EUROPEAN ASSESSMENT DOCUMENT

EAD 040759-00-0404

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EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS (ETICS)

WITH RENDERING ON BOARDS BASED ON POLYSTYRENE AND CEMENT

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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

1.1.1 Common

External Thermal Insulation Composite System (ETICS) with rendering, on insulation boards based on expanded polystyrene and cement, is intended for use as external thermal insulation to the walls of buildings. The kit is based on thermal insulation made of boards based on expanded polystyrene and cement, covered by EAD 040065-00-1201. The thermal insulation boards are factory made products of homogenous mixture of the granulates of expanded polystyrene and Portland cement Cem I 42,5 according to EN 197-1 [1], not containing any other natural or artificial aggregate. The walls for installation of the product are made of masonry (bricks, blocks, stones ...) or concrete (cast on site or as prefabricated panels).

The ETICS kit [2] comprises a prefabricated thermal insulation product installed onto the wall by bonding with supplementary mechanical fixings (anchors) or by mechanical fixing (anchors) with supplementary bonding. Types of installation are detailed in 1.3.2. The thermal insulation product is faced with a rendering consisting of one or more layers applied in-situ, one of which contains reinforcement. The rendering is applied directly to the insulating panels, without any air gap or disconnecting layer.

This EAD applies only to ETICS kit based on following specifications:

- specific thermal insulation product, based on expanded polystyrene and cement boards according to EAD 040065-00-1201, with short-term water absorption higher than 1 kg/m^2 after 24 hours of partial immersion and with accuracy of width ± 3 mm as maximum, and base coat specified by manufacturer
- rendering system with the water absorption after 1 hour less than 1 kg/m^2, if the water absorption of the reinforced base coat itself after 1 hour is equal to or more than 1 kg/m^2,
- base coat reinforced by glass fibre mesh,
- render coating created by any combination of key coat, finishing coat and/or decorative coat; eventually created by thin facing elements based on aqueous dispersion of macromolecular binders and bonded to the base coat by dispersion adhesive,
- kit fixed to the substrate by means of one of the following methods:
    - by bonding with supplementary mechanical fixings (see 1.1.2.1.2) with 20 % bonded surface area as minimum,
    - by mechanical fixing with supplementary adhesive (see 1.1.2.2.1),
- kit, where following features comply with provisions of:
    - 2.2.9.2 for bond strength between adhesive and thermal insulation product
    - 2.2.9.3 for bond strength between thermal insulation product and base coat
    - 2.2.11 for shear strength and shear modulus of elasticity of thermal insulation product.
- plastic anchors for ETICS according to EAD 330196-01-0604.
- biocide preparations only, used for treatment of render coat, approved according to Regulation (EU) No 528/2012.

This EAD does not apply to ETICS kit based on any of following components and/or conditions: [3]

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

2 See 1.3.2.

3 ETICS kits based on any construction parameter(s) mentioned below may lead to serious imperfections of installed ETICS and therefore they may require for their proper function as product additional testing not included in the scope of this EAD.

- other types of facings such as brick slips and/or ceramic tiles or artificial and/or natural stone boards etc.,
- special plastic anchors with plate where connection between anchor plate and thermal insulation product is provided only by layer of adhesive,
- ETICS applied down to the ground on foot of buildings and exposed to rising damp.

The insulation layer can consist of two insulation boards, bonded together by an adhesive, specified by the manufacturer. The ETICS with such an insulation layer shall be assessed only as a mechanically fixed one with a supplementary bonding (see 1.1.2.2.1). Installation of kit goes beyond the EAD.

The ETICS can optionally include special fittings (e.g. base profiles, corner profiles ...) for its connection to adjacent building structures (apertures, corners, parapets ...). These optional accessories are to be specified by manufacturer either by specific type or by intended performances and implemented by him into the ETICS kit specification. These optional accessories can have a significant impact on the durability of system installed.

The product is not covered by a harmonised European standard. The product is not fully covered by EAD 040083-00-0404, which doesn't cover:

- ETICS based on insulation product with water absorption higher, than specified as limit of scope of EAD 040083-00-0404,
- ETICS based on thermal insulation product with coefficient of thermal conductivity exceeding 0,065 W/(m.K), specified as limit of scope of EAD 040083-00-0404
- façade fire performance,
- mass activity of natural radionuclides,
- content, emission and/or release of dangerous substances,
- test of hygrothermal behaviour according to EN 16383.

It is assumed that the product will be installed according to the manufacturer's instructions and/or in absence of such instructions according to the usual good practice of the building professionals. Original expansion joints in substrate walls shall be abiding in the entire composition of ETICS installed.

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

1.1.2 Types of ETICS

From the design point of view and content of this EAD, ETICS are differentiated according to the methods of fixing to transfer embedded load into substrate:

1.1.2.1 Bonded ETICS

ETICS where the connection to the substrate is ensured by bonding. If specified, optionally they can include supplementary mechanical fixings.

The load is distributed only by the bonding layer. Requirements on fire safety for position, shape and dimensions of strips and/or dabs are to be taken into account.

1.1.2.1.1 Purely bonded ETICS

ETICS where no mechanical fixing is used. Purely bonded ETICS may be fully bonded (over the entire surface) or partially bonded in strips and/or dabs. No mechanical fixing is used.

Note: This type of ETICS is stated in this specification only for complete information and it is not covered by this EAD.

1.1.2.1.2 Bonded ETICS with supplementary mechanical fixings

ETICS where the mechanical fixing is used primarily to provide stability and flatness of outer face insulation boards and acts as a connection to avoid the risk of detachment. Mechanical fixing can also provide stability in case of fire.

The load is distributed only by the bonding layer. Requirements on fire safety for position, shape and dimensions of strips and/or dabs are to be taken into account.

1.1.2.2 Mechanically fixed ETICS

ETICS where the connection to the substrate is ensured by mechanical fixing. If specified, it can optionally include supplementary bonding.

The load is distributed primarily by the mechanical fixing. Requirements on fire safety on position, shape and dimensions of strips and/or dabs in case of mechanically fixed ETICS with supplementary adhesive are to be taken into account.

1.1.2.2.1 Mechanically fixed ETICS with supplementary adhesive

ETICS where the load is distributed to substrate primarily by the mechanical fixing. The adhesive is used primarily to ensure the flatness of the installed ETICS and, if specified, to distribute the self-weight of system into substrate. Requirements on fire safety on position, shape and dimensions of strips and/or dabs in case of mechanically fixed ETICS with supplementary adhesive are to be taken into account.

1.1.2.2.2 Purely mechanically fixed ETICS

ETICS where the complete load is distributed to the substrate by mechanical fixing only. It is secured on the wall only by mechanical fixing at all-times. The ETICS with the bonded area less than 20 % is considered to be purely mechanically fixed too.

Note: This type of ETICS is stated in this specification only for complete information and it is not covered by this EAD.

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

1.2.1 Intended use(s)

The product is intended for use as external thermal insulation to the external walls of buildings. The ETICS can be used on new or existing (retrofit) vertical walls. It can be used on adjacent horizontal or inclined surfaces of façades (e.g. bow windows), which are not exposed to precipitation, too. Types of substrate walls, this EAD refers to, are specified in 1.1.1.

The ETICS is designed to give the wall, to which it is applied, satisfactory thermal insulation. It should provide a minimal thermal resistance in excess of 1 m^2.K/W. In specific use, smaller thicknesses of insulation can be used subject to checking, that there is no particular problem.

The ETICS is non load-bearing construction element. It does not contribute directly to the stability of the wall on which it is installed. The ETICS can contribute to durability by providing enhanced protection from the effects of weathering.

The ETICS as the product is not intended to ensure the airtightness of the building structure. Types of ETICS covered by this EAD are specified in 1.1.1.

ETICS is expected to be designed and installed on action of dead mass, wind action and/or on action of thermal expansion in accordance with provisions of EN 1990, EN 1991-1-1, EN 1991-1-4 and EN 1991-1-5. The assessment methods given in the 2.2 are based on general experience with behaviour of ETICS in different climatic conditions of the Europe.

Surface temperatures of the order from -20 °C up to +80 °C are generally regarded as the extremes in temperature change. However, the temperatures of the air can sometimes in Northern Europe decrease to -40 °C, according to common experience test temperature -20 °C is generally considered to be sufficient for testing of freeze/thaw resistance. Solar radiation, depending on radiation flow and absorbability of the

surface (esp. its colour) can increase the surface temperature up to +80 °C. More details are stated in EN 1991-1-5.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the request to take into account a working life of the ETICS 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 is to 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. [5]

1.3 Specific terms used in this EAD

General terms given in EN 1990, EN 1991 series, ISO 2602, ISO 6707-1 are applied.

1.3.1 ETICS

External Thermal Insulation Composite System (ETICS) with rendering as described in 1.1.1 installed on substrate. The ETICS is specified by one combination of thermal insulation product and base coat.

1.3.2 ETICS kit

A set of components delivered as a kit to the site by the manufacturer to form the ETICS, with “kit” specified in Regulation No. 305/2011 (CPR), Art. 2., Clause 2.

Minimal content of components of ETIC kit according to its construction type is given in following table:

Component	*Purely bonded*	Bonded with supplementary mechanical fixings	Mechanically fixed with supplementary adhesive	*Purely mechanically fixed*
Adhesive	This type of ETICS is not covered by this EAD	yes	yes	This type of ETICS is not covered by this EAD
Thermal insulation product		yes	yes	
Base coat		yes	yes	
Reinforcement of base coat (standard mesh)		yes	yes	
Key coat and/or finishing coat		no	no	
Mechanical fixing devices		yes	yes	
Ancillary components (e.g. protective coats, supplementary reinforcement, auxiliary profiles for rendering, biocide preparations etc.)		no	no	

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.

5 Therefore it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

1.3.3 Composition of ETICS components

Composition of ETICS components as the adhesive, the base coat and the finishing coat can include a range of binders from pure polymeric to pure cementitious. They are available in the following forms:

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

1.3.4 Adhesive

ETICS component used for bonding of the thermal insulation product to the wall substrate.

1.3.5 Thermal insulation product

Factory made boards based on expanded polystyrene and cement according to EAD 040065-00-1201, prepared by casting of fresh mass into moulds. The insulation layer may consist of two insulation boards bonded together by an adhesive defined by the manufacturer of thermal insulation product. In this case, the ETICS shall be executed as mechanically fixed only.

For purpose of specification of ETICS according to this EAD the thermal insulation product is determined at least by its material base, macrostructure of cross section of boards, tensile strength perpendicular to faces without significant variability in wet conditions, class of reaction to fire and its coefficient of thermal conductivity (λ_D value).

Lambda declared λ_D declared at 23 ºC and 50 % relative humidity is to be applied for evaluation according to this EAD.

1.3.6 Rendering system

All the coats applied to the outer face of the thermal insulation product together with the reinforcement. Rendering system consists of one or more site applied layers, one of which contains reinforcement (see 1.1.1.).

- Base coat:

  Coat applied directly onto the thermal insulation product; the reinforcement is embedded into it and provides most of the mechanical properties of the rendering,

- Reinforcement:

  Glass fibre mesh embedded in the base coat to improve its mechanical strength. Differentiation is made between:

  - Standard mesh: embedded in the base coat all over the area and tied positively at joints, mostly by overlapping,
  - Reinforced mesh: optionally embedded in the base coat to the standard mesh to improve the impact resistance, generally applied without overlapping.

- Render coating:

  The render coating is applied to the base coat in one or several layers by application of a new layer on top of a last existing hardened layer. Installation also can be done in several layers (putting one layer on top of a fresh layer).

  Generally, multi-layer renders include the following:

- Key coat: Very thin coat which may be applied to the base coat and is intended to act as a preparation for the application of the finishing coat. It can also be possibly used for aesthetic reasons (for example in case of “dark” ribbed finishing coats),

- Finishing coat: Coat which contributes to the protection against weathering and can provide a decorative finish; it is applied onto the base coat with or without a key coat. If two finishing coats differ only in size of aggregate, they are considered as one type, concerning their composition EN 15824 and/or EN 998-1 apply

- Decorative coat: Coat which generally contributes to the aesthetic finishing (to cover efflorescence ...) of the finishing coat and can also provide supplementary protection against weathering.

Render coating eventually can be replaced by thin facing elements based on aqueous dispersion of macromolecular binders and bonded to the base coat by dispersion adhesive.

In specific case base coat can work as finishing coat as well and no more layers are applied on its surface. In this case the application of a finishing coat prescribed in relevant test procedures shall be omitted.

1.3.7 Mechanical fixing - plastic anchors for ETICS

Plastic anchors for ETICS according to EAD 330196-01-0604 used to fix the ETICS on the substrate against effects of wind action (if specified), against thermal actions (if specified and/or if necessary) and/or to provide stability of outer surface of thermal insulation boards.

1.3.8 Ancillary components

Any supplementary component or product specified by manufacturer as the option part of the ETICS kit and used in the ETICS, e.g. to form joints (mastics, corner strips, etc...) or to achieve continuity (mastic, joint-covers ...).

1.3.9 Substrate

The term “substrate” refers to a wall, which in itself already meets the necessary airtightness and mechanical strength requirements (resistance to static and dynamic loads).

It may be raw (without any covering) or faced with mineral or organic renders or paints or with tiles.

- Masonry walls:

Walls constructed from units of burnt clay, concrete, calcium silicate, autoclaved aerated concrete or stone laid using mortar and/or adhesive.

- Concrete walls:

Walls made of concrete either cast in situ or prefabricated at the factory.

1.3.10 R_{panel}

The mean or single failure load in pull-through test with single anchor placed at the middle of body of thermal insulation product tested, expressed in N.

1.3.11 R_{joint}

The mean or single failure load in pull-through test with single anchor placed at “T” panel joints between bodies of thermal insulation product tested, expressed in N.

1.3.12 R_k

Wind load resistance R_k is characteristic value of ability of ETICS to resist suction of wind, expressed in kN/m^2.

1.3.13 Design value of wind load resistance R_d

Design value of wind load resistance R_d is to be determined according to equation:

where:

- R_d design value of wind load action
- γ_M partial safety coefficient, representing all potential negative effects of manufacturing, storage, installation and use of product, usually given in national regulations for design of ETICS. If no national regulations are given, value of 2.0 can be applied. Values of partial safety coefficient can differ for evaluated sections of kit.
- R_k characteristic value of wind load action (see 1.3.12), determined by tests or as lower value determined by calculation according to equations:

$$R_k = (R_{panel} \times n_{panel} + R_{joint} \times n_{joint}) \times k_k$$

and

$$R_k = N_{Rk} \times (n_{panel} + n_{joint})$$

where:

- R_{panel} the mean failure load in pull-through test with single anchor placed at the middle of body of insulation panel (see 1.3.10),
- R_{joint} the mean failure load in pull-through test with single anchor placed at “T” panel joint of insulation panels (see 1.3.11)
- N_{Rk} characteristic value of pull-off resistance of plastic anchor for ETICS given in its technical specification
- n_{panel} number of plastic anchors for ETICS placed at the middle of body of insulation panel
- n_{joint} number of plastic anchors for ETICS placed at “T” panel joint of insulation panels
- k_k reduction factor for calculation of characteristic value from mean values of R_{panel}, R_{joint}, given in national regulations for design of ETICS,

1.3.14 Minimal bonded surface area *S* for bonded ETICS

The minimal bonded surface area S for bonded ETICS is calculated as follows:

$$S = \frac{30}{B} \times 100 \qquad \text{in \%}$$

where:

- S minimal bonded surface area, expressed in %
- B minimum single failure resistance of the adhesive to the thermal insulation product in dry conditions for all failure modes, expressed in kPa
- 30 bond strength between adhesive and thermal insulation product in kPa corresponding to minimal requirement on bonded ETICS (see 1.1.2.1).

Taking this formula into account, the minimum bond strength lower than 30 kPa would lead to a bonded surface higher than 100 %. Such the ETICS is to be consequently mechanically fixed.

1.3.15 Length of the wall or the distance between expansion joints

The length of the wall or the distance between expansion joints L [m] is calculated using the following equation as a function of the relevant ΔT:

$$L = \frac{U_e}{(\varepsilon_s + \alpha_{th} \times \Delta T)}$$

where

U_e displacement corresponding to the elasticity limit (see G.4 of Annex G),

ε_s shrinkage (see L.1.3.1.2 of Annex L)

α_{th} coefficient of linear thermal elongation (1 x 10^{-5}),

ΔT temperature variations in the reinforced base coat of rendering according to EN 1991-1-5 and its national annexes,

L length of wall or distance between expansion joints expressed in m.

1.3.16 Countersunk assembly

The specific installation mode of plastic anchors for ETICS, where complete plate of anchor is either bed in flat hole of specified depth in external surface of thermal insulation product or screwed into specified position in thickness of thermal insulation product. Position of anchor plate in thickness of thermal insulation product specifies manufacturer of ETICS in his manual.

Countersunk assembly significantly effects achieved test level of resistance of mechanical fixing in relation of position of anchor plate to back surface of board of thermal insulation product and its macrostructure (see 1.3.5).

1.3.17 Surface assembly

Surface assembly is the opposite type of countersunk assembly, when complete plate of anchor, or its substantial part, consisting of external circle in case of spatially shaped plate, leans on external surface of thermal insulation product.

1.3.18 Acoustic characteristics

$\Delta R_{W,direct}$ change of direct construction airborne sound insulation

$R_{W,with}$ direct construction airborne sound insulation with ETICS installed

$R_{W,without}$ direct construction airborne sound insulation without ETICS installed

$\Delta(R_W + C)_{direct}$ change of direct construction airborne sound insulation balanced with factor of adaptation to spectrum C

$R_{W,with} + C_{with}$ direct construction airborne sound insulation with ETICS installed balanced with factor of adaptation to spectrum C

$R_{W,without} + C$ direct construction airborne sound insulation without ETICS installed balanced with factor of adaptation to spectrum C

$\Delta(R_W + C_{tr})_{direct}$ change of direct construction airborne sound insulation balanced with factor of adaptation to spectrum C_{tr}

$R_{W,with} + C_{tr,with}$ direct construction airborne sound insulation with ETICS installed balanced with factor of adaptation to spectrum C_{tr}

$R_{W,without} + C_{tr}$ direct construction airborne sound insulation without ETICS installed balanced with factor of adaptation to spectrum C_{tr}

Subscript “direct” means level of characteristic without effect of lateral transmission of sound (see EN 10140-1, Annex G).

Subscript “heavy” means level of characteristic valid for heavy substrate construction of areal density 150 kg/m^2 or higher (see Clause 3.3.1.1 of EN 10140-5).

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performances of External Thermal Insulation Composite System (ETICS) with rendering, on insulation boards based on expanded polystyrene and cement are assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the product and methods and criteria for assessing of 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	--
	- reaction to fire of the ETICS		class
	- reaction to fire of the thermal insulation product		class
2	**Facade fire performance**	2.2.2	level, description
Basic Works Requirement 3: Hygiene, health and the environment			
3	**Water absorption**	2.2.3	--
	- water absorption of base coat and rendering system		level
4	**Water vapour permeability**	2.2.4	--
	- water-vapour diffusion-equivalent air layer thickness of system	2.2.4.1	level
	- water-vapour resistance factor μ of thermal insulation product	2.2.2	level
	- characteristics of rendering	2.2.4.2	level(s)
5	**Watertightness**	2.2.5	--
	- hygrothermal behaviour	2.2.5.1	description
	- freeze-thaw resistance	2.2.5.2	description
	- water retention capability of fresh mortar of base coat	2.2.5.3	level
	- freeze-thaw resistance of the complete system exposed to water	2.2.5.4	description
6	**Mass activity of natural radionuclides**	2.2.6	level
7	**Content, emission and/or release of dangerous substances**	2.2.7	--
	- SVOC and VOC	2.2.7.1	description
	- Leachable substances	2.2.7.2	description

No.	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 4: Safety and accessibility in use			
8	**Impact resistance** - resistance to hard body impact	2.2.8	category
9	**Resistance to embedded loads - bond resistance**	2.2.9	--
	- bond strength between adhesive and substrate	2.2.9.1	level
	- bond strength between adhesive and thermal insulation product	2.2.9.2	level
	- bond strength between base coat and thermal insulation product	2.2.9.3	level
	- bond strength between two layers of thermal insulation product	2.2.9.4	level
10	**Resistance to embedded loads - resistance of mechanical fixing**	2.2.10	--
	- resistance based on pull-through test of fixings only	2.2.10.1	level
	- resistance based on combination of pull-through test and static foam block test	2.2.10.2	level
	- pull-out resistance of mechanical fixing devices (anchors) from substrate	2.2.10.3	level
11	**Resistance to embedded loads - shear resistance** - shear strength and shear modulus of elasticity of thermal insulation product	2.2.11	level
12	**Resistance to embedded loads - fixing strength**	2.2.12	level
13	**Resistance to embedded loads - tensile resistance perpendicular to faces of thermal insulation product**	2.2.13	level
Basic Works Requirement 5: Protection against noise			
14	**Airborne sound insulation**	2.2.14	--
	- airborne sound insulation of ETICS	2.2.14.1	level
	- dynamic stiffness of thermal insulation product	2.2.14.2	level
	- air flow resistance of thermal insulation product (if porous type is used)		level
	- tensile strength perpendicular to faces of thermal insulation product		level
	- apparent density of thermal insulation product		level
	- density of hardened base coat		level
Basic Works Requirement 6: Energy economy and heat retention			
15	**Thermal resistance**	2.2.15	--
	- thermal resistance R_{ETICS} of ETICS	2.2.15.1	level
	- thermal resistance R_{render} of render	2.2.15.2	level
	- λ_D-value of the thermal insulation product		level
	- point thermal transmittance value χ_p of the plastic anchor(s) for ETICS		level
	- linear thermal transmittance value ψ_i of the profile(s) used and the length of profile(s)		

No.	Essential characteristic	Assessment method	Type of expression of product performance
Aspects of durability			
16	**Durability of system**	2.2.16	--
	- Bond strength after ageing	2.2.16.1	level
	- Tensile strength, elongation and protection to corrosion of glass fibre mesh	2.2.16.2	level
	- Base coat tensile characteristics	2.2.16.3	--
	- tensile strength and the elongation of the reinforced strip	2.2.16.3.1	level
	- shrinkage of hardened mortar with thickness greater than 5 mm	2.2.16.3.2	level
	- static modulus of elasticity, tensile strength and elongation at break of products with a thickness up to 5 mm	2.2.16.3.3	level

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

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer, and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant essential characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

2.2.1 Reaction to fire

The external thermal insulation composite systems (ETICS) with rendering on boards based on polystyrene and cement shall be tested using the test method(s) for the corresponding reaction to fire class according to EN 13501-1 in order to be classified according to the Commission Delegated Regulation (EU) No 2016/364.

The determination of the critical case(s) as well as the mounting and fixing provisions that are considered to be appropriate for the testing and are representative of the intended end use application are specified in Annex A. The mounting and fixing conditions for the tests are specified in Annex A.

The class of reaction to fire of the kit is given in the ETA.

The reaction to fire of thermal insulation product is given in the ETA, preferably according to CE marking of product, given by its manufacturer. If its class of reaction to fire is not available and when the product destination is a MS with this specific regulatory requirement, it is to be tested using the test method(s) relevant for the corresponding class of reaction to fire according to the Commission Delegated Regulation (EU) No 2016/364.

2.2.2 Facade fire performance

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

Information about such situation is included in Annex A.6.

The test result(s) according to relevant test method(s), selected by manufacturer from content of Annex A.6, expressed as level and/or description, is(are) given in the ETA.

2.2.3 Water absorption

Water absorption of reinforced base coat itself and of complete rendering system(s) of ETICS, applied on thermal insulation product, is to be tested according to Annex B.

This characteristic of base coat depends on action and penetration of fresh base coat into surface of thermal insulation product. The characteristic of complete rendering system depends on its ingredients (key coat, finishing coat, decorative coat) and their material composition (particle size grading, type and content of binder and additives and admixtures). Achieved level of both characteristics can vary with change of any detail in composition.

If the average value of the water absorption of the reinforced base coat after 1 hour is more than 1 kg/m^2 the average value of the water absorption after 1 hour of the ETICS with each complete rendering system shall be less than 1 kg/m^2 otherwise the ETICS with the corresponding rendering is not acceptable – see the synopsis given on the Figure 1 [6].

Following characteristics are given in the ETA:

- the average value of the water absorption in kg/(m^2.h) of the reinforced base coat after 1 hour and after 24 hours,
- the average value of the water absorption after 1 hour and after 24 hours of each complete rendering system (i.e. reinforced base coat covered with each type of finishing coat and /associating or not/ key coat and/or decorative coat).

Besides, the short-term water absorption of the thermal insulation product, determined according to Clause 2.2.3.1 of EAD 040065-00-1201, should be given in the technical description of the ETICS.

2.2.4 Water vapour permeability

The water vapour permeability is expressed as water-vapour diffusion-equivalent air layer thickness according to EN ISO 12572.

The characteristic depends directly on content and type of binder, particle size grading of used aggregate and filler and content of other components (e.g. additives, admixtures or pigment) and varies with their changes.

