European Organisation for Technical Approvals
Europäische Organisation für Technische Zulassungen
Organisation Européenne pour l'Agrément Technique

Established pursuant to Annex II of the Council Directive 89/106 of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (Construction Products Directive)

ETAG 031

GUIDELINE FOR
EUROPEAN TECHNICAL APPROVAL
of

Inverted Roof Insulation Kits

Part 1: General

Version November 2010

This Guideline for European Technical Approval is established and published in accordance with Article 11 of the Construction Products Directive as a basis for the preparation and issue of European Technical Approvals in accordance with Article 9.1 of the Construction Products Directive.

European Technical Approvals are issued by approval bodies authorised and notified in accordance with Article 10 of the Construction Products Directive. These bodies are organized in EOTA.

The European Technical Approval, according to the Construction Products Directive, is a favourable technical assessment of the fitness for use of a construction product and the technical specification of the assessed product, serving as basis for the CE marking of this product when and where a harmonised standard according to the Directive is not or not yet available.

Due to technical innovation and the progress of the state of the art, guidelines for technical approval might not reflect the latest developments and experiences gained in approval procedures. The reader of this Guideline is therefore advised to check with an EOTA member whether there are further provisions which have to be taken into account in the use of the Guideline.

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FOREWORD

- Background of the subject

This Guideline has been drawn up by the EOTA Working Group 04.01/02 Inverted Roof Insulation Kits.

The WG consisted of members from ten EU countries [Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, and the United Kingdom (Convenor)] and one EU corresponding member [Poland] and two European Industrial Associations [EXIBA and EUMEPS].

It is important to distinguish between EOTA- and CEN-involvement in the area of insulation used in Inverted Roofs. EOTA deals with the components in the assembled kits as described in the scope of this Guideline, whilst CEN deals with the insulation materials. Existing CEN test methods are used as far as possible.

The Guideline sets out the performance requirements for Inverted Roof Insulation Kits, the verification methods used to examine the various aspects of performance, the assessment criteria used to judge the performance for the intended use and the presumed conditions for the design and execution.

The general assessment approach of the Guideline is based on relevant existing knowledge and testing experience.

This ETA-Guideline Part 1 – General shall be used either as a stand-alone document when assessing kits using simple insulation boards or in conjunction with Part 2 – Insulation with Protective Finishing.

- **Reference documents**

Reference documents are referred to within the body of the ETAG and are subject to the specific conditions mentioned therein.

The **list of reference documents** (2006) for this ETAG is given in annex B. When additional parts for this ETAG are written afterwards, they may comprise modifications to the list of reference documents applicable to that part.

- Updating conditions

The edition of a reference document given in this list is that which has been adopted by EOTA for its specific use. When a new edition becomes available, this supersedes the edition mentioned in the list only when EOTA has verified or re-established (possibly with appropriate linkage) its compatibility with the guideline.

EOTA Technical Reports go into detail in some aspects and as such are not part of the ETAG but express the common understanding of existing knowledge and experience of the EOTA-bodies at that moment. When knowledge and experience is developing, especially through approval work, these reports can be amended and supplemented.

EOTA Comprehension Documents permanently take on board all useful information on the general understanding of this ETAG as developed when delivering ETA's in consensus by the EOTA members. Readers and users of this ETAG are advised to check the current status of these documents with an EOTA member.

EOTA may need to make alterations/corrections to the ETAG during its life. These changes will be incorporated into the official version on the EOTA website www.eota.eu and the actions catalogued and dated in the associated **Progress File**.

Readers and users of this ETAG are advised to check the current status of the content of this document with that on the EOTA website. The front cover will indicate if and when amendment has taken place.

Section one:

INTRODUCTION

1 PRELIMINARIES

1.1 Legal basis

This ETAG has been established in compliance with the provisions of the Council Directive 89/106/EEC (CPD) and has been established taking into account the following steps:

- the final mandate issued by the EC : 03 November 2006
- the final mandate issued by the EFTA : 03 November 2006
- adoption of the Guideline by the Executive Commission of EOTA : 13 March 2007
- opinion of the Standing Committee for Construction : 05 January 2009
- endorsement by the EC : (indicate date)

This document is published by the Member States in their official language or languages according to art. 11.3 of the CPD.

No existing ETAG is superseded

1.2 Status of ETAG

a. **An ETA is one of the two types of technical specifications** in the sense of the EC 89/106 CPD. This means that Member States shall presume that the approved Inverted Roof Insulation Kits are fit for their intended use, i.e. they enable works in which they are employed to satisfy the Essential Requirements during an economically reasonable working life, provided that:

- the works are properly designed and built;
- the conformity of the kits with the ETA has been properly attested.

b. **This ETAG is a basis for ETA's**, i.e. a basis for technical assessment of the fitness for use of an Inverted Roof Insulation Kit. An ETAG is not itself a technical specification in the sense of the CPD.

This ETAG expresses the common understanding of the approval bodies, acting together within EOTA, as to the provisions of the Construction Products Directive 89/106 and of the Interpretative Documents, in relation to the Inverted Roof Insulation Kits and uses concerned, and is written within the framework of a mandate given by the Commission and the EFTA Secretariat, after consulting the Standing Committee for Construction.

c. When accepted by the European Commission after consultation with the Standing Committee for Construction this **ETAG is binding** for the issuing of ETAs for the Inverted Roof Insulation Kits for the defined intended uses.

The application and satisfaction of the provisions of an ETAG (examinations, tests and evaluation methods) leads to an ETA and a presumption of fitness of an Inverted Roof Insulation Kit for the defined use only through an evaluation and approval process and decision, followed by the corresponding attestation of conformity. This distinguishes an ETAG from a harmonized European standard which is the direct basis for attestation of conformity.

Where appropriate, Inverted Roofs Insulation Kits, which are outside of the precise scope of this ETAG may be considered through the approval procedure without guidelines according to art. 9.2 of the CPD.

The requirements in this ETAG are set out in terms of objectives and of relevant actions to be taken into account. It specifies values and characteristics, the conformity with which gives the presumption that the requirements set out are satisfied, wherever the state of art permits and after having been confirmed as appropriate for the particular kit by the ETA.

2 SCOPE

2.1 Scope

This ETA-Guideline Part 1: General - covers inverted flat roof kits, the main component of which is thermal insulation with specific requirement levels for inverted flat roof applications. Apart from meeting specific insulation requirements also requirements and regulations concerning components and materials to be used in combination with the thermal insulation as well as the entire roof build-up are necessary for the successful use of the insulation in the inverted roof. Evaluation of the thermal insulation takes account of the end-use conditions.

A kit consists of thermal insulation and at least one defined component: filter layer, separation layer or a water flow-reducing layer.

ETAs issued on the basis of this guideline, cover either:

- The thermal insulation with filter or separation layer (e.g. geotextile) and all other components(1) of the assembled system within a set generic specification.
- The thermal insulation and a water flow-reducing layer, with all other components of the assembled system within a set generic specification.

(1) Other components are, gravel ballast, paving, drainage layers, bedding layer material and growing medium.

All components of a kit shall be subject to assessment, as well as to FPC requirements according to this guideline.

In addition to evaluating the thermal insulation, as the main subject of approval, the guideline also stipulates general requirements concerning the other component layers which are not part of the kit. This concerns for example indications on the choice of the supplementary components and materials as well as design rules, which depend on the specific application and/or the roof build-up (e.g. correction of the thermal conductivity due to moisture, correction of thermal transmittance due to water flowing).

The thermal insulation is for use fully supported above a waterproofing layer, in new or existing construction, in conjunction with a ballast/protection layer in flat roofs including untrafficked, pedestrian, green roofs, roof gardens and parking decks.

The thermal insulation boards are loose-laid and are extruded polystyrene foam boards to EN 13164: 2008 and expanded polystyrene foam boards to EN 13163: 2008.

The thermal insulation boards are used in conjunction with a protective layer(2) such as paving slabs, paviours or graded gravel and the thermal insulation is not intended to receive direct trafficking. When used in trafficked situations (e.g. parking decks, terracing or pedestrian areas) the protective layer and/or overlay suitable for the intended use shall be used. The thermal insulation shall be used in conjunction with filter/water-flow reducing layer and where necessary separation and/or drainage layers. Other components of the roof system will be taken into account in so far as they may affect, or are affected by, the performance of the kit. The waterproofing layer does not form part of the assembled system.

When assessing thermal insulation with integral protection this ETA-Guideline Part 1: General shall be used in conjunction with Part 2 –Insulation with Protective Finishing.

(2) Requirements for the protective layer are dependent on the Eurocodes and their associated Nationally Determined Parameters (e.g. for wind and structural loading).

2.2 Use categories/Product families

2.2.1 Families

Inverted Roof Kits are based on the following insulation products:

- Extruded Polystyrene (XPS)
- Expanded Polystyrene (EPS)

2.2.2 Use Categories

The areas of use are categorised in order to facilitate the assessment processes:

XPS

- Untrafficked
- Pedestrian
- Green roofs
- Roof gardens
- Parking decks

EPS

- Untrafficked
- Pedestrian

Due to the current limited history of use in green roofs and roof gardens of EPS boards, assessment shall be via the CUAP route.

2.2.3 Classes

External fire performance
Reaction to fire

2.3 Assumptions

The 'State of the Art' does not enable the development, within a reasonable time, of full and detailed verification methods and corresponding technical criteria/guidance for acceptance for some particular aspects or products. This ETAG contains assumptions taking account of the state of art and makes provisions for appropriate, additional **case by case approaches** when examining ETA-applications, within the general framework of the ETAG and under the CPD consensus procedure between EOTA members.

The guidance remains valid for other cases, which do not deviate significantly. The general approach of the ETAG remains valid but the provisions then need to be used case by case in an appropriate way. This use of the ETAG is the responsibility of the ETA-body, which receives the special application, and subject to consensus within EOTA. Experience in this respect is collected, after endorsement in EOTA-TB, in the ETAG-Format-Comprehension document.

List of main assumptions

- The existing waterproofing layer shall be watertight and in good condition.
- The roof shall be designed to avoid surface condensation within the building and deleterious condensation within the roof structure.
- The building shall be sufficiently structurally sound to carry the additional imposed load exerted by the assembled system.
- Roofs shall be properly designed with adequate falls/drainage.
- Regular maintenance of the roof shall be conducted.
- A diffusion open drainage layer shall be used in conjunction with green roofs and roof gardens.
- The ballast, paviours or other surface protection layers afford protection against the effects of ultra violet radiation.
- Filter layers, water-flow reducing layers and other components of the assembled system shall be rot resistant.

3 TERMINOLOGY

3.1 Common terminology and abbreviations

Common Terms are available in the public area of the EOTA website www.eota.eu

3.2 Terminology and abbreviations specific to this ETAG

Assembled system – the kit components and all the other components above the waterproofing layer, once installed in the works. For the purposes of these Guidelines an 'assembled system' excludes the waterproofing layer and anything beneath it.

Ballast layer –see surface protection layer.

Bearing pad – a suitable load spreading support for paving and pre-cast concrete slabs.

Bedding layer – a suitable layer of fine aggregate (e.g. coarse sand) on to which paving slabs, paviours or paving blocks are laid.

Building – a construction works that has the provision of shelter for its occupants or contents as one of its main purposes and is normally designed to stand permanently in one place.

Component – a defined constituent part of a kit (e.g. insulation, geotextile, ballast).

Detail – a special feature occurring in the main roof area or at the sides of a roof. Features include upstands (e.g. at parapets, kerbs, rooflights), expansion joints, edge details (e.g. drips, flashing), gutters, drains, penetrations, etc.

Drainage layer – a layer of material to enhance removal of water from the roof.

Expanded polystyrene foam (EPS) insulation – rigid cellular plastic thermal insulation material with an air filled closed cell structure, manufactured by moulding beads of expandable polystyrene or one of its copolymers.

Extruded polystyrene foam (XPS) insulation – rigid cellular plastic thermal insulation material with a closed cell structure with or without a skin, manufactured by extrusion and expansion of polystyrene or one of its copolymers.

