



## EUROPEAN ASSESSMENT DOCUMENT

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# KITS FOR EXTERNAL WALL CLADDINGS OF MINERAL BOARDS WITH RENDERINGS APPLIED IN-SITU

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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) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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# 1 SCOPE OF THE EAD

## 1.1 Description of the construction product

The EAD covers the assessment of kits<sup>1</sup> for external wall cladding systems in which the cladding element is made of mineral boards with a rendering applied in-situ.

The EAD is applicable to the cladding kits belonging to the families given in table 1.1. They consist of the following components:

*Note: the ETA should include the technical description of the cladding kit components.*

### 1. Cladding elements:

- Rendering systems applied in-situ, composed of:
  - finishing coat (paint or mineral rendering or organic rendering and optionally impregnation or primer);
  - reinforced base-coat (mineral or organic rendering + glass fibre mesh for reinforcement).

Rendering system components are specified by the type of material, range of thickness application, water quantity ratio (if relevant), coverage and density.

- Mineral boards (including optionally joint treatment components). Boards according to EN 12467, EN 15283-1, EN 15283-2, EN 520, EAD 210024 or any other flat board of mineral material with their own harmonized standard or EAD as an individual component, for external use, and suitable for receiving a rendering system.

Mineral boards are specified by the type of material, dimensions and density.

### 2. Board-fixings: metal screws for fixing the boards to the subframe profiles.

### 3. Subframe components (optional):

- Vertical and/or horizontal profiles made of metal materials (steel or aluminium alloy).
- Brackets made of metal materials (steel or aluminium alloy) for fastening the profiles to the substrate (e.g. external wall).
- Screws or rivets between the brackets and the profiles.
- Metal anchors between the subframe and the substrate (optional).

Profiles and brackets are specified by geometric and physical parameters (such as form and dimensions, weight, cross section, distance between profiles and between brackets) and material parameters (such as type of material, specific gravity, mechanical material properties).

Screws and anchors are specified by geometric parameters (such as form and dimensions) and material parameters (such as type of material and mechanical properties).

### 4. Breather membrane (optional): flexible sheet for waterproofing.

### 5. Thermal insulation product (optional) with its own harmonized standard or EAD as an individual component.

Thermal insulation products are specified by the type of material, dimensions, density or weight per square meter and water absorption.

### 6. Other ancillary components (optional):

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<sup>1</sup> Definition of "Kit" according to Art. 2 n° 2 of CPR. The components are assembled on site, and thus, become an "assembled kit" when installed in the construction works.

- Cavity barrier.
- Any other component used in the kit (e.g. to form joints such as sealant, corner strips, etc.; or to achieve continuity such as mastic, joint-covers, gaskets, trims, etc.).

Breather membrane and other ancillary components are specified by geometric parameters (such as form and dimensions) and material parameters (such as type of material, mechanical properties).

Table 1.2 indicates the materials and harmonized specifications related with these components.

The rendering system components can include a range of binders from pure polymeric to pure cementitious. They can be available in the following forms:

- powder (dry mortar) blended at the factory that requires only mixing with a quantity of water specified by the manufacturer;
- powder requiring addition of extra binder;
- paste requiring addition of cement;
- ready to use paste, supplied in workable consistency.

The manufacturer can provide:

- a complete kit (rendering system, mineral board, board-fixing, subframe components and optionally, breather membrane, thermal insulation product and other ancillary components),
- a minimum kit (rendering system, mineral board and board-fixing) or,
- a partial kit (minimum kit and other system components but not a complete kit).

The cladding kits covered by this EAD always include the cladding element (mineral board and rendering system). When the cladding element is not provided by the manufacturer this EAD does not apply and, then, the kit may be covered by a specific EAD (e.g. EAD 090034-00-0404).

Between the cladding elements and the thermal insulation layer or the external wall respectively, there is an air space which shall always be drained and may be ventilated or not.

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

The product is not fully covered by:

- EAD 090062 (ETAG 034 conversion) because this document specifically excludes cladding elements with renderings applied in-situ.
- EAD 090019 because this document covers a kit in which the board is made of other materials different than those given in this EAD. The boards of this material do not have their own harmonized standard or EAD as individual component.

*Note: The harmonized technical specifications given in table 1.2 do not cover similar products (kits) but just individual components.*

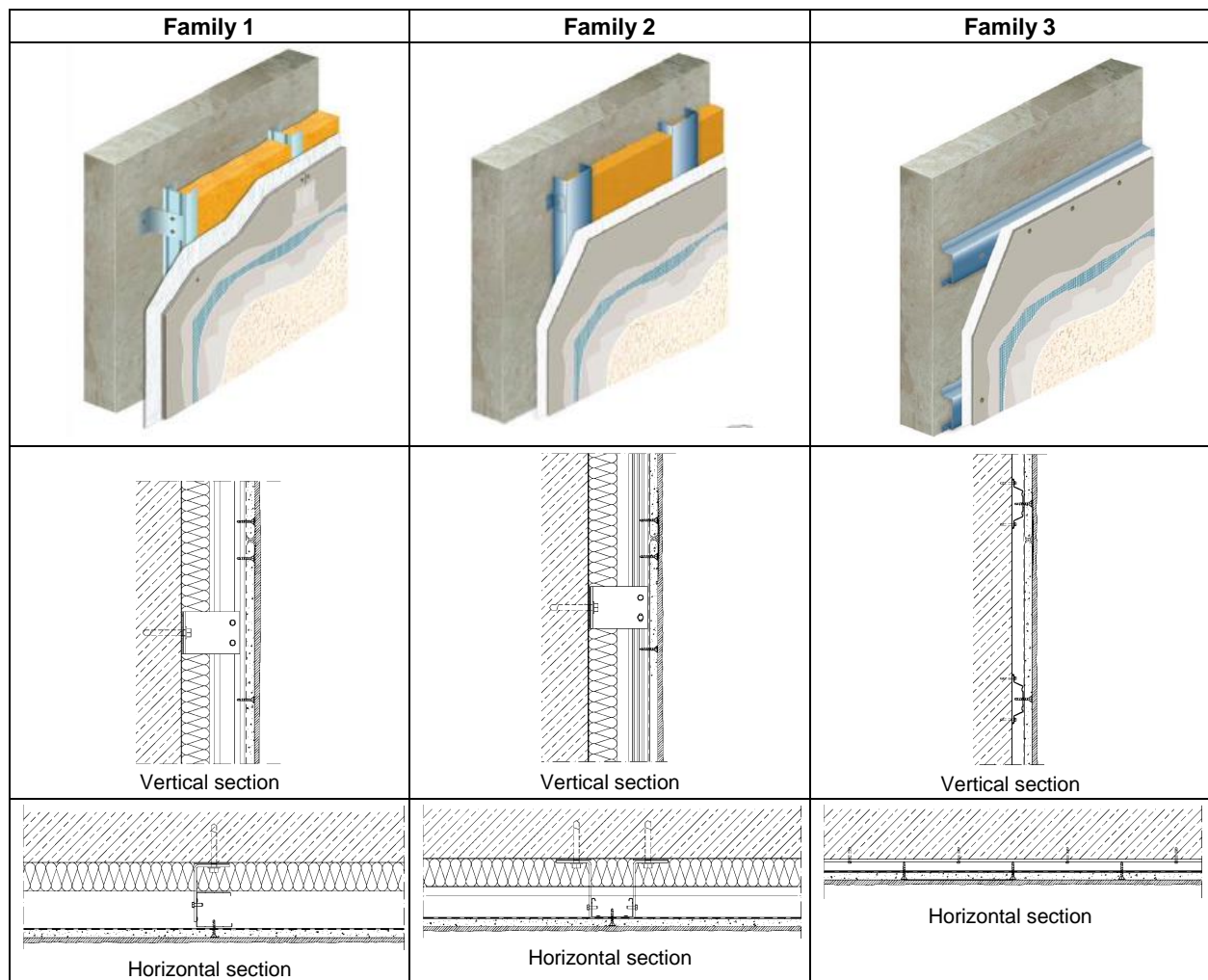
Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise its clients on the transport, storage, maintenance, replacement and repair of the product as it considers necessary.

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

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

**Table 1.1: Description of the cladding kit families.**

Family of cladding kits	Description of the cladding kit	Figure
Family 1	Kits for cladding systems based on metal subframes consisting of vertical profiles fixed to asymmetrical brackets by means of their webs.	Figure 1.1a
Family 2	Kits for cladding systems based on metal subframes consisting of vertical profiles fixed to symmetrical brackets by means of their flanges.	Figure 1.1b
Family 3	Kits for cladding systems based on metal subframe consisting of horizontal profiles.	Figure 1.1c



**Figure 1.1a:** Cladding kit family 1.

**Figure 1.1b:** Cladding kit family 2.

**Figure 1.1c:** Cladding kit family 3.

**Table 1.2: Components materials and associated product technical specifications.**

Part of the assembled system	Designation	Generic component	Possible associated component technical specifications	
			Harmonized (hEN or EAD) (*)	Other references
Rendering system	Finishing coat	Mineral mortar	EN 998-1	---
		Organic mortar	EN 15824	---
		Paint	---	EN 1062-1
		Primer / Impregnation		
	Base-coat	Mineral mortar	EN 998-1	---
		Organic mortar	EN 15824	---
Reinforcement mesh		EAD 040016-00-0404	EN 13496	
External layer	Board	Mineral board	EN 12467 EN 15283-1 EN 15283-2 EN 520 EAD 210024-00-0504	---
	Joint treatment	Joint filler (optional)	EN 998-1 EN 15824 EN 13963	---
		Joint tape (optional)	EAD 040016-00-0404 EN 13963	EN 13496
	Board-fixing	Screw	EN 14566	---
	Breather membrane	Flexible sheet for waterproofing	EN 13859-2	---
Subframe	Profile	Vertical profile (e.g. C-profile, T-profile, L-profile)	EN 14195	EN 1993 EN 1999
		Horizontal profile (e.g. U-profile, $\Omega$ -profile, Z-profile)		
	Bracket	Supporting and retaining bracket	---	EN 1993 EN 1999
	Subframe-fixing	Screw	EN 14566	EN ISO 3506-x
		Rivet	---	EN ISO 15973 to 15984 EN ISO 16582 to 16585
	Anchor to substrate	Metal anchor for use in concrete	EAD 330747 (ETAG 001 part 6) EAD 330232	---
		Bonded fasteners for use in concrete	EAD 330499	---
		Metal anchor for use in other materials	---	EN 15048-1 EN 14399-1
		Plastic anchor	EAD 330284 (ETAG 020)	---
		Metal injection anchor for use in masonry	EAD 330076 (ETAG 029)	---
Thermal insulation	Factory made thermal insulation panels	MW; EPS; XPS; PUR; PF; Other materials	EN 13162; EN 13163; EN 13164; EN 13165; EN 13166; relevant hEN or EAD	---

(\*) Other harmonized specifications applicable to these components may be used.



## 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:

- Use 1: Ventilated cladding systems (rain-screens) for external walls (for family 1, family 2 and, also family 3 when the horizontal profiles are perforated).
- Use 2: Non-ventilated cladding systems for external walls (all families).

Cladding kits are fixed to external vertical walls made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame in new or existing buildings (retrofit).

This EAD does not cover the assessment of the cladding kits under the effects of seismic actions.

### 1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the cladding kit 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<sup>2</sup>.

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

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

### 1.3.1 Cladding kit

A cladding kit is a specific kit<sup>1</sup> composed by a cladding element made of a mineral board with a rendering system applied in-situ, its board-fixings and optionally a subframe, flexible sheet of waterproofing, thermal insulation product and other ancillary components, which is to be used as external wall claddings.

### 1.3.2 Substrate

The term "substrate" refers to any of the following descriptions:

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

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

- The supporting structure of the building, which in itself does not meet the airtightness required but meets the mechanical strength requirements (resistance to static and dynamic loads), Usually, the supporting structures of the buildings are made of concrete (cast on site or prefabricated), timber or metal frame. In this case, the airtightness requirements are met by the non-load bearing external wall of the façade.

### **1.3.3 Subframe**

An intermediate assembly of vertical and/or horizontal metal profiles and metal brackets (including the fixings between the brackets and the profiles) located between the cladding element and the substrate.

### **1.3.4 Rendering system**

The term “rendering system” refers to the layer composed by the base-coat (see 1.3.5) and the finishing coat (see 1.3.7).

### **1.3.5 Base-coat**

Coat (mortar) applied directly onto the board; the reinforcement mesh is embedded into it to provide most of the mechanical properties of the rendering system.

### **1.3.6 Reinforcement mesh**

Glass fibre mesh (embedded) in the base-coat to improve its mechanical strength.

### **1.3.7 Finishing coat**

Coat applied onto the base-coat which contributes to the protection against weathering and to the aesthetic finishing.

The finishing coat can be composed by one of these options:

- Mineral or organic mortar with or without primer (see 1.3.7.1) and with or without “coating” (see 1.3.7.2).
- Coating (see 1.3.7.2) applied directly onto the base-coat without the organic or mineral mortar.

#### **1.3.7.1 Primer (or key coat)**

A very thin coat which can be applied onto the base-coat and it is intended to act as a preparation for the application of the finishing coat (mineral mortar, organic mortar or coating, see 1.3.7).

#### **1.3.7.2 Coating**

A coat composed by a paint or an impregnation (see 1.3.7.3) that may be applied directly onto the base-coat or onto the mortar.

#### **1.3.7.3 Impregnation**

A water-based fluid with hydrophobizer which reduce the water absorption of the surface (e.g. from rain). It also reduces significantly façade discoloration from rain.

### **1.3.8 Cladding element**

The term cladding element refers to both, the flat mineral board fixed on the profiles of the subframe, including its joint treatment components, and the rendering system components applied in-situ on the external surface of the board.

### **1.3.9 Board-fixing**

Screws used to secure the board to the subframe.

### **1.3.10 Subframe-fixing**

Screws or rivets used to fasten the subframe components.

### **1.3.11 Ancillary materials**

Cavity barrier or any supplementary component used in the kit (e.g. to form joints such as sealant, corner strips, etc.; or to achieve continuity such as mastic, joint-covers, gaskets, trims, etc.).

### **1.3.12 Breather membrane**

Membrane placed in the cladding kit which contributes to the watertightness of the wall.

### **1.3.13 Cavity barrier (compartmentation of air space)**

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

### **1.3.14 Air space**

It is the space between the cladding element and the insulation layer or the substrate respectively.

### **1.3.15 Ventilated air space**

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

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

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

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 2.1 shows how the performance of cladding kit is assessed in relation to the essential characteristics.

**Table 2.1: 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		
<b>Basic Works Requirement 2: Safety in case of fire</b>					
1	Reaction to fire	2.2.1	Class		
2	Façade fire performance	2.2.2	Description or Level		
3	Propensity to undergo continuous smouldering	2.2.3	Description		
<b>Basic Works Requirement 3: Hygiene, health and the environment</b>					
4	Watertightness (protection against driving rain)	2.2.4	Description or Level		
5	Water absorption (*)	2.2.5	Level		
6	Water vapour permeability (for non-ventilated façades) (*)	2.2.6	Level		
7	Drainability	2.2.7	Description		
8	Content, emission and/or release of dangerous substances	2.2.8	Description		
<b>Basic Works Requirement 4: Safety and accessibility in use</b>					
9	Wind load resistance	2.2.9	Level		
10	Impact resistance	2.2.10	Level		
11	Resistance to horizontal point loads	2.2.11	Description		
12	Mechanical resistance (**)	Bond strength (adhesion between the rendering system and the board)	2.2.12.1	Level	
13		Bending strength of the board (*)	2.2.12.2	Level	
14		Connection (board-fixing-subframe)	Embedding / Shear strength (*)	2.2.12.3	Level
15			Pull-through / pull-out resistance (*)	2.2.12.4	Description
16		Resistance of profiles	2.2.12.5		
17		Subframe-fixings	Tension/pull-out resistance (*)	2.2.12.6	Level
18			Shear load resistance (*)	2.2.12.7	Level
19		Bracket resistance (horizontal and vertical load)	2.2.12.8	Level	
<b>Basic Works Requirement 5: Protection against noise</b>					
20	Airborne sound insulation	2.2.13	Level		
<b>Basic Works Requirement 6: Energy economy and heat retention</b>					
21	Thermal resistance	2.2.14	Level		
<b>Durability (***)</b>					
22	Accelerated ageing behaviour	2.2.15.1	Description and Level		
23	Cracking strength due to board deformation	2.2.15.2	Level		
24	Dimensional stability (*):	by humidity	2.2.15.3	Level	
		by temperature			

**Table 2.1: 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
25	Moisture content (*)	2.2.15.4	Level
26	Corrosion	2.2.15.5	Description
27	UV radiation resistance (*)	2.2.15.6	Level
(*) When available, performance included in the DoP for the CE marking as individual component should be used as far as possible to avoid retesting or reassessment. (**) Mechanical resistance of the kit is assessed by means of the mechanical characteristics of the relevant kit components. See section 2.2.12. (***) Durability of the kit is assessed by means of relevant component durability, when relevant. See section 2.2.15.			

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

### 2.2.1 Reaction to fire

Reaction to fire of the whole kit shall be assessed by considering the reaction to fire of the components (rendering system components, boards, board-fixings, subframe components, breather membrane, thermal insulation products, etc.), in order to be classified according to Commission Delegated Regulation (EU) 2016/364.

When relevant, reaction to fire of the rear side of the cladding kit shall also be assessed in order to be classified according to Commission Delegated Regulation (EU) 2016/364.

The whole kit shall be classified based on the worst class of any component obtained according to a CWFT Decisions or according to the relevant tests method(s) according to EN 13501-1.

Otherwise, the cladding kit shall be tested, using the test method(s) according to EN 13501-1 relevant for the corresponding reaction to fire class, in order to be classified according to the Commission Delegated Regulation (EU) 2016/364.

Criteria given in Annex B shall be taken into account. Associated mounting and fixing rules for the SBI test shall be in accordance with Annex C.

### 2.2.2 Façade fire performance

If the manufacturer intends to declare the façade fire performance of the product, in absence of a European assessment approach, the ETA shall be issued taking into account the situation in Member States where the manufacturer intends his product to be made available on the market.

Information on such situation is included in Annex D.

The assessment method(s) used shall be indicated in the ETA.

### 2.2.3 Propensity to undergo continuous smouldering

This characteristic is only applicable for cladding kits which include the thermal insulation product (see section 1.1) made of mineral wool (MW), wood wool (WW), cork, wood fibres (WF) or made of any other vegetal or animal fibres.

The assessment of the kit propensity to undergo continuous smouldering is carried out by means of the assessment of the propensity to undergo continuous smouldering of the thermal insulation product which is representative of this essential characteristic for cladding kits.

Propensity to undergo continuous smouldering of thermal insulation product shall be assessed according to EN 16733.

*Note: When available, performance included in the DoP regarding the thermal insulation product should be used as far as possible to avoid retesting or reassessment.*

Description of propensity to undergo continuous smouldering shall be given in the ETA according to section 11 of EN 16733.

#### **2.2.4 Watertightness (protection against driving rain)**

The assessment of watertightness is intended to determine two requirements of the cladding kit:

- Water running down the outside face of the cladding kit shall not reach the inside face of the substrate.
- Materials likely to be adversely affected by water (fixings subject to corrosion, thermal insulations, etc.) shall not become damp.

This assessment shall be carried out by description considering the kit water absorption (see section 2.2.5) and the relevant design details provided by the manufacturer, regarding the connections of the cladding kit with the base edge, openings (windows or doors), etc.. These design details should be included in the ETA.

Otherwise, when no information on kit water absorption or on relevant design details is available, or when the manufacturer specifically requires it, the watertightness of the cladding kit may be determined by testing according to EN 12865 Procedure A.

