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European Assessment Document for

Kits made of insulation boards with protective finishing for inverted roofs

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD covers kits of prefabricated insulation units (hereinafter referred to as “kits”) for the inverted roofs types without special loadbearing uses, as defined at clause 1.3.1: Non-trafficable roofs, pedestrian access roofs, green roofs and roof gardens. The kits are made of at least, an insulation board, a protective finishing, and there can be if required, a separation layer and additional ballast. The insulation unit (single layer) can be made of two different extruded polystyrene (XPS) boards[1], in accordance respectively with EN 13164[2], or in accordance with EAD 040650-00-1201 (use C). The loose-laid integral protective finishing can be made of screed, mortar or ceramic, with or without gaps. In some kit, an adhesive can be used for bonding the protective finishing to the thermal insulation (Fig.1).

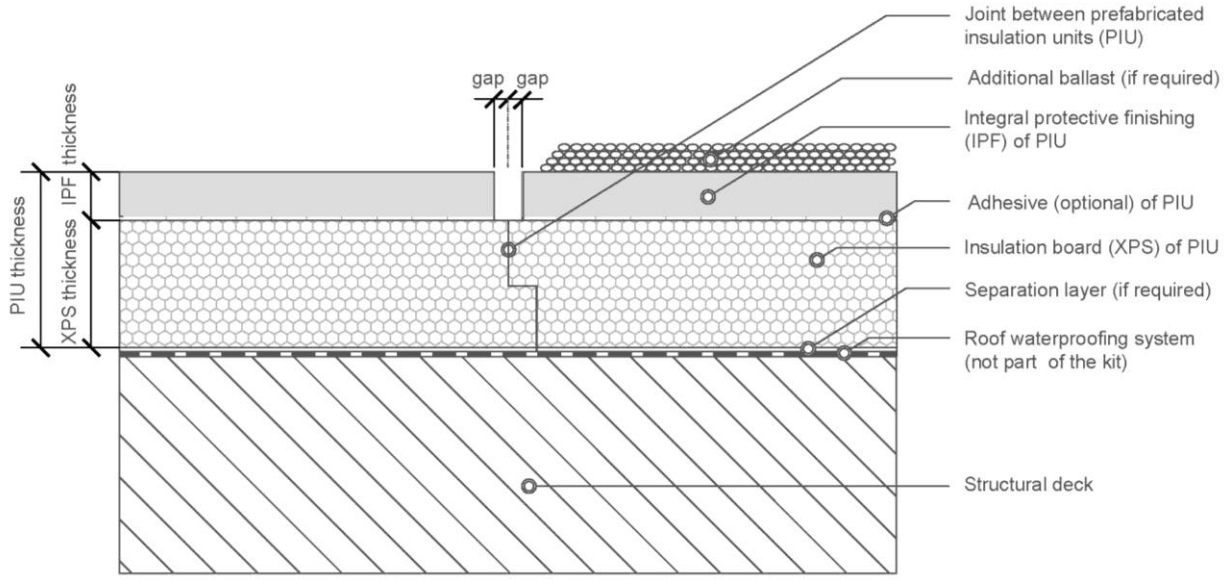

Figure 1. Schematic build-up of an inverted roof system

When installed on an inverted roof, the kits permits the execution in one single operation of both the thermal insulation and the protection layer of the roof. This protection also acts as the ballast of the thermal insulation, though some additional ballast may be needed in some cases, depending on wind uplift requirements of each site.

The protective finishing allows the diffusion of water vapour. Diffusion tight layers are not used.

The kit can incorporate other components defined by the manufacturer, such us:

- Separation layer: This component will be taken into account in so far as it may affect, or be affected by, the performance of the thermal insulation with protective finishing.
- Additional ballast that may be required due to the wind uplift forces acting on the roof is not covered by this EAD.

The following information per component shall be stated in the ETA:

- **<u>Prefabricated Insulation unit:</u>**
    - XPS thermal insulation:
        - If foam is supplied with skin or without skin (removed)
        - Dimensions, including width of the perimeter gap, density or weight per square meter

[1] XPS boards can be supplied with or without skin, if the XPS foam used in these products do not have the external skin, obviously the tests of this EAD will be performed without the external skin.

[2] All undated references to standards in this EAD are to be understood as references to the dated versions listed in chapter 4.

  - Edge treatment for joints (butt border, tongue and groove, shiplap, etc.) and its dimensions
- Protective finishing:
  - Material
  - Dimensions
  - Edge / corner treatments and its dimensions
  - Density or weight per square meter
- Adhesive:
  - Type (organic / inorganic mortar or specific adhesive)
  - Range of thickness
  - Water quantity ration (if relevant)
  - Coverage (area m^2/ litre or area m^2/kg)
  - Density or weight per square meter

- **Separation layer:**
  - Material
  - Thickness
  - Density or weight per square meter

- **Additional ballast:**
  - Material
  - Thickness range
  - Density or weight per square meter

The kits are not covered by a harmonised European standard (hEN) or EAD, because:
- EN 13164 covers only extruded polystyrene board,
- EAD 040650-00-1201 covers only extruded polystyrene boards to be used as load bearing layer and thermal insulation outside the waterproofing, including inverted roofs where this load bearing function is needed (park deck and green roof applications).

Given the specific characteristics of these kits, only XPS that meet the levels described in Table 1.1.1 can be used to comply with the intended use of the kits.

Table 1.1.1 Characteristics of XPS boards

Characteristics	Levels per type of inverted roofs			
Remark: Assessment methods are described for each relevant characteristic at clauses of chapter 2	Non-trafficable roof	Pedestrian access roof	Green roof	Roof garden
Compressive strength or stress	CS(10\Y)300			
Compressive creep	CC(2/1,5/25)50			CC(2/1,5/50)100
Deformation under specified compressive load and temperature conditions	DLT(2)5			
Long-term water absorption by diffusion	< 50 mm WD(V)5 ≥ 50 mm WD(V)3			
Long-term water absorption by total immersion	WL(T)0,7			
Dimensional stability under specified conditions	≤ 5 % DS(70,90)			
Freeze-thaw resistance	≤ 1 % FTCI			
	≥ 90 % of initial value of CC			
	< 50 mm WD(V)5 ≥ 50 mm WD(V)3 FCTD			

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

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

Relevant manufacturer's stipulations, e.g., with regard to the intended end use conditions, having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA as long as the details of the assessment methods as laid down in this EAD are respected.

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

1.2.1 Intended use(s)

The intended use of the kit is to increase the thermal insulation and protect the waterproofing membrane of the roof. The maximum roof slope upon which the kit can be used is 5 %.

The thermal insulation board with a protective finishing are for use fully supported above a waterproofing layer, in new or existing construction, in conjunction with a separation layer in roofs including pedestrian access roof, non-trafficable roofs, green roofs and roof gardens. The waterproofing layer does not form part of the kit.

1.2.2 Working life / Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the kit for the intended use of 25 years when installed in the works (provided that the kit is subject to appropriate installation (see 1.1)). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[3].

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

1.3 Specific terms used in this EAD

1.3.1 Specific terms

Adhesive. Used for bonding the protective finishing to the thermal insulation in some boards. Types of adhesives used for this purpose are polyurethane, cementitious and water based.

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

Gravel. A 'washed low fines aggregate' used for additional 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.

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.

Protective finishing. The protective finishing allows the diffusion of water vapour. Diffusion tight layers are not used. The materials used are screeds, mortars or ceramics.

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.

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

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

Single layer. Factory made board made of one layer of extruded polystyrene foam, generally with a foam skins on upper and lower surface.

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.

Non-trafficable 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.