Water vapour permeability of the system and of its parts and related characteristics are to be tested for the critical case according to 2.2.4.1 and 2.2.4.2.

Following characteristics are given in the ETA:

- the average value of water-vapour diffusion-equivalent air layer thickness in meters (of air) of each rendering system(s) according to 2.2.4.1,
- the two-sided confidence interval of water-vapour resistance factor μ at the confidence level 95% of thermal insulation product according to Clause 2.2.2 of EAD 040065-00-1201.
- particle size grading of base coat material and finishing coat (if relevant) used for tests according to L.11.4 of Annex L,
- ash content of base coat, finishing coat, key coat and/or decorative coat used for tests according to L.1.1.3 of AnnexL,
- average value of density of hardened base coat used for tests according to L.1.3 of Annex L.

6 Taken from Annex D of EAD 040083-00-0404.

2.2.4.1 Water-vapour diffusion-equivalent air layer thickness of system

The test is to be performed on all the configurations of rendering systems proposed by the manufacturer, i.e. reinforced base coat covered with each type of finishing coat and (associating or not) key coat and/or decorative coat. If the application of the key coat and/or the decorative coat is optional, configurations with and without have to be tested.

The test of water vapour permeability of system is to be performed at least on five test samples for each configuration according to Annex C.

2.2.4.2 Characteristics of rendering

Particle size grading of base coat material and finishing coat is to be tested according to L.1.1.4 of Annex L, using test method appropriate to material tested (paste or powder).

Ash content of base coat, finishing coat, key coat and/or decorative coat are to be tested according to L.1.1.3 of Annex L,

Density of hardened base coat is to be tested according to L.1.3 of Annex L, on samples for tests according to L.1.3.1 and/or L.1.3.2 of Annex L. Average value of density shall be calculated with accuracy in 10 kg.

2.2.5 Watertightness

Based on evaluation of water absorption according to 2.2.3 and Annex B, watertightness of ETICS is to be determined by the hygrothermal test on the rig, the test of freeze-thaw resistance according to synopsis given on the Figure 1, the test of water retention capability of fresh mortar of base coat according to L.1.2.1 of Annex L, and the test of freeze-thaw resistance with the complete system exposed to water.

The characteristic depends directly on tensile strength and thickness of used base coat, its capability to be applied in vertical position expressed by water retention capability of fresh mortar, particle size grading and type of binder and additives/admixtures in used finishing coat, application or not of key coat and/or decorative coat, on tensile strength of used glass fibre reinforcement and its position in layer of base coat and on execution of connections between strips of reinforcement. The characteristic can vary significantly with any change of mentioned components.

The characteristic can vary in dependence on number and type of applied climatic cycles too.

Following characteristics are given in the ETA:

- the selected type of test of hygrothermal behaviour, description of condition of surface of test rig after finish of hygrothermal behaviour test, eventual presence of surface damage and its type and size according to 2.2.5.1
- the average value, the minimum value and the estimation of standard deviation of bond strength of reinforced base coat to the thermal insulation product and the bond strength of the finishing layer to the base coat according to 2.2.5.1
- assessment of freeze/thaw resistance based on water absorption of the reinforced base coat and the rendering system according to 2.2.5.2, if applicable
- assessment of freeze-thaw resistance of the complete system determined by tests and description of samples after test according to 2.2.5.4, if applicable
- the average value, the minimum value and the estimation of standard deviation of bond strength after freeze-thaw test according to 2.2.5.2 and 2.2.5.4 if applicable,
- water retention capability of fresh mortar of base coat, used for test of hygrothermal behaviour according to 2.2.5.3
- the bottom level of 95 % quartile on confidence level 75 % of tensile strength perpendicular to faces of thermal insulation product according to Clause 2.2.4 of EAD 040065-00-1201,.

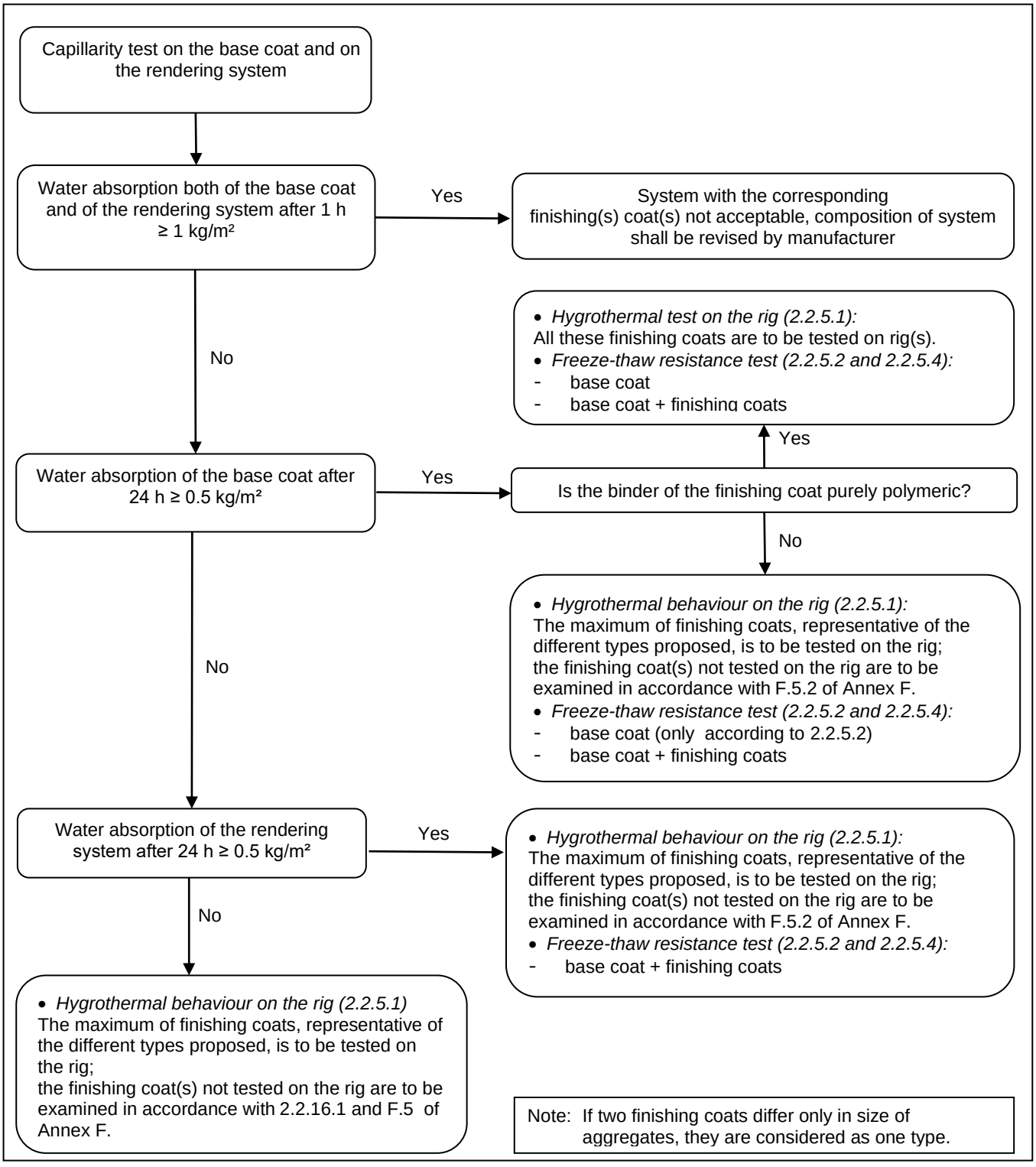

Figure. 1 Synopsis for tests of watertightness and freeze-thaw resistance

2.2.5.1 Hygrothermal behaviour

The hygrothermal behaviour of the product is to be assessed by hygrothermal test on the rig. Manufacturer can select type of test according to his intent and/or national rules for application of the product in the Member States, as follows:

- Test according to Annex I (test equivalent to Clause 2.2.6 of EAD 040083-00-0404), consisting from:
  a) 80 cycles of heating to (70 ± 5) °C and spraying by water (15 ± 5) °C
  b) 5 cycles of heating to (50 ± 5) °C and cooling to (-20 ± 5) °C
- Test according to EN 16383 with area of the test rig minimally 6 m^2, consisting from:
  a) 80 cycles of heating to (70 ± 5) °C and spraying by water (15 ± 5) °C
  b) 5 cycles of heating to (50 ± 5) °C and cooling to (-20 ± 5) °C
  c) 30 cycles of wetting by water (15 ± 5) °C, freezing to (-20 ± 5) °C and thawing by spraying water (15 ± 5) °C.

Details of test (e.g. air humidity, time of test segments, water flow for sprinkling etc.) are given in relevant test document.

If manufacturer doesn't specify type of the test, the test according to EN 16383 with area of the test rig minimally 6 m^2 is to be performed.

The critical configuration of the specimen shall be selected in both cases according to the following rules:

- At least the worst case (e.g. maximum water absorption of the ETICS components, minimum cohesion and adherence of ETICS components, minimum thickness of ETICS components, minimum bonded surface area, minimum density of fixings, etc.) or the more representative case of the ETICS shall be tested.
- Generally, only one reinforced base coat shall be used for the whole specimen.
- At the very most two exterior skins (different nature of finishing coats) can be applied per opening in the test wall (vertical divisions). Maximum two configurations in the case one opening and maximum four configurations in the case of two openings.
- If several ETICS differ only in the type of insulation board, two insulation boards can be applied to the test wall (one per opening). If two different insulation boards are tested, they shall have the same thickness.
- If different exterior skins are used, the lower part of the test wall (A = 1/3 of the total height) consists of the reinforced base coat alone (without any skin).

If base coat of product has specified thickness up to 5 mm, in both cases at least 5 test specimens for test of static modulus of elasticity, tensile strength and elongation at break according to 2.2.16.3.3 are to be prepared together with installation of the product on the rig, inserted into window on the rig before the intrinsic test and exposed during the whole test.

Test of water retention capability of fresh mortar of base coat, used for preparation of the test rig, is to be performed according to 2.2.5.3.

After finishing the test of the hygrothermal behaviour and conditioning of the test rig at minimum for 7 days at ambient temperature (20 ± 10) °C, in both cases the tests of resistance to impact according to Annex E, the tensile bond strength of reinforced base coat to the thermal insulation product to F.4 of Annex F, and the tensile bond strength of the finishing layer to the base coat according to F.5 of Annex F, are to be performed.

The test in both cases is evaluated as satisfactory if following defects either on the reinforced base coat (if a part without finishing coat is required) or on the ETICS itself have occurred neither during nor at the end of each part of test:

- blistering or peeling of any finishing coat,
- failure or cracking associated with joints between thermal insulation product boards or profiles fitted with ETICS,
- detachment of the render coat,
- cracking allowing water penetration to the insulating layer (normally ≤ 0.2 mm).

2.2.5.2 Freeze-thaw resistance

Freeze-thaw resistance of the ETICS is considered as to be satisfactory if the water absorption according to 2.2.3 of both the reinforced base coat and the rendering system is less than 0.5 kg/m² after 24 hours.

In all other cases the test of freeze-thaw resistance according to Annex D is to be performed. Synopsis for tests of watertightness and freeze-thaw resistance is given on the Figure 1.

The freeze-thaw resistance of the ETICS is evaluated as to be satisfactory if:

- samples after test show none of the defects described in 2.2.5.1 and
- bond resistances in failure after cycles satisfy the requirements of 2.2.9.3. and/or 2.2.16.1.

2.2.5.3 Water retention capability of fresh mortar of base coat

The water retention capability of fresh mortar prepared for base coat is to be tested on one specimen according to L.1.2.1 of Annex L.

2.2.5.4 Freeze-thaw resistance of the complete system exposed to water

The freeze-thaw test with the complete system exposed to water, if the water absorption of the thermal insulation is higher than 1 kg/m^2 is to be performed according Annex D.

Freeze-thaw behaviour of the ETICS shall be assessed by means of bond strength tests (see 2.2.16.1) of specimens taken from the ETICS submitted to the freeze-thaw cycles indicated in D.5 of Annex D.

At least the worst case (e.g. maximum water absorption of the ETICS components, minimum cohesion and adherence of ETICS components, maximum thickness of ETICS components, etc.) or the more representative case of the ETICS shall be tested.

If any of the following defects occur during or at the end of the freeze-thaw cycles programme, it shall be recorded:

- deterioration such as cracking that allows water penetration to the internal layers;
- detachment of the skin;
- irreversible deformation.

2.2.6 Mass activity of natural radionuclides

Mass activity of natural radionuclides Radium Ra-226, Thorium Th-232 and Potassium K-40 and activity concentration index *I* are to be determined for ETICS based on component(s) from any of building materials specified in positive list given in Directive 2013/59/EURATOM, Annex VIII on one test specimen for each relevant component of ETICS.

Mass activity of natural radionuclides Radium Ra-226, Thorium Th-232 and Potassium K-40 is to be determined by test according to EN ISO 10703 with modifications in Clause 10.1 (Preparation of sample) and Clause 11.1, Equation 4 (Calculation of volume activity) given below.

Materials in powder or paste form are to be used for test directly, hardened materials are to be crushed to particle size grading 0/2 mm. Test specimen is to be prepared by filling of tested material with natural humidity of volume of the amount 0,45 to 0,50 litre into Marinelli's container. Net weight *m* [kg] of test specimen is to be determined with accuracy in grams.

Than mass activity of radionuclides Radium Ra-226, Thorium Th-232 and Potassium K-40 is to be measured according to Clause 10.1.1 of EN ISO 10703, Test is to be evaluated according to Clause 11 of EN ISO 10703, in calculation relations instead of volume of tested specimen *V* the measured net weight of tested specimen *m* in [kg] is to be used.

The activity concentration index *I* [-] is to be calculated from determined values of mass activity of Radium Ra-226, Thorium Th-232 and Potassium K-40 by the formula given in Directive 2013/59/EURATOM, Annex VIII.

Following characteristics for relevant component(s) are given in the ETA:

- the mass activity of the radionuclides Ra-226, Th-232 and K-40 in Bq/kg;
- the calculated value of activity concentration index *I* [-].

2.2.7 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer [7] after identifying the release scenarios (in accordance with EOTA GD 014) taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market. Purely inorganic materials (e.g. boards, adhesives) do not have to be tested.

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

IA2: Product with indirect contact to indoor air (e.g. covered products) but possible impact on indoor air

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

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

2.2.7.1 SVOC and VOC

For the intended uses covered by the release scenarios IA2, semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) shall be determined in accordance with EN 16516. The loading factor to be used for emission testing is 0,007 m^2/m^3.

The preparation of the test specimen is to be performed as follows: The inert substrate (sandblasted glass or stainless steel) shall be coated by tested material as described in the manufacturer's instructions. Testing is performed using ¾ of the maximum wet film thickness according to the manufacturer's instructions. For each layer the quantity applied is verified in terms of wet weight [g/m^2] by taking weight differences.

The coating shall be carried out exactly in accordance with the manufacturer's specifications. Environmental conditions and drying time have to be reported. Cross contaminations shall be avoided.

Once the test specimen has been completely coated, it is preconditioned for 3 or 28 days. The preconditioning process takes place in a test chamber under the test chamber conditions or in a storage facility where the relevant test chamber conditions can be created.

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7 The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011). The manufacturer is **not** obliged:
- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS.

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

Once the preconditioning time has been observed, the test specimen is transferred to the emission test chamber. This point in time is considered to be the starting time of the emission test. A 28-day test period using the area-specific air flow rate q = 1,5 m/h takes place.

The test results have to be reported for the relevant parameters (e.g. chamber size, temperature and relative humidity, air exchange rate, loading factor, size of test specimen, preconditioning, production date, arrival date, test period, test result).

The relevant test results after 28 days shall be expressed in [mg/m³] and given in the ETA.

2.2.7.2 Leachable substances

For the intended use covered by the release scenario S/W1 or S/W2 the performance of the rendering system applied on inert substrate (sandblasted glass or stainless steel) (hereafter “sub-kit”) concerning leachable substances is to be assessed. A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the test specimens are conducted according to CEN/TS 16637-2:2014. The leachant shall be pH-neutral demineralised water and the ratio of liquid volume to surface area shall be (80 ± 10) l/m².

The sub-kit to be tested shall be assembled according to manufacturer’s instructions. Preparation is performed using ¾ of the maximum wet film thickness for each layer. The quantity applied in each layer is verified in terms of wet weight [g/m²] by taking weight differences.

Before testing, the prepared samples are stored for at least 28 days at (23 ± 2) °C and (50 ± 5) % RH.

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

- Acute toxicity test with Daphnia magna Straus according to EN ISO 6341
- Toxicity test with algae according to ISO 15799
- Luminescent bacteria test according to EN ISO 11348-1/A1, EN ISO 11348-2/A1 or EN ISO 11348-3/A1

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

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

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

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

2.2.8 Impact resistance

The impact resistance is tested according to Annex E and expressed according to 2.2.8.1 and 2.2.8.2.

The impact resistance category tested according to 2.2.8.1 and evaluated according to 2.2.8.2, Table 2 and Table 3, is given in the ETA.

2.2.8.1 Resistance to hard body impact

The resistance to hard body impact is expressed as impact category resistance according to 2.2.8.2.

The test is to be performed according to ISO 7892 and Annex E, on the rig after the hygrothermal test according to 2.2.5.1

Complementary tests (finishing coats not tested on the rig, double meshes, etc.) are to be carried out on separate samples according to E.3 of Annex E. Synopsis of tests related is given in 2.2.5.1 and Figure 1.

2.2.8.2 Categories of impact resistance

The categories of impact resistance are given in the Table 2 with examples of possible uses corresponding to degrees of exposure. They do not include an allowance for acts of vandalism.

The categories of impact resistance are specified as category I, II or III according to behaviour of specimen during test by heavy non deformable object of specified weight and with specified impact energy in accordance with Table 3.

Table 2 Categories of impact resistance and examples of use [8]

Impact resistance category	Description of possible uses
I	A zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use.
II	A zone liable to impacts from thrown or kicked objects, but in public locations where the height of the ETICS will limit the size of the impact; or at lower levels where access to the building is primarily to those with some incentive to exercise care.
III	A zone not likely to be damaged by normal impacts caused by people or by thrown or kicked objects.

Table 3 Specification of impact resistance categories [9]

Impact energy	Impact resistance category		
	III	II	I
10 J	--	Rendering not penetrated [2)]	No deterioration [1)]
	and	and	and
3 J	Rendering not penetrated [2)]	No deterioration [1)]	No deterioration [1)]

Notes: [1)] Superficial damage, provided there is no cracking, is considered as showing “no deterioration” for all the impacts

[2)] The test result is assessed as being “penetrated” if circular cracking penetrating as far as the thermal insulation product is observed for at least 3 of the 5 impacts.

2.2.9 Resistance to embedded loads - bond resistance

Evaluation of resistance to embedded loads for bond resistance and resistance of mechanical fixing (see 2.2.10) is to be performed according to type of ETICS (see 1.1.2) according to synopsis of tests given in Table 4.

All external and internal loading of system shall be transferred safely from ETICS into loadbearing substrate. Safety of complete system is determined by the weakest part of its composition: either by cohesion of used solid components (esp. thermal insulation product) or by adhesion and coverage ratio and/or cohesion after curing of used adhesive or paste components. Any change of any component can change achieved level of resistance.

8 Taken form Clause 2.2.8 and Table 2 of EAD 040083-00-0404.

9 Taken from Clause 2.2.8 and Table 3 of EAD 040083-00-0404.

Final value of bond resistance is to be obtained as minimum value by calculation from relevant type of bond strength (see 2.2.9.1 to 2.2.9.3) and bonded surface area (see 1.3.14).

During preparation of ETA calculated minimal bonded area according to 1.3.14, obtained from test results, is to be compared with value specified by manufacturer.

Table 4 Synopsis of tests of bond and mechanical resistance of ETICS to embedded loads

<table>
<tr><td colspan="2">Fixing type</td></tr>
<tr><td rowspan="2">Bonded with supplementary mechanical fixings[1)]</td><td>Mechanically fixed with supplementary bonding [2)]</td></tr>
<tr><td>Anchors fixed through the thermal insulation product only</td></tr>
<tr><td colspan="2">Bond strength between base coat and thermal insulation product according to 2.2.9.3</td></tr>
<tr><td>Bond strength
2.2.9.1 and 2.2.9.2,
F.2 and F.3 of Annex F</td><td>Pull-through test 2.2.10.1
H.2 of Annex H,
and/or [3)]
Static foam block test 2.2.10.2,
H.3 of Annex H,
and
Displacement test (fixing strength) 2.2.12 [4)],
Annex G</td></tr>
</table>

Notes: [1)] The tests on bonded ETICS with supplementary mechanical fixing devices are to be conducted without the fixings.

[2)] The tests on mechanically fixed ETICS with supplementary adhesive are to be conducted without the adhesive. If the bonded area is less than 20 %, the ETICS is considered to be purely mechanically fixed.

[3)] Decision on which test to perform is based on Figure H.1 and H.2 of Annex H.

[4)] Only for ETICS requiring to perform displacement test according to the criteria in 2.2.12.

2.2.9.1 Bond strength between adhesive and substrate

The test is to be performed according to F.2 of Annex F. The test specimens consisting of 5 test squares at least for each conditioning are conditioned with following media:

- without any supplementary conditioning,
- by immersion of the adhesive in water for 2 days and 2 h drying at (23 ± 2) °C and (50 ± 5) % RH,
- by immersion of the adhesive in water for 2 days and at least 7 days drying at (23 ± 2) °C and (50 ± 5) % RH.

All the test results for bond strength between adhesive and substrate after each conditioning are to be at least equal to [10]:

- in dry condition:
  - 250 kPa. one single value lower than 250 kPa but higher than 200 kPa is admissible.
- after effect of water:
  - 80 kPa at 2 hours after removing the samples from the water. One single value lower than 80 kPa but higher than 60 kPa is admissible.
  - 250 kPa at 7 days after removing the samples from the water. One single value lower than 250 kPa but higher than 200 kPa is admissible.

Following characteristics are given in the ETA:

10 Taken from Clause 2.2.11 of EAD 040083-00-0404

- the average value, the minimum value and the estimation of standard deviation of bond strength between adhesive and substrate:
  - in dry conditions
  - after immersion of the adhesive in water for 2 days and 2 h drying at (23 ± 2) °C and (50 ± 5) % RH
  - after immersion of the adhesive in water for 2 days and at least 7 days, but no more than 10 days drying at (23 ± 2) °C and (50 ± 5) % RH.

2.2.9.2 Bond strength between adhesive and thermal insulation product

The test is to be carried out for bonded ETICS (see 1.1.2.1) and for mechanically fixed ETICS with supplementary adhesive, if distribution of self-weight of ETICS by adhesive into substrate is specified by manufacturer (see 1.1.2.2.1).

The test is to be performed according to F.3 of Annex F. The parts consisting of 5 specimens each are conditioned with following media:

- without any supplementary conditioning,
- by immersion of the adhesive in water for 2 days and 2 h drying at (23 ± 2) °C and (50 ± 5) % RH,
- by immersion of the adhesive in water for 2 days and at least 7 days drying at (23 ± 2) °C and (50 ± 5) % RH.

All the test results of the bond strength between adhesive and thermal insulation product after each conditioning have to be at least equal to the values with adhesive or cohesive rupture indicated in the Table 5:

Table 5 Requirements for the values of failure resistance [11]

Mode of failure	The minimum failure resistance values after each conditioning in kPa		
	Dry condition	After effect of water	
		At 2 hours after removing the samples from the water	At 7 days after removing the samples from the water
Adhesive rupture	80 [1])	30	80 [1])
Cohesive rupture in adhesive			
Cohesive rupture in insulation	30 [2])	no requirement	no requirement

Notes: [1]) One single value lower than 80 kPa but higher than 60 kPa is admissible.

[2]) In order to comply with the minimal admissible bonded surface requirement as described in 1.3.14.

Following characteristics are given in the ETA:

- the average value, the minimum value and the estimation of standard deviation of bond strength between adhesive and thermal insulation product:
  - in dry conditions
  - after immersion of the adhesive in water for 2 days and 2 h drying at (23 ± 2) °C and (50 ± 5) % RH
  - after immersion of the adhesive in water for 2 days and at least 7 days drying at (23 ± 2) °C and (50 ± 5) % RH,
- the bonded surface area *S* calculated according to 1.3.14 for dry conditions,
- the bottom level of 95 % quartile on confidence level 75 % of tensile strength perpendicular to faces of thermal insulation product according to Clause 2.2.4 of EAD 040065-00-1201.

11 Taken from Clause 2.2.11.3 and Table 6 of EAD 040083-00-0404.

2.2.9.3 Bond strength between base coat and thermal insulation product

The test is performed according to F.4 of Annex F. The tests for following conditions on 5 test squares at least are performed:

- on a panel of the thermal insulation product faced with the base coat applied in accordance with the manufacturer's instructions and dried for at least 28 days under the same conditions as the rig,
- on samples taken from the rig after hygrothermal cycles or on separated samples placed in the climatic chamber (only if the low part of the rig does not only consist of the reinforced base coat alone, i.e. without any finishing coat) after at least 7 days of drying,
- if freeze-thaw cycles necessary according to 2.2.5: on the samples of reinforced base coat alone after the freeze-thaw cycles as foreseen in 2.2.5.2 and 2.2.5.4 (if base coat works as finishing coat) and dried for at least 7 days after the end of the cycles.

