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**ETAG N° 034**

**Edition April 2012**

**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**

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**E O T A ©**

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# Section one: INTRODUCTION

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## 1. PRELIMINARIES

### 1.1 Legal basis

The legal basis of the ETA-Guidelines is given in Part 1 – “Ventilated cladding elements and associated fixing devices”- clause 1.1.

No existing ETAG is superseded.

### 1.2 Status of ETA-guidelines

The status of ETA-Guidelines is given in Part 1 – “Ventilated cladding elements and associated fixing devices”- clause 1.2.

## 2 SCOPE

### 2.1 Scope

This Part II shall be used in conjunction with Part I – “Kits for external wall claddings, Part I: Ventilated cladding elements and associated fixing devices”, which only deals with external cladding and their mechanical fixings.

The scope of this Part II is given in clause 2.1 of Part I.

This complementary Part II of the EOTA guideline “Kits for external wall claddings” deals with the specific aspects related to cladding kits covering all the components: the external cladding elements and associated fixing devices, the subframe and its fixings to an external wall and a possible insulation layer, breather membrane and cavity barriers.

The cladding kits are intended to be used with an air space at the rear which may be ventilated or not.

### 2.2 Use categories, products families, kits

#### 2.2.1 Claddings families

The cladding families are given in clause 2.2.1 of Part I. This Part of the ETAG covers kits made up of all components of an external cladding system: the external cladding elements and associated fixing devices, the subframe and its fixings to an external wall and a possible insulation layer, breather membrane or cavity barrier.

#### 2.2.2 Use categories

Several use categories have been adopted to correspond to the degree of exposure to Impact in use (ETAG PART I § 6.4.4).

## 2.3 Assumptions

The assumptions are given in clause 2.3 of Part I.

### General recommendations

The content of an ETA deals with only:

- one family of cladding kit in accordance with the clause 2.2.1 (the fixing kits shall be completely described)
- one cladding material

In one ETA, there may be:

- several cladding dimensions (length, height, thickness)
- several cladding colours and surface textures
- several fixing types
- several fixings densities
- several types of subframe
- several types of insulation layer

## 3 TERMINOLOGY

### 3.1 Common terminology and abbreviations

For the purpose of this Part of the ETA-Guideline, the common terminology and abbreviations as stated in Part 1 – Annex A, apply.

### 3.2 Specific terminology

For the purpose of this Part of the ETA-Guideline, the specific terminology as stated in Part 1 – clause 3.2, apply.

# Section two: GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

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#### GENERAL NOTES:

See ETAG PART I.

## 4 REQUIREMENTS

The performance requirements shall be in accordance with ETAG Part 1 – Chapter 4, except for ER5 PROTECTION AGAINST NOISE and ER6 ENERGY ECONOMY AND HEAT RETENTION

### 4.1 ER5: PROTECTION AGAINST NOISE

The constructions works shall be designed and built in such a way that noise transmitted through the facade from outside is kept down to a level that will not threaten the health of occupants and will allow them to sleep, rest and work in satisfactory conditions.

The external wall including the external wall cladding shall be designed to meet the acoustic performance requirements for each project.

## 4.2 ER6: ENERGY ECONOMY AND HEAT RETENTION

The entire wall shall satisfy this requirement.

External wall claddings including an insulation layer improve thermal insulation and make it possible to reduce heating (in winter) and cooling (in summer).

Therefore the improvement of the thermal resistance of the wall introduced by the kits shall be assessed so that it can be introduced in the thermal calculations required by the national regulations on energy consumption.

Mechanical fixings and subframe components can cause localised differences in temperature and thermal bridges which influence the thermal insulating properties.

In order to establish the benefits of the kits to the wall, relevant component characteristics shall be specified as follows:

- Thermal conductivity/resistance,
- Water vapour permeability (covered under ER3),
- Water permeability (covered under ER3).

## 5 METHODS OF VERIFICATION

The methods of verification given in ETAG Part 1 – Chapter 5 shall be applied, unless additional specifications are given below.

### 5.1 ER1: Mechanical resistance and stability

See ETAG Part 1 – clause 5.1.

### 5.2 ER2: Safety in case of fire

#### 5.2.1 Reaction to fire in intended use

See ETAG Part 1 – clause 5.2.1.

