EAD **090034-01-0404**

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European Assessment Document for

Kits composed by subframe and fixings for fastening claddings and external wall elements

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

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD covers the assessment of the following products:

A. Kits composed of subframe and fixings (hereinafter referred to as “kit(s)”) for fastening skin elements (see Clause 1.3.1) on external or internal walls of buildings.

The kits consist of the following components[1]:

1. Fixings or fixing devices (hereinafter referred to as “skin fixings”) for mechanically (not glued) fastening skin elements to the subframe. See Clause 1.1.1.

2. Subframe composed of:

   - Subframe profiles made of metal materials (steel or aluminium alloy). See Clause 1.1.2.

   - Subframe brackets for fastening the profiles to the substrate (e.g., external wall). See Clause 1.1.3.

   - Subframe fixings (screws or rivets) made of metal materials (steel or aluminium alloy) between the brackets and the profiles and between the skin fixings and the profiles. See Clause 1.1.4.

   - Anchors (optional) between the subframe and the substrate. See Clause 1.1.4.

3. Other ancillary components (optional), see Clause 1.1.5.

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

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

- Complete kits (skin fixings, subframe components and optionally, other ancillary components).

- Subframe kits (only the subframe components without skin fixings), in this case, the skin fixings shall be available on the market and described in the ETA in accordance with Clause 1.1.1 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.

B. Skin fixings as constituent for fastening of skin or cladding elements and other external wall elements (hereinafter referred to as “skin fixing(s)”). See Clause 1.1.1.

C. Subframe brackets as constituent for fastening of profiles or other external wall elements (hereinafter referred to as “bracket(s)”) . See Clause 1.1.3.

The products covered by this EAD are non-load bearing construction elements. They do not contribute to the stability of the substrate on which they are installed.

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

Table 1.1.1 Description of types for the kits and their link regarding the cladding kit families according to EAD 090062-01-0404

Type of kits	**Description of the kits (*)**	**Related cladding kit family in accordance with EAD 090062-01-0404**
Type 1 (see Figure 1.1.1)	Kits where the skin fixings are metal dowels for skin elements with dowel hole. One central skin fixing supports two skin elements and at least four skin fixings are needed to support one skin element.	Family C (see Figure 1.1.3a of EAD 090062-01-0404)
Type 2 (see Figure 1.1.2a and Figure 1.1.2b)	Kits where the skin fixings are hidden metal punctual fixings (small rails, clips, clamps, pins) or other similar punctual fixings for skin elements with grooves. One central skin fixing may support two or four skin elements, and at least four skin fixings are needed to support one skin element. These kits may or may not include horizontal linear profiles. When the horizontal profiles have a specific cross-section shape for connecting to the punctual fixing, they are part of the skin fixing. When the horizontal profiles do not have a specific cross-section shape for connecting to the punctual rail, they are part of the subframe.	Family C (see Figure 1.1.3a of EAD 090062-01-0404)
Type 3 (see Figure 1.1.3a and Figure 1.1.3b)	Kits where the skin fixings are visible metal punctual fixings (small rails, clips, clamps, pins) or other similar punctual fixings for skin elements without grooves. One central skin fixing may support two or four skin elements, and at least four skin fixings are needed to support one skin element. These kits may or may not include horizontal profiles. When the horizontal profiles have a specific cross-section shape for connecting to the punctual rail, they are part of the skin fixing. When the horizontal profiles do not have a specific cross-section shape for connecting to the punctual rail, they are part of the subframe.	Family F (see Figure 1.1.6a of EAD 090062-01-0404)
Type 4 (see Figure 1.1.4)	Kits where the skin fixings are metal continuous horizontal rails for skin elements with or without grooves (hidden or visible skin fixings, respectively). One central skin fixing supports two skin elements, and two skin fixing are needed to support one skin element.	Family C and Family F (see Figure 1.1.3a and Figure 1.1.6a of EAD 090062-01-0404, respectively)
Type 5 (see Figure 1.1.5)	Kits where the skin fixings are the hidden group of components: - Special anchor (undercut anchor [2]) placed in drilled holes or in undercut holes and anchored by mechanical interlock. - Horizontal hook-rail (clamp). - Horizontal supporting rail. At least four special anchors with their respective hook-rails and horizontal supporting rails are needed to support one skin element.	Family B (see Figure 1.1.2a of EAD 090062-01-0404)
Type 6 (see Figure 1.1.6)	Kits where the skin fixings are visible screws or rivets that pierce the skin elements to fasten them directly onto the subframe. At least four skin fixings are needed to support one skin element.	Family A (see Figure 1.1.1a of EAD 090062-01-0404)
(*) All the kits may include the Groups of brackets defined in Clause 1.1.3.		

2 Specific type of undercut anchors as skin fixing of Type 5 may be covered by the EAD 330030-00-0601.

Figures 1.1.1 to 1.1.6 are schematic representations of the types of kits described in Table 1.1.1. The components of the kits are identified by the following legend.

Legend for the Figures 1.1.1 to 1.1.6:

1. Skin fixing.
2. Profile of the subframe.
3. Bracket

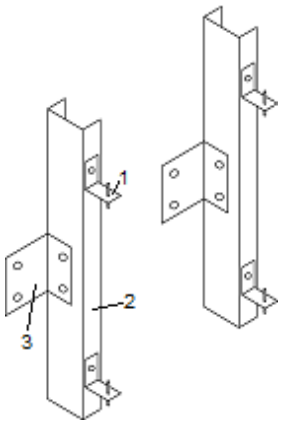


Figure 1.1.1: Kit Type 1.

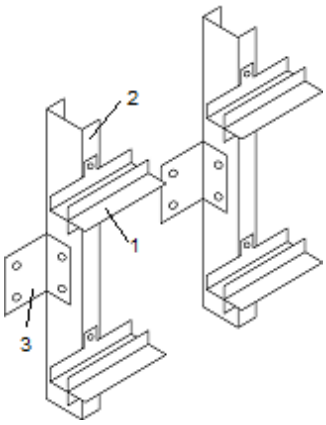


Figure 1.1.2a: Kit Type 2 (without horizontal profile).

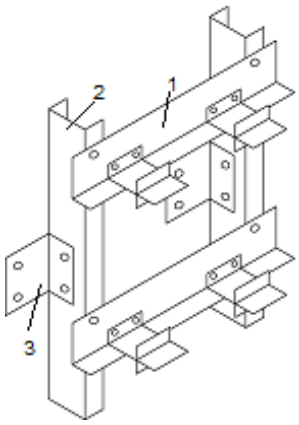


Figure 1.1.2b: Kit Type 2 (with horizontal profile).

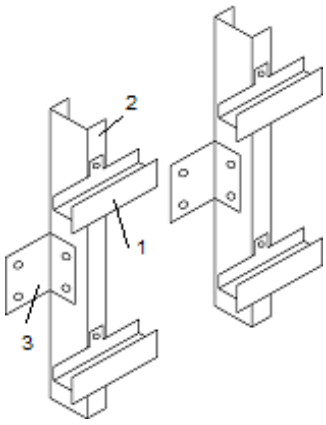


Figure 1.1.3a: Kit Type 3 (without horizontal profile).

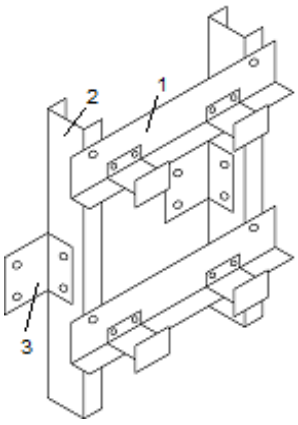


Figure 1.1.3b: Kit Type 3 (with horizontal profile).

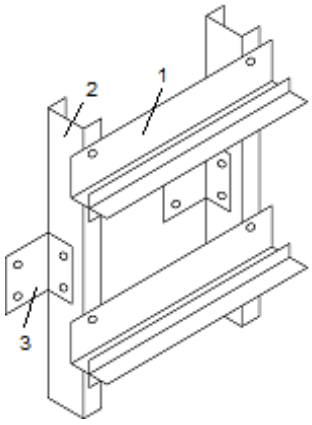


Figure 1.1.4: Kit Type 4.

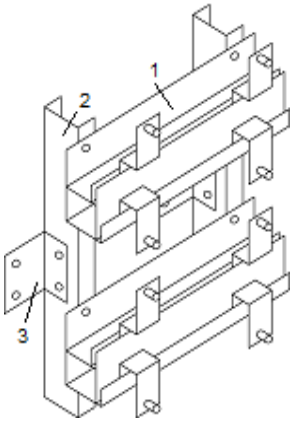


Figure 1.1.5: Kit Type 5.

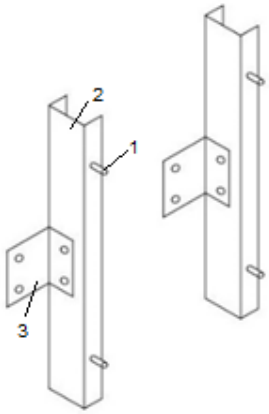


Figure 1.1.6: Kit Type 6.

The products are not covered by a harmonised European standard (hEN).

The products are not fully covered by the following harmonised technical specification:

- EAD 090062-01-0404, EAD 090019-01-0404, EAD 090058-00-0404, EAD 090125-00-0404 because they cover kits that contain the cladding elements. Kits covered by this EAD do not include the skin elements such as cladding elements. In addition, these EADs listed above only cover brackets belonging to the Group 1, they do not cover brackets belonging to Groups 2 to 4 (see Clause 1.1.3).

- EAD 090097-00-0404 because it covers kit that contains an adhesive system as the way for fixing the skin elements. Kits covered by this EAD are mechanically fixed. In addition, EAD 090097-00-0404 only covers brackets belonging to the Group 1, it does not cover brackets belonging to Groups 2 to 4 (see Clause 1.1.3).

- EN 1090-1[3] 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).

EN 14024, which covers metal profiles with thermal barrier determined for different application, is not a harmonized standard.

The products are not fully covered by EAD 090034-00-0404. Compared to the previous version of the EAD, the following changes are introduced:

- Extension of the scope by considering new types of brackets and covering the assessment of the skin fixings and brackets as an individual product.

- Reworking of the document for its alignment with the EAD 090062-01-0404 and improving the descriptions in the document.

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

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

Relevant manufacturer's stipulations, e.g., with regard to the intended end use conditions, 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 as long as the details of the assessment methods as laid down in this EAD are respected.

1.1.1 Skin fixings

Special single fixing devices, used for fastening of the skin elements to the subframe, such as small rails, clips, clamps, pins, linear profiles, screws, rivets, or any produced for the specific purpose of fastening the skin elements to the subframe.

Skin fixings are made of metal materials (steel (galvanised, hot-dipped zinc or stainless) or aluminium alloy).

The skin fixings covered by this EAD are defined according to the kit types (Type 1 to Type 5) given in Table 1.1.1 and Figures 1.1.1 to 1.1.5.

Special skin fixings relating to Type 5 and Figure 1.1.5, manufactured and installed in accordance with EAD 330030-00-0601 (i.e., anchors installed in pre-drilled or undercut holes and anchored by deformation control or torque control) are not covered by this EAD as an individual skin fixing, see Clause 1.1, bullet point B.

[3] All undated references to standards in this EAD are to be understood as references to the dated versions listed in chapter 4.

Special skin fixings relating to Type 5, but manufactured and installed differently from EAD 330030-00-0601 (e.g., fixed in pre-cut grooves) are covered as an individual product by this EAD.

Skin fixings of Type 6 according to Figure 1.1.6, as standardized screws, rivets or bolts, are not covered as an individual product by this EAD.

Minimum data for describing the skin fixings are the geometric and physical parameters (such as cross-section shape and dimensions, weight, distance range between two skin fixings, distance range to the skin 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.

1.1.2 Subframe profiles

Profiles of the subframe (hereinafter referred to as “subframe profile(s)”) are vertical and/or horizontal profiles made of metal materials (steel (galvanised, hot-dipped zinc or stainless) or aluminium alloy). See Figures 1.1.1 to 1.1.6.

Minimum data for describing the subframe profiles are the geometric and physical parameters (such as cross-section shape and dimensions, weight, maximum distance between profiles) 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.

1.1.3 Subframe brackets

Brackets of the subframe for fastening the subframe profiles to the substrate (e.g., external wall).

Subframe brackets are defined according to the following groups:

- Group 1: Metal brackets. Brackets without or with perforation (see Figure 1.1.3.1), made purely of metal material (steel (galvanised, hot-dipped zinc or stainless) or aluminium alloy).
- Group 2: Thermal barrier brackets. Metal brackets with thermal barrier, made of metal material (steel (galvanised, hot-dipped zinc or stainless) or aluminium alloy) with incorporated plastic chamber separator (see Figure 1.1.3.2).
- Group 3: Composite brackets. Brackets made of fibre reinforced polymer (FRP), with glass, basalt, carbon or aramid fibres. These brackets may contain metal parts for improving their effectiveness. These metal parts shall be mechanically connected in the manufacturing plant (see Figure 1.1.3.3).
- Group 4: Metal-rod brackets. Brackets made of threaded (stainless or hot dipped zinc) steel rods of diameter 6 mm up to 16 mm, anchored into the substrate by included fittings (see Figure 1.1.3.4). Brackets can be manufactured as singe rod, twin rod or triangle.

Thermo-stop pads as ancillary components may be used in all groups.

In the specific case of fixed point of the subframe, both loads are transferred by the bracket at the same time, in other cases only horizontal load is transferred.

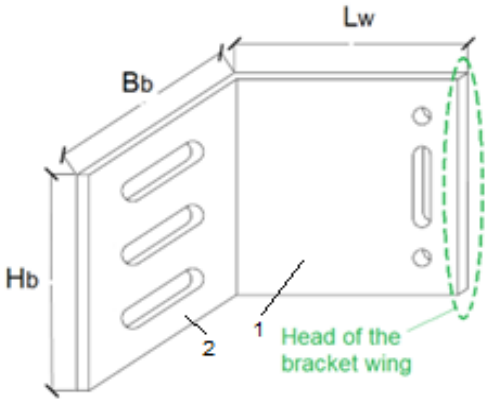
Brackets of Group 1 to 3 consist of a base (also called flange) and a wing. The base is fastened to substrate by anchors (see Clause 1.1.4) depending on the substrate material. The base can be laid on thermo-stop pad (see Clause 1.1.5) to improve its thermal insulating characteristic. The wing is protruding perpendicular to surface of substrate, mostly through layer of thermal insulating product, to fastened grid, consisting of subframe profiles with subframe fixings and supporting skin elements. To obtain lower point thermal transmittance of bracket (see Clause 2.2.11.1), bracket wings may include perforations in specified position by openings of specified number, shape, position and dimension.

Brackets of Group 4 consist, in case of fixed point of sloped and horizontal threaded rods, on side of substrate anchored into material, on side of subframe profiles connected by special pieces, which are the integral part of the bracket. In the case of brackets specified only for distribution of horizontal loads, they may be composed only by horizontal rods. Rods are fastened to substrate by anchors (see Clause 1.1.4) depending on the substrate material.

Minimum data for describing the brackets are the geometric and physical parameters (such as cross-section shape and dimensions, weight, maximum distance between brackets on the one subframe profile) 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.

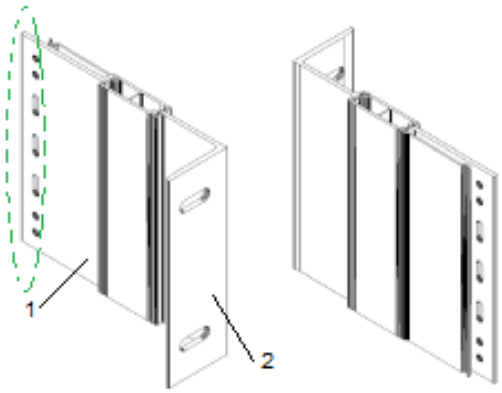
Legend for the Figures 1.1.3.1 to 1.1.3.4:

1. Bracket wing.
2. Bracket base (flange).
3. Threaded rods.
4. Special pieces.
5. Subframe profile.



B_b = Base length / L_w = Wing length / H_b = Bracket height.

Figure 1.1.3.1: Metal brackets (Group 1).



B_b, L_w and H_b given in Figure 1.1.3.1 are also applicable to this figure.

Figure 1.1.3.2: Thermal barrier brackets (Group 2).

B_b, L_w and H_b given in Figure 1.1.3.1 are also applicable to this figure.

Figure 1.1.3.3: Composite brackets (Group 3).

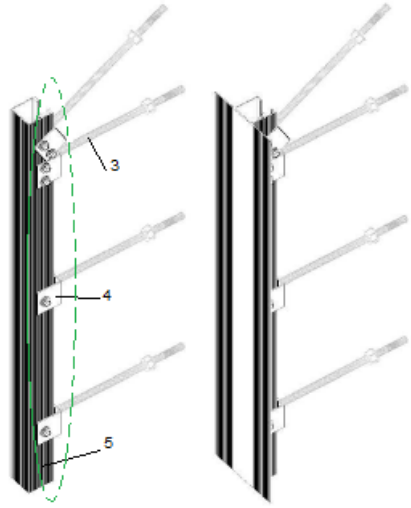


Figure 1.1.3.4: Metal-rod brackets (Group 4).

