN 634-1:1995	Cement-bonded particleboards. Specification. Part 1: General requirements.
EN 634-2:2007	Cement-bonded particleboards – Specifications – Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions.
EN 755-2:2016	Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 2: Mechanical properties.
EN ISO 10140-1:2021	Acoustics – Laboratory measurement of sound insulation of building elements – Part 1: Application rules for specific products.
EN ISO 10211:2017	Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations.
EN ISO 10352:2020	Fibre-reinforced plastics – Moulding compounds and prepregs – Determination of mass per unit area.
EN ISO 10456:2007 EN ISO 10456:2007/AC:2009	Building materials and products – Hygrothermal properties -Tabulated design values and procedures for determining declared and design thermal values.
EN ISO 10545-10:2021	Ceramic tiles - Part 10: Determination of moisture expansion.
EN ISO 10545-13:2016	Ceramic tiles - Part 13: Determination of chemical resistance.
EN ISO 10545-2:2018	Ceramic tiles. Part 2: Determination of dimensions and surface quality.
EN ISO 10545-3:2018	Ceramic tiles. Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density.
EN ISO 10545-4:2019	Ceramic tiles – Part 4: Determination of modulus of rupture and breaking strength.
EN ISO 10545-8:2014	Ceramic tiles - Part 8: Determination of linear thermal expansion.
EN ISO 11348-1:2008 EN ISO 11348-1:2008/A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test). Part 1: Method using freshly prepared bacteria.
EN ISO 11348-2:2008 EN ISO 11348-2:2008/A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test). Part 2: Method using liquid-dried bacteria.
EN ISO 11348-3:2008 EN ISO 11348-3:2008/A1:2018	Water quality. Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test). Part 3: Method using freeze-dried bacteria.
EN ISO 11358-1:2022	Plastics – Thermogravimetry (TG) of polymers – Part 1: General principles.
EN ISO 1182:2020	Reaction to fire tests for products – Non-combustibility test.
EN ISO 1183-1:2019	Plastics – Methods for determining the density of non-cellular plastics –Part 1: Immersion method, liquid pycnometer method and titration metho.

EN ISO 11925-2:2020	Reaction to fire tests – Ignitability of products subjected to direct impingement of flame – Part 2: Single-flame source test.
EN ISO 12572:2016	Hygrothermal performance of building materials and products – Determination of water vapour transmission properties.
EN ISO 12944-1:2017	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1: General introduction.
EN ISO 15148:2002 EN ISO 15148:2002/A1:2016	Hygrothermal performance of building materials and products – Determination of water absorption coefficient by partial immersion.
EN ISO 15799:2022	Soil quality. Guidance on the ecotoxicological characterization of soils and soil materials.
EN ISO 16535:2019	Thermal insulating products for building applications – Determination of long term water absorption by immersion.
EN ISO 16536:2019	Thermal insulating products for building applications – Determination of long term water absorption by diffusion.
EN ISO 1716:2018	Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value).
EN ISO 178:2019	Plastics – Determination of flexural properties.
EN ISO 1923:1995	Cellular plastics and rubbers. Determination of linear dimensions.
EN ISO 22479:2022	Corrosion of metals and alloys - Sulfur dioxide test in a humid atmosphere (fixed gas method).
EN ISO 29466:2022	Thermal insulating products for building applications – Determination of thickness.
EN ISO 29767:2019	Thermal insulating products for building applications – Determination of short term water absorption by partial immersion.
EN ISO 3451-1:2019	Plastics – Determination of ash – Part 1: General methods.
EN ISO 6341:2012	Water quality. Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea). Acute toxicity test.
EN ISO 6946:2017	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.
EN ISO 717-1:2020	Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.
EN ISO 7500-1:2018	Metallic materials – Verification of static uniaxial testing machines – Part 1: Tension/compression testing machines – Verification and calibration of the force-measuring system.
EN ISO 7827:2012	Water quality - Evaluation of the "ready", "ultimate" aerobic biodegradability of organic compounds in an aqueous medium - Method by analysis of dissolved organic carbon (DOC).
EN ISO 845:2009	Cellular plastics and rubbers – Determination of apparent density.
EN ISO 8990:1996	Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box.
EN ISO 9223:2012	Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, determination and estimation.
CEN/TS 16637-2:2014	Construction products – Assessment of release of dangerous substances – Part 2: Horizontal dynamic surface leaching test.
OECD Test Guideline 301, part A	OECD Guideline 301 for Testing of Chemicals. Part A: DOC Die-Away. Standard related with EN ISO 7827.
OECD Test Guideline 301, part B	OECD Guideline 301 for Testing of Chemicals. Part B: CO2 Evolution (Modified Sturm Test).
OECD Test Guideline 301, part E	OECD Guideline 301 for Testing of Chemicals. Part E: Modified OECD Screening.

ANNEX A: WATER ABSORPTION AND BENDING STRENGTH TEST METHODS BY CLADDING ELEMENT MATERIALS

Table A.1 summarizes the cladding element test methods to be applied for the cladding kit assessment according to clauses 2.2.5 and 2.2.12.1.

Table A.1 Cladding element test methods by materials

Cladding element material	**Test methods**	
	Water absorption	**Bending strength, Modulus of elasticity or Modulus of rupture**
Wood based	EN ISO 15148	EN 310
Metal	EN 14782 clause 4.4; EN 14783 clause 4.3; EN ISO 15148	EN 10346 clause 7.2; EN 485-2; EN 14782 clause 4.3;
Natural stone	EN 1925; EN ISO 15148	EN 12372
Agglomerated stone	EN 14617-1	EN 14617-2
HPL laminates	EN ISO 15148	EN ISO 178
Fibre-cement	EN 12467 clause 5.4.5; EN 492 clause 5.3.4; EN 494 clause 5.3.4; EN 1170-6; EN ISO 15148	EN 12467 clause 5.4.4; EN 492 clause 5.3.3; EN 494 clause 5.3.3; EN 1170-4
Concrete	EN 491 clause 5.7; EN ISO 15148	EN 491 clause 5.6
Terra cotta or ceramic	EN ISO 10545-3; EN ISO 15148	EN ISO 10545-4; EN 538
Plastic	EN ISO 15148	EN 1013 clause 5.9; EN ISO 178
Cement bonded board Cement bonded particle board	EN ISO 15148	EN 310
Thin Metallic Composite Sheets/Panels (TMCS/TMCP)	EN 14782 clause 4.4; EN 14783 clause 4.3; EN ISO 15148	Clause 2.2.4 of EAD 210046-00-1201
Wood-polymer composites (WPC) or natural fibre composites (NFC)	EN 15534-1 clause 8.3.3	EN 15534-1 Annex A

ANNEX B: REACTION TO FIRE

B.1 – GENERAL

B.1.1 – Principle

The determination of reaction to fire of the cladding kits is based on testing of “the worst case” – the most critical configuration in sense of reaction to fire. According to the rules described further in the text, the classification obtained on the most critical configuration of the cladding kit components is valid for all configurations of cladding kit components having better performance in sense of reaction to fire.

For testing of the cladding kit, the following principles shall apply regarding the selection of the relevant kit components:

- The kit components’ materials with the highest amount of organic content[13] (if there are only differences in the amount of organic content but no difference in the organic component itself) or with the highest gross heat of combustion - Q_{PCS} [MJ/kg] according to EN ISO 1716 (from now on called “Q_{PCS}-value”) shall be tested.

- The influences of different colours shall be considered by performing tests on a light, on a dark and on a colour in the middle of the range (e.g., CIELAB 40.51, 59.28, 47.98; RGB 184, 29, 19; Munsell ref. 7.5R 4/13; RAL 3020; or BS04E56).

- In addition, each kit components material selected for testing according to the previous point shall have the smallest amount of fire-retardants.

Components of a kit which are classified A1 without testing according to Decision 96/603/EC (as amended by Commission Decision 2000/605/EC and Commission Decision 2003/424/EC) do not need to be tested for an assessment according to option "a)" of clause 2.2.1. They also do not need to be tested for an assessment according to option "b)" of clause 2.2.1 if applying those test methods where each component shall be tested separately (e.g., EN ISO 1182, EN ISO 1716). In case of further calculation to determine to total Q_{PCS}-value of a composite product or a kit, these components do not contribute to the total Q_{PCS}-value, therefore, their individual Q_{PCS}-value shall be set as zero.

B.1.2 - Physical properties influencing the reaction to fire behaviour

- Type of cladding elements (e.g., material composition, thickness, density, weight per unit area).

- Organic content (binder and any other additives) of kit components, where applicable, (e.g., cladding elements made of fibre-cement, concrete, cement bonded particle, agglomerated stone, and other materials according to Table 1.1.1.1).

- Type and amount of fire-retardant[14].

- Type and nature of cladding fixings and subframe components.

Note: Fire breaks and cavity barriers are important for the behaviour of the whole facade cladding system and cannot be assessed on the basis of SBI-testing. The influence can only be observed during a large-scale test (see Annex Q). Therefore, breaks shall not be included in the mounting and fixing rules for the SBI-test.

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13 The organic content can be checked by providing the formulation or, by performing suitable characterization tests or by determining the glow loss (loss on ignition or ash content). When information on organic content per unit area is not available, the Q_{PCS}-value shall be tested to decide about the worst case.

14 The term “fire-retardant” refers both to chemicals incorporated into a product composition during the manufacturing process (sometimes known as flame-retardant) and to coatings applied onto a finished product, in both cases with the purpose of improving the product’s reaction to fire.

Although the rest of this annex applies the "worst case scenario" for deciding what to test, it is accepted that, where the manufacturer wants to assess a range of cladding kit configurations having different overall classifications, it may group these together into a number of different sub-groups (e.g., each sub-group corresponding to a different overall classification) with the 'worst case scenario' being identified for each sub-group.

B.2 - TESTING ACCORDING TO EN ISO 1182

This test method is relevant for classes A1 and A2 according to Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Using this test method, only the substantial components of the cladding kit shall be tested. 'Substantial components' are defined by thickness (≥ 1 mm) and/or mass per unit area (≥ 1 kg/m^2).

Physical properties as given in clause B.1.2 (in particular product type, density, organic content, fire-retardants) and the principles given in clause B.1.1 for the determination of the probable worst case shall be considered for selection of the specimens and the testing purposes.

B.3 - TESTING ACCORDING TO EN ISO 1716 (Q_{PCS}-VALUE)

This test method is relevant for classes A1 and A2 according to Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

This test method shall be performed to all components of the cladding kit except for cases which are classified as A1 without testing.

Parameters relevant for this test method are composition (when performing calculation of the Q_{PCS}-values, density or mass per unit area and thickness are relevant). Discrete and non-continuous mechanical fixings and ancillary components which fulfil the conditions for small components according to clause B.6 shall not be considered for testing and for the calculation of the Q_{PCS}-values.

It is not necessary to test a cladding element with different grain sizes if the organic content is the same as or lower than that of the tested cladding element.

B.4 - TESTING ACCORDING TO EN 13823 (SBI-TEST)

This test method is relevant for classes A2, B, C and D (in some cases also for A1) according to Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Mounting and fixing provisions for the SBI-test for cladding kits are indicated in Annex C.

Parameters which are relevant for this test method:

- Type of kit components (e.g., material composition, dimensions, density, weight per unit area).
- Amount of organic content of the kit components.
- Amount of fire-retardant, if any.
- Colour according to the principles as in B.1.1.

In principle, it is desirable to find the test specimen configuration that gives the worst case concerning the reaction to fire test results. In the test procedure according to EN 13823, values for the rate of heat release, total heat release, lateral flame spread, rate of smoke release, total smoke release and burning droplets shall be determined.

The test specimen shall be prepared with the kit components with the highest organic content or Q_{PCS}-values per unit area.

B.4.1 - Direct application rules of test results

See clause C.1.3.

B.5 - TESTING ACCORDING TO EN ISO 11925-2

This test method is relevant for classes B, C, D, E and F according to Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Mounting and fixing provisions for the tests are indicated in Annex C.

Parameters which are relevant:

- Type of kit components (e.g., material composition, dimensions, density, weight per unit area).
- Amount of organic content of the kit components.
- Amount of fire-retardant, if any.
- Colour according to the principles as in B.1.1.

For cladding elements with covered edges, the specimens shall be prepared both with covered edges and edges without covering (cut edges).

The tests shall be performed with surface exposure of the front side, edge exposure and possibly edge exposure of multi-layered specimen turned 90° on their vertical axis according to the rules of standard EN ISO 11925-2.

Besides, the principles specified in clause B.1 shall be applied.

B.5.1 - Application rules of test results

See clause C.1.3.

B.6 - SMALL COMPONENTS

The term “small component” is used for a component which satisfies all the following requirements:

- It is not made from class A1/A2 material,
- its mass is ≤ 50 g,
- its size is ≤ 50 mm x ≤ 50 mm or its diameter is ≤ 57 mm (equal area size as for a rectangular size of ≤ 50 mm x ≤ 50 mm) and
- its distance is ≥ 200 mm to similar components when:

- is forming part of a composite kit component (e.g., undercut anchors or anti-vibration ancillary pieces) and being situated on the surface of a component (e.g., cladding element) made of material of classes B, C, D, or E,

  or

- is completely embedded all-round in non-melting material of class A1 when used as small connecting part of kit components and without any possibility to ignite or to propagate fire.

In this case, its reaction to fire performance shall not be tested because contribution to fire growth and fire spread is negligible. Where the conditions are not met regarding the distance to other similar components or the all-round covering by non-melting A1 materials, the component shall be tested as part of the kit. The ETA shall state which components are considered as small components, where the reaction to fire performance can be seen as negligible.

Regarding linear joints (e.g., joints between cladding elements or ancillary components such as adhesive strips or double-sided tapes) might have small sizes on the surface of the elements but can contribute to fire propagation. Fire spread through the linear jointing material on the surface of the element or the façade or into the interior is of concern. Therefore, joints generally shall not be considered as products having small areas and/or surfaces.

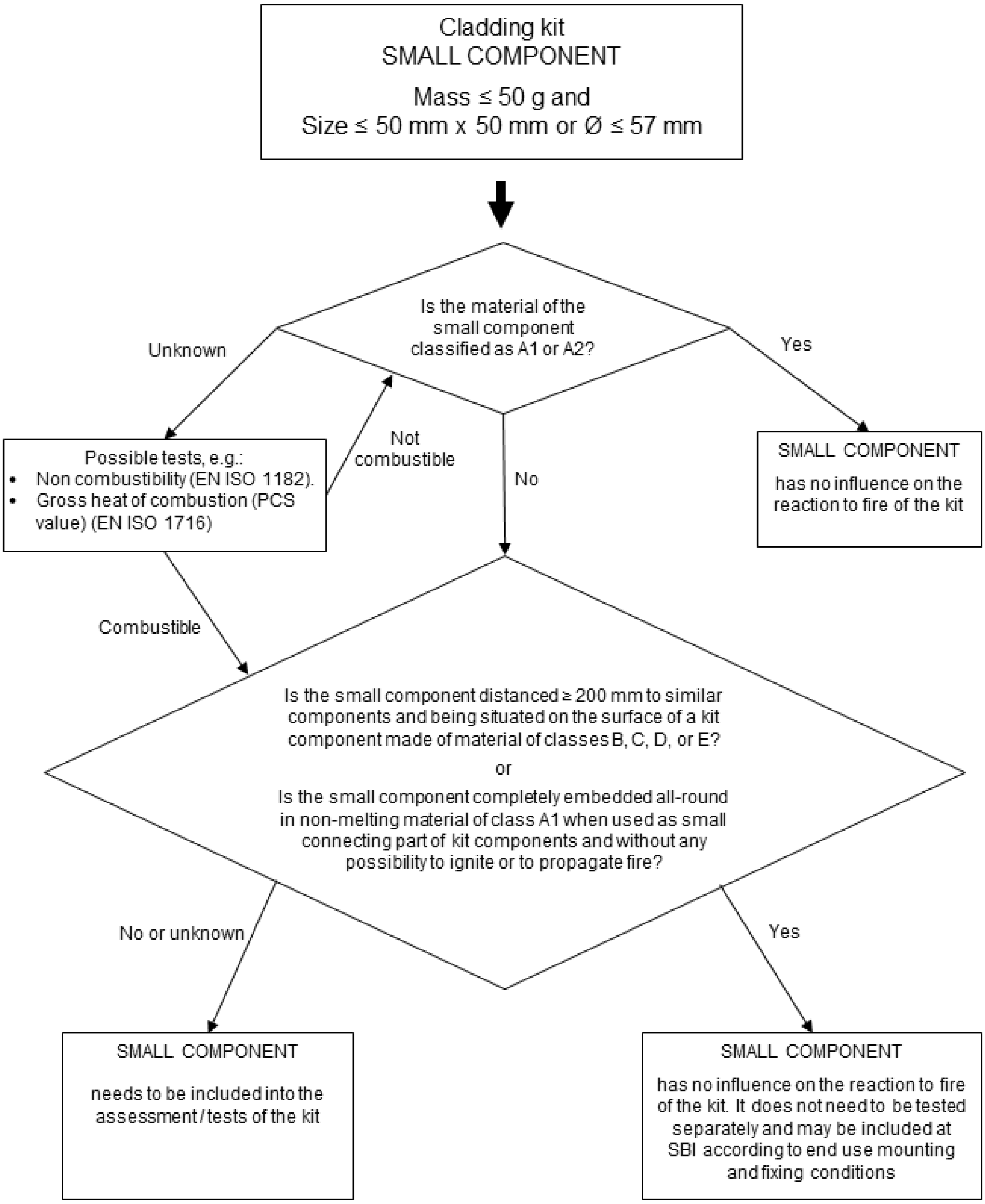


Figure B.6.1: Synopsis of small components assessment approach.

ANNEX C: MOUNTING AND FIXING PROVISIONS FOR SBI TEST (EN 13823) AND SINGLE-FLAME SOURCE TEST (EN ISO 11925-2)

C.1 - TESTING OF THE REACTION TO FIRE ACCORDING TO EN 13823 (SBI TEST)

Considerations for cladding kits included in clause B.4 shall also be considered for SBI test.

The reaction to fire testing shall be given for the whole assembled kit, in simulating its end-use conditions.

The testing standard EN 13823 gives a general description of the arrangement of the test specimen for SBI test, applicable to classes A2, B, C and D (in some cases also to A1).

This Annex describes specific provisions for cladding kits.

C.1.1 - General information

As a function of the use of the kit, the specimen shall be installed on a substrate in accordance with standard EN 13238:

- Calcium silicate or fibre-cement board or laminated gypsum board simulates a wall made of masonry or concrete,
- Non-fire-retardant-treated particle board or plywood board simulate a frame wall made with an outer planking of wood or wood-based boards.
- Steel sheet simulates a frame wall made with an outer planking of metal sheets with a melting point of at least 1000 °C.
- Aluminium sheet simulates a frame wall made with an outer planking of metal sheets with a melting point of minimum 500 ºC.
- Additional substrates not covered by EN 13238 for specific uses. In such cases, test results are only applicable for the tested configuration.

  A necessary subframe shall be formed by vertically directed beams or profiles made of non-fire-retardant-treated timber (spruce recommended, saw-cut, density not less than 350 kg/m³), aluminium or steel.

  A non-fire-retardant-treated timber subframe also covers metal subframe. Aluminium profiles cover subframes made of metal with a melting point of at least 500 °C. Steel profiles in the tests cover metal subframes with a melting point of at least 1000 °C.

All ancillary components which form part of the kit (e.g., breather membranes, thermos-stop pads, gaskets, seals, adhesive strips or double-sided tapes) shall be included in a representative manner in the test specimen unless they may be considered as small components according to clause B.6.

An air space shall always be provided behind the cladding element in accordance with the MPII (minimum of 20 mm). The bottom and top edges of the specimen shall also remain opened.

For ventilated cladding kits, a continuous airflow (without any interruption) in the air space shall be ensured. To that end, the provisions to allow a lateral airflow given in EN 13823 shall be considered as a first option. Only when the subframe profiles or studs (or any other kit component) do not allow this continuous airflow from the outer lateral edges of the test specimen wings, there shall be a gap of 10 mm between the bottom of the specimen and top level of U-profile of the SBI-test device.

For cladding kits without thermal insulation products applied to the substrate (supporting wall), two cases regarding the depth of an air gap shall be considered within the tests:

- the minimum air gap depth (between rear surface of the cladding element and the substrate) as stated according to the MPII and allowed by the subframe dimensions and geometry (but not less than 20 mm) and,

- a 40 mm air gap depth between rear surface of the cladding element and the substrate.

First, an indicative test shall be performed for each of both air gap depths. The depth showing the worst results shall be completed (at least two additional tests) in order to obtain the worst classification.

If both indicative tests point to the same classification, any greater depth of the air gap than the tested minimum one shall be classified based on this result, without additional testing.

If the indicative tests point to different classifications, additionally, the case (air gap depth) showing the best results in the indicative test can also be fully tested for classification (two additional SBI test specimens to complete the required three test results) to determine if a better classification is obtained. If so, this better classification will apply only to the best-case air gap depth and the rest of the range will have the classification obtained with the worst-case air gap depth, unless additional intermediate depths are tested to determine the point (air gap depth) where classification changes.

For cladding kits with thermal insulation products applied to the substrate (supporting wall), two cases regarding the depth of an air gap shall be considered within the tests:

- the minimum air gap depth (between rear surface of the cladding element and front surface of the thermal insulation product) as stated according to the MPII and allowed by the subframe dimensions and geometry (but not less than 20 mm) and,

- a 40 mm air gap depth between rear surface of the cladding elements and front surface of the thermal insulation product.

First, an indicative test shall be performed for each of both air gap depths. The depth showing the worst results shall be completed (at least two additional tests) in order to obtain the worst classification.

If both indicative tests point to the same classification, any greater depth of the air gap than the tested minimum one could be classified based on this worst result, without additional testing.

If the indicative tests point to different classifications, additionally, the case (air gap depth) showing the best results in the indicative test can also be fully tested for classification (two additional SBI test specimens to complete the required three test results) to determine if a better classification is obtained. If so, this better classification will apply only to the best-case air gap depth and the rest of the range will have the classification obtained with the worst-case air gap depth, unless additional intermediate depths are tested to determine the point (air gap depth) where classification changes.

If the kit includes the thermal insulation products, for insulation materials class A1 or A2 as part of the kit, a standard mineral wool insulation according to EN 13238, but with a thickness of 50 mm, shall be installed between subframe and substrate.

For other insulation materials, different conditions can be used for testing (e.g., maximum and/or minimum thicknesses, maximum and/or minimum density, unless proven otherwise). In absence of representative insulation materials, the test results shall only be valid for those applications as tested.

Tests on specimen with a total thickness of at least 200 mm (maximum testable thickness according to EN 13823, including cladding element, airgap, subframe, thermal insulation product and substrate) shall be valid for cladding kit with greater thickness.

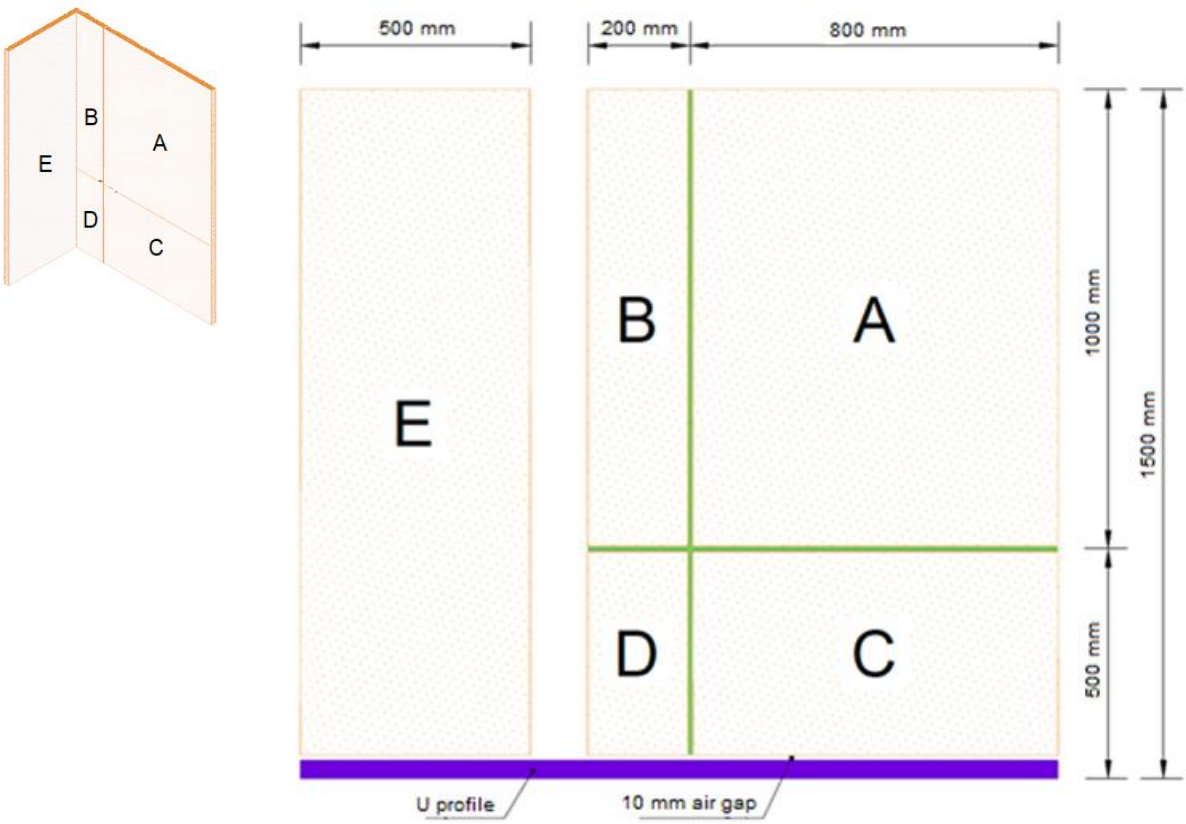
The cladding kit is fixed to the subframe. The cladding kit shall be installed with the number of cladding fixings according to the MPII. If no information is available from the manufacturer regarding the number of cladding fixings, each cladding element being part of the specimen shall be fixed with one cladding fixings at each corner of the cladding element.

When the kit presents horizontal joints, it shall be tested with, at least, a horizontal joint in the long wing at a height of 500 mm from the bottom edge of the specimen to the centre axis of the joint and when the kit tested presents vertical joints, it shall be tested with, at least, a vertical joint in the long wing at a distance of 200 mm from the corner line to the centre axis of the joint, in accordance with the Figures C.1.1.1 to C.1.1.4. In the areas A, B, C, D and E, it is possible to have other vertical and/or horizontal joints between cladding elements.

For covering a range of different widths of open joints the test shall be conducted on specimens with the highest possible width of the open joints. If only butt joints are foreseen it is recommended to conduct the test with butt joints in the test assembly.

In case where the cladding element size requires more joints than described before, the minimum and maximum density of joints shall be tested. In the internal vertical angle, no profile shall be used and the cladding elements create a vertical closed joint. Cladding elements shall not be extended up to the substrate board in order to close the air cavity behind and provide additional protection. Air cavity shall be unobstructed.

When tested rear side cladding kit (in case of asymmetrically composed cladding elements), the test shall involve a free-hanging arrangement with the flame impingement to the rear side in accordance with EN 13823 (test arrangement without open joints between the cladding elements and without thermal insulation layer on A1 or A2 substrate, so that the distance between the backing board and the cladding elements amounts to at least 80 mm – see Figure C.1.2.7).



Note: 10 mm air gap is only to be included when necessary to ensure continuous airflow (see clause C.1.1).

Figure C.1.1.1: Schematic representation of SBI test installation (front view).

Legend for Figures C1.1.2 to C.1.1.4:

1. Cladding element.
2. Cladding fixing.
3. Substrate.
4. Air space.
5. Subframe.
6. Thermal insulation product.

d = short wing cladding element thickness.

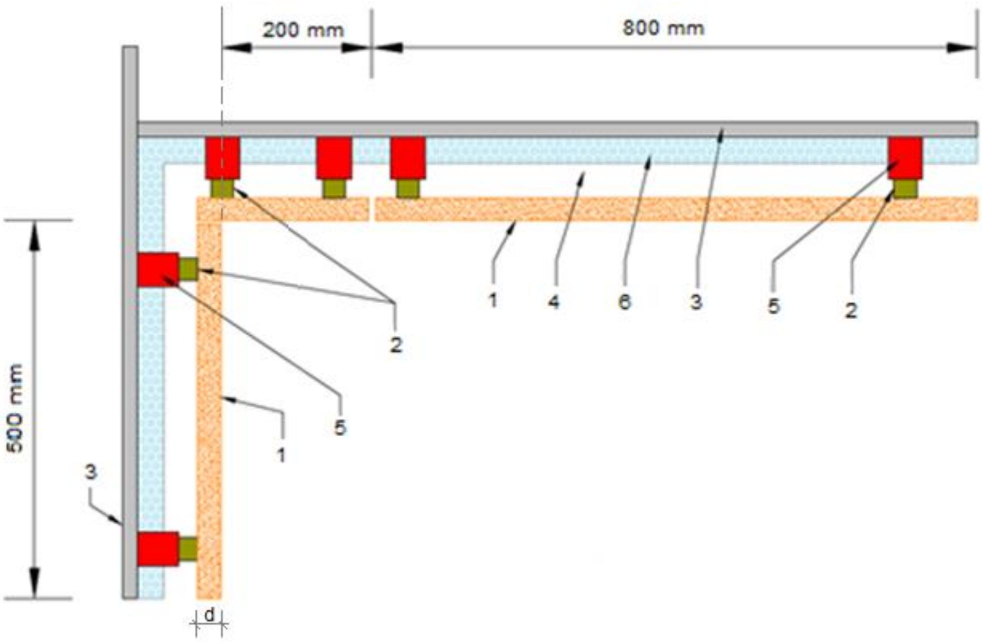


Figure C.1.1.2: Schematic representation of SBI test installation (top view – test specimen with subframe and thermal insulation product).

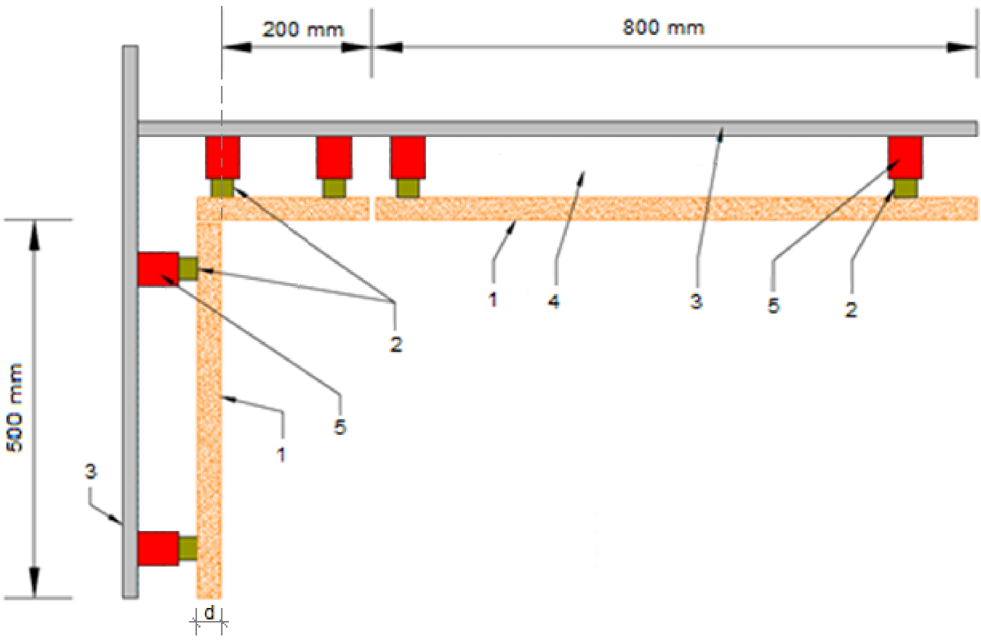


Figure C.1.1.3: Schematic representation of SBI test installation (top view – test specimen with subframe and without thermal insulation product).

