EUROPEAN ASSESSMENT DOCUMENT

EAD 090034-00-0404

June 2016

KIT COMPOSED BY SUBFRAME AND FIXINGS FOR FASTENING CLADDING AND EXTERNAL WALL ELEMENTS

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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).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD is applicable to a kit[1] composed of subframe and fixings for fastening skin elements (cladding elements and external wall elements) which consists of the following components:

1) Skin element fixing for fastening the skin elements of the following types (see schematic drawings in the figures):
   - Type 1: Metallic dowel anchor for skin elements with dowel hole (see Figure 1.1). One fixing supports two skin elements and at least four fixings are needed to support one skin element.

   - Type 2: Metallic punctual rail anchors, pins or clips for skin elements with or without groove (see Figure 1.7 and Figure 1.8 respectively). One fixing supports two or four skin elements, and at least four fixings are needed to support one skin element.

     These metallic punctual rail anchors, pins or clips can be positioned directly on the subframe vertical profile (see Figure 1.2a) or on an intermediate horizontal profile that it is fixed, in turn, on at least two subframe vertical profiles (see Figure 1.2b).

   - Type 3: Metallic punctual rail anchors, pins or clips for skin elements with or without groove (see Figure 1.7 and Figure 1.8 respectively). One fixing supports two or four skin elements, and at least four fixings are needed to support one skin element.

     These metallic punctual rail anchors, pins or clips can be positioned directly on the subframe vertical profile (see Figure 1.3a) or on an intermediate horizontal profile that it is fixed, in turn, on at least two subframe vertical profiles (see Figure 1.3b).

   - Type 4: Metallic continuous rails (horizontal profiles) for skin elements with or without groove (see Figure 1.4 and Figure 1.7 and Figure 1.8 respectively). One fixing supports two skin elements and two rails are needed to support one skin element.

   - Type 5: Metallic horizontal profiles with clamps and special anchors[2] to be placed in the undercut hole of the skin element and anchored by mechanical interlock (see Figure 1.5). At least four special anchors and clamps are needed to support one skin element.

   - Type 6: Screws or rivets that pierce the skin elements to fasten them directly onto the subframe (see Figure 1.6). At least four screws or rivets are needed to support one skin element.

   Note: These skin element fixings are related to the following cladding families indicated in section 2.2.1 of ETAG 034 Part I. Skin element fixings of types 1, 2 and 4 are related to Family C, skin element fixings of type 3 are related to Family F, the skin element fixings of type 5 are related to Family B and the skin element fixings of type 6 are related to Families A, D and E.

2) Subframe metallic vertical profiles.

3) Subframe metallic brackets.

4) Subframe metallic skin element fixings:

   - between the skin element fixings and the profiles;

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

[2] Special anchors may have their own CE marking according to an ETA via e.g. EAD 330030-00-0601.

- between the profiles and brackets.

5) Ancillary components to protect the skin element fixings (e.g. plastic rail or dowel protectors) or to complement the retention function of the skin element fixings (e.g. silent-blocks, metallic springs, adhesives and adhesives tapes).

The subframe and fixing kits are made of components mechanically assembled. Adhesives are used exclusively as ancillary components, being their contribution to the mechanical resistance of the kit ignored (mechanical characteristics of the kit components are tested without adhesive).

The subframe and fixing kits are non-load-bearing construction elements. They do not contribute to the stability of the structure on which they are installed.

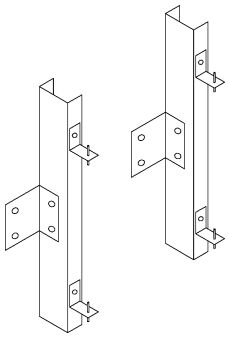

Figure 1.1: Subframe and fixing kit type 1

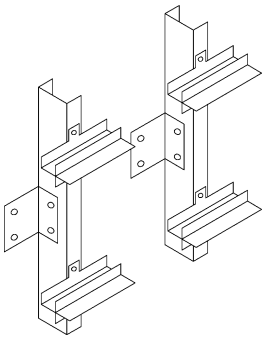

Figure 1.2a: Subframe and fixing kit type 2 (without horizontal profile)

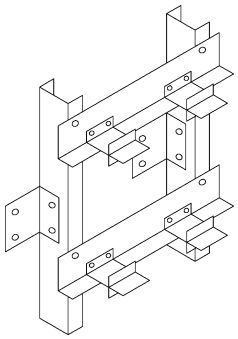

Figure 1.2b: Subframe and fixing kit type 2 (with horizontal profile)

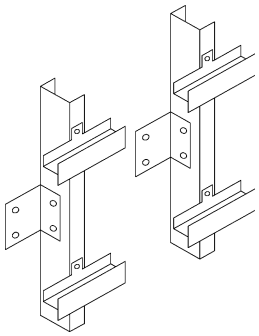

Figure 1.3a: Subframe and fixing kit type 3 (without horizontal profile)

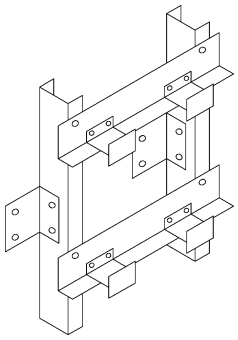

Figure 1.3b: Subframe and fixing kit type 3 (with horizontal profile)

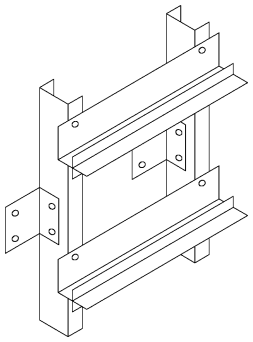

Figure 1.4: Subframe and fixing kit type 4

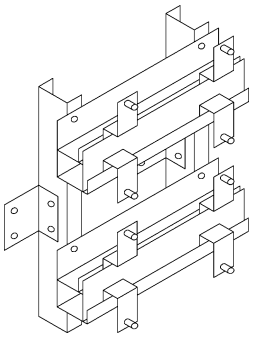

Figure 1.5: Subframe and fixing kit type 5

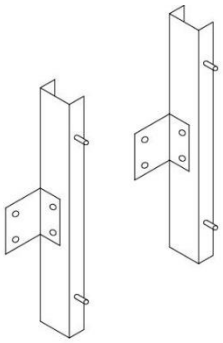

Figure 1.6: Subframe and fixing kit type 6

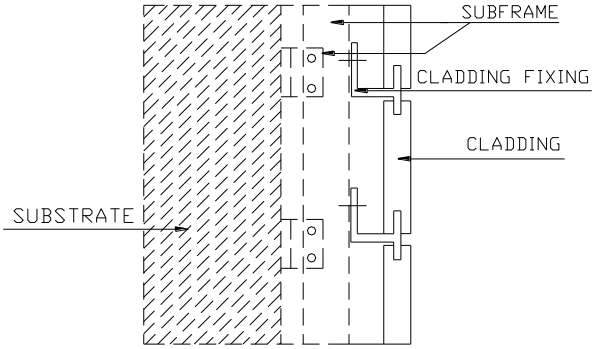

Figure 1.7: Skin element fixing for skin element with groove

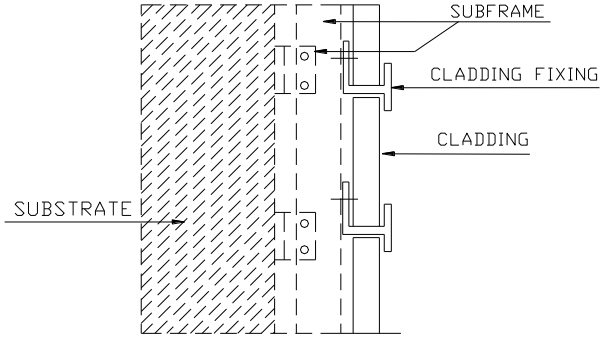

Figure 1.8: Skin element fixing for skin element without groove

The following components are not part of the kits and, therefore, they are not covered by this EAD:

- skin elements[3];
- fixings between the supporting structure and the brackets;
- other leaves of the façade, such as thermal insulations and internal layers.