Fall – the slope of the substrate in the direction of the rainwater outlets.

Filter layer – a diffusion open, UV stable and rot resistant layer of geotextile material laid between the thermal insulation layer and the protective ballast layer to prevent fines and other debris from passing through.

Flat roof – for the purpose of this document a waterproofed roof with a slope angle of less than 8.5°.

Fully supported – thermal insulation boards laid directly (without spacers) on to the waterproofing, with or without a separation layer.

***fx* value –** *f* is the drainage factor giving the fraction of the average rate of precipitation during the heating season for the location reaching the waterproofing membrane, and *x* is the factor for increased heat loss caused by rainwater flowing on the waterproofing membrane.

Gravel – a 'washed low fines aggregate' used for ballasting the kit against wind uplift. The normal size for aggregate for this purpose is between 16 to 32 mm.

Green roof – a roof consisting of the structural deck and all the layers on it, including waterproofing, thermal insulation and a thin layer of growing medium planted with vegetation and possibly including areas of paving.

Insulation with protective finishing – See Part 2 of this ETAG.

Inverted roof – a roof in which the thermal insulation is placed above the waterproofing layer.

Inverted roof insulation kit –A kit consists of thermal insulation and at least one defined component: filter layer, separation layer or a water flow-reducing layer. The other components of the assembled system (i.e. a drainage layer) may be dealt with by generic specification (see figure 1).

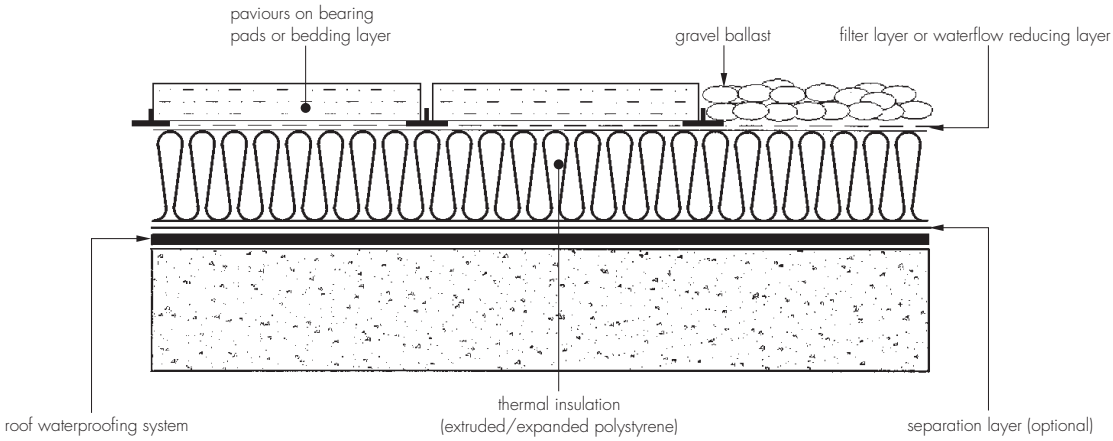


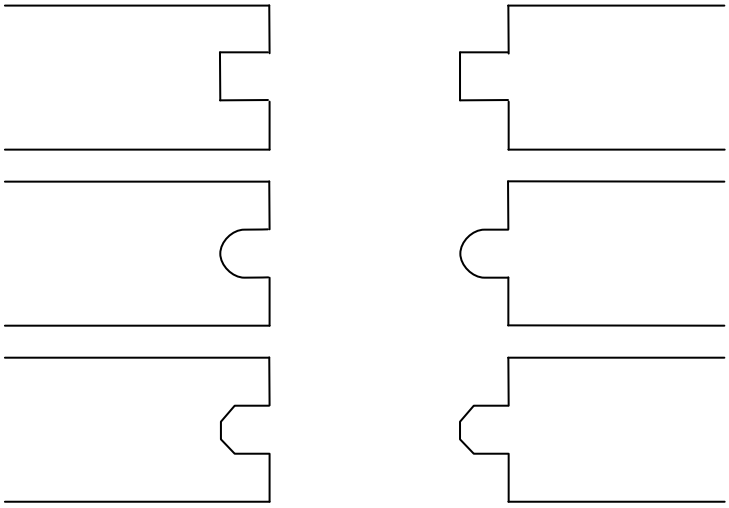
Figure 1 Schematic build-up of an inverted roof system

Joint geometry – the edges of the thermal insulation boards can have one of the following three geometries. Below are schematic diagrams of joints:

(1) Butt joint (also known as straight edge)

(2) Rebate joint (also known as shiplap or rabbet)

(3) Tongue and groove joints



Parking deck – a roof consisting of the structural deck and all the layers on it, including waterproofing, thermal insulation and a surface protective layer, designed to withstand and distribute loads produced by the traffic associated with the parking of vehicles of Category F from Eurocode EN 1991-1-1.

Pedestrian access roof – a roof consisting of the structural deck and all the layers on it, including waterproofing, thermal insulation and a surface protective layer designed for foot traffic and gathering of people greater than that required for maintenance.

Roof – the structural deck and all the layers on it, including the surface exposed to the weather and including the necessary details.

Roof garden – a roof consisting of the structural deck and all the layers on it, including waterproofing, thermal insulation, a drainage layer and a substantial layer of growing medium planted with intensive vegetation and possibly including paving.

Sample – a representative part of (one or more) of the components of the inverted roof insulation kit or a representative part of the kit (as an assembled system) for the purpose of identification and/or verification of its characteristics.

Separation layer – a continuous layer of material laid between the waterproofing and the thermal insulation component to prevent chemical reaction between them.

Structural deck – the waterproofed part of the roof that, as a construction element, has to transfer both permanent and variable loads to the other parts of the building.

Substrate – the layer of material immediately under the roof waterproofing membrane.

Surface Protection layer – a layer of ballast, graded gravel, paviours, paving slabs (including bearers bedding layer or growing medium if necessary), cast concrete for parking decks or supported tiles applied over the surface of the assembled kit. The layer provides fire protection, resistance to wind uplift, UV protection and varying degrees of resistance to mechanical damage, from traffic etc.

Thermal insulation – a thermal insulation component according to EN 13163 : 2008 or EN 13164 : 2008.

Untrafficked roof – a roof consisting of the structural deck and all the layers on it, including waterproofing, insulation and a surface protective layer not designed for foot traffic above that required for maintenance of roof and/or technical equipment.

Waterproofing layer – a layer(s) providing the primary function of preventing the transmission of water into the structure.

Water-flow reducing layer – a water resistant, diffusion open, UV stable and rot resistant, Synthetic non-woven membrane, laid between the thermal insulation component and the protective ballast layer to reduce *fx* value. The layer also prevents fines and other debris from passing through.

Section two:

GUIDANCE FOR THE ASSESSMENT OF THE FITNESS FOR USE

GENERAL NOTES

(a) Applicability of the ETAG

This ETAG provides guidance on the assessment of a family of Inverted Roof Insulation Kits and their intended uses. It is the manufacturer or producer who defines the kit for which he is seeking ETA and how it is to be used in the works, and consequently the scale of the assessment.

It is therefore possible that for some kits, which are fairly conventional, only some of the tests and corresponding criteria are sufficient to establish fitness for use. In other cases, e. g. special or innovative product or materials, or where there is a range of uses, the whole package of tests and assessment may be applicable.

(b) General lay out of this section

The assessment of the fitness of Inverted Roof Insulation Kits with regard to their fitness for intended use in construction works is a process with three main steps:

- Chapter 4 clarifies **the specific requirements for the works** relevant to the Kit and uses concerned, beginning with the Essential Requirements for works (CPD art. 11.2) and then listing the corresponding relevant characteristics of the Kits
- Chapter 5: extends the list in chapter 4 into more precise definitions and the **methods available to verify** kit characteristics and to indicate how the requirements and the relevant kit characteristics are described. This is done by test procedures, methods of calculation and of proof, etc. (selection of the appropriate methods)
- Chapter 6 provides guidance on **the assessing and judging methods** to confirm fitness for the intended use of the Kit
- Chapter 7, **assumptions and recommendations** are only relevant in as far as they concern the basis upon which the assessment of the Kits is made concerning their fitness for the intended use.

(c) Levels or classes or minimum requirements related to the essential requirements and to the product performance (see ID clause 1.2 and EC Guidance Paper E)

According to the CPD "Classes" in this ETAG refer only to mandatory levels or classes laid down in the EC-mandate.

This ETAG indicates however the compulsory way of expressing relevant performance characteristics for the Inverted Roof Insulation Kits. If, for some uses at least one Member State has no regulations, a manufacturer always has the right to opt out of one or more of them, in which case the ETA will state "no performance determined" against that aspect.

d) Working life (durability) and serviceability

The provisions, test and assessment methods in this guideline or referred to, have been written based upon the assumed intended working life of the Inverted Roof Insulation Kit for the intended use of 25 years, provided that the Kit is subject to appropriate use and maintenance (cfr. ch. 7). These provisions are based upon the current state of art and the available knowledge and experience.

An "assumed intended working life" means that it is expected that, when an assessment following the ETAG-provisions is made, and when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

The indications given as to the working life of an Inverted Roof Insulation Kit cannot be interpreted as a guarantee given by the producer or the approval body. They shall only be regarded as a means for the specifiers to choose the appropriate criteria for Inverted Roof Insulation Kits in

relation to the expected, economically reasonable working life of the works (based upon ID. par. 5.2.2).

(e) Fitness for the intended use

According to the CPD it has to be understood that, within the terms of this ETAG, products shall "have such characteristics that the works in which they are to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the Essential Requirements" (CPD, art. 2.1).

Hence, the Inverted Roof Insulation Kits shall be suitable for use in construction works, which (as a whole and in their separate parts) are fit for their intended use, account being taken of economy, and in order to satisfy the essential requirements. Such requirements shall, subject to normal maintenance, be satisfied for an economically reasonable working life. The requirements generally concern actions, which are foreseeable. "(CPD Annex I, preamble).

4 REQUIREMENTS

This chapter considers the requirements for works, and their relationship to the Inverted Roofs Insulation Kits characteristics.

This chapter sets out the aspects of performance to be examined in order to satisfy the relevant Essential Requirements, by:

- expressing in more detail, within the scope of the ETAG, the relevant Essential Requirements of the CPD in the Interpretative Documents and in the mandate, for works or parts of the works, taking into account the actions to be considered, as well as the expected durability and serviceability of the works.

- applying them to the scope of the ETAG (the kit and where appropriate its constituents, components and intended uses), and providing a list of relevant component characteristics and other applicable properties.

When a component characteristic or other applicable property is specific to one of the Essential Requirements, it is dealt with in the appropriate place. If, however, the characteristic or property is relevant to more than one Essential Requirement, it is addressed under the most important one with cross-reference to the other(s). This is especially important where a manufacturer claims "No performance determined" for a characteristic or property under one Essential Requirement and it is critical for the assessing and judging under another Essential Requirement. Similarly, characteristics or properties, which have a bearing on durability assessments may be dealt with under ER 1 to ER 6, with reference under 4.7. Where there is a characteristic which only relates to durability, this is dealt with in 4.7.

This chapter also takes into account further requirements, if any (e.g. resulting from other EC Directives) and identifies aspects of serviceability including specifying characteristics needed to identify the *components of the kit* (cf. ETA-format par. II.2).