1.1.4 Subframe fixings

Subframe fixings are:

- Screws or rivets made of metal materials (steel (galvanised, hot-dipped zinc or stainless) or aluminium alloy) between the brackets and the subframe profiles and between the skin fixings and the subframe profiles.

- Anchors (optional) between the brackets and 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.

1.1.5 Ancillary components (optional)

Ancillary components in the kit are:

- Thermo-stop pads which are non-metal plates installed between the brackets base (flange) and the substrate for reduction of the punctual thermal transmittance.

- Any other component used in the kits (e.g., to keep the position of the skin 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 purely mechanically fixed kits, the influence of ancillary adhesives (which may be used e.g., to set correct position of skin elements) on the mechanical resistance of the kits shall be not considered (i.e., they shall be not used in the assessment of the mechanical resistance of the kits). However, other influences (e.g., on 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 following intended uses depending on the product:

A. Kits intended to be used for the mechanical fastening of skin elements (see Clause 1.3.1) in façades with air space, ventilated or not, and intended to be fixed to the substrate defined in Clause 1.3.3 in new or existing buildings (retrofit).

B. Skin fixings intended to be used for mechanical fastening of skin elements (see Clause 1.3.1) to the subframe (see Clause 1.3.2).

C. Brackets intended to be used for mechanical fastening of the subframe profiles (see Clause 1.1.2) to the substrate (see Clause 1.3.3), sometimes, in addition, to reduce thermal bridge(s) and punctual thermal transmittance.

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 products (kits, skin fixings or brackets) for the intended use of 25 years when installed in the works. 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[4].

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

Specific terms and symbols included in Clauses 1.3.3, 1.3.6 to 1.3.11 and 1.3.13 of EAD 090062-01-0404 applies.

1.3.1 Skin elements

The term “skin element” refers either to cladding elements or to external wall elements in façades. Skin elements are sheets, planks, tiles, brick slips, boards, panels, or cassettes made of the durable materials intended to be used as cladding elements or wall elements, covered by continuous rendering, for exterior use.

Skin elements are not covered by this EAD, but they are related with the assessment of the kits and the skin fixings. Skin elements shall be available on the market and described in the ETA as part of the intended use of the kit and the skin fixing, therefore, these components are part of the product assembly and they are necessarily used within the product assessment process.

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

1.3.2 Subframe

Subframe is the intermediate assembly located between the skin elements including their skin fixings and the substrate.

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

- Subframe profiles (see Clause 1.1.2).

  Subframe profiles can be positioned in vertical or in horizontal direction.

- Subframe brackets (see Clause 1.1.3).

- Subframe fixings (see Clause 1.1.4).

- Ancillary components (see Clause 1.1.5).

1.3.3 Substrate

The term “substrate” refers to any of the following descriptions:

- The wall, which in itself already meets the airtightness and requirements on mechanical strength (resistance to static and dynamic loads), as well as watertightness and a relevant water vapour

[4] 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.

resistance. The substrate walls can be made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame.

- The supporting structure of the building, which in itself does not meet the airtightness requirement but meets the requirements on mechanical strength (resistance to static and dynamic loads). Usually, the supporting structures of the building are made as frame of concrete (cast on site or prefabricated), masonry, timber or metal elements. In this case, the airtightness requirements are provided by specific non-loadbearing stratum of internal layers of the façade.

1.3.4 Position convention

To avoid misunderstanding in action of load, following position convention in determination of load action is held in context of this EAD:

- Vertical position: load acts in direction of gravitation, with sign plus downwards, with sign minus upwards.
- Horizontal position: load acts in horizontal direction perpendicular to surface of substrate, with sign plus in pressure to substrate, with sign minus in tension from substrate [5].
- Transversal position: load acts in horizontal direction in parallel with surface of substrate, with sign plus in direction to right from front view to substrate, with sign minus in direction to left from front view to substrate.

To simplify arrangement of tests in relation to position of load action, test specimens can be rotated to obtain appropriate situation in test machine. Test results shall be presented in concordance with position convention.

1.3.5 Displacement convention

To avoid misunderstanding in displacement caused by load, following displacement convention in is held in context of this EAD:

- Displacement: current displacement in measured point under load in specified time, determined as difference between position of measured point under load and position of the same point before loading. Position convention in accordance with Clause 1.3.4 shall be followed.
- Permanent deformation: permanent displacement in measured point, caused by specified load in specified time, determined as difference between position of measured point before loading and position of the same point after unloading to zero. Position convention in accordance with Clause 1.3.4 shall be followed.

1.3.6 Symbols

Clause 1.3.14 of EAD 090062-01-0404 applies.

In addition, the following symbols are used in this EAD.

1.3.6.1 Symbols used for mechanical and physical quantities

Symbol	Quantity	Unit
E	Modulus of elasticity in tension.	GPa
M	Bending moment resistance of subframe profile.	Nm
Q_{PCS}	Gross heat of combustion.	MJ·kg
Q_{ad}	Additional vertical load	N or kN
VST	Vicat Softening Temperature.	°C
d	Displacement in specified position.	mm

5 Used convention of signs complies with convention for actions of wind given in EN 1991-1-4.

Symbol	Quantity	Unit
h	Thickness of the thermal insulation layer.	mm
m_{fibre}	Arithmetic average value of fibre content by weight.	%
Δ ..	Difference of determined item in specified extent	mm, N
σ_n [6]	Standard deviation of a sample	(the same unit as original data)

Symbol for specified mechanical quantity is created by symbol of relevant quantity and indexes related to type of load action. Indexes in marking shall be organized as given in Clause 1.3.6.3.

1.3.6.2 Symbols used for thermal transmittance

Symbol	Quantity	Unit
A	Area of cross-cut end of the relevant test cuboid, vertical to the heat flow.	m^2
$L_{3D,1,2}$	Three-dimensional thermal coupling coefficient for two boundary temperatures	$W/(m^2 \cdot K)$
R_{se}	External heat transfer resistance.	$(m^2 \cdot K)/W$
R_{si}	Internal heat transfer resistance.	$(m^2 \cdot K)/W$
ΔT	Temperature difference between internal and external environment.	K
U	Thermal transmittance of the undisturbed wall, without bracket / rod or profile penetrating in the thermal insulation layer.	$W/(m^2 \cdot K)$
U_{dis}	Thermal transmittance of the disturbed wall, with bracket / rod or profile penetrating in the thermal insulation layer.	$W/(m^2 \cdot K)$
l	Length of linear thermal bridge (subframe profile) considered in model	m
n	Number of point thermal bridges (brackets or rods) considered in model	--
θ_{se}	External temperature.	°C
θ_{si}	Internal temperature.	°C
λ	Coefficient of thermal conductivity of material	W/(m·K)
λ_{dry}	Coefficient of thermal conductivity of thermal insulation layer in dry conditions	W/(m·K)
χ	Point thermal transmittance of the brackets.	W/K
ψ	Linear thermal transmittance of the subframe profiles.	W/(m·K)
$\chi(h_{200})$	Point thermal transmittance of a bracket / rod for thermal insulation layer thickness of 200 mm	W/K
$\chi(h_{max})$	Point thermal transmittance of a bracket / rod for the maximum thermal insulation layer thickness.	W/K
$\chi(h_{min})$	Point thermal transmittance of a bracket / rod for the minimum thermal insulation layer thickness.	W/K
$\psi(h_{200})$	Linear thermal transmittance of a subframe profile for thermal insulation layer thickness of 200 mm	W/(m·K)
$\psi(h_{max})$	Linear thermal transmittance of a subframe profile for the maximum thermal insulation layer thickness.	W/(m·K)
$\psi(h_{min})$	Linear thermal transmittance of a subframe profile for the minimum thermal insulation layer thickness.	W/(m·K)

[6] Symbol “S” is used for this quantity in the content of the EAD 090062-01-0404.

1.3.6.3 Indexes

Index	Consequence
i	Individual (separate) value of measured quantity.
m	Arithmetic average value of measured quantity.
c	Characteristic value of measured quantity. In accordance with Equation (N.1) of EAD 090062-01-0404.
1d	Value of quantity determined at 1 mm displacement
3d	Value of quantity determined at 3 mm displacement
1	Value of quantity determined at 1 mm permanent deformation.
u	Value of quantity determined at failure.
cal	Value of quantity determined by calculation.
test	Value of quantity determined by testing.
min, max	Minimum or maximum value of quantity.
sust	Value related to the sustained vertical load.
dis	Reference of thermal quantity to disturbed wall model with brackets / rods and/or subframe profiles, penetrating thermal insulation layer

Indexes in marking of quantity, separated by comma, shall be organized in sequence according to statistic type, direction, stress type or deformation size or position, and/or conditioning.

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, skin fixings and brackets 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
Basic Works Requirement 3: Hygiene, health and the environment			
2	Content, emission and/or release of dangerous substances (only for brackets)	2.2.2	Description
Basic Works Requirement 4: Safety and accessibility in use			
3	Wind load resistance (only for kits)	2.2.3	Level
4	Resistance to vertical load (only for kits)	2.2.4	Level
5 to 9	Resistance of skin fixings (*) (only for kits and skin fixings)	Table 2.1.2	Level
10	Resistance of subframe profiles (*) (only for kits)	EAD 090062-01-0404 Clause 2.2.12.14	Description
11	Pull-out resistance of subframe fixings (*) (only for kits)	EAD 090062-01-0404 Clause 2.2.12.15	Level
12	Shear load resistance of subframe fixings (*) (only for kits)	EAD 090062-01-0404 Clause 2.2.12.16	Level
13 to 23	Resistance of brackets (*) (only for kits and brackets)	Table 2.1.3	Level and Description
Basic Works Requirement 6: Energy economy and heat retention			
24	Thermal transmittance (only for kits and brackets)	2.2.7	Level
Aspects of durability			
25	Linear thermal expansion	EAD 090062-01-0404 Clause 2.2.16.5.2	Level
26	Corrosion	EAD 090062-01-0404 Clause 2.2.16.8	Description
(*) The assessment of the kits' mechanical resistance is carried out by means of the assessment of the mechanical resistance of the relevant kit components (skin fixings, subframe profiles, brackets and subframe fixings) which are representative of this essential characteristic for kits.			

Table 2.1.2 Mechanical resistance of the skin fixings in relation with the applicable type as of the Table 1.1.1.

No	Essential characteristic	Assessment method	Applicable to kit type *(it is marked with X when is applicable)*					
			1	**2**	**3**	**4**	**5**	**6**
5	Resistance to vertical load of skin fixings	2.2.5.1	X	X	X	X	X	X
6	Resistance to horizontal load of skin fixings	2.2.5.2	X	X	X	X	X	X
7	Resistance to pulsating load of skin fixings	2.2.5.3	X	X	X	X	X	X
8	Pull-through resistance of skin fixings from subframe profile	EAD 090062-01-0404 Clause 2.2.12.12	---	X	X	X	X	---
9	Pull-out resistance (skin fixings from subframe profile)	EAD 090062-01-0404 Clause 2.2.12.15	---	---	---	---	---	X

Table 2.1.3 Mechanical resistance of the brackets in relation with the applicable group as of Clause 1.1.3

No	Essential characteristic	Assessment method	Applicable to bracket group *(it is marked with X when is applicable)*			
			1	**2**	**3**	**4**
13	Resistance of brackets to vertical load	2.2.6.1	X	X	X	X
14	Resistance of brackets to horizontal load	2.2.6.2	X	X	X	X
15	Behaviour of brackets after horizontal pulsating loads	2.2.6.3	---	X	X	X
16	Behaviour of brackets to sustained vertical loads	2.2.6.4	X (*)	X	X	X (*)
17	Behaviour of brackets after freeze-thaw cycles	2.2.6.5	---	X	X	---
18	Behaviour of brackets after immersion in water	2.2.6.6	---	X	X	---
19	Behaviour of brackets after ageing under temperature and high humidity	2.2.6.7	---	X	X	---
20	Soft body impact of brackets	2.2.6.8	---	X	X	X
21	Fibre content in composite material	2.2.6.9	---	X	X	---
22	Vicat softening temperature	2.2.6.10	---	X	X	---
23	Modulus of elasticity in tension of composite	2.2.6.11	---	X	X	---
(*) Only applicable for brackets with thermo-stop pads.						

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.

The Kits, Skin fixings and Brackets shall be described in the ETA in accordance with the minimum data for each component as indicated in Clause 1.1.

All test results of mechanical characteristics shall be rounded downwards in accordance with EN ISO 80000-1 for three valid places.

If a skin element(s) is(are) necessary to perform a specific test, its type shall be selected according to following rules:

- If no type of skin elements is specified in the Manufacturer’s Product Installation Instructions (MPII), skin element(s) of type and characteristics (e.g., material, thickness, dimensions, material strength parameters or class of reaction to fire), prescribed in the relevant clause, shall be used for the relevant test. In this case, skin element(s) shall not create the weakest point of tested specimen(s).

  Only if MPII explicitly excludes type of skin element prescribed in the relevant clause, the test shall not be performed with this type of skin element. To perform test, manufacturer can additionally specify another type of skin element, its mechanical and/or physical characteristic included. In this case, used skin element can create the weakest point of test specimen(s).

- If only one type of skin element is specified by MPII, this specified type with the most adverse mechanical and/or physical characteristics (e.g., thickness, dimensions, strength parameters or class of reaction to fire), specified separately for each relevant test, shall be used for tests, even if this skin element creates the weakest point of tested specimen(s).

- If more types of skin element, determined e.g., by material, thickness, dimensions, strength parameters or class of reaction to fire, are specified by MPII, at least the most adverse type with the most adverse characteristics (e.g., dimensions, thickness, material, strength parameters or class of reaction to fire), specified separately for each relevant test, shall be used for tests, even if this skin element creates the weakest point of tested specimen(s). In this case, preliminary tests to identify the most adverse case may be necessary separately for each type of test.

Other material types of skin elements, or skin elements made from the same material, but with less adverse material characteristics, can be tested in addition on basis of manufacturer´s request.

2.2.1 Reaction to fire

Depending on the material composition of the products (kits, skin fixings, and brackets), the following situations shall be considered:

1. Kits, skin fixings, and brackets without any combustible material component.

2. Kits, skin fixings, and brackets with any combustible material component.

2.2.1.1 Kits, skin fixings, and brackets without combustible material components

The kits, skin fixings and brackets are considered to satisfy the requirements of class A1 of the reaction-to-fire performance in accordance with the Commission Decision 96/603/EC as amended by 2000/605/CE and 2003/424/CE without the need for testing on the basis of its fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore, when the conditions referred to above are fulfilled, the performance of the product is class A1 which shall be given in the ETA.

2.2.1.2 Kits, skin fixings, and brackets with combustible material components

In the case of the components made of combustible materials fulfil the conditions as stated in Clause B.6 of EAD 090062-01-0404, they shall be considered as small components without the need for testing and assessment of kits, skin fixings and brackets shall be carried out in accordance with Clause 2.2.1.1.

In the case of the components made of combustible materials do not fulfil the conditions as stated in Clause B.6 of EAD 090062-01-0404, kits, skin fixings and brackets shall be tested, using the method(s) relevant for the corresponding reaction to fire class in accordance with EN 13501-1. The products shall be classified in accordance with the Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

Reaction to fire of the kits shall be assessed by considering the reaction to fire of the components (skin fixings, subframe profiles, brackets, subframe fixings and ancillary components), in order to be classified in accordance with Commission Delegated Regulation (EU) 2016/364.

For reaction to fire classes A2 to D, SBI test (in accordance with EN 13823) is relevant, therefore the test specimen shall include the skin element according to the intended use of the product (kits, skin fixings and brackets). When the intended use covers several skin element materials, SBI test shall be carried out both with the skin element material with the maximum gross heat of combustion - Q_{PCS} [MJ/kg] in accordance with EN ISO 1716 (hereinafter referred to as "Q_{PCS}-value") and with the skin element material with the minimum Q_{PCS}-value.

Considering that the provisions for "cladding elements" apply to the skin elements, criteria indicated in Annex B of EAD 090062-01-0404 shall be taken into account as well as, associated mounting and fixing rules for the SBI test and for tests in accordance with EN ISO 11925-2 shall be in accordance with Annex C of EAD 090062-01-0404.

The reaction to fire class shall be stated in the ETA.

2.2.2 Content, emission and/or release of dangerous substances

This characteristic is only relevant for brackets belonging to group 2 or 3 and the kits that contain such brackets.

The performance of the product 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[7] 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.

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[7] 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 **not** be asked 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.

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

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

2.2.2.1 Leachable substances

For the intended use covered by the release scenario S/W2 the performance of the kits with brackets belonging to the Group 2 or 3 (see Clause 1.1.3) or these brackets as individual products concerning leachable substances shall be assessed for these brackets.

A leaching test with subsequent eluate analysis shall take place, each in duplicate. Leaching tests of the test specimens are conducted in accordance with EN 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.

The specimen to be tested shall be taken from composite or plastic part of tested component (bracket), with its construction complying with the Manufacturer's Product Installation Instructions (MPII). Before testing, the specimen shall be stored for at least 2 days at (23 ± 2) °C and (50 ± 5) % RH, then eluates of "6 hours" and "64 days" shall be prepared.

In eluates of "6 hours" and "64 days", the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus in accordance with EN ISO 6341.
- Toxicity test with algae in accordance with EN ISO 15799.
- Luminescent bacteria test in accordance with 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 "64 days":

- Biological degradation in accordance with OECD Test Guideline 301 part A, B or E.