The technical description of the skin element fixings and subframe components shall include the definition of the parameters given in Annex A.

The manufacturer can provide:

- a complete subframe and fixing kit (skin element fixings and subframe components);
- a skin element fixing kit (skin element fixing and fixings to the subframe). In this case, an ETA can be issued in accordance with this EAD, only if the subframe components are available on the market and specified in the ETA by the description of dimensions, materials and performances of components. The manufacturer and trading reference of subframe components may be indicated. All tests for granting the ETA shall be done with the specified subframe components. A skin element fixing of type 6 is not allowed in this option because it is composed by one single element;
- a subframe kit (vertical profiles, brackets and fixings between them). In this case, an ETA can be issued in accordance with this EAD, only if the skin element fixings are available on the market and specified in the ETA by the description of dimensions, materials and performances of components. The manufacturer and trading reference of skin element fixings may be indicated. All tests for granting the ETA shall be done with the specified skin element fixings.

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

The product is not fully covered by the following harmonised technical specification: ETAG 034 – Parts I and II, edition April-2012, used as EAD, because it is only composed by the subframe and mechanical fixings and it does not include the cladding elements that are part of the cladding kits considered within the scope of both Parts.

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

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

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

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

1.2.1 Intended use(s)

This EAD covers the intended use of subframe and fixing kits for the mechanical fastening of skin elements (cladding elements or external wall elements) in façades with air space, ventilated or not, and intended to be fixed to the supporting structures defined in section 1.3.4 in new or existing buildings (retrofit).

[3] If the skin elements are cladding elements, ETAG 034 Parts I and II used as EAD apply, unless such elements are not covered by this guideline.

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 Kit composed by subframe and fixings for fastening cladding elements and also external wall elements for the intended use of 25 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[4].

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

1.3 Specific terms used in this EAD

1.3.1 Skin element

The term "skin element" refers to both of the following elements:

- cladding elements;
- external wall elements in façades.

1.3.2 Skin element fixing

Profile, bracket, screw/anchor, nail, rivet or any special fixing device used to secure the skin elements to the subframe.

1.3.3 Subframe

An intermediate assembly of vertical metal profiles and brackets (including the fixings between the brackets and the profiles) located between the skin element and the supporting structure. The subframe defined in this EAD consists of the following components:

- vertical profiles;
- brackets for fastening the profiles to the supporting structure;
- subframe fixings (screws or rivets) between the brackets and the profiles;
- fixings or anchors between the brackets and the supporting structure (this component is not considered as part of the kit).

1.3.4 Supporting structure

The term "supporting structure" refers to any of the following descriptions:

- the wall, which in itself already meets the airtightness and mechanical strength requirements (resistance to static and dynamic loads), as well as watertightness and a relevant water vapour resistance. The substrate walls can be made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame;
- the supporting structure of the building, which in itself does not meet the airtightness requirement but meets the mechanical strength requirements (resistance to static and dynamic loads). Usually, the supporting structures of the building 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 wall of the internal leaves of the façade.

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

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of Kit composed by subframe and fixings for fastening skin elements and also external wall elements is assessed in relation to the essential characteristics.

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

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 4: Safety and accessibility in use			
2	Wind load resistance	2.2.2	Level
3	Resistance to vertical load of the whole assembled system	2.2.3	Level
4	Resistance to vertical load of skin element fixings	2.2.4	Level
5	Resistance to horizontal load of skin element fixings	2.2.5	Level
6	Resistance to pulsating load of skin element fixings (i)	2.2.6	Level
7	Resistance of skin element fixings in case of inaccuracies of installation (i) (ii)	2.2.7	Level
8	Pull-through resistance of fixings (from profiles) (iii) (iv)	2.2.8	Level
9	Pull-out resistance of fixings (from profiles)	2.2.9	Level
10	Inertia and resistance of profiles	2.2.10	Description
11	Resistance to vertical load of brackets (iii)	2.2.11	Level
12	Resistance to horizontal load of brackets (iii)	2.2.12	Level
13	Mechanical characteristics of subframe fixings (iii)	2.2.13	Level
14	Corrosion	2.2.14	Description

(i) This characteristic is relevant only for complete kits or skin element fixing kits (see section 1.1).
(ii) This characteristic is only relevant for skin elements fixings type 5.
(iii) This characteristic is relevant only for complete kits or subframe fixing kits (see section 1.1).
(iv) This characteristic is not relevant for skin elements fixings type 6.

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 assembled system is verified by considering the reaction to fire of the kit components.

The metal skin element fixings and subframe components are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC Decision 1996/603/EC (as amended) without the need for testing on the basis of its listing in that Decision.

Components with coatings which do not comply with the EC decision shall be tested, using the test method(s) relevant for the corresponding reaction to fire class.

Minor (ancillary) components, being insignificant in respect to the development of a fire, can be ignored and need not be tested for their reaction to fire performance. The relevance of these products e.g. for their contribution to fire spread needs to be considered. The assessment of whether a component can be ignored and the way this question has been addressed needs to be specified according to EOTA TR 021.

The assembled system shall be classified according to Commission Delegated Regulation (EU) 2016/364 or other technical specification applicable to ventilated cladding kits comprising cladding components and associated fixings.

2.2.2 Wind load resistance

The wind load resistance (suction and/or pressure) of the assembled system shall be carried out by calculation taking into account the mechanical resistances of the kit components (skin element fixings and subframe components) obtained from sections 2.2.4 to 2.2.14.

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

Relevant elasticity and resistance equations and relevant standards (e.g. EN 1999-1-1 for aluminium) should be considered for the calculation (at ultimate and serviceability limit states).

At least for one assembled system, the calculated result shall be contrasted by testing according to Annex B.

The assessment shall be based on the mechanical characteristics of the components (see sections 2.2.4 to 2.2.14) taking into account the results of the wind suction and/or pressure tests. In this case, if the test results obtained do not confirm the results obtained by mechanical tests of the kit components, at least two other test specimens have to be tested or the mechanical resistance of the kit components shall be corrected accordingly.

The characteristic wind load resistance for the assembled system shall be indicated. This characteristic value shall be the minimum value between the calculation load limit and the test load limit for the test specimen.