4.0 Table linking ER, relevant ID and Product Characteristics

The relevant Essential Requirements, the relevant paragraphs of the corresponding IDs and the related requirements to kit/component performances are indicated in below:

ER	Corresponding ID paragraph for works	Corresponding ID paragraph for product performance	Kit/component Characteristic	ETAG paragraph on requirements
2	§ 4.2.4 Limitation of spread of fire to neighbouring construction works	§ 4.3.1.2 Products for roofs subject to fire requirements	Reaction to fire External fire performance	4.2.1 4.2.2
3	§ 3.3.1 Indoor environment § 3.3.5 Outdoor environment	§ 4.2 Performance of products	Water vapour transmission Release of dangerous substances	4.3.1 4.3.2
4	§ 3.3.1 Falling § 3.3.2 Direct impacts	§ 4.2 Performance of products	Slip resistance (Part 2 only) Resistance to wind loads Mechanical damage (Part 2 only)	4.4.2 4.4.1 4.4.3
6	§ 4.3.2 Characteristics of Products which may be relevant to the essential requirement	§ 4.3.3 Performances of products	Thermal characteristics Compression characteristics	4.6.1 4.6.2
Aspects of durability related to ER 2 ,ER3, ER4 & ER6			Compression characteristics Heat Water absorption Freeze thaw Mechanical damage (Part 2 only) Chemical resistance Compatibility of kit components with other components of the assembled system	4.7.1
Aspects of serviceability related to ER2, ER3, ER4 & ER6			Watertightness (Water-flow reducing layers only)	4.7.2

4.1 ER1: Mechanical resistance and stability

An Inverted Roof Insulation Kit makes no contribution towards enabling a construction works to meet the requirements of ER 1 Mechanical resistance and stability.

There are therefore no requirements.

4.2 ER2: Safety in case of fire

4.2.1 Reaction to fire

The reaction to fire performance of the kit components shall be in accordance with laws, regulations and administrative provisions applicable to the kit in its intended end use application. This performance shall be expressed in the form of a classification specified in accordance with the relevant EC decision and the appropriate CEN classification standard.

4.2.2 External fire performance

The external fire performance of the roof system of which the kit forms part shall be in accordance with the laws, regulations and administrative provisions. This performance shall be expressed in the form of a classification specified in accordance with the relevant EC decision and the appropriate CEN classification standard.

4.3 ER3: Hygiene, Health and the Environment

4.3.1 Water vapour permeability

The assembled kit shall not cause or contribute to causing:

- condensation at the under surface of the roof, or
- unbalanced interstitial condensation within the roof.

4.3.2 Release of dangerous substances

The kit shall be such that, when installed according to the appropriate provisions of the Member States, it allows for the satisfaction of the ER3 of the CPD as expressed by the national provisions of the Member States and in particular does not cause harmful emission of toxic gases, dangerous particles or radiation to the indoor environment nor contamination of the outdoor environment (air, soil or water).

4.4 ER4: Safety in use

4.4.1 Resistance to wind loads

The roof assembly, including the kit, shall have sufficient stability against wind loads to avoid detachment of parts of the works that, by falling down, might form the risk of injury or death of users in or around the work.

4.4.2 Slip resistance

Kits according to Part 1 do not include the uppermost layer. This characteristic is only relevant for products according to Part 2.

4.4.3 Mechanical damage

Kits according to Part 1 does not include the uppermost layer. This characteristic is only relevant for products according to Part 2.

4.5 ER5: Protection against noise

Requirements with respect to the protection against noise are not addressed, as this is dependent on the whole roof structure.

4.6 ER6: Energy economy and heat retention

4.6.1 Thermal characteristics

The assembled kit shall have a thermal performance sufficient to meet the Essential Requirements dealt with under ER6 Energy economy and heat retention.

4.6.2 Compression characteristics

The thermal insulation component shall have suitable compression characteristics to allow the assembled kit to meet the Essential Requirements dealt with under ER6 Energy economy and heat retention.

4.7 Aspects of durability, serviceability and identification

4.7.1 Aspects of durability

The assembled kit shall have sufficient resistance to the effects of deleterious actions to ensure that deterioration of components during the intended working life does not significantly affect the performance of the kit in relation to fulfilling all the Essential Requirements 2, 3, 4 and 6.

Factors to be taken into account include:

- Compression characteristics
- Heat
- Water absorption
- Freeze thaw
- Mechanical damage (Part 2 only)
- Chemical resistance
- Compatibility of kit components with the other components of the assembled system.

4.7.2 Aspects of serviceability

The following aspect of serviceability necessary for the satisfaction of the CPD shall be taken into account:

- Watertightness (Water-flow reducing layers only).

4.7.3 Aspects of Identification

The components used in the Inverted Roof Insulation Kits shall be identifiable to the extent that their properties might influence the system's ability to fulfil the Essential Requirements.

5. METHODS OF VERIFICATION

This chapter refers to the verification methods used to determine the various aspects of performance of the kits in relation to the requirements for the works (calculations, tests, engineering knowledge, site experience, etc.) as set out in chapter 4.

The possibility exists to use existing data in accordance with the EOTA Guidance Document No 004 on "The provision of data for assessment leading to ETA".

The declared value for each characteristic of the thermal insulation has to be representative for all thermal insulation thicknesses covered by the ETA, for example the λ values of the thermal insulation are dependent on board thickness. In context of the approval tests, the tests shall be performed at least on the thinnest and the thickest thermal insulation covered by the ETA. For the declaration of characteristics the range of the thermal insulation thicknesses covered by the ETA can be divided into groups.

When EUROCODES are quoted in this ETAG as the methods for the verification of certain kit/component characteristics, their application in this ETAG, as well as in the subsequent ETAs issued according to this ETAG, shall be in accordance with the principles laid down in the EC Guidance Paper on the use of EUROCODES in harmonised European technical specifications.

5.0 Table adding verification methods to tables in 4.0.

ER	ETAG paragraph on product performance	ETAG paragraph on method of verification	Specific ETAG clause on method of verification
2	4.2 Safety in case of Fire	- Reaction to fire - External fire performance	5.2.1 5.2.2
3	4.3 Hygiene, Health and the Environment	- Water vapour transmission - Release of dangerous substances	5.3.1 5.3.2
4	4.4 Safety in use	- Resistance to wind loads - Slip resistance (Part 2 only) - Mechanical damage (Part 2 only)	5.4.1 5.4.2 5.4.3
6	4.6 Energy Economy	- Thermal characteristics Thermal resistance Thermal conductivity (Lambda) Correction value for thermal transmittance - Compression characteristics	5.6.1 5.6.1.1 5.6.1.2 5.6.1.3 5.6.2
	Aspects of durability related to ER 2 ,ER3, ER4 & ER6	- Compression characteristics Compressive stress Compressive creep Deformation under specified compressive load and temperature - Heat Dimensional stability Combined UV/Heat ageing (Water-flow reducing layers only) - Water absorption Long-term water absorption by diffusion Long-term water absorption by immersion - Freeze thaw - Mechanical damage (Part 2 only) Hard body impact resistance Tensile bond strength Static loading (point loading) Wear resistance - Chemical resistance - Compatibility of kit components with other components of the assembled system	5.7.1.2 5.7.1.2.1 5.7.1.2.2 5.7.1.2.3 5.7.1.3 5.7.1.3.1 5.7.1.3.2 5.7.1.4 5.7.1.4.1 5.7.1.4.2 5.7.1.5 5.7.1.6 5.7.1.6.1 5.7.1.6.2 5.7.1.6.3 5.7.1.6.4 5.7.1.7 5.7.1.8
	Aspects of serviceability related to ER2, ER3, ER4 & ER6	- Watertightness (Water-flow reducing layers only) Resistance to water penetration Hydrostatic head	5.7.2.1 5.7.2.1.1 5.7.2.1.2

5.1 Mechanical resistance and stability

No requirements

5.2 Safety in case of fire

5.2.1 Reaction to fire

When required kit components shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1. Where the performance of the roof kit may be influenced by the surface protection layer, the reaction to fire performance of this layer shall form part of the generic specification. It is possible that some components do not require testing because they are covered by Commission Decision 1996/603//EC, as amended e.g. ballast.

5.2.2 External fire performance

Kits, intended to be fully covered in normal usage by the inorganic coverings(1) listed in the Annex of Commission Decision 2000/553/EC can be considered to satisfy the requirements regarding external fire performance without the need for testing in accordance with the Commission Decision 2000/553/EC.

A kit used in conjunction with a protection not covered by the Annex of Commission Decision 2000/553/EC shall be tested. The assembled system shall be tested in accordance with ENV 1187) to the appropriate test method for the corresponding external performance roof class for the member state concerned, in order to be classified according to EN 13501-5.

(1) Annex of Commission Decision 2000/553/EC lists the following inorganic coverings:

- *Loose laid gravel with a thickness of at least 50 mm or a mass ≥ 80 kg·m^{-2} (minimum aggregate size 4 mm, maximum 32 mm).*
- *Sand/cement screed to a thickness of at least 30 mm.*
- *Cast stone or mineral slabs of at least 40 mm thickness.**

** In the opinion of the EOTA WG the slabs shall be fully supported on the thermal insulation. If bearing pads are used the total roof assembly may have to be tested due to the gaps between the slabs.*

5.3 Hygiene, Health and the Environment

5.3.1 Water vapour transmission

5.3.1.1 Insulation

The water vapour transmission rate for homogeneous thermal insulation shall be determined(1) in accordance with EN 12086 : 1997 and declared as the water vapour diffusion resistance factor (μ).

(1) The water vapour diffusion resistance factor (μ) for EPS may be declared from the Table D.2 of EN 13163: 2008.

5.3.1.2 Water-flow reducing layer

The water vapour transmission rate of the water-flow reducing layer shall be determined in accordance with EN ISO 12572 : 2001, test condition C, and declared as the water vapour diffusion –equivalent air layer thickness (s_d).

5.3.2 Release of dangerous substances

5.3.2.1 Presence of dangerous substances in the components

The applicant shall submit a written declaration stating whether or not the supplied kit component(s) contains dangerous substances according to European and national regulations, when and where relevant in the Member States of destination, and shall list these substances.

5.3.2.2 Compliance with the applicable regulations

If the kit contains dangerous substances as declared above, the ETA will provide the method(s) which has been used for demonstrating compliance with the applicable regulations in the Member States of destination, according to the updated EU data-base (method(s) of content or release, as appropriate).

5.3.2.3 Application of the precautionary principle

An EOTA member has the possibility to provide to the other members, through the Secretary General, warning about substances which, according to Health authorities of its country, are considered to be dangerous under sound scientific evidence, but are not yet regulated. Complete references about this evidence will be provided.

This information once agreed upon, will be kept in an EOTA database, and will be transferred to the Commission services.

The information contained in this EOTA database will also be communicated to any ETA applicant.

On the basis of this information, a protocol of assessment of the component, regarding this substance, could be established on request of a manufacturer with the participation of the Approval Body, which raised the issue.

5.4 Safety in use

5.4.1 Resistance to wind loads

The calculation and assessment of the suitability of the assembled system to resist wind loading shall be carried out in accordance with Euro Code EN 1991-1-4 and the Nationally Determined Parameters.

For each specific building, the calculation of the required ballast to resist the wind up lift force shall be carried out by the roof designer.

5.4.2 Slip resistance

Kits according to Part 1 does not include the uppermost layer. This characteristic is only relevant for products according to Part 2.

5.4.3 Mechanical damage (Part 2 only)

See clause 5.7.1.6

5.5 Protection against noise

No requirements

5.6 Energy economy and heat retention

5.6.1 Thermal characteristics

5.6.1.1 Thermal resistance of the kit

The total thermal resistance of the kit is the sum of the thermal resistance of the kit's components. Since the thermal insulation is the major contributor to the kit's thermal resistance it shall be addressed in detail as follows:

The declared thermal resistance R_D of the thermal insulation shall be determined in accordance with the product standards (EN 13163: 2008, EN 13164: 2008).

For an assessment of the thermal insulation taking account of the end use conditions in an inverted roof a correction of the thermal resistance is necessary. This correction depends on the climatic conditions at the place of use and the roof build-up.

The thermal resistance design values are to be finally laid down by national regulations or, if national regulations do not exist, by national technical recommendations or by the designer of the roof. But an ETA for a thermal insulation used in an inverted roof shall include corrected values of thermal resistance due to the special application.

In the following a correction procedure taking into account two levels is given. Level 1 applies when the freeze-thaw resistance of the thermal insulation is considered critical level 2 applies when the freeze-thaw resistance of the thermal insulation is non-critical. It shall be up to the National Regulator which calculated value(s) apply in that country.