#### 5.2.2 Reaction to fire on rear side

See ETAG Part 1 – clause 5.2.2.

### 5.3 ER3 : Hygiene, health and the environment

#### 5.3.1 Watertightness of joints (protection against driving rain)

For external claddings kits designed with a ventilated air space, see ETAG Part 1 – clause 5.3.1.

For external claddings kits designed without a ventilated air space and intended to be watertight, an artificial rain test shall be carried out on the cladding kit in accordance with EN 12865 Procedure A (600 Pa maximum). The test is described in clause 5.3.1 of Part I.

### 5.3.2 Water permeability of cladding element (resistance to water diffusion)

For cladding kits without ventilated air space, the penetration and the diffusion of water in the cladding element shall be assessed from the result of the water absorption test described in annex C1.5 of Part I.

For cladding kits designed with ventilated air space, the test is not relevant.

Note: Where rain penetration is likely to reach the insulation, the insulation shall be hydrophobic and the subframe shall be made of appropriate material (protected against humidification risk: e.g. wood with hazard level 2 or 3 of biological attack in accordance with EN 335-2).

### 5.3.3 Water vapour permeability

For kits designed with ventilated air space, the test is not relevant.

For cladding kits designed without ventilated air space, the water vapour permeability of the breather membrane (if included), cladding elements and insulation material, shall be determined in accordance to EN ISO 12572 if no tabulated values according to EN 12524 are available.

### 5.3.4 Drainability

See ETAG Part 1 – clause 5.3.4.

### 5.3.5 Content and/or release of dangerous substances

See ETAG Part 1 – clause 5.3.5.

## 5.4 ER4 : Safety in use

See ETAG Part 1 – clause 5.4.

### 5.4.1 Wind load resistance

See ETAG Part 1 – clause 5.4.1.

The complete kit shall be tested in accordance with ETAG Part 1 – clause 5.4.1.1 and possibly 5.4.1.2.

### 5.4.2 Mechanical test

The cladding elements and their fixings are tested in accordance with ETAG Part 1 – clause 5.4.2.

#### 5.4.2.1 Subframe

##### **Profiles**

For wood and metal profiles, the effective moment of area shall be calculated and modulus of elasticity shall be given in accordance with an appropriate EN standard (e.g. EN 755-2 for aluminium profiles).

##### **Fixings**

For fixings connecting the subframe to the wall (anchors), the mechanical characteristics (resistance to tension and shear loads) shall be given from an ETA obtained according to relevant to the ETAG.

The mechanical characteristics (resistance to tension and shear loads) required of fixings between profiles and brackets shall be determined in accordance with Eurocode 3 or 9.

##### **Brackets**

If calculation according to relevant standards (e.g. EN 1999-1-1 for aluminium) is not possible, the load bearing capacity and deformation under loading (tension and shear) shall be determined by test in accordance with Annex E.

#### 5.4.3 Resistance to horizontal point loads

See ETAG Part 1 – clause 5.4.3.

#### 5.4.4 Impact resistance

See ETAG Part 1 – clause 5.4.4.

#### 5.4.5 Resistance to seismic actions

The kit shall be assessed in accordance with European or national regulations.

#### 5.4.6 Resistance to thermal shock

See ETAG Part 1 – clause 5.4.6.

#### 5.4.7 Hygrothermal behaviour

See ETAG Part 1 – clause 5.4.6.



## 5.5 ER5 Protection against noise

The acoustic insulation of a facade will be governed by the design and the installation. Where specific acoustic properties are claimed, the cladding kit is assessed using EN-ISO 10140 and EN ISO 717-1, on the rig (at least 4 square metres).

It is only possible to assess the sound insulation if the cladding kit is tested with the substrate (external wall). 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 skin material and the type of fixings in the substrate have to be known.

## 5.6 ER6 Energy economy and heat retention

### 5.6.1 Thermal resistance

The thermal resistance (R-value) is calculated from the thermal resistance of the insulation product, determined in accordance with 5.6.2, as described in:

- EN ISO 6946: Building components and building elements - Thermal resistance and thermal transmittance - Calculation method.

-EN ISO 10211: Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211:2007).

The thermal bridges caused by subframe mechanical fixing devices and air spaces shall be taken into account using the appropriate calculation method defined in these standards.