***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.

1.3.2 Symbols

R	Thermal resistance ($m^2 \cdot K/W$).
R_D	Declared thermal resistance ($m^2 \cdot K/W$).
F_m	Moisture conversion factor (see clause 2.2.8.2).
λ	Thermal conductivity ($W/(m \cdot K)$.
λ_D	Declared thermal conductivity ($W/(m \cdot K)$).
f_ψ	Moisture conversion coefficient (m^3/m^3) in accordance with EN ISO 10456 or Annex B of EAD 040650-00-1201.
ψ_1	Content of moisture per volume unit of the first set of conditions.
ψ_2	Content of moisture per volume unit of the second set of conditions.
μ_d	Dynamic coefficient of friction on dry surface.
μ_w	Dynamic coefficient of friction on wet surface.
$\mu_{d,wear}$	Dynamic coefficient of friction on dry surface after wear.
$\mu_{w,wear}$	Dynamic coefficient of friction on wet surface after wear

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the kit is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic		Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire				
1	Reaction to fire		2.2.1	Class
2	External fire performance of roofs		2.2.2	Class
Basic Works Requirement 3: Hygiene, health and the environment				
3	Water vapour transmission		2.2.3	Level
4	Content, emission and/or release of dangerous substances		2.2.4	Description
Basic Works Requirement 4: Safety and accessibility in use				
5	Resistance to wind loads		2.2.5	Level
6	Resistance to mechanical damage	Slip resistance on dry and wet surfaces	2.2.6	Level
7		Hard body impact resistance of thermal insulation board with a protective finishing	2.2.7.1	Level / Description
8		Tensile bond strength	2.2.7.2	Level / Description
9		Resistance to static indentation (point loading)	2.2.7.3	Level / Description
10		Wear resistance	2.2.7.4	Level / Description
11		Compressive strength of protective finishing (excluding ceramic finishing)	2.2.7.5	Level / Description
12		Ageing of prefabricated insulation units	2.2.7.6	Level / Description
13		Resistance to freeze-thaw of prefabricated insulation units	2.2.7.7	Level / Description
Basic Works Requirement 6: Energy economy and heat retention				
14	Thermal characteristics	Thermal resistance	2.2.8.1	Level
15		Thermal conductivity of the thermal insulation	2.2.8.2	Level
16		Correction of the thermal transmittance of the kit	2.2.8.3	Level
17	Resistance to compression load (thermal insulation)	Compressive strength/stress of the thermal insulation	2.2.9.1	Class / Level
18		Compressive creep of the thermal insulation	2.2.9.2	Class / Level
19		Deformation under specified compressive load and temperature of the thermal insulation	2.2.9.3	Class / Level
20	Water absorption	Long-term water absorption by diffusion of the thermal insulation	2.2.10.1	Level
21		Long-term water absorption by total immersion of the thermal insulation	2.2.10.2	Level
22		Water absorption and connected pores of the protective finishing	2.2.10.3	Level
23	Dimensional stability (thermal insulation)		2.2.11	Level
24	Resistance to freeze-thaw (thermal insulation)		2.2.12	Level / Description
25	Resistance to shear strength		2.2.13	Level
26	Density		2.2.14	Level
27	Geometrical characteristics	Thickness	2.2.15.1	Class / Level
28		Length and width	2.2.15.2	Class / Level
29		Squareness	2.2.15.3	Class / Level
30		Flatness	2.2.15.4	Class / Level

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

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

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

The kit shall be described in the ETA in accordance with the minimum data for each component as indicated in clause 1.1.

2.2.1 Reaction to fire

Purpose of the assessment

The purpose of the assessment is to provide the reaction to fire of the kit.

Assessment method

The kit or each component shall be tested, using the method(s) relevant for the corresponding reaction to fire class in accordance with EN 13501-1.

For the assessment of reaction to fire of the whole kit, one of the following options a) or b) shall apply:

a) The whole kit shall be assessed based on the worst class of any component obtained either:
   - in accordance with a CWT/CWFT[4] decision, or
   - using the test method(s) relevant for the corresponding reaction to fire class in accordance with EN 13501-1. The component shall then be classified in accordance with the Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

b) If option a) leads to too onerous classification of the kit, or if classification for one or several components are missing, then the kit shall be tested using the test method(s) relevant for the corresponding reaction to fire class in accordance with EN 13501-1. The veture kit shall then be classified in accordance with the Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Criteria and associated mounting and fixing rules for the relevant reaction to fire tests are given in Annex A.

Expression of results

The reaction to fire class of the kit shall be stated in the ETA together with those conditions for which the classification is valid.

2.2.2 External fire performance of roofs

Purpose of the assessment

The purpose of the assessment is to provide the external fire performance of the kit.

Assessment method

The roof (including the complete roof covering) in which the kit (used in conjunction with an additional ballast not cover by the Annex of Commission Decision 2000/553/EC) is intended to be incorporated, installed or applied shall be tested according to the test method referred to in EN 13501-5 and relevant for the

4 CWT: classified without testing; CWFT: classified without further testing

corresponding external fire performance roof class, in order to be classified in accordance with Commission Decision 2001/671/EC amended by Commission Decision 2005/823/EC.

Expression of results

The external fire performance class of the roof, including the test method used in accordance with EN 13501-5, clause 5, shall be stated in the ETA.

If kit intended to be incorporated, installed or applied, includes a full covering layer of additional ballast on prefabricated insulation units, or prefabricated insulation units with no gaps between its integral protective finishing) made of inorganic materials covered by Annex of Commission Decision 2000/553/EC[5] the roofis considered to satisfy the requirements for performance class X_{ROOF} (t_x) of the characteristic external fire performance in accordance with the Decision 2000/553/EC without the need for further testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

The classification from test applies to the kit as tested and any other kits covered by the scope of direct or extended application (EN 15725, clause 6.3.4 and Annex C).

Therefore, when the conditions referred to above are fulfilled, the external fire performance class of the roof is X_{ROOF} (t_x), which shall be given in the ETA.

2.2.3 Water vapour transmission

Purpose of the assessment

The purpose of the assessment is to provide the water vapour transmission behaviour of the components of the components of the kit.

Assessment method

The water vapour transmission rate (g) for thermal insulation board with a protective finishing shall be determined in accordance with EN 12086.

The water vapour transmission rate (g) for the separation layer[6] shall be determined in accordance with EN ISO 12572.

Expression of results

The water vapour transmission rate (g) for thermal insulation board with a protective finishing indicated as the water vapour diffusion resistance factor (μ). The mean value of both parameters shall be stated in the ETA, indicating the test conditions (A, B or C).

The water vapour transmission rate (g) for the separation layer shall be indicated as the water vapour diffusion resistance factor (μ). The mean value of water vapour transmission rate and water vapour diffusion resistance factor shall be stated in the ETA, indicating the dry or wet cup used.

2.2.4 Content, emission and/or release of dangerous substances

Purpose of the assessment

The purpose of the assessment is to provide the leachable substances of the kit for direct and indirect impacts on ground, soil and external water.

Assessment method

The performance of the product (components of the kits) related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided

5 Annex of Commission Decision 2000/553/EC lists the following inorganic coverings, considered applicable:

- Additional ballast made of loose laid gravel with a thickness of ≥ 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.

6 A minimum slice of the thermal insulation (5 mm thickness) should be included in the specimen.

by the manufacturer[7] after identifying the release scenarios taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

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

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

Leachable substances. For the intended use covered by the release scenario S/W2 the performance of the product concerning leachable substances has to be assessed, if the product contains agents for root penetration. A leaching test with subsequent eluate analysis must take place, each in duplicate. Leaching tests of the membrane contained agents for root penetration are conducted in accordance with CEN/TS 16637-2. The leachate shall be pH-neutral demineralized water and the ratio of liquid volume to surface area must be 25 ± 5 L/m².

The membrane must be applied to a sandblasted glass plate by heating. The edges are not sealed. The cut edges of the membrane strip exposed to the eluent should be included in the calculation as a leachable area.

The eluates taken after 6 hours / 1 day / 2 days and 6 hours / 4 days / 9 days / 16 days / 36 days / 64 days shall be analyzed for all environmentally relevant parameters, presumably at least the following:

- TOC in accordance with EN 1484.
- pH-value in accordance with EN ISO 10523.
- Electrical conductivity in accordance with EN 27888.
- Agents for root penetration concentration (µg/L), agents for root penetration release (µg/m²) and the cumulative agents for root penetration release (g/m²) according to appropriate test method.

In eluates of 6 hours and 36 days, the following biological tests shall be conducted:

- Acute toxicity test with Daphnia magna Straus in accordance with EN ISO 6341.
- Toxicity test with algae in accordance with EN ISO 8692.
- Luminescent bacteria test in accordance with EN ISO 11348-1, EN ISO 11348-2 or EN ISO 11348-3.
- For each biological test, the ecotoxic effects in accordance with the respective test method for dilution ratios 1:2, 1:4, 1:6, 1:8 and 1:16 shall be determined.

If the parameter TOC is higher than 10 mg/l, the following biological tests shall be conducted with the eluates of 6 hours and 36 days eluates: Biological degradation in accordance with OECD Test Guideline 301 part A, B or E.

Expression of results

Determined toxicity in biological tests must be expressed in the ETA as the dilution ratios, where no toxicity (in accordance with the respective test methods) is observed. Maximum determined biological degradability must be expressed as …% within …hours/days. The respective test methods for analysis shall be specified.

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7 The manufacturer may be asked to provide to the TAB the REACH related information which shall accompany the DoP (cf. Article 6(5) of Regulation (EU) No 305/2011).
The manufacturer is not obliged to:
- provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS, taking into account the installation conditions of the construction product and the release scenarios resulting from there.
Any information provided by the manufacturer regarding the chemical composition of the products is not to be distributed to EOTA to other TABs or beyond.

