EUROPEAN ASSESSMENT DOCUMENT

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IN-SITU FORMED LOOSE FILL THERMAL AND/OR ACOUSTIC INSULATION PRODUCTS MADE OF VEGETABLE FIBRES

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 Scope of the EAD 4

1.1 Description of the construction product 4

1.2 Information on the intended uses of the construction product 4

1.2.1 Intended uses 4

1.2.2 Working life/Durability 5

2 Essential characteristics and relevant assessment methods and criteria 5

2.1 Essential characteristics of the product 5

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product 6

2.2.1 Reaction to fire 6

2.2.2 Sound absorption 6

2.2.3 Thermal conductivity 7

2.2.4 Water vapour diffusion resistance 7

2.2.5 Biological resistance 7

2.2.6 Water absorption 8

2.2.7 Corrosion developing capacity 8

2.2.8 Settlement 8

2.2.9 Critical moisture content 9

2.2.10 Specific airflow resistivity 9

2.2.11 Hygroscopic sorption properties 9

3 Assessment and verification of constancy of performance 10

3.1 Systems(s) of assessment and verification of constancy of performance to be applied 10

3.2 Tasks of the manufacturer 10

3.3 Tasks of the notified body 11

4 Reference documents 12

Annex A: Determination of the declared thermal conductivity and the mass-related moisture conversion coefficient to high moisture content 13

Annex B: Determination of resistance to mould fungus 16

1 SCOPE OF THE EAD

1.1 Description of the construction product

The construction product consists of vegetable fibres with or without a binding agent, supplied as in-situ formed loose fill vegetable fibres for manual or mechanical installation, hereinafter referred to as thermal insulation product.

The type(s) of vegetable fibres are to be stated in the ETA.

The nature and the amount of the binding agent and additives are to be stated in the ETA.

The products may be treated with a flame retardant.

The vegetable fibres consist of grass, flax, hemp, jute/sisal, paper, recycled paper or untreated chipped wood.

If binding agents, additives or flame retardants are used, they may only consist of the following substances: mineral binding agent (e.g. cement, lime, siliciumdioxid, etc.), potato starch, whey, sodium carbonate, ammonium phosphate, ammonium sulfate, aluminium hydroxide, ferric oxide, urea, calcium chloride, sodium tetraborate (borax)[1] boric acid[1, 2] or disodium octaborate tetrahydrate (polybor)[1] or magnesium sulphate.

The ETA will be issued for the product on the basis of agreed data/information, deposited with the Technical Assessment Body, which identifies the product that has been assessed.

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

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

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

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

1.2 Information on the intended uses of the construction product

1.2.1 Intended uses

Thermal insulation product, to be used in cavities of roofs, walls and floors, between rafters and timber work, supplied as loose fill for manual or mechanical installation.

The assessment of the insulation product only applies if the product is used in structures where it will not be exposed to compression loads, precipitation, wetting or weathering and for construction elements with no contact to water and soil or in constructions with no risk that the critical moisture content will be exceeded.

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1 If the substances sodium tetraborate, boric acid or disodium octaborate tetrahydrate are used the insulation product has to be covered to avoid direct contact with the user of the building.

2 Boric acid is an existing biocidal active substance for which a decision for non-inclusion into Annex I or IA of Directive 98/8/EC has been adopted for Product Type 9 (fibre, leather, rubber and polymerised materials preservatives). Therefore the use of boric acid as a biocide active substance is prohibited for such product types according to Article 4(2) of Regulation (EC) No 2031/2003.

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 thermal insulation product for the intended use of 50 years when installed in the works provided that the thermal insulation product 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.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of thermal insulation product is assessed in relation to the essential characteristics.

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

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	See clause 2.2.1	Class
Basic Works Requirement 3: Hygiene, health and the environment			
2	Biological resistance	See clause 2.2.5	See clause 2.2.5
Basic Works Requirement 5: Protection against noise			
3	Sound absorption	See clause 2.2.2	Level (for sound absorption product only; sound absorption index)
Basic Works Requirement 6: Energy economy and heat retention			
4	Thermal conductivity	See clause 2.2.3	Level
5	Water vapour diffusion resistance	See clause 2.2.4	level (μ)
6	Water absorption	See clause 2.2.6	level (for specific applications only)

[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.