Besides, the following values shall be given in the ETA:

- maximum wind load resistance (Q) for which test specimen fails and the type of test specimen failure;
- calculated maximum load for the test specimen on the basis of mechanical characteristics of the components;
- maximum permanent deflection (after recovery), maximum deflection (under load) of the test specimen, loads and sensors position for these maximum deflections (after recovery and under load);
- components, their mechanical characteristics, maximum deflection of the vertical profile and maximum deflection of the horizontal profile (only for skin element fixings of types 2 and 3 with horizontal profile, and of types 4 and 5 as defined in section 1.1) used as calculation limits for the test specimen.

2.2.3 Resistance to vertical load of the whole assembled system

The resistance to vertical load of the assembled system shall be carried out by calculation taking into account the mechanical resistance of the kit components (skin element fixings and subframe components) obtained from sections 2.2.4 to 2.2.14.

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

Relevant elasticity and resistance equations and relevant standards (e.g. EN 1999-1-1 for aluminium) should be considered for the calculation (at ultimate and serviceability limit states).

At least for one assembled system, the calculated result shall be contrasted by testing according to Annex C.

The assessment shall be based on the mechanical characteristics of the components (see sections 2.2.4 to 2.2.14) taking into account, where relevant, the results of the resistance to vertical load test. In this case, if the test results obtained do not confirm the results obtained by mechanical tests of the kit components, the mechanical resistance of the kit components shall be corrected accordingly.

The resistance to vertical load, the displacement and the time at which this displacement occurs shall be indicated.

Besides, the other characteristics indicated in section C.2 of Annex C shall be given in the ETA.

2.2.4 Resistance to vertical load of skin element fixings

The assessment of the resistance to vertical load of skin element skin element fixings depends on their type:

- Types 1 to 3 (as indicated in section 1.1) shall be tested according to section D.2 of Annex D.
- Type 4 (as indicated in section 1.1) shall be assessed from one of following options:
    - calculation of the horizontal profile maximum deflection;
    - test according to section D.2 of Annex D.
- Type 5 (as indicated in section 1.1) shall be tested according to:
    - section D.3.1 of Annex D for the mechanical resistance of the connection between the anchor/clamp and the horizontal profile;
    - section D.3.2 of Annex D for the mechanical resistance of the connection between the anchor/clamp and the skin element.
- Type 6 (as indicated in section 1.1) shall be tested according to section D.3.2.2 of Annex D.

Where relevant, the horizontal profile maximum deflection shall be calculated for the skin element fixings with horizontal profiles (types 2, 3 and 5).

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

The mean value and the characteristic value according to section D.5 of Annex D shall be indicated.

2.2.5 Resistance to horizontal load of skin fixing elements

The assessment of the resistance to horizontal load of skin element fixings depends on their type:

- Types 1 to 3 (as indicated in section 1.1) shall be tested according to section D.2 of Annex D.
- Type 4 (as indicated in section 1.1) shall be assessed from one of following options:
    - calculation of the horizontal profile maximum deflection;
    - test according to section D.2 of Annex D.
- Type 5 (as indicated in section 1.1) shall be tested according to:
    - section D.3.1 of Annex D for the mechanical resistance of the connection between the anchor/clamp and the horizontal profile;

- section D.3.2 of Annex D for the mechanical resistance of the connection between the anchor/clamp and the skin element.

- Type 6 (as indicated in section 1.1) shall be tested according to Annex G b) (see figure G.2).

Where relevant, the horizontal profile maximum deflection shall be calculated for the skin element fixings with horizontal profiles (types 2, 3 and 5).

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

The mean value and the characteristic value according to section D.5 of Annex D shall be indicated.

2.2.6 Resistance to pulsating load of skin element fixings

The determination of the resistance to pulsating load of skin element fixings shall be carried out according to Annex E.

The ratio between the measured resistance to horizontal load mean values before and after pulsating loads shall be indicated in the ETA.

2.2.7 Resistance of skin element fixings in case of inaccuracies of installation

This characteristic is only relevant for fixings of type 5 as indicated in section 1.1.

The determination of the resistance in case of inaccuracies of installation shall be carried out according to Annex F.

The ratio between the measured mean values before and after pulsating loads shall be indicated in the ETA.

2.2.8 Pull-through resistance of fixings from profile

The pull-through resistance of fixings from profiles (in the case of skin element fixings of types 2 and 3 with horizontal profile and of types 4 and 5, as indicated in section 1.1) shall be tested according to Annex G.

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

The mean value and the characteristic value according to section G.5 of Annex G shall be indicated.

2.2.9 Pull-out resistance of fixings from profile

The pull-out resistance of fixings from profiles (subframe vertical profiles and horizontal profiles in the case of skin element fixings of types 2 and 3 with horizontal profile, and of types 4 and 5, as indicated in section 1.1) shall be tested according to Annex G.

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

The mean value and the characteristic value according to section G.5 of Annex G shall be indicated.

2.2.10 Inertia and resistance of profiles

The following characteristics of profiles shall be described:

- form and dimensions of the profile section according to relevant standards (e.g. EN 755-9 for aluminium);
- inertia of the profile section according to the relevant standards (e.g. EN 1999-1-1 for aluminium);
- minimum elastic limit of the material of the profile according to the relevant standards (e.g. EN 755-2 for aluminium);

- maximum admissible deflection (e.g. L/200), in accordance with wind load resistance test and admitted by the manufacturer.

2.2.11 Resistance to vertical load of brackets

The resistance to vertical load of brackets shall be carried by testing according to Annex H.

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

The mean value and the characteristic value according to section H.6 of Annex H shall be indicated.

When it is possible, calculation according to relevant standards (e.g. EN 1999-1-1 for aluminium) may be carried out provided that this calculation is contrasted by testing according to Annex H.

2.2.12 Resistance to horizontal load of brackets

The resistance to horizontal load of brackets shall be carried by testing according to Annex H.

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

The mean value and the characteristic value according to section H.6 of Annex H shall be indicated.

When it is possible, calculation according to relevant standards (e.g. EN 1999-1-1 for aluminium) may be carried out provided that this calculation is contrasted by testing according to Annex H.

2.2.13 Mechanical characteristics of subframe fixings

The mechanical characteristics (tensile and shear strength) of the fixings between the subframe components shall be defined according to the appropriate EN standard (e.g. EN 1993-1.1, EN ISO 10666, EN ISO 14589, etc.).

The mechanical characteristics (tensile and shear strength) shall be given in the ETA.

2.2.14 Corrosion

The corrosion protection of the kit components 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, EN ISO 7599 and EN 1999-1-1 for aluminium alloys, EN 10088-1 and EN 10088-2 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 stated in the ETA.

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 system is: **2+**

In addition, with regard to reaction to fire for products covered by this EAD the applicable European legal act is: Decision 2003/640/EC.

The systems are: **1, 3 or 4.**

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1 ...	Skin element fixings and subframe components				
	- Material	Supplier certificates	Acc. to values specified by manufacturer	Testing is not required	Each delivery
	- Geometry (form and dimension)	Supplier certificates	Acc. to values specified by manufacturer	Testing is not required	Each delivery
		Measuring or visual check	Acc. to values specified by manufacturer	Acc. to Control Plan	Acc. to Control Plan
	- Mechanical characteristics	Supplier certificates	Acc. to values specified by manufacturer	Testing is not required	Each delivery
		Sections 2.2.4 to 2.2.13	Acc. to values specified by manufacturer	Acc. to Control Plan	At least once each 5 years

3.3 Tasks of the notified body

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for products for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification.