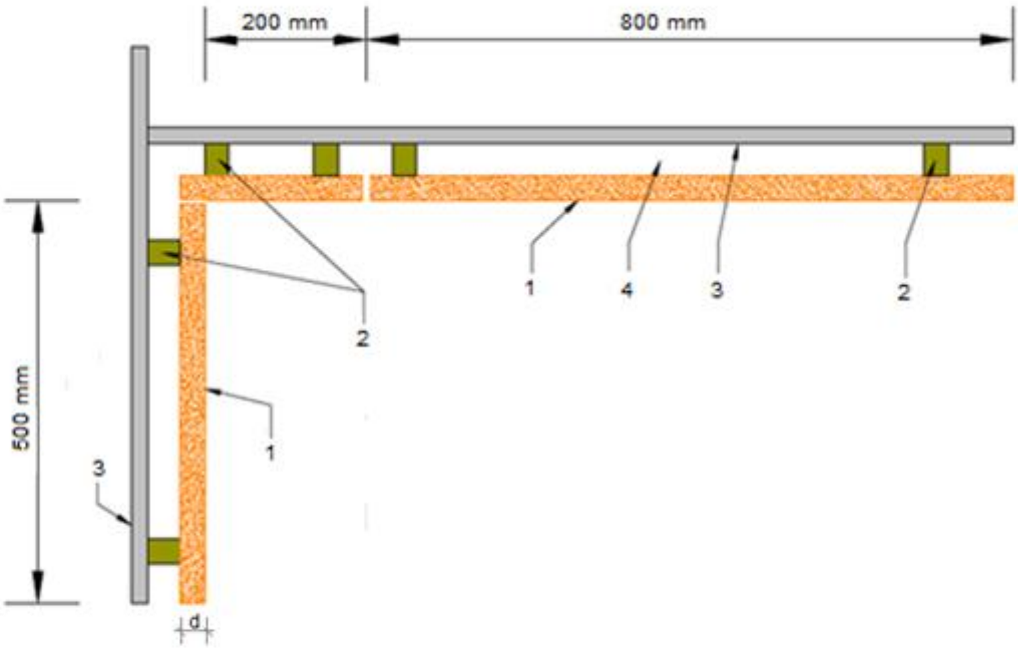


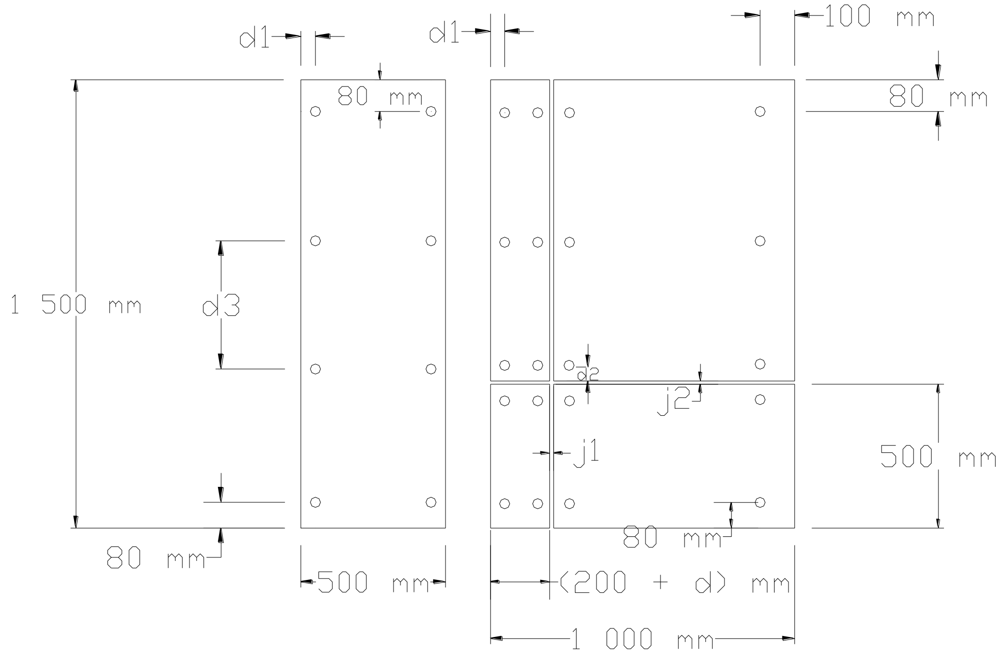
Figure C.1.1.4: Schematic representation of SBI test installation (top view – test specimen without subframe nor–thermal insulation product).

C.1.2 - Specific information

The kits are tested in a limited number of configurations to cover the influence of the parameters indicated in clause B.4.

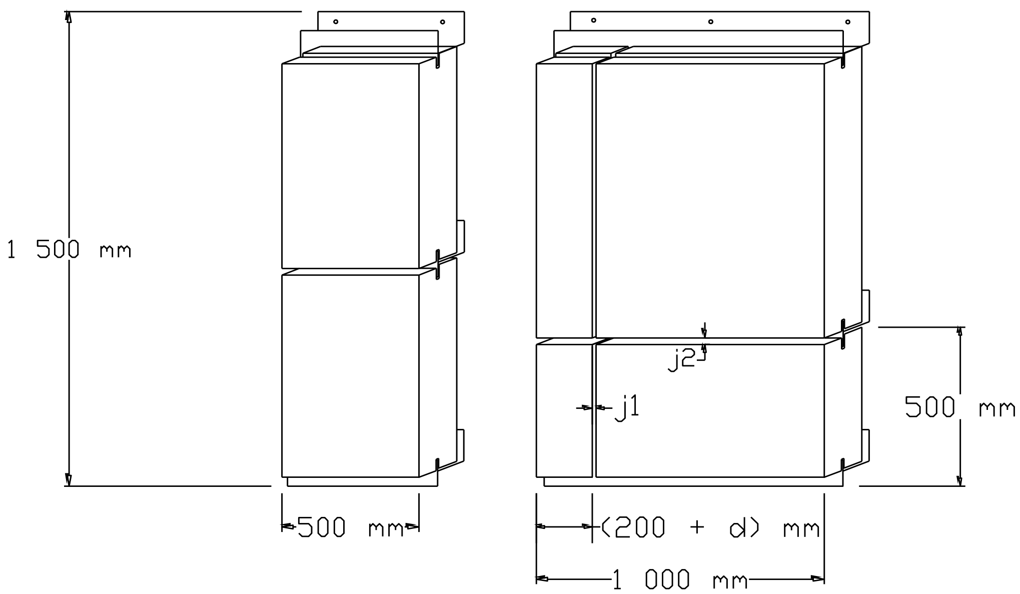
The cladding elements can be cut to size as shown in Figures C.1.2.1 to C.1.2.7.

The subframe (or the cladding fixings, when the cladding element is fixed directly to the substrate) shall be fixed to the substrate through fixings adapted to the type and material of the substrate.



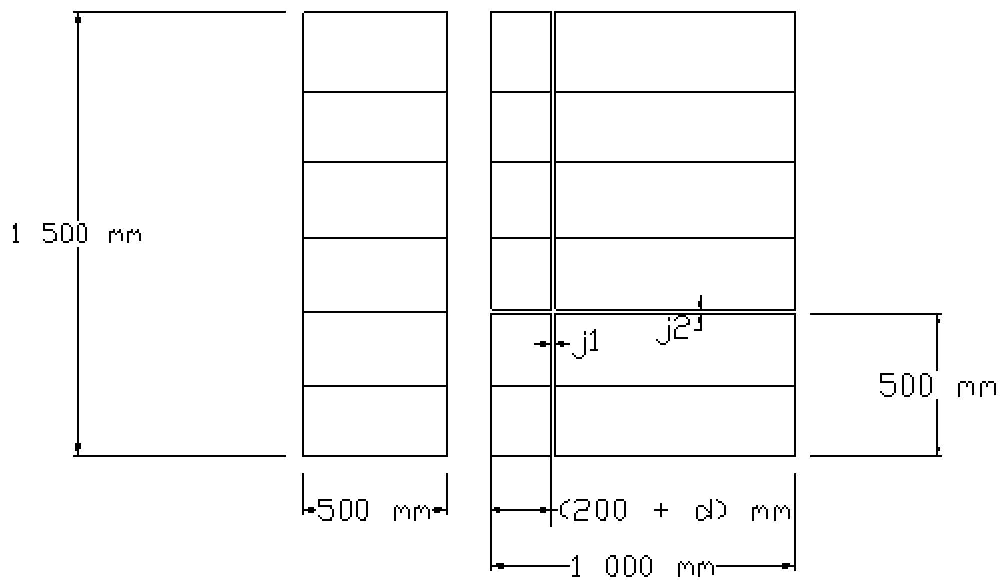
Legend:
j1 = width of vertical joint
j2 = width of horizontal joint
d1, d2 = distance of the axis of cladding fixing to the edges of the cladding element.
d3 = distance between two consecutive cladding fixings.
d = short wing cladding element thickness.

Figure C.1.2.1: Example of installation for kits family A or B.



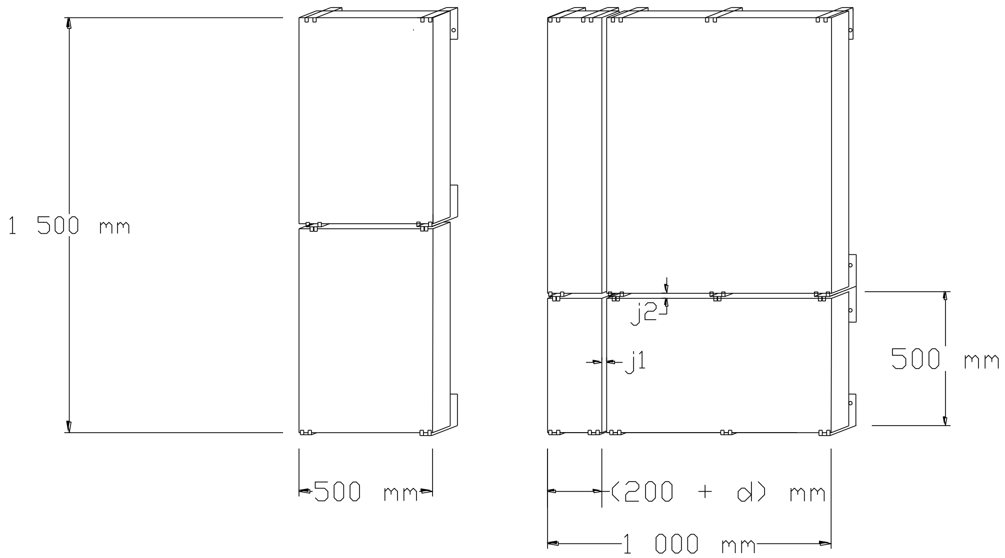
Legend:
j1 = width of vertical joint
j2 = width of horizontal joint
d = short wing cladding element thickness.

Figure C.1.2.2: Example of installation for kits family C or D.



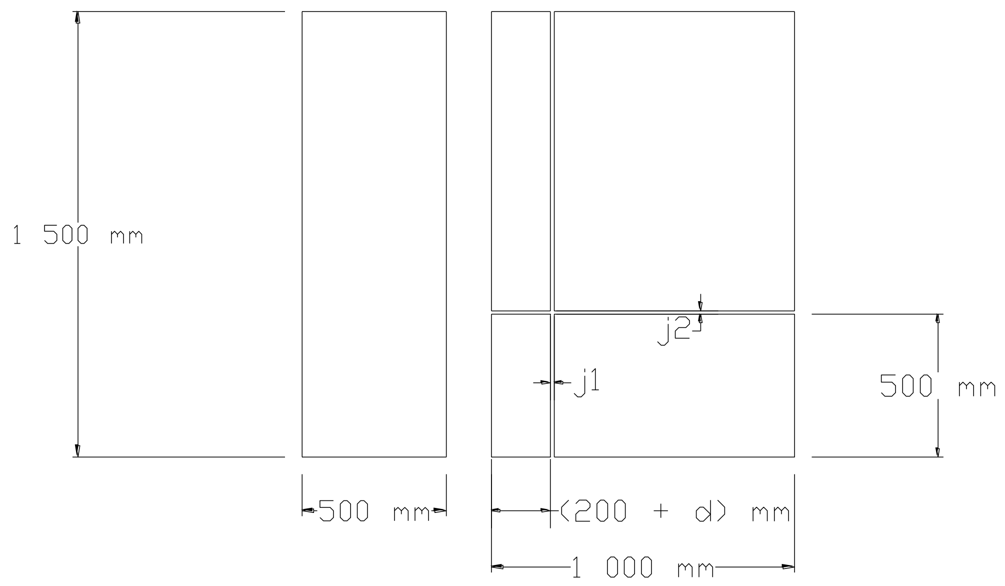
Legend:
j1 = width of vertical joint
j2 = width of horizontal joint
d = short wing cladding element thickness.

Figure C.1.2.3: Example of installation for kits family E.



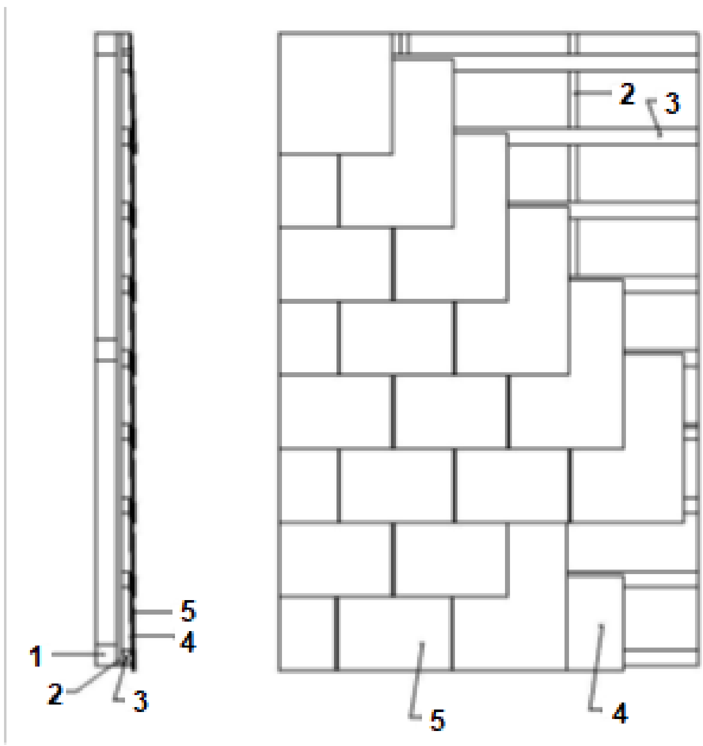
Legend:
j1 = width of vertical joint
j2 = width of horizontal joint
d = short wing cladding element thickness.

Figure C.1.2.4: Example of installation for kits family F.



Legend:
j1 = width of vertical joint
j2 = width of horizontal joint
d = short wing cladding element thickness.

Figure C.1.2.5: Example of installation for kits family G.



1 Supporting frame.

2 Timber batten (20 ± 1) mm.

3 Timber counter batt (19 ± 1) mm x (38 ± 1) mm.

4 Under eave slates.

5 Slate for testing.

Figure C.1.2.6: Example of installation for kits family H.

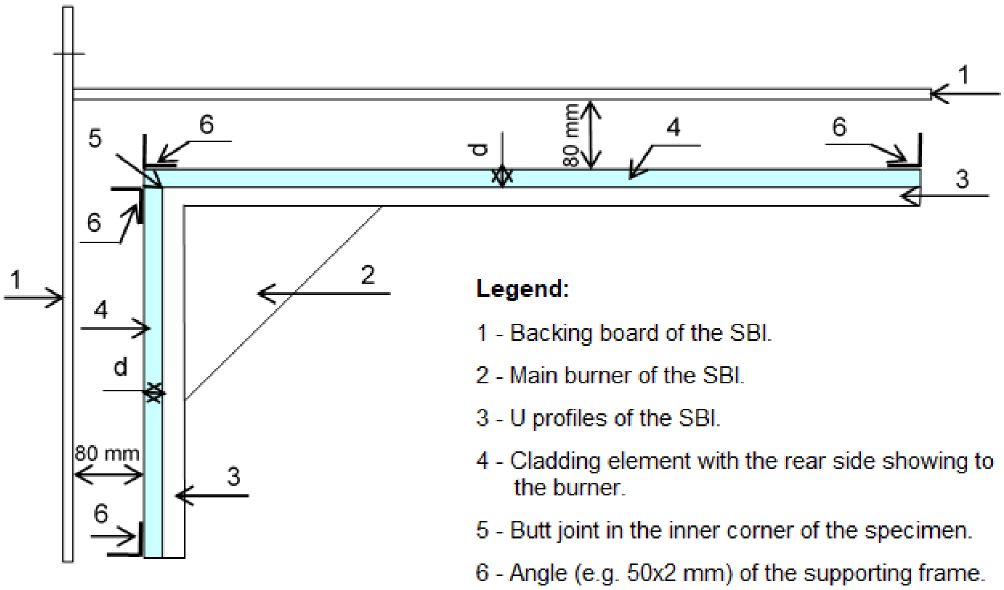


Figure C.1.2.7: Principle of testing the rear side.

C.1.3 - Extension of results

The test result (classification) shall remain valid, without test:

- For greater dimensions (height and width) of cladding elements.
- For other metal mechanical fixings with the same or higher number of cladding fixings, if metal fixings were used for testing.
- For the same type of plastic fixings as well as for metal fixings, each with the same or higher number of cladding fixings, if plastic fixings were used for testing.
- For the same type of cladding element used in applications with open vertical joint ≤ j1 (tested value) and open horizontal joint ≤ j2 (tested value) (see j1 and j2 in Figures C.1.2.1 to C.1.2.5).
- For the same density of joints or the range between the minimum and maximum density as tested.
- For other greater depth of air gap.
- When the test is carried out without thermal insulation layer, the test result is only applicable to end-use applications without thermal insulation layers.
- When the test is carried out with mineral wool insulation panels the test results shall be valid for:
  - all other greater thickness of mineral wool insulation layer with the same or greater density and the same or better reaction to fire classification;
  - the same type of panel used without thermal insulation, if the substrate chosen according to EN 13238 is made of panel with Euro-class A1 or A2 (e.g., fibres-cement panel).
- The results of reaction to fire tests, where a combustible thermal insulation material was used, are also valid for end-use applications of the tested product without thermal insulation product on solid mineral substrates of class A1 or A2-s1,d0 like masonry or concrete.
- The test result of a test with non-fire-retardant-treated timber subframe shall be valid, without test, for the same type of cladding element used with aluminium or steel subframe. The test result of a test with

an aluminium frame shall be valid, without test, for the same type of cladding element used with aluminium or steel frame. Result of tests with a steel frame are only valid for the same type of cladding elements used with metal frames with a melting point higher than 1000 °C.

- If the classification is the same, the test result of the lowest and highest thickness of the cladding element shall be valid, without test, for all the thickness in between. In other case the worst classification applies to the other thicknesses of the range.
- The result from a test with open joints shall be valid, without test, for the same type of cladding element used in applications with butt joints or joints closed by steel or aluminium profiles.
- The test results are valid for cladding elements with the same composition and same assembly (or alternatively: all product types of the same defined product family) than used in the tests. In addition, the provisions of clause B.1.1 regarding organic content and content of fire-retardants shall be considered.
- The test results are valid for the same density / weight per unit area (if only one value was tested) or the range between those values evaluated in the tests.
- The test results are valid for the same organic coating/finish or any other coatings/finishes with the same or lower Q_{PCS}-value (related to the mass in dried condition), each with the same or lower applied quantity (in dried condition) than tested.
- The test results are valid for the same inorganic coating or facing and other inorganic coatings / facings with the same or higher applied quantity per unit area.
- The test results are valid for the same colour of cladding elements than tested or for the entire range of colours, if colours as prescribed in clause B.1.1. were tested.
- The test results are valid for the same or greater size of overlapping of cladding elements than tested.

Note: other aspects indicated in the technical specifications for the cladding element material (see Table 1.1.1.1) shall be also taken into account.

C.2 - TESTING OF THE REACTION TO FIRE ACCORDING TO EN ISO 11925-2 (SINGLE FLAME SOURCE TEST)

C.2.1 - General

Due to the very limited size of the specimens as prescribed by the test standard, it is widely impossible to test the cladding kit as whole. Therefore, all essential components of the kit shall be tested separately except in cases prescribed below.

For the relevant flame exposure types to be applied within testing, see clause B.5.

C.2.2 - Thermal insulation

When the cladding kit contains the thermal insulation product, the following cases shall be considered:

<u>Case 1:</u>

According to the second paragraph of clause 2.2, thermal insulation products shall not be tested if reaction to fire is declared in their DoP and the given class according to EN 13501-1 is equal to or better than the intended class for the cladding kit (e.g., cladding kits class B or C, then the thermal insulation product shall be classified as class C).

<u>Case 2:</u>

When the reaction to fire class according to EN 13501-1 of the thermal insulation product is not declared in the DoP, or the declared class is worse than the intended class for the cladding kit, testing of the thermal insulation product shall be carried out, the test shall be performed according to the provisions of the test standard and taking into consideration the specific mounting and fixing provisions of the thermal insulation product standards (see clause 1.1.4) in connection with EN 15715.

Results and classification according to cases 1 and 2 are valid for the application of the thermal insulation product on any substrate covered by standard substrates according to EN 13238 using mechanical fixing means or adhesives (mortars) with an organic content equal to or lower than 15% (related to the mass in dried condition; see clause C.2.3).

If an adhesive with an organic content higher than 15% (related to the mass in dried condition) is used for fixing the thermal insulation product to the substrate, separate testing is required as prescribed in C.2.3.

C.2.3 - Fixing means

Case 1:

Metal linear mechanical fixings or punctual mechanical fixings of the cladding kit (cladding fixings, subframe fixings, anchors or thermal insulation product mechanical fixings) do not need to be tested according to EN ISO 11925-2 within the assessment of the kit, because their contribution to fire spread and fire growth is zero (in case of metal fixings) or low (in case of discrete plastic fixings) due to their limited dimensions and the distance to each other.

Case 2:

When the cladding kit contains the thermal insulation product fixed by means of an adhesive (mortar) with an organic content of equal or lower than 15 % (related to the mass in dried condition), such an adhesive does not need to be part of the thermal insulation test specimen tested according to EN ISO 11925-2 (see clause C.2.2)..

Case 3:

When the cladding kit contains the thermal insulation product fixed by means of an adhesive (mortar) with an organic content of more than 15% (related to the mass in dried condition) used for fixing the thermal insulation product to the substrate, it is necessary to carry out a complete set of six tests on specimens turned at 90 degrees on their vertical axis with edge exposure of the adhesive layer. The specimens consist of the substrate, the adhesive and the thermal insulation product. The following rules shall be applied for preparing the specimens:

- each type of adhesive with a different composition shall be used by selecting the variant with the highest amount of organic content and with the highest thickness,
- the thermal insulation product shall be used with the lowest thickness applied for the assessment,
- the substrate shall be the same as the one used for SBI testing of the external cladding kit as a whole.

When the cladding kit contains ancillary adhesives (see clause 1.1.5) that are not considered as small components (see clause B.6) with an organic content of more than 15% (related to the mass in dried condition) see provisions given in clause C.2.7.

C.2.4 - Breather membranes

Case 1:

Products covered by a harmonised product specification do not need to be tested, if reaction to fire is declared in their Declaration of performance (DoP), the given class according to EN 13501-1 of the breather membrane is equal to or higher than the intended class for the external cladding kit (e.g., class B or C shall be determined for the kit, than at least the breather membrane shall be classified as class C too) and the field of application of the classification given in the DoP (product parameters and end-use conditions as stated in the MPII) is valid when using the membrane as part of the cladding kit.

Case 2:

If testing of the breather membrane is required, the test shall be performed according to the provisions of the test standard and taking into consideration the following mounting and fixing provisions:

- free-hanging arrangement of the specimens without any substrate behind -> it covers all end use applications with or without any material behind,
- arrangement of the specimens directly mechanically fixed onto a representative standard substrate according to EN 13238 covering the specific application of the membrane as part of the kit.

The following product parameters are relevant for testing:

- variations of a product family (as defined by a certain combination of raw materials and a certain type of production process)
- organic content - where relevant, the product with the highest organic content shall be tested,
- thickness – where relevant, the highest and lowest thickness shall be tested,
- density / weight per unit area – where relevant, the highest and lowest density as well as the highest and lowest weight per unit area shall be tested.

Breather membranes glued to a thermal insulation product shall be tested and assessed together with the thermal insulation product.

C.2.5 - Subframe

Case 1:

Metal subframe profiles classified as A1 according to Decision 96/603/EC (as amended by Commission Decision 2000/605/EC and Commission Decision 2003/424/EC), as well as subframe profiles made of wood / wood-based materials which are covered by an applicable CWFT Decision, do not need to be tested.

Case 2:

Subframe components used for mechanically fixed cladding elements and not covered by case 1 shall be tested separately according to the provisions of the test standard and using a free-hanging test arrangement.

C.2.6 - Cladding elements

Mechanically fixed cladding elements shall be tested in a free-hanging test arrangement without any substrate or subframe profile behind.

If the cladding elements are built-in with a specific type of joints (except open joints) between neighbouring elements, this type of joint shall be considered at the lengthwise centre axis of at least two specimens of both flame exposure types (edge flaming and surface flaming).

C.2.7 - Other ancillary components

Each different ancillary component of the kit (except small components as defined in clause B.6) shall be tested separately according to the provisions of the test standard and their own harmonised product specification, if available.

Otherwise, the component shall be tested using a free-hanging test arrangement. If these tests fail, a test set-up with an appropriate standard substrate according to EN 13238 can be used representing the end-use application of the component in the kit.

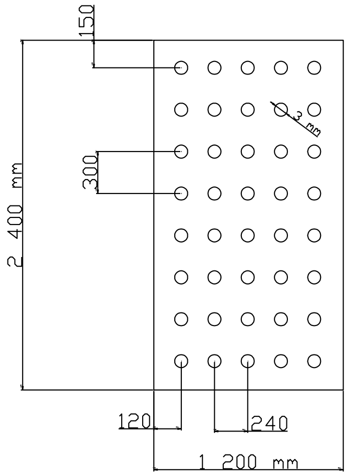
ANNEX D: ADDITIONAL CRITERIA FOR WATERTIGHTNESS TESTS

One test specimen for watertightness test shall be assembled according to the Figure D.1 representing the kit family to be assessed.

Water penetration, and possible drainability, shall be observed on the rear surface of the cladding elements mainly in the areas close to the joints and in the test specimen edges.

Optionally, for improving the possible water spraying observation, a transparent material panel (e.g., polymethyl methacrylate (PMMA) thickness 8 mm) with 3 mm diameter holes (0,01 % holes) could be placed behind the cladding elements (see Figure D.2 and Figure D.3).

E.g., if the size of specimen is 2400 mm x 1200 mm, the display of holes could be made according to Figure D.1.



Legend for Figures D.2 & D.3:

1. Cladding element.
2. Cladding fixing or subframe connection to the supporting test rig.
3. Horizontal joint between two cladding elements.
4. Cladding fixing.
5. Transparent panel (optional).
6. Supporting test rig.
7. Vertical joint between two cladding elements.
8. Air space.

Figure D.1: Example of distances between holes (drawing not to scale).

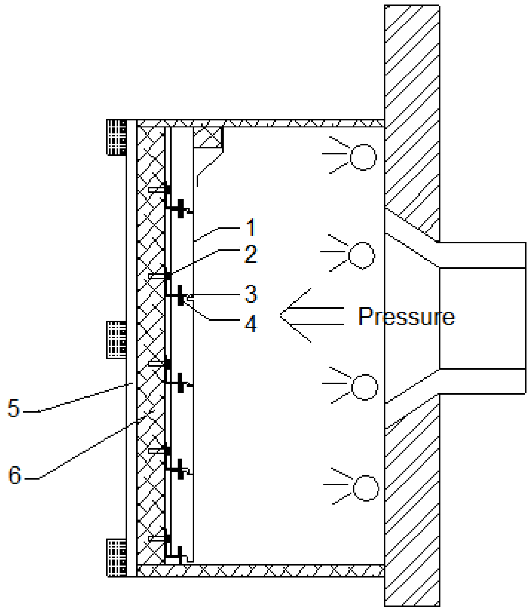


Figure D.2: Example of test device – vertical cross-section.

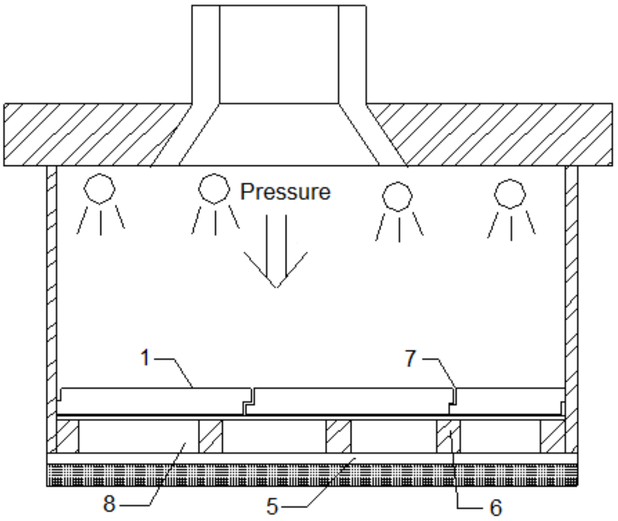


Figure D.3: Example of test device – horizontal cross-section.

Test report shall describe the test specimen. At least the following information shall be defined (data based on the MPII):

- Brackets: material, geometry, distance between two brackets and number and disposition of fixings.
- Profiles: material, geometry and distance between two profiles.
- Cladding element: material, geometry and dimension of the joint between cladding elements.
- Cladding fixing: material, geometry and number and disposition of fixings).
- Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
- Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

ANNEX E: WIND LOAD RESISTANCE ASSESSMENT

This annex contains the following information:

- The test procedure (see clause E.1) to be applied for the validation of the calculations.
- Criteria for the validation of the calculation (see clause E.2).
- Criteria for the wind load resistance calculation (see clause E.3).

E.1 - WIND SUCTION AND WIND PRESSURE LOAD TESTS

The purpose is to establish the effects of suction and pressure loads on the assembled cladding kit.

The number of tests depends on the combination of parameters presented for the assembled cladding kit.

As a minimum, the mechanically weakest assembled kit configuration shall be tested.

E.1.1 - Wind suction test

E.1.1.1 - Preparation of the test specimen

The test specimen shall be mounted in the test equipment in accordance with the MPII.

The test specimen is defined as follows:

- A non-airtight substrate (test rig) such as wood or steel rigid frame. Masonry or concrete wall may also be used as substrate; however, they shall include at least one hole per square metre with a minimum diameter of at least 150 mm.
- The assembled cladding kit shall be fixed to the test rig.
- The dimensions of the test specimen depend on the size of external cladding element and the specified cladding fixings:
  - for cladding elements which are mechanically fixed independent of each other, a minimum surface cladding elements of 1,5 m^2 shall be tested.
  - If they depend on each other vertically and horizontally, at least 3 x 3 cladding elements shall be tested.
  - If they depend on each other vertically or horizontally, at least 4 cladding elements shall be tested.
- To define the mechanically weakest composition the following aspects shall be taken into account:
  - The mechanically weakest cladding element (e.g., minimum thickness, minimum bending strength, minimum grooved cladding element resistance)
  - Number of cladding fixings by cladding element area (e.g., minimum number).
  - Span between profiles (e.g., maximum span).
  - Span between brackets (e.g., maximum span).
  - No ancillary adhesives unless it is necessary for the test specimen assembling.

The tolerances due to manufacturing and/or installation and deformations due to temperature and humidity variations shall be taken into account.

E.1.1.2 - Test equipment

The test equipment consists of a pressure or suction chamber (see Figure E.1.1.2.1) against which is placed the assembled cladding kit. The depth of chamber shall be sufficient for a constant pressure or suction to be exerted on the test specimen applied to the external surface of the assembled cladding kit irrespective of its possible deformation. The chamber is mounted on a rigid frame. The assembled cladding kit acts as the seal between the chamber and the environment. The connexion between the assembled cladding kit and the chamber shall be sufficient to allow a realistic deformation of the test specimen under the influence of simulated wind suction.

<u>Equivalent test equipment</u>

The equivalent test equipment may be used, provided that the geometric shape of the assembled cladding kit allows the foil bags to be placed in the air space and be blown out so that a uniformly distributed pressure load at the rear surface of the cladding element is possible.

The test rig consists of a rigid frame (steel construction) made of vertical longitudinal girder and horizontal profiles (anchor channel) and rigid boards or a massive wall such as masonry or concrete.

The subframe of the cladding kit shall be fixed on the rig and the cladding elements shall be fixed on the subframe according to the indications given by the manufacturer.