At least the worst case shall be tested (e.g. rendering system with greater water absorption and kit without breather membrane). It is possible to carry out the test only with the external layers of the kit (rendering system and board).

The limit level of pressure (e.g. just before water penetration) shall be given.

#### **2.2.5 Water absorption**

The assessment of the kit water absorption is carried out by means of the assessment of the water absorption of the relevant kit components (rendering system, boards and, when relevant, the watertightness of the breather membrane), which are representative of this essential characteristic for the kit.

Water absorption is also considered for:

- the assessment of the watertightness (see section 2.2.3).
- the needing to carry out the freeze-thaw resistance test (see section 2.2.15.1).

##### **2.2.5.1 Water absorption by capillarity**

Water absorption by capillarity shall be tested according to Annex E.

Testing shall be carried out:

- for the whole rendering system (finishing coat and base-coat with the reinforcement mesh) to be considered in the ETA, and
- for the reinforced base-coat alone.

The test specimens shall be prepared with the board as the substrate. The edges of test specimens shall be protected to ensure that only the rendering system or the reinforced base-coat is subject to water absorption.

Only the rendering system or reinforced base-coat of the test specimens must be submerged in a water bath.

When relevant, the test specimens shall be prepared at the same time that:

- the rig for the hygrothermal behaviour test (see section 2.2.15.1), and
- the samples for freeze-thaw resistance test (see section 2.2.15.1).

Mean<sup>3</sup> values of water absorption (in kg/m<sup>2</sup>) after 3 minutes, 1 hour and 24 hours of the kit (with and without the finishing coat) shall be given.

#### **2.2.5.2 Water permeability (water column)**

Water penetration resistance due to hydrostatic pressure of the rendering system shall be tested according to section 7.1 of EN 1015-21 (without the conditioning cycles given in section 6.3 of EN 1015-21).

Testing shall be carried out for each rendering system (finishing coat and base-coat with the reinforcement mesh) to be considered in the ETA.

The test specimens shall be prepared with the board as the substrate. If relevant, the flexible sheet for waterproofing could also be used in the test specimen.

When relevant, the test specimens shall be prepared at the same time that:

- the rig for the hygrothermal behaviour test (see section 2.2.15.1), and
- the samples for freeze-thaw test (see section 2.2.15.1).

The mean<sup>3</sup> value and the maximum value shall be given.

#### **2.2.5.3 Water absorption of the board**

Water absorption (partial and/or fully immersed) of the board shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the board should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method, the water absorption of the board shall be assessed according to sections 5.9.1 and 5.9.2 of EN 520.

The mean<sup>3</sup> value and the maximum value shall be given.

The values shall cover the range of density of the board.

#### **2.2.5.4 Watertightness of the breather membrane**

This characteristic is only relevant when the kit includes the breather membrane.

Watertightness of the breather membrane shall be assessed according to EN 13859-2.

*Note: When available, performance included in the DoP regarding the breather membrane should be used as far as possible to avoid retesting or reassessment.*

#### **2.2.6 Water vapour permeability**

This characteristic is only relevant when the cladding kit is used in non-ventilated façades (use 2).

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<sup>3</sup> The mean value is the arithmetic average value.

The assessment of the kit water vapour permeability is carried out by means of the assessment of the water vapour permeability of the relevant kit components (rendering system, board, thermal insulation product and breather membrane) representative of this essential characteristic for cladding kits.

Water vapour permeability of the following kit components:

- Rendering system components;
- Boards;
- Breather membrane (when it is part of the kit);
- Thermal insulation product (when it is part of the kit);

Shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method, the water vapour permeability of the relevant kit components shall be tested according to the method given in EN ISO 12572. Tabulated values according to EN ISO 10456 may also be defined by the manufacturer.

For organic mortar or paint EN ISO 7783 may also be considered.

In the case of the rendering system, test for the whole rendering system is recommended.

The values shall be given according to the relevant technical specification.

### 2.2.7 Drainability

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

This assessment shall be carried out by means of the analysis of the relevant design details provided by the manufacturer, regarding the connections of the cladding kit with the base edge, openings (windows or doors) to detect potential accumulation of water behind cladding system. These design details should be included in the ETA.

### 2.2.8 Content, emission and/or release of dangerous substances

The performance of the kit related to the emission and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer<sup>4</sup> after identifying the release scenarios (in accordance with EOTA TR 034) taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

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

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

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<sup>4</sup> The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is **not** obliged:

- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to 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.

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



### 2.2.8.1 Leachable substances

For the intended use covered by the release scenario S/W2, the performance of the kit concerning leachable substances has to be assessed.

The dangerous substances assessment of the kit is carried out by means of the assessment of the most relevant kit components materials, which are: the mineral board and the rendering system components materials.

The leachable substances assessment of the kit components materials shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD, leachable substances assessment of the kit components materials shall be assessed according to the following methods:

#### **For mineral boards or rendering system components made of cement-based materials:**

A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the mineral board or rendering system components conducted according to CEN/TS 16637-2:2014, but considering the steps below indicated for the leachant renewal. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area must be  $(80 \pm 10)$  l/m<sup>2</sup>.

Samples shall be prepared according to clause 8.2 of CEN/TS 16637-2:2014.

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

- aluminium, antimony, arsenic, barium, lead, cadmium, chromium (total), chromate (Cr VI), cyanide (total), cobalt, copper, molybdenum, nickel, mercury, thallium, vanadium, zinc,
- chloride (Cl<sup>-</sup>), sulphate (SO<sub>4</sub><sup>2-</sup>), fluoride (F<sup>-</sup>),
- TOC,
- pH-value, electrical conductivity, odour, colour, turbidity, and tendency to produce foam

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

Measured concentration of the leaching test according to CEN/TS 16637-2 of these cladding elements must be expressed per step for each parameter in µg/l and mg/m<sup>2</sup>. Additionally, the cumulatively released quantities must be expressed for each parameter in mg/m<sup>2</sup>.

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

#### **For mineral boards or rendering system components materials other than cement-based covered by CEN/TS 16637-2:**

A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the mineral board or rendering system components conducted according to CEN/TS 16637-2:2014. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area must be  $(80 \pm 10)$  l/m<sup>2</sup>.

Samples shall be prepared according to clause 8.2 of CEN/TS 16637-2:2014.

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

- Acute toxicity test with *Daphnia magna* Straus according to EN ISO 6341
- Toxicity test with algae according to ISO 15799

- Luminescent bacteria test according to EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.

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

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

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

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

### 2.2.9 Wind load resistance

The wind load resistance (suction and/or pressure) of the kit shall be carried out by calculation taking into account the mechanical resistances of the relevant kit components (board, board-fixing and subframe components) obtained from section 2.2.12.

At least the worst case (the mechanically weakest case) or the most representative case of the assembled kit shall be considered.

Relevant elasticity and resistance equations (continuous beams with two, three or more supports, depending on the number of brackets to be used, with uniformly distributed load) and relevant standards (e.g. EN 1999 for aluminium or EN 1993 for steel) should be considered for the calculation (at ultimate and serviceability limit state).

At least for one assembled system, the calculated result shall be contrasted by testing according to the method given in Annex F.

*Note: The manufacturer together with TAB will decide the relevant test (suction, pressure or both) to be carried out to assess at least the mechanically weakest case (worst case) taking into account the kit mechanical resistance (see section 2.2.12) and the specific design of the cladding kit specimen. In case of doubt, it is recommended to carry out both tests, suction and pressure.*

The maximum wind load resistance "Q" for assembled cladding kit shall be given.

### 2.2.10 Impact resistance

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

At least the worst case (the mechanically weakest case) of the assembled kit shall be tested.

The hard body and soft body impact resistance shall be given.

Additionally, the degree of exposure according to the use categories defined in the table G.2 in section G.3 of Annex G shall be given.

### 2.2.11 Resistance to horizontal point loads

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

At least the worst case (the mechanically weakest case) of the assembled kit shall be tested.

The cladding kit shall be capable of accommodating the horizontally applied loads acting on its surface due to maintenance works without any reduction in its performance.

Description on if there is any permanent deformation (visible deformation) on any component shall be given.

### 2.2.12 Mechanical resistances

The following mechanical essential characteristics of the kits shall be considered:

The assessment depends on the applicable kit family and the kit to be provided by the manufacturer (complete kit, partial kit or minimum kit), see section 1.1.

Mechanical essential characteristics are:

- Bond strength. See section 2.2.12.1.
- Bending strength. See section 2.2.12.2.
- Embedding/Shear strength. See section 2.2.12.3.
- Pull-through/Pull-out resistance. See section 2.2.12.4.
- Resistance of kit subframe. See sections 2.2.12.5, 2.2.12.6, 2.2.12.7 & 2.2.12.8.

#### 2.2.12.1 Bond strength

The assessment of the kit bond strength is carried out by means of the assessment of the rendering system bond strength on the board, which is representative of this essential characteristic for the kit.

Bond strength or adhesion between the rendering system and the board (in dry and other conditions) shall be tested according to the method given in Annex I or EN 1015-12.

Tests shall be carried out for the connections and the conditions given in table I.1. of Annex I.

The test specimens shall be prepared with the board as the substrate.

When relevant, the test specimens shall be prepared at the same time that:

- the rig for the hygrothermal behaviour test (see section 2.2.15.1), and
- the samples for freeze-thaw resistance test (see section 2.2.15.1).

Mean and minimum values of bond strength and the rate (in %) of rupture types (cohesive rupture and/or adhesive rupture) shall be given.

#### 2.2.12.2 Bending strength

The assessment of the kit bending strength is carried out by means of the assessment of the boards bending strength, which is representative of this essential characteristic for the kit.

The bending strength of the board shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the board should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method, the bending strength of the board shall be assessed according to section 7.3.2 of EN 12467, section 5.6 of EN 15283-1 or EN 15283-2 or section 5.7 of EN 520.

At least the worst case (the mechanically weakest case) shall be tested.

The mean<sup>3</sup> value and the characteristic value according to Annex N shall be given.

The values shall cover the range of density and thickness of the board.

#### 2.2.12.3 Embedding/Shear strength

The assessment of the kit embedding/shear strength is carried out by means of the assessment of the embedding/shear strength of the connection between the board, the board-fixing and the subframe profile, which is representative of this essential characteristic for the kit.

Embedding/Shear strength of the connection between the board, the board-fixing and the subframe profile shall be assessed according to the relevant hEN (see table 1.2) or EAD

*Note: When available, performance included in the DoP regarding the board should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the embedding/shear strength of the connection shall be assessed according to section J.1 of Annex J.

At least the worst case (the mechanically weakest case) shall be tested.

The mean<sup>3</sup> value and the characteristic value according to Annex N shall be given.

The values shall cover the range of density and thickness of the board, the range of board-fixing diameters and the range of materials and thickness of subframe profiles.

#### **2.2.12.4 Pull-through/Pull-out resistance**

The assessment of the kit pull-through/pull-out strength is carried out by means of the assessment of the pull-through/pull-out strength of the connection between the board, the board-fixing and the subframe profile, which is representative of this essential characteristic for the kit.

Pull-through/Pull-out strength of the connection between the board, the board-fixing and the subframe profile shall be assessed according to the relevant hEN (see table 1.2) or EAD

*Note: When available, performance included in the DoP regarding the board should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the pull-through/pull-out strength of the connection shall be assessed according to section J.2 of Annex J.

At least the worst case (the mechanically weakest case) shall be tested.

The mean<sup>3</sup> value and the characteristic value according to Annex N shall be given.

The values shall cover the range of density and thickness of the board, the range of board-fixing diameters and the range of materials and thickness of subframe profiles.

#### **2.2.12.5 Resistance of kit subframe profiles**

This characteristic is only relevant when the manufacturer provides a kit which includes the subframe components (see section 1.1).

The assessment of the kit subframe resistance is carried out by means of the assessment of the resistance of the profiles, which is representative of this essential characteristic for the kit.

The following characteristics shall be described:

- Form and dimensions of the profile section according to relevant standards (e.g. EN 755-9 for aluminium).
- Effective moment of area (inertia of the profile section) according to the relevant standards (e.g. EN 1999-1-1 for aluminium).
- Minimum mechanical properties of the profile material. E.g. elastic limit and modulus of elasticity in the case of metal profiles according to the relevant standards (e.g. EN 755-2 for aluminium).
- Maximum deflection admitted by the manufacturer (e.g. L/200).

#### **2.2.12.6 Tension/pull-out resistance of kit subframe-fixings**

This characteristic is only relevant when the manufacturer provides a kit which includes the subframe components (see section 1.1).

The assessment of the kit subframe resistance is carried out by means of the assessment of the tension/pull-out resistance of the fixings between subframe components, which is representative of this essential characteristic for the kit.

For fixings between subframe components, the tension/pull-out resistance on the relevant subframe component (e.g. vertical profile) shall be assessed according to the relevant hEN, EAD or Eurocode (e.g. EN 14592, EAD 330046, section 3 of EN 1993-1-8, section 3.3 of EN 1999-1-1, etc.).

*Note: When available, performance included in the DoP regarding the subframe fixing should be used as far as possible to avoid retesting or reassessment.*

When the hEN, EAD or Eurocode does not give an assessment method or when there is no relevant hEN, EAD or Eurocode applicable, the tension load/pull-out resistance of the fixing shall be tested according to the method given in section K.1 of Annex K.

At least the worst case (the mechanically weakest case) shall be considered.

For fixings connecting the subframe to the wall (anchors), tension / pull-out resistance shall be assessed according to the relevant EAD (e.g. EAD 330747 (ETAG 001-6), EAD 330284 (ETAG 020), EAD 330076 (ETAG 029) , etc.).

Test results shall be given according to the relevant EAD or section K.1 of Annex K.

#### **2.2.12.7 Shear load resistance of kit subframe-fixings**

This characteristic is only relevant when the manufacturer provides a kit which includes the subframe components (see section 1.1).

The assessment of the kit subframe resistance is carried out by means of the assessment of the shear strength of the fixings between subframe components, which is representative of this essential characteristic for the kit.

For fixings between subframe components, the shear strength of the fixings between subframe components (e.g. between the vertical profile and the bracket) shall be assessed according to the relevant hEN, EAD or Eurocode (e.g. EN 14592, EAD 330046, section 3 of EN 1993-1-8, section 3.3 of EN 1999-1-1, etc.).

*Note: When available, performance included in the DoP regarding the subframe fixing should be used as far as possible to avoid retesting or reassessment.*

When the hEN, EAD or Eurocode does not give an assessment method or when there is no relevant hEN, EAD or Eurocode applicable, the shear load resistance of the fixing shall be tested according to the method given in section K.2 of Annex K.

At least the worst case (the mechanically weakest case) shall be considered.

For fixings connecting the subframe to the wall (anchors), shear resistance shall be assessed according to the relevant EAD (e.g. EAD 330747 (ETAG 001-6), EAD 330284 (ETAG 020), EAD 330076 (ETAG 029) etc.).

Test results shall be given according to the relevant EAD or section K.2 of Annex K.

#### **2.2.12.8 Bracket resistance (horizontal and vertical load) of kit subframe**

This characteristic is only relevant when the manufacturer provides a kit which includes the subframe components (see section 1.1).

The assessment of the kit subframe resistance is carried out by means of the assessment of the resistance of the brackets, which is representative of this essential characteristic for the kit.

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

At least the worst case (the mechanically weakest case) shall be tested.

The mean<sup>3</sup> value and the characteristic value according to Annex N shall be given.

When possible, calculation according to relevant standards (e.g. EN 1999-1-1 for aluminium) can be carried out provided that this calculation is compared by testing according to the method given in Annex L. In this case no additional testing will be required.

### 2.2.13 Airborne sound insulation

The assessment of the airborne sound insulation of the kit is carried out by means of the assessment of the improvement of airborne sound insulation (see section 2.2.13.1) and the airflow resistivity of the thermal insulation, which are representative of this essential characteristic for the kit.

#### 2.2.13.1 Improvement of airborne sound insulation

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

At least the worst or the most representative assembled kit shall be tested. For the determination of the influence of the cladding kit on the sound insulation of the external wall, parameters such as the dynamic stiffness of the insulation product, the mass/m<sup>2</sup> of the rendering system, the board and the density of board-fixings must be known.

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

The weighted improvement  $\Delta R_w$ , the sound reduction index  $R_w$  with and without the assembled kit and the spectrum adaptation terms C and  $C_{tr}$ , shall be given.

#### 2.2.13.2 Airflow resistivity of the thermal insulation

This characteristic is only relevant when the manufacturer provides a kit which includes the thermal insulation product (see section 1.1).

Airflow resistivity of the kit is associated to the airflow resistivity of the thermal insulation product and it shall be assessed according to the relevant hEN or EAD (see table 1.2).

*Note: When available, performance included in the DoP regarding the thermal insulation product should be used as far as possible to avoid retesting or reassessment.*

When there is no relevant hEN or EAD applicable, the Airflow resistivity of the thermal insulation product shall be tested according to EN 29053.

Airflow resistivity value for the thermal insulation product shall be given.

### 2.2.14 Thermal resistance

#### In the case of non-ventilated façades:

Thermal resistance (R-value) of the assembled kit shall be calculated according to EN ISO 6946, using the thermal resistance of the kit components obtained from the relevant European product standards (see table 1.2), or tested according to EN 12667, EN 12939 or EN 12664. Alternatively, the thermal resistance may be tested according to EN ISO 8990. Tabulated values of the kit components materials according to EN ISO 10456 may also be defined by the manufacturer.

In the case of the rendering system, test for the whole rendering system is recommended.

The assembled kit thermal bridges shall be calculated according to EN ISO 10211.

At least, the worst or the most representative assembled kit shall be assessed.

Thermal resistance value for the assembled kit shall be given.

#### In the case of ventilated façades when the kit includes the thermal insulation product:

Thermal resistance (R-value) of the kit is associated to the resistance of the thermal insulation product and it shall be assessed according to the relevant hEN or EAD (see table 1.2).

*Note: When available, performance included in the DoP regarding the thermal insulation product should be used as far as possible to avoid retesting or reassessment.*

When there is no relevant hEN or EAD applicable, the thermal resistance of the thermal insulation product shall be tested according to EN 12667, EN 12939 or EN 12664.

Thermal resistance values for the thermal insulation product shall be given.

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

This characteristic is not relevant.

## **2.2.15 Durability**

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

- Accelerated ageing behaviour. See sections 2.2.15.1.
- Cracking strength due to board deformation. See section 2.2.15.2.
- Dimensional stability. See section 2.2.15.3.
- Moisture content. See section 2.2.15.4.
- Corrosion. See sections 2.2.15.5.
- UV radiation resistance. See section 2.2.15.6.

### **2.2.15.1 Accelerated ageing behaviour**

Accelerated ageing behaviour of the kit shall be assessed by means of bond strength test (see section 2.2.12.1) and water absorption by capillarity test (see section 2.2.5.1) of specimens taken from the assembled kit submitted to:

- The hygrothermal cycles given in section M.1 of Annex M.
- The freeze-thaw cycles given in section M.2 of Annex M. The freeze-thaw resistance test shall only be carried out when the water absorption by capillarity of the whole rendering system (see section 2.2.5.1) is greater or equal than 0,5 kg/m<sup>2</sup> after 24 hours.
- Alternatively, when required by the manufacturer, the combined test with hygrothermal and freeze-thaw cycles given in section M.3 of Annex M may be carried out.

At least the worst case (e.g. minimum bond strength, maximum water absorption by capillarity, minimum thickness of kit components, without the breather membrane, etc.) or the most representative case of the kit shall be tested. See also section M.1.2 of Annex M.

It is possible to carry out the test only with the external layers of the kit (rendering system and board).