In this case, the cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for kits composed of subframe and fixings for fastening skin elements are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	The notified body shall verify the ability of the manufacturer for a continuous and orderly control of the product according to the European Technical Assessment. In particular, the following items shall be appropriately considered: - personnel and equipment - the suitability of the factory production control established by the manufacturer - full implementation of the prescribed Control Plan				-
Continuous surveillance, assessment and evaluation of factory production control					
2.	The notified body shall verify that are maintained: - the manufacturing process of the subframe and fixing kit components - the system of factory production control - the implementation of the prescribed Control Plan				Once per year

4 REFERENCE DOCUMENTS

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

EN 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 1993-1-1	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings
EN 1999-1-1	Eurocode 9: Design of aluminium structures - Part 1-1: General structural rules.
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 10346	Continuously hot-dip coated steel flat products - Technical delivery conditions.
EN 12020-1	Aluminium and aluminium alloys. Extruded precision profiles in alloys EN AW-6060 and EN AW-6063. 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. Tolerances on dimensions and form
EN 13501-1	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.
EN ISO 7500-1	Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Verification and calibration of the force-measuring system (ISO 7500-1).
EN ISO 7599	Anodizing of aluminium and its alloys. General specifications for anodic oxidation coatings on aluminium
EN ISO 9223	Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation.
EN ISO 10666	Drilling screws with tapping screw threads. Mechanical and functional properties
EN ISO 14589	Blind rivets. Mechanical testing
ETAG 034 Part I	Guideline for European technical approval of kits for external wall claddings. Part I: Ventilated cladding kits comprising cladding components and associated fixings
ETAG 034 Part II	Guideline for European technical approval of kits for external wall claddings Part II: Cladding kits comprising cladding components, associated fixings, subframe and possible insulation layer
EOTA TR 021	Reaction to fire requirements for small components
EAD 330030-00-0601	Fastener of external wall claddings

ANNEX A Description of the components

All kit components (skin element fixings, profiles, brackets and ancillary components) according to the relevant standards (e.g. EN 1993-1-1, EN 1999-1-1, EN 755-1, EN 755-2, EN 10088-1, EN 10088-2, EN 10088-4, EN 12020-1, EN 12020-2, etc.) and with the following information:

Geometric and physical characteristics:

- form and dimensions (*);
- weight per linear meter or per unit;
- cross section in the case of profiles;
- inertia of the section in the case of profiles (*).

Material properties:

- type of material;
- specific gravity;
- elastic limit (*);
- elongation;
- tensile strength;
- modulus of elasticity (at 20 ºC);
- Poisson coefficient;
- thermal expansion coefficient between 50 ºC and 100 ºC.

(*) Characteristics also indicated in section 2.

ANNEX B Wind suction and pressure load tests

The principle is to establish the effects of suction and pressure loads on the assembled kit composed by subframe and fixings, using a generic skin element fixed according to the instructions of the kit manufacturer (ETA holder).

This generic skin element shall not be a weak point and shall therefore be chosen accordingly (e.g. the greatest thickness and weight skin element).

As a minimum, the mechanically weakest design of the assembled system shall be tested.

The test shall be carried out under laboratory conditions ((20±10) ºC and (50±20)% relative humidity).

B.1 Wind suction test

B.1.1 Preparation of the test specimen

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

The test specimen comprises:

- A non-airtight support (test rig) such as a wood or rigid steel frame.
- The assembled system must be fixed to the test rig.
- The dimensions of the test specimen depend on:
    - the size of the chosen generic skin element;
    - the span between brackets;
    - the span between vertical profiles, and in the case of kits with horizontal profiles, the span between horizontal profiles;
    - for generic skin elements which are mechanically fixed independent of each other, a minimum surface cladding of 1,5 m^2 shall be tested;
    - If generic skin elements depend on each other vertically and horizontally, at least 3 x 3 elements shall be tested;
    - If they depend on each other vertically or horizontally, at least 4 elements shall be tested.

As a minimum, it must be tested: one maximum span between brackets, three vertical profiles (two spans between profiles) and, in the case of kits with horizontal profiles, one maximum span between horizontal profiles.

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

The air permeability of the test specimen should be reduced providing no interference with mechanical resistance of the test specimen.

B.1.2 Test equipment

The test equipment consists of a pressure or suction chamber (see Figure B.1) against which is placed the assembled system. 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 system irrespective of its possible deformation. The chamber is mounted on a rigid frame. The assembled system acts as the seal between the chamber and the environment. The connection between the assembled system and the chamber shall be sufficient to allow a realistic deformation of the test specimen under the influence of simulated wind suction.

B.1.3 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 generic skin is possible.

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

The subframe of the cladding kit has to be fixed on the rig and the cladding elements have to be fixed on the subframe according to the indications given by the ETA holder.

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

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

B.1.4 Test procedure

The uniformly distributed loads are exerted on the surface of the generic skin elements.

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 B.2) until significant irreversible deformation (deformation which affects serviceability) or failure occurs.

The test is then continued until failure occurs or equipment system limit is reached.

The deflection shall be measured as a function of the load and reported in tabular or graphic form. If appropriate, the deflection measure points will be:

- on the half span between the two brackets of the central vertical profile;
- on the half span between two vertical profiles (in the case of kit with horizontal profiles the deflection must be measured on the horizontal profile zone); and
- on the central point of the generic skin element surface.

With the differential pressure reduced to zero, the permanent deflection shall be noted after 1 minute recovery. The pressure at which defect 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 system and the test equipment shall not constitute weak points and shall therefore be chosen accordingly.

B.1.5 Observations during the test

Failure is defined by any one of the following events:

- Any skin element fixing, profile or bracket breaks.
- Any skin element fixing, profile or bracket presents a significant permanent deflection.
- Any generic skin element breaks. In this case, the TAB must decide if the test results are sufficient to define the assembled system performance or if it is necessary repeat the test for the same assembled system but with other generic skin element.
- Whether the limit of the testing or measurement equipment is reached.

B.1.6 Test report

The test specimen shall be described 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);
- skin element fixing (material and geometry and number and disposition of fixings);
- generic skin element (material, geometry, density or mass per unit area, bending strength);
- fixings between the test equipment and the assembled system (position, generic type, material and geometry).

The test result is:

- failure load Q (take the last pressure without failure);
- type of failure;
- 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.