### 5.6.2 Insulation product's thermal resistance

If appropriate, the values shall be derived from the declared values according to EN 13162 to EN 13171 Thermal insulation products for buildings using the appropriate correction coefficients.

If the insulating product is not defined by reference of a harmonised EN standard, it shall be defined by reference to an ETA.

For the measurement of the R value, the following methods may be used:

-EN ISO 8990: Thermal insulation - Determination of steady-state specific thermal transmission properties – Calibrated and guarded hot box.

-EN 12667: Building materials - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance

-EN 12939: Building materials – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance

## 5.7 Aspects of durability and serviceability

For new material and material not commonly used for this application, supplementary durability tests may have to be defined. The summary of the assessment shall describe the details of test and the result obtained, case by case.

### 5.7.1 Pulsating load

See ETAG Part 1 – clause 5.7.1.

### 5.7.2 Dimensional stability

The dimensional stability is obtained in accordance with ETAG Part 1 – clause 5.7.2.

The dimensional stability of the subframe is obtained in accordance with EN standard.

### 5.7.3 Immersion in water

See ETAG Part 1 – clause 5.7.3.

### 5.7.4 Freeze-thaw

See ETAG Part 1 – clause 5.7.4.

### 5.7.5 Chemical and biological resistance

For external cladding, see ETAG Part 1 – clause 5.7.5.

For wood profiles, the Approval Body will make reference to the following European Standards as appropriate:

- EN 335-1 Durability of wood and wood based products – Definition of hazard classes of biological attack – Part 1: General
- EN 335-2 Durability of wood and wood based products – Definition of hazard classes of biological attack – Part 2: Application to solid wood
- EN 350-2 Durability of wood and wood based products – Natural durability of solid wood – Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe
- EN 351-1 Durability of wood and wood based products – Preservative-treated solid wood – Part 1: Classification of preservative penetration and retention

- EN 460 Durability of wood and wood based products – Natural durability of solid wood – Guide to the durability requirements for wood to be used in hazard classes
- EN 599-1 Durability of wood and wood based products – Performance of preventive wood preservative as determined by biological tests – Part 1: Specification according to hazard class
- EN 599-2 Durability of wood and wood based products – Performance of preventive wood preservative as determined by biological tests – Part 2: Classification and labelling

To assess durability of plastics: ISO 846                      Plastics – Methods of assessing of microorganism action

## 5.7.6 Corrosion

### 5.7.6.1 Cladding element and profiles made of corrosion protected steel, steel alloys or stainless steel

See ETAG Part 1 – clause 5.7.6.1.

### 5.7.6.2 Cladding element and profiles made of aluminium or aluminium alloys

See ETAG Part 1 – clause 5.7.6.2.

### 5.7.6.3 Fixings

See ETAG Part 1 – clause 5.7.6.3.

### 5.7.6.4 Electrochemical compatibility between subframe components

The Approval Body shall assess the electrochemical compatibility between subframe components such as brackets, fixings and profiles.

## 5.7.7 UV radiation

See ETAG Part 1 – clause 5.7.7.

## 6 ASSESSING AND JUDGING THE FITNESS FOR USE

### Preamble

See ETAG Part 1

**Table 1 - Relationship between kit and component performance to be assessed and expressions of classification, categorisation and declaration.**

ER	ETAG paragraph on product performance to be assessed	Class, use category, criterion	« No Performance Determined Option » allowed
1 to 4	See ETAG PART I, Table 3		
5	6.5 Protection against noise	Rw value	YES
6	6.6 energy economy and heat retention	R value	YES
Aspects of durability and serviceability	See ETAG PART I, Table 3		

### 6.1 Mechanical resistance and stability

Not relevant

### 6.2 Safety in case of fire

See ETAG Part 1 – clause 6.2.

### 6.3 Hygiene, health and the environment

#### 6.3.1 Watertightness of joints

See ETAG Part 1 – clause 6.3.1.

#### 6.3.2 Water permeability

A test result shall be given in accordance with annex C1.5.

Note: The correct selection of a cladding kit, based on water permeability results, will depend on the severity of the climate and the position of the kit relative to the supporting wall.

This requirement is not relevant for cladding designed with a ventilated air space.

#### 6.3.3 Water vapour permeability

The water vapour diffusion resistance of the non ventilated cladding shall be given.