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

2.2.3 Wind load resistance

This characteristic is only relevant for kits.

The assessment and expression of the results shall be in accordance with Clause 2.2.9 of EAD 090062-01-0404 considering the following adjustments:

- The so-called "cladding element(s)" in the assessment method is the "skin element(s)" under this EAD.
  - The skin element(s) to be used with the kit for the test, shall be selected in accordance with provisions given in Clause 1.3.1.
  - If necessary, in accordance with Clause 1.3.1, skin element(s) made of exterior plywood sheet in accordance with EN 636, of thickness 24 mm shall be used as skin element(s) for the test.
- The mechanical resistance of the kit components considered in the calculation shall correspond to the ones obtained under this EAD (see the essential characteristics 5 to 23 in Table 2.1.1).

2.2.4 Resistance to vertical load

This characteristic is relevant only for kits.

For kits containing brackets belonging to group 1 (see Clause 1.1.3), and skin fixings of Type 1, 2, 3, 4, 5 or 6 (see Table 1.1.1), the assessment and expression of the results shall be in accordance with Clause 2.2.12.11 of EAD 090062-01-0404.

For kits containing brackets belonging to Group 2, 3 or 4 (see Clause 1.1.3), the resistance to vertical load shall be tested in accordance with Annex A.

Test shall be carried out for at least the most adverse case (see Clause A.1), resulting from:

- type and material characteristics of brackets, vertical profiles, subframe fixings and skin fixings,
- their mutual distances and dimensions,
- skin elements,

specified in the MPII.

If manufacturer specifies more types or more mechanical variants of subframe components and their distances and dimensions, or more skin elements, other combinations can be tested in addition on basis of manufacturer´s request.

If manufacturer does not specify any type of skin element(s) either primarily or in addition, ceramic tiles of group BIa according to EN 14411 shall be used.

The test load and the maximum displacement under test load in vertical direction determined in accordance with Clause A.3 shall be stated in the ETA.

2.2.5 Resistance of skin fixings

2.2.5.1 Resistance to vertical load of skin fixings

This characteristic is only relevant for kits and skin fixings.

The resistance to vertical load of skin fixings (load acting in vertical position) shall be assessed depending on their type:

- Types 1 to 3 (see Table 1.1.1) shall be tested in accordance with Clause 2.2.12.13 (vertical position) of EAD 090062-01-0404. In addition, for those skin fixings, installed on horizontal subframe profiles in intermediate position between vertical subframe profiles, horizontal subframe profiles shall be calculated in accordance with Clause B.1.
- Type 4 (see Table 1.1.1) shall be calculated in accordance with Clause B.1.
- Type 5 (see Table 1.1.1), not assessed in accordance with the EAD 330030-00-0601 (see Clause 1.1.1), shall be tested in accordance with:
    - Clause 2.2.12.8 of EAD 090062-01-0404 for the mechanical resistance of the connection between the anchor/clamp and the skin element, considering the following adjustments:
        - The so-called “cladding element(s)” in the assessment method is the “skin element(s)” under this EAD.
        - Testing shall be carried out for at least the most adverse type and material characteristics of skin element specified in the MPII. Rules for selection of skin element material used for testing, if manufacturer specifies more types or more mechanical variants of skin elements, are given in Clause 1.3.1.
        - If manufacturer does not specify any type of skin element(s) primarily or in addition, only test of connection of skin fixing with subframe shall be performed. If skin element is necessary for the test of skin fixing in this case, ceramic tiles of group BIa according to EN 14411 shall be used.
        - The defined intended use of the product (kits and skin fixings).

- Clause B.2.2 for the mechanical resistance of the connection between the anchor/clamp and the horizontal supporting rail.
- Clause B.1 for the mechanical resistance of the horizontal supporting rail.

- Type 6 (see Table 1.1.1) shall be tested in accordance with Clause 2.2.12.6 of EAD 090062-01-0404 in accordance with the following adjustments:
  - The so-called “cladding element(s)” in the assessment method is the “skin element(s)” under this EAD.
  - Tests shall be carried out for at least the most adverse type and material characteristics of skin element specified in the MPII. Rules for selection of skin element material used for testing, if manufacturer specifies more types or more mechanical variants of skin elements, are given in Clause 1.3.1.
  - If manufacturer does not specify any type of skin element(s) primarily or in addition, only test of connection of skin fixing with subframe shall be performed using appropriate steel test tool.

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], standard deviation σ_n in [N] and the characteristic value $F_{u,C}$ in [N] in accordance with Equation (N.1) of EAD 090062-01-0404 shall be stated in the ETA.

2.2.5.2 Resistance to horizontal load of skin fixings

This characteristic is only relevant for kits and skin fixings.

The resistance to horizontal load of skin fixings (load acting in horizontal position) shall be assessed depending on their type:

- Types 1 to 3 (see Table 1.1.1) shall be tested in accordance with Clause 2.2.12.13 (horizontal position) of EAD 090062-01-0404. In addition, for those skin fixings, installed on horizontal subframe profiles in intermediate position between vertical subframe profiles, horizontal, these subframe profiles shall be calculated in accordance with Clause B.1.

- Type 4 (see Table 1.1.1) shall be calculated in accordance with Clause B.1.

- Type 5 (see Table 1.1.1) shall be tested in accordance with:
  - Clause 2.2.12.7 of EAD 090062-01-0404 for the mechanical resistance of the connection between the anchor/clamp and the skin element, considering the following adjustments:
    - The so-called “cladding element(s)” in the assessment method is the “skin element(s)” under this EAD.
    - One testing shall be carried out for each skin element material according to the defined intended use of the product (kits and skin fixings). Rules for selection of skin element material used for testing shall be applied in accordance with Clause 2.2.3.
  - Clause B.2.3 for the mechanical resistance of the connection between the anchor/clamp and the horizontal supporting rail.
  - Clause B.1 for the mechanical resistance of the horizontal supporting rail.

- Type 6 (see Table 1.1.1) shall be tested in accordance with Clause 2.2.12.5 of EAD 090062-01-0404, considering the following adjustments:
  - The so-called “cladding element(s)” in the assessment method is the “skin element(s)” under this EAD.
  - The skin element to be considered in the test specimen shall be selected according to the skin element materials intended to be used with the product, and in the way that they shall not be

the weakest point. Rules for selection of skin element material used for testing shall be applied in accordance with Clause 2.2.3.

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

The arithmetic average value $F_{u,m}$ in [N], standard deviation σ_n in [N] and the characteristic value $F_{u,C}$ in [N] in accordance with Equation (N.1) of EAD 090062-01-0404 shall be stated in the ETA.

2.2.5.3 Resistance to pulsating load of skin fixings

This characteristic is only relevant for kits and skin fixings.

The resistance to pulsating load of skin fixings shall be assessed and stated in the ETA according to Clause 2.2.16.2 of EAD 090062-01-0404 in accordance with the following adjustments:

- The so-called “cladding element(s)” in the assessment method is the “skin element(s)” under this EAD.
- For skin fixings Type 5, one testing shall be carried out for each skin element material according to the defined intended use of the product (kits and skin fixings).
- For skin fixings Type 6, the skin element to be considered in the test specimen shall be selected according to the skin elements materials intended to be used with the kit, and in the way that they shall not be the weakest point.
- Rules for selection of skin element material used for testing shall be applied in accordance with Clause 2.2.3.

2.2.6 Resistance of brackets

2.2.6.1 Resistance of brackets to vertical load

This characteristic is only relevant for kits and brackets.

The resistance to vertical load of brackets (load acting in vertical position) as arithmetic average values $F_{r,m}$, $F_{1d,m}$, $F_{3d,m}$ $F_{u,m}$ in [N], standard deviations σ_n in [N] and characteristic values $F_{r,c}$, $F_{1d,c}$, $F_{3d,c}$ $F_{u,c}$ in [N] shall be assessed and stated in the ETA in accordance with Clause 2.2.12.17 (vertical position) of EAD 090062-01-0404.

Brackets belonging to different groups, with different shape and with different composition of material shall be tested separately.

In the case of brackets belonging to Group 4 (see Clause 1.1.3), the test specimens shall be adapted in accordance with Figures C.1.2, C.1.4 or C.1.6 according to composition of rod bracket.

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

- The behaviour of brackets after freeze-thaw cycles (see Clause 2.2.6.5).
- The behaviour of brackets after immersion in water (see Clause 2.2.6.6).
- The behaviour of brackets after thermal ageing (see Clause 2.2.6.7).

2.2.6.2 Resistance of brackets to horizontal load

This characteristic is only relevant for kits and brackets.

The resistance to horizontal load of brackets (load acting in horizontal position) as arithmetic average values $F_{1,m}$, $F_{u,m}$ in [N], standard deviations σ_n in [N] and characteristic values $F_{1,c}$, $F_{u,c}$ in [N] shall be assessed and stated in the ETA in accordance with Clause 2.2.12.17 (horizontal position) of EAD 090062-01-0404.

Brackets belonging to different groups, with different shape and with different composition of material shall be tested separately.

In the case of brackets belonging to Group 4 (see Clause 1.1.3), the test specimens shall be adapted in accordance with Figures C.1.1, C.1.3 or C.1.5 according to composition of rod bracket.

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

- The behaviour of brackets after horizontal pulsating load (see Clause 2.2.6.3).
- The behaviour of brackets after freeze-thaw cycles (see Clause 2.2.6.5).
- The behaviour of brackets after immersion in water (see Clause 2.2.6.6).
- The behaviour of brackets after thermal ageing (see Clause 2.2.6.7).

2.2.6.3 Behaviour of brackets after horizontal pulsating loads

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2, 3 or 4 (see Clause 1.1.3).

Behaviour of brackets after horizontal pulsating loads shall be assessed by means of the resistance to horizontal loads of brackets tests (see Clause 2.2.6.2) before and after cycles.

Pulsating load cycles shall be carried out in accordance with the method indicated in Clause C.2.

Brackets belonging to different groups, with different shape and with different composition of material shall be tested separately.

At least three test specimens shall be considered.

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in Clause 2.2.6.2) shall be tested.

Test results shall be stated in the ETA in accordance with the resistance to horizontal loads of brackets tests (see Clause 2.2.6.2).

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

2.2.6.4 Behaviour of brackets to sustained vertical loads

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2 and 3 (see Clause 1.1.3). It is also relevant for brackets belonging to Group 1 and 4 with thermo-stop pads.

Behaviour of brackets to sustained vertical loads shall be tested in accordance with Clause C.3.

Brackets belonging to different groups, with different shape and with different composition of material shall be tested separately.

At least one test specimen shall be considered.

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in Clause 2.2.6.1) shall be tested.

The following information shall be stated in the ETA:

- The measured displacements in [mm], at initial loading ($w_{load,0h}$), at 2000 hours loading ($w_{load,2000h}$). These data may be stated by means of the time-displacement diagrams.
- The measured displacements in [mm] ($w_{residual}$), after removing of load (unloading) after 24 hours from end of test, or when no change to previous measurement is detected.
- The applied load Q_{sust} in [N].

- Optionally, the calculated creep coefficient φ_{2000h} [-].

2.2.6.5 Behaviour of brackets after freeze-thaw cycles

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

Behaviour of brackets after freeze-thaw cycles shall be assessed by means of both, the resistance to vertical loads tests (see Clause 2.2.6.1) and the resistance to horizontal loads tests (see Clause 2.2.6.2) before and after cycles.

Freeze-thaw cycles shall be carried out in accordance with the method indicated in Clause C.4.

Brackets belonging to different groups, with different shape or with different composition of material shall be tested separately.

At least three test specimens shall be considered for each load (vertical load and horizontal load).

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in Clause 2.2.6.1 for vertical load and in Clause 2.2.6.2 for horizontal load) shall be tested.

Test results shall be stated in the ETA in accordance with the corresponding resistance test, vertical loads (see Clause 2.2.6.1) and horizontal loads (see Clause 2.2.6.2).

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

In addition, the description of any defect observed in the test specimens or “No defects were observed.” shall be stated in the ETA.

2.2.6.6 Behaviour of brackets after immersion in water

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

Behaviour of brackets after immersion in water shall be assessed by means of both, the resistance to vertical loads tests (see Clause 2.2.6.1) and the resistance to horizontal loads tests (see Clause 2.2.6.2) before and after immersion in water.

Immersion in water shall be carried out in accordance with the method indicated in Clause C.5.

Brackets belonging to different groups, with different shape or with different composition of material shall be tested separately.

At least three test specimens shall be considered for each load (vertical load and horizontal load).

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in Clause 2.2.6.1 for vertical load and in Clause 2.2.6.2 for horizontal load) shall be tested.

Test results shall be stated in the ETA in accordance with the corresponding resistance test, vertical loads (see Clause 2.2.6.1) and horizontal loads (see Clause 2.2.6.2).

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

In addition, the description of any defect observed in the test specimens or “No defects were observed.” shall be stated in the ETA.

2.2.6.7 Behaviour of brackets after ageing under temperature and high humidity

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

Behaviour of brackets after ageing under temperature and high humidity shall be assessed by means of both, the resistance to vertical loads tests (see Clause 2.2.6.1) and the resistance to horizontal loads tests (see Clause 2.2.6.2) before and after thermal ageing.

Ageing under temperature and high humidity shall be carried out in accordance with the method indicated in Clause C.6.

Brackets belonging to different groups, with different shape or with different composition of material shall be tested separately.

At least three test specimens shall be considered for each load (vertical load and horizontal load).

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in Clause 2.2.6.1 for vertical load and in Clause 2.2.6.2 for horizontal load) shall be tested.

Test results shall be stated in the ETA in accordance with the corresponding resistance test, vertical loads (see Clause 2.2.6.1) and horizontal loads (see Clause 2.2.6.2).

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

In addition, the description of any defect observed in the test specimens or “No defects were observed.” shall be stated in the ETA.

2.2.6.8 Resistance of brackets to soft body impacts

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2, 3 or 4 (see Clause 1.1.3).

The resistance of brackets to soft body impacts shall be tested in accordance with the method indicated in Annex G of EAD 090062-01-0404, by impacts of small soft body of mass 3 kg and of large soft body of mass 50 kg. considering the adjustments given in the Clause C.7.

Brackets belonging to different groups, with different shape and with different composition of material shall be tested separately.

At least one test specimen containing six brackets shall be tested. Configuration of a test specimen in relation to tested component is given in the Clause C.7.3 of Annex C.

At least the worst case (the mechanically weakest case, i.e., weakest bracket in accordance with the test results obtained in in Clause 2.2.6.2 for horizontal load, brackets with weakest material, minimum thickness, minimum bracket height and maximum wing length) shall be tested.

Soft body impact resistance in [J] of each tested bracket shall be stated in the ETA.

2.2.6.9 Fibre content in composite material

This characteristic is only relevant for kits and brackets where the brackets belong to Group 3 and Group 2 with plastic reinforced with glass or other mineral fibres (e.g., polyamide PA 66 type).

The fibre content shall be determined by weight by testing of 2 test specimens at least, each one shall be taken from different bracket. Preparation of test specimens of mass 2 g to 10 g shall be performed in accordance with Clause 5 and Clause 6 of EN ISO 1172. Test method shall be in compliance with Clause 7 of EN ISO 1172, method A, evaluation of test shall be in accordance with Clause 5.1 of EN ISO 1172. The mass shall be considered constant when the difference between two last measurements, carried out at intervals of about 24 hours, is within 1 % of the last measured value.

Unlike Clause 7.1.4 of EN ISO 1172 the symbol “m_{fibre} in [%]” is used instead of the symbol “M_{glass}” as also other fibres than those made of glass can compose the product. Both individual test values of fibre content by weight $m_{fibre,i}$ and their arithmetic average value $m_{fibre,m}$, both in [%], rounded for two decimal places, shall be stated in the ETA.

2.2.6.10 Vicat softening temperature

This characteristic is only relevant for kits and brackets where the brackets belong to Group 2.

The Vicat softening temperature (VST) of the material of thermal barrier in bracket shall be determined by testing in compliance with the test method B50 of EN ISO 306, on three test specimens at least. Preparation of test specimens shall be in accordance with Clause 6 of EN ISO 306.

After preparation, test specimens shall be conditioned in accordance with Clause 7 of EN ISO 306 and then tested in accordance with Clause 8 of the standard. Finally, average value of Vicat softening temperature VST in °C shall be calculated in accordance with Clause 8.6 of EN ISO 306.

The average value of Vicat softening temperature VST in [°C], standard deviation σ_n in [ºC] of material of thermal barrier, rounded for one decimal place, shall be stated in the ETA.

2.2.6.11 Modulus of elasticity in tension of composite

This characteristic is only relevant for kits and brackets where the brackets belong to Group 3.

Modulus of elasticity in tension of the material shall be tested in accordance with EN ISO 527-4. Testing shall be performed at least on 5 test specimens of type 1B in accordance with Clause 6.1 and Figure 3 of EN ISO 527-1, cut from wing of bracket, e.g., by means of water jet cutting machine. Test specimens shall not be damaged by cutting.

If dimensions of tested bracket do not allow to prepare test specimen of type 1B, small tensile test specimens of type CP2 in accordance with Clause 6.4 of EN ISO 20753 shall be used. Thickness of test specimens shall be equal to real thickness of material, and it shall not be reduced by any procedure.