2.2.5 Resistance to wind loads

Purpose of the assessment

The purpose of the assessment is to provide the resistance to wind loads of the kit.

Assessment method

The resistance to the wind loads is given by the weight per surface of the kit. The lineal dimensions is determined in accordance with EN ISO 29465 and the weigh in accordance EN 29470 (7.2).

Expression of results

The mean mass per unit area (kg/m^2) of five full pieces of the insulation boards with protective finishing shall be stated in the ETA.

2.2.6 Slip resistance on dry and wet surfaces

Purpose of the assessment

The purpose of the assessment is to provide the slip resistance on respectively, dry and wet surfaces of each of the protective insulation finishing of the prefabricated insulation unit.

Assessment method

The assessment method is the Tribometer test, using sliders on prefabricated insulation units, on dry and wet conditions in accordance with Annex D of EN 16165, on at least 1 specimen of area 1000 x 400 mms or on at least 3 specimens with smaller area of the protective insulation finishing, and with the lowest thickness. Specimens shall be performed in laboratory at room temperature (20 ± 5 ºC). Three measurement series (each one consisting into five individual measurements shall be carried out in different traces (longitudinally, laterally and approximately 45º between these two traces), unless the protective insulation finishing provides a known directional slip resistance.

Expression of results

The individual and average values per series rounded to the nearest 0.01 shall be registered. The mean values obtained, calculated from the results of the 3rd to the 5th individual vales of the dynamic coefficients of friction respectively on dry (μ_d) and wet surfaces (μ_w) shall be stated in the ETA.

2.2.7 Resistance to mechanical damage

2.2.7.1 Hard body impact resistance of thermal insulation board with a protective finishing.

Purpose of the assessment

The purpose of the assessment is to provide the hard body impact resistance of the protective insulation finishing of the prefabricated insulation unit.

Assessment method

It shall be assessed in accordance with Annex B, using specimens prepared by ageing (EAD 040083-00-0404) and freeze-thaw. Time between manufacture and testing depends on the cure rate of the protective finishing but shall be a minimum of 28 days after manufacture.

Expression of results

The diameter and maximum indention after each impact and the residual diameter and indention shall be reported (in mm) and shall be stated in the ETA.

The ETA shall indicate any damage (e.g., localized surface cavities of small dimensions, scratches, wear marks in the form of grooves, cracking, indentation, flacking and/or delamination from the thermal insulation etc.).

Fort extended application of the test results, the general rule is that test results for the most onerous (specimens with the minimum thickness) assembly can be used to reflect the behaviour of others.

2.2.7.2 Tensile bond strength.

Purpose of the assessment

The purpose of the assessment is to provide the tensile bond strength perpendicular to the faces of the prefabricated insulation unit

Assessment method

Tensile bond strength between the protective finishing and thermal insulation shall be determined in accordance with EN 1607 on 5 specimens of 100 mm x 100 mm. Specimens shall not be tested before at least 28 days after manufacture. The two square metal stamps (targets) of appropriate size shall be affixed centrically to the specimen with suitable adhesive (e.g. by component epoxy based adhesive compatible with XPS and protective finishing insulation material). Test specimen shall be affixed through metal plates into clamps of test machine and force applied until to failure

Expression of results

The individual and average values, as well as standard deviation shall be rounded to the nearest 0.01 and be registered. The minimum and mean value, as well as standard deviation of failure tensile bond strength (kPa) and the mode of failure shall be stated in the ETA. The mean bond strength shall be ≥ 80 kPa.

2.2.7.3 Resistance to static indentation (point loading).

Purpose of the assessment

The purpose of the assessment is to provide the resistance to static indentation (point loading) of the protective insulation finishing of the prefabricated insulation unit.

Assessment method

Resistance to static indentation (point loading) of the kit shall be determined in accordance to Annex ~~B~~C.

Expression of results

The load (N) which has not damaged the protective finishing layer shall be stated in the ETA.

2.2.7.4 Wear resistance.

Purpose of the assessment

The purpose of the assessment is to provide the wear resistance of the protective insulation finishing of the prefabricated insulation unit.

Assessment method

Wear resistance shall be determined in accordance with CEN/TS 12633. Once the specimens have been worn, the slip resistance shall be determined in accordance with clause 2.2.6.

Expression of results

The mean value of dynamic coefficients of friction after wearing ($\mu_{d,wear}$ and $\mu_{w,wear}$) shall be stated in the ETA.

2.2.7.5 Compressive strength of protective finishing (excluding ceramic finishing).

Purpose of the assessment

The purpose of the assessment is to provide the compression strength of the protective insulation finishing of the prefabricated insulation unit.

Assessment method

The compressive strength of protective finishing shall be determined in accordance with EN 1015-11 on at least 6 specimens. The individual values shall be rounded to 0.05 N/mm^2. The mean value of compressive strength (N/mm^2) and standard deviation shall be rounded to 0.1 N/mm^2.

This test shall not be used for ceramic protective finishing. Ceramic protective finishing shall be assessed on result of modulus of rupture and breaking strength in accordance with EN ISO 10545-4.

Expression of results

The minimum and mean values, as well as standard deviation of breaking strength (N) shall be stated in the ETA.

2.2.7.6 Ageing of prefabricated insulation units

Purpose of the assessment

The purpose of the assessment is to provide the ageing behaviour of the prefabricated insulation unit once exposed to heat-rain ageing cycles.

Assessment method

Ageing of prefabricated insulation units shall be carried out using the heat-rain ageing regime of 80 cycles in line with EAD 040083-00-0404 (Hygrothermal cycles, clause 2.2.6) in a rig capable of holding at least three standard boards 1200 mm x 600 mm or six half boards. The rig shall be capable of heating and water spraying the test specimens in line with the cycles set out below. Specimens shall be cut from the boards after the conditioning. The cycles shall be as follows:

- Gradual heating to 70 ± 5 ºC for one hour.
- Maintain temperature at 10-15 % RH for two hours.
- Water spray at 15 ± 5 ºC for one hour at a volume of one litre per metre squared per minute.
- Leave to drain for two hours and then repeat.

Following completion of the ageing cycles: water absorption by capillarity (clause 2.2.10.3) of the protective finishing and tensile bond strength (clause 2.2.7.2) of the prefabricated insulation units shall be determined.

Expression of results

The mean value of water absorption by capillarity (kg/m^{2}h) and tensile bond strength (kPa) with and without ageing shall be stated in the ETA.

2.2.7.7 Resistance to freeze-thaw prefabricated insulation units

Purpose of the assessment

The purpose of the assessment is to provide the ageing behaviour of the prefabricated insulation unit once exposed to freeze-thaw cycles.

Assessment method

Resistance to freeze-thaw of prefabricated insulation units shall be carried out for 30 cycles using the cycle as set out in EAD 040083-00-0404 (clause 2.2.7) (simulated method).

The test shall be carried out on three specimens (length x width ≥ 20 x 20 cm). Before freeze - thaw cycling the specimens shall be stored totally immersed in water for 28 days (23 ± 2 ºC). The cycles shall be as follows:

- Exposure to water for 8 hours at 20 ± 2 ºC by total immersion.
- Freezing to -20 ± 2 ºC (fall for 2 hours) for 14 hours (total of 16 hours).

Following completion of the conditioning: hard body impact (clause 2.2.7.1) and tensile bond strength (clause 2.2.7.2) shall be determined.

Expression of results

The mean value of hard body impact (clause 2.2.7.1), tensile bond strength (clause 2.2.7.2) and failure mode and any damages (visual control) shall be stated in the ETA. After the freeze-thaw cycling, the tensile bond strength shall be ≥ 80 kPa with a recommended maximum decrease change of – 20 % on the original value.

2.2.8 Thermal characteristics

2.2.8.1 Thermal resistance.

Purpose of the assessment

The purpose of the assessment is to provide the total thermal resistance of the kit, corrected due end use conditions.

Assessment method

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 XPS (EN 13164 or EAD 040650-00-1201) shall be taken as input value for further processing according to this Clause.

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.

ETA for a thermal insulation used in an inverted roof shall include corrected values of thermal resistance due to the special application.

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 formula (1):

$$(1)\quad R = R_D / F_m$$

where,

R_D is the declared thermal resistance ($m^2 \cdot K/W$),

F_m is the moisture conversion factor (see clause 2.2.8.2).

Expression of results

The declared thermal resistance R_D ($m^2 \cdot K/W$) and the corrected thermal resistance R_{cor} ($m^2 \cdot K/W$) shall be stated in the ETA.

2.2.8.2 Thermal conductivity of the thermal insulation.

Purpose of the assessment

The purpose of the assessment is to provide the total thermal conductivity of the thermal insulation board of the prefabricated insulation unit, corrected due end use conditions.