If any of the following defects occur during or at the end of the accelerated ageing cycles programme, it shall be recorded.

- deterioration such as cracking or delamination of the rendering system or the boards that allows water penetration to the internal layers;
- detachment of the rendering system or the board;
- irreversible deformation.

The following values shall be given:

- Minimum value of bond strength tests (see section 2.2.12.1) after ageing cycles (in MPa).
- Ratio (in %) between the bond strength mean value after ageing cycles test and the mean value in the bond strength tests without ageing cycles.

- Maximum value of the water absorption by capillarity (see section 2.2.5.1) after ageing cycles (in kg/m<sup>2</sup>).
- Ratio (in %) between the water absorption by capillarity mean value after ageing cycles test and the mean value in the water absorption by capillarity tests without ageing cycles.

### 2.2.15.2 Cracking strength due to board deformation

Cracking strength due to board deformation shall be assessed by means of water absorption by capillarity tests (see section 2.2.5.1) of specimens taken from the assembled kit submitted to movement cycles given in section M.4 of Annex M.

At least the worst case (e.g. minimum bond strength, maximum water absorption by capillarity, minimum thickness of kit components, etc.) or the most representative case of the kit shall be tested.

If any of the following defects occur during or at the end of the cycles programme, it shall be recorded.

- deterioration such as cracking or delamination of the rendering system or the boards;
- detachment of the rendering system or the board;
- irreversible deformation.

The following values shall be given:

- Maximum value of the water absorption by capillarity (see section 2.2.5.1) after ageing cycles (in kg/m<sup>2</sup>).
- Ratio (in %) between the water absorption by capillarity mean value after ageing cycles test and the mean value in the water absorption by capillarity tests without ageing cycles.

### 2.2.15.3 Dimensional stability

Dimensional stability of the kit shall be assessed by means of the dimensional stability of the kit components that are known to be or suspected of being sensitive to changes in environmental relative humidity and/or temperature.

#### Dimensional stability by humidity

The dimensional stability of the kit components associated with changes in relative humidity shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the dimensional variation by humidity of the kit components shall be assessed according to EN 318 or EN 1170-7.

The maximum value for each sensitive kit component shall be given.

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

#### Linear thermal expansion

The dimensional stability of the kit components associated with changes in temperature shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the linear thermal expansion coefficient of the kit components shall be assessed according to section 3.2.6 of EN 1993-1-1, section 3.2.5 of EN 1999-1-1 or EN 14617-11.

The maximum value for each sensitive kit component shall be given.

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



#### 2.2.15.4 Moisture content

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

The moisture content of the kit components shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the shall be assessed according to EN 322.

The moisture content maximum value for each sensitive kit component shall be given.

The values shall cover the range of density of the boards.

#### 2.2.15.5 Corrosion

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

The corrosion protection of the metal components of the kits shall be described according to the appropriate EN standard (e.g. EN 10346 for continuously hot-dip coated steels).

The choice of steel, aluminium and stainless steel grade shall be described according to the appropriate EN standards (e.g. EN 10346 for continuously hot-dip coated steel, EN 755-1 and EN 1999-1-1 for aluminium alloys, EN 10088-4 for stainless steels).

The steel or aluminium grade and the respective corrosion protection shall be described in function of the field of application and the corrosivity of atmospheres defined in EN ISO 9223 (e.g. marine atmosphere, industrial atmosphere, etc.). In particularly aggressive atmospheres with extreme chemical pollution (e.g. desulphurization plants, chloride atmosphere), special measures of corrosion protection shall be foreseen.

If necessary, the performance deterioration caused by corrosion should also be described.

#### 2.2.15.6 UV radiation resistance

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

Kit components behaviour after UV radiation ageing shall be assessed according to the relevant hEN (see table 1.2) or EAD.

*Note: When available, performance included in the DoP regarding the relevant kit components should be used as far as possible to avoid retesting or reassessment.*

When the hEN or EAD does not give an assessment method or when there is no relevant hEN or EAD applicable, the following standards shall be taken into account: EN ISO 877-1, EN ISO 877-3, EN ISO 4892-1, EN ISO 4892-2, EN ISO 4892-3, EN 927-2, EN 13245-2 or EN 10169.

Test results shall be given according to the relevant hEN, EAD or standard listed above.

### 3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is Decision 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<sup>5</sup> 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 3.1a.

The actions to be undertaken by the manufacturer of the product for the different components of the kit are laid down in table 3.1b to 3.1e when the components are produced by the manufacturer itself and table 3.1f when the components are not produced by the manufacturer itself but by its supplier under the specifications of the manufacturer.

**Table 3.1a: Control plan for the manufacturer; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
<b>Factory production control (FPC)</b>					
1	<u>Components produced by the manufacturer itself:</u>				
	▪ Boards	See table 3.1b	See table 3.1b	See table 3.1b	See table 3.1b
	▪ Base-coat or finishing coat	See table 3.1c	See table 3.1c	See table 3.1c	See table 3.1c
	▪ Glass fibre reinforcement mesh	See table 3.1d	See table 3.1d	See table 3.1d	See table 3.1d
	▪ Board-fixings and subframe components	See table 3.1e	See table 3.1e	See table 3.1e	See table 3.1e
	▪ Breather membrane	Acc. to the relevant hEN or EAD	Acc. to the Control Plan	Acc. to Control Plan	Acc. to the relevant hEN or EAD
	▪ Thermal insulation product	Acc. to the relevant hEN or EAD	Acc. to the Control Plan	Acc. to Control Plan	Acc. to the relevant hEN or EAD
	▪ Ancillary components	Acc. to the Control Plan	Acc. to the Control Plan	Acc. to the Control Plan	Acc. to the Control Plan
2	<u>Components not produced by the manufacturer itself</u> (*)	See table 3.1f	See table 3.1f	See table 3.1f	See table 3.1f
(*) Components produced by the supplier under the specifications of the manufacturer.					

<sup>5</sup> Including propensity to undergo continuous smouldering, where relevant.

**Table 3.1b: Control plan when the board is produced by the manufacturer itself; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
<b>Factory production control (FPC)</b>					
<b>Incoming materials</b>					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Supplier certificates or supplier tests			
<b>Finished component</b>					
1	Geometry (form and dimensions)	When apply, acc. to the relevant hEN or EAD Otherwise measuring, visual check or section A.1 of Annex A	Acc. to the Control Plan	According to tests or control methods	Acc. to the Control Plan (*)
2	Density or mass per unit area or per unit	When apply, acc. to the relevant hEN or EAD Otherwise section A.2 of Annex A			
3	Mechanical characteristics	Test or control based on relevant sections 2.2.12.2 to 2.2.12.4			At least once each 5 years
		Test acc. to sections 2.2.12.2 to 2.2.12.4			
(*) The frequency is determined case by case depending on the type of production process, the variation in the volume produced and the production process control.					

**Table 3.1c: Control plan when the base-coat or finishing coat is produced by the manufacturer itself; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
<b>Factory production control (FPC)</b>					
<b>Base-coat and finishing coat components</b>					
<b>Incoming materials</b>					
1	Receipt materials	Delivery ticket and/or label on the package	Conformity with the order	---	Each delivery
		Supplier certificates or supplier tests			
2	Particle size grading	Acc. to the Control Plan	Acc. to the Control Plan	Acc. to the Control Plan	Acc. to the Control Plan
3	Bulk density				
<b>Production process</b>					
4	Mixing process	According to the Control Plan	According to the Control Plan	According to the Control Plan	According to the Control Plan
5	Packing				
<b>Finished component</b>					
6	Density (1)	A.3 of Annex A	Acc. to the Control Plan	According to test or control methods	Acc. to the Control Plan (*)
7	Particle size grading (2) (3)	A.4 of Annex A			
8	Dry extract at 105 °C (2)	A.5 of Annex A			
9	Ash content at 450 °C (3)	A.6.1 of Annex A			

**Table 3.1c: Control plan when the base-coat or finishing coat is produced by the manufacturer itself; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
10	Modulus of elasticity, tensile strength and elongation (1) (4)	A.7 of Annex A	Acc. to the Control Plan	According to test or control methods	Acc. to the Control Plan (*)
11	Shrinkage (1) (4)	A.8 of Annex A			
12	Crack bridging resistance (5)	Acc. to the Control Plan, method based on EN ISO 4628-4			
13	Bond strength (1) (6)	Section 2.2.12.1			At least once each 5 years
(*) The frequency is determined case by case depending on the variation in the volume produced and the production process control. (1) on hardened mortar (2) only for mortars delivered in paste (3) on powder mortar (4) only applicable to mortars (5) only for paints (6) applicable for the whole rendering system					

**Table 3.1d: Control plan when the glass fibre reinforcement mesh is produced by the manufacturer itself; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control	
<b>Factory production control (FPC)</b>						
<b>Glass fibre reinforcement mesh</b>						
<b>Incoming materials</b>						
1	Receipt materials	Delivery ticket and/or label on the package Supplier certificates or supplier tests	Conformity with the order	---	Each delivery	
<b>Finished component</b>						
1	Mass per unit area	A.9 of Annex A	Acc. to the Control Plan	According to test or control methods	Acc. to the Control Plan (*)	
2	Ash content at 625 °C	A.6.2 of Annex A				
3	Mesh size and number of filaments	A.10 of Annex A				
4	Tensile strength and elongation	without ageing				A.11 of Annex A
		with ageing				
5	Alkali resistance	Test or control acc. to the Control Plan				
(*) The frequency is determined case by case depending on the variation in the volume produced and the production process control.						

**Table 3.1e: Control plan when the board-fixings and/or subframe components are produced by the manufacturer itself; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
<b>Factory production control (FPC)</b>					
<b>Incoming materials</b>					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Supplier certificates or supplier tests			
<b>Finished component</b>					
1	Geometry (form and dimensions)	Measuring and visual check	Acc. to the Control Plan	According to tests or control methods	Acc. to the Control Plan (*)
2	Mechanical characteristics	Test or control based on relevant sections 2.2.12.3 to 2.2.12.8			
		Test acc. to sections 2.2.12.3 to 2.2.12.8			At least once each 5 years
(*) The frequency is determined case by case depending on the type of production process, the variation in the volume produced and the production process control.					

**Table 3.1f: Control plan when the components are not produced by the manufacturer; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
<b>Factory production control (FPC)</b>					
1	Components belonging to Case 1 (*)	(1)	Conformity with the order	Testing is not required	Each delivery
		(2)	Acc. to the Control Plan	Testing is not required	Each delivery
2	Components belonging to Case 2 (*):	(1)	Conformity with the order	Testing is not required	Each delivery
		▪ Characteristics declared in DoP for the specific use within the kit.	Acc. to the Control Plan	Testing is not required	Each delivery
		▪ Characteristics not declared in DoP for the specific use within the kit.	Acc. to the Control Plan	Acc. to Control Plan	Acc. to Control Plan
3	Components belonging to Case 3 (*):	(1)	Conformity with the order	Testing is not required	Each delivery
		(3)	Acc. to the Control Plan	Acc. to Control Plan	Acc. 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: supplier certificates or supplier tests or test or control acc. to tables 3.1a to 3.1e above. (3) Supplier certificates or supplier tests or Test or control acc. to tables 3.1a to 3.1e above.					

**Table 3.1f: Control plan when the components are not produced by the manufacturer; cornerstones.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
(*) Case 1: Component covered by a hEN or its own ETA for all characteristics needed for the specific use within the kit. Case 2: If the component is a product covered by a hEN or its own ETA 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 a product not (yet) covered by a hEN or its own ETA.					

### 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 cladding kit are laid down in table 3.2.

**Table 3.2: Tasks of the notified body under AVCP system 2+.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b>					
1	Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer considering the constancy of performances of kit components defined in the Control Plan (except reaction to fire).	As defined in the control plan	As defined in the control plan	As defined in the control plan	When starting the production
<b>Continuous surveillance, assessment and evaluation of factory production control</b>					
2	Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer considering the constancy of performances of kit components defined in the Control Plan (except reaction to fire).	As defined in the control plan	As defined in the control plan	As defined in the control plan	Once per year

Regarding reaction to fire, 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 tasks to be undertaken by the notified body under AVCP system 1 are laid down in table 3.3.

**Table 3.3: Tasks of the notified body under AVCP system 1.**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b>					
1	Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer limited to the constancy of performances of reaction to fire and taking into account the limit of organic material and/or the addition of fire retardants.	As defined in the control plan	As defined in the control plan	As defined in the control plan	When starting the production
<b>Continuous surveillance, assessment and evaluation of factory production control</b>					
2	Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer limited to the constancy of performances of reaction to fire and taking into account the limit of organic material and/or the addition of fire retardants.	As defined in the control plan	As defined in the control plan	As defined in the control plan	Once per year

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

Annex A establishes special methods of components used for the verification of constancy of performance, and when relevant, for the characterization of the kit component.

## 4 REFERENCE DOCUMENTS

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

EAD 040016	Glass fibre mesh for reinforcement of cement based renderings
EAD 090019	Kits for ventilated external wall claddings of lightweight boards on subframe with rendering applied in situ with or without thermal insulation
EAD 090034	Kit composed by subframe and fixings for fastening cladding and external wall elements.
EAD 090062	Kits for external wall claddings mechanically fixed (ETAG 034 conversion).
EAD 210024	Cement-bonded boards.
EAD 330046	Fastening screws for metal members and sheeting.
EAD 330076	Metal Injection Anchors for use in Masonry.
EAD 330232	Mechanical fasteners for use in concrete.
EAD 330499	Bonded fasteners for use in concrete.
EAD 330747	Fasteners for use in concrete for redundant non-structural systems (ETAG 001-6 conversion).
EAD 330284	Plastic anchors for redundant non-structural systems in concrete and masonry (ETAG 020 conversion).
EOTA TR 001	Determination of impact resistance of panels and panels assemblies.
EN 10088-1	Stainless steels - Part 1: List of stainless steels.
EN 10088-2	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes.
EN 10088-4	Stainless steels - Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes.
EN 1015-10	Methods of test for mortar for masonry - Part 10: Determination of dry bulk density of hardened mortar.
EN 1015-12	Methods of test for mortar for masonry - Part 12: Determination of adhesive strength of hardened rendering and plastering mortars on substrates.
EN 1015-21	Methods of test for mortar for masonry - Part 21: Determination of the compatibility of one-coat rendering mortars with substrates.
EN 10169	Continuously organic coated (coil coated) steel flat products - Technical delivery condition.
EN 10346	Continuously hot-dip coated steel flat products for cold forming - Technical delivery conditions.
EN 1062-1	Paints and varnishes - Coating materials and coating systems for exterior masonry and concrete - Part 1: Classification
EN 1170-7	Precast concrete products. Test method for glass-fibre reinforced cement. Part 7: Measurement of extremes of dimensional variations due to moisture content.
EN 12020-1	Aluminium and aluminium alloys - Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 - Part 1: Technical conditions for inspection and delivery.
EN 12020-2	Aluminium and aluminium alloys - Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 - Part 2: Tolerances on dimensions and form.
EN 12086	Thermal insulating products for building applications - Determination of water vapour transmission properties.
EN 12087	Thermal insulating products for building applications - Determination of long term water absorption by immersion.



EN 12088	Thermal insulating products for building applications - Determination of long term water absorption by diffusion.
EN 12467	Fibre-cement flat sheets - Product specification and test methods.
EN 12617-4	Products and systems for the protection and repair of concrete structures - Test methods - Part 4: Determination of shrinkage and expansion.
EN 12664	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Dry and moist products of medium and low thermal resistance.
EN 12667	Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance.
EN 12808-4	Grouts for tiles - Part 4: Determination of shrinkage
EN 12865	Hygrothermal performance of building components and building elements - Determination of the resistance of external wall systems to driving rain under pulsating air pressure.
EN 12939	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance.
EN 13162	Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification
EN 13163	Thermal insulation products for buildings - Factory made expanded polystyrene (EPS) products – Specification.
EN 13164	Thermal insulation products for buildings - Factory made extruded polystyrene foam (XPS) products – Specification.
EN 13165	Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products – Specification.
EN 13166	Thermal insulation products for buildings - Factory made phenolic foam (PF) products – Specification.
EN 13238	Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates.
EN 13245-2	Plastics - Unplasticized poly (vinyl chloride) (PVC-U) profiles for building applications - Part 2: PVC-U profiles and PVC-UE profiles for internal and external wall and ceiling finishes.
EN 13496	Thermal insulation products for building applications - Determination of the mechanical properties of glass fibre meshes as reinforcement for External Thermal Insulation Composite Systems with renders (ETICS).
EN 13501-1	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
EN 13823	Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item.
EN 13859-2	Flexible sheets for waterproofing - Definitions and characteristics of underlays - Part 2: Underlays for walls.
EN 13963	Jointing materials for gypsum boards - Definitions, requirements and test methods
EN 14081-1	Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements.
EN 14195	Metal framing components for gypsum board systems - Definitions, requirements and test methods
EN 14399-1	High strength structural bolting assemblies for preloading - Part 1: General requirements

EN 14566	Mechanical fasteners for gypsum plasterboard systems - Definitions, requirements and test methods
EN 14592	Timber structures - Dowel-type fasteners – Requirements.
EN 14617-11	Agglomerated stone - Test methods - Part 11: Determination of linear thermal expansion coefficient.
EN 15048-1	Non-preloaded structural bolting assemblies - Part 1: General requirements
EN 15283-1	Gypsum boards with fibrous reinforcement - Definitions, requirements and test methods - Part 1: Gypsum boards with mat reinforcement
EN 15283-2	Gypsum boards with fibrous reinforcement - Definitions, requirements and test methods - Part 2: Gypsum fibre boards
EN 15824	Specifications for external renders and internal plasters based on organic binders
EN 1602	Thermal insulating products for building applications - Determination of the apparent density.
EN 1609	Thermal insulating products for building applications - Determination of short term water absorption by partial immersion.
EN 1993	Eurocode 3: Design of steel structures.
EN 1993-1-1	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings.
EN 1993-1-8	Eurocode 3: Design of steel structures - Part 1-8: Design of joints.
EN 1999	Eurocode 9: Design of aluminium structures.
EN 1999-1-1	Eurocode 9: Design of aluminium structures - Part 1-1: General structural rules.
EN 29053	Acoustics. Materials for acoustical applications. Determination of airflow resistance. (ISO 9053:1991).
EN 318	Wood based panels - Determination of dimensional changes associated with changes in relative humidity.
EN 322	Wood-based panels. Determination of moisture content.
EN 480-8	Admixtures for concrete, mortar and grout. Test methods. Part 8: Determination of the conventional dry material content.
EN 520	Gypsum plasterboards - Definitions, requirements and test methods.
EN 755-1	Aluminium and aluminium alloys- Extruded rod/bar, tube and profiles - Part 1: Technical conditions for inspection and delivery.
EN 755-2	Aluminium and aluminium alloys - Extruded rod/bar, tube and profiles - Part 2: Mechanical properties.
EN 755-9	Aluminium and aluminium alloys - Extruded rod/bar, tube and profiles - Part 9: Profiles, tolerances on dimensions and form.
EN 822	Thermal insulating products for building applications - Determination of length and width.
EN 823	Thermal insulating products for building applications - Determination of thickness.
EN 927-2	Paints and varnishes - Coating materials and coating systems for exterior wood - Part 2: Performance specification.
EN 998-1	Specification for mortar for masonry - Part 1: Rendering and plastering mortar
EN ISO 10140-1	Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products.
EN ISO 10211	Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations.