This requirement is not relevant for cladding designed with a ventilated air space.

#### 6.3.4 Drainability

See ETAG Part 1 – clause 6.3.4.

#### 6.3.5 Content and/or release of dangerous substances

See ETAG Part 1 – clause 6.3.5.

### 6.4 Safety in Use

#### 6.4.1 Wind load resistance

See ETAG Part 1 – clause 6.4.1 (incl. 6.4.1.1 and possibly 6.4.1.2).

#### 6.4.2 Mechanical resistance

The characteristic value of pull-out and shear resistance of screws, rivets or nails shall be declared according to relevant standard.

##### 6.4.2.1 Cladding

For claddings and their fixings, the characteristics are given in accordance with ETAG Part 1 – clause 6.4. 2.

##### 6.4.2.2 Subframe

The following shall be indicated in ETA:

- The effective moment of area of profiles and modulus of elasticity profile material
- The mechanical characteristics of fixings (traction and shear)
- The characteristic resistance of brackets ( $R_{cr}$ ,  $R_{cd1}$ ,  $R_{cd2}$ ,  $R_s$  and  $R_c$ ,  $R_t$ ) as tested according to annex E
- The implantation of the fixings

#### 6.4.3 Resistance to horizontal point loads

See ETAG Part 1 – clause 6.4.3.

#### 6.4.4 Impact resistance – shatter properties

See ETAG Part 1 – clause 6.4.4.

#### 6.4.5 Resistance to seismic actions

The kit shall be assessed in accordance with European or national regulations, as long as the harmonised system is not available.

#### 6.4.6 Resistance to thermal shock

See ETAG Part 1 – clause 6.4.6.

#### 6.4.7 Hygrothermal behaviour

See ETAG Part 1 – clause 6.4.7.

### 6.5 Protection against noise

The  $R_w$  value measured according to EN ISO 10140, and rated in accordance with EN ISO 717-1, shall be indicated with the description of the supporting wall.

### 6.6 Energy economy and heat retention

The thermal resistance values of the kit shall be declared in the ETA as the total thermal resistance in  $m^2.K/W$  including any thermal bridges (e.g. fixings and brackets) in accordance with chapter 5.6.

This thermal resistance shall exceed  $0,5 m^2.K/W$ .

### 6.7 Aspects of durability and serviceability

#### 6.7.1 Pulsating load

See ETAG Part 1 – clause 6.7.1.

#### 6.7.2 Dimensional stability of external cladding element

The mean, characteristic or tabulated value (cladding and subframe) shall be indicated in the ETA.

### 6.7.3 Immersion in water

See ETAG Part 1 – clause 6.7.3.

### 6.7.4 Freeze-thaw

See ETAG Part 1 – clause 6.7.4.

### 6.7.5 Chemical and biological attack

See ETAG Part 1 – clause 6.7.5.

### 6.7.6 Corrosion

See ETAG Part 1 – clause 6.7.6.

### 6.7.7 UV radiation

See ETAG Part 1 – clause 6.7.7.

## **7 ASSUMPTIONS AND RECOMMENDATIONS UNDER WHICH THE FITNESS FOR USE OF THE PRODUCT IS ASSESSED**

See ETAG Part 1 – clause 7.

### **7.1 DESIGN OF THE WORKS**

See ETAG Part 1 – clause 7.1.

In case of non ventilated cladding kits, the wall shall also ensure water vapour tightness.

### **7.2 EXECUTION OF THE WORKS**

See ETAG Part 1 – clause 7.2.

#### **7.2.1 Execution of the kit**

See ETAG Part 1 – clause 7.2.1.

#### **7.2.2 Maintenance and repair of the works**

See ETAG Part 1 – clause 7.2.2.



## **Section three: ATTESTATION OF CONFORMITY**

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### **8 EVALUATION AND ATTESTATION OF CONFORMITY AND CE MARKING**

#### **8.1 System of attestation of conformity**

The decision is given in ETAG Part 1 – clause 8.1.

#### **8.2 Tasks and responsibilities of the manufacturer and notified bodies**

This complementary Part of the ETA-Guideline has no supplementary or modified procedures with regard to Part 1 – clause 8.2.

#### **8.3 DOCUMENTATION**

This complementary Part of the ETA-Guideline has no supplementary or modified procedures with regard to Part 1 – clause 8.3, except as given below.