All the test results of the bond strength between base coat and thermal insulation product after each conditioning have to fulfil following provisions [12]:

- to be at least equal to 80 kPa with cohesive or adhesive rupture. One single value lower than 80 kPa but higher than 60 kPa is admissible,

or

- the rupture occurs in the thermal insulation product (cohesive rupture) if the failure resistance is lower than 80 kPa.

Following characteristics are given in the ETA:

- the average value, the minimum value and the estimation of standard deviation of bond strength between base coat and thermal insulation product:
  - on a panel of the thermal insulation product faced with the base coat applied in accordance with the manufacturer's instructions and dried for at least 28 days under the same conditions as the rig,
  - on samples taken from the rig after hygrothermal cycles or on separated samples placed in the climatic chamber (only if the low part of the rig does not only consist of the reinforced base coat alone, i.e. without any finishing coat) after at least 7 days of drying
  - if freeze-thaw cycles necessary according to 2.2.5: on the samples of reinforced base coat alone after the freeze-thaw cycles as foreseen in 2.2.5.2 and dried for at least 7 days after the end of the cycles.
- the average value of tensile strength perpendicular to faces of thermal insulation product used for tests.

2.2.9.4 Bond strength between two layers of thermal insulation product

The bond strength between two layers of thermal insulation product is to be tested only in dry conditions according to EN 1607. Test is to be performed according to 2.2.9.2, but test specimens consist of two boards of thermal insulation product, bonded together by adhesive.

Following characteristics are given in the ETA:

- the type of adhesive used for bonding of two insulation layers
- the average, the minimum value and the estimation of standard deviation of bond strength between two layers of thermal insulation product and the type(s) of rupture (cohesion / adhesion)
- the average value of tensile strength perpendicular to faces of thermal insulation product used for tests.

12 Taken from Clause 2.2.11.4 and Table 7 of EAD 040083-00-0404

2.2.10 Resistance to embedded loads - resistance of mechanical fixing

Mechanical resistance to embedded loads of mechanically fixed ETICS with supplementary bonding (see 1.1.2.2.1) can be determined by one or more tests according to Annex H and/or Annex I selected according to synopsis of tests of bond strength and wind load resistance given in Table 4.

In case of incapacity of bond resistance to transfer any inserted type of load from system into substrate safely, the particular load shall be transferred from by mechanical fixing. The characteristic divides into two details: conjunction of thermal insulation product with mechanical fixing device as the first and conjunction of mechanical fixing device with substrate as the second. Level of the characteristic varies with changes of respective characteristics of thermal insulation product, mechanical fixing device, substrate and/or composition and construction of ETICS itself.

Resistance of mechanical fixing and evaluation of tests is to be performed by appropriate procedure according to:

- 2.2.10.1 for ETICS fixed by plastic anchor(s) for ETICS (EAD 330196-01-0604) if pull-through resistance at panel joints (R_{joint}) can be determined by the pull-through test according to H.2 of Annex H,
- 2.2.10.2 for ETICS fixed by plastic anchor(s) for ETICS (EAD 330196-01-0604) in case than pull-through resistance at panel joints (R_{joint}) cannot be determined by the pull-through test due to unacceptable behaviour of test specimens during the test,
- 2.2.10.3 for ETICS fixed by plastic anchor(s) for ETICS (EAD 330196-01-0604) – anchoring in substrate.

Final value of mechanical resistance according to 2.2.10.1 is to be obtained by calculation from relevant type of resistance (R_{panel} *or* R_{joint}) and number of anchor used for area unit.

2.2.10.1 Resistance based on pull-through test of plastic anchor(s) for ETICS

Resistance based on pull-through test of fixings only is based on:

- pull-through resistance of single anchor placed at the middle of body of body of thermal insulation product (R_{panel}, see 1.3.10)

and

- pull-through resistance of single anchor placed at “T” panel joints (R_{joint}, see 1.3.11) between bodies of thermal insulation product.

Test of pull-through resistance of plastic anchor(s) for ETICS is to be performed on 5 test specimens at least according to H.2 and Figure H2, scheme 2a of Annex H,. If type of installation of fixing can effect measured values (e.g. countersunk assembly), test for each specified type of installation is to be performed if necessary.

It is not recommended to determine R_{panel} and/or R_{joint} values by testing of thermal insulation products of thickness higher than 80 mm [13]. If necessary to test them, thickness tested has to be reported together with value of displacement of anchor plate for possibility to be taken into account in evaluation of wind load resistance of ETICS.

The average values of R_{panel} (see 1.3.10) and/or R_{joint} (see 1.3.11) in N per fixing in dry conditions and average deformation in failure, are valid for configuration of ETICS given as: [14]

- thermal insulation product of the same type with higher thickness and/or the same or higher thickness and higher nominal tensile strength perpendicular to the faces,

13 According to achieved experience tests performed on higher thickness give although higher values of single anchor resistance, but these higher values are achieved in very high deformations inappropriate for durability of product.

14 Sometimes it may be suitable to give separate values R_{panel} and/or R_{joint} for more specific types of plastic anchors for ETICS separately due to differences of their load bearing capacity and/or different behaviour of insulation product on the same material basis.

- anchors with the same or larger nominal plate diameter and the same or higher nominal plate stiffness (see Annex M).

Following characteristics are given in the ETA:

- the average values, the minimal values and the estimations of standard deviation of R_{panel} and/or R_{joint} in N per fixing in dry conditions,
- the average value at deformation in failure in mm,
- the material type and nominal value of thickness of thermal insulation product used for tests,
- average and minimum value of tensile strength perpendicular to faces of thermal insulation product used for tests,
- the type(s), nominal plate diameter, nominal plate stiffness, type of installation (surface or countersunk) and the characteristic value of resistance under tension load according to type of substrate of single anchor N_{Rk} for type(s) of plastic anchors for ETICS used for tests (see 2.2.9.3) or reference on type of mechanical fixing device (plastic anchors for ETICS), its harmonized technical specification (i.e. EAD 330196-01-0604) and number of its European Technical Assessment,
- if countersunk assembly of anchor(s) is used (see 1.3.16), nominal thickness of thermal insulation product between bottom edge of plate of anchor and back side of board of thermal insulation product, (i.e. thickness non-effected by installation of anchor).

2.2.10.2 Resistance based on combination of pull-through test and static foam block test

Resistance based on combination of pull-through test and static foam block test applies if resistance at "T" panel joints (R_{joint}) (see 1.3.11) cannot be determined by the pull-through test due to unacceptable behaviour of test specimens during the test).

This resistance is based on combination of tests according to Annex H, Figure H.2, scheme 2b and calculation as follows:

- pull-through resistance of single anchor placed at the middle of body of thermal insulation product (R_{panel}, see 1.3.10)

and

- static foam block test according to H3 of Annex H,

and

- calculation of pull-through resistance of single anchor placed at "T" panel joints (R_{joint}, see 1.3.11) between bodies of thermal insulation product, as given below.

The test of pull-through resistance of plastic anchor(s) for ETICS placed at the middle of body of thermal insulation product according to H.2 of Annex H, is to be performed on 5 test specimens at least (historical data obtained from testing of 3 samples may be used – see H.2 of Annex H).

Than the test specimens for static foam block test are to be prepared with plastic anchor(s) for ETICS, placed at the middle of body of thermal insulation product and in the "T" joints between them according to Figure H.2., scheme 2b of Annex H. The test is to be performed according to H.3 of Annex H, at least on 3 test specimens for thermal insulation product.

When using the combination of tests described above (see Figure H.2, scheme 2b of Annex H), the resistance R_{joint} of anchors positioned at "T" panel joints is calculated then as:

$$R_{joint} = (F_k - 2 \times R_{panel}) / 6$$

where:

F_k maximum load from the static foam block test expressed as 95 % fractile on confidence level 75 % for V_x as unknown according to Clause D.7.2, Annex D of EN 1990, rounded with accuracy in integer [15],

R_{panel} average resistance at the body of the thermal insulation product determined by the pull-through test according to H.2 of Annex H (see 1.3.10),

R_{joint} calculated average resistance at “T” panel joint (see 1.3.11), rounded with accuracy in integer.

The values of R_{panel} and/*or* R_{joint} in N per fixing in dry conditions are valid for specified configuration of ETICS given as:

- thermal insulation product of the same type with higher thickness and/or the same or higher thickness and higher tensile strength perpendicular to the faces
- anchors with the same or larger plate diameter and the same or higher plate stiffness (see Annex M) and the same type of installation.

Following characteristics are given in the ETA:

- the average values, the minimal values and the estimations of standard deviation of R_{panel} and/or R_{joint} in N per fixing in dry conditions,
- the average deformations in failure in mm (if possible),
- the number of tests used in evaluation, if it differs,
- the material type and nominal value of thickness of thermal insulation product used for tests,
- the tensile strength perpendicular to faces of thermal insulation product used for tests,
- the type(s), nominal plate diameter, nominal plate stiffness, type of installation and the characteristic value of resistance under tension load according to type of substrate of single anchor N_{Rk} for type(s) of plastic anchor(s) for ETICS used for tests (see 2.2.9.3) or reference on type of mechanical fixing device (plastic anchors for ETICS), its harmonized technical specification (i.e. EAD 330196-01-0604) and number of its European Technical Assessment
- if countersunk assembly of anchor(s) is used (see 1.3.16), nominal thickness of thermal insulation product between plate of anchor and back side of board of thermal insulation product (i.e. thickness not effected by installation of anchor).

2.2.10.3 Pull-out resistance N_{Rk} of mechanical fixing devices (anchors) from substrate

Pull-out resistance N_{Rk} of mechanical fixing devices (anchors) can be determined and evaluated according to EAD 330196-01-0604 for plastic anchors for ETICS if its value according to its manufacturer specification is not available.

Following characteristics are given in the ETA:

- type and the characteristic value of pull-out resistance of mechanical fixing devices N_{Rk} determined according to EAD 330196-01-0604, if product has not its own verification of characteristic according to harmonized technical specification,

or

- reference on type of mechanical fixing device (plastic anchors for ETICS or plastic anchor), its harmonized technical specification (i.e. EAD 330196-01-0604) and number of its European Technical Assessment.

2.2.11 Resistance to embedded loads - shear resistance

The shear strength and shear modulus of elasticity of thermal insulation product are to be tested and evaluated according to EN 12090 – see Clause 2.2.5 of EAD 040065-00-1201.

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15 Characteristic value of maximum load F_k determined by the static foam block test applied in equation equilibrates effect of multiply fixing by plastic anchors for ETICS used in test specimen in relation to average value of R_{panel}.

Dead mass of the system itself or of its separate components, and shear tension induced into base coat with rendering from thermal expansion by sun heat, shall be distributed and/or transferred into substrate by all the layer of thermal insulation product and its joints with base coat and adhesive safely.

The test is to be performed for bonded ETICS with supplementary fixing (see 1.1.2.1.2) and for ETICS mechanically fixed with supplementary adhesive (see 1.1.2.2.1).

The thermal insulation product for bonded ETICS and for ETICS mechanically fixed with supplementary adhesive, if distribution of self-weight by adhesive is specified, has to fulfil the following minimum requirements according to 1.1.1 [16]:

- shear strength $f_{\tau k} \geq 0.02$ N/mm² [17]
- shear modulus of elasticity $G_m \geq 1.0$ N/mm².

Following characteristics are given in the ETA:

- characteristic value of shear strength and characteristic value of shear modulus of elasticity of thermal insulation product as the bottom level of 95 % quartile on confidence level 75 % for V_x as unknown according to Clause D.7.2, Annex D of EN 1990.

Note: When available, performances included in the DoP for the CE marking of separate component shall be used as far as possible to avoid retesting or reassessment.

2.2.12 Resistance to embedded loads - fixing strength

The test of fixing strength (called “the displacement test”) is performed according to Annex G. The purpose of the test is to assess the longitudinal displacement of the rendering system of ETICS at the edges of the wall in relation to changes of surface temperature, specified in EN 1991-1-5.

The displacement test is not required if ETICS fulfils one or more of the following criteria [18]:

- mechanically fixed ETICS with supplementary adhesive, where the bonded area exceeds 20 %,
- $E \times d < 50\,000$ N/mm (where E is modulus of elasticity of the base coat without mesh; and d is nominal thickness of the base coat),
- ETICS is intended only for continuous areas of rendering with a width and/or height less than 10 m,
- ETICS with minimum thickness of thermal insulation product more than 120 mm and using surface assembly of anchor plates only,
- ETICS having a base coat where after the render strip tensile test according to Annex K at 2 % render strain value only cracks with a width of less than or equal to 0.2 mm are observed,
- ETICS using fixing devices of which the fatigue bonding strength has been verified by testing.

Following characteristics according to composition of ETICS mechanically fixed are given in the ETA:

- the U_e value of displacement corresponding to the elasticity limit,
- the number, type(s), nominal plate diameter, nominal plate stiffness, type of installation and the characteristic value of resistance under tension load according to type of substrate of single anchor N_{Rk} for type(s) of anchor(s) used for tests (if used) (see 2.2.10.3) or reference on type of mechanical fixing device (plastic anchors for ETICS), its harmonized technical specification (i.e. EAD 330196-01-0604) and number of its European Technical Assessment,

16 Taken from Clause 1.1 of EAD 040083-00-0404

17 The subscript "κ" indicates a characteristic value and "m" a mean value. The characteristic value is determined by statistical evaluation as the 5 % fractile of a mechanical property according to Clause D.7.2, Annex D of EN 1990.
The subscript "τ" stands for shear (strength). The letter "f" describes a strength property (originally derived from "force").

18 Taken from Clause 2.2.12 of EAD 040083-00-0404

- the average and minimum value of tensile strength perpendicular to faces of thermal insulation product used for tests,
- if countersunk assembly of anchor(s) is used (see 1.3.16), nominal thickness of thermal insulation product between bottom edge of plate of anchor and back side of board of thermal insulation product (i.e. thickness non-effected by installation of anchor),
- the link to equation for determination of length and/or height of wall and/or for determination of distance between expansion joints *L* (see 1.3.15) as a function of ΔT as supplementary information.

2.2.13 Resistance to embedded loads - tensile strength perpendicular to faces of thermal insulation product

Tensile strength perpendicular to faces shall be determined according to Clause 2.2.4 of EAD 040065-00-1201,

Characteristic value of tensile strength perpendicular to faces $\sigma_{mt,\,c}$ *[kPa]* as the bottom level of 95 % quartile on confidence level 75 % for V_x as unknown according to Clause D.7.2, Annex D of EN 1990 is stated in the ETA.

Note: When available, performances included in the DoP for the CE marking as individual component should be used as far as possible to avoid retesting or reassessment.

2.2.14 Airborne sound insulation

The airborne sound insulation of ETICS is to be determined on the basis of laboratory tests carried out in accordance with the standards EN ISO 10140-1, EN ISO 10140-2, EN ISO 10140-4 and EN ISO 10140-5 and evaluated in accordance with EN ISO 717-1.

2.2.14.1 Airborne sound insulation of ETICS

ETICS is to be tested on a basic wall with low coincidence frequency (heavy basic wall) specified by EN ISO 10140-1 and EN ISO 10140-5. Single number improvement values $\Delta R_{W,heavy}$, $\Delta(R_W + C)_{heavy}$ *and* $\Delta(R_W + C_{tr})_{heavy}$ are to be reported as evaluated according to EN ISO 10140-1, Annex G, and EN ISO 10140-5. Meaning of stated quantities and indices see 1.3.18. This test covers the acoustic performance of ETICS when combined with walls of low coincidence frequency with no abnormalities concerning their airborne sound transmission and having a mass per unit area at least ten times larger than that of the ETICS.

ETICS designed for use with another type of basic wall not corresponding to the standard heavy basic wall (e.g. hollow ceramics or cellular concrete) is to be tested on that type of wall. In such a case, the direct difference of the weighted sound reduction indices of the wall with and without the ETICS, $\Delta R_{W,direct}$, $\Delta(R_W + C)_{direct}$ *and* $\Delta(R_W + C_{tr})_{direct}$, are to be reported as evaluated according to EN ISO 10140-1, Annex G together with the description of the wall used for testing.

For the configuration of the ETICS to be tested, the following rules are to be taken into account:

- thermal insulation products with higher dynamic stiffness provide worse performance
- a higher number of fixings provides worse performance
- a higher adhesive surface coverage provides worse performance
- a higher mass of a rendering system provides better performance
- a greater thickness of the thermal insulation product provides better performance
- the performance for an thermal insulation product thickness between two tested ones can be linearly interpolated
- anchors with plastic screws/nails provide better performance than with metal screws/nails

Single number improvement values $\Delta R_{W,heavy}$, $\Delta(R_W + C)_{heavy}$ and $\Delta(R_W + C_{tr})_{heavy}$ or $\Delta R_{W,direct}$, $\Delta(R_W + C)_{direct}$ and $\Delta(R_W + C_{tr})_{direct}$ are to be calculated using following formulas:

$$\Delta R_{W,direct} = R_{W,with} - R_{W,without}$$

$$\Delta(R_W + C)_{direct} = (R_{W,with} + C_{with}) - (R_{W,without} + C_{without})$$

$$\Delta(R_W + C_{tr})_{direct} = (R_{W,with} + C_{tr,with}) - (R_{W,without} + C_{tr,without})$$

References to symbols used see in 1.3.19.

The following extension rules are to be applied:

- the performance measured may also be used for heavier rendering systems than that measured (all other parameters identical),
- the performance measured may also be used for the same type of thermal insulation product with lower dynamic stiffness than that measured (all other parameters identical),
- if the performance has been measured with different thicknesses of thermal insulation product (all other parameters identical) the values at an intermediate thickness can be obtained by linear interpolation,
- the performance measured may also be used for the same type of thermal insulation product with greater thickness than that measured (all other parameters identical),
- the performance measured may also be used for an ETICS fixed with fewer fixings than that measured (all other parameters identical),
- the performance measured may also be used for an ETICS with lower bonded surface area than that measured (all other parameters identical),
- the performance measured on the heavy wall (according to the definition in EN ISO 10140-5, Annex B) may be used in extended application for all other heavy walls (of mass per square metre between 150 kg/m^2 and 400 kg/m^2).

Following characteristics are given in the ETA:

- airborne sound insulation as single number improvement value:
  - $\Delta R_{W,heavy}$, $\Delta(R_W + C)_{heavy}$ and $\Delta(R_W + C_{tr})_{heavy}$ for use with wall substrate corresponding to the standard heavy basic wall walls of heavy type

  and/or

  - $\Delta R_{W,direct}$, $\Delta(R_W + C)_{direct}$ and $\Delta(R_W + C_{tr})_{direct}$ for use with another type of wall substrate not corresponding to the standard heavy basic wall.
- the dynamic stiffness of thermal insulation product used for tests,
- material type, conditioning (if relevant) [19], density and thickness of thermal insulation product used for tests,
- tensile strength perpendicular to faces of thermal insulation product used for tests,
- description, density of hardened base coat and calculated mean value of self-weight per square unit (kg/m^2) of the rendering system used for tests,
- type(s), number and application method of ETICS mechanical fixing (all systems except purely bonded systems, see 1.1.2.1.1) and (if relevant) reference on its harmonized technical specification (i.e. EAD 330196-01-0604) and number of its European Technical Assessment,
- nominal percentage of bonded surface, used for preparation of test specimen,
- type and characteristics (dimensions, density in kg/m^2, nature, design) of wall(s) substrate used for tests.

2.2.14.2 Characteristic of ETICS related to airborne sound insulation

Following characteristics are to be given in the ETA together with airborne sound insulation of ETICS.

The dynamic stiffness of thermal insulation product is to be tested according to EN 9052-1.

The air flow resistance of thermal insulation product is to be tested according to EN 29053.

19 Insulation product can be conditioned e.g. by repeated compression and releasing, which can change its mechanical characteristics.

The tensile strength perpendicular to faces of thermal insulation product is to be tested according to EN 1607.

The apparent density of thermal insulation product is to be tested according to EN 1602.

The density of hardened base coat is to be determined according to L.1.3 of Annex L.

2.2.15 Thermal resistance

2.2.15.1 Thermal resistance R_{ETICS} of ETICS

The thermal resistance of ETICS is to be evaluated by means of data relating to the components being included in the calculation procedures set out in Annex J. The calculation procedure can addresses thermal bridges.

The minimum thermal resistance of the ETICS R_{ETICS} is to be exceeded 1 m².K/W according to 1.1.1.[20]

Following characteristics are given in the ETA:

- the minimum thermal resistance R_{ETICS} of the ETICS kit in m².K/W,
- the thermal resistance of render R_{render} in m².K/W considered in evaluation of R_{ETICS}
- the λ_D-value and/or d/R_D-value of the thermal insulation product expressed in W/(m.K) as:
  - considered in evaluation of R_{ETICS}

  and/or

  - reference on type of thermal insulation product, its harmonized technical specification and λ_D-value declared in CE marking of product by its manufacturer

  and/or

  - λ_D-value of thermal insulation product tested according to L.2.10 of Annex L, (if declaration given by its manufacturer according to harmonised specification is not available).
- the point thermal transmittance value χ_p in W/K of the plastic anchor(s) for ETICS considered and (if relevant) their number considered in evaluation and (if relevant) reference on its harmonized technical specification (e.g. EAD 330196-01-0604) and number of its European Technical Assessment.

2.2.15.2 Characteristics of ETICS related to thermal resistance

Following characteristics are to be given in the ETA together with thermal resistance of ETICS.

The thermal resistance R_{render} of render (base coat with key coat and/or finishing coat) can be tested according to EN 12667 or considered by a deemed to satisfy value 0.02 m².K/W [21] and/or by value corresponding to material type of render according to EN ISO 10456.

The λ_D-value of the thermal insulation product is to be tested according to EN 12667, if relevant value according to harmonized technical specification, declared by its manufacturer in CE marking is not available.

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20 In special use of installation, smaller thicknesses of insulation product can be used subject to checking, that there is no particular problem.

21 Taken from Clause 2.2.23 of EAD 040083-00-0404,

The point thermal transmittance value χ_p of the plastic anchor(s) for ETICS is to be tested according to Annex N, if relevant value according to its harmonized technical specification (i.e. EAD 330196-01-0604), declared by its manufacturer in CE marking is not available.

2.2.16 Aspects of durability

2.2.16.1 Bond strength after ageing

The test is to be performed on the rig after tests of watertightness on configurations of rendering systems subjected to hygrothermal cycles and on separate test specimens for configurations not tested on the rig. Bond strength after ageing is to be determined by tests according to F.5 of Annex F.

After curing the prepared samples, following ageing is to be performed:

- one board aged by immersion in water for 7 days and then dried for at least 7 days at (23 ± 2) °C and (50 ± 5) % RH.

and/or

- if freeze-thaw cycles are necessary according to 2.2.5, at least one board aged by freeze-thaw cycles as foreseen in Annex D and dried for at least 7 days after the end of the cycles.

The bond strength after ageing is evaluated as to be satisfactory if at the end of the tests following provisions are fulfilled [22]:

- the minimum failure resistance value has to be at least 80 kPa with cohesive or adhesive rupture in adhesive.

or

- the rupture occurs in the thermal insulation product (cohesive rupture) if failure resistance is less than 80 kPa.

Following characteristics are given in the ETA:

- the average value and the estimation of standard deviation of bond strength after ageing:
  - after ageing by immersion in water for 7 days and then dried for at least 7 days at (23 ± 2) °C and (50 ± 5) % RH

  and/or

  - after ageing by freeze-thaw cycles according to Annex D and dried for at least 7 days after the end of the cycles.
- the number of tests used in evaluation, if it differs,
- the average value of tensile strength perpendicular to faces of thermal insulation product used for tests.

2.2.16.2 Tensile strength, elongation and protection to corrosion of glass fibre mesh

The tensile strength and the elongation of the glass fibre mesh are to be measured in the WEFT and WARP directions on 10 samples at least according to EAD 040016-00-0404.

If its available value, determined according to EAD 040016-00-0404 and specified by its manufacturer in CE marking of mesh, complies with following requirements, no further testing is to be performed.

22 Taken from Clause 2.2.20.2 of EAD 040083-00-0404.

After ageing, the average value of residual strength of the standard mesh (see 1.3.6) in the WEFT and WARP directions has to be at least [23]:

- 50 % of the strength in the as-delivered state
- and 20 N/mm.

After ageing, the average value of residual strength of the optional reinforced mesh (see 1.3.6) in the WEFT and WARP directions has to be at least [24]:

- 40 % of the strength in the as-delivered state
- and 20 N/mm.

The tensile strength and elongation in the WEFT and WARP directions of glass fibre mesh (standard, reinforced if relevant) used for test of watertightness are given in the ETA.