Correction procedure for thermal resistance

The corrected thermal resistance R_{cor} shall be determined in accordance with EN ISO 10456 as described in the following.

$R_{cor} = R_D / F_m$ where R_D is the declared thermal resistance

F_m is the moisture conversion factor

The factor F_m shall be determined as follows:

$F_m = e^{f_\psi * \psi_{cor}}$ where

f_ψ is the moisture conversion coefficient [m³/m³] according to EN ISO 10456 or according to Annex B of the ETAG

ψ_{cor} is the calculation value for moisture content [m³/m³] depending on the level

under level 1: $\psi_{cor} = (\psi_{diff} + \psi_{FT})$

under level 2: $\psi_{cor} = \psi_{diff}$

ψ_{diff}: limit value for the declared level of water absorption by diffusion (EN 12088) (see 6.7.1.4.1)

ψ_{FT}: limit value for the declared level of water absorption after freeze-thaw-test (EN 12091) additional to the initial water content after preparation of sample by diffusion test (see 6.7.1.5)

The roof build-up affects the thermal performance of the insulation, but this effect has not been taken into account in this ETAG.

5.6.1.2 Thermal conductivity (Lambda) of the insulation

The declared thermal conductivity λ_D of the thermal insulation shall be determined in accordance with the product standards (EN 13163: 2008, EN 13164: 2008).

For an assessment of the thermal insulation taking account of the end use conditions in an inverted roof a correction of the thermal conductivity is necessary. This correction depends on the climatic conditions at the place of use and the roof build-up.

The thermal conductivity design values are to be finally laid down by national regulations or, if national regulations do not exist, by national technical recommendations or by the designer of the roof. But an ETA for a thermal insulation used in an inverted roof shall include corrected values of thermal conductivity due to the special application.

In the following a correction procedure taking into account two levels shall be given. Level 1 applies when the freeze-thaw resistance of the thermal insulation is considered critical, level 2 applies when the freeze-thaw resistance of the thermal insulation is non-critical. It shall be up to the National Regulator which calculated value(s) apply in that country.

Correction procedure for thermal conductivity

The corrected thermal conductivity λ_{cor} shall be determined in accordance with EN ISO 10456 as described in the following.

$\lambda_{cor} = \lambda_D * F_m$ where λ_D is the declared thermal conductivity

F_m is the moisture conversion factor

The factor F_m shall be determined as follows*:*

$F_m = e^{f_\psi * \psi_{cor}}$ where

f_ψ is the moisture conversion coefficient [m³/m³] according to EN ISO 10456 or according to Annex B of the ETAG

ψ_{cor} is the calculation value for moisture content [m³/m³] depending on the level

under level 1: $\psi_{cor} = (\psi_{diff} + \psi_{FT})$

under level 2: $\psi_{cor} = \psi_{diff}$

ψ_{diff}: limit value for the declared level of water absorption by diffusion (EN 12088) (see 6.7.1.4.1)
ψ_{FT}: limit value for the declared level of water absorption after freeze-thaw-test (EN 12091) additional to the initial water content after preparation of sample by diffusion test (see 6.7.1.5)

The roof build-up affects the thermal performance of the insulation, but this effect has not been taken into account in this ETAG.

5.6.1.3 Correction value for thermal transmittance of the Inverted Roof Insulation Kit

In the case of lower *fx* values than those quoted in 6.6.1.3, the *fx* value shall be determined in accordance with the Annex C.

5.6.2 Compression characteristics

See 5.7.1.2

5.7 Aspects of durability, serviceability and identification

5.7.1 Aspects of durability

5.7.1.1 General

The aspects related to the durability of Inverted Roof Insulation Kits, and which shall be taken into account, is the retention of characteristics after exposure to:

- Compression characteristics
- Heat
- Water absorption
- Freeze thaw
- Mechanical damage
- Chemical resistance
- Compatibility of kit components with the other components of the assembled system.

5.7.1.2 Compression characteristics of the thermal insulation

5.7.1.2.1 Compressive strength/stress

The compressive strength at yield (σ_m) or stress at 10% deformation (σ_{10}) shall be determined in accordance with EN826.

5.7.1.2.2 Compressive creep

The compressive creep (ε_{ct}) and total thickness reduction (ε_t) shall be determined, in accordance with EN 1606 : 1997, after 304 days (25 years) or 608 days (50 years)(1) using a compressive stress (σ_c) defined by the Use Category.

(1) The 50 year level, as defined in EN 1606: 1997, shall be used for assessing roof garden and parking deck specifications where high compressive forces are exerted on the thermal insulation. The 50 year level, when used in the context of this ETAG, does not equate to a working life 50 years, this remains at 25 years.

5.7.1.2.3 Deformation under specified compressive load and temperature

The Deformation under specified compressive load and temperature shall be determined under a compressive load of 40 kPa and a temperature of 70°C in accordance with EN 1605: 1997.

5.7.1.3 Heat

5.7.1.3.1 Dimensional stability of the thermal insulation

The dimensional stability at a temperature of 70°C and a relative humidity of 90% for 48 hours shall be determined in accordance with EN1604.

5.7.1.3.2 Ageing by combined UV, water and heat of the water-flow reducing layer

The ageing by combined UV, water and heat shall be carried out on the water-flow reducing layer in general accordance with EN 13859-1 : 2005, Annex C. Deviating from EN 13859-1 : 2005, the test shall be performed with a cycle of five hours dry one hour water spray in accordance with EN 1297 : 2004. Following ageing the tensile properties and watertightness tests shall be repeated.

5.7.1.4 Water absorption of the thermal insulation

5.7.1.4.1 Long-term water absorption by diffusion

The long-term water absorption by diffusion shall be determined in accordance with EN 12088: 1997.

5.7.1.4.2 Long-term water absorption by immersion

The long-term water absorption by immersion shall be determined in accordance with EN 12087: 1997.

5.7.1.5 Resistance to freeze-thaw of the thermal insulation

The freeze-thaw resistance shall be determined in accordance with EN 12091: 1997 using samples prepared by water absorption by diffusion in accordance with EN 12088: 1997.

Following freeze-thaw cycling the water absorption (W_V), compressive strength at yield (σ_m) or compressive stress at 10% deformation (σ_{10}) shall be determined, whichever was assessed prior to the freeze-thaw exposure.

5.7.1.6 Mechanical damage

5.7.1.6.1 Hard body impact resistance

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

5.7.1.6.2 Tensile bond strength

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

5.7.1.6.3 Static indentation (point loading)

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

5.7.1.6.4 Wear resistance

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

5.7.1.7 Chemical resistance

5.7.1.7.1 Thermal Insulation

This shall be assessed by the Approval Body with reference to published chemical resistance data for the insulation type and the ETA Applicant's declaration. The ETA Applicant shall provide a list of chemicals or chemical families the insulation shall not come into contact with.

5.7.1.7.2 Filter Layer

This shall be assessed by the Approval Body with reference to published chemical resistance data for the filter layer type and the ETA Applicant's declaration when this layer is a defined component of the kit.

5.7.1.7.3 Water-flow reducing layer

Resistance to the effects of lime water, sodium chloride solution and sulphurous acid shall be determined in accordance with EN 1847: 2001 using a temperature of 23°C and a duration of 28 days. Following conditioning, tests for tensile strength (5.7.3.4.4) and watertightness (5.6.3.1) shall be conducted when this layer is a defined component of the kit.

5.7.1.7.4 Separation layer

This shall be assessed by the Approval Body with reference to published chemical resistance data for the separation layer and the ETA Applicant's declaration when this layer is a defined component of the kit.

5.7.1.8 Compatibility of kit components with the other components of the assembled system

The ETA Applicant shall declare the compatibility of the kit components with the other components of the kit and the assembled system.

5.7.2 Aspects of serviceability

The following characteristic of Inverted Roof Insulation Kits have been identified as being necessary to allow judgement of a kit's ability to satisfy the CPD.

5.7.2.1 Watertightness of the water-flow reducing layer

5.7.2.1.1 Resistance to water penetration

The resistance to water penetration shall be determined in accordance with EN 13859-1 : 2005 for class W1.

5.7.2.1.2 Hydrostatic head

The hydrostatic head shall be determined in accordance with EN 20811: 1992 using a rate of 100mm per minute.

5.7.3 Aspects of Identification

5.7.3.1 EPS

5.7.3.1.1 Bending strength

The bending strength (σ_b) shall be determined in accordance with EN 13163: 2008 using EN 12089: 1997 Method B (also see Annex C of EN 13163: 2008).

5.7.3.2 XPS

No additional requirements to those previously mentioned in the Chapter.

5.7.3.3 Filter layer

5.7.3.3.1 Type

The type (e.g. non-woven polyester) shall be declared if the filter layer forms part of the kit.

5.7.3.3.2 Mass per unit area

The mass per unit area shall be declared.

5.7.3.3.3 Tensile properties

The tensile strength and elongation at break shall be declared.

5.7.3.4 Water flow-reducing layer

5.7.3.4.1 Type

The type (e.g. non-woven polyethylene) shall be declared.

5.7.3.4.2 Length, width, straightness

The length, width and straightness shall be determined in accordance with EN 1848-2 : 2000.

5.7.3.4.3 Mass per unit area

The mass per unit area shall be determined in accordance with EN 1849-2: 2000.

5.7.3.4.4 Tensile properties

The tensile strength and elongation at break shall be determined in accordance with EN 12311-1: 2000 with the modifications described in EN 13859-1: 2005 Annex A.

5.7.3.4.5 Resistance to static loading

The resistance to static loading shall be determined in accordance with EN 12730: 2001 Method A.

5.7.3.5 Separation layer

5.7.3.5.1 Type

The type (e.g. non-woven polyester) shall be declared.

5.7.3.5.2 Mass per unit area

The mass per unit area shall be determined in accordance with EN 29073-1.

5.7.3.5.3 Tensile properties

The tensile strength and elongation at break shall be determined in accordance with EN 29073-3.

6 ASSESSING AND JUDGING THE FITNESS

This chapter details the performance requirements to be met (chapter 4) in precise and measurable (as far as possible and proportional to the importance of the risk) or qualitative terms, related to the kit and its intended use, using the outcome of the verification methods (chapter 5).

6.0 Table linking the Essential Requirements to product requirements.

ER	ETAG paragraph on product performance to be assessed	Class, Use category or criterion	No performance determined option allowed
2	6.2.1 Reaction to fire	Euroclass according to EN 13501-1	Yes
	6.2.2 External fire performance	Classification according to EN 13501-5(1)	Yes
3	6.3.1 Water vapour transmission	Measured or declared	Yes(2)
	6.3.2 Release of dangerous substances	By declaration	Yes(3)
4	6.4.1 Resistance to wind loads	By calculation of ballast requirements for the specific site	
	6.4.2 Slip resistance	See Part 2 for criterion	Yes
	6.4.3 Mechanical damage	See Part 2 for criteria	See below
6	6.6.1 Thermal characteristics		
	6.6.1.1 Thermal resistance	By declaration	No
	6.6.1.2 Thermal conductivity (Lambda)	By declaration	Yes(4)
	6.6.1.3 Correction value for thermal transmittance	Reference or measurement of *fx*	No
	6.6.2 Compressive characteristics	See 6.7.1.2 for criteria	See below
	6.7.1.2 Compression characteristics		
	6.7.1.2.1 Compressive stress/strength	See 6.7.1.2.1 for criterion	No
	6.7.1.2.2 Compressive creep	See 6.7.1.2.2 for criterion	No
	6.7.1.2.3 Deformation under specified compressive load and temperature	DLT(2)5	No
	6.7.1.3 Heat		
	6.7.1.3.1 Dimensional stability	See 6.7.1.3.1 for criterion	No
	6.7.1.3.2 Combined UV/Heat ageing (Water-flow reducing layers only)	See 6.7.1.3.2 for criterion	No
	6.7.1.4 Water absorption		
	6.7.1.4.1 Long-term water absorption by diffusion	See 6.7.1.4.1 for criterion	No
	6.7.1.4.2 Long-term water absorption by immersion	See 6.7.1.4.2 for criterion	No
	6.7.1.5 Freeze thaw	See 6.7.1.5 for criterion	No
	6.7.1.6 Mechanical damage		
	6.7.1.6.1 Hard body impact resistance	See Part 2 for criterion	Yes
	6.7.1.6.2 Tensile bond strength	See Part 2 for criterion	No
	6.7.1.6.3 Static indentation (point loading)	See Part 2 for criterion	Yes
	6.7.1.6.4 Wear resistance	See Part 2 for criterion	Yes
	6.7.1.7 Chemical resistance	By declaration	No
	6.7.1.8 Compatibility of kit components with other components of the assembled system	By declaration	No
	6.7.2.1 Watertightness (Water-flow reducing layers only)	See 6.7.2.1.1 for criterion	No
	6.7.2.1.1 Resistance to water penetration	See 6.7.2.1.2 for criterion	No
	6.7.2.1.2 Hydrostatic head		

(1) For deemed to satisfy protections see section 5.2.2.
(2) Water vapour transmission shall be determined for components being assessed under Part 2 of this ETAG.
(3) Not possible for substances regulated at the European level.
(4) A declaration shall be made if possible, refer to EN 13163: 2008 or EN 13164: 2008.