The documentation shall contain details relating to assembly of the sub-frame, the fixing of the sub-frame to the wall and the fixing of the rest of the kit to the sub-frame.

The fixing devices and subframe shall be accompanied by a declaration of conformity of their manufacturing and their mechanical characteristics in accordance with a schedule of conditions.

For each steel element used in the kit, the level of corrosion resistance has to be declared.

The insulation products shall be CE marked in accordance with EN standard or ETA accordance to CUAP.

#### **8.4 CE MARKING AND INFORMATION**

This complementary Part of the ETA-Guideline gives no additional or different information and/or requirements for CE-marking than those given in Part 1 – clause 8.4.

## **Section four: ETA CONTENT**

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### **9 THE ETA CONTENT**

This complementary Part of the ETA-Guideline has no supplementary or modified procedures with regard to Part 1 – clause 9, except as given below.

Further information on the kit:

- Statement on the protection against noise (clause 6.5)
- Statement on the thermal resistance of the kit (clause 6.6)
- Statement on the characteristic resistance of the brackets (clause 6.4.2.1)

# **Annex A: COMMON TERMINOLOGY AND ABBREVIATIONS**

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See ETAG Part 1 – clause Annex A.

# Annex B: REFERENCE DOCUMENTS

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## *Reference documents*

All documents of the Annex B of ETAG Part 1

These documents are referred to in the ETAG and are subject to the specific conditions mentioned therein.

- |                              |   |
|------------------------------|---|
| EN ISO 10140 (2010)          | Acoustics – Laboratory measurements of sound insulation of building elements  |
| EN ISO 717-1 (December 1996) | Acoustics – Rating of sound insulation in buildings and of building elements  |
| EN 1993-1-1 (May 2005)       | Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings  |
| EN ISO 6946 (December 2007)  | Building components and building elements – Thermal resistance and thermal transmittance - Calculation method (ISO 6946:2007)   |
| EN ISO 7500-1 (August 2004)  | Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Verification and calibration of the force-measuring system (ISO 7500-1:2004)     |
| EN ISO 8990 (December 1995)  | Thermal insulation - Determination of steady-state specific thermal transmission properties – Calibrated and guarded hot box.   |
| EN ISO 10211 (December 2007) | Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211:2007)   |
| EN 12524 (April 2000)        | Building materials and products - Hygrothermal properties - Tabulated design values   |
| EN ISO 12572 (June 2001)     | Hygrothermal performance of building materials and products - Determination of water vapour transmission properties (ISO 12572:2001)  |
| EN 12667 (January 2001)      | Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance |

EN 12865 (March 2001)	Hygrothermal performance of building components and building elements - Determination of the resistance of external wall systems to driving rain under pulsating air pressure
EN 12939 (November 2000)	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance
EN 13167 (November 2008)	Thermal insulation products for buildings - Factory made cellular glass (CG) products – Specification
EN 13168 (November 2008)	Thermal insulation products for buildings - Factory made wood wool (MW) products – Specification
EN 13169 (November 2008)	Thermal insulation products for buildings - Factory made products of expanded perlite (EPB) – Specification
EN 13170 (November 2008)	Thermal insulation products for buildings - Factory made products of expanded cork (ICB) – Specification
EN 13171 (November 2008)	Thermal insulation products for buildings - Factory made wood fibre (WF) products – Specification
ETAG 001 (Edition 1997 Amended Nov. 2006)	GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL OF METAL ANCHORS FOR USE IN CONCRETE Amended November 2006 Part one: ANCHORS IN GENERAL
ETAG 020 (Edition March 2006)	GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL of PLASTIC ANCHORS FOR MULTIPLE USE IN CONCRETE AND MASONRY FOR NON-STRUCTURAL APPLICATIONS Part one : G E N E R A L
ETAG 029 (Edition June 2010)	GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL of METAL INJECTION ANCHORS FOR USE IN MASONRY
ETAG 034 Part 1 (...)	<b>GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL of KITS FOR EXTERNAL WALL CLADDINGS - Part I : VENTILATED CLADDING KITS COMPRISING CLADDING COMPONENTS AND ASSOCIATED FIXINGS</b>

# **Annex C: METHODS RELATED TO THE IDENTIFICATION OF THE COMPONENTS**

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## **C.1 Cladding element**

See ETAG Part 1 – Annex C - clause C.1.