No	Essential characteristic	Assessment method	Type of expression of product performance
7	Corrosion developing capacity	See clause 2.2.7	Level,class,description
8	Settlement / density	See clause 2.2.8	level
9	Critical moisture content	See clause 2.2.9	level
10	Specific airflow resistivity*	See clause 2.2.10	level
11	Hygroscopic sorption properties	See clause 2.2.11	Level,description

* This characteristic also relates to BWR 5

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

For sampling, conditioning and testing (dimensions of the test specimens, minimum number of measurements, specific conditions), EN 15101 shall apply, unless otherwise is specified in the following. The value to be stated for each characteristic has to be representative for the range of density and thicknesses. The test specimens shall be chosen accordingly (number of test specimens, thickness and density of test specimens).

The subject of the references to the required content of the ETA concerning the performance of the product is the method of declaring the product performance. This just applies if the manufacturer wishes to declare such performance.

2.2.1 Reaction to fire

The thermal insulation product 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.

For reaction to fire testing the instructions for mounting and fixing according to EN 15715:2010 using the product specific details for wood fibre products (Tables A.40 and A.41) shall be used. In deviation from the standard EN 15715:2010, Table A.40, minimum and maximum thickness of the insulation product shall be tested.

Note: A final European assessment method of glowing combustion behaviour does not yet exist.

The product shall be classified according to EN 13501-1.

2.2.2 Sound absorption

The determination of the sound absorption coefficient shall be performed according to EN ISO 354. The sound characteristics shall be calculated according to EN ISO 11654, using the values for the sound absorption coefficient α_p, at the frequencies: 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz and the single number value for the weighted sound absorption coefficient α_w.
The obtained values for α_p and α_w shall be rounded to the nearest 0,05 (α_p larger than 1 shall be expressed as $\alpha_p = 1$).

2.2.3 Thermal conductivity

Lambda fractile value at 10 °C, at dry conditions

The determination of the lambda fractile value at 10 °C, at dry conditions ($\lambda_{10,dry,90/90}$), representing at least 90 % of the production with a confidence limit of 90 % shall be carried out in accordance with Annex A, clause 1.

At least 4 measurements shall be performed at a notified testing laboratory.

Mass-related moisture conversion coefficient (fu,1)

The mass-related moisture conversion coefficient ($f_{u,1}$) for the conversion of $\lambda_{10,dry}$ to $\lambda_{23,50}$ shall be determined according to Annex A, clause 2 and stated in the ETA.

Lambda declared at 23 °C and 50 % relative humidity λD(23,50)

The calculation of the lambda declared at 23 °C and 50 % relative humidity shall be carried out in accordance with Annex A, clause 3.

The calculated lambda declared at 23 °C and 50 % relative humidity $\lambda_{D(23,50)}$, representing at least 90 % of the production with a confidence level of 90 %, shall be stated in the ETA.

Mass-related moisture conversion coefficient to high moisture content ($f_{u,2}$)

The determination of the mass-related moisture conversion coefficient to high moisture content ($f_{u,2}$) shall be carried out in accordance with Annex A, clause 4.

The mass-related moisture conversion coefficient to high moisture content ($f_{u,2}$), and the moisture content mass by mass (m/m) at 23 °C and 50 % relative humidity and 23 °C and 80 % relative humidity shall be given in the ETA.

Moisture conversion factor (dry-23/50 and 23/50-23/80)

The moisture conversion factor F_{m1} for the conversion of $\lambda_{10,dry}$ to $\lambda_{23,50}$ and F_{m2} for the conversion of $\lambda_{23/50}$ to $\lambda_{23,80}$ shall be determined in accordance with EN ISO 10456:2010, equation (4).

For insulation product made of hemp, flax, jute and cellulose (made from paper) without mineral binding agent or potato starch the moisture conversion factor F_{m1} = 1,05 and F_{m2} = 1,06 can be used without testing.