B.2 Wind pressure test

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

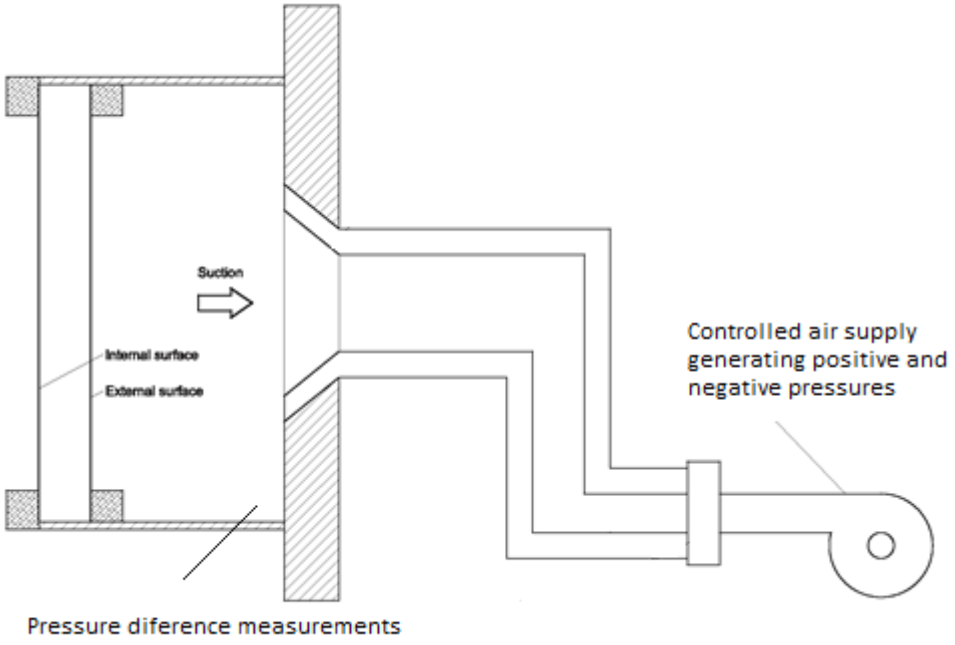

Figure B.1: Example of wind pressure and suction apparatus

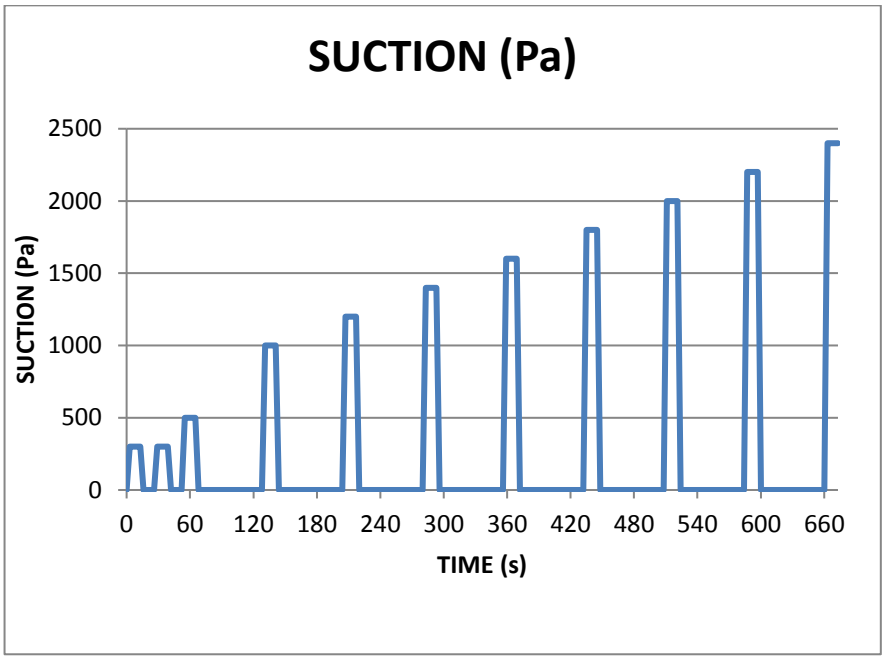

Figure B.2: Example of wind load steps

ANNEX C Resistance to vertical load test of whole assembled system

C.1 General

The principle is to establish the effects of vertical loads on the assembled systems when the skin element fixings are in their resistance to vertical load limit (obtained as indicated in sections 2.1.4, 2.1.10, 2.1.11 and 2.2.13).

The resistance limit to vertical load of the assembled system (R_v) is defined as:

- in the case of discontinuous skin element fixings (e.g. clips, small rails, pins, clamps, hungs, etc.), the mean value of vertical force for 1 mm irreversible deformation obtained according to Annex D;
- in the case of continuous skin element fixings (e.g. profiles, type 4), the minimum value of the vertical force obtained by calculation taking into account the elastic limit and the admissible deflection of the skin element fixing;
- the bracket vertical load for 1 or 3 mm of displacement (see Annex G);
- the shear resistance limits for the subframe fixings).

At least, the mechanically weakest design of the skin element fixings, subframe brackets and subframe fixings shall be tested.

One generic skin element is installed on the skin element fixings and the subframe and an additional dead load is added on top of the skin element. The subframe brackets shall be fixed to a test rigid support in accordance with the instructions of the manufacturer.

The additional dead load shall be chosen taking into account the dead load of the generic skin element (Q_w) used in the specimen, the vertical load resistance limit as defined above (R_v) and the number of skin element fixings (N) that will support the vertical force.

$Q_{ad} = R_v \times N - Q_w$

The displacement of the skin element fixings and subframe profiles shall be measured.

The test can be stopped when the deflection, after adding the dead load, is less than 0,1 mm after 1 hour.

The test result is a deflection curve as a function of time and the maximum deflection.

C.2 Test report

Test report should include:

- type, material and geometry of the assembled kit;
- the displacements and forces shall be reported in tabular or graphic form;
- the values; Q_w, R_v and Q_{ad} value.

ANNEX D Mechanical resistance of skin element fixings

The principle is to establish the mechanical resistance of discontinuous skin element fixings (e.g. clips, small rails, pins, clamps, hungs, etc.).

D.1 General

The tests shall be carried out under laboratory conditions (20±10) ºC and (50 ± 20)% relative humidity.

A minimum of 5 specimens shall be tested.

The skin element fixing shall be installed as specified by the manufacturer.

The force must be exerted at a rate of 5 mm/min on the skin element fixing.

The test is performed in successive steps with a return to zero at each level, until 1 mm irreversible deformation occurs.

Note: To obtain the forces with accuracy, it is recommended to make the control by displacement of the growth between cycles. This type of control is the best to avoid big gaps between the residual distortions that occur after each consecutive cycle.

The test is then continued until failure occurs.

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

D.2 Mechanical resistance for skin element fixings types 1 to 4

D.2.1 Resistance to vertical load (weight)

The test method is indicated in section D.1.

The test specimen consists of one skin element fixing applied to a rigid support as shown in Figure D.1.

The force shall be exerted as shown in Figure D.1.