## **C.2 Cladding Fixings**

See ETAG Part 1 – Annex C - clause C.2.

## **C.3 Profiles**

Declaration of the dimensions, physical and mechanical characteristics of material and mechanical properties.

## **C.4 Brackets**

Declaration of the dimensions, physical and mechanical characteristics of material and mechanical properties in accordance with Annex E.

## **C.5 Fixings on substrate**

### C.5.1 Generic type

Declaration of the generic type of the fixings

### C.5.2 Dimensions and performances

Fixings shall have obtained an ETA which gives dimensions, characteristics and performances in accordance with ETAG Guideline 001, 020 or 029.

## **C.6 Insulation product**

Declaration of the generic type of the insulation product according to the following standard :

- EN 13162 Thermal insulation products for buildings - Factory made mineral wool (MW) products – Specification
- EN 13163 Thermal insulation products for buildings - Factory made products of expanded polystyrene (EPS) – Specification
- EN 13164 Thermal insulation products for buildings - Factory made products of extruded polystyrene foam (XPS) – Specification
- EN 13165 Thermal insulation products for buildings - Factory made rigid polyurethane foam (PUR) products – Specification
- EN 13166 Thermal insulation products for buildings - Factory made products of phenolic foam (PF) – Specification

- EN 13167 Thermal insulation products for buildings - Factory made cellular glass (CG) products – Specification
- EN 13168 Thermal insulation products for buildings - Factory made wood wool (MW) products – Specification
- EN 13169 Thermal insulation products for buildings - Factory made products of expanded perlite (EPB) – Specification
- EN 13170 Thermal insulation products for buildings - Factory made products of expanded cork (ICB) – Specification
- EN 13171 Thermal insulation products for buildings - Factory made wood fibre (WF) products – Specification
- Or specific ETA

# **Annex D: GENERAL TEST RESULTS STATISTICAL INTERPRETATION**

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See ETAG Part 1 – Annex D.



## **Annex E: RESISTANCE OF BRACKET**

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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 tension and shear loads. The test shall be performed if calculation according to relevant standards is not possible.

The equipment is made of a traction machine of class 1 in accordance with EN 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 shall be placed in the same axis.

The lower part of the support is made of a bottom surface rigidly fixed on the lower tray of the machine and the vertical wing. The brackets are fixed to the vertical wing.

Oblong holes allow regulation of the distance between brackets and the position of bracket fixings through their own oblong hole.

Steel plates of 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 the fixing, are capable of providing a support surface under the brackets.

An axial vertical hole allows the brackets to be fixed to the profile.

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

Deflections 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.

The nature and geometric characteristics of the brackets shall be detailed in the report. The test report shall include drawings of the brackets.

Brackets are fixed to the support with bolts of suitable diameter adapted to predrilling ( $\varnothing$  6 mm minimum) by using washers.

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

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

The most unfavourable position of the fixings (the weakest design) considering the intended use shall be tested and this shall be indicated in the ETA. In the test report, the generic type, geometric and mechanical characteristics shall be given.

Fixings shall be installed in accordance with the specifications of the ETA request.

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

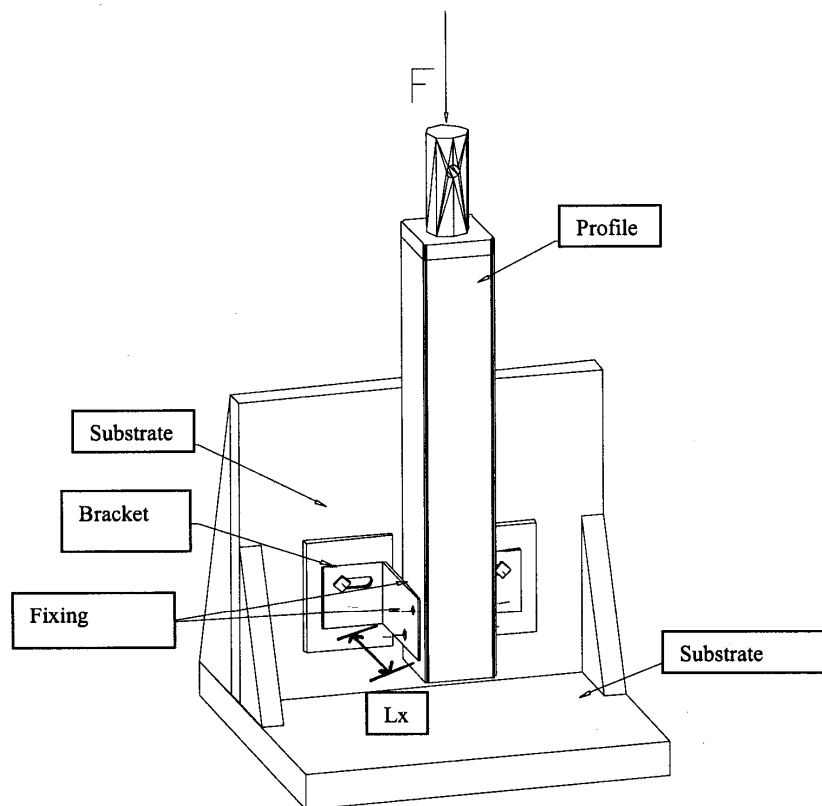
### **Resistance to vertical load (weight)**