Assessment method

The declared thermal conductivity λ_D of the thermal insulation shall be taken as input value for further processing according to this Clause.

In relation to the correction procedure for thermal conductivity λ_{cor} , it shall be determined in accordance to EN ISO 10456 (clause 7) or clause 2.2.12 of EAD 040650-00-1201, as described in the following formula (2):

$$(2)\quad \lambda_{cor} = \lambda_D * F_m$$

where,

λ_D is the declared thermal conductivity ($W/(m \cdot K)$),

F_m is the moisture conversion factor.

The factor F_m shall be determined as follows (formula 3):

$$(3)\quad F_m = e^{f\psi(\psi 2 - \psi 1)}$$

where,

f_ψ is the moisture conversion coefficient (m^3/m^3) in accordance with EN ISO 10456 or Annex B of EAD 040650-00-1201,

ψ1 is the content of moisture per volume unit of the first set of conditions,

ψ2 is the content of moisture per volume unit of the second set of conditions.

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

Expression of results

The declared thermal conductivity λ_D (W/(m·K)) and the corrected thermal conductivity λ_{cor} (W/(m·K)) shall be stated in the ETA.

2.2.8.3 Correction of the thermal transmittance of the kit

Purpose of the assessment

The purpose of the assessment is to provide the correction of the thermal transmittance of the kit due to water passing through the jointed insulation boards with protective finishing

Assessment method

The corrected thermal transmittance of the kit ΔU_r shall be determined in accordance with EN ISO 6946, and its Annex F, clause F.4.2; considering f·x, the values f and x for the kit are necessary to determinate the ΔU_r.

Without the need for testing the following fx values shall be used. The fx values due to the water flow beneath the boards of size 600 mm x 1200 mm to be used shall be assessed according to one of the following options:

a) 0.04 $W \cdot day \cdot m^{-2} K^{-1} mm^{-1}$ for an open system with boards with butted joints (considered as worst case scenario)
   or
b) In the case of lower fx values, the *f* value shall be determined in accordance with Annex ~~C~~D.

Expression of results

The correction for thermal transmittance ΔU_r (W/(m^2·K)) of the kit shall be stated in the ETA.

2.2.9 Resistance to compression loads of the thermal insulation

2.2.9.1 Compressive strength or stress of the thermal insulation[8]

Purpose of the assessment

The purpose of the assessment is to provide the compression strength or stress of the thermal insulation of the prefabricated insulation unit.

Assessment method

The compressive strength at yield or stress at 10 % deformation shall be determined in accordance with EN 13164 (clause 4.3.4).

Expression of results

The individual and mean values, as well as standard deviation shall be rounded to the nearest 0.01 and be registered. The minimum and mean as well as standard deviation of failure values of compressive strength (kPa) or compressive stress (kPa) shall be stated in the ETA (kPa) shall be stated in the ETA. The mean value of compressive strength (kPa) or compressive stress (kPa) shall meet the level given in Table 1.1.1.

8 The values of the different characteristic of the XPS can be obtained from the applicable DoP of the CE marking, based on EN 13164, or based on an ETA issued in accordance with EAD 040650-00-1201. Retesting and reassessment of components covered by CE marking shall be avoided.

2.2.9.2 Compressive creep of the thermal insulation[8].

Purpose of the assessment

The purpose of the assessment is to provide the compression creep of the thermal insulation of the prefabricated insulation unit.

Assessment method

The compressive creep and total thickness reduction shall be determined in accordance with EN 13164 (clause 4.3.6), after 304 days (25 years) or 608 days (50 years) using a compressive stress defined by the Use areas.

Expression of results

The compressive creep level shall be stated in the ETA. It shall meet the level given in Table 1.1.1.

2.2.9.3 Deformation under specified compressive load and temperature of the thermal insulation[8].

Purpose of the assessment

The purpose of the assessment is to provide the deformation under specified compressive load and temperature of the thermal insulation of the prefabricated insulation unit.

Assessment method

The deformation under specified compressive load and temperature shall be determined under a compressive load of 40 kPa and a temperature of 70 ºC in accordance with EN 1605.

Expression of results

The mean value of deformation under specified compressive load and temperature of the thermal insulation (%) shall be stated in the ETA. It shall meet the level given in Table 1.1.1.

2.2.10 Water absorption

2.2.10.1 Long-term water absorption by diffusion of the thermal insulation[8].

Purpose of the assessment

The purpose of the assessment is to provide the long term water absorption by diffusion of the thermal insulation of the prefabricated insulation unit.

Assessment method

The long-term water absorption by diffusion shall be determined in accordance with EN 16536.

Expression of results

The mean value of long-term water absorption diffusion (%) shall be stated in the ETA. This value shall meet the level indicated in Table 1.1.1.

2.2.10.2 Long-term water absorption by total immersion of the thermal insulation[8].

Purpose of the assessment

The purpose of the assessment is to provide the long term water absorption by total immersion of the thermal insulation of the prefabricated insulation unit.

Assessment method

The long-term water absorption by total immersion shall be determined in accordance with EN 13164 (clause 4.3.7.1).

Expression of results

The mean value of long-term water absorption by total immersion of the thermal insulation (%) shall be stated in the ETA. This value shall meet the level indicated in Table 1.1.1.

2.2.10.3 Water absorption and connected pores of the protective finishing.

Purpose of the assessment

The purpose of the assessment is to provide the water absorption and connected pores of the protective finishing of the prefabricated insulation unit.

Assessment method

The capacity of absorption and connected pores of the protective finishing shall be determined in accordance with:

- Water absorption (capillarity test) in accordance with EAD 040083-00-0404, clause 2.2.5.
- Connected pores in accordance with ISO 17785-2. The test shall be performed when the protective finishing have connected porosity.

Expression of results

The mean value of water absorption of the protective finishing (%) and the connected pores (%) shall be stated in the ETA.

2.2.11 Dimensional stability (thermal insulation)[8]

Purpose of the assessment

The purpose of the assessment is to provide the dimensional stability of the thermal insulation of the prefabricated insulation unit.

Assessment method

The dimensional stability at a temperature of 70 ºC and a relative humidity of 90 % for 48 hours shall be determined in accordance with EN 13164 (clause 4.3.2) for the thermal insulation.

Expression of results

The mean value of the dimensional stability (%) shall be stated in the ETA.
It shall meet the level given in Table 1.1.1.

2.2.12 Freeze-thaw resistance (thermal insulation)[8]

Purpose of the assessment

The purpose of the assessment is to provide the freeze-thaw resistance of the thermal insulation of the prefabricated insulation unit.

Assessment method

The resistance to freeze-thaw of the thermal insulation shall be determined in accordance with EN 13164 (clause 4.3.8).

Following freeze-thaw cycling, the long-term water absorption by diffusion according to clause 2.2.10.1, compressive strength at yield or compressive stress at 10 % deformation according to clause 2.2.9, and long-term water absorption by total immersion according to clause 2.2.10.2 shall be determined. The water absorption by diffusion, water absorption by total immersion and compressive strength or compressive stress at 10 % deformation shall meet these requirements:

Expression of results

All of the average respective values shall be stated in the ETA, resulting after exposure to freeze-thaw cycles and related to:

- Long-term water absorption by diffusion according to clause 2.2.10.1
- Compressive strength at yield or compressive stress at 10 % deformation according to clause 2.2.9
- Long-term water absorption by total immersion according to clause 2.2.10.2 shall be determined

The water absorption by diffusion shall meet the level indicated in Table 1.1.1.

- Reduction in compressive strength or compressive stress at 10 % deformation shall not exceed 10 % of the initial value.
- The long-term water absorption by total immersion shall meet the level indicated in Table 1.1.1.

2.2.13 Resistance to shear strength

Purpose of the assessment

The purpose of the assessment is to provide the resistance to shear strength of the thermal insulation[8] and also of the prefabricated insulation unit.

Assessment method

The shear strength of the thermal insulation and the thermal insulation with the protective finishing shall be determined in accordance with EN 12090 considering in both cases (figure 1 and 2 of this standard), the one or two specimen configuration for the tests, depending on the available claws of test device suitable for the thickness of the specimens. At least 5 specimens for one unit test or, at least 5 couples of specimens (10 in total for the two units), and of dimensions ≥ 10 cm x 20 cm) shall be prepared by cutting methods that do not change the structure of the original product. The test specimens shall be stored for at least 6 h at (23 ± 2) °C. In case of dispute, they shall be stored at 23 ± 2 °C and 50 ± 5 % relative humidity for the time specified in the relevant product standard with a minimum of 6 h (EN 12090/ cl.6.4). The metallic supports shall be affixed centrically to the specimen with suitable adhesive with higher load resistance than the components of the prefabricated insulation unit and compatible with them (e.g., some epoxy based adhesive). Force shall be applied until failure.