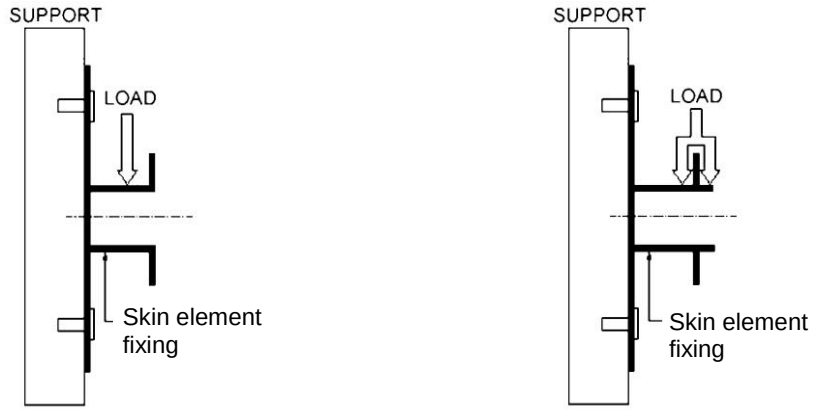

Figure D.1: Examples of test lay-out for vertical load resistance test

D.2.2 Resistance to horizontal load (wind suction)

The test method is indicated in section D.1.

The test specimen consists of one skin element fixing applied to a rigid support as shown in Figure D.2.

The force shall be exerted as shown in Figure D.2.

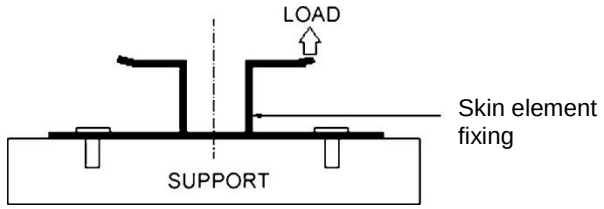

Figure D.2: Example of test lay-out for horizontal load resistance test

D.3 Mechanical resistance for skin element fixings type 5

D.3.1 Mechanical test for the connection between the clamp/anchor and the horizontal profile

The test method is indicated in section D.1.

D.3.1.1 Resistance to vertical load (weight)

The test specimen consists of the skin element fixings applied to a rigid support as shown in figure D.3. The force shall be exerted as shown in figure D.3.

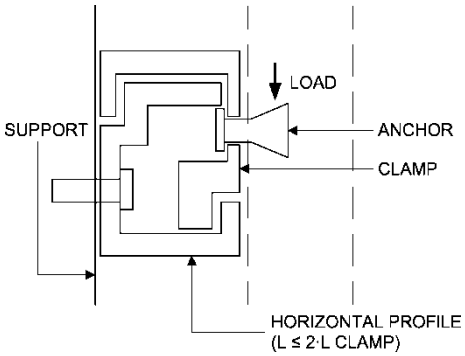

Figure D.3: Example of test layout for vertical load resistance test

D.3.1.2 Resistance to horizontal load resistance (wind suction)

The test specimen consists of the skin element fixings applied to a rigid support as shown in figure D.4. The force shall be exerted as shown in figure D.4.

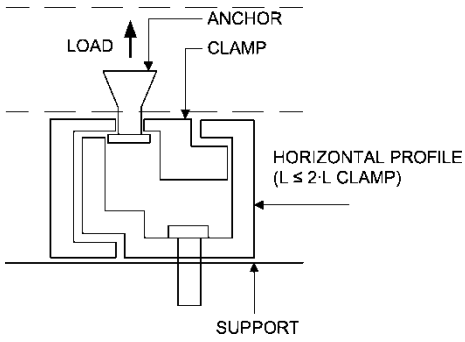

Figure D.4: Example of test layout for horizontal load resistance test

D.3.2 Mechanical test for the connection between the clamp/anchor and the skin element

D.3.2.1 General

When the anchor is considered under the scope of the EAD 330030-00-0601, the methods and criteria for assessing the connection between the clamp/anchor and the skin element specified in section 2.2 of the mentioned EAD apply.

In the other cases, the following tests have to be considered. The influence of aspects of durability on the load bearing capacity of the connections between the skin elements and the fixing elements is not assessed.

This test shall be carried out on each envisaged skin element material intended to be considered for the use of the kit.

The tests shall be carried out under laboratory conditions: (20 ± 10) ºC and (50 ± 20)% relative humidity.

At least 5 tests shall be carried out.

The tests shall be carried out on skin element sections with single anchors without edge and spacing effects.

The anchor shall be installed on the skin element as specified by the ETA holder. The

force shall be exerted as follow in the figures of relevant sections until failure.

The loading speed shall be adjusted so that the failure occurs in 1 minute +/- 30 seconds.

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

The results are expressed in N.

The test report shall detail the following in accordance with Annex A:

- specification of the skin element material used in tests;
- each failure value and mode of failure description;
- mean F_{mcs} value;
- characteristic F_{mcSC} value giving 75% confidence that 95% of the test results will be higher than this value.

D.3.2.2 Resistance to vertical load (weight)

The vertical (shear) load shall be applied on the anchor without eccentricity and without exposure to moments. This test is also relevant to vertical load resistance assessment for skin element fixings type 6.

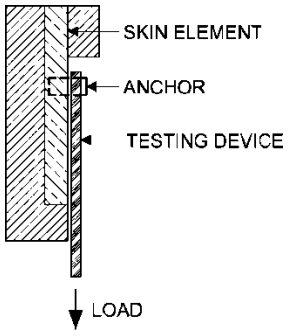

Figure D.5: Example of test layout for vertical load resistance test

D.3.2.3 Resistance to horizontal load (wind suction)

The diameter of the supporting ring shall be chosen in order to obtain the failure mode from pull-out of the anchor or cone failure of the test specimen (for example Ø ≤ 50 mm). See figure D.6.

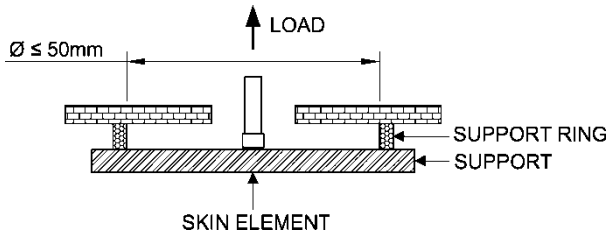

Figure D.6: Example of test lay-out for horizontal load resistance test

D.4 Test report

Test report should include:

- type, material and geometry of the skin element fixing and skin element for type 5;
- each individual displacement and force value, F_i (expressed in N), for 1 mm irreversible deformation;
- each individual failure value, F_{iu} (expressed in N), and the mode of failure description of the test specimen (breakage, significant permanent deflection, etc.);
- displacements and forces measured and reported in tabular or graphic form;
- mean values, F_m, and characteristic values, F_C, in accordance with section D.5.

D.5 Test results statistical description

$F_C = F_m - k_n \cdot S$

Where:

F_C characteristic force giving 75% confidence that 95% of the test results will be higher than this value;

F_m mean force;

k_n 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 D.1);

S standard deviation of series under consideration.

Table D.1 – Variable k_n as a function of the number of test specimens (see EN 1990, Table D1, V_x, unknown)

Number of specimens	3	4	5	6	7	8	10	20	30	∞
Variable k_n	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64

ANNEX E Pulsating load test

E.1 General

The tests shall be carried out under laboratory conditions: (20 ± 10) ºC and (50 ± 20)% relative humidity.

The skin element fixings shall be exposed to 10.000 load cycles at a frequency not higher than 6 Hz.