Before testing, test specimens shall be conditioned in laboratory conditions at temperature (23 ± 5) ºC and (50 ± 10) % for 24 hours at least. Test shall be performed in accordance with EN ISO 527-1 with speed rate of loading (10 ± 0,5) mm/min and frequency of data collection of elongation of measured length and loading force 5 Hz at least.

From the set of tests, test results visibly effected by incorrect composition of material (e.g., as unreasonably low content of fibres, matter not saturated by resin or uncured resin or bubbles in resin) shall be excluded from assessment and these effected test specimens shall be substituted by new ones. After tests, average value of test results shall be calculated and standard deviation σ_n for ungrouped results in accordance with Clause 6.1.1 of ISO 2602 shall be determined.

After this, one-sided bottom confidence interval of average value of modulus of elasticity in tension E at the confidence level 95 % in accordance with Clause 6.2 of ISO 2602, shall be calculated in [GPa] and rounded for two nearest valid places.

Modulus of elasticity in tension E, specified as one-sided bottom confidence interval at the confidence level 95 %, expressed in [GPa], shall be stated in the ETA.

2.2.7 Thermal transmittance

Thermal transmittance is assessed by means of the point thermal transmittance χ-value of the brackets and the linear thermal transmittance value ψ-value of the subframe profiles, when the subframe vertical or horizontal profiles are intended to penetrate the thermal insulation layer more than 5 % of its minimum thickness.

The point thermal transmittance χ-value of the brackets is only relevant for kits and brackets and it shall be assessed in accordance with Clause D.1.

Brackets belonging to different groups (see Clause 1.1.3) and with different geometry shall be tested separately.

The linear thermal transmittance ψ-value of the subframe profiles is relevant only for kits and it shall be assessed in accordance with the Clause D.2.

At least the worst case (i.e., for brackets belonging to Group 1 to 3, bracket with maximum thickness, maximum area in contact with the substrate (base length (B_b) and bracket height (H_b) in accordance with Figure 1.1.3.1 and maximum rod-diameter); for brackets belonging to Group 4, brackets with maximum rod diameter; and subframe profiles with maximum thickness and maximum penetration into the thermal insulation layer) shall be assessed.

Point thermal transmittance χ-value in [W/K] of each assessed bracket shall be stated in the ETA according to mode of its determination by case, selected by manufacturer in accordance with Clause D.3.

Linear thermal transmittance ψ-value in [W/(m·K)] of each assessed subframe profile shall be stated in the ETA according to mode of its determination by case, selected by manufacturer in accordance with Clause D.3.

If manufacturer does not select Case 2 according to Clause D.3, only χ-value for bracket and/or ψ-value for subframe profile for the maximum thickness of thermal insulation layer shall be given.

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 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.

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 samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	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 in accordance with 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 in accordance with 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 in accordance with 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 in accordance with EN ISO 11925-2	According to Control Plan	According to test method and Control Plan (v)	(iv)
3	Components produced by the manufacturer himself:				
	▪ Skin fixings (for products A and B in accordance with Clause 1.1)	See Table 3.2.2	See Table 3.2.2	See Table 3.2.2	See Table 3.2.23
	▪ Subframe profiles and fixings (for products A according to Clause 1.1)	See Table 3.2.3	See Table 3.2.3	See Table 3.2.3	See Table 3.2.3
	▪ Brackets (for products A and C in accordance with Clause 1.1)	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) in accordance with Commission Delegated Regulation (EU) 2016/364 and EN 13501-1

(ii) If it is necessary to perform SBI tests within the FPC, 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 skin fixings 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 characteristics in accordance with Table 2.1.2	According to Control Plan	According to Control Plan	According to Control Plan (ii)
		Direct test in accordance with relevant characteristics according to Table 2.1.2	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 in accordance with Clause 3.4.1. 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 3.2.3: Control plan when the subframe profiles and fixings 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 2.2.12.14 to 2.2.12.16 of EAD 090062-01-0404	According to Control Plan	According to Control Plan	According to Control Plan (ii)
		Direct test in accordance with relevant Clauses 2.2.12.14 to 2.2.12.16 of EAD 090062-01-0404	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 in accordance with Clause 3.4.1. 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 <u>brackets</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 characteristics in accordance with Table 2.1.3	According to Control Plan	According to Control Plan	According to Control Plan (ii)
		Direct test in accordance with relevant characteristics according to Table 2.1.3	According to Control Plan	According to Control Plan	At least once each 5 years
5	When relevant, organic content (i) for brackets of Group 1 and 4	Ash content / loss on ignition in accordance with Clause 3.4.1. Otherwise, Thermogravimetry test based on EN ISO 11358-1	According to Control Plan	According to Control Plan	Once per batch (ii)
7	Fibre content in composite material for brackets of Group 3 and, when relevant, Group 2 (i)	Test or control based on Clause 2.2.6.9	According to Control Plan	According to Control Plan	According to Control Plan (ii)
6	Vicat softening temperature (VST) for brackets of Group 2 (i)	Test or control based on Clause 2.2.6.9	According to Control Plan	According to Control Plan	According to Control Plan (ii)
8	Modulus of elasticity in tension of composite for brackets in Group 3	Test or control based on Clause 2.2.6.9	According to Control Plan	According to Control Plan	According to Control Plan (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 3.2.5: 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 in accordance with Tables 3.2.1 to 3.2.4 above.
(3) Checking of supplier certificates or supplier tests or test or control in accordance with 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 ... [product] 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 kits, skin fixings and brackets.	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the production or a new line
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 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.

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					
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 or a new line
Continuous surveillance, assessment and evaluation of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire					
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 Ash content or Loss on ignition

For products which are inorganic, i.e., products containing a low percentage of organic compounds 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 090019-01-0404	Kits for ventilated external wall claddings made of expanded glass granulates boards, magnesium oxide boards or other mineral boards, with rendering applied in situ.
EAD 090058-00-0404	Ventilated external wall cladding kit comprising a metallic honeycomb panel and its associated fixings.
EAD 090062-01-0404	Kit for external wall claddings mechanically fixed.
EAD 090097-00-0404	Kits for external wall claddings glued to the subframe.
EAD 090125-00-0404	Kits for external wall claddings with multilayer composite rigid cladding elements.
EAD 330030-00-0601	Fastener of external wall claddings.
EN 573-3:2019+A2:2023	Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition and form of products.
EN 636:2012+A1:2015	Plywood – Specification.
EN 1090-1:2009+A1:2011	Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components.
EN 1990:2023	Eurocode - Basis of structural and geotechnical design.
EN 1934:1998	Thermal performance of building - Determination of thermal resistance by hot box method using heat flow meter – Masonry.
EN 1991-1-4:2005+A1:2010	Eurocode 1: Actions on structures - Part 1-4: General actions - Wind loads.
EN 13162:2012+A1:2015	Thermal insulation products for buildings - Factory made mineral wool (MW) products – Specification.
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 13823:2010+A1:2022	Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item.
EN 13964:2014	Suspended ceilings - Requirements and test methods.
EN 14024:2023	Metal profiles with thermal barrier – Mechanical performance – Requirements, proof and tests for assessment.
EN 14411:2016	Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking
EN 16637-2:2023	Construction products: Assessment of release of dangerous substances - Part 2: Horizontal dynamic surface leaching test.
EN ISO 306:2022	Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST).
EN ISO 527-1:2019	Plastics – Determination of tensile properties – Part 1: General principles.
EN ISO 527-4:2023	Plastics - Determination of tensile properties - Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites.
EN ISO 1172:2023	Textile-glass-reinforced plastics - Prepregs, moulding compounds and laminates - Determination of the textile-glass and mineral-filler content using calcination methods.
EN ISO 1182:2020	Reaction to fire tests for products – Non-combustibility test.

EN ISO 1716:2018	Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value).
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 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 8990:1996	Thermal insulation - Determination of steady state thermal transmission properties - Calibrated and guarded hot box.
EN ISO 9053-1:2018	Acoustics - Determination of airflow resistance - Part 1: Static airflow method.
EN ISO 10211:2017	Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations (ISO 10211:2017).
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 (ISO 10456:2007).
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 11925-2:2020	Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source test.
EN ISO 15799:2022	Soil quality - Guidance on the ecotoxicological characterization of soils and soil materials.
EN ISO 20753:2023	Plastics - Test specimens.
EN ISO 80000-1:2022	Quantities and units - Part 1: General.
ISO 2602:1980	Statistical interpretation of test results. Estimation of the mean. Confidence interval.
OECD Test Guideline 301:1992	OECD guideline for testing of chemicals: Ready biodegradability, part A, B or E.

ANNEX A: TEST OF RESISTANCE TO VERTICAL LOAD OF ASSEMBLED KIT

A.1 General

This procedure is applicable to kits that contain brackets belonging to group 2, 3 or 4 (see Clause 1.1.3).

The principle is either to establish loadbearing capacity to vertical load of assembled kit or to determine the effects of vertical load on the assembled kit, when the separate components of the kit are in their resistance to vertical load limit, obtained for skin fixings as indicated in Clause 2.2.5.1, for brackets in Clause 2.2.6.1 and for connections (see row 12 in Table 2.1.1).

For this purpose, preliminary tests of resistance of bracket to vertical load in accordance with Clause 2.2.6.1 and of resistance to vertical load of skin fixings, if they are part of the kit, in accordance with Clause 2.2.5.1 can be necessary as input of preparation of test, even if manufacturer does not intent to declare characteristic “Resistance of bracket to vertical load” in accordance with Clause 2.2.6.1 and characteristic “Resistance to vertical load of skin fixings” in accordance with Clause 2.2.5.1.

When the mechanical resistance of the separate components is known, the limit vertical load in test Q_{ad} (100 %) shall be obtained as the lowest value from:

- In case of punctual skin fixings Types 1 to 3 as the arithmetic average value of vertical load for 1 mm permanent deformation ($F_{1,m}$) obtained for a single skin fixing in accordance with Clause 2.2.5.1, multiplied by number of skin fixings used in the test specimen that act as support of the skin element.
- In the case of skin fixings Type 4 or, when relevant, additional horizontal subframe profiles of skin fixings Type 2 and 3 (see Table 1.1.1 and Clause 1.1.1), as the arithmetic average value of vertical load for 3 mm displacement ($F_{3d,m}$), obtained for a single skin fixing in accordance with Clause 2.2.5.1, multiplied by the number of skin fixings in the subframe profile in the test specimen, that act as skin element supporting. Usually, for skin fixings Type 4, only the lower subframe profile supports the skin element, however, for skin fixings Type 2 and 3 with subframe profiles, the supporting subframe profile depends on the punctual skin fixings, that act as support of the skin element.
- In case of brackets, as the arithmetic average value of vertical load for 3 mm displacement ($F_{3d,m}$) obtained for a single bracket in accordance with Clause 2.2.6.1, multiplied by number of brackets in the test specimen.
- In case of connections between fixings and subframe profiles, subframe profiles together (if relevant) and subframe profiles with brackets, the arithmetic average value of the shear load resistance of subframe fixings (see row 12 in Table 2.1.1), multiplied by their separate number in detail of the test specimen.

To define the mechanically weakest case of the assembled kit the following aspects shall be considered:

- all components (brackets, subframe profiles, skin fixings, subframe fixings) made from the weakest material and minimum dimensions (including minimum thickness);
- brackets positioned in the maximum vertical and horizontal span;
- horizontal subframe profiles, if used, positioned in maximum vertical distances;
- subframe fixings of the minimum diameter of body and head, used in minimum number per one connection;

A.2 Test procedure

Test specimen shall be composed of the kit composition to be assessed for supporting one skin element (see Clause 1.3.1, e.g., in the case of subframe with vertical subframe profiles and with brackets of Group 1 to 3, the test specimen shall be composed of: two vertical subframe profiles with two brackets for supporting each subframe profile and the skin fixings for supporting the skin element). Rules for selection of skin element material used for testing shall be applied in accordance with Clause 1.3.1.

The assembled kit shall be installed on a rigid substrate (e.g., concrete wall, masonry wall or steel frame).

The skin element shall be selected according to the intended use specified for the skin fixings defined in the MPII, when no information is given, the skin element in accordance with Clause 2.2.3 shall be used. Skin element shall not be the weakest point of tested test specimen.

During installation of test specimen and after it, measuring points for determination of displacements in positive vertical position shall be prepared in following details at least:

- Point 1: In upper skin fixing points. In case of linear horizontal subframe profiles, in the middle point.
- Point 2: In bottom skin fixing points. In case of linear horizontal subframe profiles, in the middle point.
- Point 3: In the middle point of the bottom edge of the skin element.
- Point 4: In bottom of all vertical subframe profiles.
- Point 5: In upper corner of head of wing of brackets.
- Point 6: In bottom edge of bracket base (flange) under their anchoring-to-substrate point.

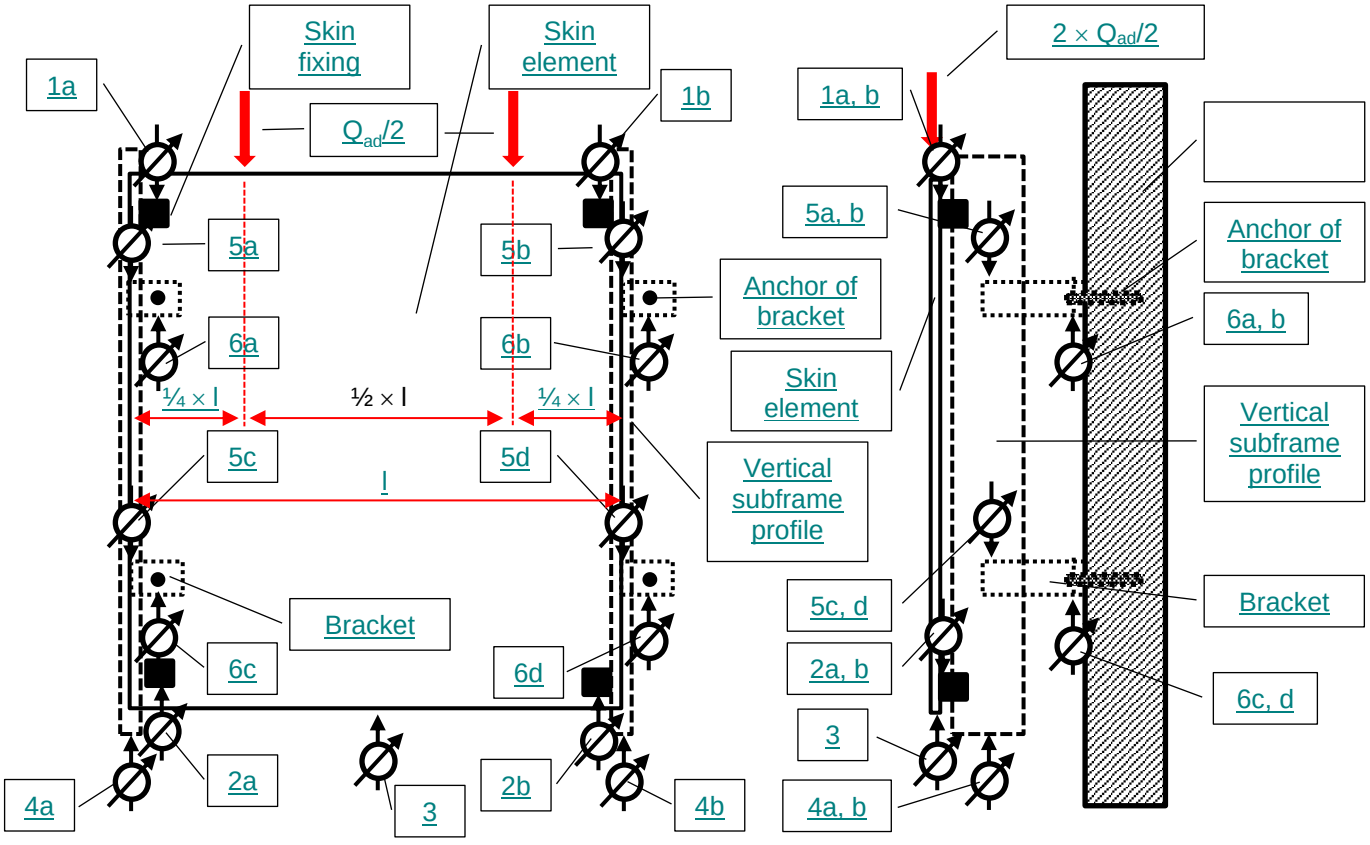


Figure A.2.1: Scheme of position of displacement gauges on specimen tested for resistance to vertical load

After installation of test specimen and measurement points, skin element, if necessary for adding of additional test load, shall be mounted. The basic value of test load Q_{ad} (100 %) shall be determined in accordance with Clause J.1, Annex J of EAD 090062-01-0404.

Then position of all measured points shall be recorded. After this, the additional load, (discounting the skin element weight) with accuracy 2 % or better shall be added as linear continuous loading on top of the skin element either by form of dead mass, or by appropriate test machine (at least of class 2 in accordance with EN ISO 7500-1). This additional load shall be added in steps of 10 % starting from the 10 % of the defined load in accordance with Clause A.1, until the test is finished (see below).

If necessary, continuous loading shall be achieved by sufficiently rigid implanting device.

For each measurement position, the displacement shall be recorded at initial state (no additional loading, only with the skin element weight) and after 10 minutes from adding the prescribed load step. Once 100 % of the additional load is reached, further loading is temporarily stopped, and the measurement shall also be carried 1 hour after this 100 % additional load.