2.2.16.3 Base coat tensile characteristics

2.2.16.3.1 Tensile strength and the elongation of the reinforced strip

The tensile strength and the elongation of the reinforced strip of base coat are to be measured in the WEFT and WARP directions according to Annex K.

Following characteristics of base coat used for test of waterightness are given in the ETA:

- the characteristic crack width w_{rk} in mm at completed cracking for the WEFT and WARP direction of the rendering system with reference to the evaluation method applied,
- the width of cracks at 2 % render strain value after the render strip tensile test if displacement test according to Annex G was not performed,
- for organic rendering systems without observed cracking the mean values of the elongation at rupture ε_{ru} in % and the respective ultimate load N_{ru} in N.

2.2.16.3.2 Shrinkage of hardened mortar with thickness greater than 5 mm

The shrinkage of hardened mortar with thickness greater than 5 mm is to be tested on three samples according to L.1.3.1.2 of Annex L.

Shrinkage of each tested specimen after 28 days (and after 56 days if relevant) of base coat used for test of waterightness is given in the ETA.

2.2.16.3.3 Static modulus of elasticity, tensile strength and elongation at break of a base coat with a thickness up to 5 mm

The static modulus of elasticity, tensile strength and elongation at break of base coats with a thickness up to 5 mm is to be tested on five samples according to L.1.3.2 of Annex L.

Static modulus of elasticity, tensile strength and elongation at break of each tested specimen of base coat used for test of waterightness are given in the ETA.

23 Taken from Clause 2.2.21.2 of EAD 040083-00-0404.

24 Taken from Clause 2.2.21.2 of EAD 040083-00-0404.

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: 97/556/EC as amended.

The systems are: **2+**

For products covered by this EAD, also with regard to their reaction to fire, the applicable European legal act is decision 97/556/EC, as amended by decision 2001/596/EC.

The systems are: **1, 2+**

Interpreting the footnotes in the aforementioned EC decision system 1 shall always apply in case of Classes A1 to C, because for obtaining one of these classifications the addition of the flame retardants to (or the limitation of organic material in) the form mass is necessary.

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 6a.

The actions to be undertaken by the manufacturer of the product for the different components of the kit are laid down in Table 6b to 6d if the components are produced by the manufacturer himself and Table 6e when the components are not produced by the manufacturer himself but by its supplier under the specifications of the manufacturer.

Table 6a: Control plan for the manufacturer; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC)					
1	Components produced by the manufacturer himself:				
	▪ Thermal insulation boards	According to the EAD 040065-00-1201	According to the Control Plan	According to the EAD 040065-00-1201	According to the EAD 040065-00-1201
	▪ Adhesive, base coat, finishing coats	See table 6b	See table 6b	See table 6b	See table 6b
	▪ Glass fibre reinforcement mesh	See table 6c	See table 6c	See table 6c	See table 6c
	▪ Anchors	See table 6d	See table 6d	See table 6d	See table 6d
2	Components not produced by the manufacturer itself (*)	See table 6e	See table 6e	See table 6e	See table 6e
(*) Components produced by the supplier under the specifications of the manufacturer.					

Table 6b: Control plan if the adhesive, base coat and finishing coat are produced by the manufacturer itself; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC)					
Adhesive, base coat and finishing coat					
Incoming materials					
1	Receipt materials	Delivery ticket and/or label on the package Supplier certificates or supplier tests	Conformity with the order	---	Each delivery
2	Particle size grading	According to the Control Plan	According to the Control Plan	According to the Control Plan	According to the prescription of the manufacturer
3	Bulk density				
Production process					
4	Mixing process	According to the Control Plan	According to the Control Plan	According to the Control Plan	According to the Control Plan
5	Packing				
Finished component					
6	Density	Annex L.1.1.1	According to the Control Plan	According to test or control methods	According to the Control Plan (*)
7	Particle size grading (1) (2)	Annex L.1.1.4			
8	Dry extract at 105ºC (1)	Annex L.1.1.2			
9	Ash content at 450ºC (1) (2)	Annex L.1.1.3			
10	Modulus of elasticity, tensile strength and elongation (3)	Annex L.1.3.2			
11	Shrinkage (4)	Annex L.1.3.1.2			

(*) The frequency is determined case by case depending on the variation in the volume produced and the production process control.
(1) only for mortars delivered in paste
(2) on powder mortar
(3) only for base coat
(4) only for base coat with a thickness greater than 5 mm

Table 6c: Control plan when the glass fibre reinforcement mesh is produced by the manufacturer himself; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC)					
Glass fibre reinforcement mesh					
Incoming materials					
1	Receipt materials	Delivery ticket and/or label on the package Supplier certificates or supplier tests	Conformity with the order	---	Each delivery

No	Subject/type of control		Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Finished component						
1	Mass per unit area		EAD 040016-00-0404	According to the Control Plan	According to test or control methods	According to the Control Plan (*)
2	Ash content at 625 ºC		EAD 040016-00-0404			
3	Mesh size		EAD 040016-00-0404			
4	Tensile strength and elongation	in as-delivered state	EAD 040016-00-0404			
		After alkali conditioning				
(**) The frequency is determined case by case depending on the variation in the volume produced and the production process control.						

Table 6d: Control plan when the anchors are produced by the manufacturer himself; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC)					
Anchors					
Incoming materials					
1	Receipt materials	Delivery ticket or label on the package	Conformity with the order	---	Each delivery
		Supplier certificates or supplier tests			
Finished component					
1	Geometry	Test or control according to the Control Plan	According to the Control Plan	According to test or control methods	According to the Control Plan (*)
2	Mechanical characteristics	Test or control according to the Control Plan			
(**) The frequency is determined case by case depending on the variation in the volume produced and the production process control.					

Table 6e: Control plan when the components are not produced by the manufacturer; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC)					
1	Components belonging to Case 1 (*)	(1)	Conformity with the order	Testing is not required	Each delivery
		(2)	According to the manufacturer specifications	Testing is not required	Each delivery
2	Components belonging to Case 2 (*):	(1)	Conformity with the order	Testing is not required	Each delivery
	▪ Characteristics declared in DoP for the specific use within the kit.	(2)	According to the manufacturer specifications	Testing is not required	Each delivery

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
	▪ Characteristics not declared in DoP for the specific use within the kit.	(3)	According to the manufacturer specifications	According to the Control Plan	According to the Control Plan
3	Components belonging to Case 3 (*):	(1)	Conformity with the order	Testing is not required	Each delivery
		(3)	According to the manufacturer specifications	According to the Control Plan	According to the Control Plan

(1) Checking of delivery ticket and/or label on the package.
(2) Checking of technical data sheet and DoP or, when relevant: supplier certificates or supplier tests or test or control according to tables 6a to 6e above.
(3) Supplier certificates or supplier tests or Test or control according to tables 6a to 6e above.

(*) Case 1: Component covered by a hEN or its own ETA for all characteristics needed for the specific use within the kit.
Case 2: If the component is a product covered by a hEN or its own ETA which, however, does not include all characteristics needed for the specific use within the kit.
Case 3: The component is a product not (yet) covered by a hEN or its own ETA.

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of verification of constancy of performance for External Thermal Insulation Composite System (ETICS) with rendering, on insulation boards based on expanded polystyrene and cement are laid down in Table 7 and Table 8.

Table 7 Control plan for the notified body; cornerstones – system 1

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for system 1)*					
1	The notified body shall ascertain verify the ability of the manufacturer for a continuous and orderly manufacturing of the product. 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 test plan.	reaction to fire* based on 2.2.1; other related characteristics laid down in the control plan, see 3.2 and related characteristic in 2.1	According to the Control Plan	According to the Control Plan	1

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Continuous surveillance, assessment and evaluation of factory production control *(for system 1)*					
2	The notified body shall verify that - the manufacturing process of the kit components; - the system of factory production control; - the implementation of the prescribed Control Plan are maintained.	reaction to fire* based on 2.2.1; other related characteristics laid down in the control plan, see 3.2 and related characteristic in 2.1	According to the Control Plan	According to the Control Plan	1/ year

**Only relevant for products of Classes A1, A2, B or C. Products/materials for which clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).*

Table 8 Control plan for the notified body; cornerstones – system 2+

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for system 2+)*					
1	The notified body shall ascertain verify the ability of the manufacturer for a continuous and orderly manufacturing of the product. 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 test plan.	Laid down in the control plan, see 3.2 and related characteristic in 2.1	According to the Control Plan	According to the Control Plan	1
Continuous surveillance, assessment and evaluation of factory production control *(for system 2+)*					
2	The notified body shall verify that - the manufacturing process of the kit components; - the system of factory production control; - the implementation of the prescribed Control Plan are maintained.	Laid down in the control plan, see 3.2 and related characteristic in 2.1	According to the Control Plan	According to the Control Plan	1/ year

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

Special methods of control and testing used for the verification of constancy of performance are given in Annex L as follows:

L.1 Adhesives, base coats, key coats and finishing coats

L.2 Thermal insulation product

L.3 Mechanical fixing devices

4 REFERENCE DOCUMENTS

EN 196-1:2016	Methods of testing cement - Part 1: Determination of strength
EN 197-1:2011	Cement - Part 1: Composition, specifications and conformity criteria for common cements
EN 822:2013	Thermal insulating products for building applications - Determination of length and width
EN 823:2013	Thermal insulating products for building applications - Determination of thickness
EN 824:2013	Thermal insulating products for building applications - Determination of squareness
EN 825:2013	Thermal insulating products for building applications - Determination of flatness
EN 826:2013	Thermal insulating products for building applications - Determination of compression behaviour
EN 998-1:2016	Specification for mortar for masonry – Part 1: Rendering and plastering mortar
EN 1602:2013	Thermal insulating products for building applications - Determination of the apparent density
EN 1603:2013	Thermal insulating products for building applications - Determination of dimension stability under constant normal laboratory conditions (23°C / 50% Relative Humidity).
EN 1604:2013	Thermal insulating products for building applications - Determination of dimensional stability under specified temperature and humidity conditions
EN 1607:2013	Thermal insulating products for building applications - Determination of tensile strength perpendicular to the faces
EN 1609:2013	Thermal insulating products for building applications - Determination of short term water absorption by partial immersion
EN 1934:1998	Thermal insulation - Determination of steady state thermal transmission properties - Calibrated and guarded hot box
EN 1990:2002+A1:2005	Eurocode: Basis of structural design
EN 1991-1-1:2002	Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
EN 1991-1-4:2005	Eurocode 1: Actions on structures - Part 1-4: General actions - Wind loads
EN 1991-1-5:2003	Eurocode 1: Actions on structures - Part 1-5: General actions – Thermal actions
EN 1992 series	Eurocode 2: Design of concrete structures
EN 1996 series	Eurocode 6: Design of masonry structures
EN 10218-1:2012	Steel wire and wire products - General. Part 1: Test methods
EN 12004:2007+A1:2012	Adhesives for tiles – Requirements, evaluation of conformity, classification and designation
EN 12086:2013	Thermal insulating products for building applications - Determination of water vapour transmission properties

EN 12090:2013	Thermal insulating products for building applications - Determination of shear behaviour
EN 12524:2000	Building materials and products - Hygrothermal properties - Tabulated design values
EN 12664:2001	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance.
EN 12667:2001	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance
EN 13238:2010	Reaction to fire tests for building products. Conditioning procedures and general rules for selection of substrates
EN 13501-1:2018	Fire classification of construction products and building elements: Part 1 – Classification using test data from reaction to fire tests
EN 13823:2010+A1:2014	Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item
EN 15715:2009	Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products
EN 15824:2017	Specification for external renders and internal plasters based on organic binders
EN 16383:2016	Thermal insulation products for building applications - Determination of the hygrothermal behaviour of external thermal insulation composite systems with renders (ETICS)
EN 16516:2017	Construction products: Assessment of release of dangerous substances. Determination of emissions into indoor air
EN 1946-1:1999	Thermal performance of building products and components - Specific criteria for the assessment of laboratory measuring heat transfer properties - Part1: Common criteria
EN 1946-4:2000	Thermal performance of building products and components - Specific criteria for the assessment of laboratories measuring heat transfer properties - Part 4: Measurements by hot box method
EN 9052-1:1992	Acoustic – Determination of dynamic stiffness – Part 1: Material used under floating floors in dwellings (idt. ISO 9052-1)
EN 29053:1993	Acoustics - Materials for acoustical applications - Determination of airflow resistance
EN ISO 717-1:2013	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation
EN ISO 1182:2010	Reaction to fire tests for building products – Non combustibility test
EN ISO 1716:2018	Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value)
EN ISO 3386-1:1997/A1:2010	Flexible cellular polymeric materials– Determination of stress – strain characteristic in compression- Part 1: Low-density materials
EN ISO 3386-2:1998/A1:2010	Flexible cellular polymeric materials– Determination of stress – strain characteristic in compression - Part 2: High-density materials

EN ISO 6341:2012 Water quality - Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) - Acute toxicity test

EN ISO 6946:2017 Building materials and products - Thermal resistance and thermal transmittance - Calculation method

EN ISO 8990:1996 Thermal insulation - Determination of steady state thermal transmission properties - Calibrated and guarded hot box

EN ISO 10211:2017 Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations.

EN ISO 10140-1:2016 Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1:2010)

EN ISO 10140-2:2010 Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation (ISO 10140-2:2010)

EN ISO 10140-4:2010 Acoustics - Laboratory measurement of sound insulation of building elements - Part 4: Measurement procedures and requirements (ISO 10140-4:2010)

EN ISO 10140-5:2010/Amd.1:2014 Acoustics - Laboratory measurement of sound insulation of building elements - Part 5: Requirements for test facilities and equipment (ISO 10140-5:2010)

EN ISO 10456:2007/AC:2009-12 Building materials and products – Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values.

EN ISO 10703:2015 Water quality - Determination of the activity concentration of radionuclides - Method by high resolution gamma-ray spectrometry

EN ISO 11348-1:2008/A1:2018 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 1: Method using freshly prepared bacteria

EN ISO 11348-2:2008/A1:2018 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 2: Method using liquid-dried bacteria

EN ISO 11348-3:2008/A1:2018 Water quality - Determination of the inhibitory effect of water samples on the light emission of Vibrio fischeri (Luminescent bacteria test) - Part 3: Method using freeze-dried bacteria

EN ISO 11925-2:2010/AC:2011-01 Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test

EN ISO 12572:2016 Hygrothermal performance of building materials and products – Determination of water vapour transmission properties – Cup method

EN ISO 13788:2012 Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods

ISO 2602:1980 Statistical interpretation of test results - Estimation of the mean - Confidence interval

ISO 3534-1:2006 Statistics - Vocabulary and symbols - Part 1: General statistical terms and terms used in probability

ISO 6707-1:2017 Buildings and civil engineering works - Vocabulary - Part 1: General terms

ISO 7892:1988	Vertical building elements - Impact resistance tests - Impact bodies and general test procedures
ISO 15799:2019	Soil quality - Guidance on the ecotoxicological characterization of soils and soil materials
CEN/TS 16637-2:2014	Construction products - Assessment of release of dangerous substances - Part 2: Horizontal dynamic surface leaching test
OECD Test Guideline 301:1992	Ready biodegradability, part A, B or E
ASTM C91/C91M-18	Standard specification for masonry cement
EAD 040016-00-0404	Glass fibre mesh for reinforcement of cement based renderings
EAD 040065-00-1201	Thermal insulation an/or sound absorbing boards based on expanded polystyrene and cement
EAD 040083-00-0404	External thermal insulation composite systems (ETICS) with renderings (superseding technical specification “ETAG 004”)
EAD 330196-01-0604	Plastic anchors made of virgin or non-virgin material for fixing of external thermal insulation composite systems with rendering (short form: Plastic anchors for ETICS)

ANNEX A – REACTION TO FIRE - SPECIFIC TEST CONDITIONS

A.1. Common

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

For the particular types of ETICS components the following principles apply:

- the base coat and finishing coat with the highest amount of organic content (related to the mass in dried condition as in end use application) or the highest Q_{PCS} value (according to EN ISO 1716. [25]) shall be used for preparing the specimen,
- each decorative coat and key coat shall be tested unless it can be neglected according to the rules below. If there are only differences in the amount of organic content but no difference in the organic component itself, the decorative coat and the key coat with the highest organic content or the highest Q_{PCS} value according to EN ISO 1716 [25]) of this organic component shall be tested,
- the decorative coat and/or the key coat can be neglected as long as they comply with the following: [26])
    - the thickness of the decorative coat is less than 200 µm,
    - and the content of organic components is of not more than 5 % (related to the mass in dried condition as in end use application)
- In addition, each coat selected for testing according to the rules above before shall have the lowest amount of flame retardants.

Product characteristics influencing the reaction to fire behaviour:

- Type of thermal insulation product (composition, thickness, density)
- Type of base coat and finishing coats (composition, thickness, mass per unit area)
- Type of key coats and decorative coats (composition, mass per unit area)
- Type of reinforcement (composition, thickness, mass per unit area)
- Type and nature of fixings
- Type and nature of fire breaks (interruptions to the continuity of insulation or any cavity
- The organic content of the binder and of any organic additive; this can be checked by providing the formulation of the component, by performing suitable identification tests or by determining the glow loss or net calorific value
- Type and amount of flame retardant intended to maintain or improve the reaction to fire performance of the ETICS or its components and consequently of building elements to which they are applied.

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

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[25]) The manufacturer is responsible for the information on organic content per unit area and gross heat of combustion (Q_{PCS}). If the information is not available, the Q_{PCS} value is tested to decide about the critical case.

[26]) This rule can be reconsidered when more experience and test result are available.

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

If necessary, gross heat of combustion (Q_{PCS}) is to be determined according to EN ISO 1716.

A.2. Testing according to EN ISO 1182

This test method is relevant for the classes A1 and A2.

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

In the following, the thermal insulation product, the base coat and the finishing coat are identified as the most significant 'substantial components', but the adhesive, the key coat, the decorative coat and any reinforcement may also be 'substantial components'.

Parameters relevant for this test method are:

- composition,
- density.

A.2.1 Thermal insulation product

For ETICS expected to be classified as A1 or A2, it is anticipated that only thermal insulation products with reaction to fire class A1 or A2 will form the insulation layer. For testing the thermal insulation product reference shall be made to the relevant product standards.

A.2.2 Render coatings

A.2.2.1 Base coats and finishing coats

The reaction to fire behaviour of base coats and finishing coats not falling under EC Decision 96/603/EC (as amended) shall be tested according to the principle specified in § General.

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

Differences concerning the density shall be considered by testing the lowest and the highest density.

A.2.2.2 Key coats and decorative coats

The principles specified in A.1 "Principle" shall be applied.

A.2.3 Adhesive

The same rules as given in A.2.2 above shall be applied.

A.2.4 Reinforcement

Each type of reinforcement that fulfils the requirements of a 'substantial component' shall be tested according to EN ISO 1182. Reinforcement that is randomly dispersed (e.g. fibres) in the render shall be tested as part of the render.

A.3 Testing according to EN ISO 1716

This test method is relevant for the classes A1 and A2.

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

Parameters relevant for this test method are: composition (when performing calculation of the Q_{PCS}-value, density or mass per unit area and thickness are relevant). Mechanical fixings and ancillary materials which are not continuous but discrete components of ETICS shall not to be considered for testing and for the calculation of the Q_{PCS}.

A.3.1 Thermal insulation product

For testing the thermal insulation product, reference shall be made to the relevant product standards.

It is not realistic to require that each thermal insulation product of the same type is tested within the classification of an ETICS. If the thermal insulation products come from different manufacturers and/or are of different thickness, density and formulation from those used in the testing, these may be used subject to the requirements of class A1 and A2 still being fulfilled.

It shall be proved by calculation (undertaken by responsible body) that the ETICS, together with the actual thermal insulation product used in end use application, still fulfils the requirements concerning the Q_{PCS} -value of product as the whole. For example, it is sufficient to determine the Q_{PCS} -value of the thermal insulation material and if this is lower than the originally tested product then it is acceptable to use the alternative insulation product instead of that used in the original test. [27]

A.3.2 Render coating

In general, when performing calculations of the unit area referred Q_{PCS}-value (related to the surface) the variant that provides the highest Q_{PCS} -value shall be considered.

The test shall be performed in accordance with the principles specified in A.1 General applied to each component of the render coating.

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

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

A.3.3 Adhesive

For the component adhesive of the ETICS, each product with a different formulation shall be tested for reaction to fire behaviour by selecting the variant with the highest amount of organic components. The test results can be directly applied to all variants with the same composition but lower amount of organic components. For the case where one of the render coatings is used as the adhesive, the rules according to A.3.2 shall be applied.

A.3.4 Reinforcement

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

A.4 Testing according to EN 13823 (SBI-test)

This test method is relevant for the classes A2, B, C and D, in some cases also for A1. [28])

In this test procedure the complete ETICS shall be tested. The ETICS is fixed to a substrate as given in Clause 5.3.2.2 of EN 15715. The fixing shall be made using either the adhesive used in the end use application or, in the case of purely mechanical fixing, by using the means of mechanical fixing used in the end use application. When adhesives are used, the test result is valid also for mechanical fixings.

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[27]) Information relating to alternative insulation products of the same type to that originally tested may be evaluated on the basis of the supplier's evidence provided within the context of its CE marking.

[28]) In cases according to Regulation (EU) 2016/364, Table 1, Footnote 2a; case A1 mentioned in EN 13501-1+A1 does not apply to ETICS.

When a purely mechanical fixing with plastic anchors is used the test result is valid also for metallic anchors.

The maximum testable thickness of the test specimen, including a standard substrate according to EN 13238, is 200 mm. However, in practice, for many ETICS, the total overall thickness may be greater than 200 mm. In such cases, using a standard substrate, the thickness of the thermal insulation product shall be reduced to provide for the maximum specimen thickness of 200 mm. Results obtained on an ETICS at 200 mm thickness are accepted for greater thicknesses.

The test specimen consists of a corner construction which shall be representative of the construction in practice. All edges are covered with the rendering system excluding the bottom edge and the top of the specimen. The floor of the test trolley beneath the test specimen can be covered by an aluminium foil (see figure A.1).

It is recommended to:

- either prepare the specimens at the lab and then put it onto the trolley (with the foil on)

or

- the manufacturer builds the wall at the factory and carries it to the lab where it is put onto the trolley.

After preparation of the test specimens they shall be conditioned according to EN 13238.

Parameters which are relevant:

- amount of adhesive
- type, thickness and density of thermal insulation product
- type, binder and thickness of each coat of render coating
- amount of organic content of each coat of render coating
- amount of flame retardant of each coat of render coating
- type of reinforcement

In principle, it is desirable to find the test specimen configuration that gives the critical case concerning the reaction to fire test results. In the test procedure according to EN 13823, values for the rate of heat release, total heat release, lateral flame spread, rate of smoke release, total smoke release and burning droplets are determined. Due to the possible effects of the thermal insulation product, the following proposals are divided by considering separately the testing of ETICS with class A1 and A2 thermal insulation products and the testing of ETICS with class B, C, D and E thermal insulation products.

A.4.1 Thermal insulation product

For the testing of ETICS with thermal insulation products with reaction to fire class A1 or A2 the thermal insulation product with the highest thickness, the highest density (with a tolerance of ±10 %) and the highest organic content (related to the mass in dried condition) has to be used for preparing the test specimen. The reaction to fire classes A1 or A2 of the thermal insulation product shall be proven separately. [29])

For the testing of ETICS with thermal insulation products with reaction to fire class B, C, D or E, each type of thermal insulation product shall be tested within the system. For each type of thermal insulation product the thermal insulation product with the highest thickness and the highest density (with a tolerance of 10 %) shall be used for preparing the test specimen. The reaction to fire class B, C, D or E of the thermal insulation product shall be proven separately. [29])

[29]) In some Member States requirements might exist to demonstrate the behaviour of products with respect to continuous glowing combustion in the case of fire. The mandates for the product standards, therefore, are currently under revision. Additional national assessment e.g. on the basis of national procedures to demonstrate this behaviour might be required until a European harmonised procedure is available.

Annex A of EAD 040065-00-1201, for choosing the samples and executing the relevant reaction to fire tests shall be applied.

For testing ETICS which are mounted onto the substrate by using an adhesive (only bonded or mechanically fixed and bonded) three specimens shall be prepared and tested

- with the highest thickness of the thermal insulation product in cases where the adhesive has an organic content of equal to or less than 15 % (related to the mass in dried condition and in end use application) and

- with the highest and the lowest thickness of the thermal insulation product in cases where the adhesive has an organic content of more than 15 % (related to the mass in dried condition and in end use application).

A.4.2 Render coatings

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

- The base coat, the key coat, the finishing coat and the decorative coat to be used for preparing the specimen, taking account of the permissible combination(s) allowed by the manufacturer, shall be determined in accordance with the principles specified in A.1. General.

- For a base coat and a finishing coat having an organic content less than or equal to 5 % (related to the mass in dried condition as used in the end use application), only the lowest thickness needs to be used for preparing the test specimen.

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

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

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

A.4.3 Adhesive

The influence of the type of adhesive having an organic content of equal to or less than 15 % (related to the mass in dry condition) is assumed to be negligible. Only the amount of organic content is considered important. Therefore, an adhesive with the highest amount of organic content should be used for preparing the test specimens applied at the maximum thickness.