The vertical profiles of the rig can be movable (sliding) so that they can be placed in the axis of the fixings of the cladding element.

Foil bags which are placed in the air space at the rear surface of the cladding element shall be blown out and they exert a uniformly distributed pressure load on the rear surface of the cladding element which corresponds to the wind suction load.

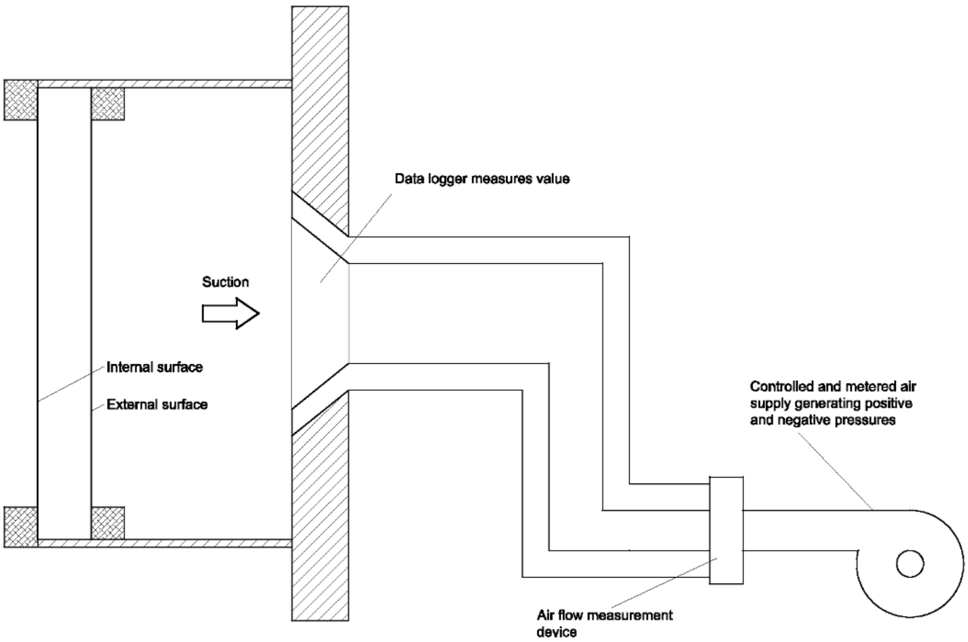


Figure E.1.1.2.1: Example of wind pressure and suction apparatus.

E.1.1.3 - Test procedure

The uniformly distributed loads shall be exerted on the surface of the assembled cladding kit.

The test shall be performed in successive steps (two steps of 300 Pa, one step of 500 Pa and one step of 1000 Pa, then steps of +200 Pa thereafter, at each step the load shall be maintained constant for at least 10 seconds and unloading after each step; see Figure E.1.1.3.1).

The test shall be continued until failure occurs (see clause E.1.1.4).

The displacement shall be measured, at the main points where this displacement may be observed (e.g., central point of the cladding element, border or corner of the cladding element, cladding fixing, profiles), as a function of the load and reported in tabular or graphic form.

With the differential pressure reduced to zero, the permanent deformation shall be noted after 1 minute recovery. Where manual mechanical measurements are used, the subsequent loading step shall be carried out once this 1 minute recovery is measured, therefore, the unload period between loading steps may be longer than the those defined in Figure E.1.1.3.1. The pressure at which any damage occurs shall be noted.

When it is observed in the test specimen a greater recovery behaviour, the permanent deformation shall also be measured 1 hour after finishing the test procedure according to Figure E.1.1.3.1.

The fixings between the assembled cladding kit and the test equipment shall not constitute weak points and shall therefore be chosen accordingly.

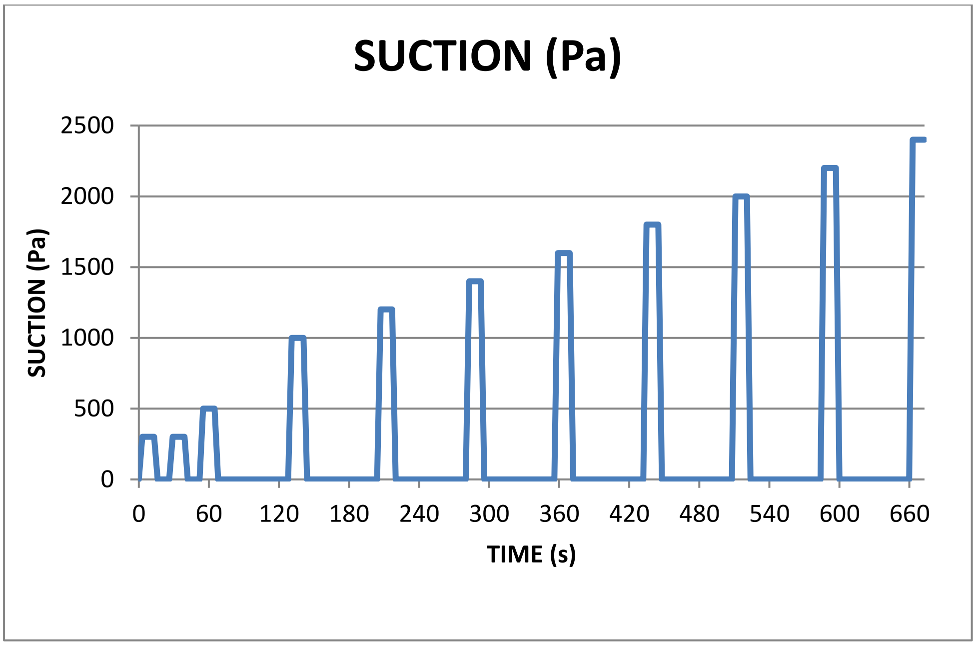


Figure E.1.1.3.1: Example of wind load steps.

E.1.1.4 - Observations during the test

Failure is defined by any one of the following events:

- Any cladding element, cladding fixing, profile or bracket breaks.
- Any cladding element, cladding fixing, profile or bracket presents a permanent deformation that affects the stability of the test specimen being a risk for the laboratory staff the subsequent loading step.
- Falling of detached components.
- Detachment of the kit subframe components.

E.1.1.5 - Test reports

The test report shall include at least:

- The failure load Q_{test}.
- The type of failure (see E.1.1.4) and the place where this failure occurs in the test specimen.
- The maximum displacement for each sensor position used on the test specimen, measured during the 10 seconds in each loading step.
- The permanent deformation for each sensor position used on the test specimen, measured after 1 minute recovering after each loading step (unloading).
- When relevant (see clause E.1.1.3), the permanent deformation for each sensor position used on the test specimen, measured after 1 hour recovering after the failure occurs (end of testing).

Note: This EAD covers a lot of possible combinations of materials and families, however, for all of them, once one component of the assembled kit fails, the whole kit fails, and it should be considered as such also in the validation of the calculation method. The type of failure and the place where the failure occurs is information also to be used in this validation.

E.1.1.6 - Test specimen description

Test report shall describe the test specimen. At least the following information shall be defined (data based on the MPII):

- Brackets: material, geometry, distance between two brackets and number and disposition of fixings.
- Profiles: material, geometry and distance between two profiles.
- Cladding element: material and geometry.
- Cladding fixing: material, geometry and number and disposition of fixings).
- Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
- Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

E.1.2 - Wind pressure test

The test procedure is similar to the one described in clause E.1.1, the only difference being that the wind action is reversed.

E.2 – CRITERIA FOR THE VALIDATION OF THE CALCULATION

The validation shall be made in a way that the results of the calculation remain statically on the safe side.

The validation criteria are:

1) The maximum wind load obtained by testing Q_{test} [kN/m^2] according to clause E.1, shall not be lower than the wind load value Q_{cal} [kN/m^2] obtained by calculation (see clause E.3) for the same tested assembled cladding kit configuration.

   $Q_{test} \geq Q_{cal}$ [kN/m^2]

   No safety factors shall be used for the validation purposes.

2) The maximum displacement measured by testing f_{test} [mm] shall not be lower than the calculated displacement f_{cal} [mm] for the same measured point on the tested cladding kit configuration and the same applicable load.

   $f_{test} \geq f_{cal}$ [mm]

When these criteria are not met, the wind load resistance calculation method and/or model shall be corrected for meeting with these criteria (e.g., by using correcting factors or by changing the method and/or model). Otherwise, the maximum value obtained by testing shall be considered as the maximum wind load resistance “Q” in [kN/m^2] for any assembled kit configuration.

E.3 – CRITERIA FOR THE WIND LOAD RESISTANCE CALCULATION

Calculations shall be performed either through a numerical structural analysis (FEM[15]) at elastic state or through simplified methods based on elasticity and resistance equations (e.g., beams related equations) considering the mechanical resistance of the kit components and connexions obtained in the relevant clauses 2.2.12.

The calculation method shall be validated by testing according to clause E.2.

For the calculation of the wind load resistance 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.

The calculation models shall include all relevant kit components, connexions between them, defined dimensions, and spans between components. All the relevant contacts between individuals kit components shall be considered into the calculation model either by considering a calculation model that includes all kit components (usually applicable when FEM analysis is used) or by considering individual calculation models taking into account the interaction/load-transition between kit components.

The wind load resistance calculation of the assembled kit shall consider, at least, the mechanical resistance properties of the components and their connexions (see Table E.3.1). Output data shall be the wind load actions Q_{cal} [kN/m^2] obtained considering the kit components and connexions resistance values.

The wind load resistance of the assembled kit Q [kN/m^2] shall be defined by the level of the weakest resistance component or connexion between them.

[15] FEM = Finite Element Method.

Table E.3.1 Criteria for the wind load calculations

Mechanical resistance property	Resistance values	Additional information
Bending resistance of the cladding element	▪ Bending strength resistance according to clause 2.2.12.1. ▪ Maximum displacement (only for flexible cladding elements) according to the MPII. Elastic modulus of the cladding element is needed.	The dimensions of the cladding element and the position of the cladding fixings shall be represented in the calculation model by considering the applicable cladding kit family. Simplified calculation methods based on theories of plates or beams may be applied.
Reaction strength at the connexion with the cladding fixing (To be applied depending on the kit family, see Table 2.1.2)	▪ Resistance of the grooved cladding element according to clause 2.2.12.2.	
	▪ Resistance of the cladding element at the dowel hole according to clause 2.2.12.3.	
	▪ Pull-through resistance according to clause 2.2.12.5.	
	▪ Axial tension resistance according to clause 2.2.12.7.	
	▪ Resistance of the slot according to clause 2.2.12.10.	
	▪ Pull-through resistance of fixings from profile according to clause 2.2.12.12.	
	▪ Resistance at failure of the punctual cladding fixing according to clause 2.2.12.13. ▪ Resistance at 1 mm permanent deformation of the punctual cladding fixing according to clause 2.2.12.13.	
	▪ Pull-out resistance of the subframe fixings according to clause 2.2.12.15.	
Resistance of the subframe profiles/studs (To be applied when the kit contains the subframe)	▪ Elastic limit of the subframe profile material by considering the properties given in clause 2.2.12.14. ▪ Maximum displacement of the subframe profile defined according to clause 2.2.12.14.	Simplified calculation methods based on theories of beams may be applied. E.g., relevant elasticity and resistance equations for continuous beams with two, three or more supports with uniformly distributed loads or punctual loads may be applied.
Reaction strength at the subframe connexion with the substrate (To be applied when the kit contains the subframe)	▪ Resistance to horizontal load at failure of the brackets according to clause 2.2.12.17. ▪ Resistance to horizontal load at 1 mm permanent deformation of the brackets according to clause 2.2.12.17.	
	▪ Shear load resistance of subframe fixings according to clause 2.12.16.	

ANNEX F: RESISTANCE TO HORIZONTAL POINT LOAD

The cladding kit shall be tested under a static load 500 N applied for one minute horizontally through two squares of 25 mm x 25 mm x 5 mm space apart (distance 440 mm) on any part of the cladding element (representing one person standing on a ladder leaning against the external surface) at room temperature and according to Figure F.1.

To define the mechanically weakest case of the assembled cladding kit the following aspects shall be taken into account:

- The mechanically weakest cladding element (e.g., minimum thickness, minimum bending strength, minimum grooved cladding element resistance).
- The mechanically weakest cladding fixings (e.g., minimum thickness, minimum mechanical material characteristics).
- Minimum number of cladding fixings by cladding element area. Maximum distance between cladding fixings.
- When applicable, the mechanically weakest subframe components (e.g., minimum thickness, minimum mechanical material characteristics).
- When applicable, maximum span between profiles.
- When applicable, maximum span between brackets.
- No ancillary adhesive unless it is necessary for the test specimen assembling.

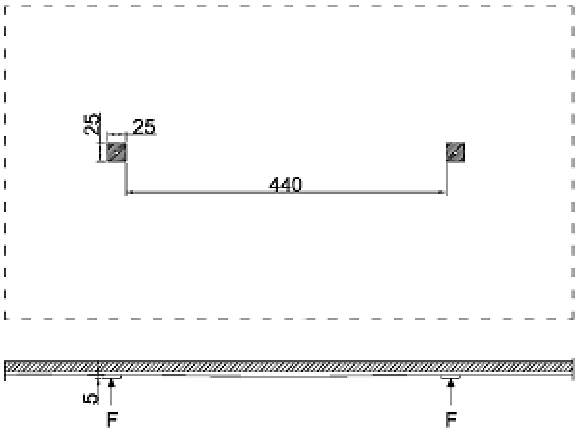


Figure F.1: Resistance to horizontal load test (dimensions in mm).

Test report shall describe the test specimen. At least the following information shall be defined (data based on the MPII):

- When applicable, brackets: material, geometry, distance between two brackets and number and disposition of fixings.
- When applicable, profiles: material, geometry and distance between two profiles.
- Cladding element: material and geometry.
- Cladding fixing: material, geometry and number and disposition of fixings).
- Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
- Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

ANNEX G: IMPACT RESISTANCE TEST

G.1 - GENERAL

The purpose is to establish the impact resistance of the cladding kit considering hard body and soft body impacts. Besides, the impact use categories corresponding to the degree of exposure to impacts in use shall be established considering the impacts for such use category.

The bodies to impact and the test equipment are given in clause G.4. The points of impact shall be selected considering the behaviour of the kit components (mainly the cladding element and its connexion with the cladding fixing) and the substrate. For selecting these points of impacts, it is recommended to carry out some indicative impacts for finding the weakest areas (e.g., centre, border, and corner of the cladding element). In all the cases, these impact areas shall always be at a distance greater than 50 mm from the cladding edge or from the cladding element fixing (connexion with the cladding element).

Hard body impacts are:

- H1 and H2 (1 J and 3 J respectively), carried out with the steel ball weighing 0,5 kg and from a height of 0,20 m and 0,61 m respectively (at least in three locations).

- H3 (10 J), carried out with the steel ball weighing 1,0 kg and from a height of 1,02 m (at least in three locations).

Soft body impacts are:

- Small soft body S1 and S2 (10 J and 60 J respectively), carried out with the soft ball weighing 3,0 kg and from a height of 0,34 m and 2,04 m respectively (at least in three locations).

- Large soft body S3 and S4 (300 J and 400 J respectively), carried out with the spherical bag weighing 50,0 kg and from a height of 0,61 m and 0,82 m respectively (at least in the space between two profiles).

Note: National building regulations in some member states may have specific impact energy requirements, in this case, other additional energy values for the hard and soft body impacts may be additionally considered and they shall be stated in the ETA.

At least, the mechanically weakest configuration shall be tested (see also clause G.5).

The size of the test specimen shall be chosen to carry out all the impacts indicated in Table G.2.1.

The dimensions of any indentation shall be reported. Any damaged observed shall be recorded.

G.2 – TEST PROCEDURE

Test procedure shall be carried out using one of following options:

1. When the impact resistance is known, the impact tests indicated in Table G.2.1 for this known impact resistance shall be performed and when successful, the increasing impacts shall be applied until highest impact category is established.

2. When the impact resistance is not known (reference method), then tests shall start with the lowest impact energies (if there is experience with similar configurations it may be used) and continue increasing the impacts, with the aim of obtaining the maximum impact resistance.

Table G.2.1 Hard and soft body impact tests

External impacts and assessment							
			Category IV	**Category III**	**Category II-b**	**Category II-a**	**Category I**
Hard body impact	H1	• Weight: 0,5 kg • Impact: 1 J (height 0,20 m) • No. impacts: 3 • Position of impacts: three different locations	No penetrated (2) and No perforated (3)	---	---	---	---
	H2	• Weight: 0,5 kg • Impact: 3 J (height 0,61 m) • No. impacts: 3 • Position of impacts: three different locations	---	No penetrated (2) and No perforated (3)	No deterioration (1)	No deterioration (1)	No deterioration (1)
	H3	• Weight: 1 kg • Impact: 10 J (height 1,02 m) • No. impacts: 3 • Position of impacts: three different locations	---	---	No penetrated (2) and No perforated (3)	No penetrated (2) and No perforated (3)	No deterioration (1)
Soft body impact	S1	• Weight: 3 kg • Impact: 10 J (height 0,34 m) • No. impacts: 3 • Position of impacts: three different locations	No deterioration (1)	No deterioration (1)	---	---	---
	S2	• Weight: 3 kg • Impact: 60 J (height 2,04 m) • No. impacts: 3 • Position of impacts: three different locations	---	---	No deterioration (1)	No deterioration (1)	No deterioration (1)
	S3	• Weight: 50 kg • Impact: 300 J (height 0,61 m) • No. impacts: 1 • Position of impacts: At least in the centre point of a cladding element	---	---	---	No deterioration (1)	---
	S4	• Weight: 50 kg • Impact: 400 J (height 0,82 m) • No. impacts: 1 • Position of impacts: At least in the centre point of a cladding element	---	---	---	---	No deterioration (1)

(1) Superficial damage (e.g., aesthetic damage without any kind of cracking), provided there is no cracking, is considered as showing "no deterioration" for all the impacts. Collapse or any other dangerous failure is not allowed.

(2) The test result is assessed as being "penetrate" if there is any cracking penetrating to be observed in the cladding element (to be also observed by the rear surface of the cladding element). Superficial cracking (no penetrating) is allowed. Collapse or any other dangerous failure is not allowed.

(3) The test result is assessed as being "perforated" if there is a destruction of the cladding element (to be also observed by the rear surface of the cladding element). Collapse or any other dangerous failure is not allowed.

G.3 - DEFINITION OF THE IMPACT USE CATEGORIES (INFORMATIVE)

The categories given in Table G.3.1 correspond to the degrees of exposure in use. They do not include an allowance for acts of vandalism.

Table G.3.1 Impact use categories

Category	Use
I	A zone readily exposed to impacts but not subject to abnormally rough use (e.g., **ground level** or **façade base** accessible to the public, such as squares, parking, schoolyards, parks, etc.). For instance, cleaning gondolas may be used on the façade.
II-a	A zone liable to impacts from thrown or kicked objects but not subject to abnormally rough use, where the height of the kit will limit the size of the impact (e.g., at **upper façade levels** that occasionally can be hit by a thrown object); or at lower levels (e.g., **ground level or façade base**) where access to the façade is primarily to those with some incentive to exercise care. For instance, cleaning gondolas may be used on the façade.
II-b	A zone liable to impacts from thrown or kicked objects but not subject to abnormally rough use, either where the height of the kit will limit the size of the impact (e.g., at **upper façade levels** that occasionally can be hit by a thrown object); or at lower levels (e.g**., ground level or façade base**) where the area surroundings the kit will limit the size of the impact or access to the façade is controlled and under surveillance). For instance, cleaning gondolas may be used on the façade.
III	A zone not likely to be damaged by normal impacts caused by people or by thrown or kicked objects, either where the height of the kit will limit the size of the impact (e.g., **high façade levels** in buildings - not including the subsequent above ground level or façade base). For instance, cleaning gondolas shall not be used on the façade.
IV	A zone out of reach from ground level in which the risk to be hit by a thrown object is very low because the height of the kit will limit the size of the impact (e.g., **high façade levels** in buildings (not including the subsequent above ground level or façade base). For instance, cleaning gondolas shall not be used on the façade.

G.4 - BODIES TO IMPACT AND TEST EQUIPMENT

G.4.1 - Soft body

<u>Principle</u>

The soft body impact test simulates an impact resulting from a person accidentally falling against the product.

The soft body shall be dropped from a height, creating an impact energy, which corresponds with the impact energy released by a person.

<u>Test apparatus</u>

The large soft body impactor shall be a spherical canvas bag of diameter (400 ± 40) mm (see Figures G.4.2.1 & G.4.2.2) filled with (3,0 ± 0,3) mm diameter glass spheres or equivalent material to give a total weight of (50 ± 0,5) kg.

The small soft body impactor shall be a spherical ball of diameter (170 ± 50) mm, made of flexible material (e.g., rubber), and filled with sand or equivalent material size ≤ 2 mm to give a total weight of (3 ± 0,03) kg where the ball shall be almost full.

G.4.2 - Hard body

<u>Principle</u>

The hard body impact test simulates the impact, resulting from an object accidentally falling against the product.

The hard body shall be dropped from a height, creating an impact energy, which corresponds with the impact energy released by hard objects.

<u>Test apparatus</u>

The hard body impactors shall be a steel ball, with a diameter of (63,5 ± 1,0) mm, with a mass of (1030 ± 40) g (1 kg steel ball) and a steel ball, with a diameter of (50 ± 0,5) mm, with a mass of (514 ± 19) g (0,5 kg steel ball).

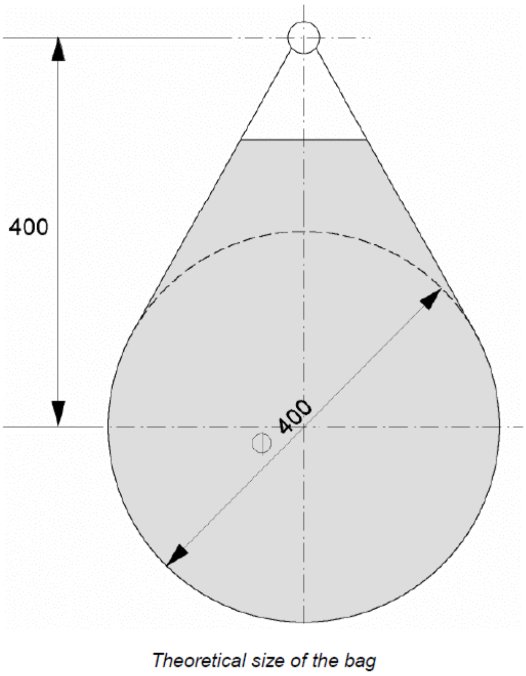


Figure G.4.2.1: Theoretical size of the bag for soft body.

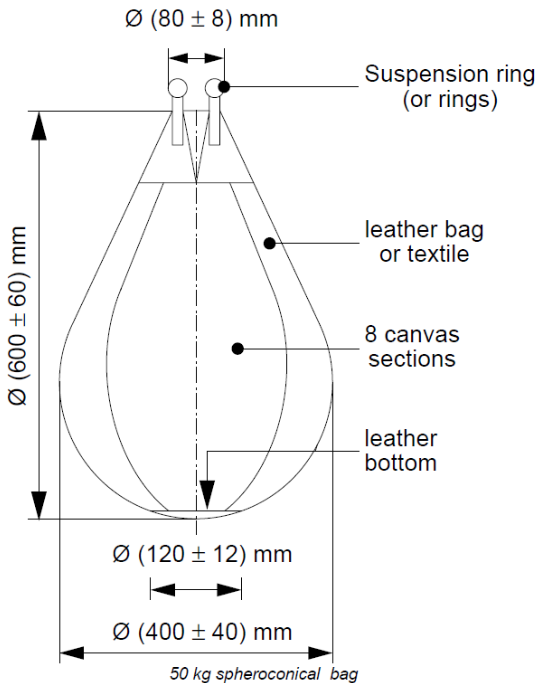


Figure G.4.2.2: Soft body impactor.

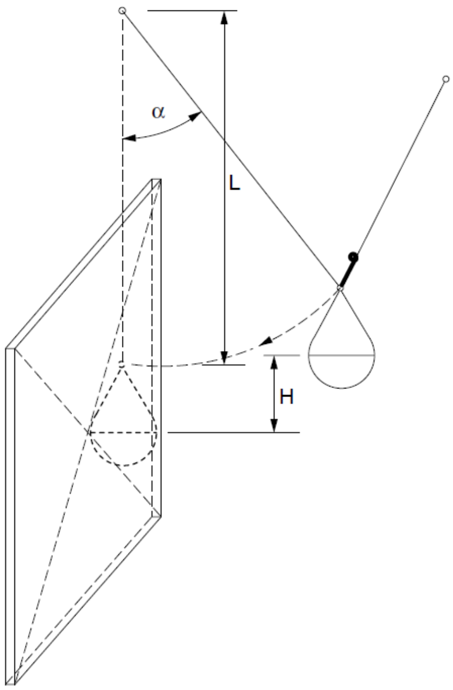


Figure G.4.2.3: Soft body impact on vertical assembly.

Legend:

H = drop height;
L = length rope;
α = drop angle (minimum 65°).

G.5 – TEST SPECIMEN

To define the mechanically weakest case of the assembled cladding kit the following aspects shall be taken into account:

- The mechanically weakest cladding element (e.g., minimum thickness, minimum bending strength, minimum grooved cladding element resistance).
- The mechanically weakest cladding fixings (e.g., minimum thickness, minimum mechanical material characteristics).
- Minimum number of cladding fixings by cladding element area. Maximum distance between cladding fixings in one direction (usually in vertical) combined with the minimum cladding element area.
- When applicable, the mechanically weakest subframe components (e.g., minimum thickness, minimum mechanical material characteristics).
- When applicable, maximum span between profiles.
- When applicable, maximum span between brackets.
- No ancillary adhesive unless it is necessary for the test specimen assembling.

G.6 – TEST REPORT

Test report shall include at least:

- Detailed information of the test specimen. At least the following information shall be defined (data based on the MPII):
  - When applicable, brackets: material, geometry, distance between two brackets and number and disposition of fixings.
  - When applicable, profiles: material, geometry and distance between two profiles.
  - Cladding element: material and geometry.
  - Cladding fixing: material, geometry and number and disposition of fixings).
  - Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
  - Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.
- For each impact: position of the impact, type of impact body, energy applied and observation on the test specimen after impacting.

ANNEX H: MECHANICAL RESISTANCE OF THE CLADDING ELEMENT

H.1 - RESISTANCE TO GROOVED CLADDING ELEMENT

The purpose is to establish the mechanical resistance of the grooved cladding element.

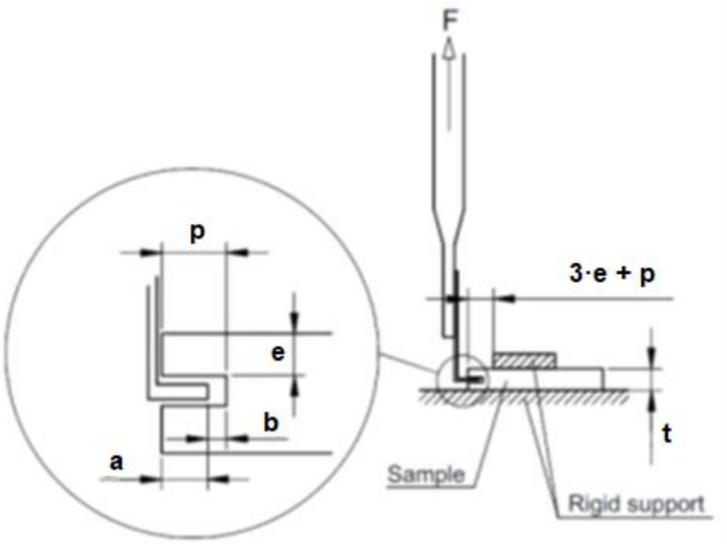
A minimum of five specimens shall be tested.

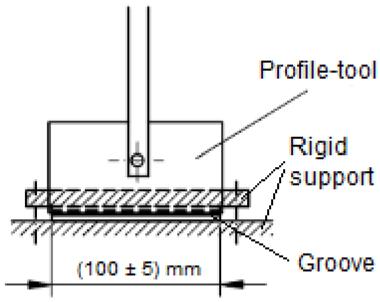
Specimens with a grooved length (100 ± 5) mm with a fitting are applied to a rigid substrate as shown in Figure H.1.1.

The force shall be exerted at a rate of (5 ± 0,5) mm/min on the profile (testing-tool).

The force is applied by pulling the head of the profile-tool with same dimension than the grooved length (100 ± 5) mm.

The dimensions “a” and “b” depend on the dimensions of the grooves of the cladding element. It is recommended that the dimension “a” corresponds with the actual dimension of the connexion between the cladding fixing and the cladding element groove. The dimension “b” shall not be greater than 5 mm (it is possible that b = 0, therefore a = p).





Legend:

t = cladding element thickness.

p = groove depth.

e = tongue thickness.

a = depth of the connexion profile-tool in the groove.

b = depth of the free space in the groove.

Figure H.1.1: Example of test specimen fixing.

Test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
  - Type and geometry of the test specimen (values of “e”, “p”, “a”, “b” and “t” indicated in Figure H.1.1).
  - Type, material and geometry of the profile or cladding fixing used to exert the force.
- Each individual force value, $F_{u,i}$ (expressed in N), and the description of the failure of the test specimen (breakage of the cladding element, significant permanent deformation of the profile or cladding fixing, etc.).
- The arithmetic average value, $F_{u,m}$ [in N], and the characteristic value, $F_{u,C}$ [in N], in accordance with equation (N.1).

H.2 – CLADDING ELEMENT CREEP TEST

This characteristic is only relevant for cladding kits which contain sloped surfaces / horizontal surfaces for the use in external ceilings, cornices, but not roofs.

The purpose is to establish the mechanical resistance of the cladding element to long term or permanent dead load (creep test).

At least one specimen shall be tested.

The test specimen shall be composed of one cladding element in horizontal position and its associated cladding fixings (the use of subframe components is also possible).

At least, the mechanically weakest configuration shall be tested (minimum thickness and maximum dimensions of the cladding element, minimum number of cladding fixings by cladding element area, the weakest mechanical resistance of cladding fixings and, when relevant, subframe components, no ancillary adhesive unless it is necessary for the test specimen assembling).

The test specimen shall be attached horizontally to a supporting frame and exposed to a constant testing load F in:

- four-point bending test arrangement when the span is equal or greater than 300 mm, points at L = Ls/3, and;
- three-point bending test arrangement when the span is smaller than 300 mm, point at L = Ls/2.

  Where L = distance between applied loads and Ls = span between two supporting points.

Test load F [in N] shall be calculated by considering the 30% of the average value of bending strength R_m [in N/mm^2] according to 2.2.12.1 and the size of the test specimen.

During the placing of the test load, the test specimen shall be propped from below in such a way that the propping can be removed quickly and smoothly in order to initiate the test.

Displacement measurements [in mm] shall start the instant that the full load is applied ($w_{load,0h}$) and then as $w_{load,Xh}$ in intervals X = 1; 2; 4; 8; 24; 48; 96; 168; 336; 672; 1344; 2000 hours (i.e., about 84 days). After end of loading period, test load shall be removed carefully without any propping of test specimen and displacement $w_{unload,Yh}$ measured in intervals Y = 1; 2; 4; 8 and 24 hours, or finished when no change to previous measurement is detected. This last measurement is to be considered the $w_{residual}$.The creep coefficient φ_{2000h} [--] for the cladding element shall be calculated using the expression:

$$\varphi_{2000h} = \frac{w_{load,2000h} - w_{load,0h}}{w_{load,0h} - (w_{laod,2000h} - w_{residual})} \qquad \text{(H.2.1)}$$

Where:

$w_{load,2000h}$ [mm] = the total displacement under load measured at the ending time X = 2000 hours (i.e., about 84 days),

$w_{load,0h}$ [mm] = the total initial displacement under load measured at the initial time X = 0 hours.

$w_{residual}$ [mm] = the total displacement measured after removing of load (unloading) after 24 hours from end of test, or when no change to previous measurement is detected.

The test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
  - When applicable, brackets: material, geometry, distance between two brackets and number and disposition of fixings.

- When applicable, profiles: material, geometry and distance between two profiles.
- Cladding element: material and geometry.
- Cladding fixing: material, geometry and number and disposition of fixings.
- Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
- Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

- Test load, F applied [in N].
- Each measured displacement [in mm], at initial loading ($w_{load,0h}$), at every interval under loading given above ($w_{load,Xh}$), at every interval after unloading ($w_{unload,Yh}$) identifying the residual value ($w_{residual}$) and calculated creep coefficient φ_{2000h} [--].
- Diagram time-displacement including all the measurements under loading.