From 100 % additional load, if the test specimen is still stable, new steps of 10 % can be added with their corresponding displacement measurement after 10 minutes loading until failure occurs.

The failure is defined as one of the following aspects:

- Test specimen collapses because of any component breaks.
- After 100 % loading, or any successive step, the test specimen presents a loss of stability (e.g., mechanical failure of any detail, displacement of any measured point is increasing without increasing of load, displacement of any measured point exceeds 15 mm or level specified in the MPII).

Behaviour of test specimen during test shall be observed and any damage of test specimen or its components shall be recorded in relation to loading step. Type of failure of test specimen shall be recorded.

A.3 Test results

Maximum vertical displacements of each group of measured points, as specified in Clause A.2, cleaned out from vertical displacement of measured points closer to flange, shall be obtained for each loading step and recorded into a table (see Table A.3.1).

Loading steps in the table shall be presented in relation to the skin element area in [m^2] used in the test specimen.

Table A.3.1 Example of presentation of test results from test of resistance to vertical load of assembled kit

Maximum value of vertical displacement (mm)									
Group of measured points	Loading step (load in kN)								
	0 % Q_{ad} [kN/m^2]	10 % Q_{ad} [kN/m^2]	20 % Q_{ad} [kN/m^2]	30 % Q_{ad} [kN/m^2]	40 % Q_{ad} [kN/m^2]	50 % Q_{ad} [kN/m^2]	60 % Q_{ad} [kN/m^2]	70 % Q_{ad} [kN/m^2]	… *)
Point 1	…	…	…	…	…	…	…	…	…
Point 2	…	…	…	…	…	…	…	…	…
Point 3	…	…	…	…	…	…	…	…	…
Point 4									
Point 5									
Point 6									

*) Further steps follow until failure occurs or until manufacturer specifies to finish the test on query of test laboratory.

Additionally, the test result shall be the curve as a function of load and the maximum displacement for each group of measured points, specified in Figure A.2.1 and as example given in Table A.4.1.

All measured displacements shall be rounded and recorded with accuracy in one decimal place. All determined loads shall be calculated with accuracy in two decimal places.

A.4 Test report

The test report shall contain at least:

- Detailed information of the test specimens. At least the following information shall be defined (data based on the MPII):
  - Brackets: material, geometry, distance between two brackets on one subframe profile and number and disposition of fixings.
  - Subframe profiles: material, geometry, and distance between two subframe profiles.
  - Skin fixings: material, geometry, and number and disposition of skin fixings.
  - Skin element: material, geometry and weight.
  - Fixings between the substrate and the assembled cladding kit (position, generic type, material and geometry).
- The additional applied load, Q_{ad}, in [kN] and in relation to the skin element area in [kN/m^2].
- The measured displacements of each group of points in [mm] and loads in [kN/m^2].
- The tabular values load-displacement (in N per mm), see Table A.4.1. In addition, graphic form separately for each measured group of points can be added, see Figure A.4.1.
- Records about any damage of tested specimen in relation to applied load and type of failure.

Table A.4.1 Example of tabular presentation of test results

Load		Vertical displacement (position) [mm]					
		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
[%] of Q_{ad}	Q_{ad} in [kN]	upper skin fixings	bottom skin fixings	middle point on bottom of skin element	bottom of vertical subframe profiles	upper corner of head of bracket wing	bottom edge of bracket flange
0 %	0	0	0	0	0	0	0
10 %	0,04	0	0	0	0	0	0
20 %	0,08	0,1	0,1	0,1	0,1	0	0
30 %	0,11	0,1	0,1	0,1	0,1	0,1	0
40 %	0,15	0,1	0,1	0,1	0,1	0,1	0
50 %	0,19	0,2	0,2	0,2	0,2	0,1	0
60 %	0,23	0,3	0,3	0,3	0,2	0,2	0
70 %	0,29	0,5	0,5	0,5	0,3	0,2	0,1
80 %	0,37	0,7	0,7	0,7	0,4	0,3	0,1
90 %	0,46	1,0	1,0	1,0	0,4	0,4	0,1
100 %	0,57	1,2	1,2	1,2	0,6	0,5	0,1
110 %	0,72	1,5	1,5	1,5	0,8	0,7	0,2
120 %	0,89	2,0	2,0	2,0	1,0	0,9	0,3
…	….	…	…	…	…	…	…

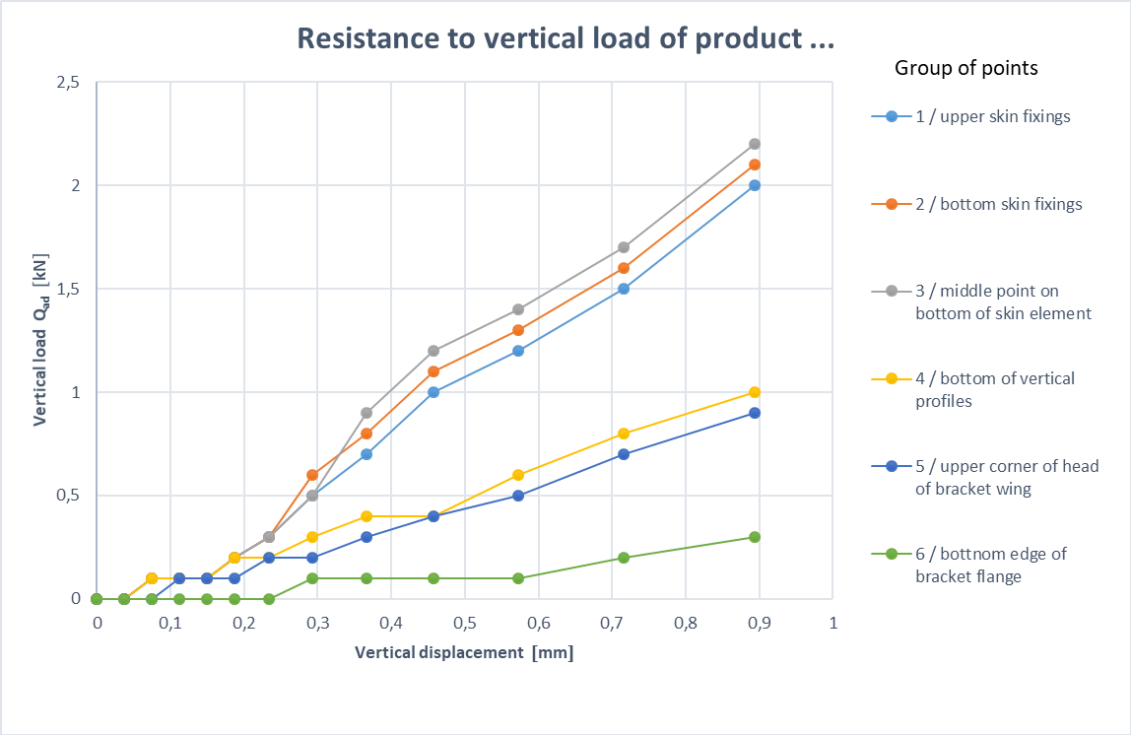


Figure A.4.1: Example of graphic expression of maximum test results

ANNEX B: MECHANICAL RESISTANCE OF SKIN FIXINGS

B.1 Bending resistance of skin fixings of type 4

B.1.1 General

Subframe profiles used such skin fixings Type 4 shall be assessed by structural calculation supplemented by testing.

Subframe profile resistance calculation (see Clause B.1.2) shall be validated by testing results obtained in accordance with Clause B.1.3. Validation criteria are defined in Clause B.1.4.

For this validation purpose, at least the worst case (the mechanically weakest case) or the most representative case (according to the MPII) of subframe profile such skin fixings Type 4 shall be tested.

Each subframe profile type and each applicable load direction, i.e., horizontal load (representing wind suction and/or pressure) or vertical load (representing dead load) shall be assessed.

By confirming the results of the validated calculation, the subframe profile resistance calculation, input and output conditions (see Clause B.1.2) shall be used for other configurations for the same type of subframe profile, i.e., for other dimensional range of the same geometry and other material resistance of the subframe profile.

For each relevant subframe profile configuration (at least for the mechanically weakest geometry and material), the arithmetic average, standard deviation σ_n and characteristic values of the punctual load ($F_{1d,cal}$, $F_{3d,cal}$, $F_{u,cal}$ in [N]) and the corresponding bending moment ($M_{1d,cal}$, $M_{3d,cal}$, $M_{u,cal}$ in [N·m]), see Clause B.1.2, shall be stated in the ETA.

B.1.2 Criteria for the resistance calculation of subframe profiles

Subframe profile calculations shall be performed either using a numerical structural simulation at elastic state, or using simplified methods based on relevant elasticity and resistance equations, both at state at failure and at state of specified displacement (1 mm and 3 mm). Fatigue situations, dynamic analysis and geometry imperfections are not considered.

When numerical structural simulation is used, specific criteria given in Clause B.1.2.1 shall be followed.

The calculation method to be used shall be validated by testing in accordance with Clause B.1.3.

For the subframe profile resistance calculation, the subframe profile itself and the applied load shall be simulated/represented through the calculation models. The calculation model shall represent at least the relevant geometry of the component, supports (including the corresponding degrees of freedom) and span.

The resistance calculations shall consider, at least, the material resistance properties (tensile strength, modulus of elasticity, etc.) and the geometric properties (form and dimensions, moment of inertia, etc.) defined for the subframe profile.

When the testing result used for the validation of the calculation is the arithmetic average value, the results obtained by calculation are also called arithmetic average value. In the same way, when the testing result used for the validation of the calculation is the characteristic value, the results obtained by calculation are also called characteristic values.

Output data shall be the punctual load action F_{cal} in [N] and the corresponding bending moment M_{cal} in [N·m] obtained at the following states:

- State of failure: considered at the material tensile yield strength: force $F_{u,cal}$ and bending moment $M_{u,cal}$.

- State at specified displacement: considered at 1 mm and 3 mm displacement at the centre span between two supports: forces $F_{1d,cal}$, $F_{3d,cal}$ and bending moments $M_{1d,cal}$, $M_{3d,cal.}$

Output calculation results shall be defined as the arithmetic average values or the characteristic values depending on the arithmetic average or characteristic testing results used for the validation of the calculation in accordance with Clause B.1.4.

B.1.2.1 Specific criteria for the use of numerical structural simulation

Numerical simulation shall be carried out by means of a software applicable for corresponding limit state and in 2D or 3D simulation depending on the specific geometry and boundary conditions to be applied on the subframe profile to be assessed. The calculation and the software shall be managed by an experimented technician[8] in numerical simulations.

Criteria defined below are applicable independently of the software. When the validation of the calculation by means of testing (see Clause B.1.4) is carried out, all these criteria are applicable to the tested specimens.

Criteria for the calculation model:

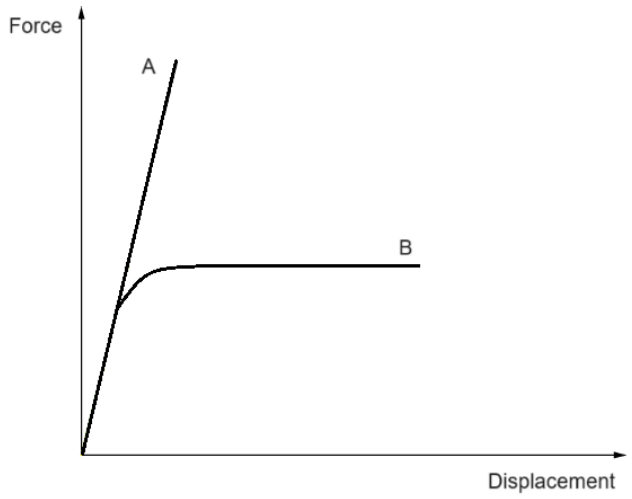
- Calculation model geometries and materials shall exactly correspond to the subframe profiles to be calculated.

- The finite elements to be considered shall be linked to the type of numerical simulation (2D or 3D), mesh density to be selected and the curvature and geometry complexity or the subframe profiles.

- The degree of freedom of the chosen finite elements shall be compatible with the calculation model and its boundary conditions (actions to be applied and connexions to the supports).

Type of structural simulation:

- Linear elastic simulation or materially non-linear simulation may be considered depending on the subframe profile material expected behaviour. Linear elastic simulation implies that the deformations are linear, the material works in linear elastic stage and the geometry is perfect. Materially non-linear simulation implies that the deformations are linear, the material works in elastic-plastic stage and the geometry is perfect (see Figure B.1.2.1.1).



Legend:

A = Linear elastic simulation.

B = Materially non-linear simulation.

Figure B.1.2.1.1: Graphical explanation for the types of structural simulations.

8 Design qualification and experience of personnel of required level at least DQL2 in accordance with Table B.1 of EN 1990 and the corresponding national regulations is recommended for the application of numerical simulations.

B.1.3 Bending resistance test of subframe profiles

Bending resistance of subframe profiles shall be tested in accordance with Clause 5.2 of EN 13964, with following settings of details of test:

- Test shall be performed on 5 test specimens at least for each position of subframe profile in position of its function in construction in accordance with position convention given in Clause 1.3.5.

- For vertical subframe profiles for positive (that is pressure of wind) and negative (that is suction of wind) position.

- For horizontal subframe profiles for horizontal positive (that is pressure of wind), horizontal negative (that is suction of wind) and vertical positive (that is dead mass) position.

Test specimens are conditioned for 24 hours before test and test is performed at laboratory conditions (23 ± 5) ºC and (50 ± 10) %.

Test specimen span shall be 1,0 m.

Subframe profile shall be supported in test machine during test by two cylindrical beds of diameter 20 mm at least. If necessary, specially shaped beds of length 50 mm each for stabilization of subframe profile in correct position may be used on both ends of tested specimen, positioned symmetrically to cylindrical beds. Loading and measurement shall be performed in compliance with Clause 5.2.2 of EN 13964, except of determination of maximum bending moment. The loads for situations at measured displacement in the centre span of 1 mm and 3 mm and the maximum load at failure (i.e., subframe profile break, or 50 mm displacement (L/20)) a shall be recorded.

After the tests, the following values shall be calculated for each subframe profile, position and situation of load in accordance with position convention as given in Clause 1.3.5:

- Arithmetic average values of the loads $F_{1d,m}$, $F_{3d,m}$, $F_{u,m}$, in [N] and of the corresponding bending moments $M_{1d,m}$, $M_{3d,m}$, $M_{u,m}$, in [N·m],

- Characteristic values of the loads $F_{1d,C}$, $F_{3d,C}$, $F_{u,C}$ in [N], and of the corresponding bending moments $M_{1d,C}$, $M_{3d,C}$, $M_{u,C}$ in [N·m], at measured displacements 1 mm and 3 mm and at load at failure. Characteristic values $F_{1d,C}$, $F_{3d,C}$, $F_{u,C}$, $M_{1d,C}$, $M_{3d,C}$, $M_{u,C}$ shall be determined in accordance with Equation (N.1) of EAD 090062-01-0404.

In extended application, test results are valid for the following cases:

- Subframe profiles with the same moment of inertia in specified position in accordance with position convention as given in Clause 1.3.5, but different dimensions, made of material with the same or greater mechanical properties.
- Subframe profiles with greater moment of inertia in specified position in accordance with position convention given in Clause 1.3.5, made of material with the same or greater mechanical properties.

B.1.4 Criteria for the validation of the resistance calculation of subframe profiles

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

The validation criterion is:

- The load obtained by testing at state of failure and at state of specified displacement (1 mm and 3 mm), punctual load F_{test} in [N] and the corresponding bending moment M_{test} in [N·m] (see Clause B.1.3), shall not be lower than the load value, punctual load F_{cal} in [N] and the corresponding bending moment M_{cal} in [N·m] obtained by calculating (see Clause B.1.2) for the same configuration as tested.

  - $F_{test} \geq F_{cal}$ [N] and $M_{test} \geq M_{cal}$ [N·m].

  - No safety factors shall be used for the validation purposes.

When these criteria are not met, the resistance calculation method and/or model shall be corrected to meet 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 load resistance for any geometry of the subframe profile configuration.

For each limit state and for each reference tested value (arithmetic average and characteristic value) the validation criteria shall be applied.

B.2 Mechanical resistance test for the connection between the clamp/anchor and the horizontal subframe profile with skin fixings of type 5

B.2.1 General

The tests shall be carried out under conditions (23 ± 5) ºC and (50 ± 10) % relative humidity.

A minimum of 5 specimens shall be tested.

The skin fixing shall be installed as specified by the MPII.

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

The test shall be performed in successive displacement steps measured under load and unload conditions, until 1 mm permanent deformation occurs under unload conditions.

Steps are defined in accordance with displacement growths: steps of 0,25 mm, 0,5 mm, or 1,0 mm shall be selected depending on the behaviour of the skin fixing under load. After each step, the skin fixing shall be unloaded, and the permanent deformation shall be measured after 1 minute from unloading.

When 1 mm permanent deformation occurs, the test under load conditions can 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 skin fixing (data based on the MPII).
- Each individual displacement and force value, $F_{1,I}$ in [N], for 1 mm permanent deformation.
- Each individual failure value, $F_{u,i}$ 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, $F_{1,m}$, $F_{u,m}$, standard deviations σ_n and the characteristic values, $F_{1,C}$, $F_{u,C}$, in accordance with Equation (N.1) of EAD 090062-01-0404.