The influence of adhesives having an organic content of more than 15 % cannot be assumed to be negligible. Therefore, each type of adhesive with a different composition shall be tested by selecting the variant with the highest organic content.

A.4.4 Reinforcement

The specimens shall be prepared with the reinforcement that is intended to be used in end use application. If different reinforcements are intended to be used, the reinforcement with the highest Q_{PCS}-value per unit area shall be used for preparing the SBI specimen. At the long wing of the SBI specimens a vertical joint of the reinforcement shall be included at a distance of 200 mm away from the inner corner of the specimens by 100 mm overlapping of the two layers of the reinforcement (that means the joint begins at a distance of 150 mm and ends at a distance of 250 mm away from the inner corner). The test results from a system with an overlap of the reinforcement of 10 cm are valid for all joints with an overlapping of 10 cm or more.

A.4.5 Application of test results

The test result is valid for:

- thermal insulation products:

- of the same type,
- with lower density,
- with lower thickness or between those evaluated in the tests, provided that the worst result of the two thicknesses tested is used for intermediate thicknesses,
- with equal or less organic content,

- base coats and finishing coats:
  - with equal or less organic content,
  - with equal or greater content of the same type of flame retardants,
  - with equal or greater thickness if the organic content is equal to or less than 5 %,
  - with thickness between those evaluated, provided that the worst result of the two thicknesses tested is used for intermediate thicknesses
- key coats:
  - with equal or less organic content,
  - with equal or greater content of the same type of flame retardants,
- decorative coats:
  - with equal or less organic content per unit area,
  - with equal or greater content of the same type of flame retardants,
- adhesives:
  - with equal or less organic content and equal or less thickness if the organic content is equal to or less than 15 %,
  - of the same type, with equal or less organic content and equal or less thickness if the organic content is greater than 15 %,
- reinforcements:
  - with an equal or lower Q_{PCS}-value per unit area.

A.5 Testing according to EN ISO 11925-2

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

In this test procedure, the ETICS is tested without using a substrate. The maximum thickness of the test specimen is 60 mm. In cases where the thickness of the ETICS is larger than 60 mm, the thermal insulation product may be reduced for the purposes of testing. The results from the testing of specimens at 60 mm are applicable to greater thicknesses.

Parameters which are relevant:

- type and amount of adhesive,
- type, thickness and density of thermal insulation product
- type, binder and thickness of each coat of render coating
- amount of organic content of each coat of render coating
- amount of flame retardant of each coat of render coating

- type of reinforcement.

The specimens are prepared in such a way that the edges are not covered with the rendering system (cut edges). The tests are performed with surface flaming of the front side and possibly edge flaming of the test specimen turned by 90° according to the rules of standard EN ISO 11925-2.

A.5.1 Thermal insulation product

A thermal insulation product, representative in its characterisation (type, reaction to fire classification and density) for the end use application shall be used. The ETICS shall be evaluated incorporating the thermal insulation product at the highest possible thickness and the highest and the lowest possible densities.

For ETICS with thermal insulation products classified class E, the test results are valid only for the thermal insulation products as used in the test. Manufacturer has the possibility of using thermal insulation products from different manufacturers when the following additional tests are performed and conditions are fulfilled or the manufacturer provides the necessary evidence. For thermal insulation products, it shall be proven separately that the product fulfils the requirements for reaction to fire class E.

Annex A of EAD 040065-00-1201, for choosing the samples and executing the relevant reaction to fire tests shall be applied.

A.5.2 Render coatings

For testing one specific rendering system representing a range of different coats, the rules as mentioned in A.4.2 apply.

A.5.3 Adhesive

For adhesives (mortars) having an organic content of equal to or lower than 15 % (related to the mass in dried condition) it can be assumed that they fulfil the requirements of the class B without testing according to EN ISO 11925-2. Therefore, no need exists to take into account such adhesives for preparing and testing specimens of ETICS according to this standard.

For adhesives having an organic content of more than 15 % (related to the mass in dried condition) it is necessary to carry out a complete set of six additional tests on specimens turned at 90 degrees on their vertical axis with edge exposure of the adhesive layer. The specimens consist of the substrate, the adhesive and the thermal insulation product. The following rules shall be applied for preparing the specimens.

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

A.5.4 Reinforcement

The specimen shall be prepared with the reinforcement intended to be used in end use application. If different reinforcements are intended to be used, the reinforcement with the highest Q_{PCS}-value per unit area has to be tested.

A.5.5 Application of test results

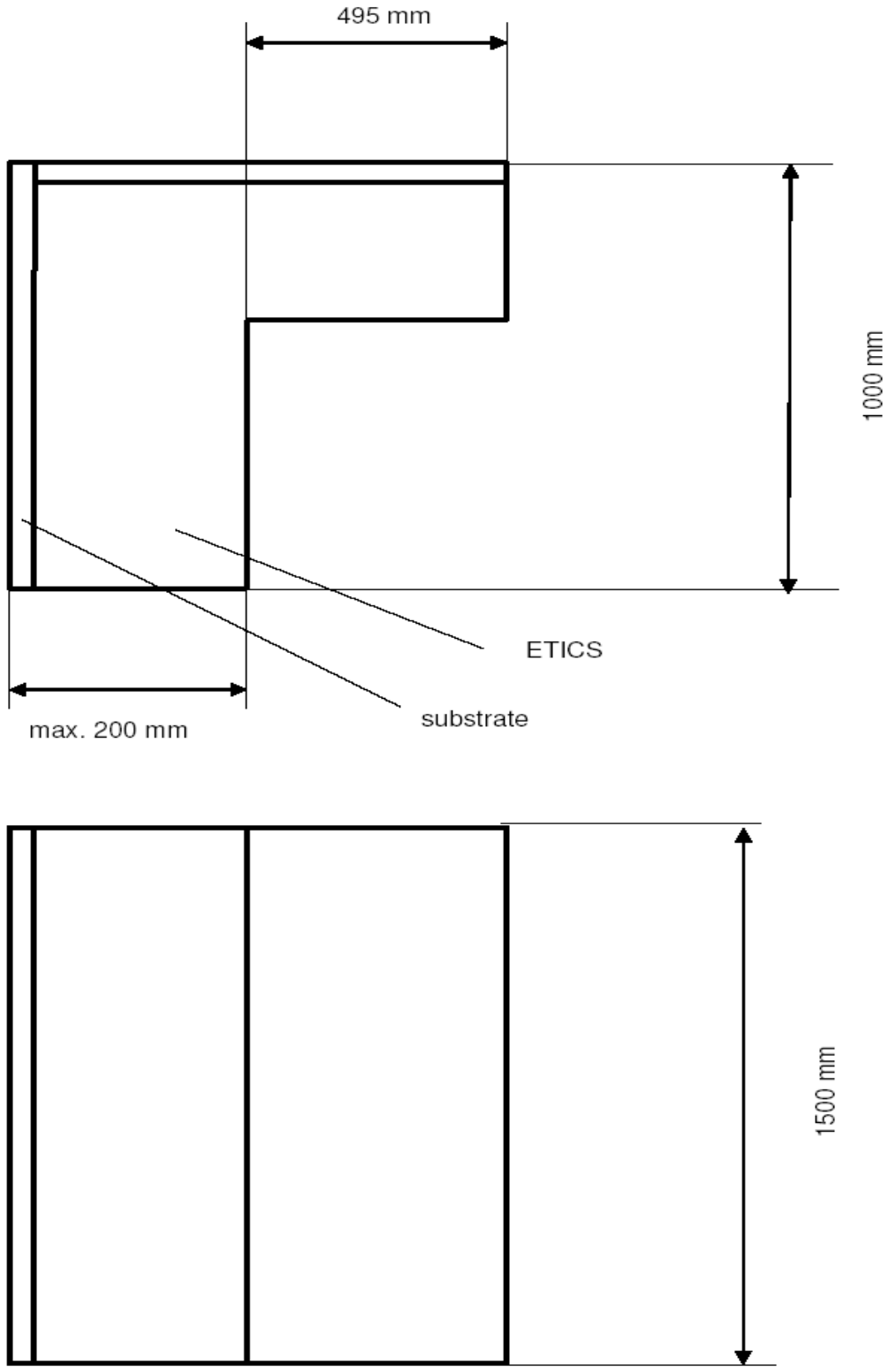
The test result covers end use application arrangements with the same type of thermal insulation product (excluding insulation made of polystyrene classified as reaction to fire class E) as used in the tests with thicknesses and densities as described in A.5.1 and equal or lower organic content.

The test results from tests with thermal insulation products made of polystyrene classified class E are valid for ETICS with thermal insulation products as used in the test or for ETICS with any polystyrene thermal insulation products classified class E when the test evidence according to A.5.1 was provided.

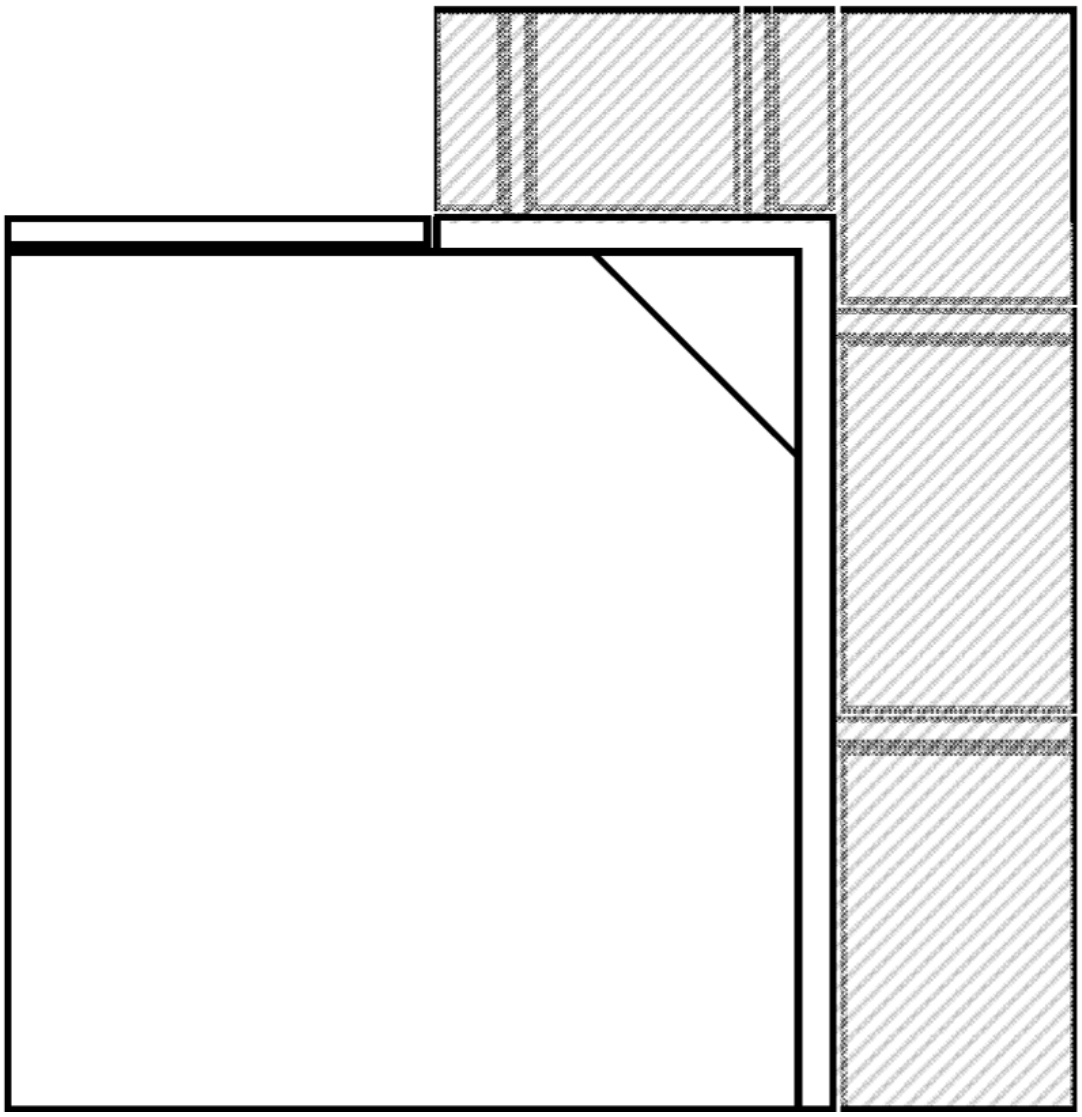
For the direct application of test results regarding base coat, key coat, finishing coat, decorative coat, reinforcement and adhesive the same rules shall apply as given in clause A.4.5.

Figure A.1: Schematic drawing of the test specimen in the SBI-test according to EN 13823

Remark: This proposed test specimen arrangement is not in accordance with the standard due to the extended substrate of the small specimen wing, but is supposed to represent better the end use application.



Aluminium foil covered area shown in grey hatching:



A.6 Assessment methods applied in EU / EFTA member states for assessing the fire performance of facades

Country	Assessment method
Austria	ÖNORM B 3800-5
Czech Republic	ČSN ISO 13785-1
Denmark, Sweden, Norway	SP Fire 105
Finland	• SP Fire 105 • BS 8414
France	LEPIR 2
Germany	• DIN 4102-20 Complementary reaction-to-fire test for claddings of exterior walls, • Technical regulation A 2.2.1.5
Hungary	MSZ 14800-6:2009 Fire resistance tests. Part 6: Fire propagation test for building façades
Ireland	BS 8414 (BR 135)
Poland	PN-B-02867:2013
Switzerland, Liechtenstein	• DIN 4102-20 • ÖNORM B 3800-5 • Prüfbestimmung für Aussenwandbekleidungssysteme

ANNEX B – WATER ABSORPTION TEST

B.1 Common

These tests have 3 purposes, to determine:

- the water absorption, in order to assess according to 2.2.2 further process of testing,
- which finishing coats should be applied on the rig to be subjected to hygrothermal test on the rig,
- whether the freeze-thaw testing described in Annex D is necessary.

B. 2 Preparation of the samples

Samples are prepared each by taking a piece of the specified thermal insulation product. Surface area to be at least 200 mm x 200 mm. Samples are applying in accordance with the manufacturer's instructions, e.g. thickness, mass per unit area and method of application, both:

- the reinforced base coat alone

and

- all the configurations of complete rendering systems proposed by the manufacturer, i.e. reinforced base coat covered with each type of finishing coat and (associating or not) key coat and/or decorative coat. If the application of the key coat and/or the decorative coat is optional, at least configurations without them shall be tested.

Within a type of finishing coat, the test shall be carried out with at least the thickest layer (generally higher particle size grading with floated finishing aspect).

Three samples are prepared for each configuration. Quantities and/or thicknesses applied shall be recorded as well as identification of the render's components according to Annex L.

The edges of the samples the thermal insulation product included are sealed against water to ensure that during subsequent testing only the face of the reinforced base coat or the rendering system is subjected to water absorption. After preparation the samples are conditioned for at least 7 days, but no more than 10 days at (23 ± 2) °C and (50 ± 5) % RH.

After conditioning the test samples are subjected to a series of 3 cycles comprising the following phases:

- 24 h immersion in a water bath (tap water) at (23 ± 2) °C. The samples are immersed rendered face downwards, to a depth of 2 to 10 mm, the depth of immersion dependent upon surface roughness. To achieve complete wetting of rough surfaces, the samples shall be tilted as they are introduced into the water. The depth of immersion can be regulated in the water tank by means of a height-adjustable slat.
- 24 h drying at (50 ± 5) °C.

If interruptions are necessary (e.g. at week-ends etc.) the samples are stored at (23 ± 2) °C and (50 ± 5) % RH after the drying at (50 ± 5) °C.

After the cycles the samples are stored for at least 24 h at (23 ± 2) °C and (50 ± 5) % RH.

B.3 Capillarity test procedure:

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

The samples are weighed after 3 minutes' immersion in the bath and weight is recorded as reference mass with accuracy in 0.1 g.

The samples are immersed for 1 hour and then for 24 hours in total. After both of periods they are removed, the surface of the samples is dried with a damp sponge cloth carefully and samples are weighted. Their weight is recorded again.

B.3 Analysis of test results:

Calculation is undertaken to determine the mean (average) water absorption of the three samples per square meter after 1 and 24 hours. The outcome of these results will determine the following:

- Necessity of further testing of water absorption of the reinforced base coat with finishing coat and key coat / decorative coat respectively according to this EAD:

  If the water absorption of the reinforced base coat after 1 hour is equal to or more than 1 kg/m^2, the water absorption after 1 hour of each rendering system shall be tested.

- Hygrothermal behaviour:

  For the choice of the finishing coats to be applied on the rig, see 2.2.5.1,

- Freeze-thaw test:

  For the choice of the finishing coats see 2.2.5 and Figure 1.

  The freeze-thaw test (see 2.2.5 and Figure 1) shall be performed if the water absorption of either the reinforced base coat or the rendering coating is equal to or more than 0.5 kg/m^2 after 24 hours.

Note: In order to provide information about the stabilization for some ETICS the water absorption measured can be plotted on a chart as a function of $\sqrt{t}$.

ANNEX C – TESTS OF WATER VAPOUR PERMEABILITY

C.1 Common

Within a type the test has to be carried out with the thickest continuous layer (generally higher particles size grading with floated finishing aspect).

C.2 Samples

The samples are prepared by applying the rendering to the thermal insulation product in accordance with the manufacturer's instructions and conditioned for at least 28 days at (23 ± 2) °C and (50 ± 5) % RH. Quantities and/or thicknesses applied are to be recorded as well as density of hardened base coat, particle size grading of base coat and finishing coat and ash content of base coat, finishing coat, key coat and decorative coat (if used).

Than five test samples of at least 5000 mm^2 are obtained by separating the rendering system from the thermal insulation product.

C.3 Test procedure

The test is carried out on the rendering system in accordance with EN ISO 12572.

The test is to be carried out in according to Test conditions set C, wet state, aqueous solution of of ammonium dihydrogen phosphate ($NH_4H_2PO_4$).

C.4 Result of test

The results are expressed as water-vapour diffusion-equivalent air layer thickness in metres (of air) and the resistance to water vapour diffusion is determined as the mean value of measured specimens.

The value of water-vapour diffusion-equivalent air layer thickness in metres (of air) is to be stated on the tested rendering system(s) with precision corresponding to enable the designer to evaluate the risk of interstitial condensation.

Usually the result of tests is to be rounded to 1/10 m (one decimal).

ANNEX D – FREEZE-THAW TESTS

D.1 Freeze-thaw test of rendering - Common

Freeze-thaw resistance of the ETICS is considered as acceptable if the water absorption of both the reinforced base coat and the rendering system is less than 0.5 kg/m² after 24 hours.

In all other cases the following test of freeze-thaw shall be performed.

The test shall be carried out on three samples 500 mm x 500 mm consisting of a piece of the specified thermal insulation product covered by:

- reinforced base coat without finishing coat if its water absorption is equal to or higher than 0.5 kg/m^2 after 24 hours,
- all the configurations of rendering systems proposed by the manufacturer (i.e. reinforced base coat covered with each type of finishing coat and (associating or not) key coat and/or decorative coat which lead to a water absorption equal to or higher than 0.5 kg/m^2 after 24 hours. If the application of the key coat and/or the decorative coat is optional, at least configurations without them shall be tested.

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

If the thermal insulation board has one dimension at least smaller, the test can be performed on square specimens of smaller dimensions. Dimensions of test specimen in that case are to be given in the ETA.

Quantities and/or thicknesses applied shall be recorded as well as related characteristics of the render's components according to Annex L.

D.2 Cycles

Than the samples are subjected to a series of 30 cycles (one cycle lasts for 24 hours) comprising of:

- exposure to water for 8 hours at initial temperature of (23 ± 2) °C by immersion of the samples, render face downwards in a water bath, by the method described in Annex B (water absorption test),
- freezing to (-20 ± 2) °C, fall to prescribed temperature for 5 hours measured at the sample surface or for 2 hours measured in the conditioned air, standing for 11 and 14 hours respectively, total of 16 hours. The regulation is to be obtained by conditioned air.

Starting the test samples are manually inserted in water bath as prescribed. After their conditioning they are manually transferred into freeze chamber. When freezing period is finished, they are manually transferred back into water bath and the cycle repeats.

If the test is interrupted, because the samples are handled manually and there are stops during weekends, the samples shall always be maintained immersed in water between the cycles as described in described in Annex B.

When required number of cycles is achieved, the test samples are manually removed from freeze chamber and for test of bond strength dried at least 7 days, but no more than 10 days, at (23 ± 2) °C and (50 ± 5) % RH.

D.3 Observations after the test

Immediately at the end of the freeze-thaw test cycles observations relating to a change in characteristics of the surface or to the behaviour of the entire ETICS are recorded according to 2.2.5.1.

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

A bond strength test shall be performed in accordance with F.5 on each sample submitted to freeze-thaw cycles and result shall be reported.

D.4 Test report

Test report on freeze-thaw resistance shall contain at least:

- registered data of the stages of the installation:
    - the date and time of the various stages
    - name and production lot of the components
    - way of renders preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers,…)
    - quantities and/or thickness of renders applied per square metre
    - drying period between each layer
    - any other information meaningful for the test and its result.
- registered values of bond strength and impact resistance of each sample.

D.5 Freeze-thaw test of complete system exposed to water - Common

The freeze-thaw test with the complete system exposed to water is to be performed, if the water absorption of the thermal insulation is higher than 1 kg/m^2.

D.6 Preparation of the specimen

The test shall be carried out on at least three specimens.

Dimensions of test specimen 500 mm x 500 mm, but if the thermal insulation board has one dimension at least smaller, the test can be performed on square specimens of smaller dimensions. Dimensions of test specimen in that case are to be given in the ETA.

These specimens are prepared according to the manufacturer's instructions on a piece of the specified insulation product covered by all the configurations of rendering systems proposed by the ETA-applicant (i.e. reinforced base coat covered with each type of finishing coat and (associating or not) key coat and/or decorative coat. If the application of the key coat and/or the decorative coat is optional, at least configurations without them shall be tested).

These test specimens are to be cured for at least 28 days at (23 ± 2) °C and (50 ± 5) % RH.

Quantities and/or thicknesses applied are to be recorded as well as identification of the skin components.

After curing before the test the sides of the test specimen including the insulation board are to be sealed by coating against water to ensure them during subsequent testing.

D.7 Freeze-thaw cycles

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

1. Water immersion of the specimen placed horizontally, with rendering system facing down for 30 minutes. The bottom surface shall be at least 5 cm below the waterline.

2. Water dripping of the specimen placed vertically on a grid at (23 ± 2) °C and (50 ± 5) % RH for 30 minutes. In every cycle, the sample is laid on a different side so that it rotates in angle 90 º.

3. Freezing of the specimen by cold air at (-15 ± 3) ºC for 2 hours at least.

4. Stabilization of the test specimen in air at (23 ± 2) °C and (50 ± 5) % RH for 1 hour at least.

D.8 Observations

At the end of the test, observations relating to a change in characteristics of the surface are recorded as follows:

- the surface of the ETICS must be examined to establish whether any cracking has occurred. The dimensions and position of any cracks should be measured and recorded,
- the surface should also be checked for any blistering or peeling and the location and extent should again be recorded,
- any distortion at the edges of the specimens shall.

D.9 After the cycles

After the freeze-thaw cycles, bond strength test (see 2.2.16.1) is to be carried out on each specimen submitted to freeze-thaw cycles.

These tests are to be performed after at least 7 days of drying, but no more than 10 days, at (23 ± 2) °C and (50 ± 5) % RH.

D.10 Test report

See D.4

ANNEX E – IMPACT RESISTANCE TEST

E.1 Common

The hard body impact test shall be performed according to ISO 7892 on the rig after the watertightness test (heat-rain and the heat-cold cycles) according to 2.2.16.

The test shall be performed on 3 samples by 2 types of steel ball in 2 impact energies:

- impact energy of 10 J carried out with the steel ball of 1.0 kg falling from a height of 1.02 m,
- impact energy of 3 J carried out with the steel ball of 0.5 kg falling from a height of 0.61 m.

Within a type of finishing coat, the test shall be carried out with the thinnest layer at least (generally on the lowest particle size grading with ribbed finishing aspect).

The tested points of impact are to be selected taking into account various modes of behaviour of boards, their cladding (in joints and in medium part of boards) and location of impact point in an area of bigger rigidity (connections of reinforcement) to find the weakest point.

If necessary complementary tests (finish coats not tested on the rig, double meshes, etc.) shall be carried out on separate samples.

E.2 Observation after the test

At the end of the test following observations relating to behaviour of ETICS are recorded:

- the diameter of the impact is measured and recorded,
- the presence of any micro cracks or cracks at the impact point and at the circumference is observed and reported.

E.3 Complementary tests

Complementary tests shall be tested on separate samples of dimensions 500 × 500 mm at least and aged by immersion in water for 6 to 8 days according to 2.2.2 and then dried for 7 days, but no more than 10 days, at least at (23 ± 2) °C and (50 ± 5) % RH.