6.1 Mechanical resistance and stability

No requirements.

6.2 Safety in case of fire

6.2.1 Reaction to fire

The kit components shall be classified according to either, EN 13501-1 or EC Decision 96/603/EC as amended.

6.2.2 External fire performance

Where appropriate, roofs may be classified in accordance with EC Decision 2000/553/EC without the need for testing, and according to other Decisions that can apply. The ETA shall define clearly the build up of the roof(s) that is/are subject to relevant Decision.

Test results in accordance with ENV 1187 shall be used to classify the relevant roof of which the kit forms part of the assembled system in accordance with EN 13501-5. The ETA shall define clearly the build up of the roof receiving this classification.

The classification from test applies to the kit tested and any other kits covered by the scope of direct or extended application. If the ETA Applicant produces kits outside the scope of direct/extended application, and these kits are intended for uses subject to EFP, the Applicant shall have additional testing performed.

6.3 Hygiene, Health and the Environment

6.3.1 Water vapour transmission

6.3.1.1 Insulation

The water vapour transmission rate is determined in accordance with 5.3.1.1 and expressed as water vapour diffusion resistance factor (μ).

6.3.1.2 Water-flow reducing layer

The water vapour transmission rate shall be determined in accordance with 5.3.1.2 and expressed as the water vapour diffusion –equivalent air layer thickness (s_d). The s_d-value shall be a maximum of 0.1 m.

6.3.2 Release of dangerous substances

The kit shall comply with all relevant European and national provisions applicable for the uses for which it is brought to the market. The attention of the applicant shall be drawn on the fact that for other Member States of destination there may be other requirements, which would have to be respected. For dangerous substances contained in the component but not covered by the ETA, the NPD option (no performance determined) shall be applicable.

If chemicals are added to prevent root penetration, these chemicals shall be listed in consideration to Biocide Directive (Directive 98/8/EC) in the ETA.

6.4 Safety in use

6.4.1 Resistance to wind loads

The assembled roof systems, including ballast, shall have the ability to resist wind loading in accordance with the Euro Code EN 1991-1-4.

6.4.2 Slip resistance

Kits according to Part 1 does not include the uppermost layer. This characteristic is only relevant for products according to Part 2.

6.4.3 Mechanical damage (**Part 2 only**)

See clause 6.7.1.6.

6.5 Protection against noise

No requirements.

6.6 Energy economy and heat retention

6.6.1 Thermal characteristics

6.6.1.1 Thermal resistance

The declared thermal resistance R_D and the corrected thermal resistance R_{cor} for climatic levels 1 and/or 2 determined in accordance with 5.6.1.1 shall be given in the ETA.

6.6.1.2 Thermal conductivity (Lambda) of the insulation

The declared thermal conductivity λ_D and the corrected thermal conductivity λ_{cor} for climatic levels 1 and 2 determined in accordance with 5.6.1.2 shall be given in the ETA.

6.6.1.3 Correction value for thermal transmittance of the Inverted Roof Insulation Kit

The correction (*fx)* for thermal transmittance of the Inverted Roof Insulation Kit shall be determined in accordance with 5.6.1.3 and shall be given in the ETA.

Without the need for testing the following *fx* values shall be used:

(a) 0,02 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$ for roof gardens, green roofs or parking decks with a cast concrete surface protection layer
(b) 0,03 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$ for a kit using thermal insulation components with profiled joints (e.g. rebate, tongue and groove) and open covering (other than those mentioned in (a))
(c) 0,04 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$ for a kit with butt-edged thermal insulation components and open covering (other than those mentioned in (a)).

Where the manufacturer wishes to declare *fx* values lower than those above, the values shall be determined in accordance with 5.6.1.3.

6.6.2 Compression characteristics

See clause 6.7.1.2.

6.7 Aspects of durability, serviceability and identification

6.7.1 Aspects of durability

6.7.1.1 General

The assessment shall take the following factors into account.

6.7.1.2 Compression characteristics of the thermal insulation

6.7.1.2.1 Compressive strength/stress (CS)

The compressive strength at yield or stress at 10% deformation, determined in accordance with 5.7.1.2.1, shall meet the level according to EN 13163: 2008 or EN 13164: 2008 given in table 6.1.

Table 6.1 Compressive stress(1)

Use Category	Minimum requirements	
	EPS	XPS
Untrafficked	CS(10)200	CS(10\Y)300
Pedestrian	CS(10)200	CS(10\Y)300
Green roof	N/A(2)	CS(10\Y)300
Roof garden	N/A(2)	CS(10\Y)300
Parking decks	N/A	CS(10\Y)500

(1) The values for EPS and XPS in this table are derived from successful use in service.
(2) Due to the current limited history of use in green roofs and roof gardens of EPS boards assessment shall be via the CUAP route.
N/A – not applicable.

6.7.1.2.2 Compressive creep (CC)

The compressive creep, determined in accordance with 5.7.1.2.2, shall meet the level according to EN 13163: 2008 or EN 13164 : 2008 given in table 6.2.

Table 6.2 Compressive creep

Use Category	Requirement
Untrafficked	CC(2/1,5/25)50
Pedestrian	CC(2/1,5/25)50
Green roof	CC(2/1,5/25)50(1)
Roof garden	CC(2/1,5/50)100(1)
Parking decks	CC(2/1,5/50)150(2)

(1) Due to the current limited history of use in green roofs and roof gardens of EPS boards assessment shall be via the CUAP route.
(2) EPS does not have sufficient compressive stress for this use.

6.7.1.2.3 Deformation under specified compressive load and temperature (DLT)

The deformation under specified compressive load and temperature determined in accordance with 5.7.1.2.3, shall be DLT(2)5.

6.7.1.3 Heat

6.7.1.3.1 Dimensional stability of the thermal insulation

The dimensional stability determined in accordance with 5.7.1.3.1 shall meet the values given below.

EPS 1% [DS(70,90)1]
XPS 5%

6.7.1.3.2 Ageing by combined UV, water and heat of the water-flow reducing layer

Following ageing by combined UV, water and heat in accordance with 5.7.1.3.2 the membrane shall meet the following criteria:

Tensile strength – The reduction in tensile strength shall not exceed 20% of the original value

Watertightness – No change from its initial class as defined in EN 13859-1: 2005.

6.7.1.4 Water absorption of the thermal insulation

6.7.1.4.1 Long term water absorption by diffusion (WD(V))

The long-term water absorption by diffusion determined in accordance with 5.7.1.4.1 shall meet the values given below.

EPS	< 100 mm	WD(V)5
	≥ 100 mm	WD(V)3
XPS	< 50 mm	WD(V)5
	≥ 50 mm	WD(V)3

6.7.1.4.2 Long term water absorption by immersion (WL(T))

The long-term water absorption by immersion determined in accordance with 5.7.1.4.2 shall meet the level according to EN 13163: 2008 or EN 13164: 2008 given below.

EPS WL(T)2
XPS WL(T)0,7

6.7.1.5 Resistance to freeze-thaw (FT) of the thermal insulation

Following freeze-thaw determined in accordance with 5.7.1.5 the water absorption and compression strength shall meet the requirements given below.

Additional water absorption in volume (%)

EPS		≤ 5%
XPS	FT2	≤ 1%

Reduction in compressive strength shall not exceed 10% of the initial value for EPS and XPS.

6.7.1.6 Mechanical damage

6.7.1.6.1 Hard body impact resistance

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

6.7.1.6.2 Tensile bond strength

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

6.7.1.6.3 Static indentation (point loading)

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

6.7.1.6.4 Wear resistance

This requirement only applies to insulation with protective finishing (see Part 2 of this ETAG).

6.7.1.7 Chemical resistance

6.7.1.7.1 Insulation

The evidence assessed shall show the insulation will retain its functionality following exposure to defined chemicals and list any chemicals or chemical families the insulation shall not come into contact with.

6.7.1.7.2 Filter Layer

The evidence assessed shall show the filter layer will retain its functionality following exposure to defined chemicals.

6.7.1.7.3 Water-flow reducing layer

Following ageing in accordance with 5.7.1.7.3 the membrane shall meet the following criteria:

Tensile strength – The reduction in tensile strength shall not exceed 20% of the original value.

Watertightness – No change from its initial class as defined in EN 13859-1 2005.

6.7.1.7.4 Separation layer

The evidence assessed shall show the separation layer will retain its functionality following exposure to defined chemicals.

6.7.1.8 Compatibility of kit components with the other components of the assembled system

The ETA Applicant shall declare the compatibility of the kit components with the other components of the kit and the assembled system.

6.7.2 Aspects of serviceability

6.7.2.1 Watertightness of the water-flow reducing layer

6.7.2.1.1 Resistance to water penetration

The resistance to water penetration, determined in accordance with 5.6.3.1, shall meet class W1 according to EN 13859-1: 2005.

6.7.2.1.2 Hydrostatic head

The hydrostatic head, determined in accordance with 5.6.3.2, shall be greater than 1000 mm**.**

6.7.3 Aspects of Identification

6.7.3.1 EPS

6.7.3.1.1 Bending strength (BS)

The bending strength (σ_b) determined in accordance with 5.7.3.1.1 shall comply with the level according to EN 13163: 2008 Annex C given in table 6.3.

Table 6.3 Bending strength for different compressive stress/strengths

Compressive stress/strength value (k·Pa)	Category	Bending strength (k·Pa)
200	BS 250	250
250	BS 350	350
300	BS 450	450

6.7.3.2 XPS

No additional requirements to those previously mentioned in this Chapter.

6.7.3.3 Filter layer

6.7.3.3.1 Type

The declaration shall state the polymer type and component structure (e.g. woven, non-woven).

6.7.3.3.2 Mass per unit area

The mass per area of the filter layer shall not be greater than a declared 150 gm^{-2}.

6.7.3.3.3 Tensile properties

The manufacturer's declared value for tensile properties with tolerances shall be stated.

6.7.3.4 Water flow-reducing layer

6.7.3.4.1 Type

The declaration shall state the polymer type and component structure.

6.7.3.4.2 Length, width, straightness

The length, width and straightness, when determined in accordance with 5.7.3.4.2 shall be within the requirements given in Table 6.4.

Table 6.4 Length, width and straightness requirements

Characteristic	Requirement
Length	Manufacturer's declared value (–0%)
Width	Manufacturer's declared value (-0,5% to +1,5%)
Straightness	30 mm deviation from straightness per 10 m length or in proportion for shorter lengths (e.g. 15 mm for 5 m length)

6.7.3.4.3 Mass per unit area

The mass per unit area, when determined in accordance with 5.7.3.4.3 shall be within the declared tolerance of the manufacturer's declared value.