EN ISO 10456	Building materials and products - Hygrothermal properties -Tabulated design values and procedures for determining declared and design thermal values.
EN ISO 10666	Drilling screws with tapping screw thread - Mechanical and functional properties.
EN ISO 11348-1	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 1: Method using freshly prepared bacteria.
EN ISO 11348-2	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 2: Method using liquid-dried bacteria.
EN ISO 11348-3	Water quality. Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test). Part 3: Method using freeze-dried bacteria.
EN ISO 1182	Reaction to fire tests for products - Non-combustibility test.
EN ISO 11925-2	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.
EN ISO 12572	Hygrothermal performance of building materials and products - Determination of water vapour transmission properties.
EN ISO 14588	Blind rivets - Terminology and definitions.
EN ISO 15148	Hygrothermal performance of building materials and products - Determination of water absorption coefficient by partial immersion.
EN ISO 15973	Closed end blind rivets with break pull mandrel and protruding head.
EN ISO 15974	Closed end blind rivets with break pull mandrel and countersunk head.
EN ISO 15975	Closed end blind rivets with break pull mandrel and protruding head.
EN ISO 15976	Closed end blind rivets with break pull mandrel and protruding head.
EN ISO 15977	Open end blind rivets with break pull mandrel and protruding head.
EN ISO 15978	Open end blind rivets with break pull mandrel and countersunk head.
EN ISO 15979	Open end blind rivets with break pull mandrel and protruding head.
EN ISO 15980	Open end blind rivets with break pull mandrel and countersunk head.
EN ISO 15981	Open end blind rivets with break pull mandrell and protruding head.
EN ISO 15982	Open end blind rivets with break pull mandrel and countersunk head.
EN ISO 15983	Open end blind rivets with break pull mandrel and protruding head.
EN ISO 15984	Open end blind rivets with break pull mandrel and countersunk head.
EN ISO 16582	Open end blind rivets with break pull mandrel and protruding head.
EN ISO 16583	Open end blind rivets with break pull mandrel and countersunk head.
EN ISO 16584	Open end blind rivets with break pull mandrel and protruding head.
EN ISO 16585	Closed end blind rivets with pull mandrel and protruding head.
EN ISO 1716	Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value).
EN ISO 3506-1	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and studs.
EN ISO 3506-2	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 2: Nuts.
EN ISO 3506-3	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 3: Set screws and similar fasteners not under tensile stress.
EN ISO 3506-4	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 4: Tapping screws.

EN ISO 4628-4	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 4: Assessment of degree of cracking (ISO 4628-4:2016)
EN ISO 4892-1	Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance.
EN ISO 4892-2	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013).
EN ISO 4892-3	Plastics - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps.
EN ISO 6341	Water quality. Determination of the inhibition of the mobility of <i>Daphnia magna</i> Straus (Cladocera, Crustacea). Acute toxicity test.
EN ISO 6946	Building components and building elements - Thermal resistance and thermal transmittance - Calculation method.
EN ISO 717-1	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation.
EN ISO 7783	Paints and varnishes - Determination of water-vapour transmission properties - Cup method.
EN ISO 877-1	Plastics - Methods of exposure to solar radiation - Part 1: General guidance.
EN ISO 877-3	Plásticos. Métodos de exposición a la radiación solar. Parte 3: Exposición intensificada por radiación solar concentrada.
EN ISO 8990	Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box.
EN ISO 9223	Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation.
ISO 15799	Soil quality. Guidance on the ecotoxicological characterization of soils and soil materials.
CEN/TS 16637-2	Construction products - Assessment of release of dangerous substances - Part 2: Horizontal dynamic surface leaching test.

## ANNEX A – SPECIAL COMPONENTS TEST METHODS

This annex establishes special test methods of components used for the verification of constancy of performance and, when relevant, for the characterization of the components.

### A.1 Dimensions of the boards

Dimensions of the boards are measured according to the relevant hEN (see table 1.2) or EAD.

When the hEN or EAD does not give an assessment method, the dimensions of the board shall be measured according to the relevant sections of EN 12467, EN 15283-1, EN 15283-2 or EN 520.

### A.2 Density of the boards

Density of the boards are measured according to the relevant hEN (see table 1.2) or EAD.

When the hEN or EAD does not give an assessment method, the dimensions of the board shall be measured according to the relevant sections of EN 12467, EN 15283-1, EN 15283-2 or EN 520.

### A.3 Density of mortars

#### A.3.1 Product as delivered

##### Pastes and liquids

This is measured at  $(23 \pm 2)$  °C in a 1000 cm<sup>3</sup> cylinder.

##### Powders

This is measured at  $(23 \pm 2)$  °C in a 500 cm<sup>3</sup> cylinder.

##### Method of operation

The results are recorded after maximum packing down on a vibrating table and levelling of the surface. The results are expressed in kg/m<sup>3</sup> (mean value of 3 tests).

#### A.3.2 Fresh mortar

##### Preparation of mortar

The mortar is prepared in the laboratory according to manufacturer's instructions.

In most cases, manufacturers shall specify both spray (large surfaces) and trowel (small surfaces) applied mortar. Therefore, unless the ETA-Applicant specifies the method of application, or the most onerous application method can be determined, tests shall be conducted with both spray and trowel applied material and the density of both shall be measured. The ETA should specify the densities and their tolerances for trowel and spray applied renderings.

##### Method of operation

The apparent density is determined using a 1 litre cylindrical container, previously tared (mass  $M_0$  in g). The container is filled with paste and after compacting down, wiped off and weighed (mass  $M_1$  in g). The density of the paste (in kg/m<sup>3</sup>) is equal to  $M_1 - M_0$ . The density of the paste is measured immediately after mixing.

#### A.3.3 Hardened mortar

The specimens shall be prepared according to section A.3.2 using an adequate formwork or mould.

Apparent density of hardened mortar shall be determined by measuring mass and dimensions. The accuracy for weighing is 1/1000 and for the dimensions is 1/100.

Alternative method according to EN 1015-10 can be used.

## **A.4 Particle size grading**

### Pastes

Particle size grading is established from a sample of fillers removed from the manufactured product after washing on a sieve, mesh size 0,08 mm or after any other suitable and pertinent preparation. The test is carried out after drying at least 105 °C.

### Powders

Particles size grading is established from a sample of fillers removed from the manufactured product.

### Method of operation

The test is performed using air stream sieving on an about 50 g specimen for 5 minutes per sieve. The curve is traced from 0,04 (for powders) or 0,08 (for pastes) to 4 mm with at least 5 intermediate sieves.

## **A.5 Dry extract (only pastes and liquids)**

### **A.5.1 Lime and polymer based products**

This is determined after placing the sample in a ventilated oven set at  $(105 \pm 5)$  °C until a constant mass is obtained.

The mass is regarded as constant if the difference in mass between two successive weighing, one hour apart, does not exceed 0,1 g.

Initial weighing for testing:

- 2 g for liquid products (impression, etc.),
- 5 g for products in paste form.

The results are expressed as a percentage relative to the initial mass (mean value of 3 tests).

Alternative method according to EN 480-8 can be used.

### **A.5.2 Silicate based products**

The dry extract is determined by the following method:

A - Initial weighing of approximately 5 g (product in the as-delivered state) on an aluminium sheet, approximately 100 mm x 100 mm, 2/3 covered.

B - Pre dry for 1 hour at  $(125 \pm 10)$  °C. Dry for 2 hours at  $(200 \pm 10)$  °C.

C - Final weighing.

Weighing accuracy shall be within 5 mg.

The difference in mass from the initial weighing is accounted for by volatile components including water of crystallization.

The results are expressed as a percentage relative to the initial mass (mean value of 3 tests).

Alternative method according to EN 480-8 can be used.

## A.6 Ash content

### A.6.1 Base-coat and finishing coats

#### Pastes and liquids

The ash content is determined on the same samples as those on which the dry extract has been measured.

#### Powders

The ash content is determined at 450 °C and 900 °C on a sample of approximately 5 g pre-dried at  $(100 \pm 5)$  °C or at  $(200 \pm 5)$  °C for silicate based products, to constant mass. The mass is regarded as constant if the difference in mass between two successive weightings, one hour apart, does not exceed 0,1 g.

#### Method of operation

- The sample is placed in a tared crucible either fitted with a lid or enclosed in a leak-tight container and the whole is weighed,
- After the lid has been removed, where necessary, the crucible is placed in the oven maintained at ambient temperature,
- The temperature of the oven is then raised to  $(450 \pm 20)$  °C (ash content at 450 °C) or to  $(900 \pm 20)$  °C (ash content at 900 °C) and maintained at that temperature for 5 hours,
- The crucible is allowed to cool down to room temperature in the desiccators before being weighed.

The results are expressed as a percentage relative to the initial mass after drying (mean value of 3 tests).

*Note: the tolerances at 900 °C may become larger, taking account of the products' composition.*

### A.6.2 Glass fibre reinforcement mesh

The ash content is determined at  $(625 \pm 20)$  °C on three 100 mm square samples, cut parallel to the yarn and at least 100 mm apart from the side to constant mass.

The result is expressed as a percentage relative to the initial mass.

Alternative method according to EAD 040016 can be used.

## A.7 Modulus of elasticity, tensile strength and elongation

### A.7.1 Products with a thickness greater than 5 mm

#### Preparation and storing of test samples

The mortar is prepared by mixing as described in section A.3.2.

Test samples, conforming to the dimensions defined in the paragraphs below, are prepared in metal moulds in two layers.

Each layer is compacted into position by dropping alternately each side of the mould from a height of 5 mm approximately ten times. The test samples are then levelled with a metal ruler.

The test samples are removed from the mould after 24 h.

They are then stored for at least 28 days at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % relative humidity.

### Dynamic modulus of elasticity (Resonance frequency method)

The dynamic modulus of elasticity is determined on prismatic test samples measuring 25 mm x 25 mm x 285 mm.

The test is carried out on 3 samples prepared as described above.

The individual values of the apparent density (in kg/m<sup>3</sup>) and the modulus (in MPa) of the 3 test samples and the mean value of the results obtained are noted.

The principle of the measurement consists of measuring the basic resonance frequency of a test sample under longitudinal vibration.

#### 1 – Apparatus:

The apparatus used for carrying out this measurement comprises:

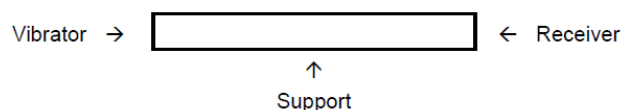
- a) A variable frequency oscillator, with a frequency range of 20 kHz and an accuracy of 1%.
- b) An electromagnetic vibrator which may or may not be in mechanical contact with the test sample; its mass shall be very light compared to that of the test sample.
- c) A receiver, an electromechanical transducer and an amplifier; its mass shall be very light compared to that of the test sample.

The resonance frequencies of the vibrator and the receiver shall not fall between 0,5 kHz and 20 kHz.

- d) An amplifier.
- e) An apparatus indicating the vibration amplitudes (voltmeter, milliammeter, oscilloscope).
- f) A very narrow support on which the test sample rests during the measurement, which shall not hinder the longitudinal vibration of the test sample and which shall be in the nodal plane.

#### 2 - Testing

The sample is centred on the support. The vibrator and the receiver are placed as shown in the figure below:



It is important that the ends of the test piece are free to vibrate in an axial direction. The vibration generator and the receiver, if they are in contact with the test piece, should exert an equal very weak stress on the two ends. In this case, it is recommended to weakly bond the mobile part of the vibrator to the sample using a coupling product (mastic). The same applies for the receiver.

The variable frequency oscillator supplies the vibrator and the test piece vibrates longitudinally. The vibrations are collected by the receiver and after amplification their amplitude is shown on a dial (voltmeter, milliammeter, oscilloscope). For most frequency ranges, the vibration amplitude is quite small. But for certain frequencies, the displacement becomes appreciable. The resonance conditions are created when maximum amplitude is obtained on the indicating dial.

The frequency of the basic longitudinal resonance corresponds to the lowest frequency for which a maximum amplitude is obtained (for the higher harmonic frequencies a resonance is also produced).

Two measurements are carried out: the vibration is produced successively at the two ends of the test piece. The mean value is recorded. If the difference between the two values is higher than 5 % the vibrations are restarted.

The measurements of the mass and dimensions of the test piece are needed to calculate the modulus. The accuracy for weighing is 1/1000 and for the dimensions 1/100.

#### 3 - Expressing the results:



As the basic longitudinal resonance frequency, the mass and the dimensions of the test piece are known the dynamic modulus of elasticity is determined using the following formula:

$$E_d = 4 \cdot L^2 \cdot F^2 \cdot \rho \cdot 10^{-6}$$

$E_d$  = Longitudinal dynamic modulus of elasticity in Newton per square millimetre.

$L$  = Length of test piece in metres.

$F$  = Longitudinal resonance frequency in Hertz.

$\rho$  = Mass per unit volume in kg/m<sup>3</sup>.

## **A.7.2 Products with a thickness up to 5 mm**

### Preparation and storing of test samples

The mortar is prepared by mixing as described in section A.3.2.

The tests are performed on test samples measuring 3 mm x 50 mm x 300 mm.

Moulds for the samples are made using appropriately positioned 3 mm thick strips of extruded polystyrene adhered to expanded polystyrene boards.

After the mortar (without reinforcement) has dried, test samples are cut from the polystyrene with hot wire.

The test sample is subjected to a tensile test until it breaks using a suitable machine which records the tensile stress and elongation. The distance between the jaws of the machine is 200 mm. The sample is held between the jaws with the interposition of pads.

The tensioning speed is 2 mm/minute.

The tests are carried out on five samples stored for at least 28 days at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH and on five samples which have undergone the hygrothermal test (placed in the window of the specimen).

## **A.8 Shrinkage**

The measurement is carried out on three samples of product measuring 20 mm x 40 mm x 160 mm prepared and stored as described in section A.3.2, by inserting measuring spindles in the front end (10 mm x 40 mm) of the samples.

Measurements are carried out at regular intervals. The value after 28 days is recorded. In addition, if there is doubt in the curve associated with stabilisation, the test is continued and the value after 56 days is recorded.

Alternative method according to EN 12617-4 or EN 12808-4 can be used.

## **A.9 Mass per unit area of reinforcement mesh**

The mass per unit area is determined by measuring and weighting a one metre length of mesh.

For reinforcement in roll form, the width of the sample should be the same as the roll width.

The result is expressed in g/m<sup>2</sup>.

Alternative method according to EAD 040016 can be used.

## **A.10 Mesh size and number of filaments**

The mesh size is determined by measuring the distance between 21 yarns (e.g. 20 mesh) in warp and in weft direction.

The mesh opening is calculated by subtracting the thickness of the yarn from the mesh size.

Alternative method according to EAD 040016 can be used.

### **A.11 Tensile strength and elongation of reinforcement mesh**

Tensile strength and elongation of the reinforcement mesh is determined according to EN 13496 in the following conditions:

- As-delivered state: after conditioning the samples at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH for at least 24 hours.
- After ageing: after immersion the samples for 28 days in the alkaline solution at  $(23 \pm 2)$  °C. 20 samples (10 in the weft and 10 in the warp direction) in 4 litres solution.

Alternative method according to EAD 040016 can be used.

## ANNEX B – REACTION TO FIRE

### B.1 General

#### B.1.1 Principle

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

For the particular parts of the cladding kit components, the following principles apply:

- The kit components material with the highest amount of organic content<sup>6</sup> (if there are only differences in the amount of organic content but no difference in the organic component itself) or the highest PCS value (according to EN ISO 1716) shall be tested.
- In addition, each kit components material selected for testing according to the previous point shall have the lowest amount of flame retardants.

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

- Type of rendering system components (composition, thickness, mass per unit area).
- Type of board (composition, thickness, density).
- The organic content of the binder and of any organic additive of the boards or rendering system components; this can be checked by providing the formulation of the component, by performing suitable characterization tests or by determining the glow loss or net calorific value.
- Type and amount of flame retardant.
- Type and nature of board-fixings and subframe components.

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

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

Components of a kit, where these require separate assessment (as opposed to being tested as part of the kit as a whole), which are classified A1 without testing according to Decision 96/603/EC (as amended) do not need to be tested.

### B.2 Testing according to EN ISO 1182

This test method is relevant for classes A1 and A2.

Using this test method, only the substantial components of the kit need to be tested. ‘Substantial components’ are defined by thickness ( $\geq 1$  mm) and/or mass per unit area ( $\geq 1$  kg/m<sup>2</sup>).

In the following, the base-coat, reinforcement mesh, finishing coats, boards, subframe components, thermal insulation product and breather membrane are considered as “Substantial components”.

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<sup>6</sup> When relevant, the manufacturer is responsible for the information on organic content per unit area. If the information is not available, the PCS value shall be tested to decide about the worst case.

Parameters relevant given in section B.1 shall be applied.

### **B.2.1 Base-coat and finishing coat**

The reaction to fire behaviour of the base-coat and finishing coat not falling under EC Decision 96/603/EC (as amended) shall be tested taking into account the principles given in section B.1.

The test results can be directly applied to all variants with the same base-coat and finishing coat with a lower amount of organic components. When the subject of the directly applied result contains a flame retardant, it shall be of the same type and its content shall be at least that of the product tested.

Differences greater than tolerances  $\pm 10\%$  concerning the density shall be considered by testing the lowest and the highest density.

### **B.2.2 Board, thermal insulation product, breather membrane and subframe components**

For kits expected to be classified as A1 or A2, it is anticipated that only boards, thermal insulation product, breather membrane and subframe components with reaction to fire class A1 or A2 will form part of the kit. For testing these components, reference shall be made to the relevant product standards or other relevant documents.

Differences greater than tolerances  $\pm 10\%$  concerning the density shall be considered by testing the lowest and the highest density.

## **B.3 Testing according to EN ISO 1716 (PCS value)**

This test method is relevant for classes A1 and A2.

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

Parameters relevant for this test method are: composition (when performing calculation of the PCS<sub>s</sub>-value), density or mass per unit area and thickness. Mechanical fixings and ancillary materials which are not continuous but discrete components of cladding kit do not need to be considered for testing and for the calculation of the PCS<sub>s</sub>.

### **B.3.1 Base-coat and finishing coat**

In general, when performing calculations of the unit area referred PCS<sub>s</sub>-value (related to the surface) the variant that provides the highest PCS<sub>s</sub>-value shall be considered.

The test shall be performed in accordance with the principles specified in section B.1 applied to each component.

It is not necessary to test a base-coat or finishing coat with different grain sizes if the organic content is the same as or lower than that of the tested component.

The test results can be directly applied to all variants with the same base-coat and finishing coat but with a lower amount of organic components. When the subject of the directly applied result contains a flame retardant, it shall be of the same type and its content shall be at least that of the product tested.

### **B.3.2 Board**

For testing the board, reference shall be made to the relevant product standards or EAD.

It is not realistic to require that each board of the same material is tested within the classification of a kit. If the board come from different manufacturers and/or are of different thickness, density and formulation from those used in the testing, these may be used subject to the requirements of class A1 and A2 still being fulfilled. It shall be proved by calculation the kit, together with the actual board used in end use application, still fulfils the requirements concerning the PCS-value of the whole product. For example, it is sufficient to

determine the PCS-value of the board and if this is lower than the originally tested product then it is acceptable to use the alternative board instead of that used in the original test.

*Note: Information relating to alternative board of the same material to that originally tested may be evaluated on the basis of the supplier's evidence provided within the context of its CE marking.*

### **B.3.3 Reinforcement**

Each type of reinforcement shall be tested according to EN ISO 1716. For reinforcement that is randomly dispersed (e.g. fibres) in the render then it shall be tested as part of the render.

### **B.3.4 Thermal insulation product and breather membrane**

For testing the insulation product or breather membrane, reference shall be made to the relevant product standards or other related documents.