B.2.2 Resistance to vertical load (dead load)

Test procedure is given in Clause B.2.1.

The test specimen consists of the skin fixings applied to a rigid substrate as shown in Figure B.2.2.1.

The force shall be exerted as shown in Figure B.2.2.1.

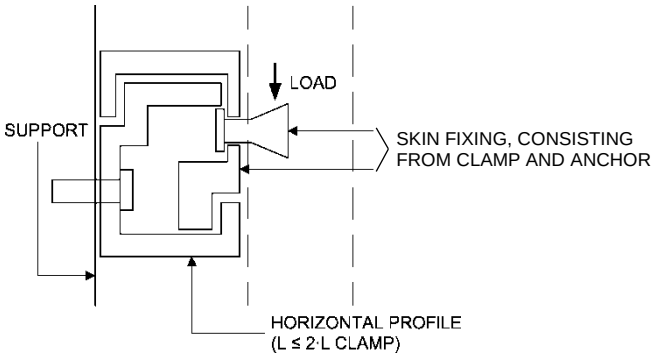


Figure B.2.2.1: Example of test layout for vertical load resistance test.

B.2.3 Resistance to horizontal load resistance (wind suction)

Test procedure is given in Clause B.2.1.

The test specimen consists of the skin fixing applied to a rigid support as shown in Figure B.2.3.1. The force shall be exerted as shown in Figure B.2.3.1.

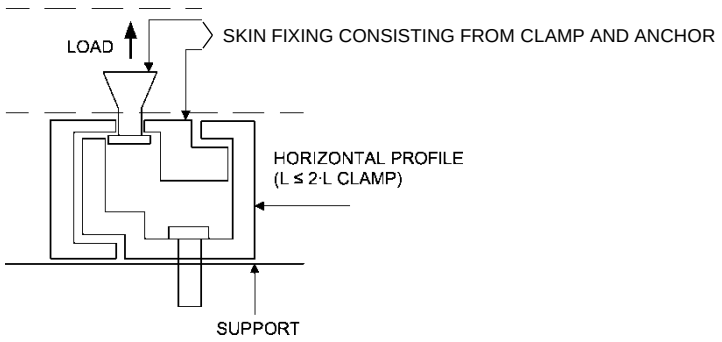


Figure B.2.3.1: Example of test layout for horizontal load resistance test.

ANNEX C: ASSESSMENT METHODS OF BRACKETS

C.1 Adjustments for brackets Group 4

Brackets of Groups 1, 2 and 3 shall be adjusted for testing in accordance with Annex L of EAD 090062-01-0404.

Brackets of Group 4 shall be adjusted in accordance with composition into rigid substrate, created by rigid steel support or by concrete element of thickness at least 120 mm in accordance with Figures C.1.1 to C.1.6.

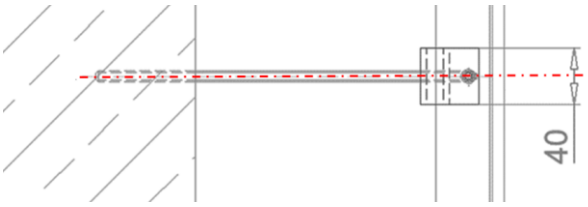


Figure C.1.1: Example of loading and measurement axis for horizontal load testing.

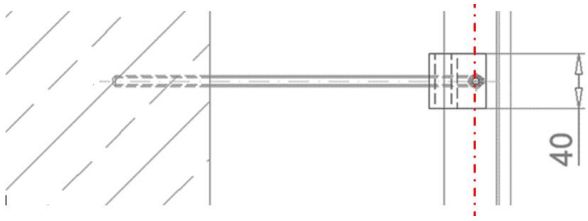


Figure C.1.2: Example of loading and measurement axis for vertical load testing on single rod bracket.

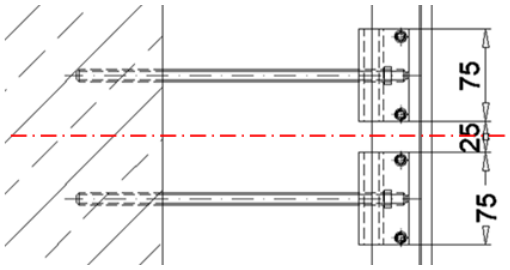


Figure C.1.3: Example of loading and measurement axis for horizontal load testing on twin rod bracket.

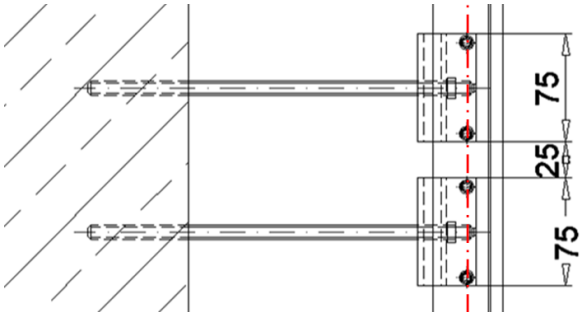


Figure C.1.4: Example of loading and measurement axis for vertical load testing on twin rod bracket.

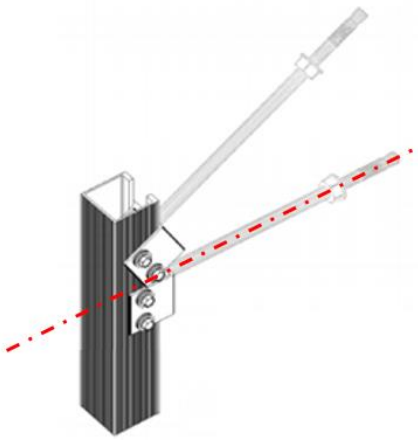


Figure C.1.5: Example of loading and measurement axis for horizontal load testing on triangle bracket.

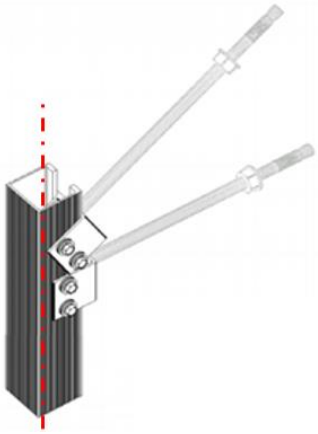


Figure C.1.6: Example of loading and measurement axis for vertical load testing on triangle bracket.

C.2 Pulsating load cycles

The bracket shall be exposed to 10000 load cycles of tensile load in horizontal direction at a frequency from 2 Hz up to 5 Hz (reference method). Optionally, the brackets exposition shall be extended to 25000 and/or 50000 load cycles depending on whether the bracket 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:

- upper load F_{max} = 50 % x $F_{u,C}$;
- lower load F_{min} = 10 % x $F_{u,C}$,

  Where $F_{u,C}$ = characteristic value of the resistance to horizontal load at failure (see Clause 2.2.6.2) determined in accordance with Equation (N.1) of EAD 090062-01-0404.

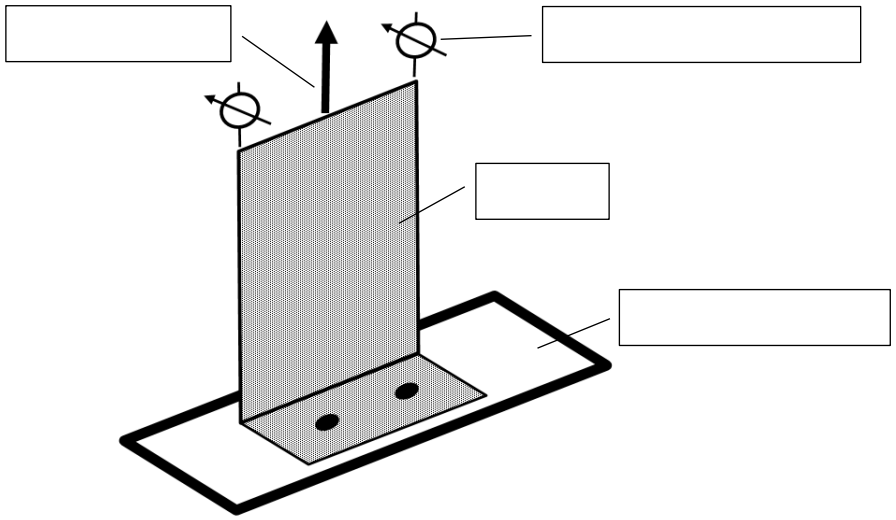


Figure C.2.1: Scheme of test of bracket in pulsating load

During each cycle the load shall vary like a sine curve between F_{max} and F_{min}. The displacement at state of maximum load shall be measured during the first loading up to F_{max} and then either continuously or at least after 10, 100, 1000 and 10000 load cycles (reference method), in case of discontinuous measurement with break of loading in maximum value of load in specified cycle. Optionally, also after 25000 and/or 50000 load cycles.

The load shall be applied in accordance with the resistance to horizontal load test (see Clause 2.2.6.2). Displacement is measured at the point where the load is applied.

After completion of the load cycles the specimen shall be unloaded, the permanent deformation measured after 2 hours, and the resistance to horizontal load test after cycles test (see Clause 2.2.6.2) shall be carried out.

Test report shall include at least:

- Information required for the test report in accordance with the resistance to horizontal load test (see Clause 2.2.6.2).
- Frequency applied in Hz.
- Results of displacement under load conditions measured after 1, 10, 100, 1000 and 10000 cycles. Optionally, also after 25000 and/or 50000 load cycles.

- Test results shall be given in accordance with the resistance to horizontal load test (see Clause 2.2.6.2).

C.3 Sustained vertical load test

C.3.1 General

This test is only applicable for kits and brackets where the brackets belong to Group 2 and 3 (see Clause 1.1.3). It is also relevant for brackets belonging to Group 1 and 4 with thermo-stop pads.

Test specimen consists of one bracket installed according to the MPII installed onto a rigid substrate (e.g., concrete wall, a masonry wall of thickness 250 mm or a steel frame) connected to a piece made of vertical subframe profile, timber stud or test equipment tool for applying the sustained load (e.g., see Figure C.3.1.1). For brackets belonging to Group 4, the adjustments considered in Clause C.1 shall also be considered. When more than one bracket is considered in the test (e.g., for two asymmetrical brackets) the test results shall correspond to the number of brackets tested.

At least 1 test specimen shall be tested.

After installation, test specimen shall be exposed to 2000 hours of constant sustained vertical load (e.g., see Figure C.3.1.1). Test load shall correspond to 2/3 of the arithmetic average value for vertical load $F_{u,m}$ in [N] as specified in Clause 2.2.12.17 of EAD 090062-01-0404 ($Q_{sust} = 2/3 \cdot F_{u,m}$).

The load shall be applied in the way to avoid as much as possible the possible eccentricity with respect to the vertical axis of the subframe fixings connecting the bracket with the piece of subframe profile, stud or testing tool.

Test is performed at (23 ± 5) °C and (50 ± 10) % RH laboratory conditions.

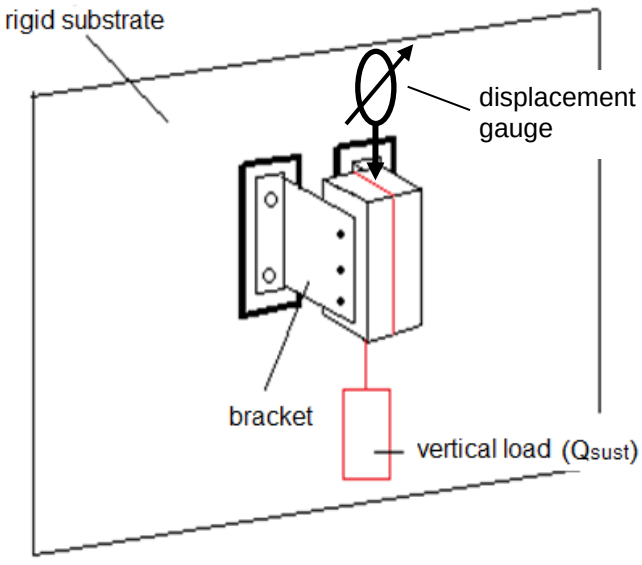


Figure C.3.1.1: Example of test arrangement for sustained vertical load.

Vertical displacement of test specimen shall be measured on upper side of wing of bracket in vertical axis of the subframe fixings, used for connection of brackets to auxiliary central loading tool, with accuracy 0,02 mm or better.

The displacement measurements in [mm] shall start the instant that the sustained load (Q_{sust}) 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 83,3 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 earlier when no change to previous measurement is detected. This last measurement is to be considered the permanent deformation ($w_{residual}$).

Test specimen shall be regularly visually controlled all the time of test together with measurement and any damage during test or after finish of test shall be recorded.

The following values shall be calculated, when more than one test specimen is tested, arithmetic average values shall be calculated:

- Difference between the displacement at initial loading ($w_{load,0h}$) and after 24 hours after removing the sustained load ($w_{residual}$).
- Optionally:
  - Difference between the displacement at initial loading ($w_{load,0h}$) and after 2000 hours ($w_{load,2000h}$).
  - Creep coefficient φ_{2000h} [--] for the bracket shall be calculated using the expression:

$$\varphi_{2000h} = \frac{w_{load,2000h} - w_{load,0h}}{w_{load,0h} - (w_{laod,2000h} - w_{residual})} \qquad \text{(C.3.1.1)}$$

Where:

$w_{load,2000h}$ [mm] = the total displacement under load measured at the ending time X = 2000 hours (i.e., about 83,3 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.

C.3.2 Test report

The test report shall contain at least:

- Detailed information of the test specimen. At least the following information shall be defined (data based on the MPII):
  - Bracket: materials, geometry and position of the subframe fixings. Material and geometry of the thermo-stop pads, when applicable.
  - Subframe profile, stud or test tool used: material and geometry.
  - Fixings between the substrate and the assembled brackets (position, generic type, material and geometry).
- Test sustained load applied, Q_{sust} 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, optionally the calculated creep coefficient φ_{2000h} [--].
- Diagram time-displacement including all the measurements under loading.
- Reference on any damage (for example cracks, permanent deformation, twist, delamination, and so on) identified on test specimen(s) during or after test.

C.4 Freeze-thaw cycles

C.4.1 General

This test is only applicable for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

The brackets shall be exposed to 100 freeze-thaw cycles in two batches, batch of 3 test specimens at least for test of resistance to vertical load (see Clause 2.2.6.1), batch of 3 test specimens at least for test of resistance to horizontal load (see Clause 2.2.6.2).

Freeze-thaw cycles comprise the following phases:

- Cool (freeze phase) in the freeze chamber which shall reach a temperature of (-20 ± 4) °C within 1 hour to 2 hours, specimens shall be held at this temperature for a further 1 hour.

- Heat (thaw phase) by flooding of chamber with water of temperature (20 ± 4) °C within 10 minutes and hold at this temperature for a further 3 hours.

Before the exposure to freeze-thaw cycles, the test specimens shall be immersed in water at ambient temperature (> 10 °C) for 48 hours at least.

After exposure, test specimens shall be removed from chamber and dried at (23 ± 5) °C and (50 ± 10) % RH for 24 hours up to 3 days, and examined for any damage caused by freeze-thaw cycles.

After this conditioning, the batches are tested in specified number for resistance to vertical load in accordance with Clause 2.2.6.1 and for resistance to horizontal load in accordance with Clause 2.2.6.2.

C.4.2 Observations before and after conditioning

The surface of all test specimens shall be examined before conditioning to establish whether any damage (e.g., any cracking, blistering, etc.) is present on tested specimens. The dimensions and positions of defects, if present, shall be defined, recorded and marked (e.g., by durable marker) on test specimens.

At the end of conditioning, the surface of test specimens shall be carefully examined to establish whether any new damage (e.g., cracking, blistering, degradation of plastic or composite material, detachment, cracking, loss of adhesion, ongoing formation of cracks, etc.) has occurred, or if any original damage has increased.

The observations relating to a change in tested brackets, dimensions and positions of all defects shall be recorded.

C.4.3 Test report

The test report shall contain at least:

- Observations on damages recorded before freeze-thaw cycles.

- Observations on damages recorded after completion of freeze-thaw cycles.

- Detail photos of damages occurred on each test specimen after the freeze-thaw cycles and, if necessary, after each visual inspection.

- Results of resistance tests carried out after freeze-thaw cycles, resistance to vertical load (see Clause 2.2.6.1) and resistance to horizontal load (see Clause 2.2.6.2).

C.5 Immersion in water

C.5.1 General

This test is only applicable for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

The brackets shall be immersed in water at the temperature (60 ± 2) °C for 90 days, batch of 3 test specimens at least for test of resistance to vertical load (see Clause 2.2.6.1), batch of 3 test specimens at least for test of resistance to horizontal load (see Clause 2.2.6.2).

After exposure, test specimens shall be removed from bath and dried at (23 ± 5) °C and (50 ± 10) % RH for 24 hours up to 3 days, and examined for any damage caused by immersion in water.

After this conditioning, the batches are tested in a specified number for resistance to vertical load in accordance with Clause 2.2.6.1 and for resistance to horizontal load in accordance with Clause 2.2.6.2.

C.5.2 Observations before and after conditioning

See Clause C.4.2.