Within a type of finishing coat, the test shall be carried out with at least the thinnest layer (generally the lowest particle size grading with ribbed finishing aspect). Quantities and/or thicknesses applied shall be recorded as well as identification of the render's components according to Annex L.

In case of test with reinforced mesh, the extrapolation of results to very different products (other mesh size, other mass per unit area, etc.) shall be carefully examined.

In case of possible optional use of key coat and/or decorative coat, the configurations without them shall be tested at least.

E.4 Test report

Test report on impact resistance shall contain at least:

- registered data of the stages of the installation:
    - the date and time of the various stages
    - name and production lot of the components
    - way of renders preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers,…)
    - quantities and/or thickness of renders applied per square metre

- quantities and/or thickness of reinforcement applied per square metre
- drying period between each layer
- any other information meaningful for the test and its result.

- registered values of impact resistance of each sample.

ANNEX F – PULL-OFF TEST

F.1 Common

The following tests of bond strength shall be performed:

- bond strength test between adhesive (mortar or paste) and substrate
- bond strength test between adhesive (mortar or paste) and thermal insulation product
- bond strength between base coat and thermal insulation product

Synopsis of tests of bond strength and mechanical resistance is given in 2.2.9 and Table 4.

F.2 Bond strength test between adhesive (mortar or paste) and substrate

The tests are performed on the following substrates:

- a substrate consisting of a smooth concrete slab at least 40 mm thick. The water/cement ratio shall be of the order of 0.45 to 0.48. The tensile strength of the slab shall be at least 1.5 N/mm^2. The moisture content of the slab prior to the test shall be 3 % of the total mass maximally.

and for cement-free adhesive additionally:

- for cement-free adhesive on the raw surface of the most absorbent substrate of those specified by the manufacturer.

F.2.1 Preparation of samples

The adhesive is spread on the substrate according to F.2 normally with the thickness from 3 up to 5 mm, unless another value is specified by manufacturer. Three separate slabs of concrete substrate are recommended to use.

After allowing the adhesive to cure at (23 ± 2) °*C* and (50 ± 5) % RH for at least 28 days, 5 test squares of area from 15 up to 25 cm^2 are cut on each substrate slab through the adhesive according to Figure F.1 using an angle grinder.

Metal plates of appropriate size and thickness (stiffness) are bonded to the test squares using a suitable adhesive. Than the substrate slabs are conditioned as set in 2.2.9.1, one slab for each condition.

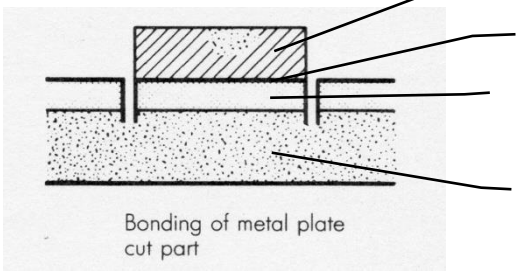


Figure F.1: Pull-off test

F.2.2 Pull-off test

The pull-off test (see Figure F.1) is performed at a tensioning speed of 10 ± 1 mm/min on the all test squares on each substrate slab.

During the test following information shall be recorded for each test sample:

- tested area of sample (dimensions in mm),
- failure loading in kN,
- the thickness of adhesive,
- type of failure according to Clause 3.6 of EN 12004.

The bond strength of each tested sample is calculated as a portion of failure loading and tested area and result is expressed in kPa with accuracy in 0.1 kPa.

The mean bond strength is calculated from five test results at least.

F.3 Bond strength test between adhesive (mortar or paste) and thermal insulation product

The test shall be carried out for bonded ETICS (see 1.1.2.1) and for mechanically fixed ETICS with supplementary adhesive (see 1.1.2.2.1).

The tests for conditions specified in 2.2.9.2 are to be performed.

F.3.1 Preparation of samples

The adhesive is spread on the thermal insulation product normally with the thickness from 3 up to 5 mm, unless another value is specified by manufacturer. Three separate substrate slabs is recommended to use.

After curing the adhesive at (23 ± 2) °C and (50 ± 5) % RH for at least 28 days, the slabs are conditioned as set in 2.2.9.2, one slab for each condition.

After conditioning, 5 test squares with the same nominal dimensions as the samples for testing of the tensile strength perpendicular to faces according to the respective technical specification of the thermal insulation product (EAD 040065-00-1201) shall be cut through the adhesive according to Figure F.1 using an angle grinder.

Square metal plates of appropriate size and thickness (stiffness) are bonded to the test squares with a suitable adhesive.

F.3.2 Pull-off test

The pull-off test (configuration see on Figure F.1) is performed at a tensioning speed of 10 ± 1 mm/min on 5 test squares at least on each slab.

During the test following information shall be recorded for each test sample:

- tested area of sample (dimensions in mm),
- failure loading in kN,
- the thickness of adhesive
- type of failure (in thermal insulation product, in connection of thermal insulation product and adhesive or in tested adhesive).

The bond strength of each tested sample is calculated and result is expressed in kPa with accuracy as integer.

The mean bond strength is calculated from five test results at least.

F.4 Bond strength test between base coat and thermal insulation product

The tests for conditions specified in 2.2.9.3 are to be performed.

F.4.1 Preparation of samples

The base coat is spread on the thermal insulation product normally with the thickness specified by the manufacturer, if not from 2 up to 4 mm. Reinforcement is not used. Three separate substrate slabs are recommended to use.

After curing the base coat at (23 ± 2) °C and (50 ± 5) % RH for at least 28 days, the slabs are conditioned as set in 2.2.9.3, one slab for each condition.

After conditioning, 5 test squares with the same nominal dimensions as the samples for testing of the tensile strength perpendicular to faces according to the respective technical specification of the thermal insulation product (hEN or EAD) shall be cut through the adhesive according to Figure F.1 using an angle grinder.

Square metal plates of appropriate size and thickness (stiffness) are affixed to these areas with a suitable adhesive.

F.4.2 Pull-off test

The pull-off test (see Figure F.1) is performed at a tensioning speed of 10 ± 1 mm/min on 5 test squares at least on each substrate slab.

During the test following information shall be recorded for each test sample:

- tested area of sample (dimensions in mm),
- failure loading in kN,
- failure mode (in thermal insulation product, in connection of thermal insulation product and base coat, in tested base coat, in connection of base coat and finish coat and/or in finish coat if used).

The bond strength of each tested sample is calculated and result is expressed in kPa with accuracy as integer.

The mean bond strength is calculated from five test results at least.

F.5 Bond strength after ageing

The method of preparation of sample depends whether a finishing coat has been tested on the rig according to 2.2.5.1 or not. Details are given in 2.2.5 and Figure 1.

F.5.1 Finishing coat tested on the rig

The test of bond strength is carried out on the rig after the test of hygrothermal behaviour (heat-rain and heat-cold cycles at least) and at least 7 days drying.

Five test squares are cut through the rendering system up to the substrate interface according to Figure F.1 using an angle grinder. The dimensions should be the same as the samples for testing the tensile strength perpendicular to faces according to EAD 040065-00-1201. Metal plates of appropriate size and stiffness are bonded to it using a suitable adhesive.

Afterwards the bond strength test between base coat and thermal insulation product (see F.4) is measured at a tensioning speed of 1 to 10 mm/min.

The individual and mean values are recorded and the results expressed in kPa with accuracy in integer.

F.5.2 Finishing coat not tested on the rig

The test of bond strength is performed on test board(s) of thermal insulation product faced with the reinforced rendering system applied in accordance with the manufacturer's instructions.

After curing the samples at (23 ± 2) °C and (50 ± 5) % RH for at least 28 days, ageing of prepared test board(s) according to 2.2.16.1 is to be performed.

After ageing five test squares are cut on test board(s) through the rendering system up to the substrate interface according to Figure F.1 using an angle grinder. The dimensions should be the same as the samples for testing the tensile strength perpendicular to the faces according to EAD 040065-00-1201.

In case of possible optional use of key coat and/or decorative coat, at least the configurations without the key coat and/or the decorative coat shall be tested. Metal plates of appropriate size and stiffness are bonded to the squares using a suitable adhesive.

Afterwards the bond strength test (see F.4) is measured at a tensioning speed of 10 ± 1 mm/min.

The bond strength of each tested sample is calculated and result is expressed in kPa with accuracy in integer.

F.6 Test report

Test report on bond strength shall contain at least:

- registered data of the stages of the installation:
    - the date and time of the various stages
    - name and production lot of the components
    - way of renders preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers,…)
    - quantities and/or thickness of renders applied per square metre
    - drying period between each layer
    - any other information meaningful for the test and its result.
- registered values of dimensions, failure loading and failure type of each sample
- calculated bond strength of each sample
- calculated mean value of bond strength for each type of test.

ANNEX G – DISPLACEMENT TEST

G.1 Common

The purpose of the test is to determine the longitudinal displacement of the ETICS at the edges of the wall.

G.2 Preparation of samples

The test is performed with the thinnest thermal insulation product envisaged to be covered by the ETA. A reinforced concrete slab measuring 1.0 m × 2.0 m with a thickness of 100 mm is prepared with a smooth surface.

A small layer of sand is placed on top of the slab to allow the insulation panel to slide. Three (2 + 2/2) insulating boards are applied to the concrete slab with tight butt joints as illustrated in Figure G.1. The ETICS shall be fixed with the minimum number of mechanical fixing devices according to the manufacturer's instructions.

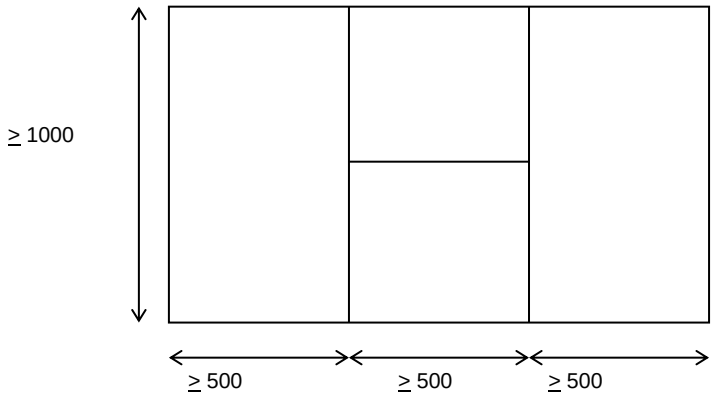


Figure G.1 Arrangement of insulation boards in displacement test

The reinforced base coat is then applied to the thermal insulation product according to the manufacturer's specification. The reinforcement shall protrude on all sides of the slab by about 300 mm.

The rendering shall be cured for at least 28 days at (23 ± 2) ºC and (50 ± 5) % RH.

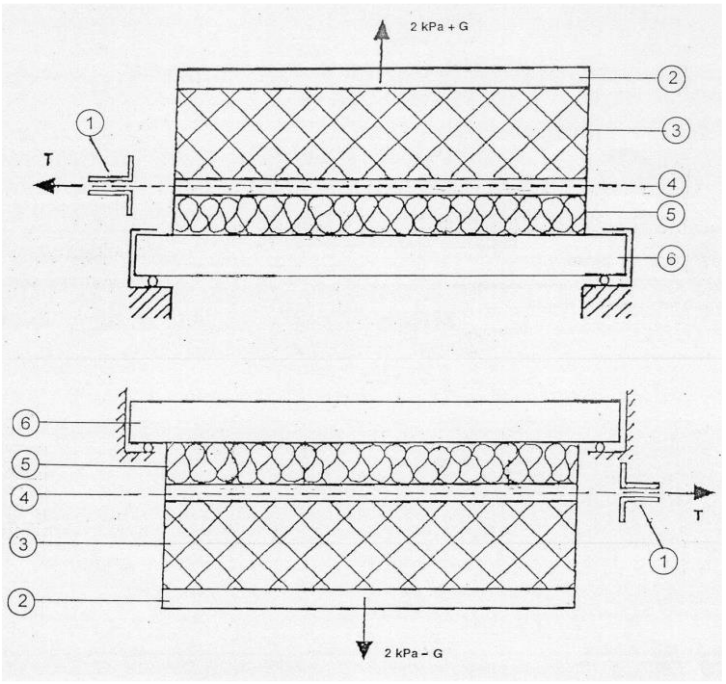
Before testing, a foam block is bonded to the cured rendering; the protruding ends of the reinforcement are then fixed to the clamping jaws over their full length.

G.3 Execution of test

A simulated wind suction load of 2 000 *Pa* is applied to the ETICS via the foam block and glued plywood or other rigid panel. Principle for preparation of test is illustrated in Figure G.2

Simultaneously a normal tensile load is applied to the rendering of the ETICS via the clamped-in reinforcement. At a tensioning speed of 1 mm/min the displacement of the ETICS relative to the concrete slab and the corresponding load is measured and recorded.

Preferably the concrete slab is placed on top and the ETICS is applied under the slab.



1 – Clamping jaws

2 – Plywood panel

3 – Foam block

4 – Reinforcement

5 – Thinnest insulation product

6 – Reinforced concrete slab

Figure G.2 Principle for preparation of test

G.4 Analysis of results

The load/displacement curve is recorded, possibly until failure occurs and the displacement U_e corresponding to the limit of elasticity is determined (see Figure G.3):

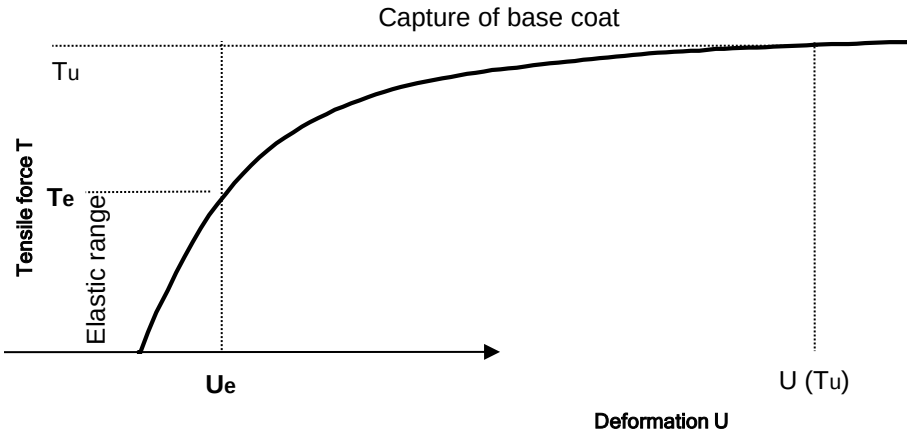


Figure G.3 Principle for preparation of test

G.5 Test report

Test report on displacement test shall contain at least:

- registered data of the stages of the installation:
  - the date and time of the various stages
  - name and production lot of the components

  - way of renders preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers,…)
  - quantities and/or thickness of renders applied per square metre
  - drying period between each layer
  - any other information meaningful for the test and its result.
- registered values of displacement during test
- calculated displacement corresponding to the elasticity limit.

ANNEX H – PULL-THROUGH TESTS

H.1 Common

The purpose of the test is to determine the working diagram and failure load in pull-through of anchor through thermal insulation product.

The pull-through test can be performed in dry conditions in two possible configurations according to assessed ETICS specification:

- with anchors placed at the body of the thermal insulation product (R_{panel}) – see 1.3.9 and Figure H.1

and

- with anchors placed at the panel joints (R_{joint}) – see 1.3.11 and scheme 2a on Figure H.2

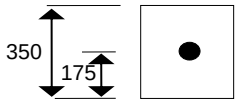
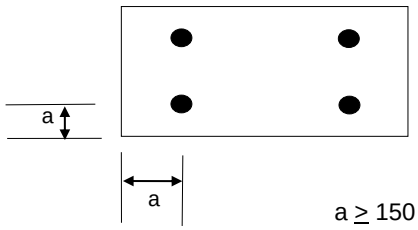
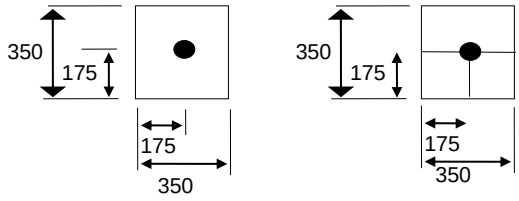
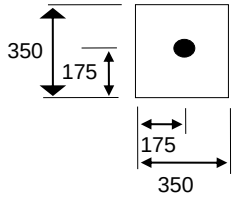
Test samples	Test method
(1a) 	Pull-through test H.2
or (1b) 	Static foam block test H.3

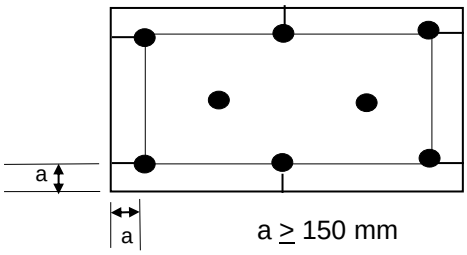
Figure H.1 Test samples for ETICS mechanically fixed by anchors (dimensions in mm) for test with anchors placed at the body of the thermal insulation product (R_{panel}).

The tests shall be carried out at least on the thinnest thermal insulation product envisaged to be covered by the ETA. For further evaluation of the test, the load/displacement graph shall be recorded.

It is not recommended to determine R_{panel} or R_{joint} values by testing of thermal insulation products of thickness higher than 80 mm. These values have to be reported together with information about displacement so that they can be taken into account in assessment of wind load resistance of an ETICS.

If ETICS is specified with thermal insulation product of thickness higher than 80 mm only, effect of thickness on R_{panel} and R_{joint} values shall be considered in evaluation.

<table>
<tr><th>Test samples</th><th>Test method</th></tr>
<tr><td>(2a)
 
</td><td>Pull-through test
H.2</td></tr>
<tr><td rowspan="2">or
(2b)
 

and
 

a ≥ 150 mm</td><td>Pull-through test
H.2</td></tr>
<tr><td>Static foam block test
H.3</td></tr>
</table>

Figure H.2 Test samples for ETICS mechanically fixed by anchors (dimensions in mm) for test with anchors placed at the panel joints (R_{joint}).

H.2 Pull-through test of anchors

The pull-through test of anchors is not required if the ETICS is a bonded one with anchors used as supplementary device only (see 1.1.2.1.2).

The test is to be performed in dry conditions.

Samples consisting of board of thermal insulation product of dimensions 350 mm × 350 mm with an anchor driven through the centre of each sample (or at panel joints as described at Figure H.1 and Figure H.2), are bonded, using a suitable adhesive, to a rigid substrate (see Figure. H.3). The head of the anchor is covered previously with a self-release sheet.

When the adhesive has cured, a pulling force is exerted, at a loading rate of 20 mm/min between the rigid plate and the end of the anchor protruding through the thermal insulation product until failure.

5 or more tests depending on the variance of test results shall be carried out. However, historical data obtained from testing of 3 samples can be used on responsibility of TAB.

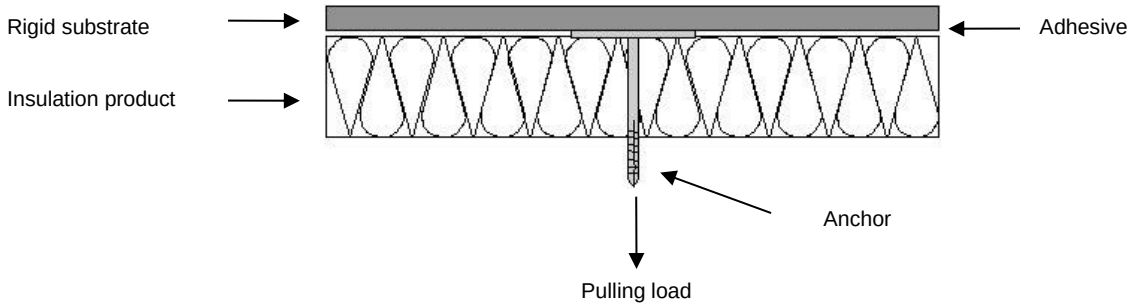


Figure H.3 Pull-through test sample

Test result is void if the rupture occurs in the edge. In such case the dimensions of the sample shall be increased.

The test report shall detail:

- each individual and mean values of failure load expressed in N with accuracy in integer,
- each individual and mean values of deformation at failure expressed in mm with accuracy in integer,
- load/displacement graphs for all test specimens,
- type of anchor tested, diameter and stiffness of its plate
- tensile strength perpendicular to the face of the thermal insulation product tested (test result according to EN 1607).

H.3 Static foam block test

The ETICS is applied to a concrete slab without any supplementary adhesive with dimensions chosen according to the standard production size of the thermal insulation product using the minimum thickness.

Test samples shall be prepared in accordance with the manufacturer's instructions on position of anchors and/or profiles and taking into account the influence of the anchors and/or profiles positioned at the panel joints.

For thermal insulation product based on EAD 040065-00-1201, 3 or more tests (depending on the variance of test results) shall be carried out.

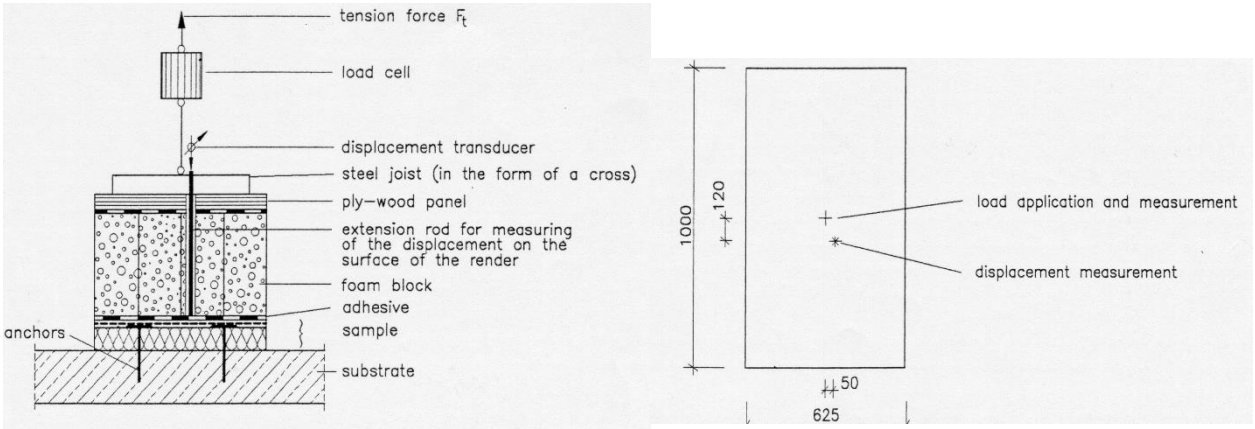


Figure H.4 Test set-up for the static foam block test

Test details are illustrated in Figure H.4. The testing load *F* is generated by a hydraulic jack and transferred via a load cell to plywood or other rigid panel of sufficient stiffness. The loading speed shall be in the order of 10 ± 1 mm/min.

Plywood or other rigid panel is connected to a base coat of tested specimen by foam blocks glued on both sides by appropriate adhesive. The foam blocks shall be weak enough to follow all displacements of the coating without affecting the bending stiffness of the ETICS. Therefore, the blocks are cut to rectangular pieces not exceeding 300 mm × 300 mm in width. The height of the blocks shall be at least 300 mm. [1])

As the surface of the sample is not directly accessible, the displacement of the render surface is measured via an extension rod passing through a hole in one of the foam blocks.

The test is carried out to failure in dry conditions.

Test report on static foam block test shall contain at least:

- registered data of the stages of the installation:
    - the date and time of the various stages
    - name and production lot of the components
    - way of base coat preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers, …)
    - tensile strength perpendicular to the face of the thermal insulation product tested
    - quantities and/or thickness of base coat applied per square metre
    - quantities, position and type of anchors and/or profiles used
    - any other information meaningful for the test and its result.
- registered values of displacement and failure load during the test.

[1]) A suitable initial length of the foam block elements is 500 mm. The foam blocks can be cut off with a hot wire after the test is finished. They may be reused at least 20 times until the remaining length reaches about 300 mm.

The tensile strength of the foam material shall be in the range of 80 - 150 kPa, the rupture strain shall exceed 160 %. The compressive strength according to ISO 3386-1 or -2 shall be in the order of 1,5 - 7,0 kPa. An example of a suitable material is polyether foam.

ANNEX I – HYGROTHERMAL TEST ON THE RIG

I.1 Common

Hygrothermal test on the rig is to be performed as a part of determination of watertightness of ETICS according to 2.2.6.

Based on the outcome of the water absorption test (see 2.2.3) the specification of the product to be tested is specified (see 2.2.5 and Figure 1).

Accompanying samples are prepared at the same time as the rig in order to evaluate the following characteristics after heat/rain and heat/cold cycles (for sample size and number: see relevant test method):

- bond strength between the base coat and thermal insulation product – only if the low part of the rig does not only consist of the reinforced base coat alone, i.e. ETICS with only one finishing coat) (see F.5 of Annex F)

- Tensile strength and elongation at break (see L1.3.2 of Annex L,) – only for products with an application thickness up to 5 mm.