It is not realistic to require that each insulation product or breather membrane of the same type of material is tested within the classification of a kit. If the product or breather membrane come from different manufacturers and/or are of different thickness, density and formulation from those used in the testing, these may be used subject to the requirements of class A1 and A2 still being fulfilled. It shall be proved by that the kit, together with the actual product or breather membrane used in end use application, still fulfils the requirements concerning the PCS-value of the whole product. For example, it is sufficient to determine the PCS-value of the insulation product or breather membrane and if this is lower than the originally tested product then it is acceptable to use the alternative insulation product or breather membrane instead of that used in the original test.

*Note: information relating to alternative insulation product or breather membrane of the same type of material to that originally tested may be evaluated on the basis of the supplier's evidence provided within the context of its CE marking.*

## **B.4 Testing according to EN 13823 (SBI-test)**

This test method is relevant for classes A2, B, C and D (in some cases also for A1).

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

Parameters which are relevant for this test method:

- Type of kit components (composition, dimensions, density).
- Amount of organic content of the kit components.
- Amount of flame retardant, if any.

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

The test specimen shall be prepared with the kit components with the highest organic content or PCSs-value per unit area.

### **B.4.1 Direct application rules of test results**

See section C.3 of Annex C.

## **B.5 Testing according to EN ISO 11925-2**

This test method is relevant for classes B, C, D and E.

Parameters which are relevant:

- Type of kit components (composition, dimensions, density).
- Amount of organic content of the kit components.
- Amount of flame retardant, if any.

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

The tests are performed with surface flaming of the front side and possibly edge flaming of the test specimen turned 90° according to the rules of standard EN ISO 11925-2.

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

## ANNEX C – MOUNTING AND FIXING PROVISIONS FOR THE SBI TEST

Considerations for kits included in section B.4 of Annex B shall also be considered for SBI test.

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

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

This Annex describes specific provisions for cladding kits.

### C.1 General information

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

- Calcium silicate or fibre-cement board simulates a wall made of masonry or concrete,
- Non-FR particle board simulates a wall made of timber frame,
- Steel sheet simulates a wall made of metal frame.

The frame is made from non-fire retardant treated timber, aluminium or steel.

All ancillary components which form part of the kit shall be included in a representative fashion in the test specimen.

An air space is always provided behind the cladding element in accordance with the manufacturer's instructions (minimum of 20 mm).

In the case of kits for ventilated façade, the bottom and top edges of the specimen shall also remain opened. There may be a gap of 10 mm between the bottom of the specimen and top level of U-profile of the SBI-test device.

If mineral wool insulation layer is planned in end-use situation of the kit, a 50 mm thick insulation product made of mineral wool according to EN 13162, with a density of 30 kg/m<sup>3</sup> to 70 kg/m<sup>3</sup>, shall be installed between frame and substrate.

For other insulation materials, different conditions can be used for testing (e.g. maximum and/or minimum thicknesses, maximum and/or minimum density, unless proven otherwise).

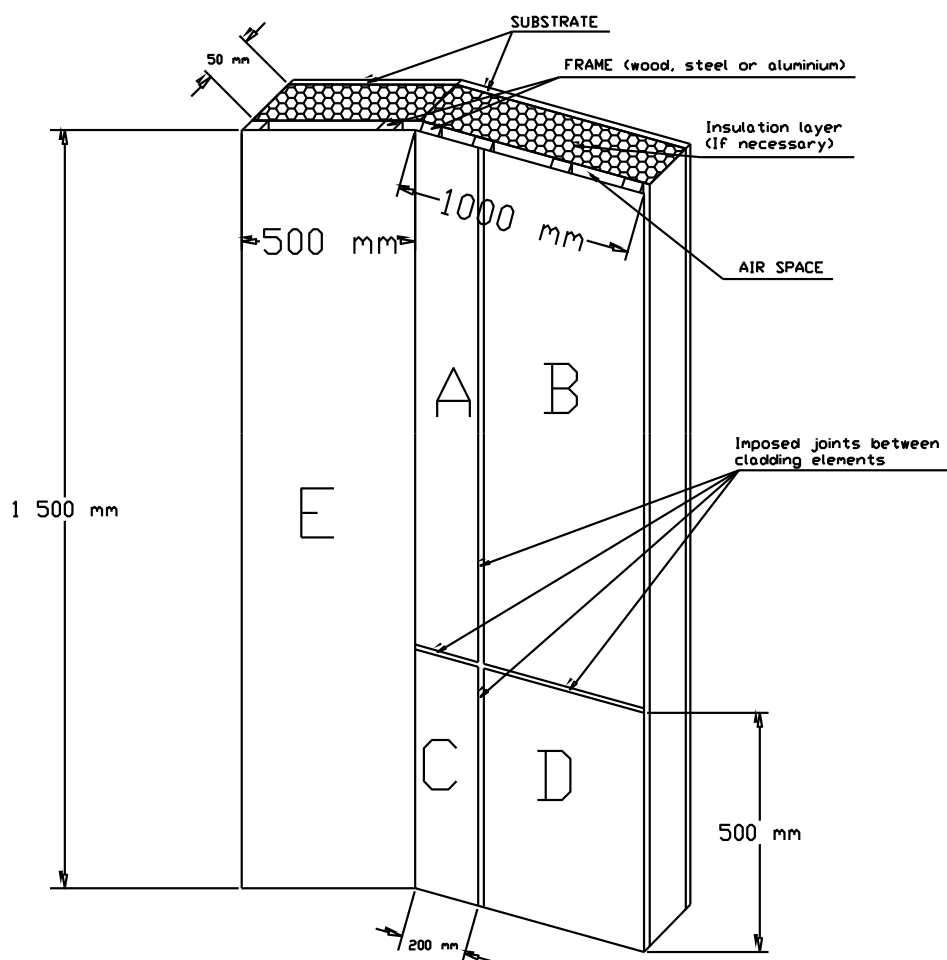
If non insulation layer is considered in the test specimen the test result is applicable provided that the insulation layer placed behind the cladding element is made of materials of class A1 or A2-s1,d0 (e.g. mineral wool).

The cladding kit is fixed to the frame. The cladding kit shall be installed with the board-fixing density defined by the manufacturer as specified in the ETA.

When the kit presents a horizontal joint, it shall be tested with a horizontal joint in the long wing at a height of 500 mm from the bottom edge of the specimen and when the kit tested presents a vertical joint, it shall be tested with a vertical joint in the long wing at a distance of 200 mm from the corner line, in accordance with the figure C.1. In the areas A, B, C, D and E, it is possible to have other vertical and/or horizontal joints between boards, if their size is not big enough.

In the internal vertical angle, no profile shall be used and the boards create a vertical closed joint.

*Note: Asymmetrically composed cladding products shall be tested in such a way that the rear of the product is exposed to the flame.*



**Figure C.1:** Example of SBI test installation.

*Note: The two wings are perpendicular.*

## C.2 Specific information

The kits are tested in a limited number of configurations to cover the influence of the parameters given in section B.4 of Annex B.

The boards can be cut to size as shown in figures C.2.

The board-fixing and subframe shall be fixed to the substrate through fixings adapted to the type and material of the substrate.

### C.2.1 Rendering system

By testing one specific rendering system representing a range of different rendering systems, the following rules shall be applied to discriminate the composition, which is able to represent a range of rendering systems:

- The rendering systems components to be used for preparing the specimen, taking account of the permissible combination(s) allowed by the manufacturer, shall be determined in accordance with the principles specified in section B.1.
- For a base-coat and a finishing coat having an organic content less than or equal to 5% (related to the mass in dried condition as used in the end use application), only the lowest thickness needs to be used for preparing the test specimen.



- For a base-coat or a finishing coat having an organic content higher than 5%, both the lowest and the highest thickness of the layer of the base-coat and finishing coat shall be used for preparing the test specimens.

Regardless of the organic content, only the highest thickness of a base-coat and a finishing coat shall be tested on board with class A1 or A2-s1,d0.

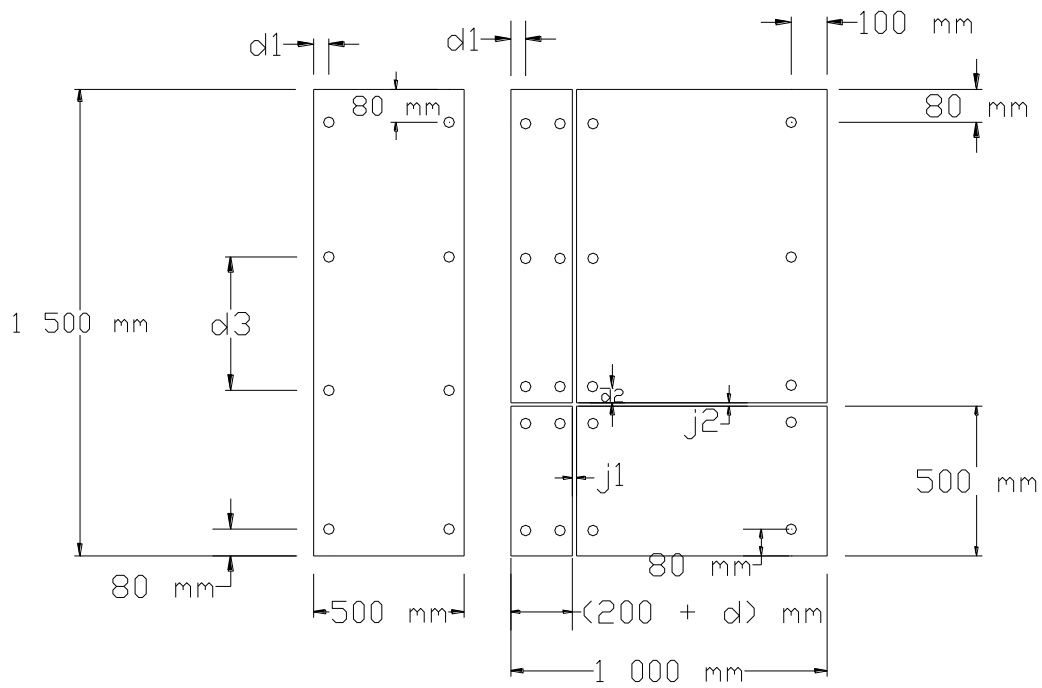
When the only difference in coatings is thickness and it is 0,5 mm or less, the coatings may be considered to be the same.

### C.3 Extension of results

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

- For rendering systems components:
  - with equal or lower organic content or PCSs-value per unit area,
  - with equal or higher content of the same type of flame retardants,
  - with base-coat and finishing coat with equal or greater thickness if the organic content is equal or less than 5%,
  - base-coat and finishing coat having more than 5% organic content:
    - with equal or greater thickness if only the lowest thickness has been tested,
    - or, with thickness between those evaluated, provided that the worst result of the two thickness tested is used for intermediate thickness.
- For boards:
  - of the same material,
  - of greater dimensions (height and width),
  - the range of boards between lowest and highest density, for boards reaction to fire different to class A1 or A2,
  - with equal or lower organic content or PCSs-value per unit area,
  - with equal or higher content of the same type of flame retardants.
- For other higher density of board-fixings.
- For other higher thickness of air space.
- When the test is carried out without insulation layer, the test result is applicable provided that the insulation layer placed behind the cladding element in the end-use situation is made of materials of class A1 or A2-s1,d0 (e.g. mineral wood).
- When the test is carried out with mineral wool insulation shall be valid for:
  - all other greater thickness of mineral wool insulation layer with the same density and the same or better reaction to fire classification;
  - the same type of panel used without insulation, if the substrate chosen according to EN 13238 is made of panel with Euro-class A1 or A2 (e.g. fibres-cement panel).
- The results of reaction to fire tests, where a combustible insulation material was used as substrate, are also valid for end-use applications of the tested product without insulation on solid mineral substrates of class A1 or A2-s1,d0 like masonry or concrete.
- The test result of a test with non-fire treated timber frame shall be valid, without test, for the same type of board and rendering system used with aluminium or steel frame.

*Note: other aspects given in the relevant hEN standards or EAD for the kit component materials should be also taken into account.*



**Figure C.2:** Example of installation for kits family A or B.

**ANNEX D – FAÇADE FIRE PERFORMANCE ASSESSMENT METHODS**

<b>Country</b>	<b>Assessment method</b>
Austria	ÖNORM B 3800-5
Czech Republic	ČSN ISO 13785-1
Denmark, Sweden, Norway	SP Fire 105
Finland	<ul style="list-style-type: none"> <li>• SP Fire 105</li> <li>• BS 8414</li> </ul>
France	LEPIR 2
Germany	<ul style="list-style-type: none"> <li>• DIN 4102-20 Complementary reaction-to-fire test for claddings of exterior walls,</li> <li>• Technical regulation A 2.2.1.5</li> </ul>
Hungary	MSZ 14800-6:2009 Fire resistance tests. Part 6: Fire propagation test for building façades
Ireland	BS 8414 (BR 135)
Poland	PN-B-02867:2013
Slovak Republic	ISO 13785-2
Switzerland, Lichtenstein	<ul style="list-style-type: none"> <li>• DIN 4102-20</li> <li>• ÖNorm B 3800-5</li> <li>• Prüfbestimmung für Aussenwandbekleidungssysteme</li> </ul>
UK	BS 8414 -1:2015 and BS 8414-2:2015

## ANNEX E – WATER ABSORPTION BY CAPILLARITY TEST

### E.1 Preparation of the test specimen

Test shall be carried out on at least three specimens.

Specimens shall have a surface area of at least 200 mm x 200 mm, and installed according to the manufacturer's instructions.

The following aspects should be recorder in the test report:

- thickness of each layer of the specimen;
- weigh of the whole specimen;
- summary of the manufacturer's instruction used for the specimen installation.

As given in section 2.2.5.1, tests shall be carried out for:

- the whole rendering system (finishing coat and base-coat with the reinforcement mesh) to be considered in the ETA, and
- for the reinforced base-coat alone.

The edges of the specimens (including the board) should be sealed against water, to ensure that during subsequent testing, only the front face of the specimen is subject to water absorption.

### E.2 Conditioning of the specimens

The prepared specimens are conditioned for 7 days at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH.

They are then subject to a series of 3 cycles comprising the following phases:

- Phase 1: 24 h partial immersion in a water bath (tap water) at  $(23 \pm 2)$  °C

The specimens are immersed face downwards, to a depth of 2 to 10 mm, the depth of immersion depends upon surface roughness. To achieve complete wetting of rough surfaces, the specimens shall be tilted as they are introduced into the water. The depth of immersion can be regulated in the water tank by means of a height-adjustable slat.

- Phase 2: 24 h drying at  $(50 \pm 5)$  °C

If interruptions are necessary, e.g. at weekends or holidays, the specimens are stored at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH after the drying at  $(50 \pm 5)$  °C.

After the cycles, the specimens are stored for at least 24 h at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH.

### E.3 Test procedure

To start the capillarity test, the specimens are again immersed in a water bath as described above.

The specimens are weighed after 3 minutes immersion in the bath (reference weight) and then after 1 hour and 24 hours. Prior to the second and subsequent weighing, water adhering to the surface of the specimen is removed with a damp sponge cloth.

### E.4 Test results

Calculation is undertaken to determine the mean value of water absorption per square metre after 3 min, 1 hour and 24 hours of the three specimens.

## ANNEX F – WIND SUCTION AND PRESSURE LOAD TESTS

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

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

At least, the mechanically weakest design shall be tested.

### F.1 Wind suction test

#### F.1.1 Preparation of the test specimen

The test specimen shall be mounted in the test equipment in accordance with the manufacturer's instructions.

The test specimen is defined as follows:

- A non-airtight substrate (test rig) such as wood or steel rigid frame. Masonry or concrete wall may also be used as substrate; however, they have to include at least one hole per square metre with a minimum diameter of at least 150 mm.
- The assembled kit must be fixed to the test rig.
- The dimensions of the test specimen depend on the size of boards and the specified board-fixings, a minimum surface of 1,5 m<sup>2</sup> shall be tested.
- To define the mechanically weakest design the following aspects shall be taken into account:
  - The mechanically weakest board (e.g. minimum thickness, minimum bending strength, without rendering system, etc.)
  - Density of board-fixings (e.g. minimum density).
  - Span between profiles (e.g. maximum span).
  - Span between brackets (e.g. maximum span).

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

The mechanical properties of the components used for the test are to be known.

#### F.1.2 Test equipment

The test equipment consists of a pressure or suction chamber (see figure F.1) against which is placed the assembled kit. The depth of chamber shall be sufficient for a constant pressure or suction to be exerted on the test specimen applied to the external surface of the assembled kit irrespective of its possible deformation. The chamber is mounted on a rigid frame. The assembled kit acts as the seal between the chamber and the environment. The connection between the assembled kit and the chamber shall be sufficient to allow a realistic deformation of the test specimen under the influence of simulated wind suction.

##### Alternative test equipment

The alternative test may be used, provided that the geometric shape allows the foil bags to be placed in the air space and be blown out so that a uniformly distributed pressure load at the rear face of the board is possible.

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

The subframe of the kit has to be fixed on the rig and the boards have to be fixed on the subframe according to the indications given by the manufacturer.

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

Foil bags which are placed in the air space at the rear side of the board are blown out and they exert a uniformly distributed pressure load on the rear face of the board which corresponds to the wind suction load.

### **F.1.3 Test procedure**

The uniformly distributed loads are exerted on the surface of the assembled kit.

The test is performed in successive steps (two steps of 300 Pa, one step of 500 Pa and one step of 1000 Pa, then steps of +200 Pa thereafter, at each step the load is maintained constant for at least 10 seconds and returned to zero after each step; see figure F.2) until significant irreversible deformation (deformation which affects serviceability) or failure occurs.

The test is then continued until failure occurs.

The deflection shall be measured, at the relevant points (e.g. central point of the board between two profiles, board-fixing, profiles, etc.), as a function of the load and reported in tabular or graphic form.

With the differential pressure reduced to zero, the permanent deflection shall be noted after 1 minute recovery. The pressure at which defects or damage occur shall be noted.

Additionally, if relevant, the permanent deflection 1 hour after failure occurs shall be noted.

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

### **F.1.4 Observations during the test**

Failure is defined by any one of the following events:

- Any board, board-fixing, profile or bracket breaks.
- Any board, board-fixing, profile or bracket presents a significant permanent deflection.
- Falling of detached components.
- Failure or detachment of the kit subframe.
- The measurement equipment system limit.

Additionally, any crack on the rendering system or the board must be observed and noted.

### **F.1.5 Test results**

The test result is:

- The failure load Q.
- The type of failure.
- The value of maximum permanent deflection (after 1 minute recovery), the maximum deflection of the test specimen and the load and sensor position for this maximum permanent deflection and maximum deflection.

The test results are only valid for the assembled kit tested.

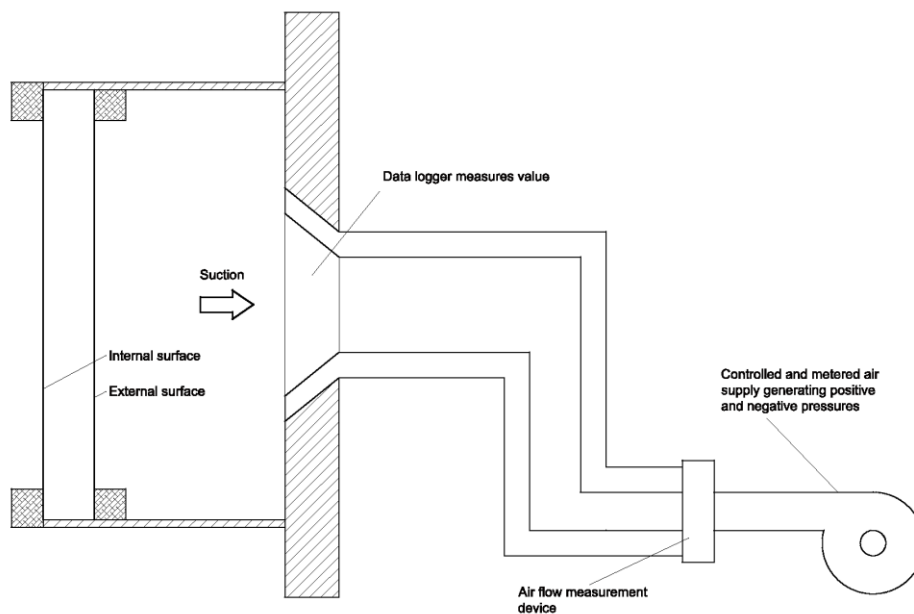
### F.1.6 Test specimen description

It is necessary to describe the test specimen by giving details about:

- Brackets (material, geometry, distance between two brackets and number and disposition of fixings).
- Profiles (material, geometry and distance between two profiles).
- Board (material and geometry).
- Board-fixing (material and geometry and number and disposition of fixings).
- Fixings between the test equipment and the assembled kit (position, generic type, material and geometry).
- Rendering system applied.