ANNEX I: MECHANICAL RESISTANCE OF THE CONNEXION BETWEEN THE CLADDING ELEMENT AND THE CLADDING FIXING

I.1 - PULL-THROUGH RESISTANCE (for kits family A, D & E) and AXIAL TENSION RESISTANCE (for kits family B)

I.1.1 – General test procedure

Test series shall be carried out on specimens composed of one cladding element piece and one cladding fixing considering the configuration of the assembled kit according to the MPII.

It is recommended to carry out the test series for the corner and border position of the cladding fixing for all kit families (A, B, D & E) and, for kits family A & B also for the centre position of the cladding fixing (see Figures I.1.1.2).

However, for reducing the number of tests, the test series shall be carried out, at least for the corner position of the cladding fixing on the cladding element and for the mechanically weakest specimen (e.g., minimum thickness of the cladding element, weakest material of the cladding element and cladding fixing, minimum diameter of cladding fixing, minimum distance to the borders (edge distance) of the cladding element). In this option, test results obtained for corner position shall be considered as the performance for border and centre position unless specific test on border and/or centre position are carried out.

The cladding fixing shall be installed on the cladding element according to the MPII. In the case of kits family B, the cladding fixing is referred only to the undercut anchor (see Table 1.1.1).

The test series shall be carried out separately on at least two rings, minimum diameter ($d_{ring,min}$) and large diameter ($d_{ring,lar}$) for each cladding fixing position. In addition, it is recommended to carry out the test on one extra medium diameter ring ($d_{ring,med}$) to be chosen between the minimum and large diameter.

Minimum diameter ($d_{ring,min}$) shall be chosen between 50 mm and 70 mm depending on the size of the cladding fixing (pull-out/pull-through failure is expected with this diameter).

Large diameter ($d_{ring,lar}$) shall be chosen by considering one of the following options depending on the test equipment dimensions (in this case, either pull-out/pull-through failure or failure due to cladding element bending is expected):

- Option 1 (reference method): diameter equal to the maximum distance ($d_{ring,lar} = d_{max}$) between two consecutive cladding fixings on one cladding element according to the MPII.
- Option 2: diameter not smaller than ($d_{ring,lar} \geq 0,45 \times d_{max}$), where d_{max} is the maximum distance between two consecutive cladding fixings). In this case, test results shall be corrected applying the equation given in Table I.1.1.1.
- Option 3: this option is only applicable when both, the test is carried out without moment restriction according to the Figure I.1.1.1c, and for centre position test in at least 3 x 3 cladding fixing composition. In this option, the large diameter shall be the distance for which the bending moment of the cladding element is equal to zero. I.e.,:
    - $d_{ring,lar} = 0,50 \times d_{max}$ when the distance, a_{bord} (see Figure I.1.1.2b) between the extreme cladding fixing and the border is lower than $0,1 \times d_{max}$.
    - $d_{ring,lar} = 0,60 \times d_{max}$ when the distance, a_{bord} (see Figure I.1.1.2b) between the extreme cladding fixing and the border is lower than $0,2 \times d_{max}$.
    - $d_{ring,lar} = 0,80 \times d_{max}$ when the distance, a_{bord} (see Figure I.1.1.2b) between the extreme cladding fixing and the border is lower than $0,3 \times d_{max}$.

For each test series (see Table I.1.1.1), at least five test specimens shall be carried out.

An axial tension load perpendicular to the cladding element shall be exerted until failure occurs. The load shall be exerted on the cladding fixing as depicted at the Figures I.1.1.1 (reference method) while the testing ring is pushed on the surface of the cladding element by reaction force to the axial tension load additional compression stress on the cladding element surface.

Optionally, for family A, D & E, a compression load may be exerted on the head of the cladding fixing when the tension resistance of the cladding fixing head is known (data based on the MPII). The applied load speed rate shall be adjusted to (5 ± 0,5) mm/min.

Test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
    - Type of material of the cladding element and the cladding fixing.
    - Form and dimensions of the cladding element and the cladding fixing.
    - Bending strength of the cladding element.
    - Maximum distance between two consecutive cladding fixings on one cladding element.
    - Minimum distance between the cladding fixing and the borders of the cladding element.
- Diameters of the rings used for each test series.
- Each individual failure value, $F_{u,i}$ (expressed in N), and the mode of failure of the test specimen (cladding fixing pull-out or deformation, cladding element cone failure, etc.).
- The arithmetic average values, $F_{u,m}$ [in N], and the characteristic values, $F_{u,C}$ [in N], in accordance with equation (N.1).

Table I.1.1.1 Test series

N.	Test specimen	Cladding fixing position	Ring diameter	Cladding element dimension	Corrections
1	Mechanically weakest specimen	Corner	Minimum diameter: ▪ $d_{ring,min}$ = 50 mm to 70 mm	See Figure I.1.1.2a	---
2			Large diameter: ▪ Option 1: $d_{ring,lar} = d_{max}$ ▪ Option 2: $d_{ring,lar} \geq 0{,}45 \times d_{max}$		when Option 2, the values shall be corrected as indicated in the note (*)
3			Medium diameter (optional): ▪ $d_{ring,med} = d_{ring,min}$ to $d_{ring,lar}$		---
4		Border (optional)	Minimum diameter: ▪ $d_{ring,min}$ = 50 mm to 70 mm	See Figure I.1.1.2b	---
5			Large diameter: ▪ Option 1: $d_{ring,lar} = d_{max}$ ▪ Option 2: $d_{ring,lar} \geq 0{,}45 \times d_{max}$		when Option 2, the values shall be corrected as indicated in the note (*)
6			Medium diameter (optional): ▪ $d_{ring,med} = d_{ring,min}$ to $d_{ring,lar}$		---
7		Centre (optional for kit family A & B)	Minimum diameter: ▪ $d_{ring,min}$ = 50 mm to 70 mm	See Figure I.1.1.2c	---
8			Large diameter: ▪ Option 1: $d_{ring,lar} = d_{max}$ ▪ Option 2: $d_{ring,lar} \geq 0{,}45 \times d_{max}$ ▪ Additionally, for at least 3x3 cladding fixing composition, see (**)		when Option 2, the values shall be corrected as indicated in the note (*)
9			Medium diameter (optional): ▪ $d_{ring,med} = d_{ring,min}$ to $d_{ring,lar}$		---

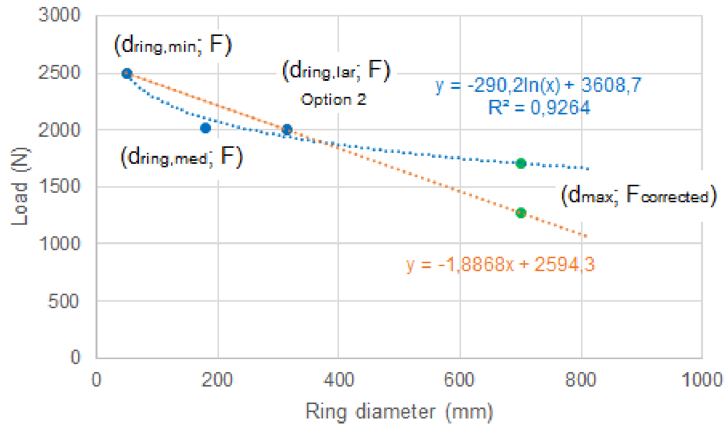
Where:

d_{max} = maximum distance between two consecutive cladding fixings, date to be provided by the manufacturer.

(*) When large diameter is reduced according to Option 2, the load values for the maximum distance between two consecutive cladding fixings (d_{max}) shall be corrected by extrapolation of the pair of values tested ($d_{ring} – F_i$) using one of the following options:

1) the two-points straight line obtained from the values for minimum ($d_{ring,min}$) and large diameter tested ($d_{ring,lar}$).

2) the three-points curve obtained from the values for minimum ($d_{ring,min}$), medium ($d_{ring,med}$) and large diameter tested ($d_{ring,lar}$), with a regression coefficient R > 0,90. See example diagram of these corrections below.



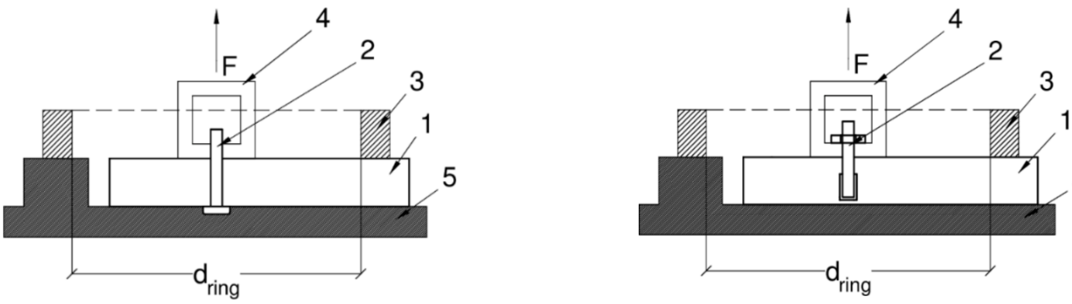
(**) See Option 3 in clause I.1.1.

Legend for Figures I.1.1.1:

1. Cladding element.
2. Cladding fixing.
3. Testing-ring (minimum thickness 10 mm).
4. Testing-tool or subframe profile piece.
5. Testing-support.

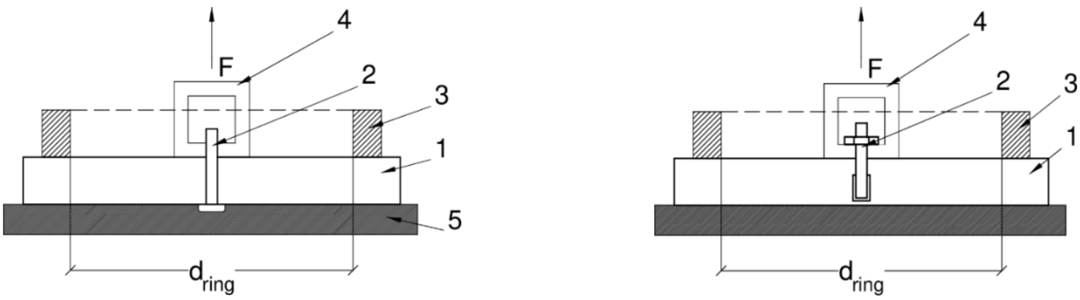
F = Load.

d_{ring} = Testing-ring diameter ($d_{ring,lar}$; $d_{ring,med}$ or $d_{ring,min}$).



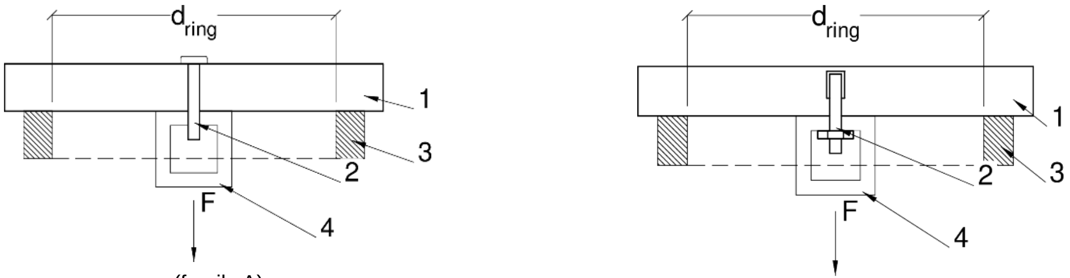
(family A, D & E) (family B)

Figure I.1.1.1a: Example of axial tension load exerted on the test specimen (corner or border position).



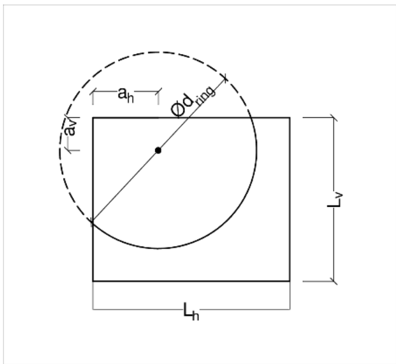
(family A, D & E) (family B)

Figure I.1.1.1b: Example of axial tension load exerted on the test specimen (centre position).



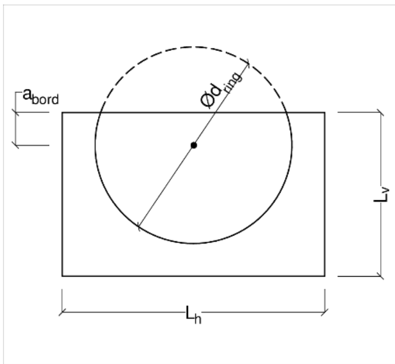
(family A) (family B)

Figure I.1.1.1c: Example of axial tension load exerted on the test specimen (centre position).



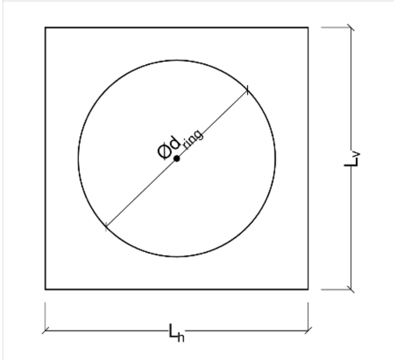
$L_v \geq \max(200 \text{ mm}; a_v + d_{ring}/2 + 50 \text{ mm})$
$L_h \geq \max(200 \text{ mm}; a_h + d_{ring}/2 + 50 \text{ mm})$

Figure I.1.1.2a: Corner position.



$L_v \geq \max(200 \text{ mm}; a_{bord} + d_{ring}/2 + 50 \text{ mm})$
$L_h \geq \max(200 \text{ mm}; d_{ring} + 100 \text{ mm})$
$a_{bord} = \min(a_v; a_h)$

Figure I.1.1.2b: Border position.



$L_v = L_h \geq \max(200 \text{ mm}; d_{ring} + 100 \text{ mm})$

Figure I.1.1.2c: Centre position.

Legend for Figures I.1.1.2:

a_v = minimum distance to the horizontal border according to the MPII.
a_h = minimum distance to the vertical border according to the MPII.
a_{bord} = distance to the border.
L_v = dimension of the test specimen cladding element in vertical direction.
L_h = dimension of the test specimen cladding element in horizontal direction.
d_{ring} = each diameter ($d_{ring,lar}$; $d_{ring,med}$ or $d_{ring,min}$) of the testing-ring according to Table I.1.1.1.

I.1.2 - Criteria for the use of test results according to EAD 330030-00-0601

In the case of kits family B, results of tests A1b and A1c according to Table A.1 of EAD 330030-00-0601 shall be used provided that an indicative test shall be carried out according to the procedure given above in this clause for minimum diameter and large diameter of the ring. At least one test specimen shall be considered for this indicative test. The test specimen shall have the same dimensions and components as the one considered in the testing according to EAD 330030-00-0601. If the test results obtained according to this indicative test are lower than those obtained according to EAD 330030-00-0601, the test results according to EAD 330030-00-0601 shall not be used.

I.2 – RESISTANCE UNDER SHEAR LOADS (for kits family A, B, D & E)

I.2.1 – General test procedure

The tests shall be carried out on specimens composed of one cladding element piece and one cladding fixing considering the configuration of the assembled kit according to the MPII. The test specimen shall be mechanically fixed to a wooden batten or a metal profile (testing-tool) using the actual cladding fixing or a fixing with envisaged diameter of the cladding fixing. This testing-tool and connexion shall not be the mechanically weakest point of the test specimen.

The test shall be carried out, at least for the border position of the cladding fixing on the cladding element (minimum distance to the borders according to the MPII, a_{bord}, shall be considered) and for the mechanically weakest specimen (e.g., minimum thickness of the cladding element, weakest material of the cladding element and cladding fixing, minimum diameter of cladding fixing, minimum distance to the borders of the cladding element).

In addition, it is recommended to carry out the test for the corner position of the cladding fixing.

For both positions, minimum distance to the borders according to the MPII shall be considered (see Figures I.2.1.1).

The cladding fixing shall be installed on the cladding element according to the MPII. In the case of kits family B, the cladding fixing is referred only to the undercut anchor (see Table 1.1.1).

The shear load shall be applied on the cladding fixing without eccentricity and without exposure to moments (see Figure I.2.1.1) until failure (either by pull-through of the cladding element or by breaking or deformation of the cladding fixing).

At least five test specimens shall be carried out.

A shear load parallel to the faces of the cladding element shall be exerted on one of the parts of the test specimen (cladding element or testing-tool) as follow in the Figures I.2.1.1 until failure occurs. The speed rate shall be adjusted to (5 $\pm$ 0,5) mm/min.

Test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
    - Type of material of the cladding element and the cladding fixing.
    - Form and dimensions of the cladding element and the cladding fixing.
    - Minimum distance between the cladding fixing and the borders of the cladding element.
- Each individual failure value, $F_{u,i}$ (expressed in N), and the mode of failure of the test specimen (cladding element pull-through failure or cladding fixing breaking or deformation, etc.).
- The arithmetic average values, $F_{u,m}$ [in N], and the characteristic values, $F_{u,C}$ [in N], in accordance with equation (N.1).

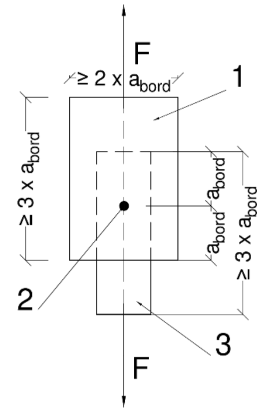


Figure I.2.1.1a: Test specimen in border position (shear load).

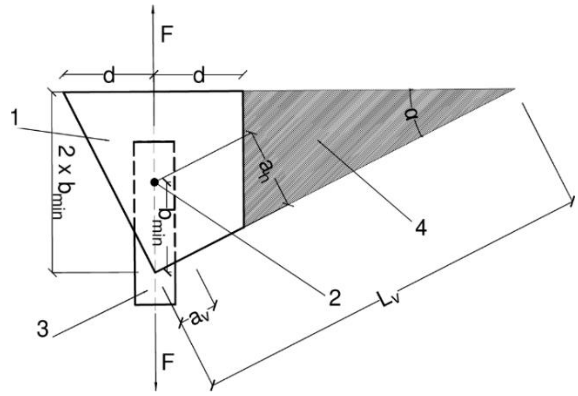


Figure I.2.1.1b: Test specimen in corner position (shear load).

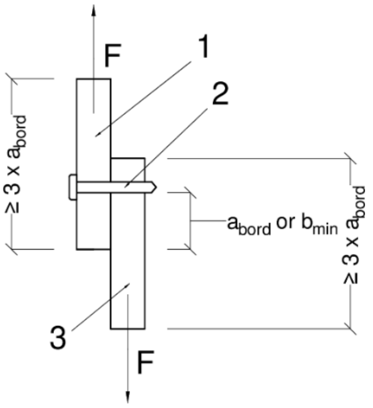


Figure I.2.1.2a: Example of shear load exerted on the test specimen for kits family A, D & E (border or corner position).

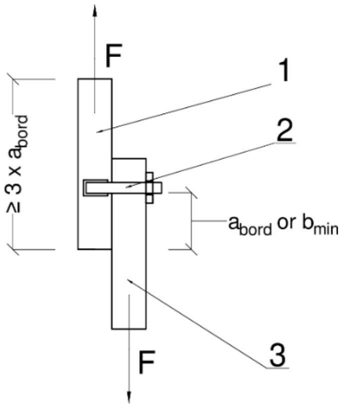


Figure I.2.1.2b: Example of shear load exerted on the test specimen for kits family B (border or corner position).

Legend for Figures I.2.1.2:

1. Cladding element.
2. Cladding fixing.
3. Testing -tool or subframe profile piece.
4. Cladding element part to be cut (discarded). When a_v & a_h are different.

F = load.

a_v = minimum distance to the vertical border according to the MPII.

a_h = minimum distance to the horizontal border according to the MPII.

a_{bord} = distance to the border.

$b_{min} = (a_v^2 + a_h^2)^{0,5}$.

$\tan \alpha = a_v / a_h$.

$d = 2 \times b_{min} \times \tan \alpha$.

I.2.2 - Criteria for the use of test results according to EAD 330030-00-0601

In the case of kits family B, results of tests A2a and A2b according to Table A.1 of EAD 330030-00-0601 shall be used provided that an indicative test shall be carried out according to the procedure given above in this clause. At least one test specimen shall be considered for this indicative test. The test specimen shall have the same dimensions and components as the one considered in the testing according to EAD 330030-00-0601. If the test results obtained according to this indicative test are lower than those obtained according to EAD 330030-00-0601, the test results according to EAD 330030-00-0601 shall not be used.

I.3 - COMBINED TENSION AND SHEAR LOAD RESISTANCE (for kits family B and kits family A, D & E with sloped surfaces)

I.3.1 – General test procedure

Test shall be carried out according to clause I.1 where the force shall be exerted as follow in the Figures I.3.1.1 until failure. The direction of load shall correspond to an angle of 30° and 60° relative to the plane of the cladding element.

Legend for Figures I.3.1.1:

1. Cladding element.
2. Cladding fixing.
3. Testing-ring.
4. Testing -tool or subframe profile piece.
5. Testing-support.

F = Load.
d_{ring} = Testing-ring diameter.
γ, β = angles.

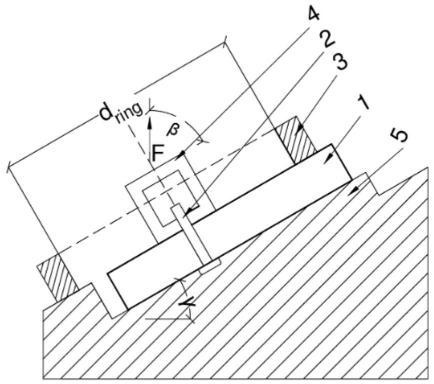


Figure I.3.1.1a: Test specimen angle γ = 30º (corner or border position).

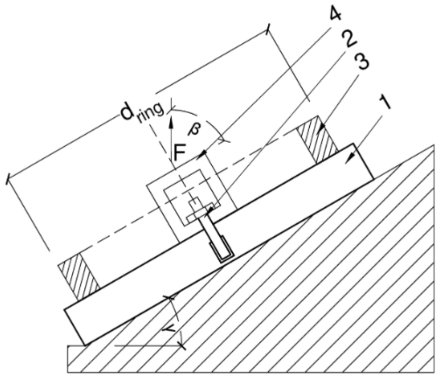


Figure I.3.1.1b: Test specimen angle γ = 30º (centre position).

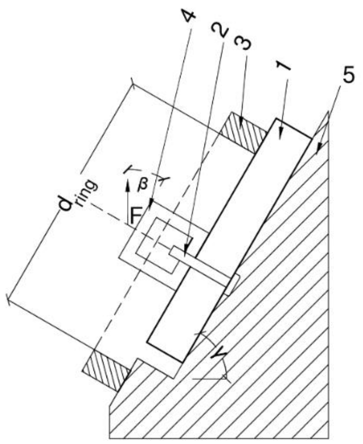


Figure I.3.1.1c: Test specimen angle γ = 60º (corner or border position).

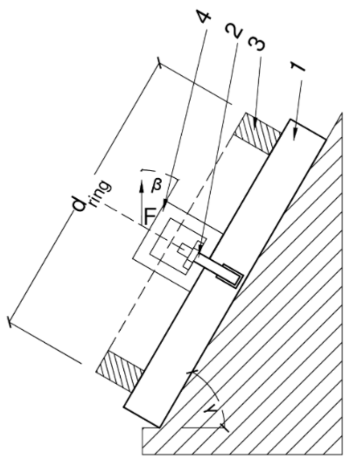


Figure I.3.1.1d: Test specimen angle γ = 60º (centre position).

I.3.2 - Criteria for the use of test results according to EAD 330030-00-0601

In the case of kits family B, results of tests A3 according to Tavle A.1 of EAD 330030-00-0601 shall be used provided that an indicative test shall be carried out according to the procedure given above in this clause for minimum diameter and large diameter of the ring. At least one test specimen shall be considered for this indicative test. The test specimen shall have the same dimensions and components as the one considered in the testing according to EAD 330030-00-0601. If the test results obtained according to this indicative test are lower than those obtained according to EAD 330030-00-0601, the test results according to EAD 330030-00-0601 shall not be used.

I.4 - RESISTANCE OF SLOT (for kits family G with cladding element made of TMCP)

This test procedure shall be carried out for TMCP in for hung cassettes where their borders have been cut in form of slot (see Figure I.4.1).

A minimum of five specimens shall be tested.

One test specimen is composed of one piece of TMCS (reinforced or not by riveted profile on its lateral side) and the actual cladding fixing according to the MPII. At least, the test shall be carried out with the mechanically weakest specimen (e.g., minimum thickness of the cladding element, weakest material of the cladding element and cladding fixing, minimum dimension of cladding fixing, minimum distance to the borders of the cladding element).

Dimensions of the test specimen are defined in Figure I.4.1 where the dimension A, B, C & D depends on the actual shape of the cutting according to the MPII. Test specimens may be obtained from an unfolded TMCS or from a folded cassette (see Figure I.4.2) when the dimension of the test specimen (L_v) may be cut from the lateral edge of the cassette.

Test specimens shall be tested under normal laboratory conditions.

A force is exerted, at a speed rate of (5 ± 0,5) mm/min on the cladding fixing until failure (excessive deformation or breaking).

Additionally, when relevant, a test in the vertical direction of the cassette (resistance of dead load or anti-lift up) shall be performed.

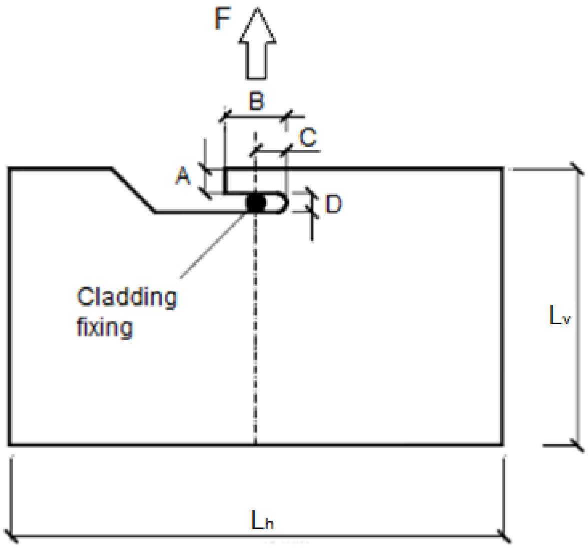


Figure I.4.1: Example of resistance of slot test.

Legend:
L_h = (200 ± 10) mm
L_v = (125 ± 10) mm
A = slot tongue thickness.
B = slot length.
C = B/2.
D = slot thickness.
F = load.

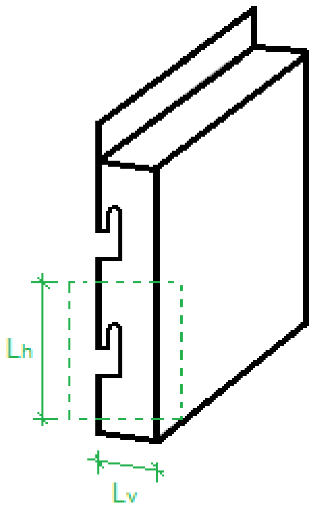


Figure I.4.2: Example of cassette with slots.

Test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
  - Type of material of the cladding element and the cladding fixing.
  - Form and dimensions of the specimen piece (including the slot's dimensions) and the cladding fixing.

- Each individual failure value, $F_{u,i}$ (expressed in N), and the mode of failure of the test specimen (cladding fixing pull-out or deformation, cladding element failure, etc.).
- The arithmetic average values, $F_{u,m}$ [in N], and the characteristic values, $F_{u,C}$ [in N], in accordance with equation (N.1).

ANNEX J: MECHANICAL RESISTANCE OF THE CLADDING FIXING

J.1 - RESISTANCE TO VERTICAL LOAD (for punctual and linear fixings of kits family C & F)

The purpose is to establish the effect of an additional dead load on the assembled cladding kit.

One cladding element is installed to a rigid substrate according to a), b) or c) an additional dead load is added on top of it.

Test procedure shall consider the following cases respect to configurations of the cladding kit:

a) the subframe is part of the cladding kit. In this case, the cladding element shall be installed using the mechanically weakest (i.e., weakest materials and minimum geometry) cladding fixings and subframe components (profiles and brackets).

b) the subframe is not part of the cladding kit but the cladding kit is intended to be used on subframes specified by the manufacturer and are available on the market. In this case, the cladding element shall be installed using the mechanically weakest (i.e., weakest materials and minimum geometry) cladding fixing and the weakest subframe (profiles and brackets) from those specified by the manufacturer.

c) the cladding kit is intended to be fixed directly to the substrate (without subframe). The specimen is installed directly to the substrate using the weakest cladding fixings (i.e., weakest material and minimum geometry).

The additional dead load (Q_{ad}) shall be defined considering one of the following aspects:

- Equivalent to two cladding elements dead load (Q_w). $Q_{ad} = 2 \times Q_w$ [in N].
- In the case of punctual cladding fixings (e.g., small rails, clips, clamps, pins or other similar punctual cladding fixing), the additional dead load shall be chosen from equation (J.1.1) considering the dead load of the cladding element (Q_w) to be used in the test specimen, the arithmetic average value for the individual vertical load resistance of the cladding fixing ($F_{1,m}$) obtained as indicated in clause J.3.3 for 1 mm permanent deformation, and the number of cladding fixings (n):

  $Q_{ad} = F_{1,m} \times n - Q_w$ [in N] (J.1.1)

- In the case of linear cladding fixings (e.g., rail profiles or other similar linear cladding fixing), the additional dead load shall be chosen from the minimum value of the vertical load obtained by calculation considering the elastic limit and the ultimate displacement defined in the MPII for the linear cladding fixing to be used in the test specimen. When the MPII does not give such information, L/100 shall be used (where L is the spam between two supports of the linear cladding fixing, e.g., distance between two subframe profiles).

The constant additional dead load shall be applied at the middle of the upper edge of the cladding element, as shown in Figures J.1.1, J.1.2 and J.1.3. Figures show two specific geometries of cladding fixings. For other cladding fixings with different geometry the same test principle shall be followed.

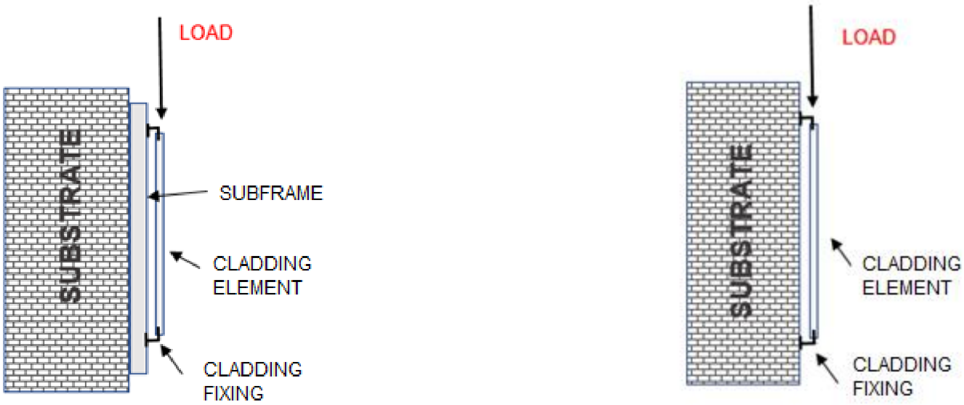
The load is applied at $L_h/2$, where "L_h" is the cladding element length in horizontal direction.

Punctual cladding fixings Linear cladding fixings

Figure J.1.1: Examples of test lay-out for punctual and linear cladding fixings when a subframe is used (cases a) and b) defined above). Frontal view,

Punctual cladding fixings Linear cladding fixings

Figure J.1.2: Examples of test lay-out for punctual and linear cladding fixings installed directly to the substrate (case c) defined above). Frontal view,



Cases a) or b) Case c)

Figure J.1.3: Examples of test lay-out for cases a) or b) and c). Side view.

The displacements of the cladding element (measured on the middle point of the upper or bottom edge), cladding fixings (measured on each bottom cladding fixing which are the ones that support the cladding element) and subframe profiles (measured on upper or bottom cross-section of the profiles), if relevant according to the tested cladding kit, shall be measured by means of the corresponding displacement sensors on these components. All the respective measurements shall be obtained in absolute values with respect to the substrate.