Expression of results

The individual and mean values, as well as standard deviation shall be rounded to the nearest 0.01 and be registered, as well as the test method followed (one or two specimens). The minimum and mean as well as standard deviation of failure values of shear strength (kPa) shall be stated in the ETA.

2.2.14 Density

Purpose of the assessment

The purpose of the assessment is to provide the respective density values of the thermal insulation and also of the protective finishing, of the prefabricated insulation units.

Assessment method

It shall be assessed the lowest and highest thicknesses of the components of the prefabricated insulation units. They shall be carefully separated by suitable cutting tools (by hand, if possible, hot wire cutter, avoiding damages to the specimens). The respective densities of the thermal insulation[8] and of the protective finishing shall be determined in accordance with EN ISO 29470 (including previous preparation and conditioning) on at least 5 specimens of dimensions (length x width) ≥ 20 cm x 20 cm.

Expression of results

The individual and mean values, shall be rounded to the nearest 0.01 and be registered. The mean values obtained shall be stated in the ETA.

2.2.15 Geometrical characteristics

2.2.15.1 Thickness.

Purpose of the assessment

The purpose of the assessment is to provide the respective thicknesses values of the thermal insulation[8] and also of the protective finishing, of the prefabricated insulation units.

Assessment method

The thicknesses shall be determined in accordance with EN ISO 29466. The components of the prefabricated insulation units shall be carefully separated by suitable cutting tools (by hand, if possible, hot wire cutter, avoiding damages to the specimens).

Expression of results

The individual and mean values, shall be registered. The mean values obtained shall be stated in the ETA for the insulation[8] and the protective finishing.

2.2.15.2 Length and width.

Purpose of the assessment

The purpose of the assessment is to provide the respective length and width values of the thermal insulation[8] and also of the protective finishing, of the prefabricated insulation units.

Assessment method

The lengths and widths shall be determined in accordance with EN ISO 29465. The components of the prefabricated insulation units shall be carefully separated by suitable cutting tools (by hand, if possible, hot wire cutter, avoiding damages to the specimens).

Expression of results

The individual and mean values, shall be registered. The mean values obtained shall be stated in the ETA for the insulation[8] and the protective finishing.

2.2.15.3 Squareness.

Purpose of the assessment

The purpose of the assessment is to provide the respective squareness values of the thermal insulation[8] and also of the protective finishing, of the prefabricated insulation units.

Assessment method

The squareness on length and width shall be determined in accordance with EN 824. The components of the prefabricated insulation units shall be carefully separated by suitable cutting tools (by hand if possible, hot wire cutter, avoiding damages to the specimens).

Expression of results

The individual and mean values, shall be be registered. The mean values obtained shall be stated in the ETA for the insulation[8] and the protective finishing.

2.2.15.4 Flatness.

Purpose of the assessment

The purpose of the assessment is to provide the respective flatness values of the thermal insulation and also of the protective finishing, of the prefabricated insulation units.

Assessment method

The flatness shall be determined in accordance with EN ISO 29468. The components of the prefabricated insulation units shall be carefully separated by suitable cutting tools (by hand if possible, hot wire cutter, avoiding damages to the specimens).

Expression of results

The individual and mean values, shall be registered. The mean values obtained shall be stated in the ETA for the insulation[8] and the protective finishing.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD, the applicable European legal acts is Commission Decision 1999/91/EC, as amended by Commission Decision 2001/596/EC.

The applicable AVCP system is 3 for any use except for uses subject to regulations on reaction to fire.
For uses subject to regulations on reaction to fire the applicable AVCP system regarding reaction to fire are 1, or 3 or 4 depending on the conditions defined in the said Decision.

In addition, with regard to external fire performance for products covered by this EAD the applicable European legal act is Decision 98/436/EC, as amended by Commission Decision 2001/596/EC. The system is 3 for products requiring testing or 4 for products “deemed to satisfy’ without testing.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

The manufacturer (regarding the components he buys from the market with DoP) shall take into account the Declaration of Performance issued by the manufacturer of that component. No retesting is necessary.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control		Test or control method[9][10]	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Factory production control (FPC) [including testing of specimens taken at the factory in accordance with a prescribed test plan]						
1	Identification of incoming materials		Documents according Control Plan	According to control plan	According to test or control methods	Every batch
2	Separation layer	Mass per unit area	EN ISO 9073-1	According to control plan	According to test or control methods	Once per batch
		Tensile properties	EN ISO 9073-3			Once per 10 batches
3	Thermal insulation[7]	Thermal resistance Thermal conductivity	EN 13164	According to control plan	According to test or control methods	Once every 24 hours Ageing once every 2 years
		Reaction to fire				See EN 13164
		Length and width				Once every 2 hours
		Squareness				Once every 4 hours
		Flatness				Three times every 8 hours
		Thickness				Once every 2 hours
		Compressive strength/stress				Once every 12 hours
	Thermal insulation	Water absorption				Once per year
		Freeze-thaw	EN 13164			Once every 2 years
4	Thermal insulation with protective finishing	Length and width	EN ISO 29465	According to control plan	According to test or control methods	Once every 2 hours
		Squareness	EN 824			Once every 4 hours
		Flatness	EN ISO 29468			Three times every 8 hours
		Thickness	EN ISO 29466			Once every 2 hours
		Density	EN ISO 29470			Once per batch
		Bond strength	EN 1607			Once a week
		Freeze-thaw resistance	Clause 2.2.2.7			Once every 2 years
6	Protective finishing	Thickness of protective finishing	EN ISO 29466			Once per batch
		Density (non-ceramic only)	EN 1015-10			Once per day
		Flexural strength (non-ceramic only)	EN 1015-11			Once per 40 batches
		Modulus of rupture and breaking strength (ceramic only)	EN ISO 10545-4			

9 For incoming materials or finished components delivered by a supplier, the manufacturer of the kit is responsible and has to ensure that the tasks of the Control Plan for the manufacturer shall be respected also by the supplier as far as he is concerned. If not, then the manufacturer of the kit shall fulfil the tasks under the Control Plan.

10 In all cases, the TAB and the manufacturer may agree to alternative test or internal control methods.

3.3 Tasks of the notified body

The intervention of the notified body is only necessary under AVCP system 1 and 2+.
The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance for the kit are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method (*)	Criteria, if any	Minimum number of specimens	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the kit.	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer	As defined in control plan	As defined in control plan	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan.	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	As defined in control plan	As defined in control plan	Once per year

4 REFERENCE DOCUMENTS

CEN/TS 12633:2014	Method of polishing specimens prior to the measurement of slip and skid resistance.
CEN/TS 16637-2:2014	Construction products – Assessment of release of dangerous substances – Part 2: Horizontal dynamic surface leaching test.
EAD 040083-00-0404	External thermal insulation composite systems (ETICS) with renderings.
EAD 040650-00-1201	Extruded polystyrene foam boards as load bearing layer and/or thermal insulation outside the waterproofing.
EN 824:2013	Thermal insulating products for building applications – Determination of squareness.
EN 998-1:2016	Specification for mortar for masonry - Part 1: Rendering and plastering mortar
EN 1015-10: 1999/ A1: 2006	Methods of test for mortar for masonry – Part 10: Determination of dry bulk density of hardened mortar.
EN 1015-11:2019	Methods of test for mortar for masonry – Part 11: Determination of flexural and compressive strength of hardened mortar.
EN 1484:1997	Water analysis - Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC).
EN 1605:2013	Thermal insulating products for building applications – Determination of deformation under compressive load and temperature conditions.
EN 1607:2013	Thermal insulating products for building applications – Determination of tensile strength perpendicular to faces.
EN 10456:2012	Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values.
EN 12086:2013	Thermal insulating products for building applications – Determination of water vapour transmission properties.
EN 12090:2013	Thermal insulating products for building applications – Determination of shear behaviour.
EN 12730:2017	Flexible sheets for waterproofing. Bitumen, plastic and rubber sheets for roof waterproofing. Determination of resistance to static loading
EN 13164:2012+A1:2015	Thermal insulation products for buildings – Factory made products of extruded polystyrene foam (XPS) – Specification.
EN 13238:2010	Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire test.
EN 13501-5:2016	Classification of construction products and building elements – Part 5: Classification using test data from external fire exposure roof test.
EN 13823:2020+A1:2022	Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item
EN 15715:2009	Thermal insulation products - Instructions for mounting and fixing for reaction to fire testing - Factory made products
EN 15725:2023	Extended application on the fire performance of construction products and building elements: Principle of EXAP standards and EXAP reports.
EN 16165:2021	Determination of slip resistance of pedestrian surfaces - Methods of evaluation