### F.2 Wind pressure test

The test procedure is similar to section F.1, the only difference being that the wind action is reversed.



**Figure F.1:** Example of wind pressure and suction apparatus.

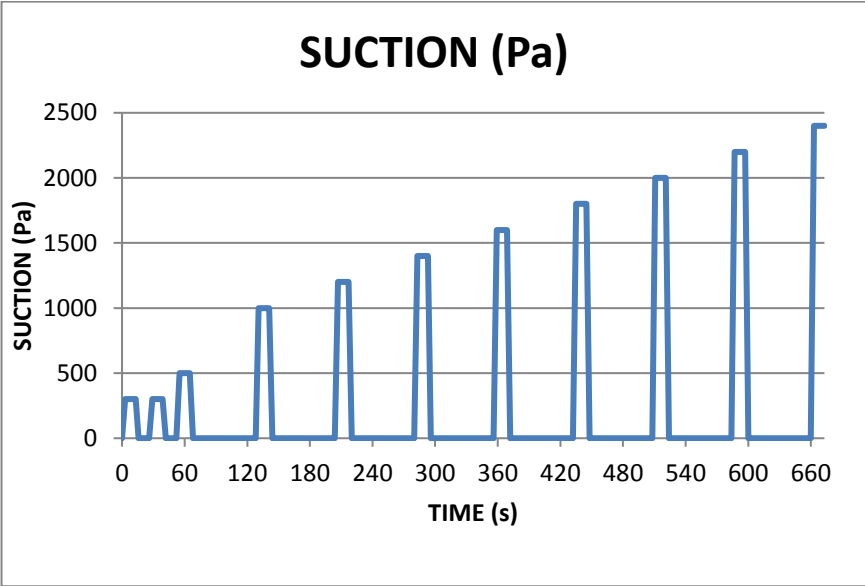


Figure F.2: Example of wind load steps.



## ANNEX G – IMPACT RESISTANCE TEST

### G.1 General

The principle is to establish the impact resistance of the kit considering hard body and soft body impacts. Besides, it is established the impact use categories to correspond to the degree of exposure to impacts in use.

The bodies to impact and the test equipment are given in EOTA TR 001. The points of impact shall be selected taking into account the behaviour of the rendering system, board and the substrate, varying according to whether the impact point is or is not located in an area of greater rigidity (at less than 50 mm from the edge of the board).

Hard body impacts are:

- H1 and H2 (1 J and 3 J respectively), carried out with the steel ball weighing 0,5 kg and from a height of 0,20 m and 0,61 m respectively (at least in three locations).
- H3 (10 J), carried out with the steel ball weighing 1,0 kg and from a height of 1,02 m (at least in three locations).

Soft body impacts are:

- Small soft body S1 and S2 (10 J and 60 J respectively), carried out with the soft ball weighing 3,0 kg and from a height of 0,34 m and 2,04 m respectively (at least in three locations).
- Large soft body S3 and S4 (100 J and 400 J respectively), carried out with the spherical bag weighing 50,0 kg and from a height of 0,61 and 0,82 m respectively (at least in the space between two profiles).

*Note: The manufacturer may consider other energy values for the hard and soft body impacts. Any change shall be given in the ETA.*

At least, the mechanically weakest design shall be tested.

The size of the test specimen shall be chosen to carry out all the impacts given in table G.1.

The dimensions of any indentation and any damage caused shall be reported.

### G.2 Test procedure

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

1. When the impact resistance is chosen by the manufacturer or it is known, using the impact tests given in table G.1 for this impact resistance chosen or known.
2. When the impact resistance is not known, starting with lowest impact bodies and continue increasing the impacts, with the aim of obtaining the maximum impact resistance.

**Table G.1: Hard and soft body impact tests.**

External impacts and assessment						
			Category IV	Category III	Category II	Category I
Hard body impact	H1	<ul style="list-style-type: none"> <li>Weight: 0,5 kg</li> <li>Impact: 1 J (height 0,20 m)</li> <li>No. impacts: 3</li> <li>Position of impacts: three different locations</li> </ul>	Not penetrated (2) Not perforated (3)	---	---	---
	H2	<ul style="list-style-type: none"> <li>Weight: 0,5 kg</li> <li>Impact: 3 J (height 0,61 m)</li> <li>No. impacts: 3</li> <li>Position of impacts: three different locations</li> </ul>	---	Not penetrated (2) Not perforated (3)	No deterioration (1)	No deterioration (1)
	H3	<ul style="list-style-type: none"> <li>Weight: 1 kg</li> <li>Impact: 10 J (height 1,02 m)</li> <li>No. impacts: 3</li> <li>Position of impacts: three different locations</li> </ul>	---	---	Not penetrated (2) Not perforated (3)	No deterioration (1)
Soft body impact	S1	<ul style="list-style-type: none"> <li>Weight: 3 kg</li> <li>Impact: 10 J (height 0,34 m)</li> <li>No. impacts: 3</li> <li>Position of impacts: three different locations</li> </ul>	No deterioration (1)	No deterioration (1)	---	---
	S2	<ul style="list-style-type: none"> <li>Weight: 3 kg</li> <li>Impact: 60 J (height 2,04 m)</li> <li>No. impacts: 3</li> <li>Position of impacts: three different locations</li> </ul>	---	---	No deterioration (1)	No deterioration (1)
	S3	<ul style="list-style-type: none"> <li>Weight: 50 kg</li> <li>Impact: 300 J (height 0,61 m)</li> <li>No. impacts: 1</li> <li>Position of impacts: At least in the centre point of a cladding element</li> </ul>	---	---	No deterioration (1)	---
	S4	<ul style="list-style-type: none"> <li>Weight: 50 kg</li> <li>Impact: 400 J (height 0,82 m)</li> <li>No. impacts: 1</li> <li>Position of impacts: At least in the centre point of a cladding element</li> </ul>	---	---	---	No deterioration (1)
<p>(1) Superficial damage, provided there is no cracking, is considered as showing "no deterioration" for all the impacts. Collapse or any other dangerous failure is not allowed.</p> <p>(2) The test result is assessed as being "penetrate" if there is any cracking penetrating to be observed in the base-coat or in the board (to be also observed by the rear side) in at least 2 of 3 impacts. Superficial cracking (no penetrating) is allowed. Collapse or any other dangerous failure is not allowed.</p> <p>(3) The test result is assessed as being "perforated" if there is a destruction of the rendering system that is shown up to a level beyond the reinforcement mesh or the board is broken (to be also observed by the rear side) in at least 2 of 3 impacts. Collapse or any other dangerous failure is not allowed.</p>						

### G.3 Definition of the impact use categories (informative)

The categories given in table G.2 correspond to the degrees of exposure in use. They do not include an allowance for acts of vandalism.

**Table G.2: Impact use categories.**

Category	Use
I	A zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use. (e.g.: Façade bases in buildings sited in public locations, such as squares, schoolyards or parks. Cleaning gondolas may be used on the façade).
II	A zone liable to impacts from thrown or kicked objects, but in public locations where the height of the kit will limit the size of the impact; or at lower levels where access to the building is primarily to those with some incentive to exercise care (e.g.: Façade bases in buildings not sited in public locations (e.g. squares, schoolyards, parks) or upper façade levels in buildings sited in public locations that occasionally can be hit by a thrown object (e.g. ball, stone, etc.). Cleaning gondolas may be used on the façade).
III	A zone not likely to be damaged by normal impacts caused by people or by thrown or kicked objects (e.g.: Upper façade levels in buildings (not including base) not sited in public locations, that occasionally can be hit by a thrown object (e.g. ball, stone, etc.). Cleaning gondolas should not be used on the façade).
IV	A zone out of reach from ground level (e.g. High façade levels that cannot be hit by a thrown object. Cleaning gondolas should not be used on the façade).

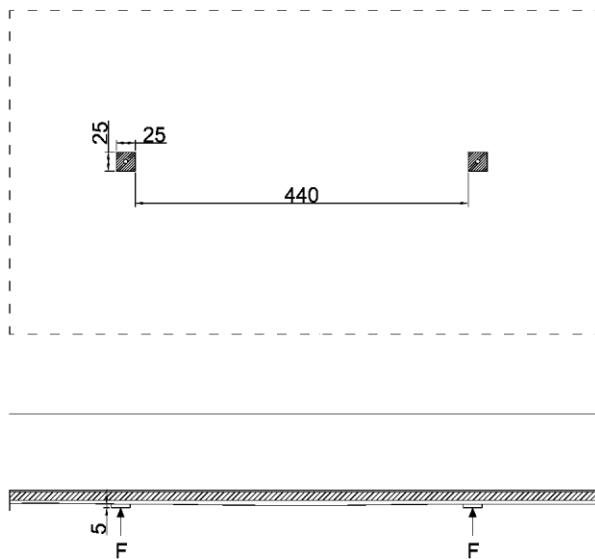
## ANNEX H – RESISTANCE TO HORIZONTAL POINT LOAD

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

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

- The mechanically weakest cladding element (e.g. minimum thickness, minimum bending strength, etc.).
- The mechanically weakest board-fixings (e.g. minimum thickness, minimum mechanical material characteristics, etc.).
- Minimum density of board-fixings.
- The mechanically weakest subframe components (e.g. minimum thickness, minimum mechanical material characteristics, etc.).
- Maximum span between profiles.
- Maximum span between brackets.

The mechanical properties of the components used for the test is to be known.



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

## ANNEX I – BOND STRENGTH TEST

### I.1 General

Tests shall be carried out for the connections and conditionings given in table I.1.

Bond strength	Specimen conditioning (i)	Bond strength minimum level (MPa)
		Continuous rendering as exterior skin
Between the whole rendering system and the board	a) dry conditions	≥ 0,08 (iii) or ≥ 0,03 if cohesive rupture in the board
	b) after hygrothermal cycles (ii)	≥ 0,06 (iv) or ≥ 0,03 if cohesive rupture in the board
	c) after freeze-thaw cycles	test for selecting the worst case to be tested to hygrothermal and freeze-thaw cycles (see section M.1.2 of Annex M)
	d) 2 d. H <sub>2</sub> O + 2 h. drying	
	c) 2 d. H <sub>2</sub> O + 7 d. drying	test for selecting the worst case to be tested to hygrothermal and freeze-thaw cycles (see section M.1.2 of Annex M)
	f) 7 d. H <sub>2</sub> O + 7 d. drying for finishing coats not tested to hygrothermal cycles	
Between the reinforced base-coat and the board	a) dry conditions	≥ 0,08 (iii) or ≥ 0,03 if cohesive rupture in the board
	d) after hygrothermal cycles (ii)	≥ 0,06 (iv) or ≥ 0,03 if cohesive rupture in the board
	b) 2 d. H <sub>2</sub> O + 2 h. drying	test for selecting the worst case to be tested to hygrothermal and freeze-thaw cycles (see section M.1.2 of Annex M)
	c) 2 d. H <sub>2</sub> O + 7 d. drying	
(i) The different conditionings are defined as: a) after at least 28 days curing at (23 ± 2) °C and (50 ± 5) %RH, i.e. without any supplementary conditioning (on dry conditions); b) on samples taken from the specimen after hygrothermal cycles (see section M.1 of Annex M) or after the alternative test combining hygrothermal and freeze-thaw cycles (see section M.3 of Annex M); c) on specimens after freeze-thaw cycles (see section M.2 of Annex M); d) after immersion in water for 2 days and 2 hours drying at (23 ± 2) °C and (50 ± 5) %RH after removing the samples from the water; e) after immersion in water for 2 days and 7 days drying at (23 ± 2) °C and (50 ± 5) %RH after removing the samples from the water; f) after immersion in water for 7 days and 7 days drying at (23 ± 2) °C and (50 ± 5) %RH after removing the samples from the water. (ii) On samples taken from the specimen. (iii) The minimum value of the test results shall be greater or equal than this value with adhesive rupture. One single test result lower than 0,08 MPa but higher than 0,06 MPa is admissible. (iv) The mean value of the test results shall be greater or equal than this value with cohesive or adhesive rupture.		

**Table I.1:** Bond strength. Conditioning and minimum level.

### I.2 Preparation of the test specimen

Samples with appropriate size to obtain the cut specimens shall be prepared according to the manufacturer instructions. Components used, thickness, weight and method of application shall be recorded.

Samples are cured at least 28 days at (23 ± 2) °C and (50 ± 5)% RH (conditioning given as a) in table I.1).

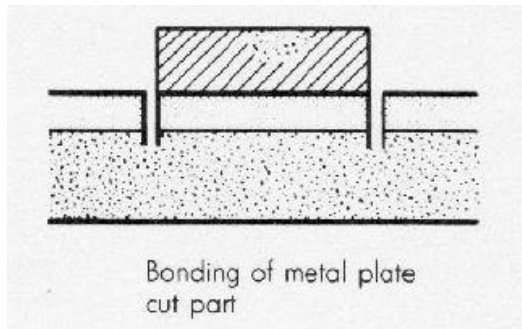
Test shall be carried out on at least five specimens, for each connection and conditioning, obtained by cut on the large sample size.

Each specimen shall have a square surface with dimension 50 mm x 50 mm or a circular surface diameter 50 mm.

The specimens are cut through the layers according to figure I.1 (cutting until the board) using an adequate tool. At least 50 mm of distance is necessary between each specimen and with the border of the sample. Metal plates of appropriate size are affixed to these areas with a suitable adhesive.

### I.3 Test procedure

The bond strength test (see figure I.1) is performed until the board at a tensioning speed between 1 to 10 mm/minute.



**Figure I.1:** Bond strength test.

### I.4 Test results

Each individual value of bond strength and the rupture type (cohesive rupture and/or adhesive rupture) shall be recorded.

## ANNEX J – MECHANICAL RESISTANCE OF THE CONNECTION BETWEEN THE BOARD AND THE BOARD-FIXING

### J.1 – EMBEDDING / SHEAR STRENGTH

Test shall be carried out on at least five specimens for each position:

- Corner (see figure J.1.1).
- Border (see figure J.1.2).

Each specimen shall be composed of a board (size at least 100 mm x 100 mm), fixed to the metal profile with only one fixing.

To define the mechanically weakest case the following aspects shall be taken into account:

- The mechanically weakest board (e.g. minimum thickness, minimum bending strength, without rendering system, etc.).
- The mechanically weakest board-fixing (e.g. minimum diameter, minimum material resistance, etc.).
- The mechanically weakest profile (e.g. minimum thickness, minimum material resistance, etc.).
- Without the rendering system.

When testing, the edge distances  $a_{min}$  and  $b_{min}$  (according to figures J.1.1 to J.1.4) shall be confirm the smallest edge distances intended to be used for the kit board.

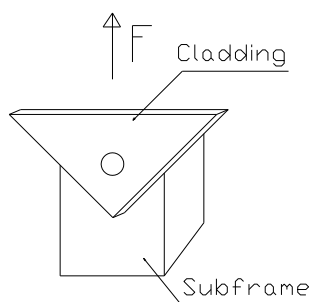
The force is applied as show in figures J.1 until failure. The speed rate shall be adjusted to 5 mm/min.

Failure is defined by breaking of the board, the board-fixing or the profile.

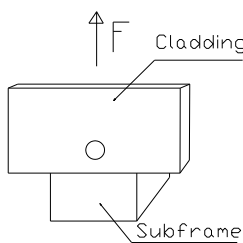
Test report should include:

- Type, material and geometry of the specimen components.
- Each individual failure value,  $F_{iu}$  (expressed in N), and the mode of failure of the test specimen.
- The mean<sup>3</sup> values,  $F_m$ , and the characteristic values,  $F_c$ , in accordance with Annex N.

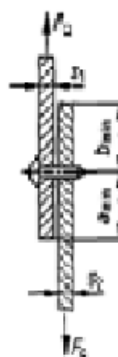
The mechanical properties of the components used for the test is to be known.



**Figure J.1.1:** Example of shear strength (corner).



**Figure J.1.2:** Example of shear strength (border).



$F_Q$ : shear force  
 $a_{min}$ : smallest intended edge distance of board  
 $b_{min}$ : smallest intended edge distance of the profile  
 $s_1$ : thickness of the board  
 $s_2$ : thickness of the profile

**Figure J.1.3:** Specimen dimensions.

## J.2 - PULL-THROUGH / PULL-OUT RESISTANCE

Test shall be carried out on samples with a board-fixing driven through board position (centre, border and corner) and connected to a profile, or to a test tool representing the same material and thickness of the profile, taking into account the configuration of the kit defined by the manufacturer.

It is recommended to carry out test series for each position (centre, border and corner) or, at least, for the mechanically weakest sample (e.g. minimum thickness of the board, minimum diameter of board-fixing, corner or border position, minimum distances to the borders, etc.).

The board-fixing shall be installed on the board as specified by the manufacturer.

The test series shall be carried out separately on one ring 50 mm diameter for each position.

For each series, at least 5 test specimens shall be carried out.

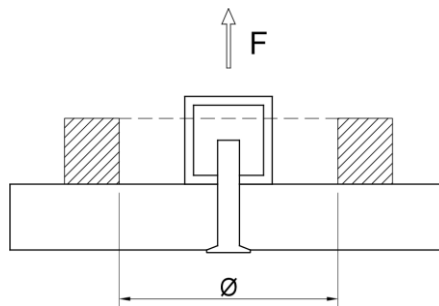
An axial tension load is exerted on the fixing. The speed rate shall be adjusted to 5 mm/min. The force can be applied either by pushing on the head of the anchor or pulling the end of the fixing.

The force is applied as show in figures J.2.1 and J.2.2 until failure by pulling through.

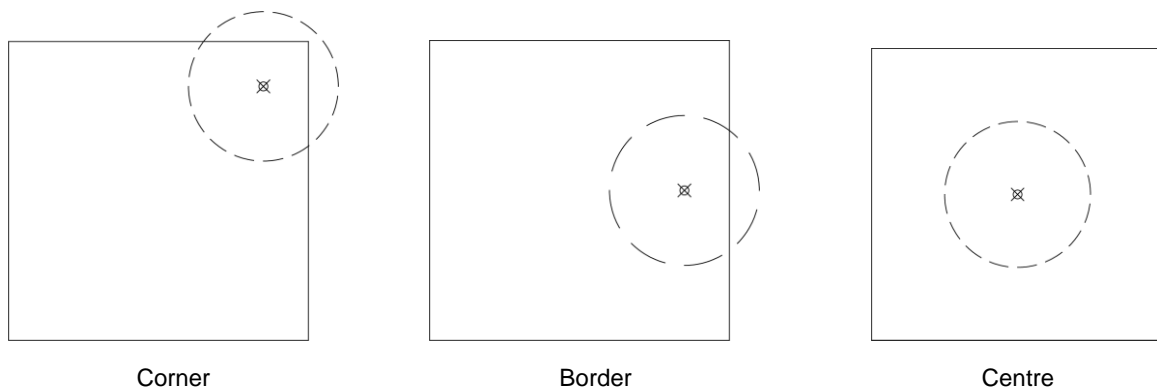
Test report should include:

- Type, material and geometry of the board-fixing.
- Each individual failure value,  $F_{iu}$  (expressed in N), and the mode of failure of the test specimen (pull-out of the anchor, cone failure, etc.).
- The mean<sup>3</sup> values,  $F_m$ , and the characteristic values,  $F_c$ , in accordance with Annex N.