6.7.3.4.4 Tensile properties

The tensile strength and elongation at break, when determined in accordance with 5.7.3.4.4 shall be within the declared tolerance of the manufacturer's declared value.

6.7.3.4.5 Resistance to static loading

The resistance to static loading is expressed as the load, which has either not caused leakage of the water-flow reducing layer and/or not penetrated EPS substrate more that 10mm.

6.7.3.5 Separation layer

6.7.3.5.1 Type

The declaration shall state the polymer type and component structure of the separation layer.

6.7.3.5.2 Mass per unit area

The mass per unit area shall be determined in accordance with 5.7.3.5.2 shall be within the declared tolerance of the manufacturer's declared value.

6.7.3.5.3 Tensile properties

The tensile strength and elongation at break shall be determined in accordance with 5.7.3.5.3 shall be within the declared tolerance of the manufacturer's declared value.

7 ASSUMPTIONS AND RECOMMENDATIONS UNDER WHICH THE FITNESS FOR USE OF THE KIT IS ASSESSED

This chapter sets out the assumptions and recommendations for design, installation and execution, packaging, transport and storage, use, maintenance and repair under which the assessment of the fitness for use according to the ETAG can be made (only when necessary and in so far as they have a bearing on the assessment or on the kits).

7.1 Design of works

7.1.1 Falls/drainage

The roof shall be designed with adequate falls unless the roof waterproofing system has been specifically designed for use in totally flat roof specifications. Additional drainage may be required for zero falls.

The roof shall be designed with adequate drainage to avoid the long-term presence of excess water above the thermal insulation layer. Transient presence of water above the thermal insulation layer, such as ponding caused by intensive rainfall, can be considered as non-critical.

Drainage shall be designed in accordance with either EN 752 or EN12056 and taking into account national regulation.

7.1.2 Thermal transmittance (U-Value)

When designing the roof the thermal transmittance shall be calculated using the correction procedure for inverted roofs contained within Annex D.4 of EN ISO 6946 amendment 1 shall be applied (see section 6.6.1.3 also). In the case of butt edged boards the correction for air voids contained within Annex D.2 of EN ISO 6946 amendment 1 shall be applied.

7.1.3 R-value of the deck

The roof shall be designed to avoid surface condensation within the building. If the kit is used on a lightweight deck with a mass per unit area of less than 250 $kg \cdot m^{-2}$ the thermal resistance of the layers below the waterproofing shall be at least 0,15 $m^2 \cdot K \cdot W^{-1}$ in order to avoid the formation of condensation.

7.1.4 Building structure

The building shall be sufficiently structurally sound to carry the imposed load exerted by the assembled system.

In the case of parking decks, significant horizontal dynamic loads caused by vehicular traffic shall not be transferred to the thermal insulation boards. This shall be taken into account in the design of the roof.

7.1.5 Roof build-up above insulation

The roof build-up above thermal insulation layer shall allow the diffusion of water vapour. Diffusion tight layers, such as plastic foils shall not be used.

7.1.6 Ballasting

The ballasting shall be designed to resist the wind uplift force for the specified building. Gravel used for ballasting shall preferably be rounded, washed and low fines (the presence of fines could block/clog the filter layer).

7.1.7 Filter layers

The filter layer will also act to stabilise the thermal insulation layer.

7.1.8 Drainage layers

For green roof or roof garden specifications the roof designer shall select a suitable drainage layer.

7.1.9 Compatibility of materials

All materials used in the roof shall be compatible or measures shall be taken to ensure no deleterious effects occur between materials. For example, PVC waterproofing layers may require a separation layer.

7.1.10 Installed equipment

Any equipment installed on the roof shall be based on a suitable support

7.1.11 Flotation of boards

Flotation of boards is not a problem since the ballast used with the assembled kit will counteract the problem. Additionally a geotextile layer can be used to stabilise the boards against displacement. The geotextile layer would also act as a filter layer in the assembled kit. Also positioning of additional drainage above the waterproofing level and the geometry of the board joints alleviate the problem. Displacement by flotation of boards should be minimised by the presence of sufficient and operational drainage outlets (downspouts).

7.1.12 National Regulations

The designer shall take into account the laws, regulations and administrative provisions of the member states relating to the roof build-up in addition to this ETA Guideline.

7.2 Packaging, transport and storage

The packaging shall protect the kit components from damage during normal handling and transportation.

The kit components shall be protected from prolonged exposure to sunlight by either storage under cover, or covering with a suitable material.

Care shall be taken to prevent contact between the thermal insulation components and non-compatible materials as per the ETA Applicant's advice.

Storage of the thermal insulation components in the vicinity of low flash point materials shall be avoided

7.3 Execution of works (thermal installation, assembling, incorporation, etc., including, if necessary, test methods for verifications on site)

7.3.1 Waterproofing layer

The waterproofing layer is outside the scope of this ETAG, but shall be confirmed as watertight and fit for use before installation of the other layers. When used in green roofs and roof gardens the waterproofing layer shall be root resistant unless a root barrier layer shall be used.

7.3.2 Thermal insulation

Only undamaged thermal insulation boards shall be installed and cut boards shall be kept to a minimum.

7.3.3 Substrate

The insulation boards shall be laid on a sufficiently even surface.

7.3.4 Installation of the kit

The components of the kit shall be installed in accordance with the ETA holder's guidance.

The thermal insulation shall be installed in a single layer with staggered joints to ensure than no cross-joints occur. Board joints shall be closely installed.

7.3.5 Water- flow reducing layer

The water-flow reducing layer shall be installed with minimum overlaps specified by the ETA applicant. The recommended minimum is 150 mm.

7.3.6 Filter layer

The filter layer shall be installed and overlapped in accordance with the filter layer manufacturer's instructions.

7.4 Maintenance and repair

7.4.1 General maintenance

The owner of the building should check drainage outlets at least once a year and clear any blockages. Any roofs adjacent to trees should be inspected twice a year (i.e. Autumn and Spring).

7.4.2 Displacement of ballast

Any ballast displaced, for example, by wind scouring, maintenance work should be promptly returned to its original state.

7.4.3 Uncontrolled vegetation

Any unwanted vegetation, moss, algae etc. growing on the roof should be removed during maintenance checks.

Use of chemicals (e.g. weed-killers) should be checked for compatibility with the ETA Applicant and waterproofing manufacturer.

Section three:

ATTESTATION AND EVALUATION OF CONFORMITY

8 EVALUATION AND ATTESTATION OF CONFORMITY AND CE MARKING

8.1 System of attestation of conformity

According to the decision 97/556/EC of the European Commission[1] the system(s) of attestation of conformity given in Tables 2a and 2b apply.

According to the communication of the European Commission[2] the system(s) of attestation of conformity laid down in the decision 97/556/EC of the European Commission[1] for External Thermal Insulation Composite Systems/Kits with Rendering and given in Table 2a can also be applied to Inverted Roof Insulation Kits.

Table 2a System(s) of attestation of conformity applicable to Inverted Roof Insulation Kits

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Inverted Roof Insulation Kits	Insulation of roofs	-	**2+**
System 2+: See Directive 89/106/EEC Annex III.2.(ii), first possibility including certification of factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of the factory production control.			

System 2+: Declaration of conformity of the product by the manufacturer on the basis of:

(a) Tasks for the manufacturer:

(1) initial type-testing of the product*;
(2) factory production control;
(3) testing of samples taken at the factory in accordance with a prescribed test plan.

(b) Tasks for the notified body:

(4) certification of factory production control on the basis of:
– initial inspection of factory and of factory production control;
– continuous surveillance, assessment and approval of factory production control.

**Approval tests will have been conducted by an Approval Body or under its responsibility (which may include a proportion conducted by an approved laboratory or by the manufacturer, witnessed by the Approval Body) in accordance with Section 5 of this ETAG. The Approval Body will have assessed the results of these tests in accordance with Section 6 of this ETAG, as part of the ETA issuing procedure.*

These tests shall be used for the purposes of initial type-testing. In this respect Approval Bodies shall be able to have open arrangements with the relevant Notified Bodies to avoid duplication, respecting each others responsibilities.

In addition, according to the decision 97/556/EC of the European Commission[1] the system(s) of attestation of conformity given in Table 2b applies to Inverted Roof Insulation Kits with regard to reaction to fire.

1 Official Journal of the European Communities L 229 of 20/8/1997

2 Letter of the European Commission of 03/11/2006 to EOTA

Table 2b Choice of the system of attestation of conformity applicable to Inverted Roof Insulation Kits with respect to reaction to fire

Product(s)	Intended use(s)	Level(s) or class(es) *(reaction to fire)*	Attestation of conformity system(s)
Inverted Roof Insulation Kits	for uses subject to regulations on reaction to fire	A1*, A2*, B*, C* A1**, A2**, B**, C**, D, E, (A1 to E) *** ,F	1 3 4

System 1: See Directive 89/106/EEC Annex III.2.(i), without audit-testing of samples
System 3: See Directive 89/106/EEC Annex III.2.(ii), Second possibility
System 4: See Directive 89/106/EEC Annex III.2.(ii), Third possibility

* Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)

** Products/materials not covered by footnote (*)

*** Products/materials that do not require to be tested for reaction to fire (e.g. Products/materials of class A1 according to Commission Decision 96/603/EC, as amended)

The system(s) of attestation of conformity referred to above is (are) defined as follows:

System 1: Certification of the conformity of the product by a notified certification body on the basis of:

(a) Tasks for the manufacturer:

(1) factory production control;
(2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks for the notified body:

(3) initial type–testing of the product;
(4) initial inspection of factory and of factory production control;
(5) continuous surveillance, assessment and approval of factory production control.

System 3: Declaration of conformity of the product by the manufacturer on the basis of:

(a) Tasks for the manufacturer:

factory production control;

(b) Tasks for the notified body:

initial type-testing of the product.

System 4: Declaration of conformity of the product by the manufacturer on the basis of:

Tasks for the manufacturer:

– initial type-testing of the product;
– factory production control.

8.2 Tasks and responsibilities of the manufacturer and notified bodies

8.2.1 Tasks of the manufacturer

The corner stones of the actions to be undertaken by the manufacturer of the Inverted Roof Insulation Kit in the procedure of attestation of conformity are laid down in Table 3.

For the purposes of CE marking the testing for the ETA assessment is considered to be the Initial Type Testing.

Table 3 Control plan for the manufacturer

Nr	Subject/type of control *(kit component, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 3.2.3, 2.4 or 5.2)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
(1)	(2)	(3)	(4)	(5)	(6)
Factory production control (FPC) including testing of samples in accordance with a prescribed test plan[(1)]					
Thermal insulation					
1	Reaction to fire	5.2.1	6.2.1		As per EN 13163 : 2008 or EN 13164 : 2008 as appropriate
2	Thermal resistance Thermal conductivity	5.6.1.1	6.6.1.1		
3	Length and width	EN 822	EN 13163 : 2008 EN 13164 : 2008		
4	Squareness	EN 824			
5	Flatness	EN 825			
6	Thickness	EN 823			
7	Compressive strength/stress	5.7.1.2.1	6.7.1.2.1		
8	Long term water absorption by diffusion	5.7.1.4.1	6.7.1.4.1		Once per year
9	Freeze-thaw	5.7.1.5	6.7.1.5		Once every two years
Water-flow reducing layer[(2)]					
10	Reaction to fire	5.2.1	6.2.1		Once every three years
11	Water vapour transmission properties	5.3.1.2	6.3.1.2		Once per 40 shifts
12	Water penetration	5.6.3.1	6.6.3.1		Once per 40 shifts
13	Combined UV and heat ageing	5.7.1.3.2	6.7.1.3.2		Once every two years
14	Length, width, straightness	5.7.3.4.2	6.7.3.4.2		Once per 40 shifts
15	Mass per unit area	5.7.3.4.3	6.7.3.4.3		Once per shift
16	Tensile properties	5.7.3.4.4	6.7.3.4.4		Once per 10 shifts
Filter layer[(2)]					
17	Reaction to fire	5.2.1	6.2.1		Once every three years
18	Mass per unit area	5.7.3.3.2	6.7.3.3.2		Once per shift
19	Tensile properties	5.7.3.3.3	6.7.3.3.3		Once per 10 shifts
Separation layer[(2)]					
20	Reaction to fire	5.2.1	6.2.1		Once every three years
21	Mass per unit area	5.7.3.5.2	6.7.3.53		Once per shift
22	Tensile properties	5.7.3.5.3	6.7.3.5.3		Once per 10 shifts

(1) If the component of the kit is a product bought by the kit manufacturer on the open market the "control plan" shall specify the tasks relating to:

a) the acceptance control and testing to be exercised and documented by the kit manufacturer for this particular component as a part of the "factory production control" of the kit manufacturer,

b) the acceptance control and testing by notified bodies for this particular component as a part of the activities of the notified bodies at the kit factory.