EN 27888:1993	Water quality – Determination of electrical conductivity.
EN ISO 3451-1:2019	Plastics - Determination of ash - Part 1: General methods (ISO 3451-1:2019)
EN ISO 6341:2012	Water quality – Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) – Acute toxicity test. (ISO 6341:2012)
EN ISO 6946:2021	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.
EN ISO 8692:2012	Water quality – Fresh water algal growth inhibition test with unicellular green algae.
EN ISO 9073-1:2023	Nowovens – Test methods – Part 1: Determination of mass per unit area.
EN ISO 9073-3:2023	Nowoven – Test methods – Part 3: Determination of tensile strength and elongation at break using the strip method.
EN ISO 10456: 2007/AC:2009	Building materials and products - Hygrothermal properties -Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007)
EN ISO 1716:2018	Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value) (ISO 1716:2018)
EN ISO 10523:2012	Water quality – Determination of pH.
EN ISO 10545-4:2019	Ceramic tiles – Part 4: Determination of modulus of rupture and breaking strength.
EN ISO 11348-1:2007	Water quality – Determination of the inhibitory effect of water samples on the light emission of Vibrio Fischeri (Luminescent bacteria test) – Part 1: Method using freshly prepared bacteria.
EN ISO 11348-2:2007	Water quality – Determination of the inhibitory effect of water samples on the light emission of Vibrio Fischeri (Luminescent bacteria test) – Part 2: Method using liquid-dried bacteria.
EN ISO 11348-3:2007	Water quality – Determination of the inhibitory effect of water samples on the light emission of Vibrio Fischeri (Luminescent bacteria test) – Part 3: Method using freeze-dried bacteria.
EN ISO 11358-1:2022	Plastics — Thermogravimetry (TG) of polymers — Part 1: General principles
EN ISO 11925-2020	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2:2020)
EN ISO 12572:2018	Hygrothermal performance of building materials and products – Determination of water vapour transmission properties – Cup method
EN ISO 16536:2019	Thermal insulating products for building applications – Determination of long term water absorption by diffusion.
EN ISO 29465:2022	Thermal insulating products for building applications – Determination of length and width.
EN ISO 29466:2022	Thermal insulating products for building applications – Determination of thickness.
EN ISO 29468:2022	Thermal insulating products for building applications – Determination of flatness.
EN ISO 29470:2021	Thermal insulating products for building applications – Determination of the apparent density.
ISO 17785-2:2018	Testing methods for pervious concrete — Part 2: Density and void content

ANNEX A: REACTION TO FIRE

A.1 General

A.1.1 Principle

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

For the particular parts of the veture kit, the following principles apply:

- Within a family of components (integral protective finishing, XPS insulation and if required adhesives) made of the same material the component with the highest amount of organic content[11] (if there are only differences in the amount of organic content but no difference in the organic component himself) or the highest gross heat of combustion – Q_{PCS} [MJ/kg] value in accordance with EN ISO 1716 (from now on called “Q_{PCS}-value”) of this organic component shall be tested.
- In addition, each component selected for testing in accordance with the previous point shall have the lowest amount of flame retardants.

Components of a kit which are classified A1 without testing in accordance with Decision 96/603/EC (as amended by Commission Decision 2000/605/EC and Commission Decision 2003/424/EC) or applicable harmonised standard[12] or EAD, do not need to be tested for an assessment in accordance with option “a)” of clause 2.2.1. In case of further calculation to determine to total Q_{PCS}-value of a component, these components do not contribute to the total Q_{PCS}-value, therefore, their individual Q_{PCS}-value shall be set as zero.

A.1.2 Physical properties influencing the reaction to fire behaviour

The following parameters influence the reaction to fire behaviour:

- Type of XPS insulation product (composition, thickness, density).
- Type of Integral protection finishing (composition, organic content, thickness, density, width of perimeter gap).
- Type, composition and coverage of adhesive between XPS insulation and integral protective finishing.
- Type and amount of flame retardant[13] if used in components.

A.2 Testing in accordance with EN 13823 (SBI-test)

This test method is relevant for classes A2, B, C and D (in some cases also for A1) in accordance with Commission Delegated Regulation (EU) 2016/364 in connection with EN 13501-1.

Mounting and fixing provisions for the SBI-test for the kit are indicated in section A.2.1.

Parameters which are relevant for this test method are defined in clause A.1.2.

In principle, it is desirable to find the test specimen configuration that gives the worst case concerning the reaction to fire test results. In the test procedure in accordance with EN 13823, values for the rate of heat

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11 The organic content can be checked by providing the formulation or by performing suitable characterisation tests as defined by the applicable standard, or by determining the glow loss (loss on ignition (thermogravimetry, e.g., according to EN ISO 11358-1, or ash content according to EN ISO 3451-1). When information on organic content per unit is not available, the Q_{PCS}-value shall be tested to decide about the worst case.

12 The protective finishing with an organic distribute homogeneous content ≤ 1% (in weight or volume) can be classified as A1 (EN 998-1).

13 The term “fire retardant” refers both to chemicals incorporated into a product composition during the manufacturing process (sometimes known as flame retardants) and to coatings applied onto a finished product, in both cases with the purpose of improving the product´s reaction to fire.

release, total heat release, lateral flame spread, rate of smoke release, total smoke release and burning droplets shall be determined.

A.2.1 Mounting and fixing provisions for the SBI-test

In this test procedure the kit shall be tested. The kit shall be installed as described at clause 6.3.2.9.2 of EN 15715 (using fixings composed by screws and washers) in order to allow the specimen be stable or fixed to a substrate representing that on which the kit is loose laid in the end use application (Figures A.2.1.1 and A.2.1.2)

The maximum testable thickness of the test specimen, including a standard substrate in accordance with EN 13238, is 200 mm. In such cases, using a standard substrate, the thickness of the insulation product shall be reduced to provide for the maximum specimen thickness of 200 mm. Results obtained on a kit at 200 mm thickness are accepted for greater thicknesses. The test specimen consists of a corner construction which shall be representative of the construction in practice. All edges shall be uncovered excluding the top edge of the specimen if immobilizer profiles are used. The floor of the test trolley beneath the test specimen shall be covered by an aluminium foil.