The upper load F_{max} and the lower load F_{min} shall be chosen accordingly. In general the following loads can be considered as appropriate:

- For skin element fixing types 1 to 5: upper load F_{max} = 50% x $F_{u,5\%}$; lower load F_{min} = 20% x $F_{u,5\%}$ ($F_{u,5\%}$ = characteristic value determined according to section D.5 for the results of the horizontal load tests according to Annex D).
- For skin element fixing type 6: upper load F_{max} = 25% x F_C; lower load F_{min} = 10% x F_C (F_C = characteristic value determined according to section G.5 for the results of the pull-out load tests according to Annex G).

During each cycle the load shall vary like a sine curve between F_{max} and F_{min}. The displacement shall be measured during the first loading up to F_{max} and either continuously or at least after 1, 10, 100, 1.000 and 10.000 load cycles.

After completion of the load cycles the skin element fixings shall be unloaded, the displacement measured and a horizontal load test performed as indicated in Annex D.

At least 5 tests should be performed.

E.2 Test report

Test report should include:

- type, material and geometry of the test specimen;
- results of displacement measured after 1, 10, 100, 1.000 and 10.000 cycles;
- results of horizontal load resistance test.

ANNEX F Resistance in case of inaccuracies of installation

F.1 General

This test is only applicable to type 5 skin element fixings as indicated in section 1.1. At least, this test shall be carried out on the worst case. The worst case shall be chosen taking into account minimum values of the test results for the horizontal load resistance obtained according mechanical tests indicated in section D.3 of Annex D.

The tests shall be carried out under laboratory conditions: (20 ± 10) ºC and (50 ± 20)% relative humidity.

The resistance to horizontal load test according to section D.3 of Annex D shall be carried out on not correctly installed skin element fixings. The test shall comprise one or more of following options:

- the anchor which embedment depth is not fully positioned;
- the anchor which is not fully expanded;
- the anchor which is installed by different installation torque moments;
- the clamp on the horizontal profile in not fully positioned.

At least 5 tests should be performed.

F.2 Test report

Test report should include:

- type, material and geometry of the test specimen;
- results of test horizontal load resistance.

ANNEX G PULL-THROUGH / PULL-OUT RESISTANCE TEST

The principle is to establish the resistance of the connection between the profiles of the subframe and the skin element fixings.

The test shall comprise one or more of the following tests:

a) simple pull-through test, to determine the resistance of the fixing through the perforation in the subframe profile;

b) simple pull-out test, to determine the resistance of the fixing through the perforation in the subframe profile;

c) combination of the pull-through and pull-out test, to determine the resistance of the connection between the subframe profile and the cladding fixing.

The manufacturer shall decide which of these tests shall be carried out taking into account the cladding kit configurations.

G.1 Preparation of the test specimen

For each pull-through, pull-out or the combination of both, a minimum of 3 specimens shall be tested.

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

Each test specimen will be composed of:

- options a) and b): one subframe profile and the fixing defined for its connection with the cladding fixing;
- option c): the subframe profile, the cladding fixing and the fixing defined for the connection between them.

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 ± 2) °C before the test.

G.2 Test equipment

The apparatus must consist of:

- a dynamometer;
- a test support as shown in figures G.1 to G.3, depending on the type of test indicated above.

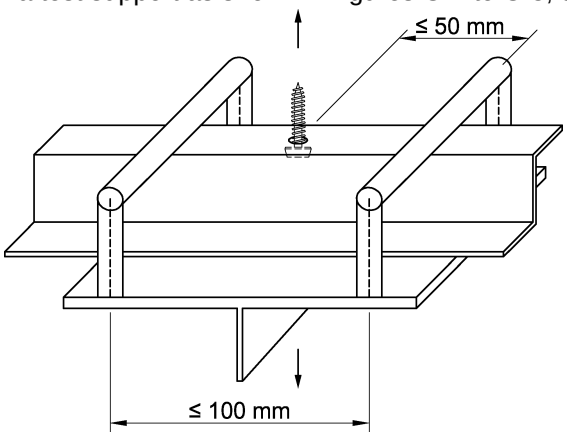

Figure G.1: Example of pull-through test

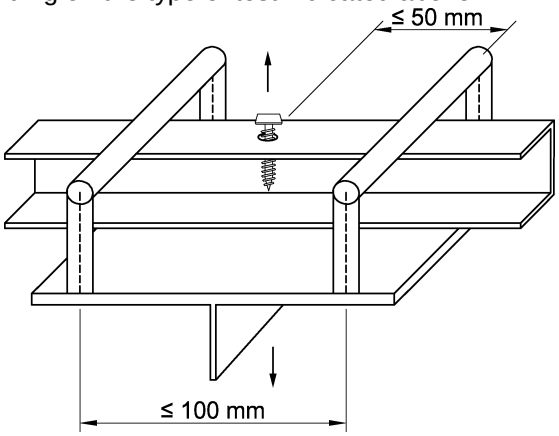

Figure G.2: Example of pull-out test

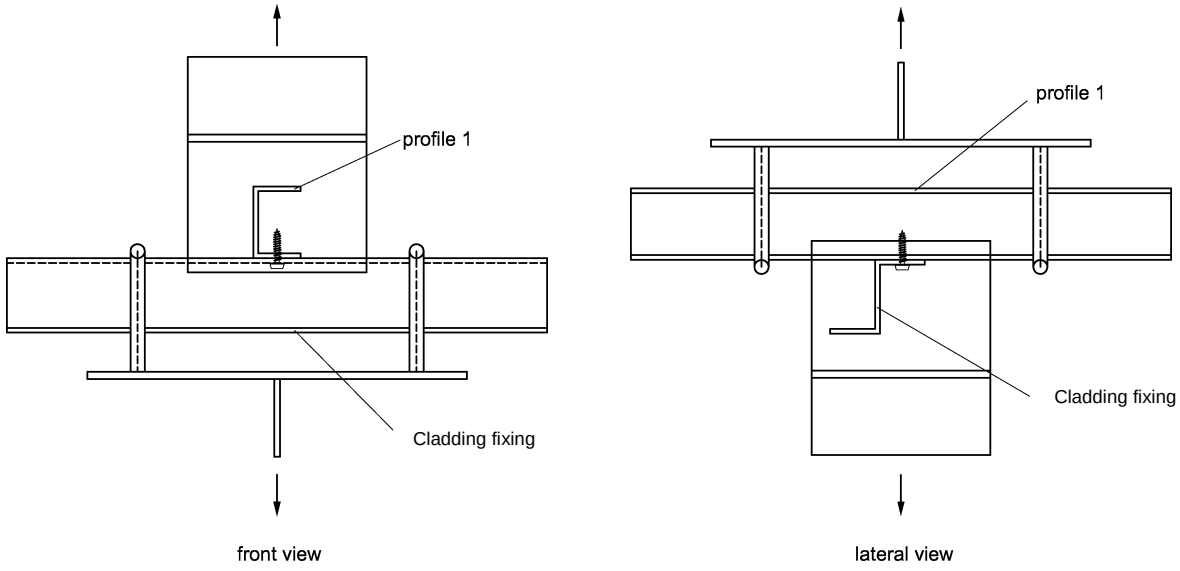

Figure G.3: Example of pull-through and pull-out combination test

G.3 Test procedure

The tests shall be carried out under laboratory conditions ((20±10) ºC and (50±20)% relative humidity).