C.5.3 Test report

The test report shall contain at least:

- Observations on damages recorded before immersion in water.
- Observations on damages recorded after completion of immersion in water.
- Detail photos of damages occurred on each test specimen after immersion in water and, if necessary, after each visual inspection.
- Results of resistance tests carried out after immersion in water, resistance to vertical load (see Clause 2.2.6.1) and resistance to horizontal load (see Clause 2.2.6.2).

C.6 Ageing under temperature and high humidity

C.6.1 General

This test is only applicable for kits and brackets where the brackets belong to Group 2 or 3 (see Clause 1.1.3).

The brackets shall be exposed at the temperature (80 ± 2) °C and (90 ± 5) % RH for 90 days, batch of 3 test specimens at least for test of resistance to vertical load (see Clause 2.2.6.1), batch of 3 test specimens at least for test of resistance to horizontal load (see Clause 2.2.6.2).

After exposure, test specimens shall be removed from chamber and conditioned at (23 ± 5) °C and (50 ± 10) % RH for 24 hours up to 3 days, and examined for any damage caused by conditioning.

After this conditioning, the batches are tested in a specified number for resistance to vertical load in accordance with Clause 2.2.6.1 and for resistance to horizontal load in accordance with Clause 2.2.6.2.

C.6.2 Observations before and after conditioning

See Clause C.4.2.

C.6.3 Test report

- The test report shall contain at least:
- Observations on damages recorded before ageing under temperature and high humidity.
- Observations on damages recorded after completion of ageing under temperature and high humidity.
- Detail photos of damages occurred on each test specimen after ageing under temperature and high humidity and, if necessary, after each visual inspection.
- Results of resistance tests carried out after ageing under temperature and high humidity, resistance to vertical load (see Clause 2.2.6.1) and resistance to horizontal load (see Clause 2.2.6.2).

C.7 Soft body impact test

C.7.1 General

This test is only applicable for kits and brackets where the brackets belong to Group 2, 3 or 4 (see Clause 1.1.3).

The resistance of brackets to soft body impacts shall be tested in accordance with the method indicated in Annex G of EAD 090062-01-0404, considering the following adjustments.

- Clause G.1 of EAD 090062-01-0404 is applicable considering adjustments defined below.
- Clause G.2 of EAD 090062-01-0404 shall be substituted by Clause C.7.2.
- Clause G.3 of EAD 090062-01-0404 is not applicable, the impact use categories are only applicable for kits that contains the skin element (e.g., cladding kits) where the whole set of hard bodies and soft bodies impacts in accordance with Table G.2.1 of EAD 090062-01-0404 are carried out.
- In Clause G.4 of EAD 090062-01-0404, only Clause G.4.1 is applicable.
- Clause G.5 of EAD 090062-01-0404 shall be substituted by Clause C.7.3.
- Clause G.6 of EAD 090062-01-0404 shall be substituted by Clause C.7.4.

C.7.2 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 C.7.2.1 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.

Test shall be performed at normal laboratory conditions (23 ± 5) °C and (50 ± 10) % RH.

When no deterioration (see Table C.7.2.1) is observed, the test specimen is considered as that resists the corresponding impact resistance.

Each impact shall be carried out on a fresh part of the test specimen, however if an impact with a lower energy appears to cause no damage, the same location may be used for impacts at higher energy. In this case, if the higher impact energy causes any deterioration (see Table C.7.2.1), the same higher impact shall be repeated in other test specimen area or new test specimen to confirm that it does not resist such impact energy.

Table C.7.2.1 Soft body impact tests

External impacts			**Observations for the assessment**
Soft body impact	S1	• Weight: 3 kg • Impact: 10 J (height 0,34 m) • Number of impacts for each position: 3 • Sequence of impacts: position No. 3, 1, 2, 4 in accordance with Figure C.7.2.1.	No deterioration (1)
	S2	• Weight: 3 kg • Impact: 60 J (height 2,04 m) • Number of impacts for each position: 3 • Sequence of impacts: position No. 3, 1, 2, 4 in accordance with Figure C.7.2.1.	No deterioration (1)
	S3	• Weight: 50 kg • Impact: 300 J (height 0,61 m) • Number of impacts for each position: 1 • Sequence of impacts: position No. 5, 4, 6, 1, 2, 3, 7 in accordance with Figure C.7.2.1.	No deterioration (1)
	S4	• Weight: 50 kg • Impact: 400 J (height 0,82 m) • Number of impacts for each position: 1 • Sequence of impacts: position No. 5, 4, 6, 1, 2, 3, 7 in accordance with Figure C.7.2.1.	No deterioration (1)
(1) No deterioration means that none of the following aspects shall be observed: - Any bracket or kit component is broken or visually deformed in a way that the test specimen stability is compromised. - Any bracket or kit component presents visible cracks, delamination, or defect. If any damage is observed in the skin element (see Clause 1.3.1), it shall be neglected. The skin element may be replaced when it does not work properly after an impact.			

C.7.3 Test specimen

C.7.3.1 Test specimen for kits

In the case of kits, the test specimen shall be the mechanically weakest case of the assembled kit considering a skin element (rules for its selection see Clause 2.2.3) that shall not be the weakest point of the assembling.

The test specimen shall include, at least the configuration of brackets defined in Figure C.7.3.2.1. For brackets belonging to Group 4 (see Clause 1.1.3) the adjustments considered in Clause C.1 shall be considered.

The area of the skin element to be selected for the testing, depends on the kit configuration.

To define the mechanically weakest case of the assembled kit, the following aspects shall be considered:

- The mechanically weakest skin fixings (e.g., minimum thickness or diameters, minimum mechanical material characteristics).
- Minimum number of skin fixings by skin element area. Maximum distance between skin fixings in one direction (usually in vertical) combined with the minimum skin element area.
- The mechanically weakest subframe components (e.g., minimum thickness, minimum mechanical material characteristics).
- Maximum span between subframe profiles.
- Maximum span between brackets, with the configuration given in Figure C.7.3.2.1.

Test specimen shall be attached to a rigid substrate (e.g., concrete wall, masonry wall or steel frame).

C.7.3.2 Test specimen for brackets

In the case of brackets, the test specimen (see Figure C.7.3.2.1) shall correspond with the mechanically weakest case according to the MPII. To define the mechanically weakest case of the assembled test specimen, the maximum span between brackets according to MPII shall be considered.

Each different bracket type (different form, material, and bracket height) shall be tested.

One skin element (rules for its selection see Clause 2.2.3) that shall not be the weakest point of the assembling shall be considered and shall be connected to the brackets by means subframe profiles according to MPII.

When no information is given the following information for the test specimen arrange may be considered:

- Distance between axes of brackets shall be 600 mm in vertical position and 900 mm in horizontal position.
- For the connection between the skin element and the brackets, vertical T subframe profiles of dimensions 80×45×2 mm made of aluminium alloy AW 6060 (EN 573-3), fixed to brackets by steel bolts of M8 size, one bolt per bracket, shall be used. In this case, subframe profiles shall overhang outer edges of brackets for 100 mm at least.
- Skin element made of exterior plywood sheet of thickness 24 mm and of dimensions 800 mm height and 2000 mm width.
- Skin element fixed to vertical subframe profiles by cylindrical headed self-tapping screws of size 5,5 × 45 at least, equipped with steel washers of external diameter 10 to 12 mm, one screw per 100 mm, positioned closely to axis of vertical T subframe profile.

Test specimen shall be attached to a rigid substrate (e.g., concrete wall, masonry wall or steel frame).

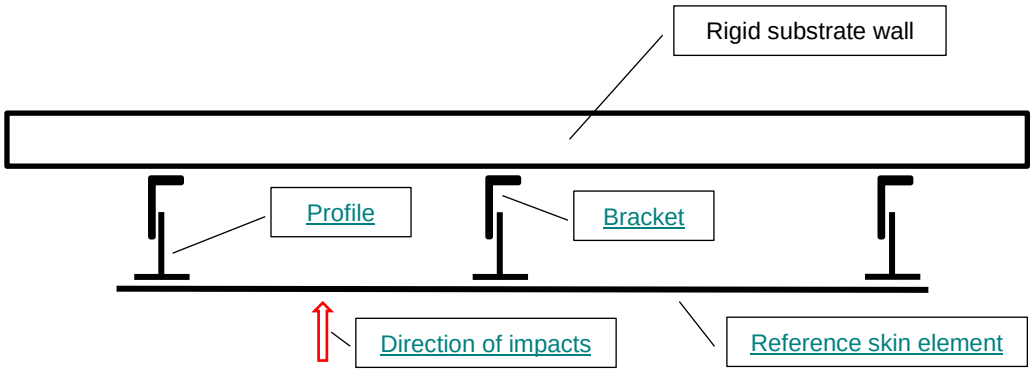


Figure C.7.3.2.1a: Example of test arrangement and impact location – vertical view.

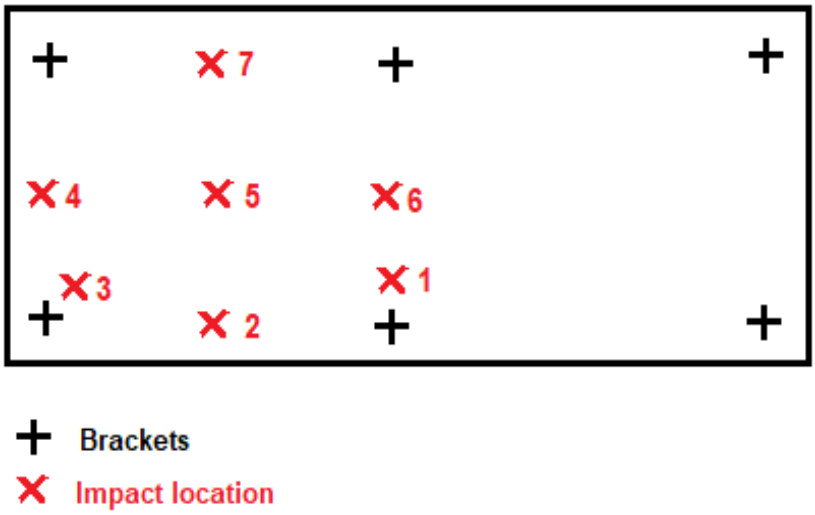


Figure C.7.3.2.1b: Example of test arrangement and impact location – front view.

C.7.4 Test report

The test report shall contain at least:

- Detailed information of the test specimen. At least the following information shall be defined:
  - Brackets: material, geometry, distance between two brackets and number and disposition of fixings.
  - Subframe profiles: material, geometry and distance between two subframe profiles.
  - Skin fixing: material, geometry and number and disposition of fixings).
  - Skin element: material and geometry.
  - Fixings between the test equipment (rigid substate) and the assembled test specimen (position, generic type, material and geometry).
- For each impact: position of the impact, type of impact body, energy applied and observation on the test specimen after impacting.

ANNEX D: POINT THERMAL TRANSMITTANCE OF BRACKETS / RODS AND LINEAR THERMAL TRANSMITTANCE OF SUBFRAME PROFILES

D.1 General

This annex describes the assessment method of the point thermal transmittance χ-value in [W/K] of brackets or rods, and the linear thermal transmittance ψ-value in [W/(m·K)] of subframe profiles that penetrate the thermal insulation layer more than 5 % of its minimum thickness.

This method is based on the comparative results of the thermal transmittance of an undisturbed model wall (without brackets / rods or subframe profiles) and a disturbed model wall (with brackets / rods or subframe profiles, which create a thermal bridge and the consequent heat loss).

The higher the thermal resistance of the undisturbed wall, the higher the influence of the brackets and subframe profiles related to the thermal transmittance of the wall. Therefore, the calculation model considers the most unfavourable substrate (made of normal-weight concrete) and a range of thermal insulation thickness with low thermal conductivity.

The point thermal transmittance χ-value and linear thermal transmittance ψ-value may increase or decrease with increasing thickness of the thermal insulation layer material depending on the type of bracket (dimensions and material) and type of subframe profile (dimensions, material and penetration in the thermal insulation layer). The behaviour is not linear as it is represented in the Figure D.1.1 for three different situations (different χ-values).

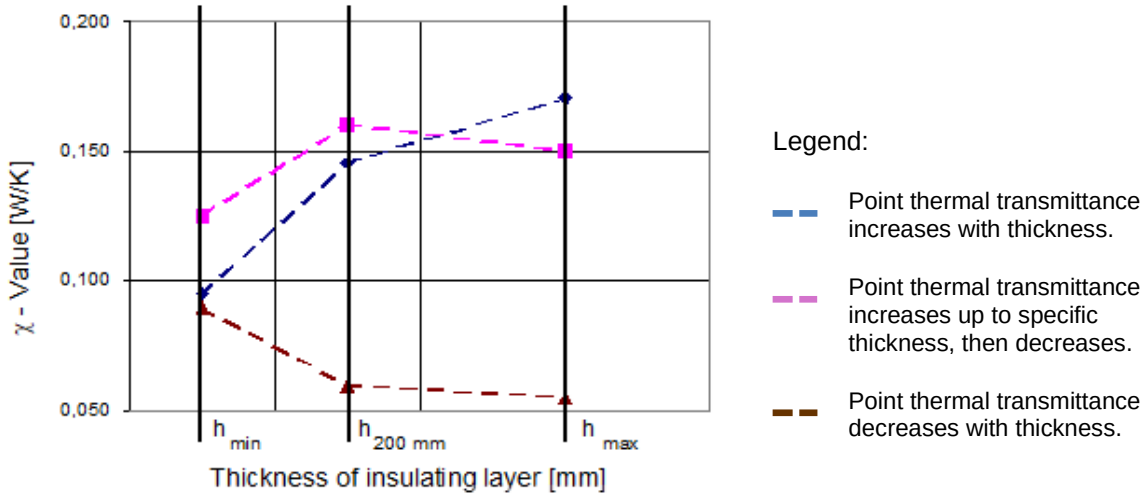


Figure D.1.1: Variants of point thermal transmittance χ-value depending on the thickness of the thermal insulation layer.

The point thermal transmittance χ-value for brackets / rods results from Equation (D.1.1).

The linear thermal transmittance ψ-value of subframe profiles results from Equation (D.1.2).

$$\chi = \frac{U_{dis} - U}{n} \quad [W/K] \quad (D.1.1)$$

$$\psi = \frac{U_{dis} - U}{l} \quad [W/(m \cdot K)] \quad (D.1.2)$$

where

χ [W/K]	=	Point thermal transmittance of brackets / rods.
ψ [W/(m·K)]	=	Linear thermal transmittance of subframe profiles.
U_{dis} [W/(m²·K)]	=	Thermal transmittance of the disturbed wall, with bracket / rod or subframe profile penetrating in the thermal insulation layer.
U [W/(m²·K)]	=	Thermal transmittance of the undisturbed wall, without bracket / rod or subframe profile penetrating in the thermal insulation layer.
n	=	Number of brackets / rods per unit area [1/m²] in the calculation or test model.
l	=	Length of subframe profiles per unit area [1/m] in the calculation or test model.

D.2 Assessment method

D.2.1 General

The point thermal transmittance (χ-value) of bracket and the linear thermal transmittance (ψ-value) of subframe profile shall be carried out by means of calculation or testing. Both methods are considered equivalent and shall be carried out for the reference wall model (test specimen) described in Clause D.2.2.

The point thermal transmittance χ-value of bracket results from calculation in accordance with Equation (D.1.1) with the thermal transmittance U_{dis} of the disturbed wall model (i.e., including “n” brackets) determined by means of calculation (see Clause D.2.2) or by means of testing (see Clause D.2.3).

The linear thermal transmittance ψ-value of subframe profile results from calculation in accordance with Equation (D.1.2) with the thermal transmittance U_{dis} of the disturbed wall model (i.e., including “n” subframe profiles) determined by means of calculation (see Clause D.2.2) or by means of testing (see Clause D.2.3).

D.2.2 Wall model (test specimen)

The wall model[9] for the calculation and testing for determination of the point thermal transmittance χ-value and linear thermal transmittance ψ-value shall consider the following dimensions and conditions:

- The disturbed wall model shall be configured as an area (at least 1,0 m x 1,0 m) that includes, at least one bracket / rod or, at least one subframe profile. The final dimensions of the wall area shall be selected depending on the number and position of the brackets / rods and subframe profiles to be considered. See Figure D.2.2.1 for brackets and Figure D.2.2.2 for subframe profiles.
- The undisturbed wall model shall have the same area than the one considered for the disturbed wall model. See Figure D.2.2.3.
- The dimensions and materials to be considered shall be the ones defined in Table D.2.2.1 and specified in accordance with EN ISO 10456.
- The thickness of the thermal insulation layer “h” is described in Clause D.2.3. The brackets/rods and subframe profiles shall be arranged according to the MPII. The data concerning the wall model component layers shall remain untouched.
- In the case of subframe profiles, subframe profile shall cover all the length of wall model (test specimen).
- For testing of subframe profiles (see Figure D.2.2.2), the tested subframe profile shall be fixed outside the measured area of the test specimen, e.g., by means of an auxiliary timber subframe around the test specimen, the subframe profile is fixed to by steel screws.

9 The wall model shall not be understood as a complete external wall but the specific specimen configuration.

- Subframe profile shall penetrate in the thermal insulation layer the distance equivalent to the one corresponding to the actual subframe profile supposing an air space distance between external surface of thermal insulation layer and rear side of skin element 20 mm.