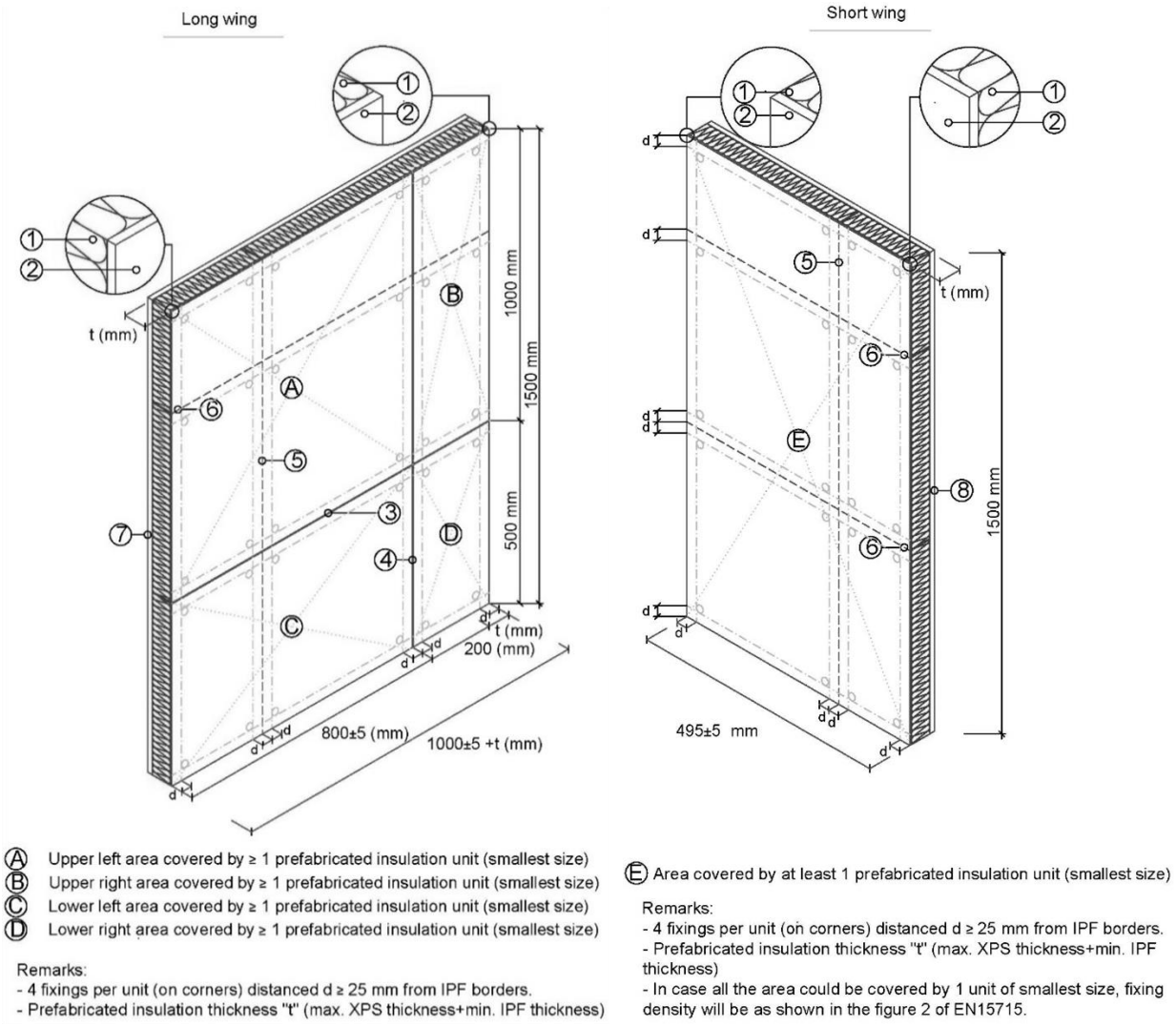

Figure A.2.1.1: Schemes of long and short wings of SBI test before assembly

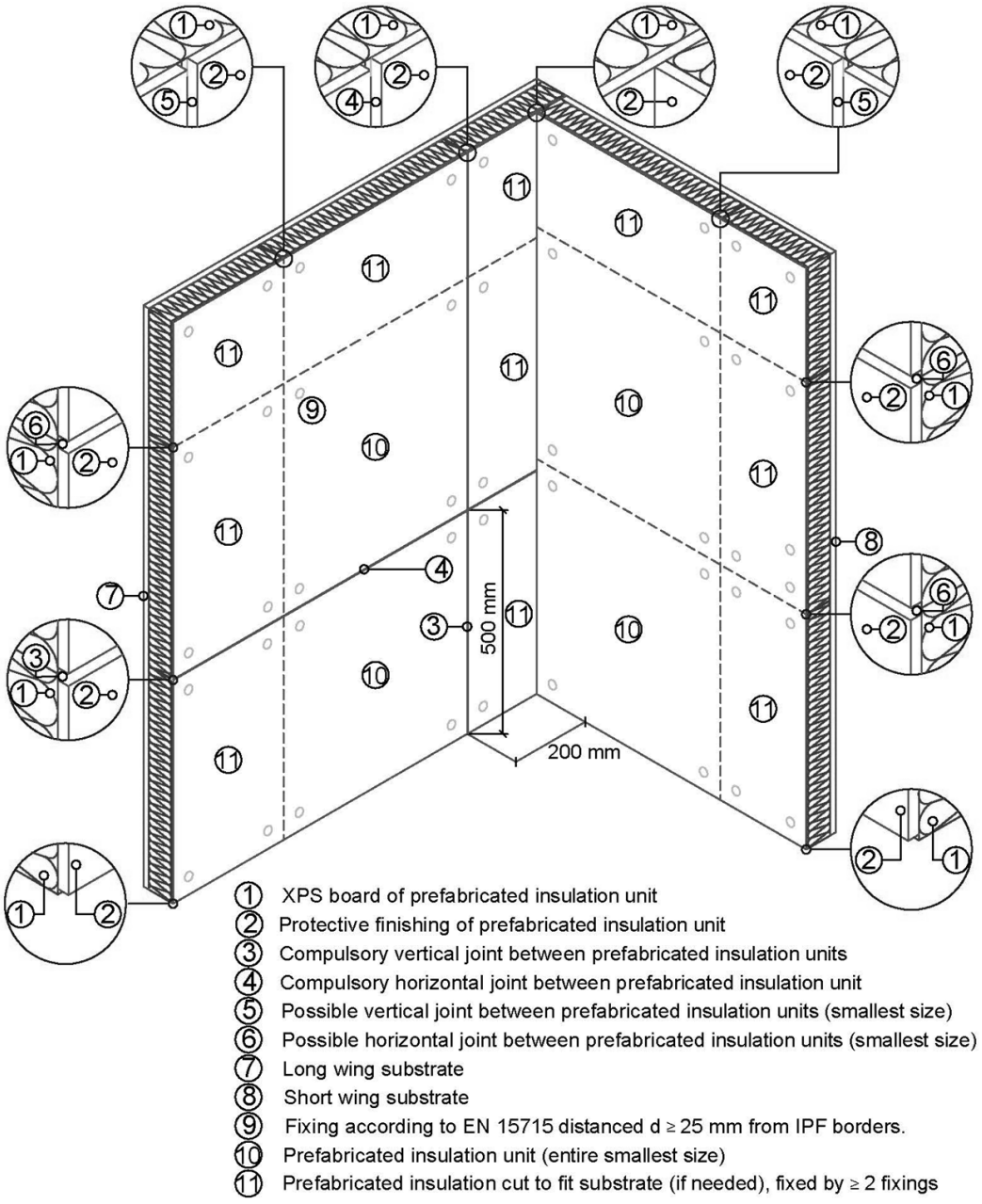

Figure A.2.1.2: Schemes of long and short wings of SBI test after assembly

It is recommended to prepare the specimens at the lab and then put it onto the trolley (with the foil on), or the manufacturer builds the wall at the factory and carries it to the lab where it is put onto the trolley. After preparation of the test specimens, they shall be conditioned in accordance with EN 13238.

A.2.2 Application of test results

The test result is valid for kits composed by prefabricated units of bigger sizes (it means less naked joints exposed and smaller gaps, as well as :

- XPS Insulation products:
  - With lower density, or the density range between those values evaluated in the tests.
  - With lower thickness or between those evaluated in the tests, provided that the worst result of the two thicknesses tested is used for intermediate thicknesses.

- Integral Protective Finishing
    - With bigger thickness
    - With lower density if its reaction to fire classes is B, C, D or E.
    - With lowest coverage of adhesive
- Components with equal or lower organic content.
- Components with equal or lower PCS_S-value per unit area.
- Components with equal or higher content of the same type of flame retardants.

A.3 Testing in accordance with EN ISO 11925-2

A.3.1 Mounting and fixing provisions

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

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

Parameters which are relevant for this test method are those described at A.1.2

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

A.3.2 Application of test results

The results from the testing of specimens at 60 mm are applicable to prefabricanted insulation units of greater thicknesses, as well as.

- XPS Insulation products:
    - With lower density, or the density range between those values evaluated in the tests.
    - With bigger thickness
- Integral Protective Finishing
    - With bigger thickness
    - With lower density if its reaction to fire classes is B, C, D or E.
    - With lowest coverage of adhesive
- Components with equal or lower organic content.
- Components with equal or lower PCS_S-value per unit area.
- Components with equal or higher content of the same type of flame retardants.

ANNEX B. DETERMINATION OF HARD BODY IMPACT RESISTANCE OF THERMAL INSULATION BOARD WITH A PROTECTIVE FINISHING

B.1 Scope

Annex A specifies the method of the determination of the impact resistance of the thermal insulation board with a protective finishing.

B.2 Principle

The hard body impact test simulates the impact, resulting from an object accidentally fall against the thermal insulation board with a protective finishing.

The hard body shall be dropped from a height, creating an impact energy, which corresponds with the impact energy released when objects impact against the thermal insulation board with a protective finishing.

The test shall be conducted with reference to safety in use, i.e. verification whether the specimens would prevent an object falling through.

B.3 Apparatus

For safety in use, the hard body impactor shall be a steel ball, with a diameter of 63.5 mm (± 1), with a mass of 1030 g (± 40) (1 kg steel ball).

B.4 Test specimen

Number of test specimens. The number of test specimens is at least three.

Dimensions of the specimens. The test specimens shall be the full individual piece of thermal insulation board with a protective finishing.

Curing and conditioning. The test shall be carried out in normal laboratory conditions (23 ± 2 ºC, 50 ± 5 % HR).

B.5 Test Assembly

- The thermal insulation board with a protective finishing shall be horizontally positioned on supports.
- The most onerous point of impact shall be chosen. It could be in the centre of the specimens.

B.6 Test Procedure

- The test shall be carried out in a horizontal position.
- The hard body impactor with mass (m) shall be dropped from a height (h), so that the total impact energy (E = g x h x m) corresponds with one of hard body impact test (1 kg steel ball): 3 Joules or 10 Joules.
- In most cases g = 9,81 m/s.
- The height (h) is measured between the designated point of impact and the height of release of the hard body impactor.