The initial displacement when the dead load is applied shall be measured. Then the displacements shall be measured at least each hour. The test can be stopped if after two measurements in one subsequent hour the increment of the displacement is less than 0,1 mm.

The test result is a displacement curve for each point of measurement as a function of time and the measured displacements.

The test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
    - When applicable, brackets: material, geometry, distance between two brackets and number and disposition of fixings.
    - When applicable, profiles: material, geometry and distance between two profiles.
    - Cladding element: material and geometry.
    - Cladding fixing: material, geometry and number and disposition of fixings.
    - Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
    - Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.
- The additional applied dead load, Q_{ad}, (in N).
- The graphic or tabular values time-displacement (in hours-mm).

J.2 - PULL-THROUGH RESISTANCE OF FIXINGS FROM LINEAR AND PUNCTUAL CLADDING FIXING (family B, C and F)

A minimum of five specimens shall be tested.

The test specimens shall be mounted in accordance with the MPII.

Each test specimen shall be composed of one linear cladding fixing or punctual cladding fixing (number 1 in the figures below), and the subframe fixing (number 2 in the figures below) defined for its connexion with the subframe.

The length of the linear cladding fixing shall be 300 mm ± 10 mm (see Figure J.2.1). In addition, this test may be carried out combined with the test according to clause K.1 provided that the test specimen includes the whole connexion (linear cladding fixing, subframe fixing (screw or rivet) and subframe profile). See the Figure K.1.3. In the combined test, the test result shall be considered as the result for both characteristics (clauses J.2 & K.1).

Punctual cladding fixings shall be tested at their actual size (see Figure J.2.2). In addition, this test may be carried out combined with the test according to clause J.3.2 provided that the test specimen in clause J.3.2 includes the actual fixing to the subframe (or substrate when the kit is fixed directly to the substrate).

The subframe fixing (number 2 in the figures below) shall be placed perpendicular to the cladding fixing (number 1 in the figures below) as described in Figures J.2.1 and J.2.2, and the force (F) shall be applied until failure.

Test specimen shall be clamped by a testing-tool (number 3 below) fastened to the testing machine support (number 4 below). The testing-tools shall be either supporting rollers with diameter (20 ± 5) mm or other kind of clamper where the part for the subframe fixing side shall be rounded part with diameter (20 ± 5) mm.

Test specimens shall be conditioned for at least 2 hours at (23 ± 2) °C before the test.

The apparatus shall consist of:

- A dynamometer,
- A test support as shown in the following figures, depending on the type of test indicated above, the importance of the test is that the profile/wood stud is supported on both sides of the subframe fixing.

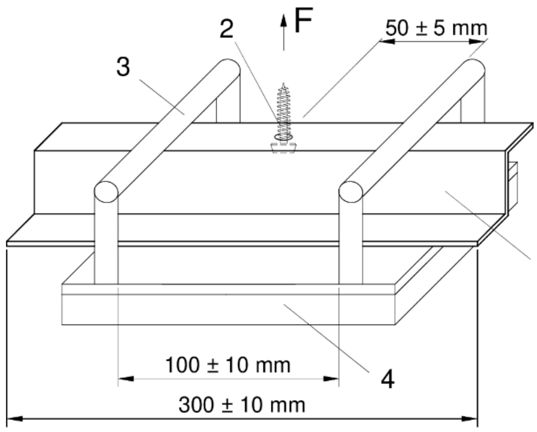


Figure J.2.1: Example of pull-through test for linear fixing.

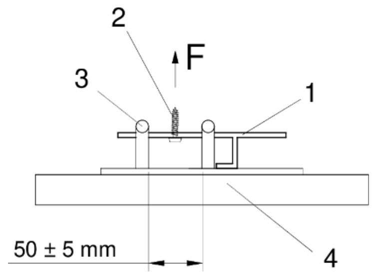


Figure J.2.2: Example of pull-through test for punctual fixing.

Legend:
1. Cladding fixing.
2. Subframe fixing.
3. Testing-tool.
4. Testing support.

The test shall be carried out using a tensioning speed of (20 ± 1) mm/min. When is observed that the test specimen behaviour is affected by this tensioning speed (e.g., there is not accurate force/displacement measurements, lower speeds, not less than (5 ± 0,5) mm/min, shall be considered.

Failure shall be defined by any one of the following events:

- Linear or punctual fixing breaks.
- Screw / rivet breaks.

Test report shall include at least:

- Type, material and geometry of the components (data based on the MPII).
- Each individual failure value, $F_{u,i}$ (expressed in N).
- The mode of failure description of the test specimen.
- The arithmetic average values, $F_{u,m}$ [in N], and the characteristic values, $F_{u,C}$ [in N], in accordance with equation (N.1).

J.3 - RESISTANCE OF PUNCTUAL CLADDING FIXING (for kits family C, F & H)

The purpose is to establish the mechanical resistance of punctual cladding fixings (e.g., small rails, clips, clamps, pins or other similar punctual cladding fixing).

J.3.1 - General test procedure

The horizontal load resistance and the vertical load resistance of the punctual cladding fixing shall be tested.

A minimum of five specimens for horizontal load resistance and other five specimens for vertical load resistance shall be tested.

The cladding fixing shall be installed according to the MPII.

The force shall be exerted at a rate of (5 ± 0,5) mm/min on the cladding fixing.

The test shall be performed in successive displacement steps measured under load conditions, until 1 mm permanent deformation occurs under unload conditions. Steps shall be defined according to displacement growths: steps of 0,25 mm, 0,5 mm, or 1,0 mm shall be selected depending on the behaviour of the cladding fixing under load. After each step, the cladding fixing shall be unloaded, and the permanent deformation shall be measured.

When 1 mm permanent deformation occurs, the test shall be continued until failure.

The displacements and forces shall be measured and reported in tabular or graphic form.

Test report shall include at least:

- Type, material and geometry of the cladding fixing (data based on the MPII).
- Each individual displacement and force value, $F_{1,i}$ (expressed in N), for 1 mm permanent deformation.
- Each individual failure value, $F_{u,i}$ (expressed in N), and the mode of failure description of the test specimen (breakage, significant permanent deformation, etc.).
- The displacements and forces shall be measured and reported in tabular or graphic form.
- The arithmetic average values, $F_{1,m}$, $F_{u,m}$, and the characteristic values, $F_{1,C}$, $F_{u,C}$, in accordance with equation (N.1).

J.3.2 - Horizontal load resistance (wind suction)

Test procedure is given in clause J.3.1.

The test specimen consists of one cladding fixing applied to a rigid substrate as shown in Figures J.3.2.1 and J.3.2.2.

The force shall be exerted to the complete flange of the cladding fixing, as shown in Figure J.3.2.1 and J.3.2.2. Force shall be applied perpendicular to the plane of the envisage cladding element. The figures show two specific geometries of punctual cladding fixing. For cladding fixings with different geometry, the same principle shall be followed.

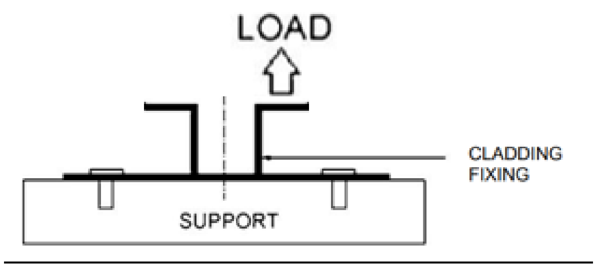


Figure J.3.2.1: Example of test lay-out for horizontal load resistance test for families C & F.

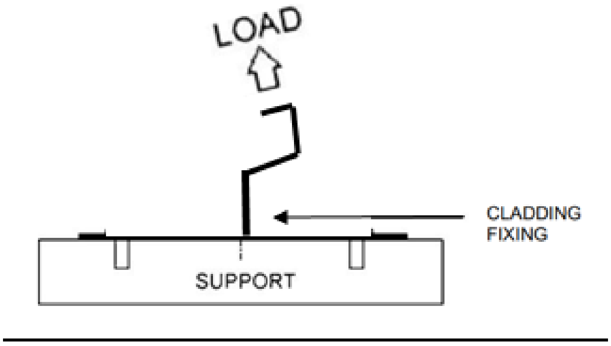


Figure J.3.2.2: Example of test lay-out for horizontal load resistance test for family H.

J.3.3 - Vertical load resistance (weight)

Test procedure is given in clause J.3.1.

The test specimen consists of one cladding fixing applied to a rigid substrate as shown in Figure J.3.3.1.

The application of the vertical load shall be representative of the way the load is transmitted from the cladding element to the cladding fixing. When necessary, the vertical load shall be applied via a test-tool (or mould) having the actual shape of cladding element connexion (e.g., a mould having the same groove geometry than the one of the cladding elements at the connexion point)

Figure J.3.3.1: Examples of test lay-out for vertical load resistance test.

ANNEX K: MECHANICAL RESISTANCE OF SUBFRAME FIXINGS

K.1 - TENSION / PULL-OUT RESISTANCE

A minimum of five specimens shall be tested.

The test specimens shall be mounted in accordance with the MPII.

Each test specimen shall be composed of one subframe profile/stud (number 1 in the figures below) and the subframe fixing (number 2 in the figures below) defined for its connexion with the cladding fixing.

The length of the subframe profile/stud shall be, at least (300 ± 10) mm (see Figures K.1.1 & K.1.2).

This test may be carried out combined with the test according to clause J.2 for linear cladding fixings provided that the test specimen includes the whole connexion (linear cladding fixing, subframe fixing (screw or rivet) and subframe profile). See the Figure K.1.3. In the combined test, the test result shall be considered as the result for both characteristics (clauses J.2 & K.1).

The subframe fixing (number 2 in the figures below) shall be placed perpendicular to the subframe profile/stud (number 1 in the figures below), and the force (F) shall be applied until failure.

Test specimen shall be clamped by a testing-tool (number 3 below) fastened to the testing machine support (number 4 below). The testing-tools shall be either supporting rollers with diameter (20 ± 5) mm or other kind of clamper where the part for the subframe fixing side shall be rounded part with diameter (20 ± 5) mm.

Test specimens shall be conditioned for at least 2 hours at (23 ± 2) °C before the test.

The test apparatus shall consist of:

- A dynamometer,

- A test support as shown in the examples below, depending on the type of test indicated above, the importance of the test is that the profile/wood stud is supported on both sides of the subframe fixing.

Legend for the Figures K.1.1 to K.1.3:

1. Subframe profile.
2. Subframe fixing.
3. Testing-tool.
4. Testing support.
5. Cladding fixing (for combined pull-out & pull-thorough test).

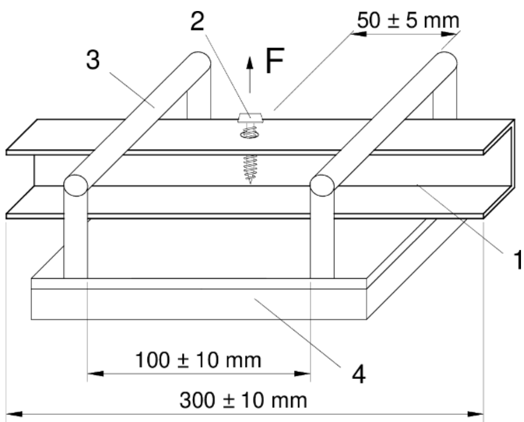


Figure K.1.1: Example of pull-out test on metal profile.

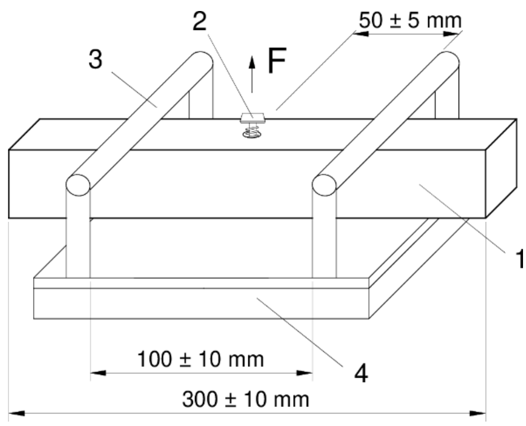


Figure K.1.2: Example of pull-out test on wood stud.

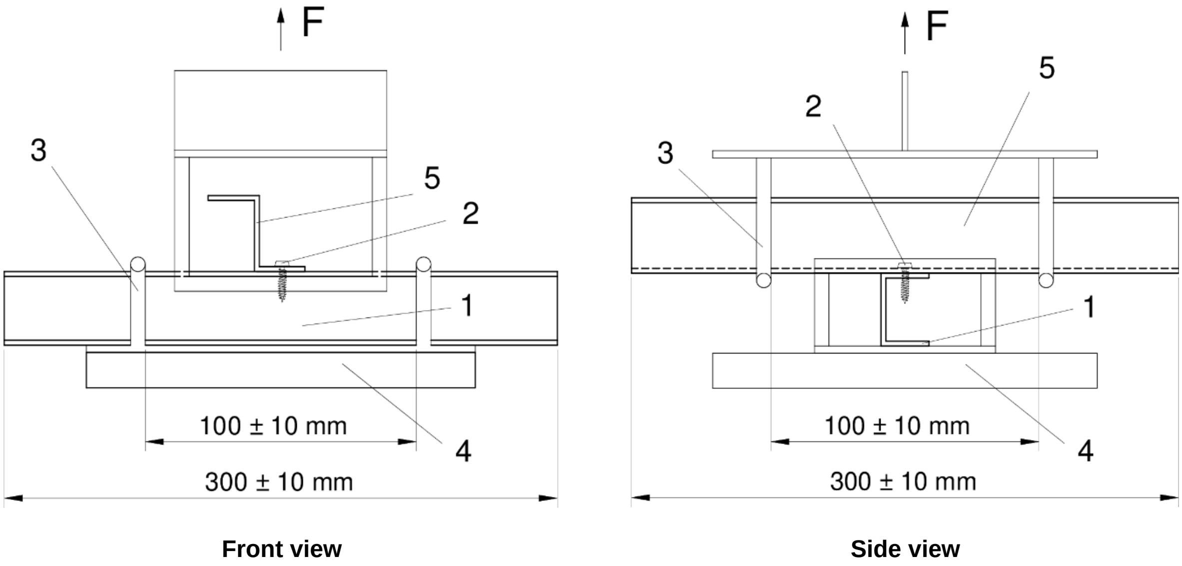


Figure K.1.3: Example of combined (pull-out & pull-through) test on metal profile.

The test shall be carried out using a tensioning speed of (20 ± 1) mm/min. When is observed that the test specimen behaviour is affected by this tensioning speed (e.g., there is not accurate force/displacement measurements, lower speeds, not less than (5 ± 0,5) mm/min, shall be considered.

Failure shall be defined by any one of the following events:

1. Profile/stud breaks.
2. Fixing breaks.

Test report shall include at least:

- Type, material and geometry of the components (profile/stud and fixings) (data based on the MPII).
- Each individual failure value, $F_{u,i}$ (expressed in N).
- The mode of failure description of the test specimen.
- The arithmetic average values, $F_{u,m}$, and the characteristic values, $F_{u,C}$, in accordance with equation (N.1).

K.2 - SHEAR LOAD RESISTANCE

A minimum of five specimens shall be tested.

The test specimens shall be mounted in accordance with the MPII.

Each test specimen shall be composed of two sheets or one stud and one sheet of the same materials and thickness than those of the subframe components to be connected and the fixing defined for this connexion.

The total dimension of the two overlapped sheets shall be (150 ± 10) mm x (50 ± 5) mm (see Figure K.2.1).

Dimension of the overlapped area of the sheets shall be (40 ± 5) mm (see Figure K.2.1).

The overlapped sheets shall be aligned (see lateral view in Figure K.2.1).

Test specimens shall be conditioned for at least 2 hours at (23 ± 2) °C before the test.

The test apparatus shall consist of:

- A dynamometer,
- A test support as shown in the Figure K.2.1.

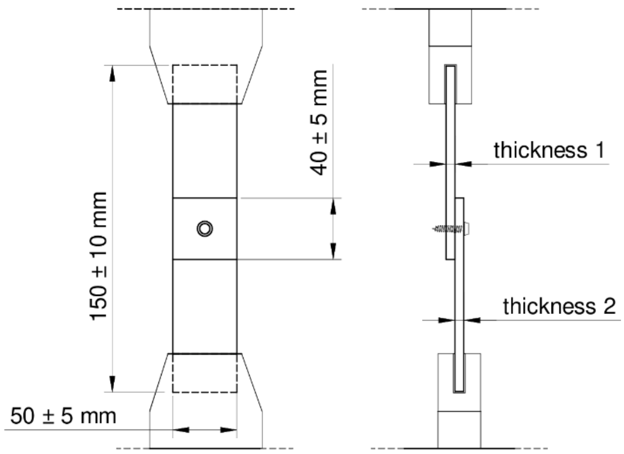


Figure K.2.1: Example of shear test.

The test shall be carried out using a tensioning speed of (20 ± 0,5) mm/min. When is observed that the test specimen behaviour is affected by this tensioning speed (e.g., there is not accurate force/displacement measurements, lower speeds, not less than (5 ± 0,5) mm/min, shall be considered.

The fixing shall be placed as described in Figure K.2.1, and the force shall be applied through the two sheets or through the timber stud and the sheet until failure.

Failure shall be defined by any one of the following events:

1. Metal sheet or timber stud breaks.
2. Fixing breaks.

Test report shall include at least:

- Type, material and geometry of the components (data based on the MPII).
- Each individual failure value, $F_{u,i}$ (expressed in N).
- The mode of failure description of the test specimen.
- The arithmetic average values, $F_{u,m}$, and the characteristic values, $F_{u,C}$, in accordance with equation (N.1).

ANNEX L: RESISTANCE OF BRACKETS (HORIZONTAL AND VERTICAL LOAD)

L.1 - GENERAL

The aim of the test is to determine the load bearing capacity and wind resistance of the brackets and their fixings to the subframe under shear and tension loads respectively.

Resistance of brackets shall be tested under:

- Vertical load (weight), see clause L.4.2.
- Horizontal load (wind), see clause L.4.3.

Test and measuring equipment shall be in accordance with clause L.2.

Test specimens shall be tested in accordance with clause L.3.

L.1.1 – Test series

One test series shall be carried with at least five test specimens (see clause L.4.1).

Brackets defined for a kit usually correspond with one material (steel or aluminium alloy) although it may include a rage of alloys (mechanical properties range), a rage of several shapes (different configurations and dimensions of holes or extra tongues for profile installation), several geometries (variations in the thickness, wing length (L_w), base length (B_b), and bracket height (H_b), e.g., see figure L.1.1.1) and if they include or not a thermo-stop pad in their base area.

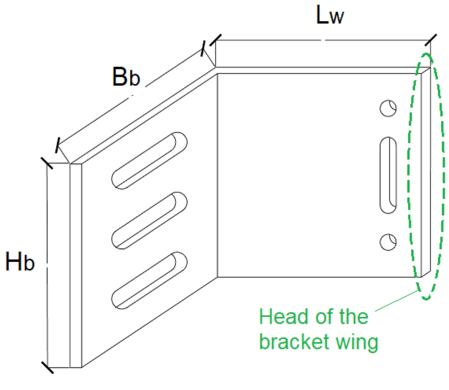


Figure L.1.1.1: Example of shape and geometry for a vertical subframe configuration bracket.

It is recommended to carry out the test series for each bracket (each material properties, each shape, each geometry, and with and without thermos-stop pad). However, for reducing the number of tests, the following criteria shall be considered for deciding the amount of test series for the assessment:

1. Each loading test (vertical and horizontal load) shall be assessed independently.
2. Brackets shall be grouped by considering the same shape (number and disposition of holes in both, the base, and the wing area) and the same base geometry (base length and bracket height). Therefore, the variations in one group shall be due to thickness range, wing length range, different materials mechanical properties and the thermo-stop pad use or not.
3. Each group shall be tested.
4. Within a group, the test series may be reduced considering the following options:

a. The worst case for each possible variation within a group, i.e., material alloy with minimum elastic limit, minimum thickness, and brackets with the greater wing length. In this option, test results obtained for the tested brackets shall be extended to the other bracket variations in this group.

b. The worst and the representative cases for each possible variation, i.e., material alloy with minimum, maximum and possible intermediate elastic limits, minimum, maximum and possible intermediate thicknesses, and maximum, minimum and intermediate wing lengths. In this option, test results obtained for the tested brackets shall be extended to the other bracket variations in this group with greater elastic limit alloys, greater thicknesses, and smaller wing lengths.

In addition, the influence of the thermo-stop pads in the mechanical resistance of the brackets shall be considered by carrying out indicative tests for deciding the worst case.

L.2 - TEST EQUIPMENT

The equipment is made of a traction-compression machine of class 1 in accordance with EN ISO 7500-1, minimum capacity of 10 kN, in the vertical axis, whose main elements are the following:

- A lower part allowing fixing of the brackets to the test equipment.
- An upper mobile part which shall be fixed to the tool-profile or actual profile in order to guarantee only a vertical displacement of this element.

These parts shall be placed in the same symmetry plane.

Additionally, a displacement measurement sensor shall be used according to the specifications given below.

The lower part of the support is made of a rigid substrate (e.g., a horizontal basis and a vertical perpendicular surface, see Figure L.4.2.1).

This substrate shall:

- be rigidly fixed on the lower tray of the machine,
- be rigid enough to allow the correct execution of the test.

Whenever the substrate is not made of steel, steel plates shall be used to provide a support surface under the brackets (minimum thickness 5 mm and with a surface area at least equal to the double of the surface of the bracket base, incorporating a hole of diameter equal to that of fixing).

The upper part consists of a traction-compression device appropriate to the cross-section of the profile.

The upper mobile part and the attached profile shall be vertically aligned with the substrate.

Displacements under loading and unloading (see Figure L.4.1.1) shall be taken equal to displacements of the mobile crosspiece (actuator), in addition, for obtaining a more accurate precision on the measurement points, sensors of displacement (with a minimum accuracy of 0,1 mm) shall be considered:

- either in the axis of the profile (where the load is applied),
- or on the head of the bracket wing (see Figure L.1.1.1). In this case, criteria values given in clauses L.4.2 shall be corrected by considering the distance between the axis of the load application (profile axis, see Figure L.4.1.2a) and the head of the bracket wing (see Figure L.1.1.1).

Measurements obtained from displacement sensors shall be the reference ones and displacement sensors shall be linked up with a graphic recorder allowing to draw the curve strength-displacement (see Figure L.4.1.1).

L.3 - MOUNTING PROVISIONS OF TEST SPECIMENS

L.3.1 - Fixings of brackets to substrate

Brackets shall be fixed to the substrate according to the following:

- Vertical load test shall be in accordance with Figure L.4.2.1 for vertical profile subframe configuration. In the case of horizontal profile subframe configuration, the brackets shall be positioned on the substrate according to their actual way for supporting vertical loads.
- Horizontal load test shall be in accordance with Figure L.4.3.1 for vertical profile subframe configuration. In the case of horizontal profile subframe configuration, the brackets shall be positioned on the substrate according to their actual way for supporting horizontal loads.
- The worst position of the fixings between the brackets and the profiles (the weakest composition) considering the intended use shall be tested.
- The type of anchor between the bracket and the substrate shall be chosen according to the type of substrate and the MPII. Whenever no fixings to substrate are given in the MPII, bolts of suitable diameter adapted to predrilling (Ø 6 mm minimum) by using washers shall be used.
- The fixing bolt (anchor) on the support shall be positioned in the oblong hole at the maximum specified distance from the profile.

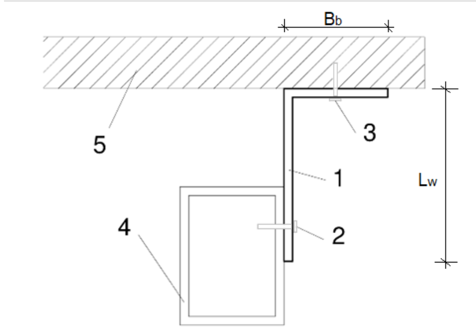
Note: The anchors (fixing between the bracket and the substrate) shall not represent a weak point of the test specimen.

L.3.2 - Brackets

Each test specimen shall consist of:

- For asymmetrical brackets that support the profile for one profile side (e.g., see Figure L.3.2.1 for vertical profile subframe configuration), there are two options:
    - Option 1: only one bracket mounted on one side of the profile. This configuration shall be considered for vertical load resistance test (see clause L.4.1) when the configuration of the bracket attachment on the substrate does not allow the rotation of the bracket while the vertical load is applied.
    - Option 2: two brackets mounted on both sides of the profile (positioned either opposite to each other, or subsequently each other depending on the profile type and the MPII). This configuration shall be considered for vertical load resistance test (see clause L.4.1) when the configuration of the bracket attachment on the substrate allows the rotation of the bracket while the vertical load is applied. E.g., when only one hole of the bracket base is used to include the anchor.
- For symmetrical brackets (bracket that support the profile for both profile sides, see Figure L.3.2.2), only one bracket shall be mounted on both sides of the profile.

Test specimen mounting and fixing shall be in accordance with the MPII.



Legend:
1. Bracket.
2. Fixing.
3. Anchor.
4. Profile.
5. Substrate.

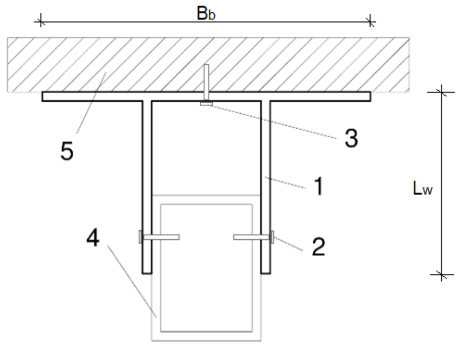


Figure L.3.2.1: Example of asymmetrical brackets.

Figure L.3.2.2: Example of symmetrical brackets.

L.3.3 - Fixings profile-bracket

Profile shall be fixed to brackets according to the following:

- The type of bracket fixing on the profile shall correspond to the fixing to be used in the assembled kit.
- Fixings shall be installed in accordance with the specifications of the manufacturer.
- The weakest configuration of brackets and its fixings. If the manufacturer allows that not all the holes available at bracket wing shall necessarily be filled by fixings, then the most adverse positions of the fixings shall be used.

L.3.4 - Profile

Whenever it is possible the actual profile defined for the kit shall be used in the test.

The metal profile can also be simulated by a square or rectangular section steel tube of 1,5 mm minimum thickness.

L.4 - TEST PROCEDURE (VERTICAL AND HORIZONTAL LOADS)

L.4.1 – General aspects applicable to both vertical and horizontal loading tests

A minimum of five specimens shall be tested.

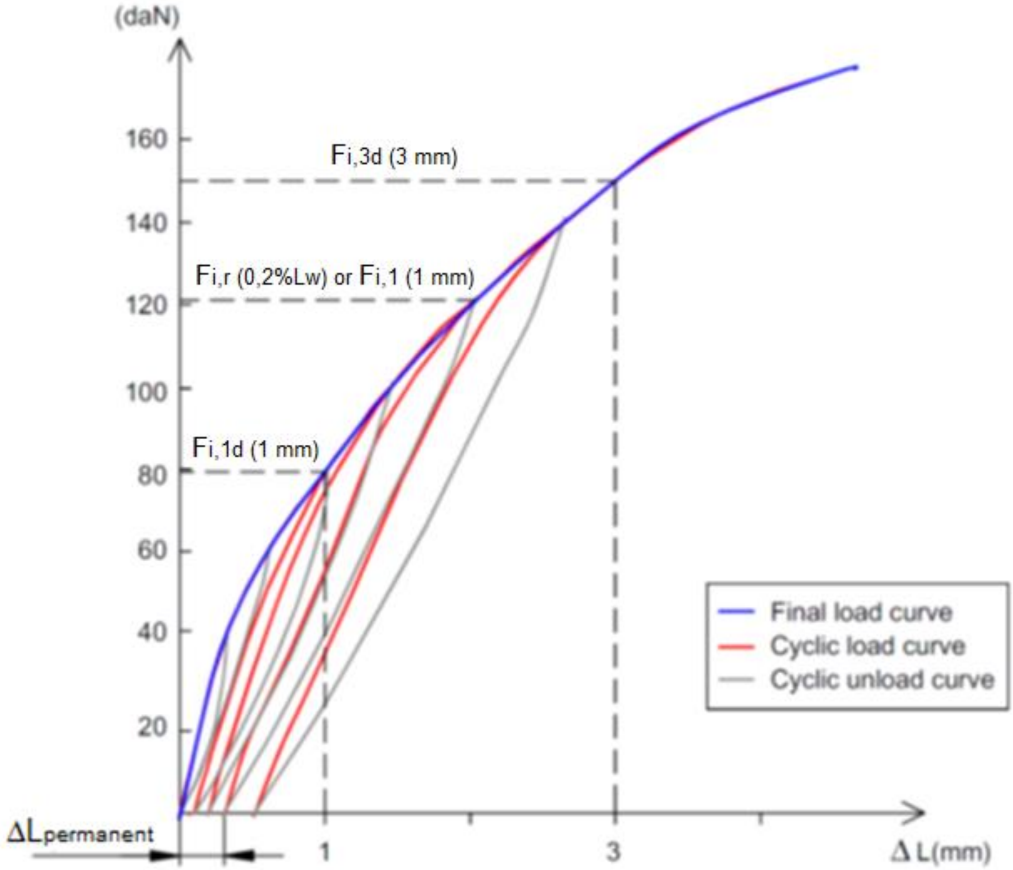
Brackets are subjected to a succession of cycles as defined hereinafter during the test. In each cycle a growing load is applied and then the specimen shall be unloading.

Figure L.4.1.1 shows an example of this loading-unloading test procedure for reaching the permanent deformation criteria points ($F_{i,r}$ in the case of vertical load and $F_{i,1}$ in the case of horizontal load).

Load shall be applied in constant speed (5 ± 0,5) mm/min on the profile in order to avoid a dynamic failure of the test specimen.

The measurement points for the test results shall be referred to the axis where the load is applied which shall be aligned with the fixings between the bracket and the profile (actual profile or testing tool-profile), see figures L.4.1.2. Criteria of measurements are defined in clauses L.4.2 and L.4.3.

Note: The term "displacement" refers to the measured distance at the measurement point during the application of the load. The term "permanent deformation" refers to the measured distance at the measurement point when recovering after the unloading (no loading applied).



$F_{i,r}$ (0,2%L_w) = applied load that causes a permanent deformation on the bracket in the loading direction measured at the measurement point (after unloading) equal to $\Delta L_{permanent}$ = 0,2 x L_w / 100 (for vertical load).

$F_{i,1}$ (1 mm) = applied load that causes a permanent deformation on the bracket in the loading direction measured at the measurement point (after unloading) equal to $\Delta L_{permanent}$ = 1 mm (for horizontal load).

$F_{i,1d}$ (1 mm) = applied load that cause a displacement of 1 mm measured at the measurement point under loading.

$F_{i,3d}$ (3 mm) = applied load that cause a displacement of 3 mm measured at the measurement point under loading.

Figure L.4.1.1: Example of strength-displacement loading-unloading steps for obtaining the permanent deformation.

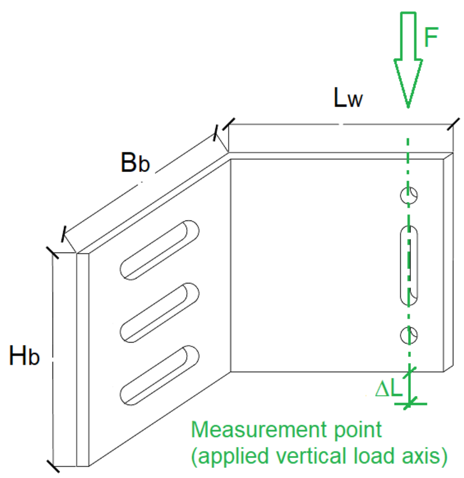


Figure L.4.1.2a: Example of measurement point for vertical load testing.

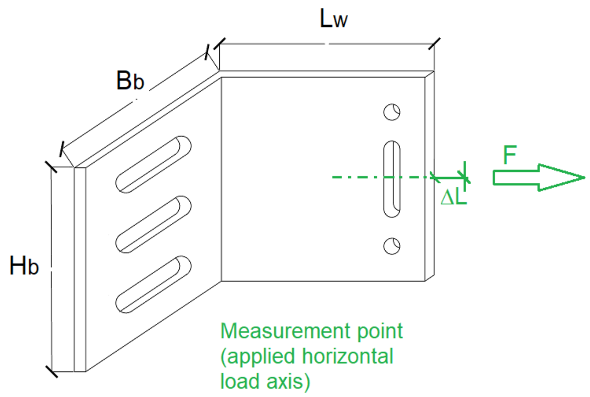


Figure L.4.1.2b: Example of measurement point for horizontal load testing.