In the case of reinforced base coat with a thickness greater than 5 mm complementary samples shall be prepared also to perform the test on the hardened product according to L.1.3.1 of Annex L.

I.2 Principles related to the preparation of the rig

- As a general rule, only one reinforced base coat and at the very most four finishing coats in vertical divisions can be applied per one rig.

- If several adhesives are proposed for the ETICS, only one with the lowest bond strength between adhesive (mortar or paste) and thermal insulation product (see F.3 of Annex F) shall be tested on the rig.

- If more than 4 finishing coats are proposed for the ETICS, the maximum number of coats, representative of the different types proposed, shall be tested on rig(s). Furthermore, if the water absorption of the reinforced base coat after 24 h is equal to or more than 0.5 kg/m² (see 2.2.2), each type of finishing coat containing a pure polymeric binder (non cementitious) shall be submitted to hygrothermal cycles on rig(s). Any finishing coats not tested on the rig shall be examined according to 2.2.16.1 and F.5 of Annex F.

- If different finishing coats can be used in the ETICS, the lower part of the test rig (height of 1.5 x insulating panel width) consists of the reinforced base coat only without any finishing coat.

- If several ETICS differ only in the method of fixing (bonded or mechanically fixed) of the thermal insulation product, the test is only carried out on the ETICS applied with adhesive at the edge of the rig and with mechanical fixings devices in the centre.

- If several ETICS differ only in the type of thermal insulation product, two thermal insulation products can be applied to the rig. The thermal insulation products are divided vertically at the centre of each rig.

- The ETICS is applied, in accordance with the manufacturer's instructions, to a sufficiently stabilized masonry or concrete substrate.

- The ETICS shall also be applied to the lateral faces with a uniform maximum thickness of thermal insulation product of 20 mm. If the thermal insulation product is not available in this thickness, the lateral faces can be covered with a thickness of 20 mm expanded polystyrene.

- Thermal insulation product requiring stabilization (prescribed delay between production and sale) shall be no older than 15 days beyond the minimum specified period.

The dimensions of the rig shall be:

- total surface ≥ 6 m^2

- total width ≥ 2.50 m
- total height ≥ 2.00 m.

A rectangular opening (consisting of the absence of the ETICS on the substrate at this area) is included at the corner of the rig, 0.40 m wide by 0.60 m high, positioned 0.40 m from the edges according to Figure I.1.

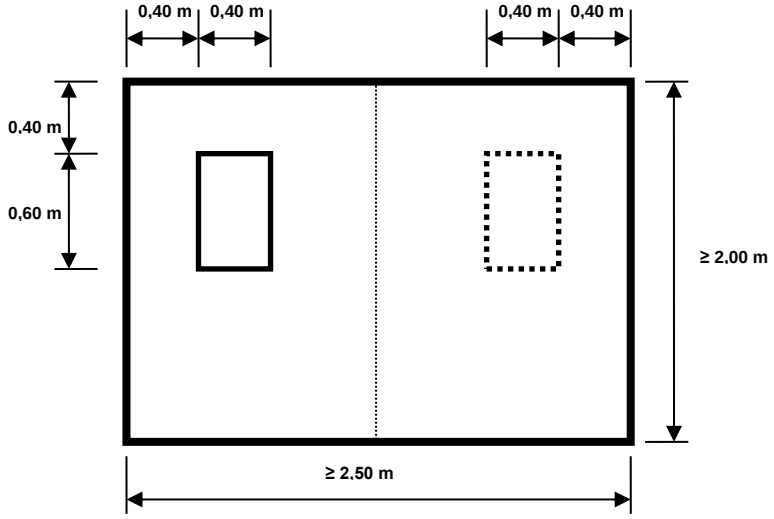


Figure I.1 Dimensions of the test specimen for the hygrothermal test on the rig

Note: If two thermal insulation products are foreseen to be applied to the rig, two symmetrical openings shall be included at both of the upper corners of the rig. Furthermore, two openings shall be applied in order to affect all tested finishing coats.

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

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

I.3 Preparation of the rig

The rig preparation shall be made by the manufacturer. It shall be supervised by the laboratory in charge of the test regarding:

- stabilization in case of thermal insulation product (prescribed delay between production and sale), thermal insulation product shall be not older than 15 days beyond the minimum specified period,
- checking of the respect of manufacturer prescriptions: all stages shall be in accordance with the Technical File of the manufacturer,
- registering of all the stages of the installation:
  - the date and time of the various stages
  - temperature and % RH (relative humidity) during the installation (every day – at least at the beginning)
  - name and production lot of the components
  - way of fixing the thermal insulation product
  - figure describing the rig (place of the fixings and of the joints between the panels …)
  - way of renders preparation (tool, % of mixing, possible pause time before application …) as well as their way of application (hand tool, machines, number of layers …)

- quantities and/or thickness of renders applied per square metre
- drying period between each layer
- use and position of accessories
- any other information meaningful for the test and its result.

Quantities and/or thicknesses applied shall be recorded as well as identification of the render's components according to Annex L.

I.4 Conditioning of the rig

The rig with ETICS installed is cured indoors for a minimum of 4 weeks. During the curing time the ambient temperature shall be between 10 °C and 25 °C. The relative humidity shall not be less than 50 %.

To ensure that these conditions are met, records shall be made at regular intervals. To prevent the ETICS from drying out too rapidly, the manufacturer may require the render to be wetted once per week by spraying for approximately 5 minutes. This wetting shall start at a time according to the prescriptions of the manufacturer.

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

For a reinforced base coat with a thickness up to 5 mm, some samples are prepared according to L.1.3.2 of Annex L, and placed in the opening of the rig.

I.5 Hygrothermal cycles

The test apparatus is positioned against the front face of the rig, 0.10 to 0.30 m from the edges.

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

I.5.1 Heat-rain cycles:

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

1. Heating to 70°C (rise for 1 hour) and maintaining at (70 ± 5) °C and 10 to 30 % RH for 2 hours (total of 3 hours),
2. Spraying for 1 hour (water temperature (15 ± 5) °C, amount of water 1 l/m² min),
3. Leave for 2 hours (drainage).

I.5.2 Heat-cold cycles:

After at least 48 hours of subsequent conditioning at temperatures between 10 and 25 °C and a minimum relative humidity of 50 %, the same test rig is exposed to 5 heat/cold cycles of 24 hours comprising the following phases:

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

I.5.3 Observations during the test

At periods of every four cycles during the heat/rain cycles and at every cycle during the heat/cold cycles, observations relating to a change in characteristics or performance (blistering, detachment, crazing, loss

of adhesion, formation of cracks, etc …) of the entire ETICS and of the part of the rig consisting of only the reinforced base coat are recorded as follows:

- the surface finish of the ETICS is examined to establish whether any cracking has occurred. The dimensions and position of any cracks shall be measured and recorded,
- the surface shall also be checked for any blistering or peeling and the location and extent shall again be recorded,
- the sills and profiles shall be checked for any damage/degradation together with any associated cracking of the finish. Again the location and extent shall be recorded.

Following the completion of the test, a further investigation is conducted involving removal of sections containing cracks to observe any water penetration within the ETICS.

I.5.4 After the heat-rain and heat-cold cycles

Bond strength tests according to Annex F, F.4 and F.5.1 and impact resistance test according to Annex E shall be performed after at least 7 days of drying in temperature between 10 °C and 25 °C and a minimum relative humidity of 50 %.

I.5.5 Bond strength after ageing

Bond strength after ageing is tested according to F.5 of Annex F.

I.5.6 Test report

Test report on hygrothermal behaviour of ETICS after the heat-rain and heat-cold cycles shall contain at least:

- registered data of the stages of the installation:
  - the date and time of the various stages
  - temperature and % RH (relative humidity) during the installation (every day – at least at the beginning)
  - name and production lot of the components
  - way of fixing the thermal insulation product
  - figure describing the rig (place of the fixings and of the joints between the panels, …)
  - way of renders preparation (tool, % of mixing, possible pause time before application, …) as well as their way of application (hand tool, machines, number of layers,…)
  - quantities and/or thickness of renders applied per square metre
  - drying period between each layer
  - use and position of accessories
  - any other information meaningful for the test and its result.
- description of finish surface of the ETICS after the heat-rain and heat-cold cycles if any has occurred during the heat-rain and heat-cold cycles, and their location, position and dimensions if any occurs,
- description if any blistering or peeling occurs during the heat-rain and heat-cold cycles has occurred, and their location, position and dimensions,

- damage/degradation of the sills and profiles together with any associated cracking of the finish, if any has occurred during the heat-rain and heat-cold cycles, and their location, position and dimensions,

- results of test of bond strength and test of impact resistance performed on the rig after the heat-rain cycles.

ANNEX J – THERMAL RESISTANCE

The additional thermal resistance provided by the ETICS (R_{ETICS}) to the substrate wall is calculated from the thermal resistance of the thermal insulation product ($R_{insulation}$) determined in accordance with the appropriate hEN or EAD for the relevant thermal insulation product, and from either the tabulated R_{render} value of the render system (R_{render} may be calculated as 0.02 m².K/W or R_{render} determined by test according to EN 12667 or EN 12664 depending on expected thermal resistance) according to equation:

$$R_{ETICS} = R_{insulation} + R_{render} \qquad [(m^2 \cdot K)/W]$$

as described in EN ISO 6946 and EN ISO 10456.

If the thermal resistance cannot be calculated, it can be tested on the complete ETICS as described in EN 1934.

The thermal bridges caused by mechanical fixing devices influence the thermal transmittance of the entire wall and shall be taken into account using the following equation:

$$U_c = U + \Delta U \qquad [W/(m^2 \cdot K)]$$

where:

U_c corrected thermal transmittance of the entire wall, including thermal bridges

U thermal transmittance of the entire wall, including ETICS, without thermal bridges according to equation

$$U = \frac{1}{R_{ETICS} + R_{substrate} + R_{se} + R_{si}} \qquad [W/(m^2 \cdot K)]$$

$R_{substrate}$ thermal resistance of the substrate wall [(m²·K)/W]

R_{se} external surface thermal resistance [(m²·K)/W]

R_{si} internal surface thermal resistance [(m²·K)/W]

ΔU correction term of the thermal transmittance for mechanical fixing devices $\Delta U = \chi_p * n$ (for anchors)

χ_p point thermal transmittance value of the anchor [W/K] (see Annex N). If not specified in the anchors ETA, the following values apply:

χ_p = 0.002 W/K for anchors with a plastic screw/nail, stainless steel screw/nail with the head covered by plastic material, and for anchors with an air gap at the head of the screw/nail.

χ_p = 0.004 W/K for anchors with a galvanized steel screw/nail with the head covered by a plastic material

χ_p = 0.008 W/K for all other anchors (critical case)

n number of anchors per m².

The influence of thermal bridges can also be calculated as described in EN ISO 10211. It shall be calculated according to this standard if there are more than 16 anchors per m² foreseen. The declared χ_p values do not apply in this case.

ANNEX K - RENDER STRIP TENSILE TEST

K.1 Common

This test is determined for the evaluation of the crack behaviour of the reinforced base coat by determination of the crack width distribution and the "characteristic crack width" W_{rk} at completed cracking.

K.2 Preparation of test sample

A render strip sample has the size 600 mm × 100 mm × d_r and consists of the reinforcement and the base coat. "d_r" is thickness of the base coat with embedded reinforcement.

The reinforcement with a length of 800 mm is arranged within the base coat according to the manufacturer's instructions. It shall protrude about 100 mm at both ends. The protruding parts of the reinforcement are placed on the render surfaces on which two metal plates are glued by appropriate glue.

If the reinforcement is not in the middle, two strips shall be glued to a double symmetrical specimen where the thinner parts of the strips are in the middle of the specimen.

As an alternative to bonding the specimen between two steel plates the fixing of the test sample can be done using a PVC foil (thickness 1.5 to 2.0 mm, Shore-A-hardness 82) and pneumatic/hydraulic clamping device (see Figure K.1).

The test is performed in warp and weft direction on three render strips each. The number of threads in one direction shall be the same for all the three strips.

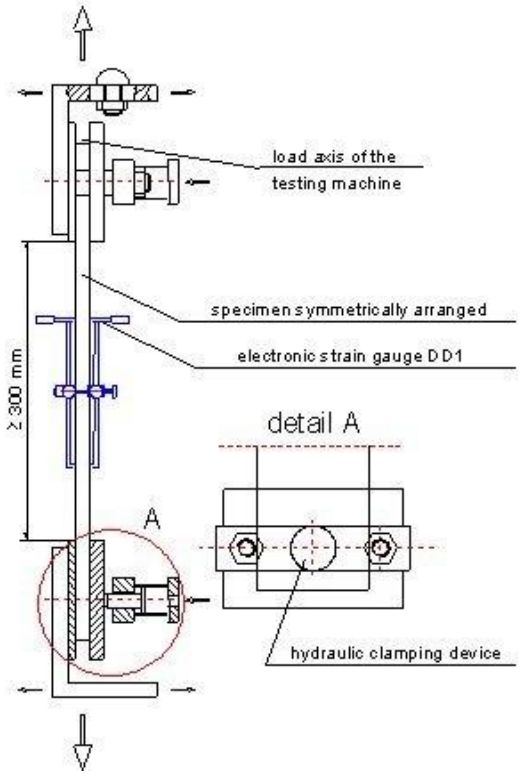


Figure K.1 Test set-up for the render strip tensile test

K.3 Test procedure

The tensile loading is applied in deformation-controlled mode with a rate of strain of 0,5 mm/min. The loading is measured via a static uniaxial tensile testing machine of class 1 according to EN ISO 7500-1. The displacements are measured by two electronic displacement gauges for ± 2.5 mm, precision class 0.1 (e.g. of DD1 type).

The length of the measuring distance shall amount to at least 100 mm. The measuring points shall be arranged such that they are at least 75 mm off the outer limits of the load introducing elements. The gauge length shall be 150 mm and such that it is at least 75 mm away from the peaks of the metal plates. The two electronic displacement gauges are fixed the same way on the front and backside and/or the face sides of the specimen with the possibility of a separate analysis of the measurement results.

The render strips are loaded 10 times up to 50 % of the crack strength expected, for organic rendering systems up to a maximum of 250 N per test strip. Loading and release shall last about 1 to 2 minutes. During the 11-th cycle the render strips are loaded until cracking and subsequently until failure.

If no early failure occurs, the loading process is interrupted at render strain values of 0.3 %, 0.5 %, 0.8 %, 1.0 %, 1.5 %, and 2.0 %. The quantity of cracks within the measured range is counted and recorded. The crack width shall be classified with the frequency occurred in the crack developing record (see Table K.1) in categories of ≤ 0.05 mm, ≤ 0.10 mm, ≤ 0.15 mm, ≤ 0.20 mm, ≤ 0.25 mm, and > 0.25 mm. The maximum crack width Wmax measured in each case shall be recorded with an accuracy of 1/100 mm.

It is recommended to measure the crack width with a magnifier with fiftyfold magnification; an exaggerated preciseness is not appropriate due to the irregularities of the cracks.

Sample	ε	Number of cracks on sample side A with a crack width of w [mm]								Number of cracks on sample side B with a crack width of w [mm]							
	[%]	≤ 0,05	≤ 0,10	≤ 0,15	≤ 0,20	≤ 0,25	> 0,25	max	Σ cracks	≤ 0,05	≤ 0,10	≤ 0,15	≤ 0,20	≤ 0,25	> 0,25	max	Σ cracks
1.0.1	0.3																
	0.5																
	0.8																
	1.0																
	1.5																
	2.0																

Table K.1 Crack developing record for the tension test with render strip

K.4 Analysis of test results

K.4.1 Exact procedure (I)

The related constituent equations are derived from the recorded load-strain diagram for the warp and weft direction. The render strain ε_{rk} with completed cracking can be read from that. For this state of expansion, however, at least at 0.5 % expansion the characteristic crack width w_{rk} is determined from all the test results on hand as 95 % quintile with 75 % confidence level in the specified operational steps following hereinafter. In doing so intermediate values can be interpolated linearly:

- determination of the strain ε_{rk} with "completed cracking" (constituent equations derived from the load-strain diagrams); $\varepsilon_{rk} \geq 0{,}5$ %,
- number of sample sides and measured crack widths per render tension state from the recorded crack developing record (see Table K.1),
- determination of the mean value of the crack widths $w_{m,I}$ measured at expansion state ε_{rk} of the "completed cracking". In addition, it is possibly necessary to consider the next higher and lower state and to linearly interpolate the crack widths measured,
- for the mean value $w_{m,I}$ determined of the crack width the respective standard deviation σ is determined,

- depending on the number of tests and the confidence level of 75 % for experimental analyses on ETICS the k_n value for the 95 % quantile results from statistical data according to Clause D.7.2, Annex D of EN 1990, according to equation:

$$w_{rk} = w_{m,I} + (\sigma \times k_n)$$

where

w_{rk}	characteristic crack width in mm
$w_{m,I}$	mean value of the crack width for procedure I in mm
σ	estimate of standard deviation
k_n	coefficient of estimation according to Table D.1, Annex D of EN 1990.

K.4.2 Simplified procedure (II)

The characteristic crack width for ε'_{rk} = 0.8 % is determined as 95 % quantile with 75 % confidence level in the specified operational steps following hereinafter.

- determination of the mean value of the crack width $w_{m,II}$ at tension stat' ε'_{rk} = 0.8 %.
- for the mean value $w_{m,II}$ determined of the crack width the respective estimation of standard deviation σ is determined.
- depending on the number of tests and the confidence level of 75 % for experimental analyses on ETICS the k_n value for the 95 % quantile results from statistical data according to Clause D.7.2, Annex D of EN 1990 according to equation:

$$w_{rk} = w_{m,II} + (\sigma \times k_n)$$

For organic rendering systems without observed crack width the elongation at rupture ε_{ru} and the respective ultimate load N_{ru} shall be determined as a mean value from each of the individual tests.

ANNEX L – TESTS ON COMPONENTS

L.1 Common

These test methods shall be applied where tests of components used for assessment of ETICS are necessary for evaluation of achieved level(s) of performances of ETICS in relation to real level(s) of characteristics of components used for tests.

In some cases, such as where a specification of performances of component is sufficient to identify its characteristics, the identification tests do not need to be performed as far as the component is identified according to its harmonized specification by means such and its trade name.

L.1 Adhesives, base coats, key coats and finishing coats

L.1.1 Product as delivered

The following tests are performed on homogenised and unmodified products.

L.1.1.1 Density

Pastes and liquids:

This is measured at (23 ± 2) °C in a 100 cm^3 or 1000 cm^3 cylinder.

Powders:

This is measured at (23 ± 2) °C in a 500 cm^3 cylinder.

Method of operation:

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

L.1.1.2 Dry extract (only pastes and liquids)

L.1.1.2.1 Lime and polymer based products

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

The mass is regarded as constant if the difference in mass between two successive weightings, one hour apart, does not exceed 0.1 g.

Initial weighing for testing:

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

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

L.1.1.2.2 Silicate based products

The dry extract is determined by the following method:

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

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

C - Final weighing.

Weighing accuracy shall be within 5 mg.

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

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

L.1.1.3 Ash content

Pastes and liquids:

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

Powders:

The ash content is determined at 450°C and 900°C on a sample of approximately 5 g pre-dried at (100 ± 5) °C or at (200 ± 5) °C for silicate based products, to constant mass. The mass is regarded as constant if the difference in mass between two successive weightings, one hour apart, does not exceed 0.1 g.

Method of operation:

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

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

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

L.1.1.4 Particle size grading

Pastes:

Particle size grading is established from a sample of fillers removed from the manufactured product after washing on a sieve, mesh size 0.08 mm or after any other suitable and pertinent preparation.

The test is carried out after drying at least at 105 °C.

Powders:

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

Method of operation:

The test is performed using air streamed sieving on an about 50 g specimen for 5 minutes per sieve. The curve is traced from 0.04 (for powders) or 0.08 (for pastes) to 4 mm with at least 5 intermediate sieves.

L.1.2 Fresh mortar

L.1.2.0 Preparation of mortar

The mortar is prepared in the laboratory using a concrete mixer (pan type) in accordance with EN 196-1.

The tests are carried out immediately after mixing unless otherwise specified by the manufacturer (possible delay time necessary prior to application).

L.1.2.0.1 Dry mortar

- 2 kg of powder is poured into the container and the required amount of water as specified by the manufacturer is added,
- The whisk is turned manually a few times to clear the path of the mixer,
- The material is mixed for 30 seconds at low speed,
- The walls of the container are scraped and powder gathered on the whisk is detached with a spatula, if necessary,
- The material is mixed again for 1 minute at low speed.

L.1.2.0.2 Paste requiring addition of cement and powder requiring addition of extra binder

- For pastes 1 liter of paste is poured into the container and the amount of cement prescribed by the manufacturer is added.
- For powders 2 kg of powder is poured into the container and the amount of extra binder prescribed by the manufacturer is added.
    - the whisk is turned manually a few times to clear the path of the mixer,
    - the material is mixed for 30 seconds at low speed,
    - the walls of the container are scraped and powder gathered on the whisk is detached with a spatula, if necessary,
    - the material is mixed again for 3 minutes at high speed.

L.1.2.0.3 Ready to use paste

Pastes have to be homogenized before use.

L.1.2.1 Water retention capability

Water retention capability is determined for the fresh mortar, mixed as detailed in L.1.2.0.

The test is performed using the apparatus described in the standard ASTM C.91. The mortar is subjected to vacuum for 15 minutes as follows:

- For base coat and finishing coat(s) (except coat(s) whose binder is pure polymeric), the vacuum applied is 50 mm Hg (pressure difference between the exterior and the interior of the container) (see Figure L.1.)
- For adhesives, the residual pressure is 60 mm Hg (absolute pressure inside the container) (see Figure L.2)

The dish is fitted with a filter paper (diameter 150 mm of 65 g/m²), previously moistened and drained by placing on a dry filter paper, filled with paste, levelled and weighed prior to the test (as the mass of the empty dish including the moist filter paper is known, the mass of the mixed paste and the corresponding mass of the water used for mixing can be calculated in g).

These operations take place within 10 minutes of mixing. After 15 minutes (from when mixing started) the apparatus is subjected to vacuum for 15 minutes; the dish is then weighed again after wiping off the undersurface, and the loss of water (e) in g can be calculated by subtraction.

The water retention capability is expressed as a % of the initial mass of the water used for mixing (E):

$$\frac{E-e}{E} x100$$

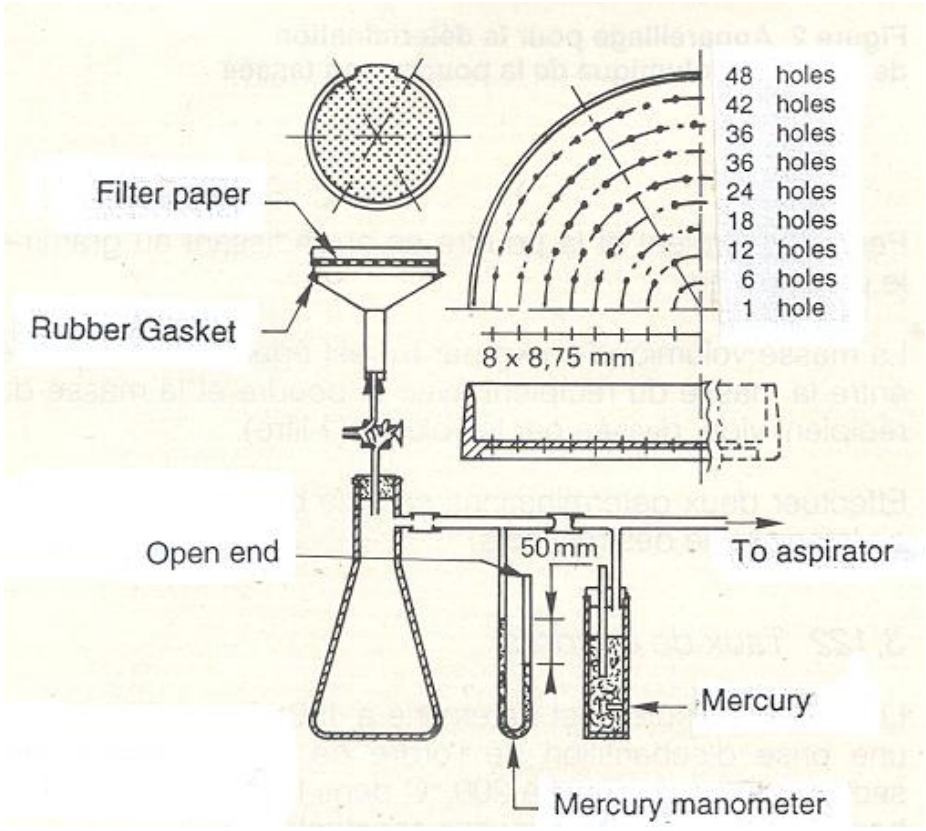


Figure L.1 Apparatus Assembly for the water retention test under 50 mm Hg vacuum

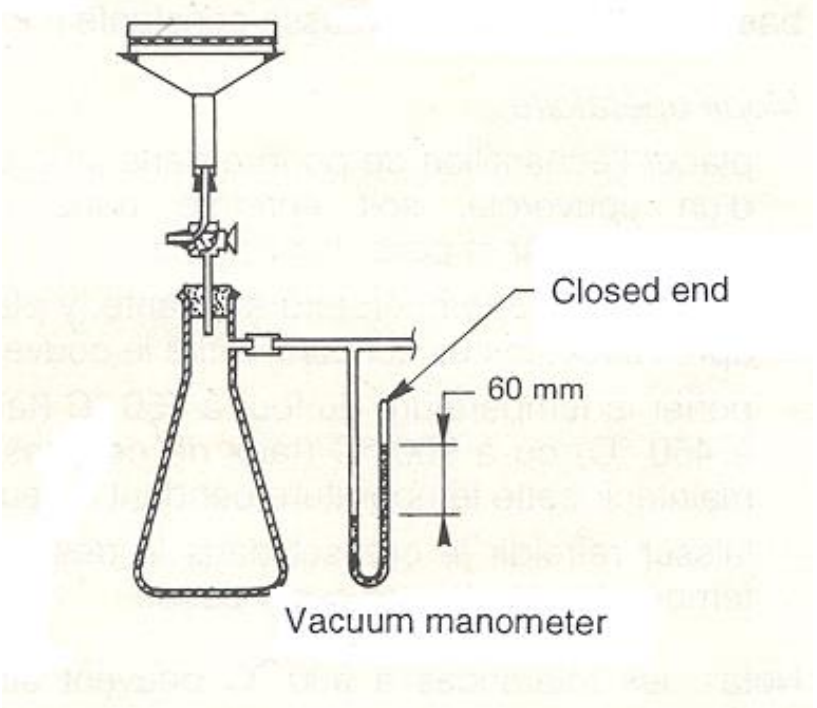


Figure L.2 Apparatus Assembly for the water retention test under 60 mmHg residual pressure

L.1.2.2 Density of fresh mortar

The mortar is prepared as detailed in L.1.2.0.