The test shall be carried out at a rate of 20 mm/min. When relevant, lower rates may be considered.

In test options a) and b), the fixing shall be placed perpendicular to the subframe profile as described in Figure G.1 and Figure G.2, and the force must be applied either through the support or by the fixing up to failure.

In test option c), the force shall be applied through the supports up to failure.

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

1. Any profile breaks.
2. Any fixing breaks.

G.4 Test report

The pull-through resistance and/or the pull-out resistance are expressed in N.

The test report shall detail the following in accordance with section G.5:

- each individual F_i, value;
- mean F_m, value;
- characteristic F_C value giving 75% confidence that 95% of the test results will be higher than this value;
- mode of failure description;
- type of fixing and description of the fixing (e.g. geometry and dimensions).

G.5 General test results statistical description

$F_C = F_m - k_n \cdot S$

Where:

F_C characteristic breaking force giving 75% confidence that 95% of the test results will be higher than this value;

F_m mean breaking force, either under tension or shear;

k_n 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 G.1);

S standard deviation of series under consideration.

Table G.1: The variable k_n as a function of the number of test specimens (see EN 1990, Table D1, V_x, unknown)

Number of specimens	3	4	5	6	7	8	10	20	30	∞
Variable k_n	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64

ANNEX H Brackets resistance test

H.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 G.4.1;
- horizontal load (wind), see section G.4.2.

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

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

H.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 support (e.g. a horizontal basis and a vertical perpendicular surface, see Figure E.2).

This support shall:

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

Whenever the support 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 support.

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 H.1).

H.3 Mounting provisions of test specimens

H.3.1 Fixings of brackets to support

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

- Vertical load test shall be in accordance with Figure H.2.

- Horizontal load test shall be in accordance with Figure H.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 support shall be chosen according to the type of support and the ETA-holder specifications. When no fixings to support are defined by the manufacturer, bolts of suitable diameter adapted to predrilling (Ø 6 mm minimum) by using washers shall be used.
- The fixing bolt (anchor) on the support shall be positioned in the oblong hole at the maximum specified distance from the profile.

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

H.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.

H.3.3 Fixings profile-bracket

Profile shall be fixed to brackets according to the following:

- The type of bracket fixing on the profile shall correspond to the fixing to be used in the 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.

H.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.

H.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 H.1 shows an example of test procedure.

The 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.

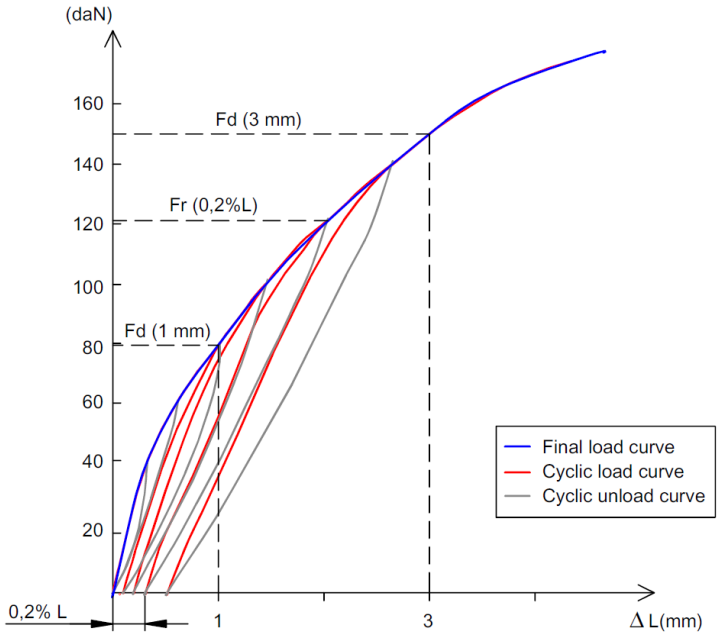

Figure H.1: Example of curve strength-displacement

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

Note: The manufacturer shall appraise the need 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 ≤ 5 mm/min.

Mean 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 section H.6.

H.4.1 Vertical load resistance test

The vertical load test shall be carried out considering the following:

- The test specimen shall be in accordance with Figure H.2.
- The test shall be carried out in accordance with section H.3.
- Test results shall be in accordance with section H.4.

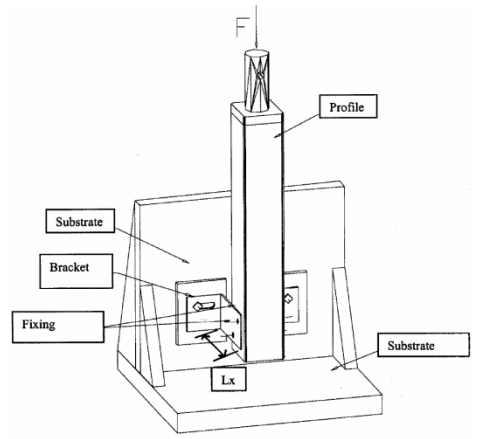

Figure H.2: Vertical load test. Example of test device

The following results shall be recorded during the tests:

1st 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:

$$\Delta L = \frac{0{,}2 \cdot L_x}{100}$$

where L_x is the length of the perpendicular wing to the support.

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.

2nd 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.

3rd 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.

H.4.2 Horizontal load resistance test

The horizontal load test shall be carried out considering the following:

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

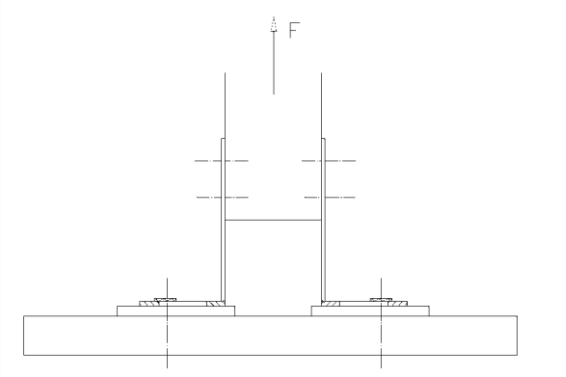

Figure H.3: Horizontal load test. Example of test device

The following results shall be recorded during the tests:

1st 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.

2nd 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.

H.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;

- 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;
- curve strength-displacement for each test specimen;
- identification of fixings (between the brackets and the support or between the brackets and the profile):
  - description or generic type;
  - dimensions (diameter, length, etc.);
  - material;
  - fixing method to the support;
  - washers and nuts (if they are used):
    - description or generic type;
    - dimensions (diameter, length, etc.);
    - material.

H.6 General test results statistical description

$F_{u,5} = F_{mean} - k_n \cdot S$

Where:

$F_{u,5}$ characteristic breaking force giving 75% confidence that 95% of the test results will be higher than this value

F_{mean} mean breaking force, either under tension or shear

k_n 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 H.1)

S standard deviation of series under consideration

Table H.1 – The variable k_n as a function of the number of test specimens (see EN 1990, Table D1, V_x, unknown)

Number of specimens	3	4	5	6	7	8	10	20	30	∞
Variable k_n	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64