Table D.2.2.1: Values of thermal conductivity of materials and dimensions of the wall model

Wall model layer	**Thermal conductivity coefficient λ_{dry} [W/(m·K)]**	**Thickness of the layer [mm]**
Interior plaster: gypsum plaster without aggregate	0,57	10
Substrate (normal-weight concrete)	2,30	175
Thermal insulation layer	0,035 (*)	See Clause D.2.3
Bracket / rod / subframe profile	According to the material (see EN ISO 10456)	According to the actual dimensions (**)

(*) In the case of testing, the thermal insulation layer shall be made of mineral wool in accordance with EN 13162 with a thermal conductivity in the range from 0,035 to 0,040 W/(m·K) and an airflow resistance in accordance with EN ISO 9053-1 in the range from 8 to 12 kPa·s/m^2.

(**) At least the worst case shall be considered (i.e., the brackets with maximum area of the base (flange), maximum thickness and maximum thermal conductivity; rods with maximum diameter and maximum thermal conductivity; subframe profile with maximum thickness and maximum thermal conductivity).

Legend to Figures D.2.2.1 to D.2.2.3:

1 – Interior plaster.
2 – Concrete substrate wall.
3 – Thermal insulation layer.
4 – Anchor.
5 – Bracket.
6 – Subframe profile.

Symbols are given in Clause 1.3.6.2.

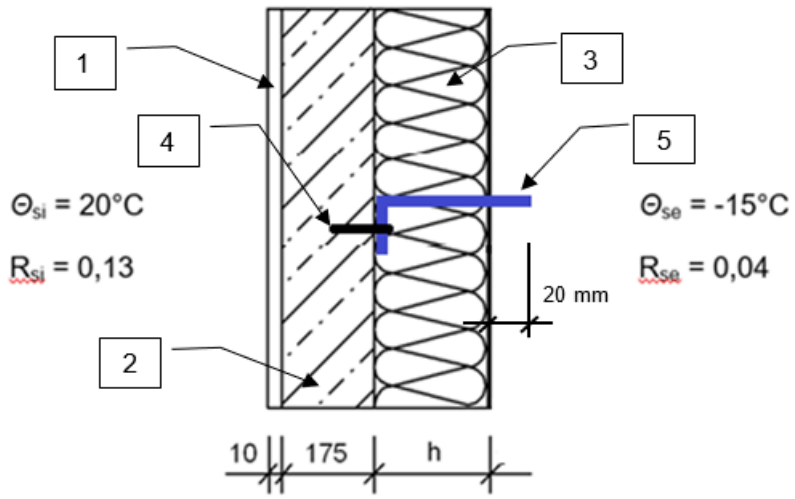


Figure D.2.2.1: Cross-section scheme of the reference wall model considering a bracket (not full-scale). Top-view.

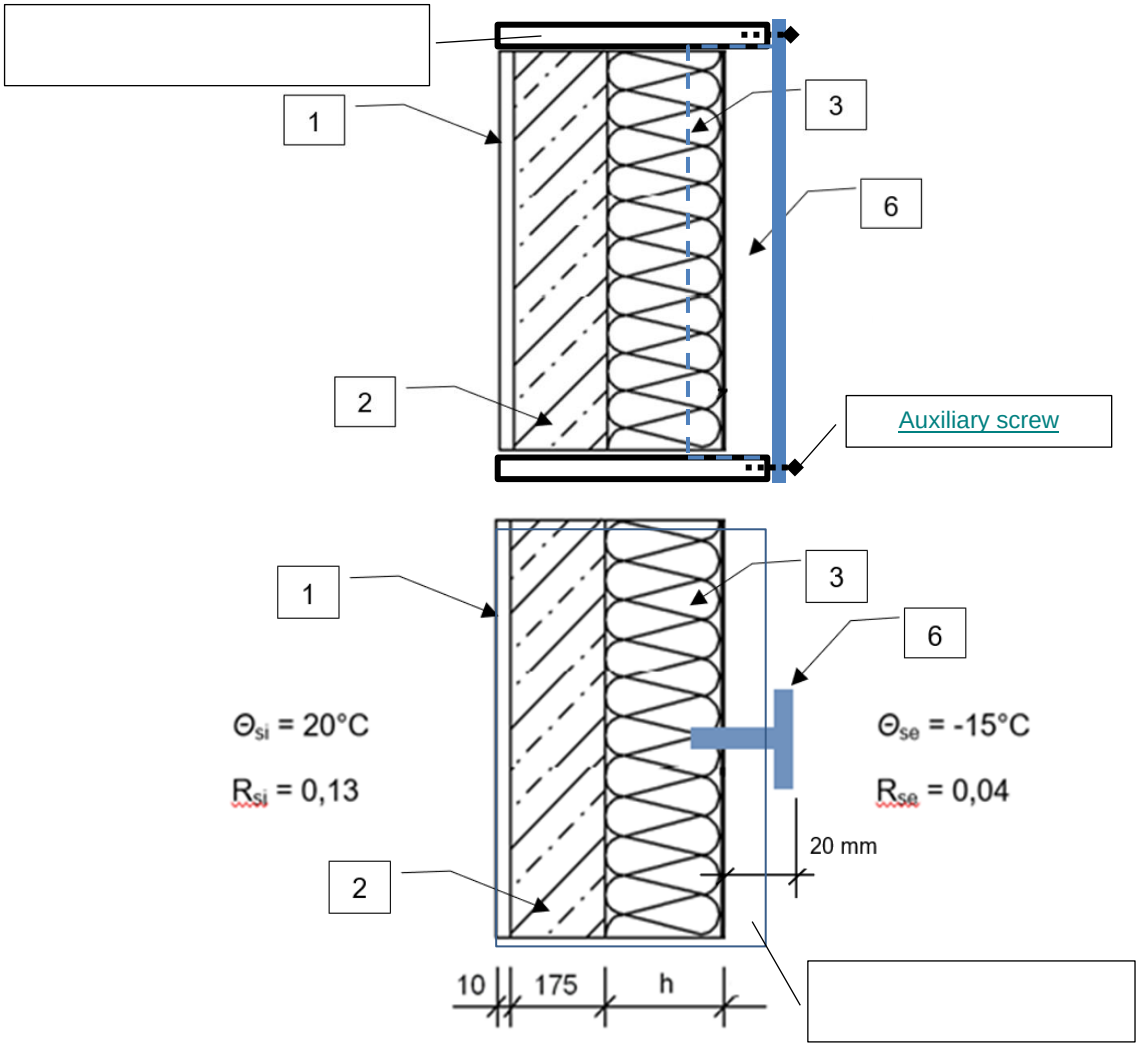


Figure D.2.2.2: Cross-section scheme of the reference wall model considering a subframe profile (not full-scale). Top-view in the case of a vertical subframe profile or lateral-view in the case of horizontal subframe profile.

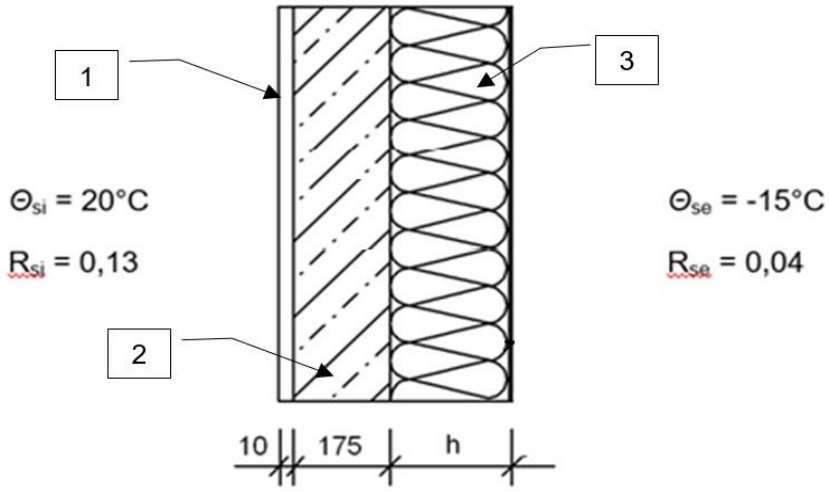


Figure D.2.2.3: Cross-section scheme of the reference wall model for undisturbed wall (not full-scale). Top-view or lateral-view.

D.2.3 Thickness of the thermal insulation layer

The thickness of the thermal insulation layer material has a significant influence on the point thermal transmittance χ-value and the linear thermal transmittance ψ-value.

The χ-value and ψ-value shall be determined for the ranges of thermal insulation layer thickness (h_{min} , h_{max}), in addition, when relevant, an intermediate reference thickness h = 200 mm shall also be tested.

The point thermal transmittance χ-value for the extreme thicknesses of thermal insulation layer (h_{min}, h_{max}), and additionally for the intermediate reference value (h_{200}) shall be determined as follows:

$\chi(h_{min})$ = for the minimum thickness (h_{min}) of the thermal insulation layer range intended to be used.

$\chi(h_{200})$ = for the reference thickness of the thermal insulation layer h = 200 mm.

$\chi(h_{max})$ = for the maximum thickness (h_{max}) of the thermal insulation layer range intended to be used.

In case of the result χ(200 mm) is smaller than $\chi(h_{min})$, calculation or testing of $\chi(h_{max})$ can be neglected. It is assumed that in any case $\chi(h_{max})$ is smaller than or equal to χ(200 mm).

The linear thermal transmittance ψ-value shall be determined in the same way:

$\psi(h_{min})$ = for the minimum thickness (h_{min}) of the thermal insulation layer range intended to be used.

$\psi(h_{200})$ = for the reference thickness of the thermal insulation layer h = 200 mm.

$\psi(h_{max})$ = for the maximum thickness (h_{max}) of the thermal insulation layer range intended to be used.

In case of the result ψ(200 mm) is smaller than $\psi(h_{min})$, calculation or testing of $\psi(h_{max})$ can be neglected. It is assumed that in any case $\psi(h_{max})$ is smaller than or equal to ψ(200 mm).

D.2.4 Boundary conditions

The conventional surface resistances shall be used in accordance with EN ISO 6946 Table 7, for the horizontal direction of the heat flow thermal conductivity, symbols given in Clause 1.3.6.2:

R_{se} = 0,04 $(m^2 \cdot K)/W$

R_{si} = 0,13 $(m^2 \cdot K)/W$

For the measurement applies:

The temperature difference between inside and outside shall be ΔT = 35 K, (e.g., θ_{se} = -15 °C ; θ_{si} = 20 °C, symbols given in Clause 1.3.6.2).

The edge surfaces of the test specimen shall be considered as adiabatic.

D.2.5 Calculations in accordance with EN ISO 10211

For the determination of the point thermal transmittance χ-value and the linear thermal transmittance ψ-value, the thermal transmittance of the wall with brackets / rods or subframe profiles U_{dis} shall be determined for each of the wall model to be considered (see Clause D.2.2).

The dimensions of the wall model area to be calculated shall be at least 1.0 × 1.0 meter, with one bracket positioned in the centre of calculated area, or with one profile positioned in the horizontal axis of calculated area. In case of separate bracket of Group 4, created by separate rod (see Figure 1.1.3.4), dimensions of

model can be decreased to 0.5 × 0.5 meter. Composition of calculated wall shall be in accordance with Clause D.2.2 and Figures D.2.2.1 up to D.2.2.3.

If disturbance in thermal field, caused by the bracket or by the subframe profile, have any effect on the edges of calculated area (except of area edges with ends of subframe profile), its dimensions shall be enlarged until this disturbance is eliminated and thermal flow on edges of calculated area shall not be affected by heat flow through material of bracket or of subframe profile.

Calculation shall be performed at least for the most adverse case, specified by the biggest dimensions of cross-section of bracket wing (or diameter of rod(s) in case of bracket of Group 4, see Figure 1.1.3.4) or of profile, the biggest coefficient of thermal conductivity of material of bracket wing (rod) or of profile, and in case of profile by the biggest embedment depth of profile in thermal insulation layer. Coefficient of thermal conductivity of thermal insulation layer in dry conditions λ_{dry} shall be used for calculation in accordance with Table D.2.2.1, and for material of bracket or of profile in accordance with Tables 3 an 4 of EN ISO 10456.

Calculation shall be performed for thicknesses h_{min}, h_{200} and h_{max} in accordance with Clause D.2.3 and MPII. If MPII does not specify either h_{min} or h_{max}, calculation shall be performed only for thickness 200 mm and thickness specified by MPII.

Calculation results shall be used in the same way as test results obtained in accordance with Clause D.2.6.

The thermal conductivity of potential cavities (e.g., in case of tested subframe profile of U-shape, with cavity rotated into insulation surface) shall be determined in accordance with EN ISO 6946 Table 8.

The subdivision of the wall model for calculation by means of the numerical method shall be accomplished in accordance with Clause 7.3 of EN ISO 10211. Input data shall be set in accordance with Clause 8 of EN ISO 10211.

Annex A, Clause A.2 (d) of EN ISO 10211 determines that the subdivision shall be sufficiently fine, that if “n” subdivisions are chosen, the sum resulting from the heat flows does not deviate from the subdivisions more than 1 % which would result in the case of second subdivisions.

There is recommended to set dimensions of calculated model so that edges of thermal insulation layer exceed edges of cross section of considered bracket in relevant direction at least for double of thickness of thermal insulation layer, taken into account.

In case of subframe profile, it is recommended to set dimensions of calculated model in longitudinal axis of subframe profile for 1 meter and perpendicular to its axis at least for double of thickness of thermal insulation layer, taken into account. Thermal flow of calculated model on both sides with edges of evaluated subframe profile shall be set as equal to zero in accordance with Clause 9.2.2 of EN ISO 10211.

The three-dimensional thermal coupling coefficient $L_{3D.1,2,dis}$ for two boundary temperatures of the disturbed wall model area (with brackets / rods or subframe profiles) shall be determined in accordance with Clause 10.2, Equation (8) of EN ISO 10211.

The thermal transmittance U of the undisturbed model wall (i.e. without brackets / rods or subframe profiles, see Figure D.2.2.3) for determination of the three-dimensional thermal coupling coefficient $L_{3D.1,2}$ for two boundary temperatures shall be calculated in accordance with Clause 6.5.2 of EN ISO 6946.

Dimensions for determination of $L_{3D,1,2}$ and $L_{3D,1,2,dis}$ shall be identical even including orientation, if width and length of model are different.

Then point thermal transmittance χ-value and the linear thermal transmittance ψ-value shall be calculated as follows:

	$\chi = \frac{L_{3D,1,2} - L_{3D,1,2,dis}}{n}$	W/K	(D.2.5.1)
	$\psi = \frac{L_{3D,1,2} - L_{3D,1,2,dis}}{l}$	W/(m·K)	(D.2.5.2)

Where

$L_{3D,1,2}$ = Three-dimensional thermal coupling coefficient of model undisturbed by bracket / rod or profile penetrating in the thermal insulation layer in [W/(m²·K)];

$L_{3D,1,2,dis}$ = Three-dimensional thermal coupling coefficient of model disturbed by bracket / rod or profile penetrating in the thermal insulation layer in [W/(m²·K)];

n = Number of point thermal bridges (brackets or rods) considered in model, usually n = 1;

l = Length of linear thermal bridge (subframe profile) in [m], considered in model.

In accordance with Clause 14.2.1 of EN ISO 10211, the three-dimensional thermal coupling coefficients shall be determined with five decimal places. The point thermal transmittance χ-value and the linear thermal transmittance ψ-value, to be calculated, shall be given rounded to four decimal places.

D.2.6 Testing

The determination of the thermal transmittance U_{dis} of the disturbed wall model (with brackets / rods or subframe profiles) shall be tested in accordance with EN ISO 8990 or EN 1934 (both methods are considered equivalent). A reference test specimen shall be used in accordance with Clause D.2.2.

The thermal transmittance U of the undisturbed model wall (without brackets / rods or subframe profiles) shall be measured in accordance with the same method and test specimen materials and dimensions as for the thermal transmittance U_{dis}.

When placing the pieces (brackets / rods or subframe profiles), the distance to the edge and between them shall not fell below 300 mm or the double of tested thickness of thermal insulation layer. Bigger value shall be used.

D.3 Example for determining the point thermal transmittance χ-values of a bracket or of ψ-values of subframe profiles

Below there is an example for the expression of the results when determining the point thermal transmittance χ-value of a bracket.

Example:

Considering that a bracket is defined to be used for thicknesses of thermal insulation layer h_{min} = 50 mm to h_{max} = 320 mm, and the following values of point thermal transmittance χ-value in accordance with thicknesses of thermal insulation layer have been determined by calculation or testing:

$$\chi(h_{min}) = 0{,}159 \text{ W/K}; \qquad \chi(h_{200}) = 0{,}181 \text{ W/K} \qquad \text{and } \chi(h_{max}) = 0{,}215 \text{ W/K}.$$

One of the following cases shall be used for the expression of the results depending on the range of thermal insulation thickness:

Case 1: One χ-value for the whole area of insulation thicknesses from 50 mm to 320 mm:

$$\chi(h=50\div320 \text{ mm}) = 0{,}215 \text{ W/K}$$

Case 2: Two χ-values with distinction between areas of insulation thicknesses up to 200 mm and above 200 mm:

$$\chi(h\leq200 \text{ mm}) = 0{,}181 \text{ W/K}; \quad \chi(h>200 \text{ mm}) = 0{,}215 \text{ W/K}$$

The same procedure of specification of characteristic for ψ-value(s) of subframe profile(s) shall be used.