The loading-unloading cycle succession (see Figure L.4.1.1) shall be defined according to displacement growths, it shall be carried out in steps of ΔL = 0,25 mm, 0,5 mm, or 1,0 mm depending on the expected behaviour of the bracket under loading (rigid or deformable).

In case of doubts on the step dimension to be applied, an indicative previous test may be carried out with one extra specimen for each vertical and horizontal loading. Lower step dimensions may be considered depending on the results of the indicative test (usually for deformable brackets). The load shall be applied in order to meet the condition: constant, speed of load (5 $\pm$ 0,5) mm/min.

Arithmetic average values $F_{r,m}$, $F_{1d,m}$, $F_{3d,m}$, $F_{u,m}$, [in N] and characteristic values $F_{r,C}$, $F_{1d,C}$, $F_{3d,C}$, $F_{u,C}$, [in N] shall be obtained for each test result series (see clauses L.4.2 and L.4.3) .

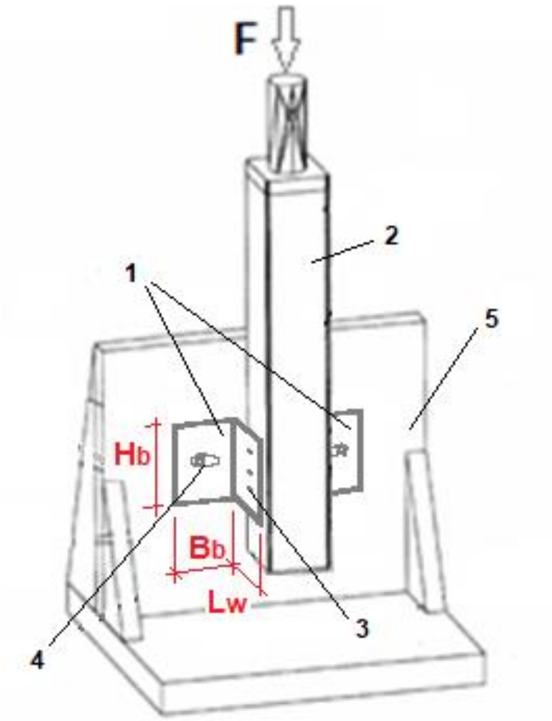
The characteristic values ($F_{r,C}$, $F_{1d,C}$, $F_{3d,C}$ and $F_{u,C}$) of the bracket is obtained according to equation (N.1).

L.4.2 – Vertical load resistance test

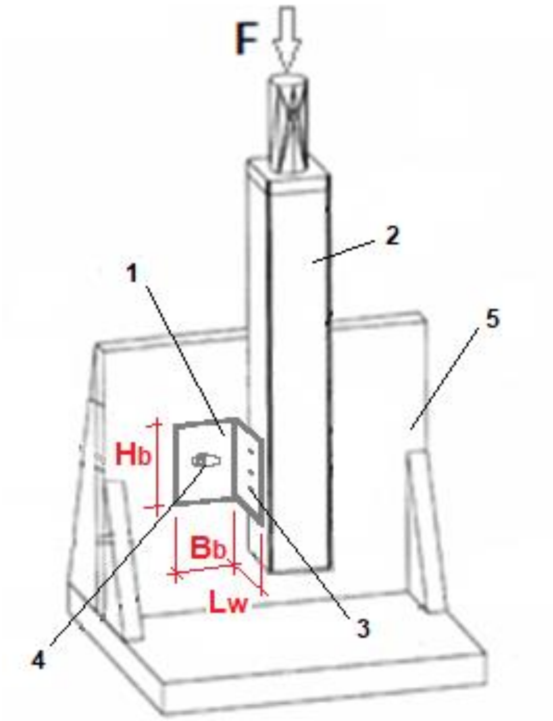
Test procedure is given in clause L.4.1.

Vertical load test shall be carried out considering the following:

- The test specimen shall be in accordance with clause L.3.
- The test procedure shall be carried out in accordance with clause L.4.1.
- Test results shall be in accordance with clause L.4.1.



Vertical profile subframe configuration for two asymmetrical brackets positioned opposite to each other or symmetrical bracket.



Vertical profile subframe configuration for one asymmetrical bracket.

Legend:	3. Fixing.	
1. Bracket.	4. Anchor.	L_w = bracket wing length.
2. Profile.	5. Substrate.	F = load.

Figure L.4.2.1: Vertical load test. Example of test device for vertical profile subframe configuration.

Following results shall be recorded during the tests:

<u>1st Criterion: $F_{i,r}$ load</u>

$F_{i,r}$ is the applied load that causes a permanent deformation on the bracket in the loading direction measured at the measurement point (after unloading) equal to $\Delta L_{permanent}$ = 0,2 x L_w / 100 where L_w is the length of the bracket wing perpendicular to the substrate.

Because the bracket behaviour may be different depending on the bracket type, there are three possibilities:

1) The value 0,2%·L_w permanent deformation is reached before 1 mm displacement.

2) The value 0,2%·L_w permanent deformation is reached between 1 mm and 3 mm displacement. Shown at the Figure L.4.1.1.

3) The value 0,2%·L_w permanent deformation is reached after 3 mm displacement.

In all these cases, the loading cycles shall be applied until the value 0,2%·L_w permanent deformation is reached.

<u>2nd Criterion: $F_{i,1d}$ and $F_{i,3d}$ loads</u>

$F_{i,1d}$ and $F_{i,3d}$ are the applied loads that cause a displacement under load of 1 and 3 mm respectively measured at the measurement point.

Note: Due to the fact that $F_{i,1d}$ and $F_{i,3d}$ are related to displacement values instead of permanent deformation values, it is possible that loads $F_{i,1d}$ and/or $F_{i,3d}$ can be attained before $F_{i,r}$ load is reached (see 1st Criterion: $F_{i,r}$ load).

<u>3rd Criterion: $F_{i,u}$ Load</u>

$F_{i,u}$ is the load that corresponds to the failure.

Failure is defined by any one of the following events:

1. Any bracket breaks.

2. Any bracket reaches the ultimate displacement defined in the MPII. When the MPII does not give such information, 10 mm of displacement shall be used.

3. Any fixing or anchor breaks.

L.4.3 - Horizontal load resistance test

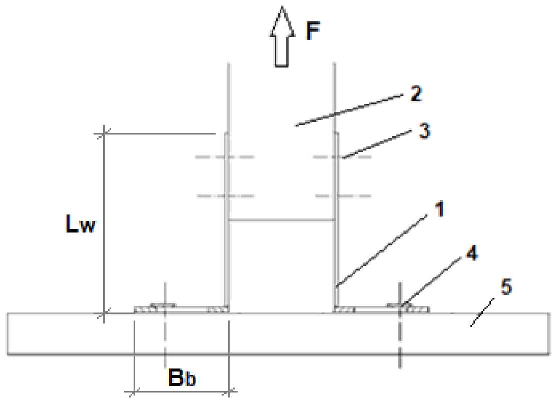
Test procedure is given in clause L.4.1.

Horizontal load test shall be carried out considering the following:

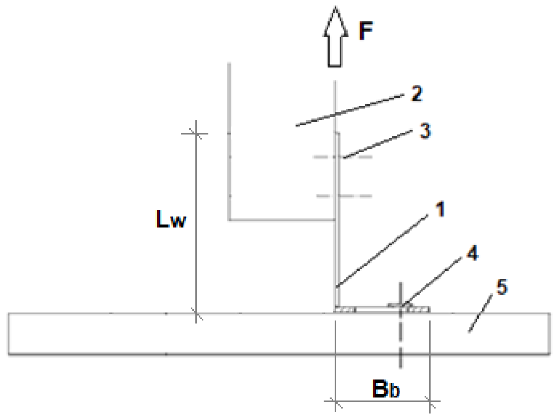
- The test specimen shall be in accordance with Figure L.4.3.1. Brackets are fixed to the horizontal substrate.

- The test shall be carried out in accordance with clause L.4.1.

- Test results shall be in accordance with clause L.4.1.



Configuration for two asymmetrical brackets or symmetrical brackets.



Configuration for one asymmetrical bracket.

Legend:

1. Bracket.	3. Fixing.	L_w = bracket wing length.
2. Profile.	4. Anchor.	F = load.
	5. Substrate.	

Figure L.4.3.1: Horizontal load test. Example of test device.

Following results shall be recorded during the tests:

1st Criterion: $F_{i,1}$ Load

$F_{i,1}$ is the applied load that causes a permanent deformation on the bracket in the loading direction measured at the measurement point (after unloading) equal to $\Delta L_{permanent}$ = 1 mm.

Because the bracket behaviour may be different depending on the bracket type, the value 1 mm permanent deformation may be obtained close or far over 1 mm displacement.

In all these cases, the loading cycles shall be applied until the value $\Delta L_{permanent}$ = 1 mm permanent deformation is reached.

2nd Criterion: $F_{i,u}$ Load

$F_{i,u}$ is the load that corresponds to the failure.

Failure is defined by any one of the following events:

1. Any bracket breaks.
2. Any bracket reaches the ultimate displacement defined in the MPII. When the MPII does not give such information, 10 mm of displacement shall be used..
3. Any fixing or anchor breaks.

L.5 - TEST REPORT

Test report shall include at least:

- Material and geometric characteristics of the brackets, including drawings of the brackets. Data based on the MPII.
- Description of the failure of the test specimens (break, ultimate displacement, failure of fixings).

- Figure including position and number of fixings between components and the axis in which the load is applied for each test group.
- The number of brackets corresponding to the test results, including a reference to the use of symmetrical or asymmetrical brackets. Whenever a test has been carried out by means of two symmetrical brackets, test results shall clearly refer to the corresponding configuration.
- The diagram strength-displacement as the Figure L.4.1.1 for each test specimen.
- Identification of anchors between the brackets and the substrate, and fixings between the brackets and the profile:
  - Description or generic type.
  - Dimensions (diameter, length, etc.), including the fixing head and integrated washer dimensions, if any.
  - Material.
  - Method used to connect with the substrate. E.g., passing screw with nuts, anchor inserted on the substrate, etc.
  - Washers and nuts (if they are used):
    - Description or generic type.
    - Dimensions (diameter, length, etc.)
    - Material.

L.6 - CRITERIA FOR THE VALIDATION OF THE CALCULATION

The validation shall be made in a way that the results of the calculation remain statically on the safe side.

Assessment of brackets may be carried out by calculations through a numerical structural analysis (FEM[10]) at elastic state provided that, for each group of bracket as it is defined in clause L.1.1, the values obtained by testing at each state criteria given in clauses L.4.2 and L.4.3 shall not be lower than the values obtained by calculation for the same composition at the same state criteria.

When these criteria are not met, the calculation method and/or model shall be corrected for meeting with these criteria (e.g., by using correcting factors or by changing the method and/or model). Otherwise, the values obtained by testing shall be considered.

No safety factors shall be used for the validation purposes.

The bracket model to be used for each calculation shall be precise with the tested bracket shape and dimensions, the restrictions boundary conditions due to the anchors, fixings and substrate, the bracket materials and the actual points of loading application and displacement measurements.

Once the calculation method is validated, it can be used for obtaining the performance of other bracket dimensions of the same shape.

ANNEX M: DURABILITY

M.1 - HYGROTHERMAL BEHAVIOUR TEST

M.1.1 - Principles related to the preparation of the specimen

The cladding kit shall be applied, in accordance with the MPII, to a rigid stabilised masonry or concrete substrate (cured minimum 28 days).

The installation details of the kit components, position of the joints between cladding elements, cladding fixings, etc. shall be checked and registered by the laboratory.

The dimension of the weather surface of the test wall depends on the test equipment although they shall always be:

- Surface: ≥ 6,00 m^2.
- Width: ≥ 2,50 m.
- Height ≥ 2,00 m.

M.1.2 - Hygrothermal cycles

The test apparatus is positioned against the front face of the specimen, 0,10 m to 0,30 m from the edges.

The specified temperatures during the cycles shall be measured at the surface of the specimen. The regulation shall be obtained by adjustment of the air temperature.

Heat - rain cycles:

The specimen shall be subjected to a series of 80 cycles (6 hours each cycle), comprising the following phases:

1. Heating to 70°C (rise for 1 hour) and maintaining at (70 ± 5) °C and 10% to 30% RH for 2 hours (total of 3 hours).
2. Spraying for 1 hour, water temperature (15 ± 5) °C, amount of water 1,0 l/m² min.
3. Leave for 2 hours (drainage).

Heat-cold cycles:

After at least 48 hours of subsequent conditioning at temperature (20 ± 10) °C and a minimum relative humidity of 50%, the same test specimen is exposed to 5 heat/cold cycles of 24 hours comprising the following phases:

1. Exposure to (50 ± 5) °C (rise for 1 hour) and maximum 30% RH for 7 hours (total of 8 hours).
2. Exposure to (- 20 ± 5) °C (fall for 2 hours) for 14 hours (total of 16 hours).

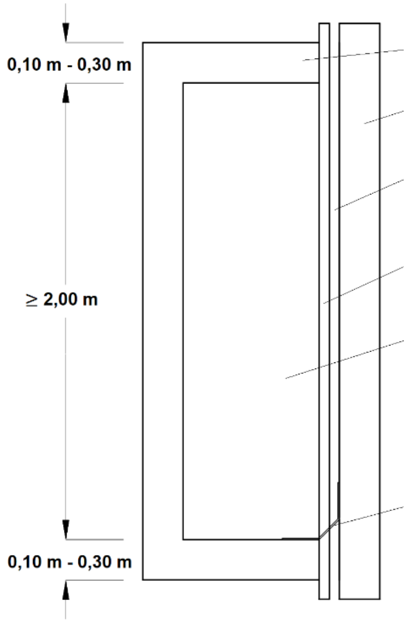
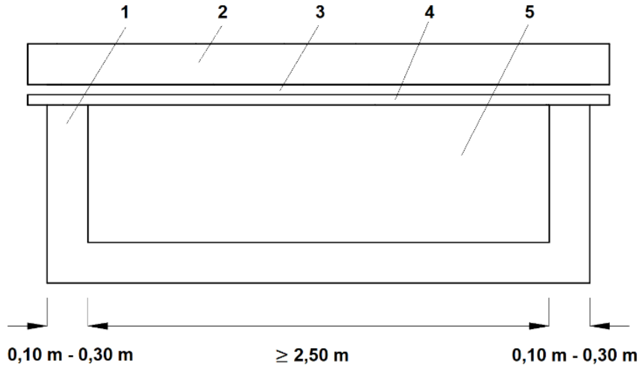


Figure M.1.2.1a: Schematic vertical cross-section of test specimen and test equipment.



Legend:

1. Test equipment chamber wall.
2. Substrate.
3. Air space.
4. Cladding kit.
5. Test equipment chamber interior.
6. Device or sheet for the drainability of the water than may penetrate in the air space.

Figure M.1.2.1b: Schematic horizontal cross-section of test specimen and test equipment.

M.1.3 - Observations during the tests

At periods of every four cycles during the heat/rain cycles and at every cycle during the heat/cold cycles, observations relating to a change in characteristics or performance (blistering, detachment, crazing, loss of adhesion, formation of cracks, etc.) are recorded as follows:

- the surface of the cladding element shall be examined to establish whether any cracking has occurred. The dimensions and position of any cracks shall be measured and recorded,
- the surface shall also be checked for any blistering or peeling, and the location and extension shall be recorded,
- the other specimen components shall be checked for any damage/degradation/corrosion together with any associated cracking of the cladding element. Again, the location and extension shall be recorded.

Following the completion of the test, a further investigation shall be conducted involving removal of sections containing cracks to observe any water penetration.

M.1.4 - Test report

The test report shall include at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
    - When applicable, brackets: material, geometry, distance between two brackets and number and disposition of fixings.
    - When applicable, profiles: material, geometry and distance between two profiles.
    - Cladding element: material, geometry and dimension of the joint between cladding elements.
    - Cladding fixing: material, geometry and number and disposition of fixings).

- Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
- Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

- Observations recorded during the test (see clause M.1.3).
- Photos to detail the damages occurred on each specimen after the cycles and, if necessary, after each visual inspection.

M.2 - PULSATING LOAD CYCLES

The cladding fixings shall be exposed to 10000 load cycles at a frequency not greater than 6 Hz (reference method). Optionally, the cladding fixings exposition shall be extended to 25000 and/or 50000 load cycles depending on whether the cladding kit is intended to be used in buildings highly exposed to wind loads.

The upper load F_{max} and the lower load F_{min} shall be chosen accordingly depending on the kit family. The following loads shall be considered:

- For kit family A, D & E: upper load F_{max} = 50% x $F_{u,C}$; lower load F_{min} = 20% x $F_{u,C}$ ($F_{u,C}$ = characteristic value of the pull-through resistance (see clause 2.2.12.5) determined according to equation (N.1)).
- For kit family B: upper load F_{max} = 50% x $F_{u,C}$; lower load F_{min} = 20% x $F_{u,C}$ ($F_{u,C}$ = characteristic value of the axial tension resistance (see clause 2.2.12.7) determined according to equation (N.1)).
- For kit family G: upper load F_{max} = 50% x $F_{u,C}$; lower load F_{min} = 20% x $F_{u,C}$ ($F_{u,C}$ = characteristic value of the resistance of slot (see clause 2.2.12.10) determined according to equation (N.1)).
- For kit family C, F (for punctual cladding fixings) & H: upper load F_{max} = 50% x $F_{1,C;}$ lower load F_{min} = 20% x $F_{1,C}$ ($F_{1,C}$ = characteristic value of the resistance of punctual cladding fixing (see clause 2.2.12.13) determined according to equation (N.1)).

During each cycle the load shall vary like a sine curve between F_{max} and F_{min}. The displacement shall be measured during the first loading up to F_{max} and either continuously or at least after 1, 10, 100, 1000 and 10000 load cycles (reference method). Optionally, also after 25000 and/or 50000 load cycles.

The load shall be applied according to the corresponding mechanical test to be applied depending on the kit family (clauses 2.2.12.5, 2.2.12.7, 2.2.12.10 or 2.2.12.13). Displacement is measured at the point where the load is applied.

After completion of the load cycles the specimen shall be unloaded, the permanent displacement measured, and the corresponding mechanical tests indicated in the points above shall be carried out.

Test report shall include at least:

- Information required for the test report according to the corresponding mechanical test to be applied depending on the kit family (clauses 2.2.12.5, 2.2.12.7, 2.2.12.10 or 2.2.12.13).
- Frequency applied in Hz.
- Results of displacement measured after 1, 10, 100, 1000 and 10000 cycles. Optionally, also after 25000 and/or 50000 load cycles.
- Test results shall be given according to the corresponding mechanical tests indicated in the points above.

M.3 - FREEZE-THAW CYCLES

The number of cycles required on the geographical zones where the kit is intended to be used. The following options shall be considered:

- Option 1: 25 freeze-thaw cycles, for cladding kits intended to be used where they may be subject heat, moisture and occasional frost, e.g., where they are either protected from or not subjected to severe weather conditions.

- Option 2 (reference method): 50 freeze-thaw cycles, for cladding kits intended to be used where they may be subject to heat, high moisture and severe frost.

The cladding element shall be subjected to freeze-thaw cycles according to clause 7.4.1.3 of EN 12467.

After completion of the freeze-thaw cycles the cladding element shall be submitted to bending strength test according to clause 2.2.12.1.

Additionally, depending on the kit family, the corresponding mechanical tests according to clauses 2.2.12.2, 2.2.12.3, 2.2.12.5, 2.2.12.7 and 2.2.12.10 shall also be carried out after the freeze-thaw cycles.

The total number and dimensions of test specimens to be submitted to freeze-thaw cycles depends on the bending strength tests (see clause 2.2.12.1) and the additional mechanical tests (clauses 2.2.12.2, 2.2.12.3, 2.2.12.5, 2.2.12.7 and 2.2.12.10) to be carried out after cycling.

The test results shall be given according to the corresponding mechanical tests.

M.4 – IMMERSION IN WATER CYCLES

The number of cycles required on the geographical zones where the kit is intended to be used. The following options shall be considered:

- Option 1: 25 water immersion-dry cycles, for cladding kits intended to be used where they may be subject heat, moisture and occasional frost, e.g., where they are either protected from or not subjected to severe weather conditions.

- Option 2 (reference method): 50 water immersion-dry cycles, for cladding kits intended to be used where they may be subject to heat, high moisture and severe frost.

The cladding element shall be subjected to water immersion-dry cycles according to clause 7.3.6.3 of EN 12467.

After completion of the water immersion-dry cycles the cladding element shall be submitted to bending strength test according to clause 2.2.12.1.

Additionally, depending on the kit family, the corresponding mechanical tests according to clauses 2.2.12.2, 2.2.12.3, 2.2.12.5, 2.2.12.7 and 2.2.12.10 shall also be carried out after the freeze-thaw cycles.

The total number and dimensions of test specimens to be submitted to water immersion-dry cycles depends on the bending strength tests (see clause 2.2.12.1) and the additional mechanical tests (clauses 2.2.12.2, 2.2.12.3, 2.2.12.5, 2.2.12.7 and 2.2.12.10) to be carried out after cycling.

The test results shall be given according to the corresponding mechanical tests.

ANNEX N: TEST RESULTS STATISTICAL DESCRIPTION

$F_{,C} = F_{,m} - k_n \cdot S$ (N.1)

Where:

$F_{,C}$ = the characteristic value giving 75 % confidence that 95 % of the test results will be greater than this value

$F_{,m}$ = the arithmetic average value of a testing series.

k_n = the variable as a function of the number of test specimens for 5 % (p = 0,95) with 75 % confidence level when the population standard deviation is unknown (see Table N.1).

S = the standard deviation of series under consideration.

Table N.1 The variable kn as a function of the number of test specimens (see EN 1990, Table D1, Vx, unknown).

Number of specimens	3	4	5	6	7	8	10	20	30	∞
Variable k_n	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64

ANNEX O: DURABILITY TESTS FOR THIN METALLIC COMPOSITE SHEETS/PANELS (TMCS/TMCP)

O.1 - FLEXURAL STIFFNESS AFTER SHORT TERM EXPOSURE TEST

O.1.1 - Preparation and conditioning of specimens and test procedure

A minimum of five specimens shall be tested for each conditioning: (20 ± 2) ºC and (80 ± 2) ºC.

Test specimens shall be identical to the ones used for the testing according to clause 2.2.4.1 of EAD 210046-00-1201. Dimensions: (400 ± 0,5) mm x (100 ± 0,5) mm x (at least, the minimum TMCS thickness).

Four-points bending (FPB) tests (Figure O.1.1.1) shall be carried out according to clause 2.2.4.1 of EAD 210046-00-1201 except:

- The load shall be a constant weight instead of an incremented load at uniform speed.
- The test shall be carried out placing the specimens in an adequate chamber for conditioning at (20 ± 2) ºC and (80 ± 2) ºC.

The visible part of the cladding element (TMCS) shall be positioned facing downwards.

The value of the constant weight (F_w) to be applied (e.g., by means a weight unit) shall be calculated according to equation (O.1.1.1) for reaching the elastic limit of the faced skin sheets of the cladding element (TMCS).

$F_{weight} = (\sigma_e * L_b * t) / L_s$ (O.1.1.1)

where:

F_{weight} = constant weight load to be applied (in N).

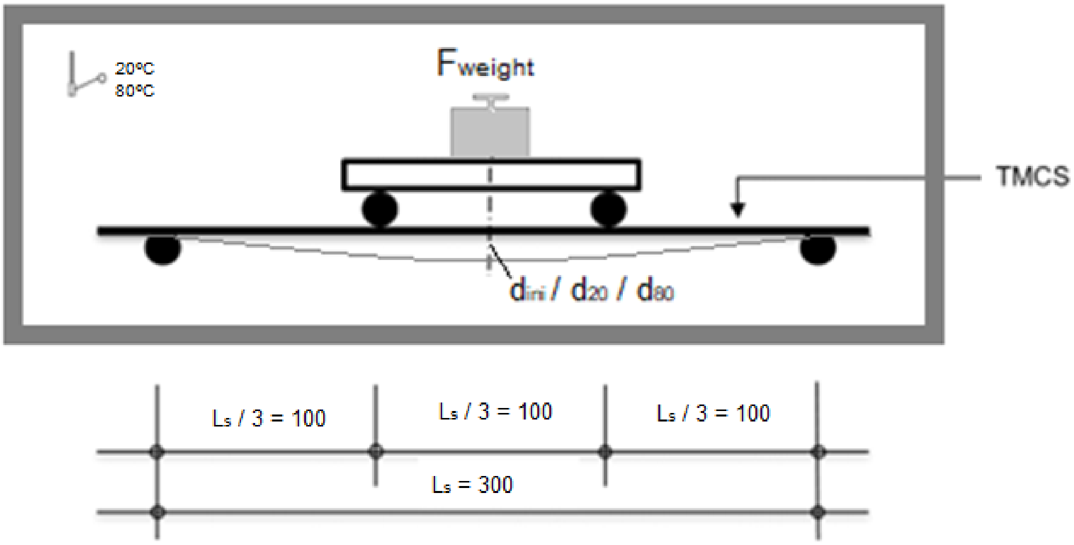
σ_e = elastic limit (in MPa) of the metal faced skin sheets (data based on the MPII).

L_s = span between the axis of supports (in mm).

L_b = width of the test specimen (100 ± 0,5) mm.

t = total thickness of TMCS (in mm).

The load (weight unit) shall be applied on the test specimen (see Figure O.1.1.1) once each one of the temperatures (20 ºC and 80 ºC) are reached. The initial displacement (d_{ini}) when the load is applied, and the displacement (d_{20} and d_{80}) after 1 hour submitted to these respective expositions (20 ºC and 80 ºC) shall be measured.



d_{ini} = initial displacement when the weight (F_{weight}) is applied.
d_{20} = displacement after one hour at (20 ± 2) °C.
d_{80} = displacement after one hour at (20 ± 2) °C.

Figure O.1.1.1: Scheme of flexural stiffness resistance test (dimensions in mm).

O.1.2 - Expression of the results

The report shall include at least:

- Description of the specimens: batch and date of manufacturing, type of cladding element (TMCP), total thickness and thickness of the metal faced skin sheets, elastic limit of the metal faced skin sheets.
- Applied weight load F_{weight} (in N).
- Average $d_{m\text{-}ini}$, $d_{m\text{-}20}$, $d_{m\text{-}80}$, [in mm] and characteristic values $d_{C\text{-}ini}$, $d_{C\text{-}20}$, $d_{C\text{-}80}$, [in mm] (see equation (N.1)) corresponding to initial conditions, after 1 hour at (20 ± 2) °C (d_{20}) and after 1 hour at (80 ± 2) ºC (d_{80}).
- Ratio or relative displacement change expressed in % obtained from the average values. Ratio = ($d_{m\text{-}20}$ / $d_{m\text{-}80}$) x 100.
- Description of any signs of degradation after visual inspection on each specimen after exposure and after testing.

O.2 - RESISTANCE OF ROUTED AND RETURNED EDGE OF TMCP AFTER TPB TEST, FLEXURAL PULSATING LOADS

This test only applies to TMCP in form of cassettes assembled by means of TMCS cut and folded.

O.2.1 - Preparation and conditioning of specimens

A set of 10 specimens per TMCS thickness, (5 per initial conditions and 5 per pulsating loads) with routed and returned edges on its shorter sides, and dimensions as defined in Figure O.2.1.1 shall be prepared.

The TMCP edges shall be prepared according to the MPIIfor cutting and folding the TMCS in an angle of 90º.

Specimens' folded edges shall be riveted to a testing rig made of rigid profiles (which may be also part of the cladding element or cladding fixing) fixed to testing frame.

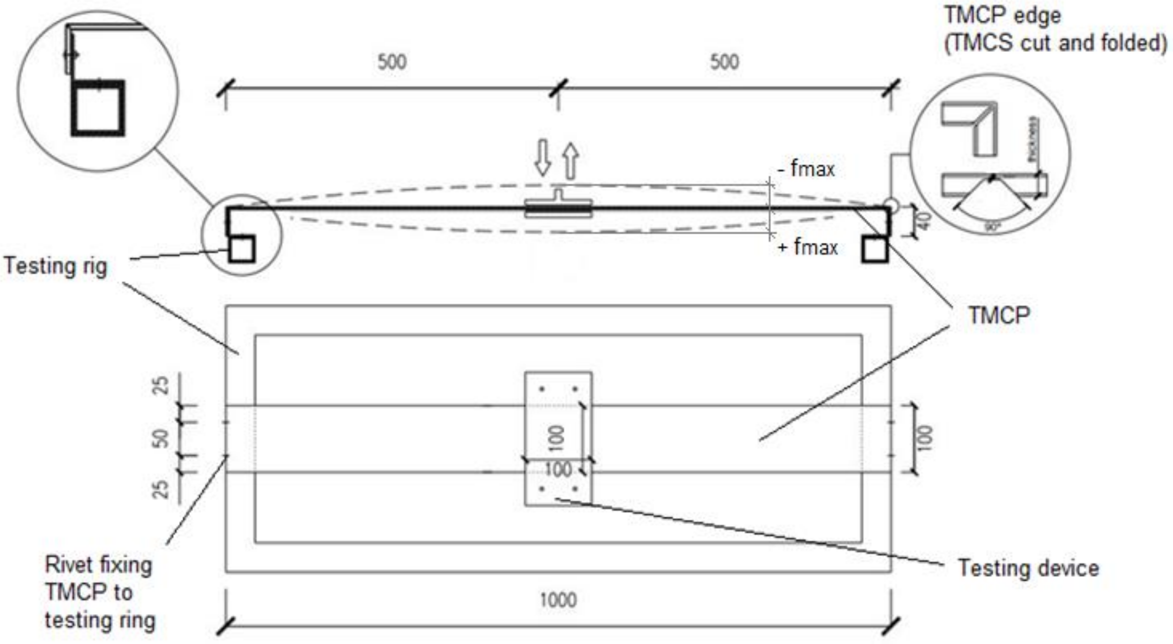


Figure O.2.1.1: Scheme of test (dimensions in mm).

O.2.2 - Testing procedure

Maximum displacement (f_{max}) of the TMCP shall be obtained from the MPII. When the MPII does not give such information, f_{max} = L/100 shall be used.

An initial three-points bending tests (TPB) shall be carried out under normal laboratory conditions. For this purpose, a universal testing device class 0.5, a displacement measurement device type LVDT (Linear Variable Differential Transformer) and an adequate clamping device shall be used, according to the Figure O.2.1.1. Specimens shall be placed with their external side facing upwards.

A reference load (F_{ref}) shall be applied under normal laboratory conditions at a speed rate of (5 ± 0,5) mm/min on the middle of span, until the maximum displacement (f_{max}) stated according to the MPII is reached.

Then, the test specimen shall be exposed to 10000 load cycles at a frequency not greater than 0,5 Hz (reference method). Optionally, the test specimen exposition shall be extended to 25000 and/or 50000 load cycles depending on whether the cladding kit is intended to be used in buildings highly exposed to wind loads.

The upper load F_{max} and the lower load F_{min} shall be chosen accordingly. In general, the following loads can be considered:

- Upper load F_{max} = (+ F_{ref}).
- Lower load F_{min} = (- F_{ref}).

During each cycle the load shall vary like a sine curve between F_{max} and F_{min}. The displacement shall be measured during the first loading up to F_{max} and either continuously or at least after 1, 10, 100, 1000 and 10000 load cycles. Optionally, also after 25000 and/or 50000 load cycles.

Displacement is measured at the point where the load is applied.

After completion of the load cycles the specimen shall be unloaded, the displacement measured, and the three-points bending tests (TPB) shall be carried out until TMCP breaking or excessive deformation (either in the panel's edges or in the middle of the span).

O.2.3 - Expression of results

The report shall include at least:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel (TMCP) and thickness of sheets (TMCS).
- Results of displacement measured after 1, 10, 100, 1000 and 10000 cycles. Optionally, also after 25000 and/or 50000 load cycles.
- Description of any signs of degradation after visual inspection on each specimen after exposure and/or testing. In particular, no cracks, delamination or breakage shall occur during exposure to cycles.
- Individual $F_{u,i}$ [N], mean $F_{u,m}$ [N] and characteristic $F_{u,C}$ [N] (see equation (N.1)) values of the final TPB force obtained.
- Load / displacement curves.
- Description of any signs of degradation after visual inspection on each specimen after testing.
- Frequency applied in Hz.