If the component of the kit bought by the kit manufacturer on the open market is a construction product bearing the CE-marking on its own right, the tasks a) and b) above should, as far as possible, be specified by reference to the respective hEN or separate product ETA, in particular its provisions for the AoC and CE-marking.

(2) Only applicable if component is a specific product defined by the ETA applicant as part of the kit.

8.2.2 Tasks of notified bodies

The corner stones of the actions to be undertaken by the notified body (bodies) in the procedure of attestation of conformity for Inverted Roof Insulation Kits are laid down in Table 4.

Table 4 Control plan for the notified body (bodies)

Nr	Subject/type of control *(kit component, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 3.2.3, 2.4 or 5.2)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
(1)	(2)	(3)	(4)	(5)	(6)
Initial type-testing of the product (ITT)					
1	Reaction to fire	5.2.1		As per relevant EN	When starting the production process of the CE marked product or when starting a new production line
Initial inspection of factory and FPC					
2	Inspection of the factory and factory production control of the manufacturer as described in the Manufacturer's Technical Dossier (MTD) and the control plan	Control of devices, equipment and the documentation of the FPC			When starting the production process or when starting an new production line
Continuous surveillance, judgment and assessment of FPC					
3	Surveillance, assessment and approval of the factory production control of the manufacturer as described in the MTD and the control plan	Control of the documentation of the FPC			Twice a year

8.2.3 Special methods of control and testing used for the evaluation

Not applicable

8.3 CE marking and accompanying information

According to Council Directive 93/68/EEC[3] the CE marking consists of the letters "CE" in the form laid down in the Directive, followed by the identification number of the notified certification body, where applicable.

The CE marking of Inverted Roof Insulation Kits shall be accompanied by the following information:

- the name and address of the producer (legal entity responsible for the manufacturer),
- the last two digits of the year in which the CE marking was affixed,
- *for AoC systems 1:* the number of the EC certificate of conformity,
- *for AoC systems 2+:* the number of the EC certificate for the factory production control,
- the number of the European Technical Approval,

[3] Official Journal of the European Communities L 220 of 30.8.1993

Example of CE-Marking and accompanying information:

CE 1234	"CE" symbol Identification number of notified certification body
Any Company Street 1, City, Country 10 1234-CPD-0321	Name and address of the producer (legal entity responsible for the manufacturer) Two last digits of year of affixing CE Marking Number of EC certificate of conformity *(for AoC system 1)* or EC certificate for the FPC *(for AoC systems 2+)*
ETA-10/…. ETAG 031	ETA number ETAG number *(where relevant)*

Section four: ETA CONTENT

9 THE ETA CONTENT

9.1 The ETA-content

The ETA content shall be in accordance with the Commission Decision 97/571/EC, dated 22 July 1997.

In section II.2 "characteristics of products and methods of verification "the ETA shall include the following note:

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the kits falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

The ETA will contain the generic specification of the other components of the assembled system, which are not part of the kit.

Information on the performance of the kit:

- Use category (untrafficked, pedestrian, and for XPS green roof, roof garden or parking decks)
- Indication of the assumed working life
- Classification of the kit with respect to external fire performance
- Statement on the presence or otherwise of dangerous substances including concentration
- Correction value for thermal transmittance of the Inverted Roof Insulation Kit
- Minimum and maximum roof slope upon which the kit can be used
- Wind loading

Information on the components

Thermal Insulation

- Type of thermal insulation
- Reaction to fire
- Thermal resistance/thermal conductivity (declared and corrected)
- Dimensions
- Joint geometry
- Compressive strength/stress
- Compressive creep
- Deformation under specified compressive load and temperature conditions
- Dimensional stability under specified temperature and humidity conditions
- Long term water absorption by diffusion
- Long term water absorption by immersion
- Freeze-thaw resistance
- Water vapour transmission (if declared)
- Chemical resistance

Water-flow reducing layer

- Type
- Reaction to fire
- Dimensions
- Mass per unit area
- Water vapour transmission properties

- Water penetration – before and after ageing
- Hydrostatic head
- Tensile strength – before and after ageing
- Static loading
- Chemical resistance

Filter layer

- Type
- Reaction to fire
- Dimensions
- Mass per unit area
- Tensile strength – before and after ageing
- Chemical resistance

Separation layer

- Type
- Mass per unit area
- Chemical resistance
- Reaction to fire

Terminology and Assumptions

All necessary definitions (see Chapter 3) and assumptions (see Chapter 7) shall be stated in the ETA.

9.2 Additional information

It shall be stated in the ETA whether or not any additional (possibly confidential) information shall be supplied to the Notified Body for the evaluation of conformity purposes.

Annex A
REFERENCE DOCUMENTS

Council Directive 89/106/EEC (21 December 1988) – Directive relating to Construction Products (CPD)

CONSTRUCT 97/571/EC (22 July 1997) – Commission Decision of 22 July 1997 on the general format of European Technical Approval for construction products

Commission Decision 2000/553/EC of 6 September 2000 implementing Council Directive 89/106/EEC as regards the external fire performance of roof coverings

Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market

EN 822 – Thermal insulating products for building applications – Determination of length and width

EN 823 – Thermal insulating products for building applications – Determination of thickness

EN 824 – Thermal insulating products for building applications – Determination of squareness

EN 825 – Thermal insulating products for building applications – Determination of flatness

EN 826 – Thermal insulating products for building applications – Determination of compression behaviour

ENV 1187 – Test methods for external fire exposure to roofs

EN 1297: 2004 – Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing - Method of artificial ageing by long term exposure to the combination of UV radiation, elevated temperature and water

EN 1604: 1997 – Thermal insulating products for building applications – Determination of dimensional stability under specific temperature and humidity conditions

EN 1605: 1997 – Thermal insulating products for building applications – Determination of deformation under compressive load and temperature conditions

EN 1606: 1997 – Thermal insulating products for building applications – Determination of compressive creep

EN 1847: 2001– Flexible sheets for waterproofing – Plastic and rubber sheets for waterproofing – Methods for exposure to liquid chemicals including water

EN 1848-2: 2000– Flexible sheets for waterproofing – Determination of length, width and straightness – Part 1: Bitumen sheets for roof waterproofing

EN 1849-2: 2000– Flexible sheets for waterproofing – Determination of thickness and mass per unit area – Part 1: Bitumen sheets for roof waterproofing

EN 1991-1-4 – Eurocode – General actions – Wind actions

EN 12086: 1997 – Thermal insulating products for building applications – Determination of water vapour transmission properties

EN 12087: 1997 – Thermal insulating products for building applications – Determination of long term water absorption by immersion

EN 12088: 1997 – Thermal insulating products for building applications – Determination of long term water absorption by diffusion

EN 12089: 1997 – Thermal insulating products for building applications – Determination of bending behaviour

EN12091: 1997 – Thermal insulating products for building applications – Determination of freeze-thaw resistance

EN 12311-1: 2000 – Flexible sheets for waterproofing – Determination of tensile properties – Part 1: Bitumen sheets for roof waterproofing

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 12730: 2001 – Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to static loading

EN 12939 : 2001 – Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance

EN 13163: 2008 – Thermal insulation products for buildings – Factory made products of expanded polystyrene (EPS) - Specification

EN 13164 : 2008 – Thermal insulation products for buildings – Factory made products of extruded polystyrene foam (XPS) - Specification

EN 13501-1 – Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire test

EN 13501-5 – Classification of construction products and building elements – Part 5: Classification using test data from external fire exposure roof test

EN 13859-1:2005 – Flexible sheets for waterproofing – Definitions and characteristics of underlays – Part1: Underlays for discontinuous roofing

EN 20811: 1992 – Textiles. Determination of resistance to water penetration. Hydrostatic pressure test.

EN 29073-1: 1992 – Textiles – Test methods for nonwovens – Determination of mass per unit area

EN 29073-3: 1992 – Textiles – Test methods for nonwovens – Determination of tensile strength and elongation

EN ISO 6946*Incorporating amendment No.1* – Building components and building elements – Thermal resistance and thermal transmittance – Calculation method

EN ISO 10456– Building materials and products – Procedures for determining declared values and design thermal values

EN ISO 12572: 2001 – Hygrothermal performance of building materials and products – Determination of water vapour transmission properties

Annex B

Determination of the Moisture Conversion Coefficient *fψ* of the Thermal Conductivity of the Insulation

B.1 Scope

This Annex specifies the method for determination of the moisture conversion coefficient *fψ* of the thermal conductivity of the insulation. This method allows the Approval/Notified Body to verify an ETA Applicant's claims for a lower moisture conversion coefficient than that quoted in EN ISO 10456 and this ETAG.

B.2 Principle

The moisture conversion coefficient is determined on the basis of measurements of the thermal conductivity at several moisture conditions.

The conditioning of samples is performed by water absorption by diffusion (EN 12088).

B.3 Apparatus

B.3.1 Water absorption by diffusion apparatus

Water absorption by diffusion apparatus is in accordance with EN 12088.

B.3.2 Heat flow meter

A horizontal single specimen heat flow meter apparatus.

B.3.3 Polyethylene film

Either a polyethylene film or bag capable of being sealed vapour tight.

B.4 Test specimen

Five test specimens, of length and width dimensions 500 mm x 500 mm and a thickness of 50 mm, are taken and from different production runs.

B.5 Procedure

B.5.1 The test specimens are dried at 70℃ until c onstant mass, smaller than 0,1% of initial mass per day, is attained.

B.5.2 The thermal conductivity is determined at a mean temperature of 10 ± 0,3℃ according to EN 12667 using a heat flow meter apparatus with a temperature difference of 10 to 15℃.

B.5.3 The mean value $\lambda_{10,dry}$ is calculated to the nearest 0,0001 $W(m \cdot K)^{-1}$.

B.5.4 The water absorption is accelerated by putting the specimens into a diffusion test apparatus, according to EN 12088, until a range of 4 to 6% by volume has been reached. If necessary the Standard's test period of 28 days shall be prolonged until the range is reached. The test specimens are turned over every 7 days.

The test is stopped if the range of 4 to 6% has not been reached after 84 days. In this case the specimens showing the water absorption after 84 days are used for the next steps of the test procedure.

B.5.5 The test specimens are wrapped in polyethylene film or placed in a polyethylene bag, and sealed, for three weeks to allow homogeneous distribution of humidity within the test specimen at 23 ± 5ºC..

B.5.6 The thermal conductivity measurement is repeated (see B.5.2) using the heat flow meter apparatus with a temperature difference of 4 to 6℃. The specimens are made on the wrapped specimens to avoid loss of water vapour during the measurements. The lower plate of the apparatus is used as hot side and the upper plate as cold side. The heat flow direction and small temperature difference is required to avoid movement of humidity during measurement.

B.5.7 The following step in the water absorption test is carried out by placing the test specimens into the diffusion test apparatus until 8 to 10% by volume is achieved. If necessary the Standard's test period of 28 days shall be prolonged until the range is reached. The test specimens are turned over every 7 days.

The test is stopped if the range of 8 to 10% has not been reached after 84 days. In this case the specimens showing the water absorption after 84 days are used for the next steps of the test procedure. The calculated conversion coefficient applies only up to the water absorption reached in the test (see B.5.13).