The apparent density is determined using a 1 litre cylindrical container, previously tarred (mass M_0 in g). The container is filled with paste and after compacting down, wiped off and weighed (mass M_1 in g). The density of the paste (in $kg.m^{-3}$) is equal to $M_1 - M_0$.

The density of the paste is measured immediately after mixing.

L.1.3 Hardened base coat (without reinforcement)

The apparent density is determined on three specimens 160 mm x 40 mm x 40 mm (prism mould compartments) by measuring mass and dimensions. The specimens are cured for at least 28 days at (23 ± 2) °C and (50 ± 5) % relative humidity.

The precision for weighing is 0,1 g and for the dimensions 1 mm.

L.1.3.1 Products with a thickness greater than 5 mm

L.1.3.1.0 Preparation and storing of test samples

The mortar is prepared by mixing as described in L.1.2.0.

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

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

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

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

L.1.3.1.1 Dynamic modulus of elasticity (Resonance frequency method)

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

The test is carried out on the following:

- 3 samples prepared as described in L.1.3.1.0.
- 3 samples prepared with product taken at the time of the preparation of the rig described (see 2.2.16).

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

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

1 - Apparatus

The apparatus used for carrying out this measurement comprises:

a) A variable frequency oscillator with a frequency range of 20 kHz and a precision of 1 %.

b) An electromagnetic vibrator which may or may not be in mechanical contact with the test sample; its mass shall be very light compared to that of the test sample.

c) A receiver, an electromechanical transducer and an amplifier; its mass shall be very light compared to that of the test sample.

The resonance frequencies of the vibrator and the receiver shall not fall between 0.5 kHz and 20 kHz.

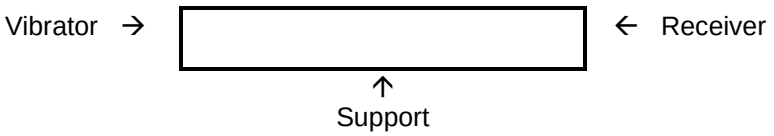
d) An amplifier.

e) An apparatus indicating the vibration amplitudes (oscilloscope).

f) A very narrow support on which the test sample rests during the measurement, which shall not hinder the longitudinal vibration of the test sample and which shall be in the nodal plane.

2 - <u>Testing</u>

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



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

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

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

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

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

3 - Expressing the results

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

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

where:

E_d = longitudinal dynamic modulus of elasticity in N/mm^2
L = length of test piece in meters
F = longitudinal resonance frequency in Hz
ρ = mass per unit volume in kg/m^3.

<u>L.1.3.1.2 Shrinkage test</u>

The measurement is carried out on three samples of base coat measuring 20 mm x 40 mm x 160 mm prepared and stored as described in L.1.3.1.0, by inserting measuring spindles in the front end (10 mm x 40 mm) of the samples. Measurements are carried out at regular intervals. The value after 28 days is

recorded. In addition, if there is doubt in the curve associated with stabilization, the test is continued and the value after 56 days is recorded.

L.1.3.2 Products with a thickness up to 5 mm: static modulus of elasticity, tensile strength and elongation at break

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

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

After the base coat, without reinforcement has dried, test samples are cut from the polystyrene with hot wire.

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

The tensioning speed is 2 mm/min.

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

L.2 Thermal insulation product

L.2.1 Density measurement

In accordance with EN 1602.

L.2.2 Dimensional characteristics and appearance

L.2.2.1 Length and width

In accordance with EN 822.

L.2.2.2 Thickness

In accordance with EN 823.

L.2.2.3 Squareness

In accordance with EN 824.

L.2.2.4 Flatness

In accordance with EN 825.

L.2.2.5 Surface condition

This is visually assessed.

L.2.3 Compression test

In accordance with Clause 2.2.10 of EAD 040065-00-1201.

L.2.4 Dimensional stability tests

In accordance with:

- EN 1603, Method B1;
- EN 1604 (conditionings stated in ETA for the particular ETICS).

L.2.5 Reaction to fire

According to appropriate test procedures according to EN 13501-1+A1 and Annex A of EAD 040065-00-1201.

L.2.6 Water absorption

The test shall be performed in accordance with EN 1609, Method A.

L.2.7 Water vapour permeability

The test shall be performed in accordance with EN ISO 12572, climatic condition A.

L.2.8 Tensile test perpendicular to the faces in dry conditions

The test shall be performed in accordance with EN 1607, samples according to Clause 2.2.4 of EAD 040065-00-1201.

L.2.9 Shear strength and shear modulus of elasticity test

The test shall be performed in accordance with EN 12090 for the relevant thermal insulation product on a sample of thickness 60 mm and of maximal thickness in ETICS kit specified.

L.2.10 Thermal resistance

The test shall be performed in accordance with EAD 040065-00-1201, Annex B..

L.3 Mechanical fixing devices

L.3.1. Plastic anchors for ETICS, plastic anchors

L.3.1.1 Dimensions

The measurements are to be performed according to EAD 330196-01-0604.

L.3.1.2 Load characteristics if necessary (depending on the type of material)

The result is to be stated in the accompanying documents.

L.3.1.3 Energy economy and heat retention

Point thermal transmittance of plastic anchors is tested according to Annex N.

ANNEX M – TEST OF PLATE STIFFNESS OF PLASTIC ANCHORS FOR ETICS

M.1 General

The load resistance of the ETICS fixed by anchors is particularly linked to the mechanical properties of the anchor plate and the insulation material. The minimum requirements to the properties of the anchor plate are relevant for ETA for ETICS.

These properties are
- the load resistance and
- the plate stiffness.

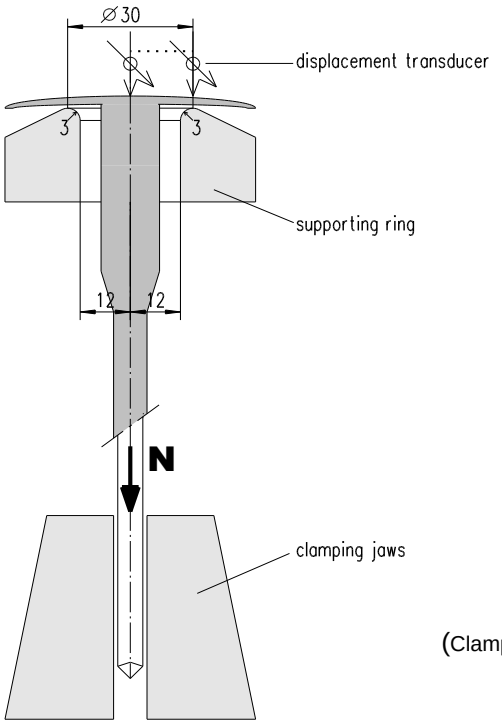
of the anchor plate

This Annex covers pull-through tests to evaluate the pull-through resistance of the anchor plate and the plate stiffness of plastic anchors for fixing of ETICS with rendering. The pull-through test shall be carried out according to following clauses.

M.2 Details of method and criteria for assessment

The failure load of the anchor plate shall be determined from at least 5 tests using the product type to be assessed only. During the tests the anchor plate shall rest on a solid support ring with a clear inside diameter of 30 mm. A preload can be applied for determination of the stiffness for curved anchor plates in a way, that the tension load is be transmitted at the inside edge of the support ring. If the anchor plate is stiffened by ribs, recesses, which prevent a contact between the ribs and the supporting ring and the load transmission is not effected by the ribs, shall be designed in the steel ring.

A principle test setup is shown in Figure M.2.



(Clamping jaw is clamping the expansion element)

Figure M.2 Principle description of the test for determination of the plate stiffness

For plastic anchor plates, which change their mechanical properties under influence of humidity, the tests shall be carried out using air-humid conditioned anchors but always in ambient temperature

(standard conditions: equilibrium water content at T = +23 °C and 50 % relative humidity). The tension load is transmitted over the anchor shaft with a loading rate of 1 kN/min ± 20 %.

M.3 Assessing of method and criteria for assessment

M.3.1 Load resistance

The characteristic resistance has to be determined from the 5%-quantile of the ultimate loads for a confidence level of 90 %. This value has to be stated in the ETA. The characteristic resistance shall at least comply with the characteristic resistance in the ETICS according to this EAD. If the characteristic resistance amounts at least 1.0 kN, the universal application mentioned above can be ensured. The reduction of the resistance of the anchor plate caused by increased temperature is included in this value.

M.3.2 Plate stiffness

For getting a comparable dimension for the plate stiffness, the tangent stiffness (c) has to be determined for every test. This tangent stiffness states the gradient of an idealised straight line between the points s_u (displacement in mm) with the appropriate tension force N_u = 0 kN and s_o = 1 mm (displacement) with the appropriate tension force N_o in the load-displacement-diagram (see Figure M.3.1).

The plate stiffness and the diameter of the anchor plate shall be stated in the ETA.

Tangents stiffness (in kN/mm):

$$\mathbf{c} = \frac{\mathbf{N_o} - \mathbf{N_u}}{\mathbf{s_o} - \mathbf{s_u}} = \frac{\mathbf{N_o}}{\mathbf{1mm} - \mathbf{s_u}} \qquad \text{(M.3.1)}$$

with $s_u \leq 0.3\ S_o$

The evaluated values should be rounded upward expediently to $^1/_{10}$ kN and be stated related to 1 mm deformation (e.g. 0.3 kN/mm / 0.4 kN/mm / 0.5 kN/mm / 0.6 kN/mm / 0.7 kN/mm).

For characterising the plate stiffness the mean value has to be stated in ETA. The coefficient of variation shall not exceed 20 %.

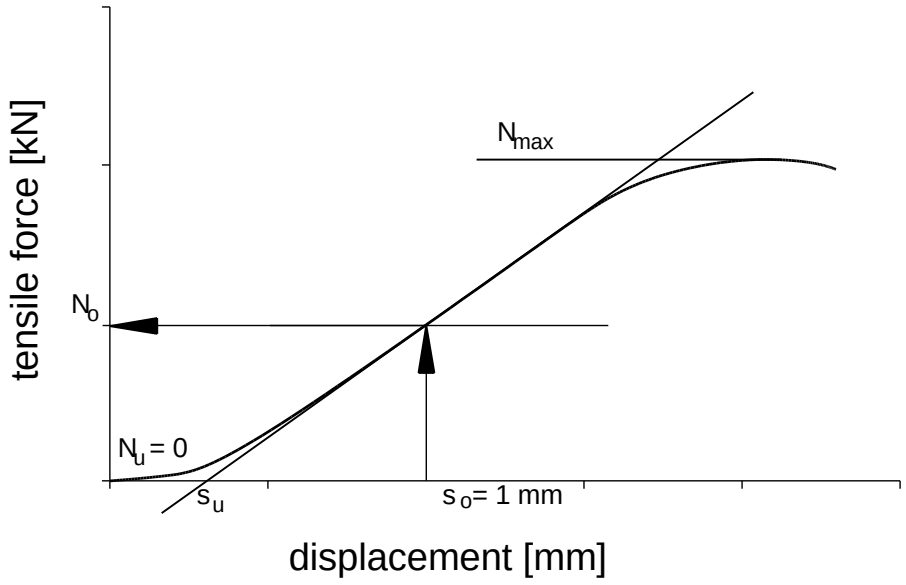


Figure M.3.1 Load-displacement-diagram with the idealized straight line

ANNEX N – POINT THERMAL TRANSMITTANCE OF PLASTIC ANCHORS FOR ETICS

N. 1 General

Anchor in ETICS penetrates thermal insulation layer, acts as thermal bridge and increases heat loss in the sphere of influence of the anchor. Effect of anchor on thermal performance of ETICS is determined by the point thermal transmittance χ of the anchor. The value of the point thermal transmittance χ depends on the dimensions of cross section of anchor construction, material of anchor (its thermal conductivity) and thermal conductivity and thickness of the insulating layer and the substrate.

ETICS are produced in a large range of thicknesses (approx. between 50 mm and 450 mm). At present time, the average thickness of the insulating layer is approx. 150 mm with a tendency to rise. The χ-value can increase with a greater thickness of the insulating layer, the behaviour is not linear. Variants of relation of point thermal transmittance χ to thickness of the insulating layer are shown on Figure N.1.

The point thermal transmittances χ is to be listed separately for thicknesses of the insulating layer of the ETICS "up to 150 mm" and "greater than 150 mm". This is appropriate in order not to require the most unfavourable χ-value for the entire area of the insulating layer thickness as representative dimension.

To simplify the procedure of assessment, the χ-value can be determined in the most unfavourable substrate (base material group), where the anchor may be used. Alternatively the χ-value can be determined for each base material group separately. Manufacturer can select the procedure, if he does not, procedure with specification of critical case is to be applied.

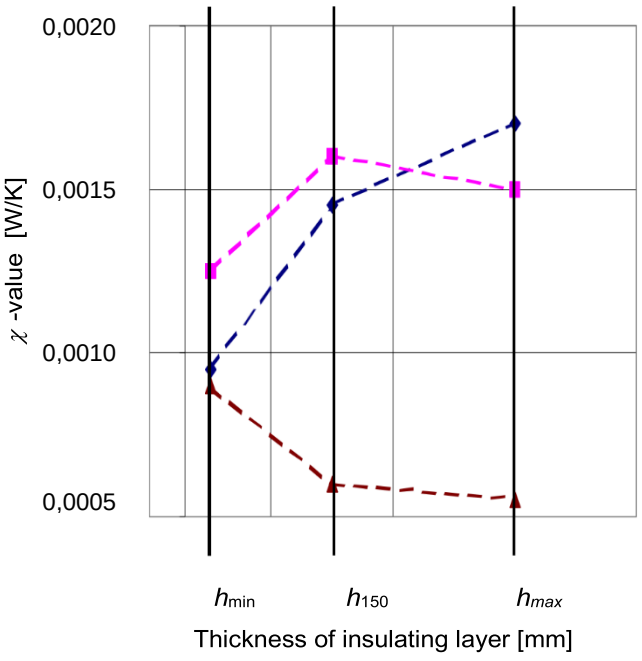


Figure N.1 Variants of relation of point thermal transmittance χ to thickness of the insulating layer

N. 2 Assessment of point thermal transmittance

The point thermal transmittance χ results from equation:

$$\chi = \frac{U_c - U}{n}$$

where χ is point thermal transmittance of an anchor [W/K]

U_c thermal transmittance of the wall with ETICS and anchor(s) [W/(m²·K)]

U thermal transmittance of the wall with ETICS, without anchor(s) [W/(m²·K)]

n number of anchors per m² [1/m²]

For each insulating layer thickness and for each base material group (substrate) calculated with the point thermal transmittances are to be determined according to N.3.1. The final value(s) of the point thermal transmittance χ is to be rounded to four decimal places upwards and given in the ETA.

The step "0 W/K" is given in the ETA, if the peak value of the point thermal transmittance of anchor χ in the considered range is smaller than 0,0005 W/K. In such case, the following note is to be recorded for the step "0 W/K" in the ETA for relevant type of anchor: "The point thermal transmittance χ of the anchor is smaller than 0,0005 W/K and therefore its effect in calculation of thermal characteristic of the ETICS can be neglected."

Description of the nominal value of the point thermal transmittance

The nominal value of the point thermal transmittance χ is to be given for each base material group or for the most unfavourable base material group, in which the anchor may be used. The point thermal transmittance χ is to be given as a single value or tabulated depending on the base material group. For examples for the description, See N.4.

Nominal values determined only for the most unfavourable base material group
The nominal values includes all base material groups, with which the anchor might be used, as index (see N.3.1.2). The area of insulating layer thickness for which the nominal value is valid is stated in brackets behind the "χ". Indexing of the base material groups is optional when the nominal value is determined from base material group A.

Nominal values determined for different base material groups
These values are to be stated in a table, which includes all base material groups, the anchor might be used with, line by line and the areas of insulation thickness, for which the nominal value shall be given, column by column.

N.2.1 Different nominal values for the areas of insulating layer thickness

The nominal value of the point thermal transmittance χ will be determined for the significant areas as follows:

$\chi(h \leq 150)$ the major value of $\chi(h_{min})$ and $\chi(150\ mm)$

$\chi(h > 150)$ the major value of $\chi(h_{max})$ and $\chi(150\ mm)$

where h is insulating layer thickness of the ETICS [mm]

h_{min} minimum insulating layer thickness according to the manufacturer instruction [mm]

h_{max} maximum insulating layer thickness according to the manufacturer instruction [mm]

The nominal value of the point thermal transmittances has to be rounded upwards and shown in the following steps in W/K: 0 / 0.001 / 0.002 / 0.003 / 0.004 / 0.006 / 0.008

N.2.2 No distinction between areas of insulating layer thickness

If only one significant χ-value is given as nominal value, it results as peak value from all tests according to N.3.2:

$\chi(h_{min} - h_{max})$ peak value (i.e. maximum) for the range from $h = h_{min}$ to $h = h_{max}$

The nominal value of the point thermal transmittances has to be rounded upwards and shown in the following steps in W/K: 0 / 0.001 / 0.002 / 0.003 / 0.004 / 0.006 / 0.008

N.3 Details of the test method

N.3.1 Test sample and conditions

For determination of the point, thermal transmittance χ the following reference construction is used as basis:

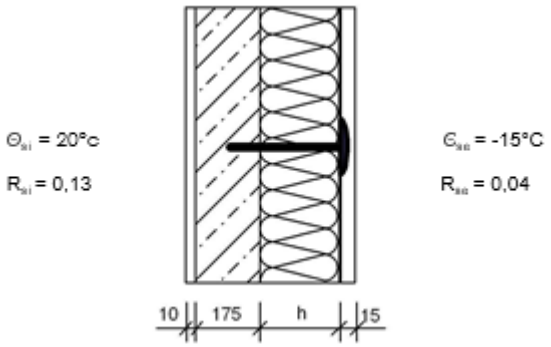


Figure N.3.1 Drawing of the reference construction (not full-scale)

Thickness of thermal insulation layer *h* for testing is taken according to way selected by manufacturer, as specified below. The anchor has to be arranged according to the installation manual of the manufacturer in centre of test specimen in position as in real construction.

For the building component layers the characteristic values of used construction material according to EN 12524 are to be used:

Table N.3.1.1 Characteristic values of thermal conductivity of materials of reference construction

Building component layer	Design value of thermal conductivity [W/(m·K)]	Thickness of the layer [mm]
interior plaster: gypsum plaster without aggregate	0,57	10
substrate	See Table N.3.1.2	175
insulating layer	0,035	h_{min}
External rendering: lime cement plaster	1,0	15

Table N.3.1.2 Characteristic design values of the base material groups

Base material group	Description	Design value of thermal conductivity [W/(m·K)]
A	Normal weight concrete	2,30
B	Solid masonry	1,20
C	Hollow or perforated masonry	0,56
D	Lightweight aggregate concrete with open structure	0,36
E	Autoclaved aerated concrete	0,16

Thickness of insulating layer

The thickness of the insulating layer has influence on the point thermal transmittance χ. The nominal value of the point thermal transmittance χ is to be determined for the ranges of insulating layer thickness h ≤ 150 mm and h > 150 mm. Based on manufacturer´s request, if the point thermal transmittance χ for three thicknesses of insulating layer is determined, thicknesses assessed are as follows:

$\chi(h_{min})$ = for the smallest thickness of the insulating layer h_{min} indicated by the manufacturer

$\chi(h_{150})$ = for the thickness of the insulating layer h = 150 mm

$\chi(h_{max})$ = for the biggest thickness of the insulating layer h_{max} indicated by the manufacturer

If determined value χ(150 mm) is smaller than $\chi(h_{min})$, test of $\chi(h_{max})$ can be neglected, because it is assumed that in any case $\chi(h_{max})$ is smaller than or equal to χ(150 mm).

Anchor characteristics

The thermal conductivity of anchor material is to be taken according to EN 12524 or ISO 10456.

The dimensions of the anchor are to be determined by means of a test specimen or they are to be taken from the manufacturer's technical documentation.

Boundary conditions

The heat transfer resistances for external and internal surface are taken from 6.8 and Table 7 of EN ISO 6946 for the horizontal thermal conductivity by values R_{se} = 0.04 (m²·K)/W and R_{si} = 0.13 (m²·K)/W.

The temperature difference between inside and outside surface of tested specimen is to be ΔT = 35 K (e.g.: θ_{se} = -15 °C; θ_{si} = 20 °C).

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

N.3.2 Measurement

The determination of the thermal transmittance U_c is to be performed in accordance with EN 1946-1 and 1946-4. The measurement can be realised according to EN ISO 8990.

A reference test specimen without anchors with identical thickness of insulating layer is to be used for each measured thickness. The thermal transmittance U of the undisturbed test specimen is to be measured according to the same method as for the thermal transmittance U_c.

Note: When placing the anchor, the distance to the edge and between the anchors should not fall below 300 mm.

N.4 Example of description of nominal values of the point thermal transmittance χ

Examples for the description of nominal values of the point thermal transmittance χ:

Example 1: Single values

An anchor might be used in the base material groups A and B for thicknesses of insulating layer h_{min} = 50 mm up to h_{max} = 320 mm. Following nominal values have been determined by test:

χ(h ≤ 150 mm) = 0.002 W/K and χ(h > 150 mm) = 0.003 W/K

A listening as table is not necessary because the nominal values have been determined for one base material group only. The description is given in single values.

Case 1: Distinction between areas of insulation thicknesses:

χ(h ≤ 150 mm) = 0.002 W/K; χ(h > 150 mm) = 0.003 W/K

Case 2: One χ-value for the whole area of insulation thicknesses:

χ(h = 50 – 320 mm) = 0.003 W/K

Indexing is not necessary because the nominal value was calculated with base material group A.

Example 2: Table or single values

An anchor might be used in the base material groups B, C and D for thicknesses of insulating layer h_{min} = 50 mm up to h_{max} = 250 mm. Following nominal values have been determined by test:

χ_B(h ≤ 150 mm) = 0.002 W/K and χ_B(h > 150 mm) = 0.001 W/K

χ_D(h ≤ 150 mm) = 0.001 W/K and χ_D(h > 150 mm) = 0.001 W/K

Values for χ_C have not been determined. The values from the next higher base material group B apply for this group also.

Alternative A: Description as single values

One of the following description has to be stated for the anchor:

Case 1: $\chi_{B, C, D}$(h ≤ 150 mm) = 0.002 W/K; $\chi_{B, C, D}$ (h > 150 mm) = 0.001 W/K

Case 2: $\chi_{B, C, D}$(50 - 250 mm) = 0.002 W/K

Alternative A: Description as table

One of the following description is to be stated for the anchor:

Case 1: Distinction between areas of insulation thickness

Base material group	Description	χ [W/K)]	
		thickness of insulation layer	
		h ≤ 150 mm	h > 150 mm
B	Solid masonry	0.002	0.001
C	Hollow or perforated masonry	0.002	0.001
D	Lightweight aggregate concrete with open structure	0.001	0.001

Case 2: One χ - value for the whole area of insulation thicknesses

Base material group	Description	χ [W/K)]
		thickness of insulation layer from 50 mm to 250 mm
B	Solid masonry	0.002
C	Hollow or perforated masonry	0.002
D	Lightweight aggregate concrete with open structure	0.001