O.3 - RESISTANCE OF SLOT AND ITS CLADDING FIXING DEVICE AFTER PULSATING LOADS

O.3.1 - Preparation and conditioning of specimens

A minimum of five specimens shall be tested.

Test specimens shall be identical to the ones used for the testing according to clause I.4.

O.3.2 - Testing procedure

The test specimen shall be exposed to 10000 load cycles at a frequency not greater than 6 Hz (reference method). Optionally, the test specimen exposition shall be extended to 25000 and/or 50000 load cycles depending on whether the cladding kit is intended to be used in buildings highly exposed to wind loads.

The upper load F_{max} and the lower load F_{min} shall be chosen accordingly. In general, the following loads can be considered:

- Upper load F_{max} = 50% x $F_{u,C}$
- Lower load F_{min} = 20% x $F_{u,C}$

where: $F_{u,C}$ = characteristic value of the resistance of the slot (see clause I.4.1) determined according to equation (N.1).

During each cycle the load shall vary like a sine curve between F_{max} and F_{min}. The displacement shall be measured during the first loading up to F_{max} and either continuously or at least after 1, 10, 100, 1000 and 10000 load cycles. Optionally, also after 25000 and/or 50000 load cycles.

The load shall be applied according to the test procedure given in clause I.4.1. Displacement is measured at the point where the load is applied.

After completion of the load cycles the specimen shall be unloaded, the displacement measured, and the resistance of the slot test (according to clause I.4.1) shall be carried out.

O.3.3 - Expression of results

The report shall include at least:

- Information required for the test report according to the clause I.4.1.
- Results of displacement measured after 1, 10, 100, 1000 and 10000 cycles. Optionally, also after 25000 and/or 50000 load cycles.
- Description of any signs of degradation after visual inspection on each specimen after exposure and/or testing. In particular, no cracks, delamination or breakage shall occur during exposure to cycles.
- Individual $F_{u,i}$, mean $F_{u,m}$ and characteristic $F_{u,C}$ (see equation (N.1)) values of the resistance of the slot (expressed in N).
- Load/displacement curves.
- Frequency applied in Hz.

ANNEX P: ADDITIONAL PROVISIONS FOR DETERMINATION THE CHARACTERISTIC PROPENSITY TO UNDERGO CONTINUOUS SMOULDERING

This annex specifies the additional provisions for determination the characteristic *Propensity to undergo continuous smouldering* of kit components made of mineral wool, wood wool, cork, wood-based boards/panels, wood fibres, any other vegetable or animal fibres or phenolic foam.

P.1 - PROVISIONS FOR PRODUCTS MADE OF MINERAL WOOL[16]

P.1.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- the product variations of a product family (as defined by a certain combination of raw materials and other additives and produced in a certain production process)[17];
- the product or product variant with the highest organic content (in percentage per mass), determined according to EN 13820;
- the product or product variant with the highest density as well as a density of about 100 kg/m^3 (± 15%); if this range is lower than 115 kg/m^3, then only the product or product variant with the highest density (density determined in accordance with EN 1602);
- the product or product variant with the highest thickness. If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the backside to the maximum testable thickness of about 100 mm. (thickness determined in accordance with EN ISO 29466 on at least three specimens),
- each different produced fibre orientation, i.e., lengthwise and crosswise to the length direction of the specimen as well as perpendicular to the surface of the specimen front side;
- without any facings, coatings (or similar) – existing facings or coatings shall be removed when preparing the test specimens.

P.1.2 - Preparation of test specimen

The tests shall be done on free-hanging specimens without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions, and without any joints (see further).

If the product is only available in lengths lower than 800 mm, the test specimens shall be prepared by using two (or more) smaller pieces of the mineral wool, which shall put together with a butt joint. This joint shall be positioned in the highest possible distance to the bottom edge of the test specimens. Connexion of the pieces of the test specimens shall be carried out in such a manner that a permanent and close contact is ensured between both pieces at the joint for the entire testing and monitoring time.

16 For products made of mineral wool fibres and aerogel the same provisions shall apply as given in this clause P.1 for factory-made products made of mineral wool.

17 In order to permit the TAB to apply extended application rules for test results within the assessment, it is recommended that the manufacturer should provide (but he is not obliged to do so) sufficient information (e.g., on the basis of the composition of the products in question), allowing the TAB to determine which products or product variants should be submitted to testing and so to reduce the number of tests required..

P.1.3 - Extended application of test results

The test results considering the aforementioned parameters are also valid for products:

- of the same defined product-family,
- with lower organic content,
- with all lower densities,
- with lower thickness and also with greater thickness when 100 mm thick specimens were tested,
- with all fibre orientations,
- with any facings or coatings and
- for any end-use conditions.

P.2 - PROVISIONS FOR PRODUCTS MADE OF WOOD WOOL OR WOOD CHIPS

P.2.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

a) Homogeneous products

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., the type of wood, binder and additives, and produced in a certain production process)[17],
- the product or product variant with the highest organic content (in percentage per mass), determined according to EN 13820,
- the product or product variant with the highest density as well as the lowest density, determined by tests according to EN 1602,
- the product or product variant with the highest thickness or – if greater than 100 mm – highest testable thickness of 100 mm, determined according to EN ISO 29466 on at least three specimens,
- each different produced orientation of the wood wool / wood chips (i.e., lengthwise and crosswise to the length direction of the specimen),
- without any facings, coatings, or suchlike – existing facings or coatings shall be removed when preparing the test specimens

b) Non-homogeneous products (composite boards)

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., the type of wood, binder and additives, possible combinations of wood wool / wood chips and other possible layer materials, and produced in a certain production process),
- the product or product variant with the highest as well as lowest density of the wood wool / wood chip layer,
- the product or product variant with the highest thickness of the wood wool / wood chip layer,
- each different produced orientation of the wood wool / wood chips and the fibres of the second layer in case of materials made of mineral wool, wood fibres, cork or any other animal or vegetable fibres (i.e., lengthwise and crosswise to the length direction of the specimen),

- the product or product variant with the highest organic content (in percentage per mass), determined by tests according to EN 13820,
- the product or product variant with the highest as well as lowest density of the second layer material, in case of combination with material which may also show propensity to undergo continuous smouldering (wood fibre, cork or materials made of any other vegetable or animal fibres),
- the product or product variant with the highest density as well as a density of about 100 kg/m³ (± 15 %) of the second layer in case the material is made of mineral wool; if the highest density of the range is equal or lower than 115 kg/m³, then only the product or product variant with the highest density. The density shall be determined in accordance with EN 1602),
- the product or product variant with the highest density of the second layer material, in case of combination with any other products which do not show propensity to undergo continuous smouldering,
- the product or product variant with the highest thickness of the second layer material, in case of combination with material which may also show propensity to undergo continuous smouldering (wood fibre, cork, mineral wool or materials made of any other vegetable or animal fibres) or,
- the product or product variant with the lowest thickness of the second layer material, in case of combination with any other material which do not show propensity to undergo continuous smouldering.

P.2.2 - Preparation of tests specimens

The tests shall be done on specimens taken from 2-layer-composite boards (with one external wood wool / wood chip layer), which also cover 3-layer composite boards (with two external wood wool / wood chip layers).

In case of composite boards made of wood wool / wood chips and second layer material which may also show propensity to undergo continuous smouldering (wood fibre, cork, mineral wool or materials made of any other vegetable or animal fibres), both layers shall be exposed by the ignition source within the tests.

In case of composite boards made of wood wool / wood chips and any other second layer material, which do not show propensity to undergo continuous smouldering, only the wood wool / wood chip layer shall be exposed by the ignition source within the tests.

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.2.3 - Extended application of test results

The determined performance of the tested product shall be expressed in accordance with clause 11 of EN 16733. The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family (as defined by e.g., type of wood, binder and additives),
- with lower organic content of the wood wool / wood chip layer,
- with all densities of the wood wool / wood chip layers between those evaluated,
- with lower densities in case of mineral wool as second layer material or in case of layer material which do not show propensity to undergo continuous smouldering,
- with all densities between those evaluated in case of wood fibre, cork or any other materials made of vegetable or animal fibres as second layer,

- with lower thickness of the wood wool / wood chip layer as well as of the second layer and also with greater thickness of the layers when the layer thickness of the tested specimen was of about 100 mm,
- with all orientations of the wood wool / wood chips and the second layer material in case of materials made of mineral wool, wood fibre, cork or any other animal or vegetable fibres,
- with any facings or coatings or suchlike and
- for any end-use conditions.

P.3 - PROVISIONS FOR PRODUCTS MADE OF CORK

P.3.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of binder and additives etc., and produced in a certain production process)[17],
- the product or product variant with the highest and lowest density, determined by tests according to EN 1602,
- the product or product variant with the highest thickness, determined by tests according to EN ISO 29466 on at least three specimens,
- each different produced orientation, if relevant (i.e., lengthwise and crosswise to the length direction of the product),
- without any facings, coatings, or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

P.3.2 - Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.3.3 - Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with all densities between those evaluated,
- with lower thickness and also with greater thickness when 100 mm thick specimens were tested,
- with all orientations, if all relevant orientations (lengthwise and crosswise) had been tested,
- with any facings or coatings or suchlike and
- for any end-use conditions.

P.4 - PROVISIONS FOR WOOD-BASED BOARDS / PANELS

P.4.1 - Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw material, e.g., binder, additives, wood type of the wood shapes / wood fibres etc., and produced in a certain production process)[17];
- the product or product variant with the highest as well as the lowest density of the wood-based board / panel, determined by tests according to EN 323,
- the product or product variant with the highest thickness of the wood-based board / panel, determined by tests according to EN ISO 29466 on at least three specimens,
- each different produced shape / fibre orientation (i.e., lengthwise and crosswise to the length direction of the specimen);
- without any external non-substantial facings, coatings, or suchlike – existing external non-substantial facings or coatings shall be removed when preparing the test specimens.

P.4.2 - Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.4.3 - Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with all densities of wood-based boards / panels between those evaluated,
- with lower thickness of wood-based boards / panels and also with greater thickness when 100 mm thick specimens were tested,
- with all shape / fibre orientations, if all relevant orientations had been tested,
- with any external non-substantial facings or coatings or suchlike and
- for any end-use conditions.

Note: The aforementioned provisions refer to homogenous boards / panels or non-homogenous boards / panels only with external non-substantial layers. In case of composite products consisting of wood-based boards / panels and further substantial layers, the provisions given in clause P.2 shall be used as orientation for the development of appropriate provisions.

P.5 - PROVISIONS FOR PRODUCTS MADE OF WOOD FIBRE

P.5.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of binder and additives, and produced in a certain production process)[17],
- wood type of the wood fibres,
- type of production process,
- the product or product variant with the highest and lowest density, determined by tests according to EN 1602,
- the product or product variant with the highest thickness, determined by tests according to EN ISO 29466 on at least three specimens,
- each different produced fibre orientation (i.e., lengthwise and crosswise to the length direction of the product),
- without any facings, coatings, or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

P.5.2 - Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.5.3 - Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family (as defined by e.g., binder type and additives, wood type of the fibres, including the production process),
- with all densities between those evaluated,
- with lower thickness and also with greater thickness when 100 mm thick specimens were tested,
- with all fibre orientations, if all relevant orientations had been tested,
- with any facings or coatings or suchlike,
- for any end-use conditions.

P.6 - PROVISIONS FOR PRODUCTS MADE OF VEGETABLE OR ANIMAL FIBRE

P.6.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of fibres, type of binder and additives / treatment, and produced in a certain type of production process)[17];
- the product or product variant with the highest and lowest density, determined by tests according to EN 1602,
- the product or product variant with the highest thickness, determined by tests according to EN ISO 29466 on at least three specimens,
- each different produced fibre orientation (i.e., lengthwise and crosswise to the length direction of the specimen),
- without any facings, coatings, or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

P.6.2 - Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.6.3 - Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with all densities between those evaluated,
- with lower thickness and also with greater thickness when 100 mm thick specimens were tested,
- with all fibre orientations, if all relevant orientations had been tested,
- with any facings or coatings or suchlike and
- for any end-use conditions.

P.7 - PROVISIONS FOR PRODUCTS MADE OF PHENOLIC FOAM

P.7.1 - Sample input data

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of binder and additives / treatment, and produced in a certain type of production process)[17];
- the product or product variant with the highest and lowest density, determined by tests according to EN1602,
- the product or product variant with the highest thickness, determined by tests according to EN ISO 29466 on at least three specimens,
- each different produced orientation (i.e., lengthwise and crosswise to the length direction of the specimen),

- without any facings, coatings, or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

P.7.2 - Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions because propensity to undergo continuous smouldering is hardly affected by end-use conditions. If the clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

P.7.3 - Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with all densities between those evaluated,
- with lower thickness and also with greater thickness when 100 mm thick specimens were tested,
- with all orientations, if all relevant orientations had been tested,
- with any facings or coatings or suchlike and
- for any end-use conditions.

ANNEX Q: ASSESSMENT METHODS APPLIED IN EU/EFTA MEMBER STATES FOR ASSESSING THE FIRE PERFORMANCE OF FACADES

Country	Assessment method
Austria	ÖNORM B 3800-5
Belgium	• BS 8414-1 • BS 8414-2 • DIN 4102-20 • LEPIR 2
Czech Republic	ČSN ISO 13785-1
Denmark, Sweden, Norway	SP Fire 105
Finland	• SP Fire 105 • BS 8414
France	LEPIR 2
Germany	• DIN 4102-20 Complementary reaction-to-fire test for claddings of exterior walls, • Technical regulation A 2.2.1.5
Hungary	MSZ 14800-6:2020 Fire resistance tests. Part 6: Fire propagation test for building façades
Ireland	BS 8414 (BR 135)
Poland	PN-B-02867:2013
Switzerland, Liechtenstein	• DIN 4102-20 • ÖNorm B 3800-5 • Prüfbestimmung für Aussenwandbekleidungssysteme

ANNEX R: RESISTANCE TO SEISMIC LOADS

R.1 – GENERAL

The purpose of the methods presented herein is the assessment of the resistance to seismic loads of kits for external wall claddings mechanically fixed.

To complete the resistance to seismic loads assessment the following three properties shall be determined by means of dynamic and displacement tests:

- Out-of-plane fundamental vibration period, T_a, in [s]. See clause R.5.1.
- Out-of-plane acceleration relative to the representative damage states (DS1, DS2, DS3) defined in clause R.2, $a_{g,R,DS1,out}$, $a_{g,R,DS2,out}$, $a_{g,R,DS3,out}$, in [m/s^2]. See clause R.5.2.
- In-plane displacement relative to the representative damage states (DS1, DS2, DS3) defined in clause R.2, $\Delta d_{max,R,DS1,ip}$, $\Delta d_{max,R,DS2,ip}$, $\Delta d_{max,R,DS3,ip}$, in [%]. See clause R.6.1.

R.2 – DAMAGE STATES

For testing out-of-plane acceleration and in-plane displacement, three representative damage states (DS) have been defined for cladding kits.

These defined damage states intended to represent the seismic response of the assembled cladding kits to the out-of-plane accelerations and the in-plane displacements considered in the tests.

The level of the damage observed for the achievement of each damage state is defined for each component of the cladding kit, according to Table R.2.1. The damage state achieved by the cladding kit shall correspond to the most advanced damage state among the observed damage types.

If, due to facility limitations, a damage state is not attained during the test, the seismic performance parameter corresponding to that damage state is the maximum recorded during the test.

Table R.2.1 Damage scheme for external wall claddings mechanically fixed

Component of the assembled cladding kit	**Damage type**		
	DS1 – Minor damage state	**DS2 – Moderate damage state**	**DS3 – Major damage state**
Cladding elements	• Slight in-plane or out-of-plane cladding element rotation.	• Significant out-of-plane cladding elements rotations. • Minor cracks in cladding elements providing fall out of pieces with mass equal or less than 0,2 kg.	• Cladding elements overturning providing fall out of pieces with mass more than 0,2 kg.
Cladding fixings	• Failure of at least 10% of the total amount of cladding fixings.	• Failure of at least 30% of the total amount of cladding fixings	• Failure of at least 50% of the total amount of cladding fixings
Subframe components (vertical and/or horizontal profiles, brackets, screws, metal anchors)	• Minor plastic deformations of profiles. • Failure of at least 10% of total brackets, screws, and metal anchors.	• Moderate plastic deformations of profiles. • Failure of at least 30% of total brackets, screws, and metal anchors.	• Severe plastic deformations of profiles. • Failure of at least 50% of total brackets, screws, and metal anchors.

Table R.2.1 Damage scheme for external wall claddings mechanically fixed

Component of the assembled cladding kit	**Damage type**		
	DS1 – **Minor damage state**	**DS2 –** **Moderate damage state**	**DS3 –** **Major damage state**
Thermal insulation products	• No damage.	• Collapse of thermal insulation product with a mass equal or less than 0,2 kg.	• Collapse of thermal insulation product with a mass more than 0,2 kg.
Ancillary components (breather membrane, cavity barrier, joint-covers, gaskets, trims)	• No damage.	• Collapse of an ancillary component with a mass equal or less than 0,2 kg.	• Collapse of an ancillary component with a mass more than 0,2 kg.
DS1: Minor damage state achievement implies the need to slightly repair the assembled cladding kit to restore its original condition. . This damage state is equivalent to a lower level for DLS-damage limitation state stated in EN 1998-1 (Eurocode 8). **DS2:** Moderate damage state achievement implies that the assembled cladding kit is damaged so that it shall be partially replaced. This damage state is equivalent to a higher level DLS-damage limitation state stated in EN 1998-1 (Eurocode 8). **DS3:** Major damage state implies that the damage level is such that either the assembled cladding kit needs to be totally replaced or the life safety is not ensured. This damage state is equivalent to ULS-ultimate limit state stated in EN 1998-1 (Eurocode 8).			

R.3 – TEST SPECIMEN

At least two test specimens shall be assessed, according to Table R.3.1. The same specimen configurations shall be used for both out-of-plane (see clause R.5) and in-plane displacement (see clause R.6) tests.

The specimen shall fully reflect the assembled cladding kit including all necessary fittings and fixings, including joints according to the MPII. The specimen shall include all integral components which may have a detrimental effect on the seismic performance of the kit.

The dimensions of the test specimen depend on the size of the cladding element and on the specified cladding fixings. It is suggested to carry out tests on a 3 x 3 cladding elements specimen if the cladding element dimensions and the testing facility properties allow it. In general, an odd number of cladding elements shall be considered both in horizontal and vertical direction. For example, if the big cladding elements are tested, i.e., over 3 meters width or length, one panel in horizontal direction can be considered.

Table R.3.1 Definition of representative cases for seismic assessment

Kit component	**Case 1**	**Case 2**
Cladding element	Minimum thickness, maximum size	Maximum thickness, minimum size
Cladding fixing	Minimum density by cladding element	Maximum density by cladding element
Subframe profiles	Maximum span between profiles	Minimum span between profiles
Subframe brackets	Maximum span between brackets	Minimum span between brackets
Subframe fixings and anchors	Minimum density of subframe fixings	Maximum density of subframe fixings
Thermal insulation products	Minimum density of fixing by panel	Maximum density of fixing by panel

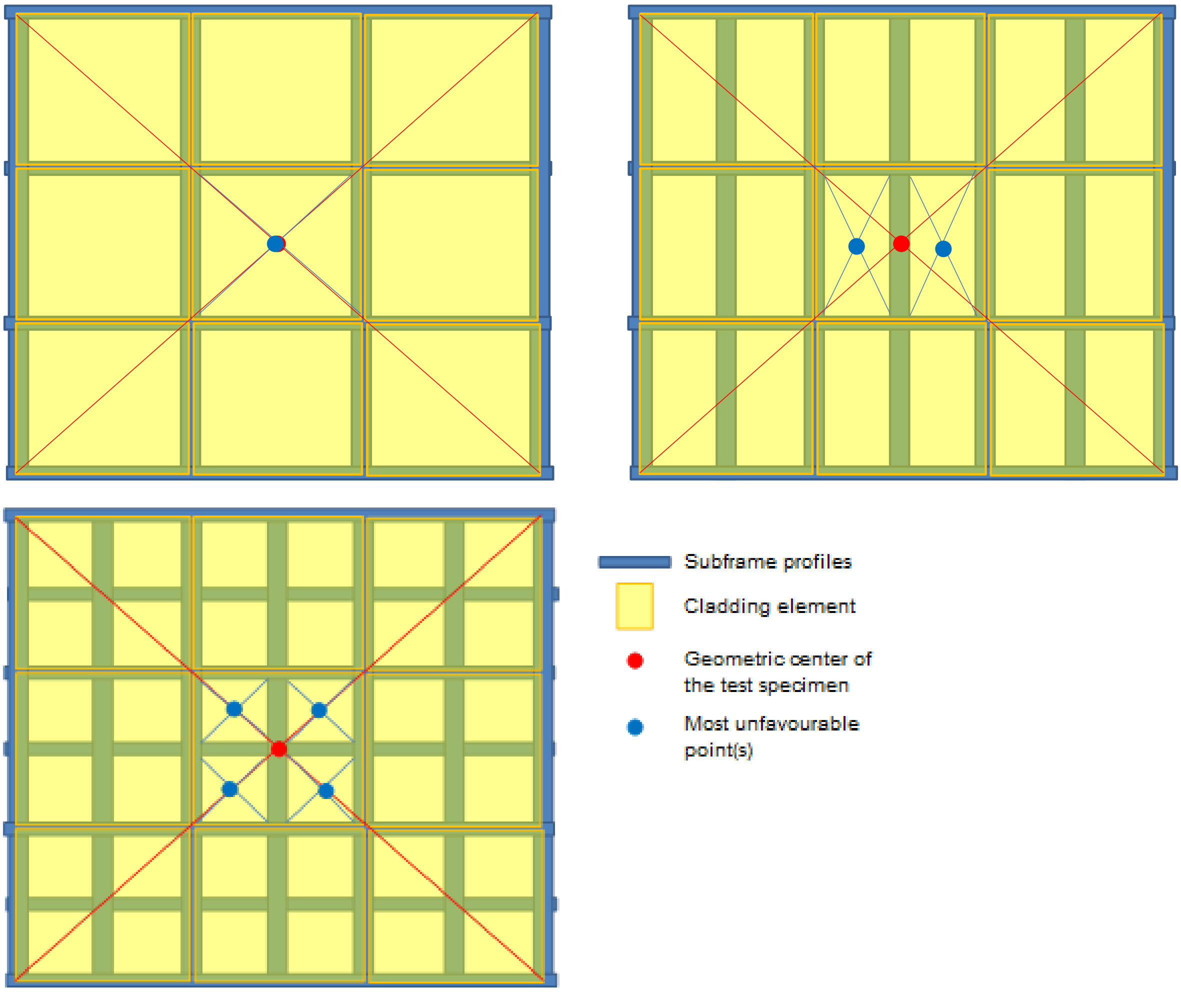


Figure R.3.1: Example for identification of the most unfavourable point(s) in which out-of-plane acceleration shall be recorded.

R.4 – TEST SETUP AND EQUIPMENT

Tests shall be carried out by using a test equipment capable to replicate both, dynamic (out-of-plane) and in-plane displacement, loading protocols with at least two degrees of freedom in the horizontal plane. The test equipment shall provide at least, one hydraulic actuator capable to move the assembly (e.g., movable beams in Figure R.4.1) supporting the cladding kit in the in-plane direction, i.e., in the plane of the panel, horizontally (see green arrow in Figure R.4.1a) and one hydraulic actuator capable to move the assembly supporting the cladding kit in the out-of-plane direction, i.e., in the direction perpendicular to panel plane (see blue arrow in Figure R.4.1a). Hydraulic actuators shall be commanded by a digital controller, where the control panel allows applying the desired displacement amplitudes, frequencies, displacement waveforms, and number of cycles.

A suitable test setup, i.e., intermediate elements between the test equipment and the cladding kit, representing the building part to which the cladding kit is fixed, shall be eventually designed to simulate real installation conditions of an assembled cladding kit including its connexion with the main structure, according to provision based on the MPII.

The test equipment presented in Figure R.4.1 is an example of a suitable test configuration. However, others test setups shall be accepted as long as they are able to reproduce the same conditions.

The monitoring system shall be constituted, as minimum, by:

- Displacement sensors (e.g., laser displacement transducers), located at the bottom and at the top of the specimen in order to monitor the in-plane and out-of-plane displacements of the cladding elements (see Figure R.4.2).

- Tri-axial accelerometers located at least in the most unfavourable point of the cladding element closest to the geometric centre of the assembled kit (see Figure R.4.2a), and at the bottom of the supporting structure (see Figure R.4.2b). The analysis of 3D accelerations may help to better understand the test results. For instance, unexpected vertical accelerations may help understand that the specimen is not properly fixed.

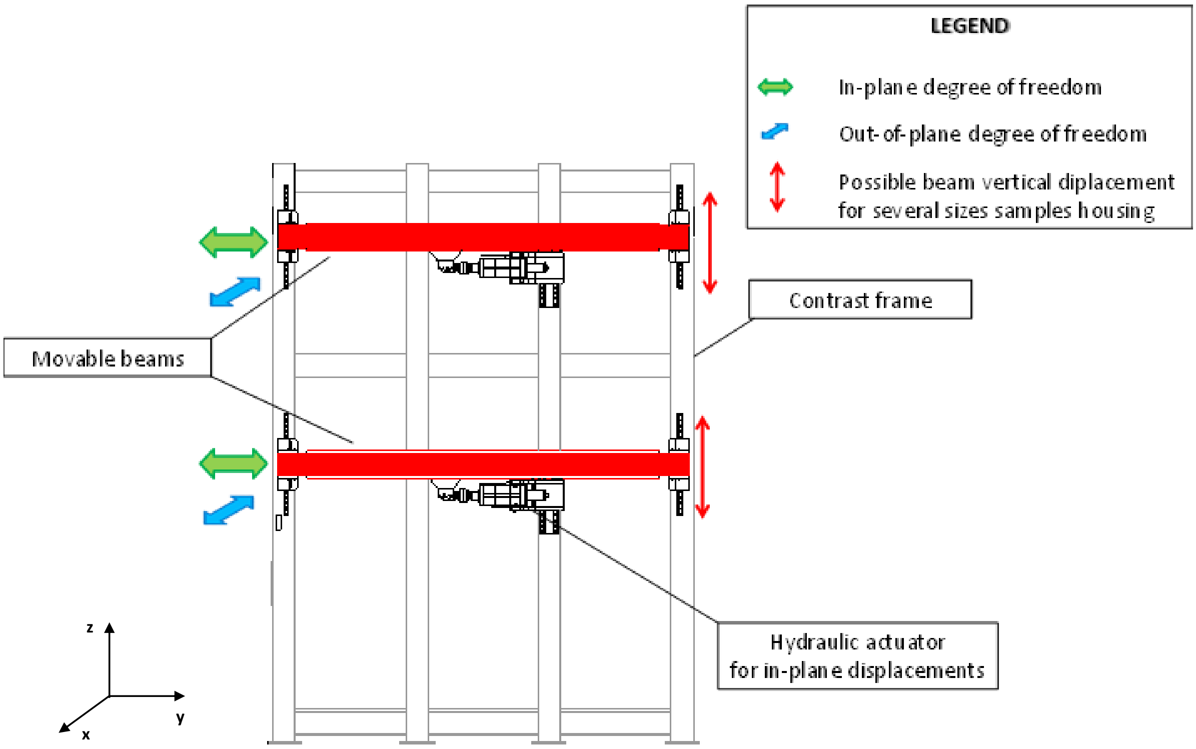


Figure R.4.1a: Example of test equipment for assembled cladding kits. Frontal view.

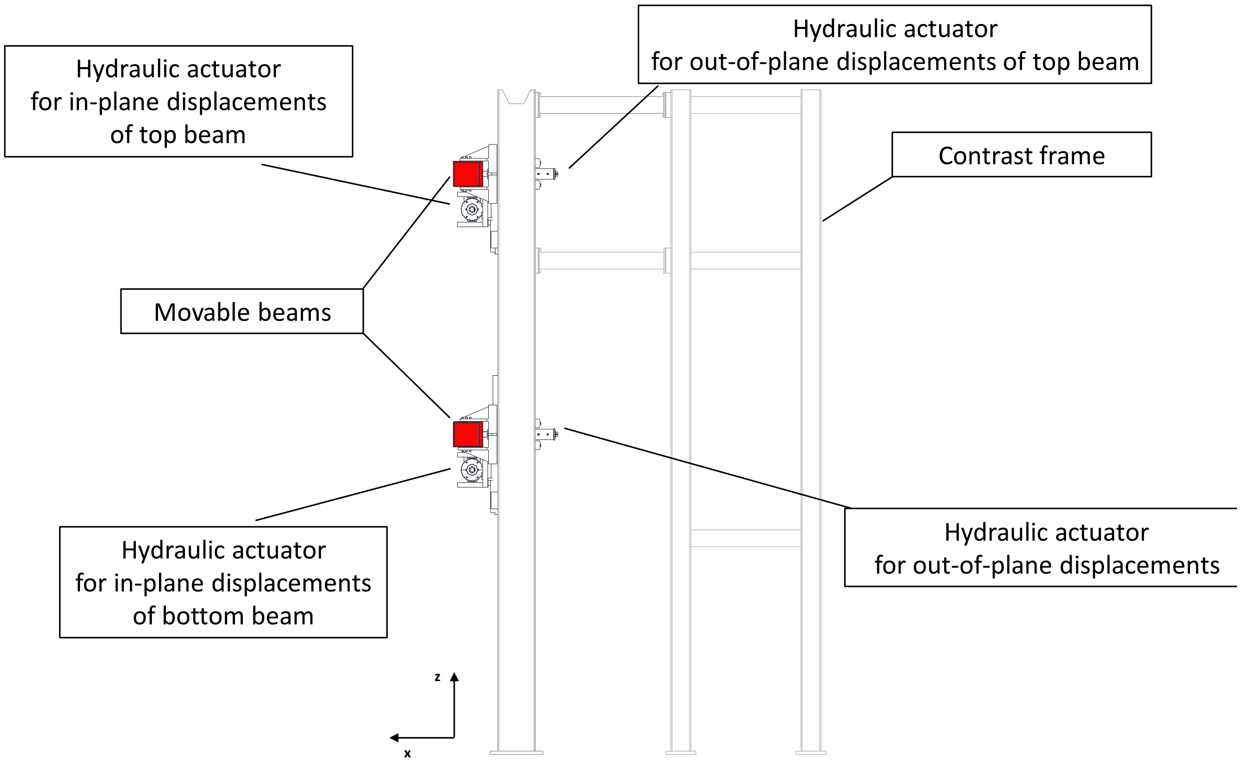


Figure R.4.1b: Example of test equipment for assembled cladding kits: Lateral view.