The mechanical properties of the components used for the test is to be known.



**Figure J.2.1:** Example of pull-through test in corner.



**Figure J.2.2:** Example of pull-through test, screw in corner, border and centre.



## ANNEX K – MECHANICAL RESISTANCE OF SUBFRAME-FIXINGS

### K.1 - TENSION / PULL-OUT RESISTANCE

A minimum of 5 specimens shall be tested.

The test specimens must be mounted in accordance with the manufacturer instructions.

Each test specimen will be composed of one subframe profile and the fixing defined for its connection with the board-fixing.

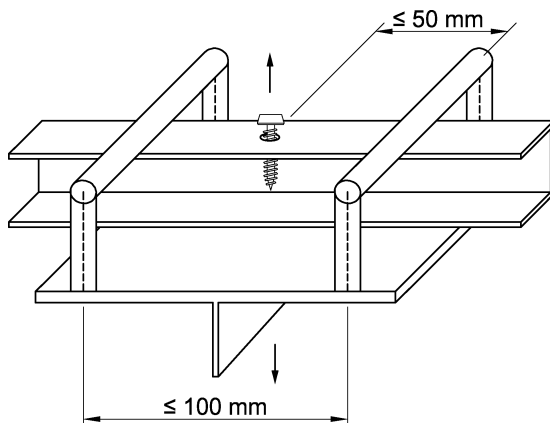
The length of the subframe profile should be 300 mm approximately, however, depending on the cladding kit configuration, other dimensions may be chosen.

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

The mechanical properties of the components used for the test is to be known.

The test apparatus must consist of:

- A dynamometer,
- A test support as shown in the following figures, depending on the type of test given above.



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

The test shall be carried out using a tensioning speed of 20 mm/min. When relevant, lower speed may be considered.

The fixing must be placed perpendicular to the subframe profile as described in figure K.1.1, and the force must be applied either through the support or by the fixing until failure.

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

1. Profile breaks.
2. Fixing breaks.

Test report should include:

- Type, material and geometry of the components (profile and fixings).
- Each individual failure value,  $F_{iu}$  (expressed in N).
- The mode of failure description of the test specimen.
- The mean<sup>3</sup> values,  $F_m$ , and the characteristic values,  $F_c$ , in accordance with Annex N.

## K.2 - SHEAR LOAD RESISTANCE

A minimum of 5 specimens shall be tested.

The test specimens must be mounted in accordance with the manufacturer instructions.

Each test specimen will be composed of two sheets of the same materials and thickness than those of the subframe components to be connected and the fixing defined for this connection.

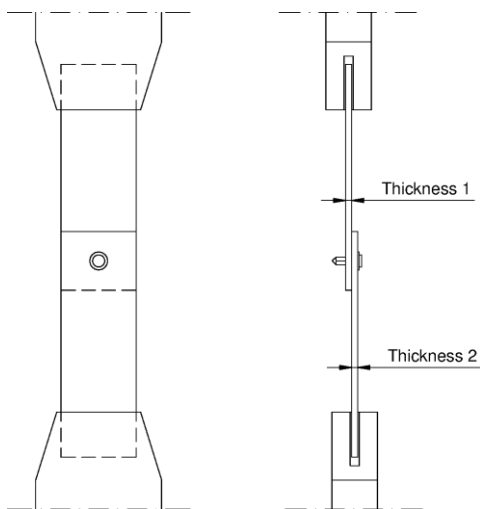
The dimensions of the sheets should be 150 mm x 50 mm approximately, however, other dimensions may be chosen.

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

The mechanical properties of the components used for the test is to be known.

The test apparatus must consist of:

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



**Figure K.2.1:** Example of shear test.

The test shall be carried out using a tensioning speed of 20 mm/min. When relevant, lower speed may be considered.

The fixing must be placed as described in figure K.2.1, and the force must be applied through the two sheets until failure.

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

1. Metal sheet breaks.
2. Fixing breaks.

Test report should include:

- Type, material and geometry of the components.
- Each individual failure value,  $F_{iu}$  (expressed in N).
- The mode of failure description of the test specimen.
- The mean<sup>3</sup> values,  $F_m$ , and the characteristic values,  $F_c$ , in accordance with Annex N.

## **ANNEX L – RESISTANCE OF BRACKETS (HORIZONTAL AND VERTICAL LOAD)**

### **L.1 General**

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

Resistance of brackets shall be tested under:

- Vertical load (weight), see section L.4.1.
- Horizontal load (wind), see section L.4.2.

Test and measuring equipment shall be in accordance with section L.2.

Test specimens shall be tested in accordance with section L.3.

The mechanical properties of the components used for the test is to be known.

### **L.2 Test equipment**

The equipment is made of a traction machine of class 1 in accordance with EN ISO 7500-1, minimum capacity of 1000 daN, in the vertical axis, whose main elements are the following:

- a lower part allowing fixing of the brackets to the profile
- an upper mobile part allowing fixing to the profile.

These parts must be placed in the same axis.

Additionally, a load-displacement measurement device shall be used.

The lower part of the support is made of a rigid substrate (e.g. a horizontal basis and a vertical perpendicular surface, see figure L.2).

This substrate shall:

- be rigidly fixed on the lower tray of the machine,
- be rigid enough to allow the correct execution of the test.

Whenever the substrate is not made of steel, steel plates shall be used to provide a support surface under the brackets (minimum thickness 5 mm and with a surface area at least equal to the surface of the bracket wing, incorporating a hole of diameter equal to that of fixing).

The upper part consists of a traction device appropriate to the section of the profile.

The upper mobile part and the attached profile shall be vertically aligned with the substrate.

Displacements under load can be taken equal to displacements of the mobile crosspiece but it is preferable to have sensors of displacement:

- either in the axis of the profile
- or on the head of each bracket

Displacement sensors are linked up with a graphic recorder allowing to draw the curve strength-displacement (see figure L.1).

### **L.3 Mounting provisions of test specimens**

#### **L.3.1 Fixings of brackets to substrate**

Brackets shall be fixed to the substrate according to the following:

- Vertical load test shall be in accordance with figure L.2.
- Horizontal load test shall be in accordance with figure L.3.
- The worst position of the fixings (the weakest design) considering the use shall be tested.
- The type of anchor between the bracket and the substrate must be chosen according to the type of substrate and the manufacturer specifications. Whenever no fixings to substrate are defined by the manufacturer, bolts of suitable diameter adapted to predrilling ( $\varnothing$  6 mm minimum) by using washers shall be used.
- The fixing bolt (anchor) on the support shall be positioned in the oblong hole at the maximum specified distance from the profile.

*Note: The anchors (fixing between the bracket and the substrate) shall not represent a weak point of the test specimen.*

#### **L.3.2 Brackets**

Each test specimen shall consist of one (asymmetrical) or two brackets mounted in accordance with the specifications of the manufacturer.

Nevertheless, an asymmetrical bracket may be tested by means of two brackets in opposition on both sides of the profile. The test may be done on a single bracket as well (asymmetric layout).

Whenever several lengths of wings are available, at least the weakest mechanically bracket configuration shall be tested.

#### **L.3.3 Fixings profile-bracket**

Profile shall be fixed to brackets according to the following:

- The type of bracket fixing on the profile must correspond to the fixing to be used in the system.
- Fixings shall be installed in accordance with the specifications of the manufacturer.
- The worst position of the fixings (the weakest design) considering the use shall be tested.

#### **L.3.4 Profile**

Whenever it is possible the profile defined for the system shall be used in the test.

The metal profile can also be simulated by a square or rectangular section steel tube of 1,5 mm minimum thickness.

### **L.4 General test procedure (vertical and horizontal loads)**

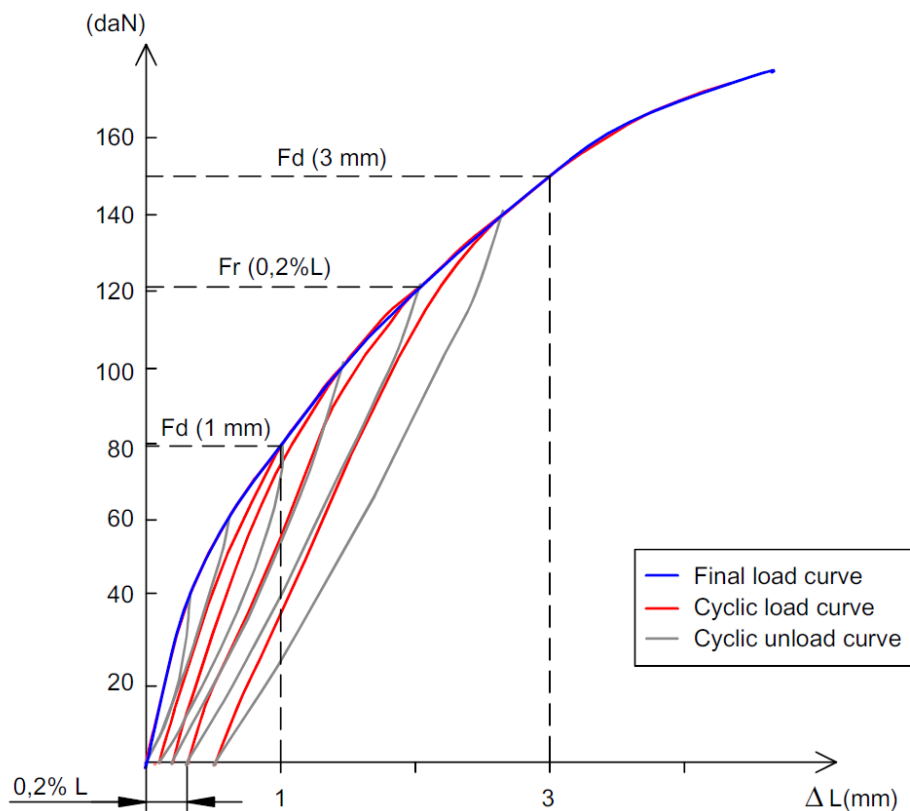
A minimum of 5 specimens shall be tested

Brackets are subjected to a succession of cycles during the test. In each cycle a growing load is applied and then returned to zero.

Figure L.1 shows an example of test procedure.

Load shall be applied in constant speed to the profile in order to avoid a dynamic failure of the test specimen.

*Note: The term “displacement” refers to the measured distance at the head of wing during the application of the load. The term “Residual distortion” refers to the measured distance at the head of wing after the application of the load.*



**Figure L.1:** Example of curve strength-displacement.

According to the typology of bracket, the manufacturer may decide if cycles are defined either by means of load growths or by means of displacement growths under load.

*Note: The manufacturer may appraise the necessity for previous tests in order to define the most appropriate growth (load or displacement) for each bracket.*

If the cycle succession is defined according to load growths, it shall be carried out in steps of 10 daN in vertical load resistance tests and in steps of 20 daN in horizontal load resistance tests. The load shall be applied in order to meet the condition: constant speed of load < 500 daN/min.

If the cycle succession is defined according to displacement growths, it shall be carried out in steps of 0,25 mm, 0,5 mm, or 1,0 mm depending on the behaviour of the bracket under load. The load shall be applied in order to meet the condition: constant speed of load  $\leq$  5 mm/min.

Mean<sup>3</sup> and characteristic resistance shall be obtained for each test result series from the test specimens (“i” specimens) e.g.  $F_{r1}$  to  $F_{ri}$ ;  $F_{1d1}$  to  $F_{1di}$ ;  $F_{3d1}$  to  $F_{3di}$  and  $F_{s1}$  to  $F_{si}$ .

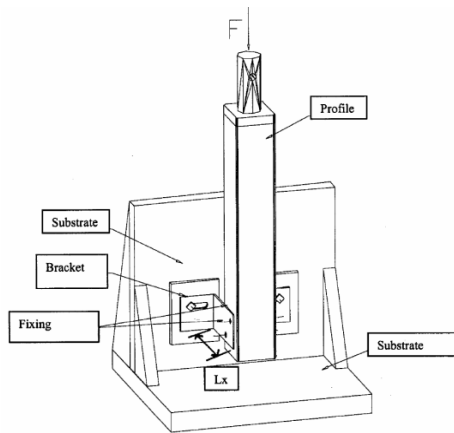
The characteristic resistance ( $R_{cr}$ ,  $R_{cd1}$ ,  $R_{cd2}$  and  $R_s$ ) of the bracket is obtained according to Annex N.

#### L.4.1 Vertical load resistance test

Vertical load test shall be carried out considering the following:

- The test specimen shall be in accordance with figure L.2.
- The test shall be carried out in accordance with section L.3.

- Test results shall be in accordance with section L.4.



**Figure L.2:** Vertical load test. Example of test device.

Following results shall be recorded during the tests:

### **1<sup>st</sup> Criterion: $F_r$ load**

$F_r$  is the load that causes a residual distortion on the bracket measured at the head of wing (after returning to zero) equal to:

$$\Delta L = \frac{0,2 \cdot L_x}{100} \quad \text{where } L_x \text{ is the length of the perpendicular wing to the substrate.}$$

*Note:* To obtain  $F_r$  with accuracy, growths between cycles (load or displacement) shall be appropriate in order to avoid big gaps between the residual distortions obtained after consecutive cycles.

### **2<sup>nd</sup> Criterion: $F_{1d}$ and $F_{3d}$ loads**

$F_{1d}$  and  $F_{3d}$  are the loads that cause a displacement under load of 1 and 3 mm respectively measured at the head of wing.

*Note:* Due to the fact that  $F_{1d}$  and  $F_{3d}$  are related to displacement values instead of residual distortion values, it is possible that loads  $F_{1d}$  and/or  $F_{3d}$  can be attained before  $F_r$  load is reached.

### **3<sup>rd</sup> Criterion: $F_s$ Load**

$F_s$  is the load that corresponds to the failure.

Failure is defined by any one of the following events:

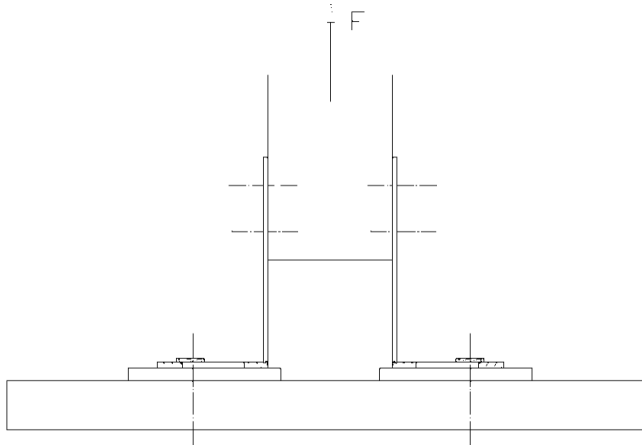
1. Any bracket breaks.
2. Any bracket presents a significant permanent deflection.
3. Any fixing breaks.

*Note:* When a failure is defined by a significant permanent deflection, a unified failure criterion (e.g. 10 mm displacement) shall be followed for all test specimens belonging to the same test group.

#### L.4.2 Horizontal load resistance test

Horizontal load test shall be carried out considering the following:

- The test specimen shall be in accordance with figure L.3. Brackets are fixed to the horizontal substrate.
- The test shall be carried out in accordance with section L.3.
- Test results shall be in accordance with section L.4.



**Figure L.3:** Horizontal load test. Example of test device.

Following results shall be recorded during the tests:

##### **1<sup>st</sup> Criterion: $F_m$ Load**

$F_m$  is the load that causes a residual distortion on the bracket measured at the head of wing (after returning to zero) equal to 1 mm.

*Note: To obtain  $F_m$  with accuracy, growths between cycles (load or displacement) shall be appropriate in order to avoid big gaps between the residual distortions obtained after consecutive cycles.*

##### **2<sup>nd</sup> Criterion: $F_t$ Load**

$F_t$  is the load that corresponds to the failure.

Failure is defined by any one of the following events:

1. Any bracket breaks.
2. Any bracket presents a significant permanent deflection.
3. Any fixing breaks.

*Note: When a failure is defined by a significant permanent deflection, a unified failure criterion (e.g. 10 mm displacement) shall be followed for all test specimens belonging to the same test group.*

## L.5 Test report

Test report shall include:

- Material and geometric characteristics of the brackets, including drawings of the brackets.
- Description of the failure of the test specimens (break, significant permanent deflection, failure of system fixings), including the failure criterion in case of failure due to significant permanent deflections.
- Figure including position and number of fixings between components for each test group.
- The number of brackets corresponding to the test results, including a reference to the use of symmetrical or asymmetrical brackets. Whenever a test has been carried out by means of two symmetrical brackets, test results shall clearly refer to the corresponding configuration.
- The curve strength-displacement for each test specimen.
- Identification of fixings (between the brackets and the substrate or between the brackets and the profile):
  - Description or generic type.
  - Dimensions (diameter, length, etc.).
  - Material.
  - Fixing method to the substrate.
  - Washers and nuts (if they are used):
    - Description or generic type.
    - Dimensions (diameter, length, etc.)
    - Material.



## ANNEX M – DURABILITY

This annex describes the following durability tests:

- Two types of accelerated ageing tests, which are:
  1. Hygrothermal behaviour test (see section M.1), which include:
    - Heat-rain cycles
    - Heat-cold cycles
  2. Freeze-thaw behaviour test (see section M.2).

Alternatively, when the manufacturer requires it, a combined hygrothermal and freeze-thaw cycles test may be carried out according to section M.3.

The principle is to determine the effects of accelerated ageing procedures on the kit.

After the accelerated ageing procedures, bond strength tests (see section 2.2.12.1) shall be carried out on samples taken of the test specimens.

The initial test specimens (without accelerated ageing procedures) shall be prepared at the same time that these test samples.

- Cracking strength due to board deformation (see section M.4)

### M.1 - HYGROTHERMAL BEHAVIOUR TEST

#### M.1.1 Principles related to the preparation of the specimen

The kit must be installed, in accordance with the manufacturer's instructions, onto a sufficiently stabilised masonry or concrete substrate (minimum 28 days).

The test wall shall have one or two openings (depending on the number of rendering system configurations that are to be tested) positioned as given in the figures M.1.1. The dimension of the weather surface of the test wall shall be:

- width:  $\geq 2,50$  m (for one opening) or  $\geq 3,00$  m (for two openings)
- height  $\geq 2,00$  m

The openings shall be at the upper part of the test wall positioned at a distance  $\geq 0,40$  m from the edges (preferably positioned as shown in figures M.1.1, for one and two openings). The openings shall have a width and a height of  $(0,5 \pm 0,1)$  m.