The test is carried out on at least 5 samples.

The test sample shall be in accordance with the Figure E 1.

The fixing bolt on the support shall be capable of location in the oblong hole at the maximum specified distance from the profile.

Sensors are linked up with a graphic recorder allowing to draw the curve strength-displacement (design is given below in Figure E 2).



**Figure E 1 – Example of test device**

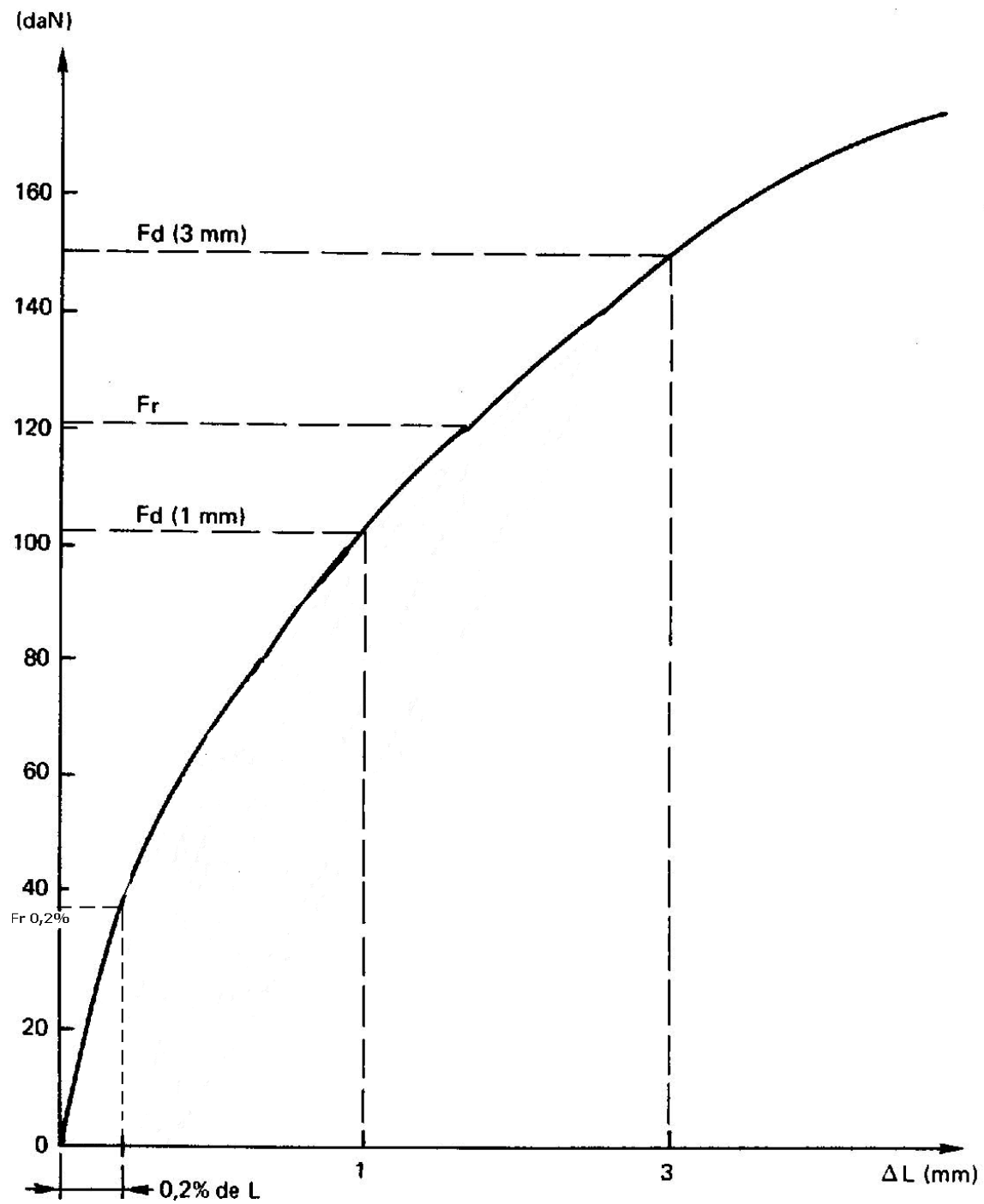


Figure E 2 – example of curve strength-displacement

The profile is subjected to a succession of cycles, the load in traction growing by 10 daN each cycle.

Apply the load by regulating the speed of load in order to meet the condition: constant speed of load < 500 daN/minute.

Brackets are qualified by two criteria, the first relating to acceptable stress in metal, the second relating to distortion under load.

- 1<sup>st</sup> criterion:  
The load  $F_r$  is that at for which the bracket acquires a residual distortion measured at the head of wing, equal to:

$$\Delta \ell = \frac{0,2 \cdot L_x}{100} \quad L_x \text{ being the length of the wing}$$

- 2nd criterion:  
The loads  $F_{1d}$  and  $F_{3d}$  are those which correspond to 1 and 3 mm displacement.
- 3rd criterion:  
The load  $F_s$  is that which corresponds to the failure.