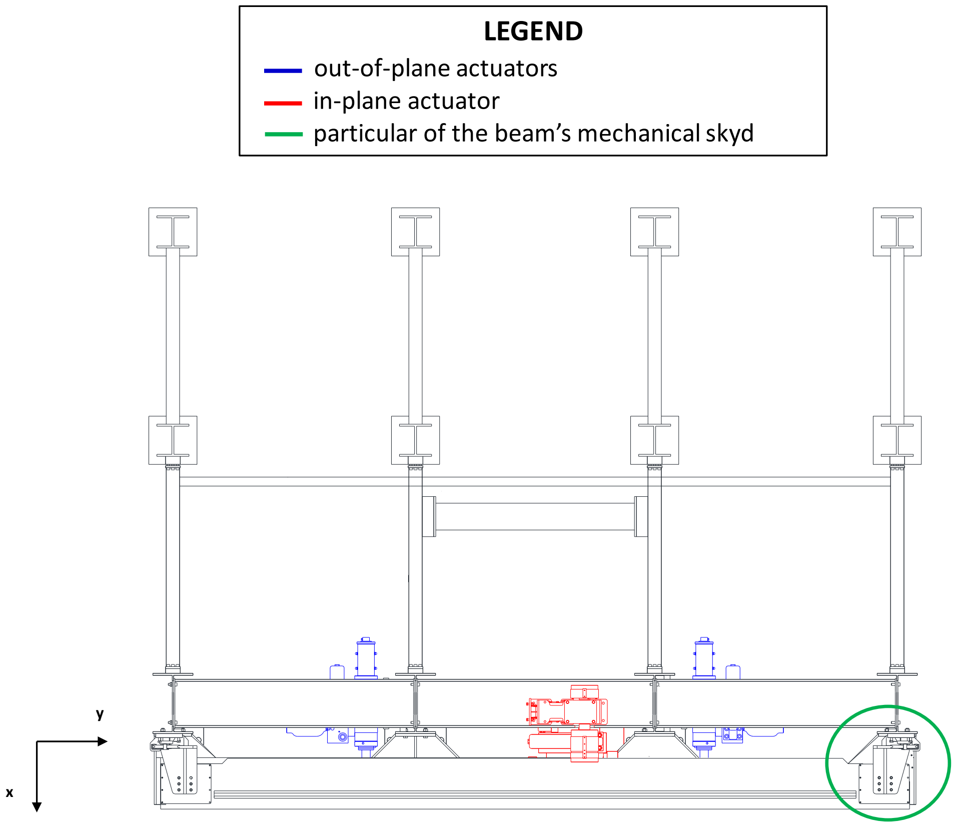
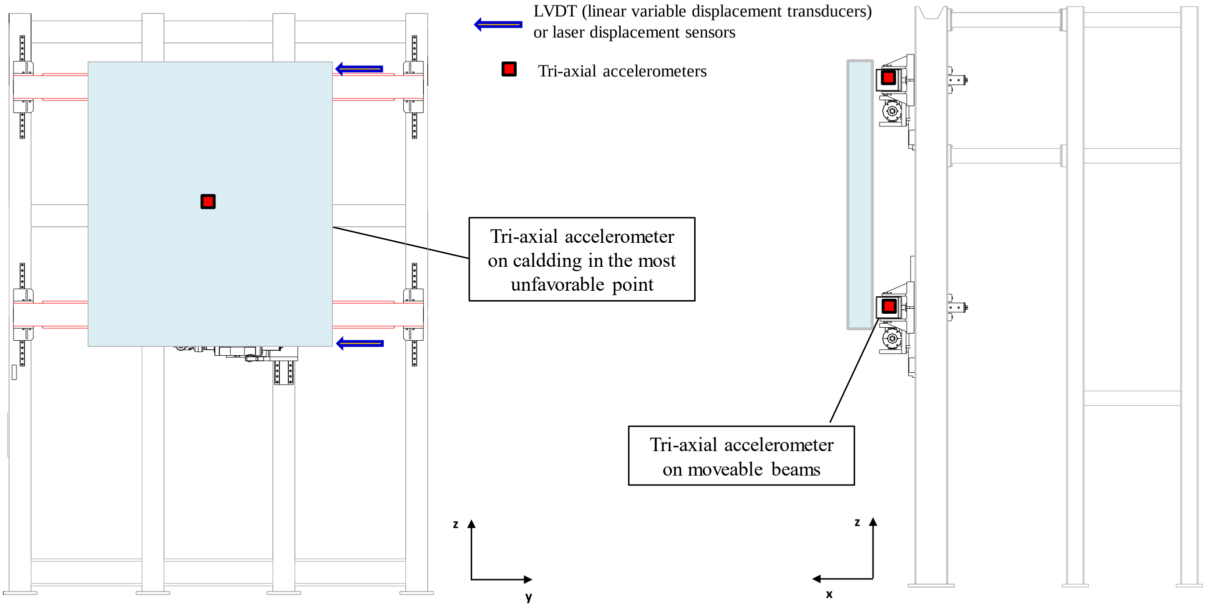


Figure R.4.1c: Example of test equipment for assembled cladding kits: Top view.



(a) **(b)**

Figure R.4.2: Example of monitoring system: (a) frontal and (b) lateral view.

R.5 – DYNAMIC TEST PROCEDURE

Dynamic tests shall be performed to assess both the fundamental vibration period, T_a, and the out-of-plane accelerations (x-direction) corresponding to the achievement of defined damage states. The same specimen shall be subjected to both tests since resonance-search tests (used for the vibration period assessment) shall be carried out in such a manner not to damage the specimen.

R.5.1 – Experimental procedure for out-of-plane fundamental vibration period assessment

The assessment of the fundamental vibration period of the assembled cladding kit shall be carried out by means of resonance-search tests. The resonance-search tests shall be performed applying a white noise signal to the out-of-plane (x-direction) of the test specimen. The peaks of x-direction acceleration of the signal shall be at most of (0,10 ± 0,05) g, in order to avoid damage in the kit components. In addition, the signal shall have an energy content ranging from 1 Hz to 20 Hz and a minimum duration of one minute.

The equipment needed is as follows:

1. Accelerometer “A” (see the Figure R.5.1.1) is monitoring input signal (white noise) in x-direction.

2. Accelerometer “B” (see the Figure R.5.1.1) is measuring response accelerations in sampling frequency of 100 Hz in x-direction.

Accelerometer “A” shall record one of the two accelerations listed below:

- The sub-structure acceleration, i.e., that of the intermediate elements between the test equipment and the cladding kit, in correspondence of the most unfavourable point of the specimen, if a sub-structure is used to connect the specimen to the movable beams.
- The bottom beam acceleration, if no sub-structure is used to connect the specimen to the movable beams.

One of the two above mentioned signal shall be considered as input signal (see bottom acceleration signal in Figure R.5.1.1).

Accelerometer “B” shall record continuously the specimen accelerations in out-of-plane x-direction (output acceleration in Figure R.5.1.1).

Both the records of accelerometers “A” and “B” are needed to compute the corresponding Fourier Transform Functions of input and output signals, the system transfer function.

The Transfer Function shall be assessed as the ratio between the Fourier Transform Functions related to the output and input signals, as previously defined (see Figure R.5.1.2). The natural frequency of the tested component, f_a, shall be defined as the frequency associated with the highest amplitude peak of the Transfer Function.

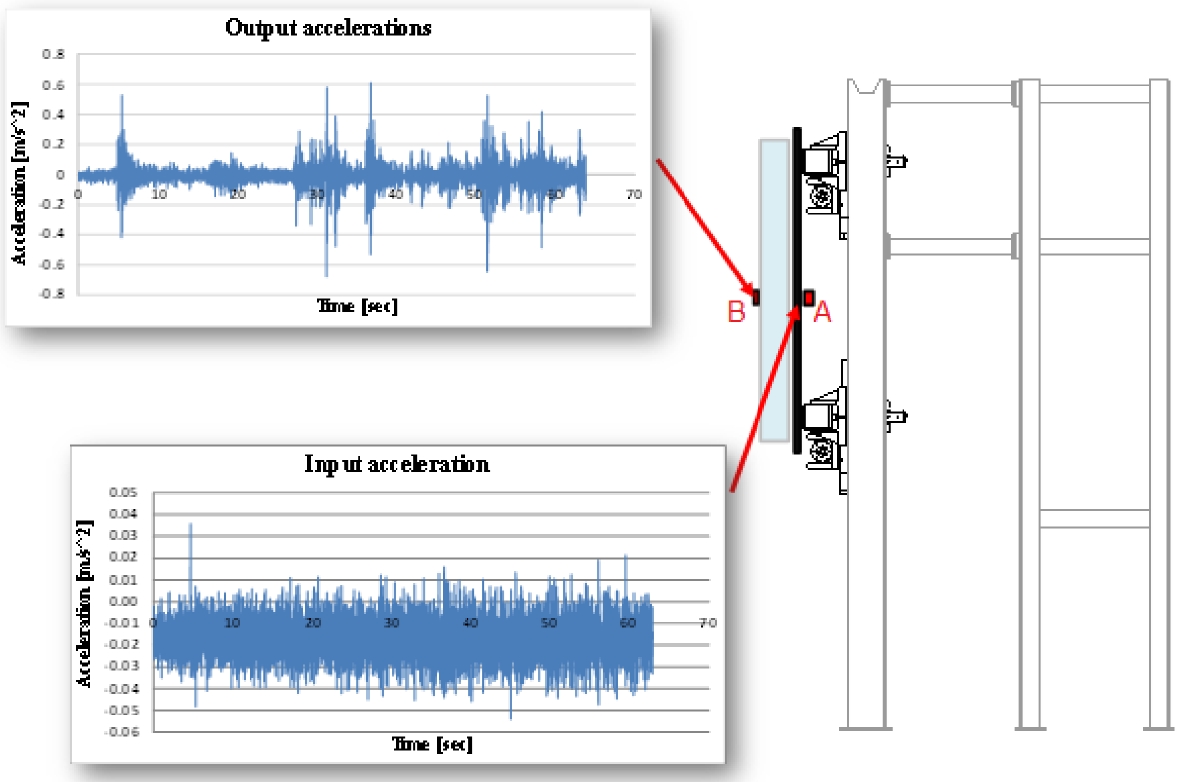


Figure R.5.1.1: Example of input acceleration signal recorded at the substructure level and output acceleration signals recorded on the specimen.

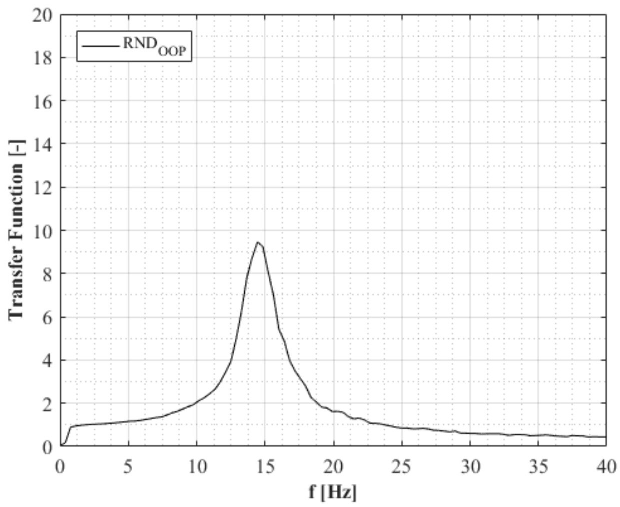


Figure R.5.1.2: Example of Fourier transfer function.

If the Fourier Transform Function shows more than one peak in a close-range (see example of Figure R.5.1.3), the frequency corresponding to the higher one can be selected as natural frequency of the cladding kit.

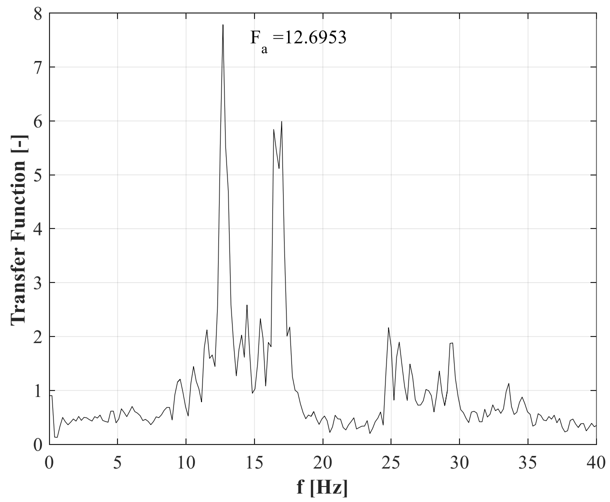


Figure R.5.1.3: Example of two peaks in a close-range.

It is worth noting that Fourier Transfer Function shows the resonances of all elements involved in test including the test machine. For instant, it is not rare to find a natural frequency of the test apparatus below 20 Hz, although it depends on the test machine. For this reason, it is strongly recommended to evaluate again the Transfer Function for the output signal when actuators are stopped, and the test specimen is moving in free vibrations. If a comparison between the results of free and forced vibrations shows a potential interference between natural frequencies of testing apparatus and specimen, the input signal should be filtered so as to attenuate resonance phenomena at the frequency of the testing machine.

The fundamental vibration period shall be obtained as:

$$T_a = \frac{1}{f_a} \quad [s] \qquad (R.5.1)$$

R.5.2 – Experimental procedure for out-of-plane acceleration assessment

Dynamic tests shall be performed by applying *artificial x-direction input acceleration time-histories*[18] with increasing intensity in the assembled cladding kit out-of-plane direction. The procedure is explained below.

Step 1. At first, the *input acceleration time-history* shall be obtained according to the procedure explained in clause R.5.2.1. The maximum acceleration value of the *input acceleration time history* is defined as $a_{x,max}$ (see Figure R.5.2.1).

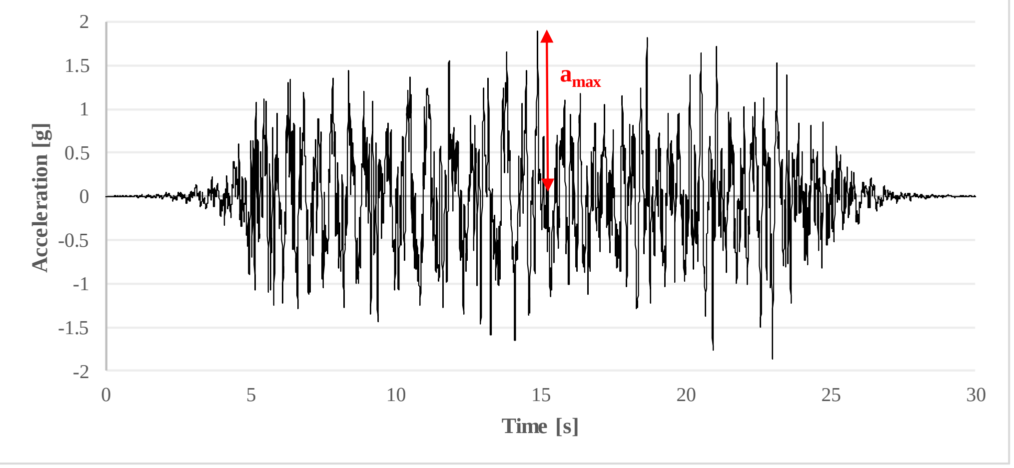


Figure R.5.2.1 Example of *input acceleration time-history*.

Step 2. The specimen and the corresponding equipment is installed on the testing apparatus.

Step 3. Several acceleration time-histories shall be obtained by linearly scaling down the input acceleration time-history of step 1, starting from 5%·$a_{x,max}$ up to 100% $a_{x,max}$, in 5% steps. Each acceleration time-history corresponds to a sub-step of the x-direction dynamic out-of-plane test (see Table R.5.2.1). If it is expected that accelerations lower than 5%·$a_{x,max}$ can affect the integrity of the component, lower initial accelerations can be considered. The test shall continue up to either the failure of the specimen or the attainment of the test facility limits.

Table R.5.2.1 Definition of the dynamic test sub-steps

Step of the dynamic test [-]	Maximum applied acceleration [m/s²]
3.1	0,05 · a_{max}
3.2	0,10 · a_{max}
3.3	0,15 · a_{max}
3.4	0,20 · a_{max}
…	…
3.i	0,05 · i · a_{max}
…	…
3.n	1,00 · a_{max}

18 Artificial acceleration time-histories are accelerograms numerically generated and iteratively modified in order to have input signals whose response spectrum is compatible, with a given tolerance, with a target spectrum.

During each sub-step of the test, the corresponding acceleration time-histories shall be applied simultaneously at the bottom and at the top beam of the test equipment in the specimen out-of-plane x-direction and damage of each component of the assembled cladding kit, eventually occurred, shall be recorded by filling out a damage scheme.

At the end of the i-th sub-step the test equipment shall be stopped and the specimen shall be observed for further damage identification.

The level of the damage recorded in each sub-step shall be compared with Table R.5.2.1 in order to identify the achievement of one of the three damage states. The damage state achieved by the cladding kit shall correspond to the most advanced damage state among the damage types observed.

The maximum value of the acceleration time-history applied during the step corresponding to the achievement of a damage state, will represent the x-direction out-of-plane acceleration, $a_{g,R,DSi,out}$ (with i = 1, 2 or 3) for that specimen.

If, due to facility limitations, a damage state is not attained during the test, the seismic performance parameter corresponding to that damage state is the maximum recorded during the test.

R.5.2.1 - Procedure for the selection of the input acceleration time-history

In order to define the input acceleration time history, it is necessary to firstly define a Reference Response Spectrum (herein after RRS).

The RRS can be assumed equal to a simplified version of the spectral acceleration formulas reported in clause 4.3.5 of EN 1998-1 (Eurocode 8), as defined in equation (R.5.2.1.1) in time domain or in equation (R.5.2.1.2) in frequency domain.

(R.5.2.1.1):

$$\begin{cases} \dfrac{S_a}{(\alpha \cdot S)} = \left[\dfrac{10}{1+4\left(1-\dfrac{T_a}{T_0}\right)^2}\right] & T_a < T_0 \\ \dfrac{S_a}{(\alpha \cdot S)} = 10 & T_0 \le T_a < T_1 \\ \dfrac{S_a}{(\alpha \cdot S)} = 8 + \dfrac{2}{(T_1 - T_2)}(T_a - T_2) & T_a \ge T_1 \end{cases}$$

Where:

- S_a is spectral acceleration used to calculate the horizontal equivalent static force to be applied to the non-structural elements.
- α is the ratio between the reference peak ground acceleration on stiff soil for the considered limit state and the acceleration of gravity.
- S is the soil amplification factor.
- T_a is the fundamental vibration period of the non-structural elements.
- T_0 is the starting period of the RRS and is equal to 0,08·s.
- T_1 is the period corresponding to the beginning of the constant acceleration branch of RRS and is equal to 0,714 s.
- T_2 is the period corresponding to the last descending brunch of RRS and is equal to 1,33 s.

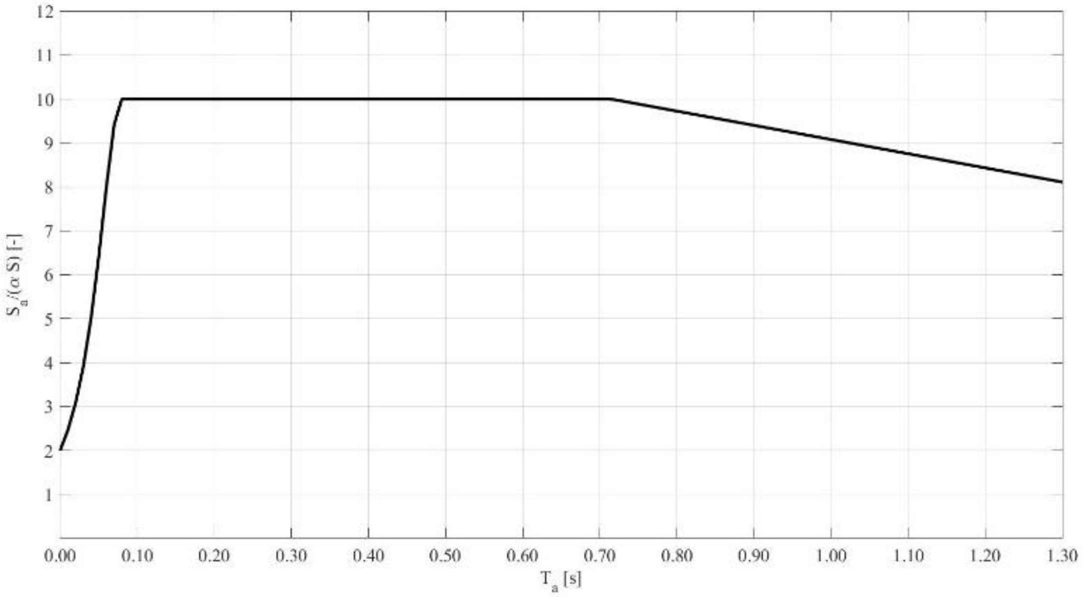


Figure R.5.2.1.1: Reference response spectrum (RRS), 5% damping. In time domain.

(R.5.2.1.2):

$$\begin{cases} \dfrac{S_a}{(\alpha \cdot S)} = 8 + \dfrac{2}{(f_1 - f_0)}(f_a - f_0) & f_a < f_1 \\ \dfrac{S_a}{(\alpha \cdot S)} = 10 & f_1 \le f_a < f_2 \\ \dfrac{S_a}{(\alpha \cdot S)} = \left[\dfrac{10}{1 + 4\left(1 - \dfrac{f_2}{f_a}\right)^2} \right] & f_a \ge f_2 \end{cases}$$

Where f_0 = 0,75·Hz; f_1 = 1,4 Hz and f_2 = 12,5 Hz.

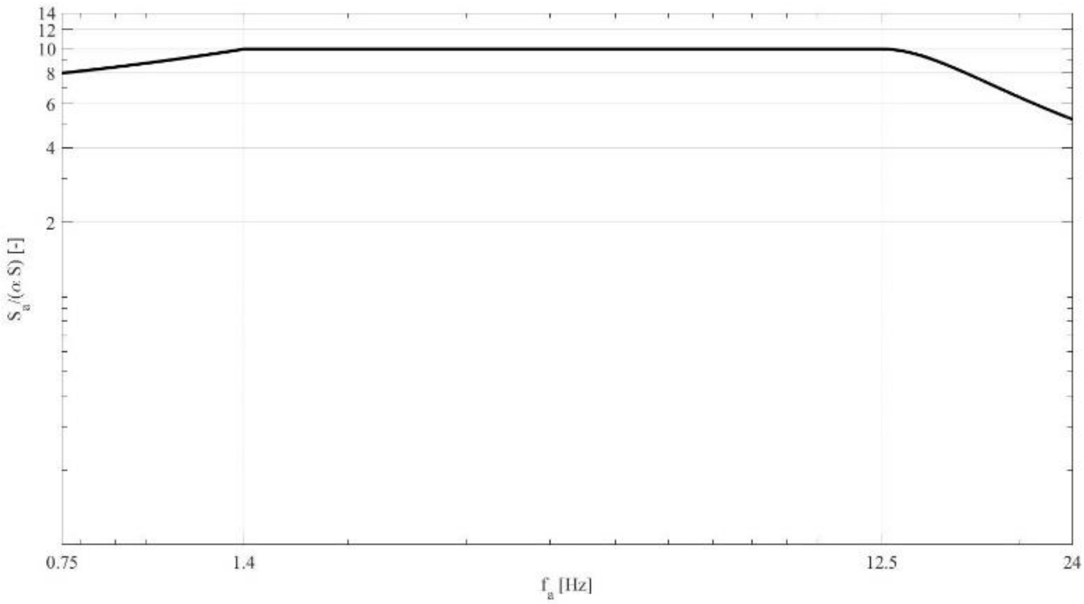


Figure R.5.2.1.2: Reference response spectrum (RRS), 5% damping. In frequency domain.

The Reference Response Spectrum given in Figures R.5.2.1.1 (time domain) and R.5.2.1.2 (frequency domain) refers to the displacement of a SDOF (single degree of freedom system), which is considered an infinitely rigid system representing the component (in this case the cladding kit) attached to the main structure (i.e., the machine in the experimental test).

Starting from this Reference Response Spectrum, an acceleration time-history shall be chosen in a manner that the relative spectrum (also defined as Test Response Spectrum-TRS) shall be compatible with the RRS defined assuming $\alpha \cdot S_a = 0,40$ g, over the frequency range from 1,4 Hz to 24 Hz.

The starting acceleration time-history shall be nonstationary broadband random excitations having an energy content ranging from 1 Hz to 32 Hz and a bandwidth resolution equal to one sixth-octave. The total duration of the input motion shall be 30 seconds, which includes 5 seconds for the acceleration ramp-up, 20 seconds of strong motion time duration and 5 seconds for the decay time. The amplitude of the narrowband signal shall be adjusted until the TRS envelops the RRS. It is recommended that the TRS shall be between 30% and 90% of RRS. Figure R.5.2.1.3 shows 2 TRS examples spectra enveloping a RRS "target" spectrum.

In the performance of a test program, the TRS may not fully envelop the RRS. The general requirement for a retest shall be exempted if the following criterion is met:

- a maximum of two of the one-sixth octave analysis points may be below the RRS by than 10% or less, provided that, for each point, the adjacent one-sixth-octave points are at least equal to RRS.

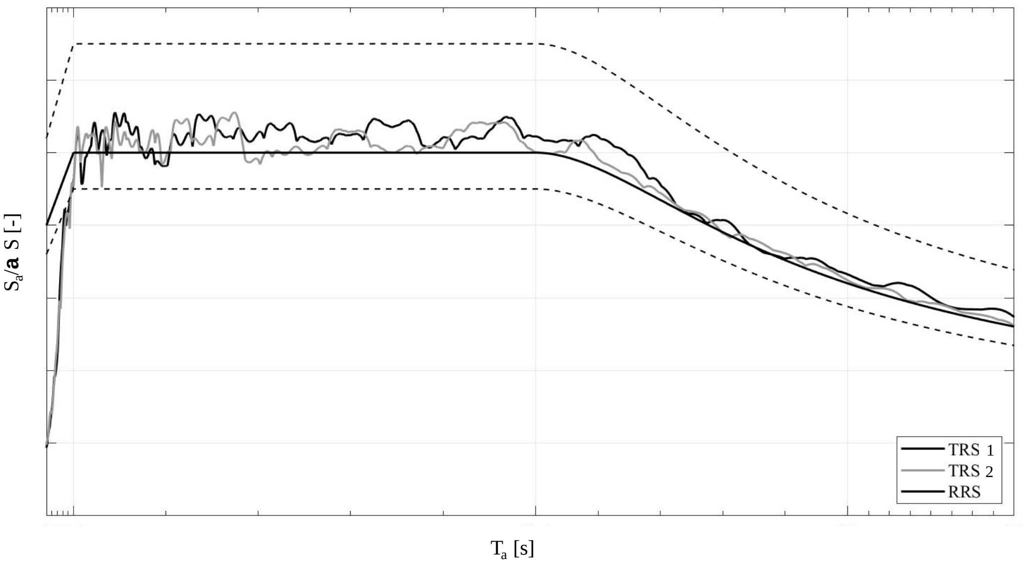


Figure R.5.2.1.3: Example of TRS spectra enveloping RRS spectrum.

The obtained acceleration time-history shall be also compatible with the test equipment limitations. For this purpose, a "filter tool" can be used in order to generate a signal compatible with the maximum displacements applicable by the test equipment. In particular, the signal can be filtered through high-pass filters considering a maximum frequency threshold equal to 0,75 f_a if 0,75 f_a does not exceed 3,5 Hz, whereas if 0,75 f_a exceeds 3,5 Hz, this latter frequency should be considered as maximum frequency threshold for high-pass filters.

R.6 – IN-PLANE DISPLACEMENT TESTS

In-plane displacement tests shall be performed to assess the in-plane displacements according to the procedure explained below.

R.6.1 – Experimental procedure for in-plane limit displacements assessment

Displacement tests shall be carried out by applying a “crescendo” displacements history in the in-plane direction (y-direction) of the component (see green arrow in Figure R.3.4.1.a). Crescendo test shall consist of a concatenated series of “rump up” intervals and “constant amplitude” intervals. As shown in Figure R.6.1.1, in plane displacement steps between constant amplitude intervals shall be 6 mm. Rump up intervals and constant amplitude intervals shall consist of four sinusoidal cycles each.

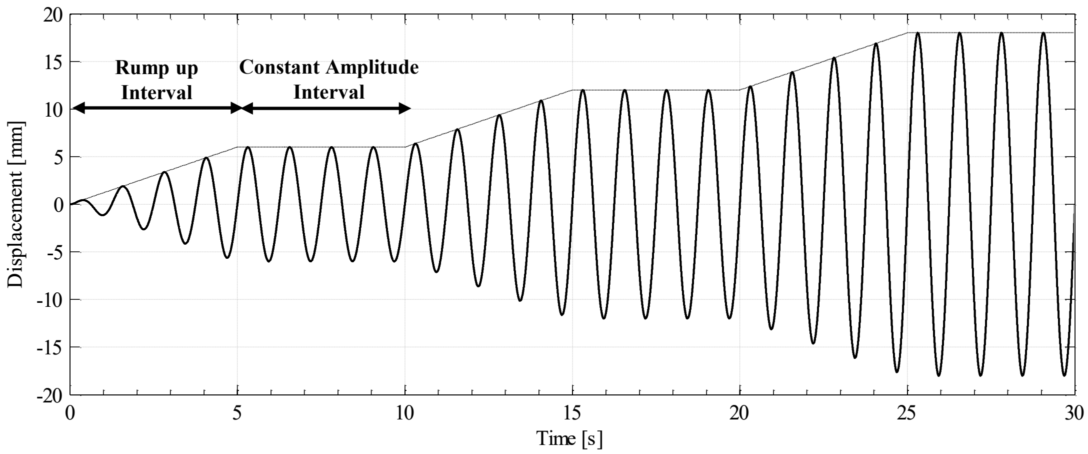


Figure R.6.1.1: Rump-up interval and Constant Amplitude Interval of Displacement in Test.

The crescendo test shall be performed at a frequency of 2 Hz for total applied relative displacements between the base and the top of the specimen of ± 75 mm or less, and 1 Hz for total applied racking displacements greater than 75 mm.

Each crescendo test (see Figure R.6.1.2) shall be run continuously until the first of the following condition exists (a video recording of the test, synchronized with the clock of the testing apparatus is highly recommended for off-line processing):

- fallout of any component (mainly cladding elements) of the assembled cladding kit,
- the maximum applied displacement is equal to ± 150 mm.

Damage of each component of the assembled cladding kit shall be recorded during the tests by filling out a damage scheme, according to Table R.2.1. The measured relative ~~applied~~ displacement between the base and the top of the specimen corresponding to the achievement of each damage state, divided by the specimen height, will represent the y-direction in-plane inter-story drift $\Delta d_{max,R,DSi,ip}$ of the specimen, , where i = 1, 2 or 3 refers to the limit states described in clause R.2.

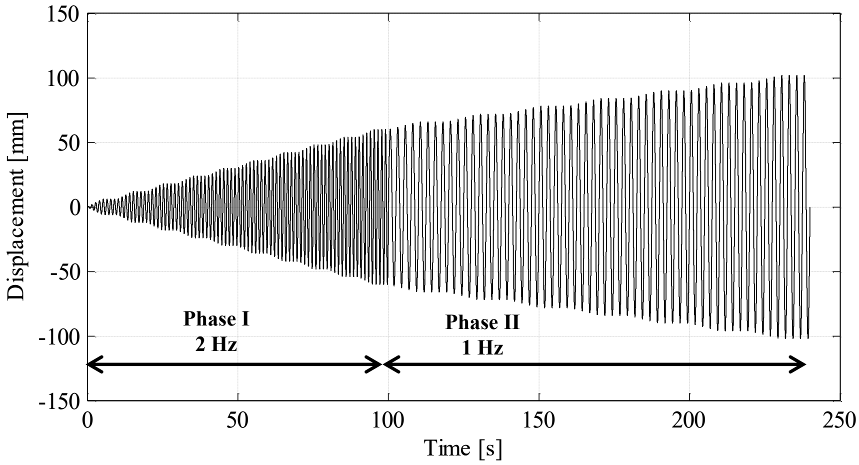


Figure R.6.1.2: Displacement Test.

R.7 – TEST REPORT

Test report shall include at least:

1) Complete description of the test specimen and its components. At least the following information shall be defined (data based on the MPII):

   - Brackets: material, geometry, distance between two brackets and number and disposition of fixings.
   - Profiles: material, geometry and distance between two profiles.
   - Cladding element: material and geometry.
   - Cladding fixing: material, geometry and number and disposition of fixings).
   - Fixings between the test equipment and the assembled cladding kit (position, generic type, material and geometry).
   - Ancillary adhesive, if it is used: generic type, geometry and disposition of adhesive spots or beads.

2) Description of the test equipment.

   - A detailed sketch of the testing apparatus (front and lateral view) including the specimen geometry and the position of each sensor adopted (e.g., accelerometers and LVDTs) to measure the test results.
   - A description of the specimen and of each sensor depicted in the sketch.
   - A description of the equipment (hardware and software) adopted for data acquisition and processing.

3) Results:

   - Out-of-plane fundamental vibration period, T_a, in [s].
   - Values of out-of-plane acceleration corresponding to the achievement of each representative damage state (DS1, DS2, DS3), $a_{g,R,DS1,out}$, $a_{g,R,DS2,out}$, $a_{g,R,DS3,out}$, in [m/s^2].
   - Specific damages observed in the test specimen during the dynamic tests.

- Values of in-plane displacement corresponding to the achievement of each representative damage states (DS1, DS2, DS3) $\Delta d_{max,R,DS1,ip}$, $\Delta d_{max,R,DS2,ip}$, $\Delta d_{max,R,DS3,ip}$, in [%].
- Specific damages observed in the test specimen during the in-plane displacement tests.