The configuration of the specimen shall be decided according to the following rules:

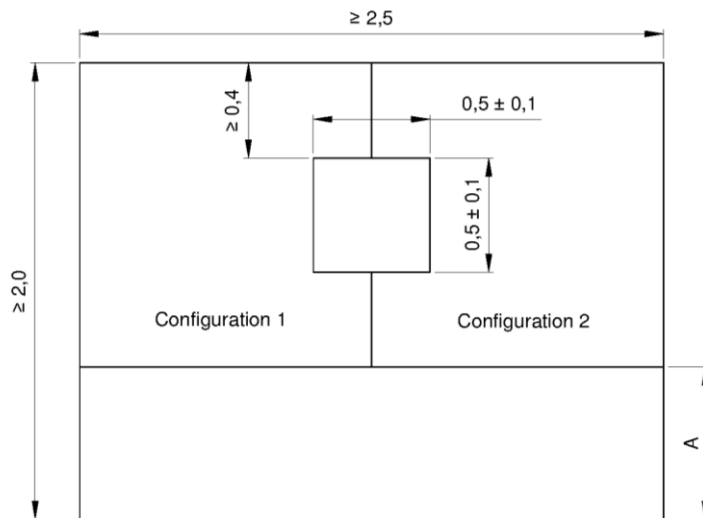
- At least the worst case (e.g. maximum water absorption of the rendering systems, minimum bond strength, minimum thickness of the rendering system components, etc) or the most representative case of the kit shall be tested. Additional tests given in section M.1.2 may also be taken into account to select the worst case.
- As general rule, for each opening, only one board and only one reinforced base-coat shall be used for the specimen.
- At the very most two rendering systems (different nature of finishing) can be applied per opening in the test wall (vertical divisions). Maximum two configurations in the case one opening (see figure M.1.1a) and maximum four configurations in the case of two openings (see figure M.1.1b).

- If different finishing coats are used, the lower part of the test piece ( $A = 1/3$  of the total height) consists of the reinforced base-coat alone (without any finishing coat).

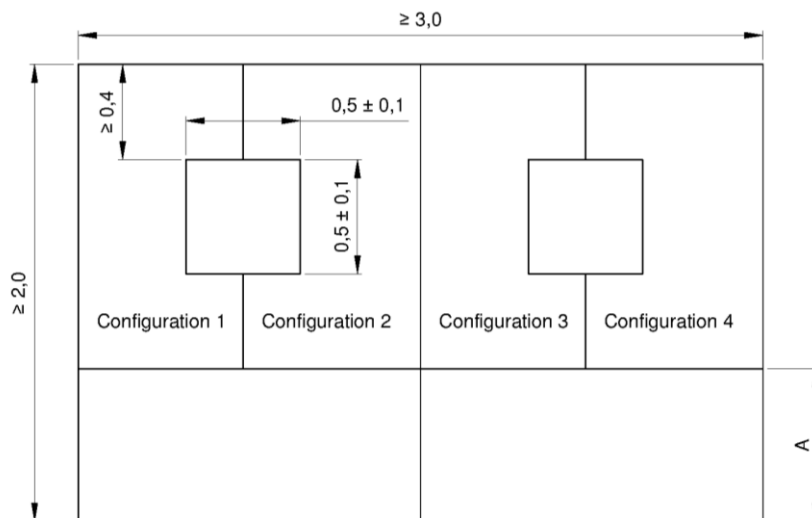
Any finishing coat not tested on the specimen shall be assessed by means of bond strength tests according to section 2.2.12.1 after immersion in water for 7 days and 7 days drying at  $(23 \pm 2) ^\circ\text{C}$  and  $(50 \pm 5) \% \text{RH}$  after removing the samples from the water.

Special methods for reinforcing corners of the opening are applied, if necessary.

Installation of the window sill and other ancillary materials is under responsibility of the manufacturer.



**Figure M.1.1a:** Example of hydrothermal behaviour test specimen with one opening (dimensions in metres).



**Figure M.1.1b:** Example of hydrothermal behaviour test specimen with two openings (dimensions in metres).

### M.1.2 Tests for selecting the worst case

When the assessment covers a range of different finishing coats, it is possible to select the worst case to be included in the hydrothermal cycle test rig by means of bond strength tests according to section 2.2.12.1 after:

- immersion in water for 2 days and 2 hours drying at  $(23 \pm 2) ^\circ\text{C}$  and  $(50 \pm 5) \% \text{RH}$  after removing the samples from the water;

- immersion in water for 2 days and 7 days drying at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH after removing the samples from the water;

Bond strength lower values should be considered as worst case.

### **M.1.3 Preparation of the specimen**

The preparation of the specimen shall be carried out by the manufacturer and be supervised by the laboratory in charge of the test, regarding:

- Checking of the respective manufacturer prescriptions: all stages shall be in accordance with the technical documentation of the manufacturer.
- Registering of all the stages of the installation:
  - the date and time of the various stages,
  - temperature and % RH during the installation (every day – at least at the beginning),
  - name and production lot of the components,
  - figure describing the specimen (place of the kit components and of the joints, ...),
  - way of base-coat and finishing coat preparation (tool, % of mixing, possible pause time before application,...) as well as their way of application (hand tool, machines, number of layers,...),
  - quantities and/or thickness of base-coat and finishing coat applied per square meter,
  - drying period between each layer,
  - use and position of accessories,
  - any other relevant information.

Quantities and/or thicknesses applied shall be recorded as well as characterization of the rendering system components.

### **M.1.4 Conditioning of the specimen**

Each layer shall be cured inside for the time defined by the manufacturer (if no information is given, the whole specimen shall be cured for 28 days). During the curing time the ambient temperature shall be  $(20 \pm 10)$  °C. The relative humidity shall not be less than 50%. To ensure that these conditions are met, records shall be made at regular intervals.

To prevent the layers from drying out too rapidly the manufacturer may require the layers to be wetted once per week by spraying for approximately 5 minutes. This should start according to the prescriptions of the manufacturer.

During the curing time any deformations of the layers, i.e. blistering, cracking, are recorded.

### **M.1.5 Hygrothermal cycles**

The test apparatus is positioned against the front face of the specimen, 0,10 m to 0,30 m from the edges.

The specified temperatures during the cycles are measured at the surface of the specimen. The regulation shall be obtained by adjustment of the air temperature.

#### Heat - rain cycles:

The specimen is subjected to a series of 80 cycles, comprising the following phases:

1. Heating to 70°C (rise for 1 hour) and maintaining at  $(70 + 5)$  °C and 10% to 30% RH for 2 hours (total of 3 hours).

2. Spraying for 1 hour, water temperature  $(15 \pm 5)$  °C, amount of water  $(1,5 \pm 0,5)$  l/m<sup>2</sup> min.
3. Leave for 2 hours (drainage) at  $(20 \pm 5)$  °C.

#### Heat-cold cycles:

After at least 48 hours of subsequent conditioning at temperatures  $(20 \pm 10)$  °C and a minimum relative humidity of 50%, the same test specimen is exposed to 5 heat/cold cycles of 24 hours comprising the following phases:

1. Exposure to  $(50 \pm 5)$  °C (rise for 1 hour) and maximum 30% RH for 7 hours (total of 8 hours).
2. Exposure to  $(- 20 \pm 5)$  °C (fall for 2 hours) for 14 hours (total of 16 hours).

#### **M.1.6 Observations during the tests**

At periods of every four cycles during the heat/rain cycles and at every cycle during the heat/cold cycles, observations relating to a change in characteristics or performance (blistering, detachment, crazing, loss of adhesion, formation of cracks, etc.) of the whole rendering system and of the part of the specimen consisting of only the reinforced base-coat are recorded as follows:

- the surface finish (base-coat or whole rendering system) of the kit must be examined to establish whether any cracking has occurred. The dimensions and position of any cracks should be measured and recorded,
- the surface should also be checked for any blistering or peeling, and the location and extent should again be recorded,
- the sills and profiles should be checked for any damage/degradation together with any associated cracking of the finish. Again, the location and extent should be recorded.

Following the completion of the test, a further investigation is conducted involving removal of sections containing cracks to observe any water penetration within the kit (e.g. back of the board).

#### **M.1.7 After the cycles**

After the heat-rain and heat-cold cycles, bond strength tests (see section 2.2.12.1) shall be carried out on samples taken from the test specimens.

These tests shall be performed after at least 7 days drying.

#### **M.1.8 Test report**

The test report shall detail the following:

- Observations recorded during the test (see section M.1.6).
- Photos to detail the damages occurred on each specimen after the cycles and, if necessary, after each visual inspection.

### **M.2 FREEZE-THAW BEHAVIOUR TEST**

The freeze-thaw test shall be carried out as determined by the analysis of the capillarity test (see section 2.2.5.1), i.e. shall be carried out except when the water absorption after 24 hours of both, the reinforced base-coat (without finishing coat) and the whole rendering system (with finishing coat) determined for each type of finishing coat is less than 0,5 kg/m<sup>2</sup>.

#### **M.2.1 Test specimen preparation**

The test shall be carried out on at least three samples 500 mm x 500 mm.

These samples are prepared according to the manufacturer's instructions and then stored for at least 28 days at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH.

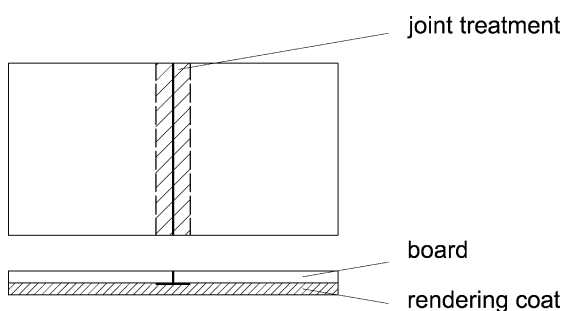
The test specimens shall be prepared with the board as substrate. At least three specimens shall be tested for each case.

Each test specimen must be made of:

- Substrate made of two board pieces connected by an intermediate joint (with the respective joint treatment), see figure M.2.1 minimum area for each board piece should be  $900 \text{ cm}^2$  (e.g.  $300 \times 300 \text{ mm}$  or  $200 \text{ mm} \times 500 \text{ mm}$ ).
- Each rendering system to be assessed.

The edges of the specimens (including the board) should be sealed against water.

Quantities and/or thicknesses applied shall be recorded as well as characterization of the board and rendering system components.



**Figure M.2.1:** Example of freeze-thaw behaviour test specimen

### M.2.2 Freeze-thaw cycles

The specimens are subjected to a series of 30 cycles comprising:

1. Exposure to water for 8 hours at  $(23 \pm 4)$  °C by immersion of the specimens, with the rendering system submerged in a water bath, according to the method described in section 2.2.5.1.
2. Freezing to  $(-20 \pm 2)$  °C (fall for 2 hours) for 14 hours (total of 16 hours).

If the test is interrupted, because the specimens are handled manually and there are stops during weekends or holidays the specimens shall always be stored at a temperature of  $(-20 \pm 2)$  °C between the cycles.

**Remark:** the specified temperatures are measured at the surface of the samples. The regulation is obtained by conditioned air.

### M.2.3 Observations

At the end of the test, observations relating to a change in characteristics of the surface or to the behaviour of the kit are recorded according to section M.1.6.

Any distortion at the edges of the samples shall also be reported.

### M.2.4 After the cycles

After the freeze-thaw cycles, bond strength tests (see section 2.2.12.1) shall be carried out on each specimen submitted to freeze-thaw cycles.

These tests shall be performed after at least 7 days drying.

### **M.2.5 Test report**

See section M.1.8.

## **M.3 ALTERNATIVE TEST WITH COMBINED HYGROTHERMAL AND FREEZE-THAW CYCLES**

### **M.3.1 Principles related to the preparation of the samples**

See section M.1.1.

### **M.3.2 Preparation of the specimen**

See section M.1.2 and M.1.3.

### **M.3.3 Conditioning of the specimen**

See section M.1.4.

### **M.3.4 Hygrothermal cycles**

The test apparatus is positioned against the front face of the specimen, 0,10 m to 0,30 m from the edges.

The specified temperatures during the cycles are measured at the surface of the specimen. The regulation shall be obtained by adjustment of the air temperature.

#### Heat - rain cycles:

The specimen is subjected to a series of 80 cycles (6 hours each cycle), comprising the following phases:

1. Heating to 70°C (rise for 1 hour) and maintaining at  $(70 \pm 5)$  °C and 10% to 30% RH for 2 hours (total of 3 hours).
2. Spraying for 1 hour, water temperature  $(15 \pm 5)$  °C, amount of water  $(1,5 \pm 0,5)$  l/m<sup>2</sup> min.
3. Leave for 2 hours (drainage) at  $(20 \pm 5)$  °C.

#### Heat-cold cycles:

After at least 48 hours of subsequent conditioning at temperature  $(20 \pm 10)$  °C and a minimum relative humidity of 50%, the same test specimen is exposed to 5 heat/cold cycles of 24 hours comprising the following phases:

1. Exposure to  $(50 \pm 5)$  °C (rise for 1 hour) and maximum 30% RH for 7 hours (total of 8 hours).
2. Exposure to  $(-20 \pm 5)$  °C (fall for 2 hours) for 14 hours (total of 16 hours).

#### Freeze-thaw cycles:

After at least 48 hours of subsequent conditioning at temperature  $(20 \pm 10)$  °C and a minimum relative humidity of 50%, the same test specimen is exposed to:

- Conditioning the test specimen spraying for 8 hours, water temperature  $(15 \pm 5)$  °C, amount of water  $(1,5 \pm 0,5)$  l/m<sup>2</sup>·min.
- 30 freeze/thaw cycles of 8 hours comprising the following phases:
  - Freeze the surface of the specimen at least 2 hours to  $(-20 \pm 5)$  °C and maintain it for 4 hours (in total 6 hours).

- Thaw the specimen for 1 hour at temperature of  $(20 \pm 5)$  °C.
- Spraying for 8 hours, water temperature  $(15 \pm 5)$  °C, amount of water  $(1,5 \pm 0,5)$  l/m<sup>2</sup>:min.

After the 30 cycles condition specimen at ambient temperature  $(20 \pm 10)$  °C.

### **M.3.5 Observations during the tests**

At periods of every four cycles during the heat/rain cycles and at every cycle during the heat/cold cycles and freeze-thaw cycles, observations relating to a change in characteristics or performance (blistering, detachment, crazing, loss of adhesion, formation of cracks, etc.) of the whole rendering system and of the part of the specimen consisting of only the reinforced base-coat are recorded as follows:

- the surface finish (base-coat or whole rendering system) of the kit must be examined to establish whether any cracking has occurred. The dimensions and position of any cracks should be measured and recorded,
- the surface should also be checked for any blistering or peeling, and the location and extent should again be recorded,
- the sills and profiles should be checked for any damage/degradation together with any associated cracking of the finish. Again, the location and extent should be recorded.

Following the completion of the test, a further investigation is conducted involving removal of sections containing cracks to observe any water penetration within the kit (e.g. back of the board).

### **M.3.6 After the cycles**

See section M.1.7.

### **M.3.7 Test report**

See section M.1.8.

## **M.4 - CRACKING DUE TO SUBSTRATE DEFORMATION**

This section establishes the procedure to carry out the substrate deformation cycles to assess the behaviour of the rendering system due to these deformations.

After the substrate movement cycles procedure water absorption by capillarity test is necessary (see sections 2.2.5.1).

### **M.4.1 Test specimen conditioning**

The tests specimens shall be conditioned for 28 days in normal laboratory conditions corresponding to  $(20 \pm 10)$  °C and  $(50 \pm 20)$  % relative humidity.

### **M.4.2 Test specimen preparation**

At least 4 test specimens are necessary (after the cycles, one of these test specimens will be used for the water permeability test and the other three test specimens will be used for the water absorption test).

The test specimen shall consist of a substrate (board) and the rendering system (base-coat and finishing coat) applied over the substrate.

The substrate dimensions and the span length shall be chosen taking into account the following rules:

- a) The ratio span length / nominal thickness shall be equal or higher than 15.

b) The test specimen wide shall be equal or higher than five times their nominal thickness.

An example of the dimensions for the test specimen can be 900 mm long by 300 mm wide with a span length of 600 mm.

The rendering system must be applied with the worst or the most representative thickness (e.g. minimum thickness) applied according to the manufacturer's instructions.

### M.4.3 Test procedure

After conditioning, the test specimen is placed on a support at either end such that there is a minimum clear span of the distance between vertical profiles.

A cyclical downward vertical distributed force (load and unload) is applied to the test specimen at the mid-span as shown in figure M.4.1.

The cyclical force is applied during 100 cycles.

The force to be applied must be  $F = 0,25 \cdot F_{\max}$  where  $F_{\max}$  is the maximum load reached in the bending strength test (see section 2.2.12.2).

After the substrate movement cycles procedure water absorption by capillarity test is necessary (see sections 2.2.5.1).

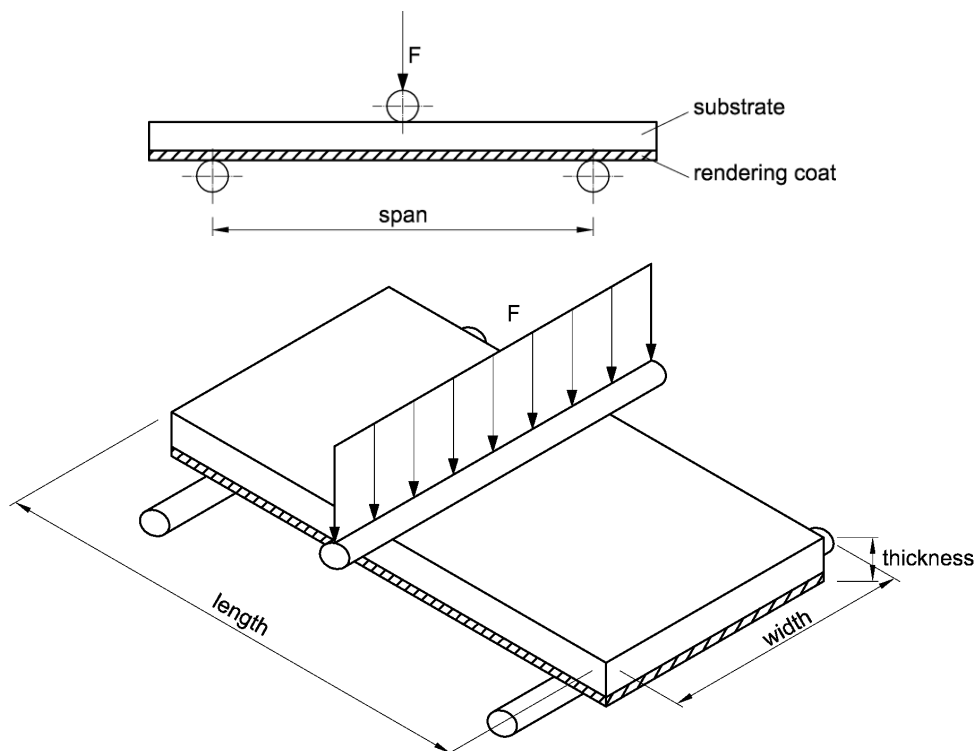


Figure M.4.1: Example of test specimen.

### M.4.4 Test results

The condition of the rendering on the deflected board shall be inspected immediately after the test. Any cracking, spalling, adhesive or cohesive failure shall be recorded.

The dimensions of the test specimen, the applied load, the span length, the number of cycles and the frequency shall be given.



## ANNEX N – TEST RESULTS STATISTICAL DESCRIPTION

$$F_{u,5} = F_{\text{mean}} - k_n \cdot S$$

Where:

$F_{u,5}$  = the characteristic breaking force giving 75 % confidence that 95 % of the test results will be higher than this value

$F_{\text{mean}}$  = the mean<sup>3</sup> breaking force, either under tension or shear

$k_n$  = the variable as a function of the number of test specimens for 5 % ( $p = 0,95$ ) with 75 % confidence level when the population standard deviation is unknown (see table N.1)

$S$  = the standard deviation of series under consideration

**Table N.1** – The variable  $k_n$  as a function of the number of test specimens (see EN 1990 Eurocode: *Basis of structural design*, table D1,  $V_x$ , unknown).

Number of specimens	3	4	5	6	7	8	10	20	30	$\infty$
Variable $k_n$	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64