The test is performed on at least 5 samples from which the 4 series of results  $Fr_1$  to  $Fr_5$  and  $F1d_1$  to  $F1d_5$  and  $F3d_1$  to  $F3d_5$  and  $Fs_1$  to  $Fs_5$  are derived.

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

### Resistance in horizontal load (wind suction)

The test sample shall be in accordance with the Figure E 3.

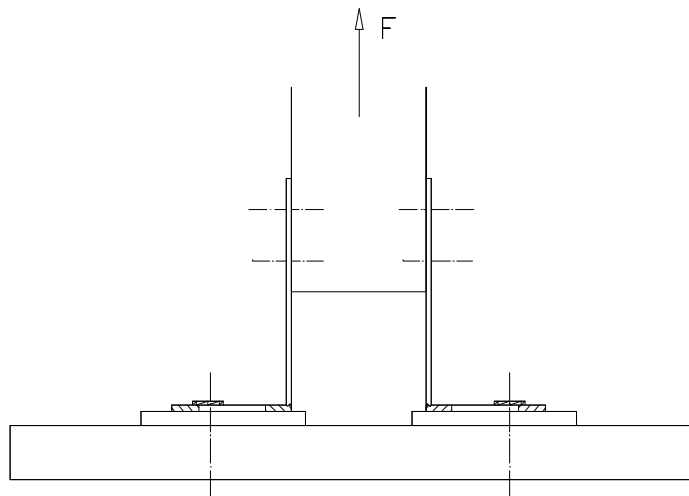


Figure E 3 – Example of device

On the traction machine, the bracket wings are fixed to the support in accordance with the Figure E 3.

This fixing is constituted by a bolt of diameter ( $\varnothing$  6 mm) corresponding to the hole breadth in the bracket wing and disposed in the head at the maximum distance from the other wing.

The other wing of the bracket is fixed to a rigid metal profile. A sensor of strength and a sensor of displacement are linked to the traction machine.

The profile is subjected to a succession of cycles, the load in traction growing by 20 daN each cycle with return to zero (load).

Apply the load by regulating the speed of load in order to meet the condition: constant speed of load < 500 daN/minute.

The load  $F_m$  is obtained for a residual distortion measured in head of wing, equal in 1 mm and the load  $F_t$  which correspond to the failure.

The characteristic resistances  $R_c$  and  $R_t$  are obtained in accordance with Annex D.