B.7 Expression of results

The test report shall contain at least the following information:

- no collapse: the test result is favourable when, after the test, the specimen maintains its mechanical integrity and is still capable of carrying its own weight in the tested position;
- no penetration: the test result is favourable when, after the test, the impactor has not passed the test specimen;
- no projection: the test result is favourable when, after the test, the impactor:

- It has not created parts of the specimen to project from the face of the specimen, to cause injury by contact.
- There are no visible (to the naked eye) cracks, depressions, protuberances or any other defects in the materials.
- Deformations, which only affect the appearance, are allowed, but shall be mentioned in the test report.

The diameter and maximum indention after each impact and the residual diameter and indention shall be stated in the ETA (in mm).

It shall be indicated any damage (e.g., localized surface cavities of small dimensions, scratches, wear marks in the form of grooves, cracking, indentation, flaking and/or delamination from the thermal insulation etc.).

For extended application of the test results, the general rule is that test results for the most onerous (minimum thickness) assembly can be used to reflect the behaviour of others.

Recommended areas of usage according to result are given in Table A.7.1.

Table B .7.1 Hard body impact resistance

Result	Use area
Major cracking and/or delamination	Non-trafficable roof
Minor cracking, indentation and/or flaking	Pedestrian access roof only for maintained
No damage to protective finishing	Pedestrian access roof and Green roof / Roof garden

B .8 Test report

The test report shall contain at least the following information:

a. Reference to this procedure.
b. The name of the testing laboratory.
c. Date of testing.
d. A description of the test instruments.
e. A description of the product tested, including designation, dimensions, and any relevant identification characteristic.
f. A description of the specimen tested, and reference to its marking.
g. A description of conditioning and preparation of the specimen.
h. A description of test conditions (temperature and RH).
i. Any damage or perforation detected.

ANNEX C. DETERMINATION OF THE RESISTANCE TO STATIC INDENTATION

C.1 Scope

Annex B specifies the method of the determination of the resistance to static indentation of thermal insulation board with a protective finishing.

C.2 Principle

The resistance to static indentation of the product shall be determined by applying a given static load by means of a steel puncturing tool to the exposed side of the product for a period of 24 hours and investigating whether the test specimen is perforated or not by a visual control.

C.3 Apparatus

A device in accordance with EN 12730 (clause 5.5), to apply the constant loads, according to Table C.3.1, on a steel puncturing tool.

Table C.3.1 Loads

Level of resistance	Loads (N)	Use area
L1	70 ± 1	Non-trafficable roof
L2	150 ± 1	Pedestrian access roof only for maintained
L3	200 ± 1	Pedestrian access
L4	250 ± 1	Green roof / Roof garden

Puncturing tool. A 10 mm diameter steel rod, with a hemispherical end (EN 12730).

C.4 Test specimen

Number of test specimens. The number of test specimens are three.

Dimensions of the specimens. The test specimens shall be the complete individual piece of thermal insulation board with a protective finishing.

Curing and conditioning. The product shall be conditioned at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 % for a period of at least of 28 days.

C.5 Test Procedure

- The test shall be carried out at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 %.
- Position the loading device in a distance of at least 100 mm from the sides of the specimen.
- Place the puncturing tool on the exposed side of the test specimen and connect it to the loading device.
- Apply the load to the steel rod (see Table B.3.1), starting from the minimum load (70 N) and increasing the load until the puncturing tool damages or perforates the specimen.
- Remove the test specimen; examine the installed product visually for perforation and damage.

C.6 Expression of results

Determine whether the test specimen has been perforated or shows any damage by visual examination. The resistance to static indentation (point loading) shall be expressed as the load which has not damaged the protective finishing layer (i.e., penetrated, indented and/or cracked) in three out of three parallel tests. Recommended areas of usage according to result are given in Table B.3.1.

C.7 Test report

The test report shall contain at least the following information:

a. Reference to this procedure.
b. The name of the testing laboratory.
c. Date of testing.
d. A description of the specimen, including dimensions, curing and conditioning.
e. Any damage or perforation detected.
f. All operating details not specified in this procedure, as well as incidents likely to have influenced the results.

ANNEX D. TEST METHOD FOR DETERMINING WATER FLOW THROUGH KITS MADE OF INSULATION BOARDS WITH PROTECTIVE FINISHING

D.1 Scope

Annex C specifies the method for determination of water flow through of a kits made of insulation boards with protective finishing to determinate the drainage factor f (EN ISO 6946).

D.2 Principle

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

D.3 Apparatus

Test frame. A frame able to support a minimum size of 3.6 m x 2.4 m specimen (see figure ~~C~~D.4.1).

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

The spray nozzles shall be set 1.5 m above the specimen surface. The spray pattern and number of nozzles depend on the area of the specimen 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 specimen and 1 m between the two nozzles on each side, is sufficient.

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

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

D.4 Test specimen

The minimum specimen area is 3.6 m x 2.4 m[14] 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 specimen to prevent over spray).

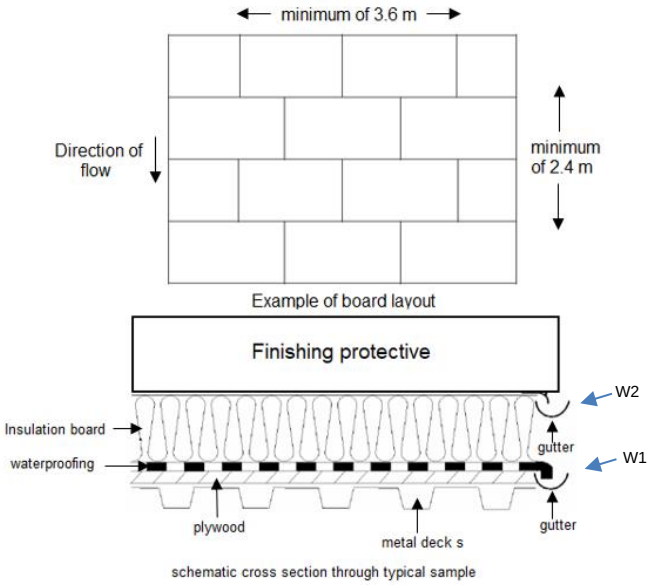

Figure D.4.1 - Example and section of board layout

[14] The minimum size of 3.6 m x 2.4 m applies to the standard board size of 1200 mm x 600 mm. For greater board sizes the area shall be increased accordingly. Figure ~~C~~D.4.1.

The test specimen shall consist of a suitable substrate such as, for example, standard trapezoidal steel deck with a flat plywood substrate attached to the deck. The plywood substrate shall have a waterproofing membrane bonded to it. The membrane shall extend over the substrate and is draped into a gutter. The thermal insulation with the protective finishing shall 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 specimen and draped into a second gutter. If used a water-flow reducing/filter layer shall then loose-laid over the boards and 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 specimen area.

The test shall be carried out on the minimum thickness of thermal insulation and protective finishing.

D.5 Test Procedure

- To prepare for the real measurement, water shall be sprayed onto the roof assembly, until a runoff of water occurs via the gutter from the waterproofing (W1) is at an equilibrium.
- Subsequently the test shall be 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.
- An initial flow rate of 0.5 $l \cdot m^{-2} \cdot min^{-1}$ nominal, at a temperature of 20 ± 5 °C, is used.
- The procedure shall be repeated at flow rates of 0.4, 0.3 and 0.,2 $l \bullet m^{-2} \bullet min^{-1}$ nominal and the resulting flow rates recorded and then again in ascending order back to 0,5 $l \bullet m^{-2} \bullet min^{-1}$.
- The following shall be 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. If the protective finishing is not porous, the run-off into W_2 is from the upper surface of the boards under test.

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

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

- The analysis shall be based on the following assumptions:

  For the **fx** value of 0.04 given in EN ISO 6946 in the worst case: butt jointed[15].

  f (drainage factor) = 1

  x is a constant 0.04 $W \cdot m^{-2} \cdot K^{-1}$.

  Note: 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.

  $x = 4190\ J \cdot kg^{-1} \cdot K^{-1} \times 1000\ kg \cdot m^{-3} \times (0.864/(1000 \times 86400))\ m \cdot s^{-1} = 0.04\ W \cdot m^{-2} \cdot K^{-1}$

  To calculate a lower **f** = drainage factor giving the fraction of precipitation reaching the waterproofing membrane

  $\mathbf{W_{1(ave)} / W_T}$ = average flow from the waterproofing/total flow over the roof

  Therefore: $f = W_{1(ave)} / (W_{1(ave)} + W_{2(ave)})$ or $W_{1(ave)} / WT$

D.6 Test report. The test report shall contain al least include the following information:

a. Reference to this procedure.
b. The name of the testing laboratory.
c. Date of testing.

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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 waterflow 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.