B.5.8 The test specimens are wrapped in polyethylene film or placed in a polyethylene bag, and sealed, for three weeks to allow a homogeneous distribution of humidity within the test specimen.

B.5.9 The thermal conductivity measurement is repeated using a temperature difference of 4 to 6℃ as described above .

B.5.10 The mean slope of the curve is determined by regression.

B.5.11 $\lambda_{10,\psi}$ is the value of thermal conductivity determined by evaluation of the curve at a mean humidity content ψ after step B.5.7.

B.5.12 The moisture conversion coefficient is determined in accordance with EN ISO 10456:

$$f\psi = \frac{\ln \frac{\lambda_{10,\psi}}{\lambda_{10,dry}}}{\psi}$$

where, $f\psi$ is the moisture conversion coefficient volume by volume
$\lambda_{10,dry}$ is the thermal conductivity of the thermal insulation dry
$\lambda_{10,\psi}$ is the thermal conductivity of the thermal insulation following water absorption by diffusion
ψ is the corresponding moisture content volume by volume at $\lambda_{10,\psi}$.

B.5.13 Restrictions concerning the application of this method:

If the water absorption of 8 to 10% has not been reached according to C.5.7 the calculated conversion coefficient $f\psi$ applies only up to the water absorption reached.

The calculated value $f\psi$ shall not be less than 1,5 and/or 60% of the moisture conversion coefficients quoted in EN ISO 10456 (the higher numerical value shall be applied)(1).

Note: The restrictions mentioned above are necessary to avoid wrong extrapolations, misinterpretretations of the method and to limit the risk of measurement inaccuracies.

(1) If the value is less than 1,5 and/or 60% of the coefficients quoted in EN ISO 10456 then the value is set to 1,5 and/or 60% (the higher numerical value shall be applied).

B.6 Test report

The test report shall include the following information:

a) reference to this ETAG and Annex;
b) the name of the testing laboratory;
c) date/period of test;
d) a description of the test specimens, including dimensions;
e) obtained values for $\lambda_{10,dry}$, $\lambda_{10,\psi}$, ψ and $f\psi$;
f) details concerning B.5.4 and B.5.7 (duration of the steps, water absorption values reached);
g) all operating details, not specified in this Annex, as well as incidents likely to have influenced the process.

Annex C
Test Method for Determining Water Flow Through an Inverted Roof Kit

C.1 Scope

This Annex specifies the method for determination of water flow through an Inverted Roof Kit used in a gravel ballasted roof. This method allows the Approval/Notified Body to verify an ETA Applicant's claim of a *fx* value for a kit lower than those quoted in section 6.6.1.3 of this ETAG.

C.2 Principle

The determination is performed by the measurement of the amount of water passing through the specified kit at different flow rates.

C.3 Apparatus

C.3.1 Test frame

A frame able to support a minimum size of 3,6 x 2,4 metre sample.

C.3.2 Water spray rig

Water spray rig with flowmeters to allow control of volume of applied water.

The spray nozzles are set 1.5m above the sample surface. The spray pattern and number of nozzles are dependent on the area of the sample to give the most even distribution. For example for a 3,6 m by 2,4 m area with slope, four nozzles in a rectangular pattern, 1 m from sides, a maximum of 0,3 m from the top edge of the sample and 1 m between the two nozzles on each side, is sufficient.

C.3.3 Water collection system

Gutter systems to collect water at the points of outflow from the system

C.3.4 Water measurement system

A method to measure the water from the two collection points either by flowmeter or collection and weighing.

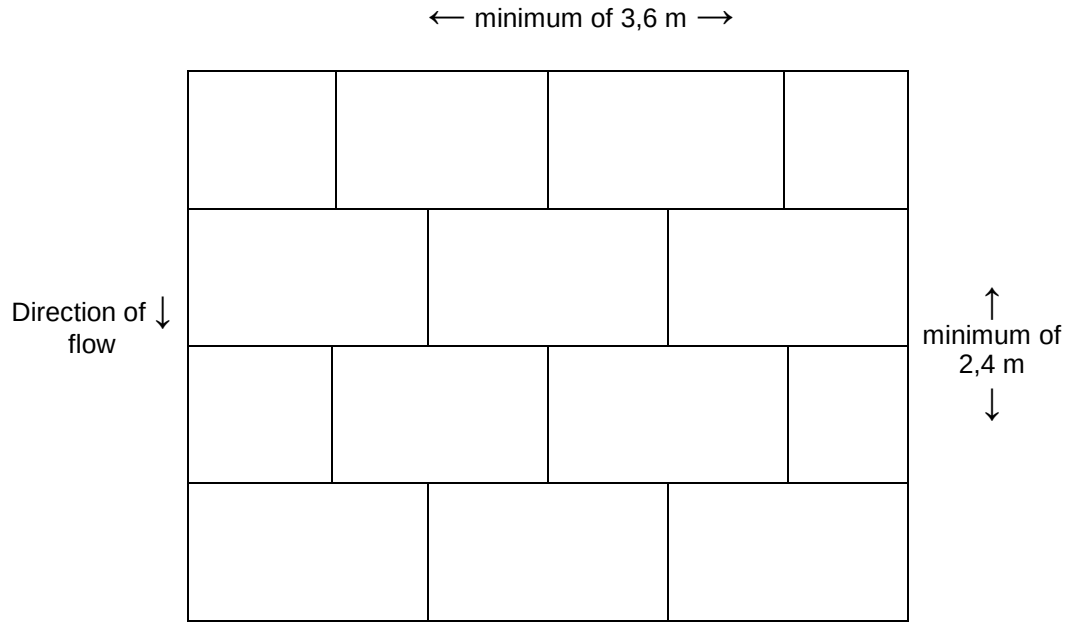
C.4 Test specimen

The minimum sample area is 3.6 x 2.4 metres(1) mounted on a frame with a fall of 1 in 40 (2.5% slope/1.4° angle of slope). Test can be carried out at zero slope for kits that are being used in zero fall specifications, with suitable modifications to the collection system (i.e. collection on all four sides and suitable water resistant curtain around sample to prevent over spray).

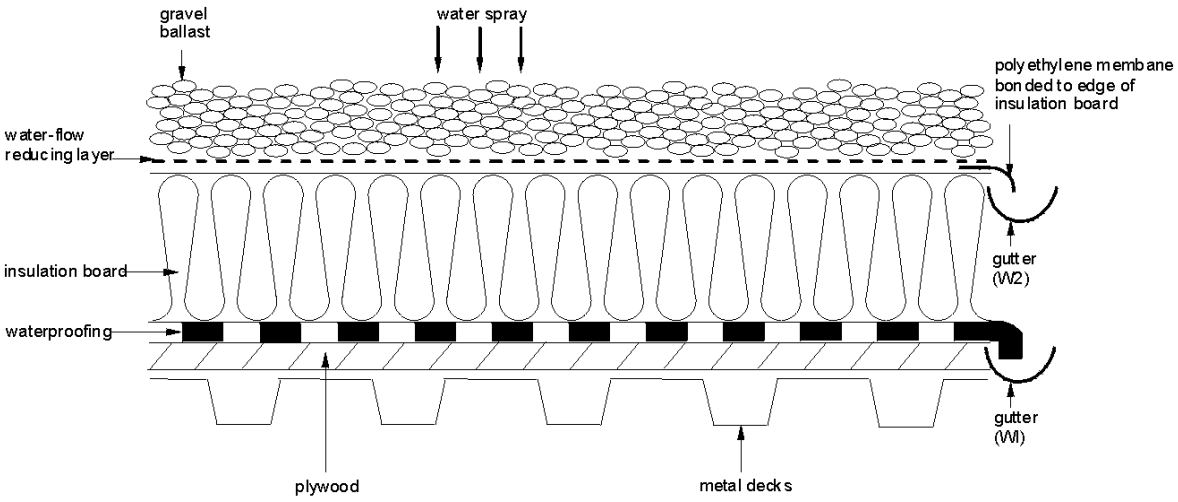
The test specimen consists of a suitable substrate such as, for example, standard trapezoidal steel deck with a flat plywood substrate attached to the deck. The plywood substrate has a waterproofing membrane bonded to it. The membrane extends over the substrate and is draped into a gutter. The thermal insulation is laid in a staggered pattern, in line with normal practice, over the membrane. A polyethylene membrane is then bonded to the top edge of insulation boards at the lower end of the sample and draped into a second gutter. If used a water-flow reducing/filter layer is then loose-laid over the boards and also draped into the second gutter. When using a water-flow reducing layer at least one overlap in each direction shall occur in the layer within the sample area. Finally a 50 mm layer of 16 – 32 mm size gravel is applied.

The test shall be carried out on the minimum thickness of thermal insulation put forward by the ETA Applicant.

(1) The minimum size of 3,6 x 2,4 metres applies to the standard board size of 1200 x 600 mm. For greater board sizes the area shall be increased accordingly.



Example of board layout



schematic cross-section through typical sample

C.5 Procedure

C.5.1 To prepare for the real measurement, water is sprayed onto the roof assembly, at the rate given in C.5.2, until a run off of water occurs via the gutter from the waterproofing (W1) is at an equilibrium.

Subsequently the test is performed at decreasing flow rates. For each flow rate the water is sprayed onto the roof assembly for one hour. The flow rate is measured at gutter W1 (the run-off water from the waterproofing) and recorded once at a steady flow is achieved. Measurement of water shall be carried out either by using flowmeters in the drain line or by weighing over time.

C.5.2 An initial flow rate of 0.5 $l \cdot m^{-2} \cdot min^{-1}$ nominal, at a temperature of 20 ± 5℃, is used.

C.5.3 The procedure is repeated at flow rates of 0,4, 0,3 and 0,2 $l \cdot m^{-2} \cdot min^{-1}$ nominal and the resulting flow rates recorded and then again in ascending order back to 0,5 $l \cdot m^{-2} \cdot min^{-1}$.

C.5.4 The following are recorded:

W_T = Total spray rate.

W_1 = Flow rate of water collected in gutter from waterproofing.

W_2 = Flow rate of water collected in gutter from water-flow reducing/filter layer and top surface of insulation.

$W_{1(ave)}$ = Mean of W_1 for all measurements

$W_{2(ave)}$ = Mean of W_2 for all measurements

The analysis is based on the following assumptions:

For the *fx* value of 0,04 given in EN ISO 6946 in the worst case (butt jointed) *f* (drainage factor) = 1and *x* is a constant 0,04 $W \cdot m^{-2} \cdot K^{-1}$ based on the thermal heat capacity of water (4190 $J \cdot kg^{-1} \cdot K^{-1}$), the density of water (1000 $kg \cdot m^{-3}$) and a correction factor based on saturated flow characteristics of 0,864 $mm \cdot day^{-1}$. The saturated flow characteristics relate to the ease that water can pass through a saturated roof construction.

x = 4190 $J \cdot kg^{-1} \cdot K^{-1}$ x 1000 $kg \cdot m^{-3}$ x (0,864/(1000x86400))$m \cdot s^{-1}$ = 0,04 $W \cdot m^{-2} \cdot K^{-1}$

f = drainage factor giving the fraction of precipitation reaching the waterproofing membrane $W_{1(ave)}/W_T$ = average flow from the waterproofing/total flow over the roof

therefore

$f = W_{1(ave)}/(W_{1(ave)} + W_{2(ave)})$ or $W_{1(ave)}/W_T$

C.6 Test report

The test report shall contain the following:

a) Reference to this ETAG and Annex D;

b) The name of the testing laboratory;

c) Date/period of test;

d) A description of the test specimens, including dimensions of specimen, thickness of board geometry of the board joints, thermal insulation layout, slope of specimen, the layers used within the system including ballast type, relevant characteristics and number and overlap of joints in the water-flow reducing layer;

e) W_T, W_1 for each flow rate, W_2 for each flow rate, $W_{1(ave)}$ and $W_{2(ave)}$;

f) All operating details, not specified in this Annex, as well as incidents likely to have influenced the process.