The moisture conversion factors Fm1 and Fm2 shall be given in the ETA.

2.2.4 Water vapour diffusion resistance

The determination of the water vapour transmission shall be carried out according to EN 12086:2013. The climate condition according to EN 12086:2013, paragraph 7.1 (A or C), used for testing shall be given in the ETA.

The water vapour resistance factor μ shall be stated in the ETA.

In the absence of measurement, the water vapour resistance factor μ of products made of vegetable fibres without mineral binding agent and with a density less than 115 kg/m³ may be assumed to be between 1 and 4. It shall be stated in the ETA that the most unfavourable factor μ depending on construction has to be used for calculation.

2.2.5 Biological resistance

The determination of the growth of mould fungus shall be carried out according to method A and/or method B:

Method A:

The determination and the expression of results are performed according to Annex B of this EAD.

Method B:

The determination is performed according to EN 15101-1:2013, Annex F.

The results are expressed according to Table 5 of EN 15101-1:2013.

It shall be stated clearly in the ETA to which method the given results apply.

2.2.6 Water absorption

The determination of short term water absorption by partial immersion shall be carried out according to EN 1609 method A.

The water absorption in kg/m² shall be stated in the ETA in levels using steps of 1 kg/m².

2.2.7 Corrosion developing capacity

The corrosion developing capacity on metal construction products shall be assessed according to EN 15101-1, Annex E.

The test result shall be given following EN 15101-1, clause 4.3.5.

2.2.8 Settlement

The settlement depends on the density of the product, the thickness or height of the in-situ formed insulation and the application. Therefore the settlement should be assessed for different densities, at different thicknesses or heights covering the intended use conditions.

2.2.8.1 Settling of loose fill insulation applied in ceilings

a)
In the case of free placing (e. g. on the ceiling or between beams) the characteristics shall be determined following EN 15101-1:2013, Annex B3. Deviating from EN 15101-1:2013 the test shall be performed with 3 test specimens stored at (23 ± 2) °C and (50 ± 5) % relative humidity (without conditioning at 40 °C/90 % r.h.). The density of the specimens shall approximately correspond to the minimum density covering in the ETA.

The settling s_v, of the loose fill insulation shall be stated in the ETA together with the minimum installation density and the maximum thickness to be observed. Equation B.6 of EN 15101-1 is used for calculation.

b)
In the case of subsequent blowing into closed cavities, the characteristics shall be determined according to a). But in this case the insulation material is blown into a closed box.

The settling s_v, of the loose fill insulation shall be stated in the ETA together with the minimum installation density and the maximum thickness to be observed.

2.2.8.2 Settling of loose fill insulation applied in cavities of walls and between rafters

The determination of settlement s_d shall be carried out according to EN 15101:2013, Annex B2. The density of the specimens shall approximately correspond to the minimum density covering by the ETA.

The settling s_d shall be given in the ETA using the class according to EN 15101-1:2013, Table 2, together with the minimum installation density and the maximum thickness to be observed.

2.2.8.3 Settling of loose fill insulation under impact excitation and constant temperature and humidity conditions

The determination of settlement s_D shall be carried out according EN 15101:2013, Annex B3, with specimens representing the density range covered by the ETA.

The settling s_D shall be given in the ETA. The indication of settling s_D is not required if the settling S_{cyc} according to the following clause is given in the ETA.

2.2.8.4 Settling under cyclical temperature and cyclic humidity

The determination of settlement shall be carried out according to EN 15101:2013, Annex B1.

The settling S_{cyc} shall be given in the ETA using the classes according to EN 15101-1:2013, Table 1.

2.2.8.5 Calculating the thermal resistance

The ETA shall include a provision that in case of free placing (e.g. on the ceiling or between beams) a reduced insulation layer thickness for calculating the thermal resistance is to be determined from the installation thickness taking account the settlement.

For this purpose the reduction value in %, determined from the highest value of settlement rounded upwards to the nearest one percent, shall be given in the ETA based on the test results according to 2.2.8.1, 2.2.8.3 and/or 2.2.8.4.

2.2.9 Critical moisture content

Testing and assessing procedures are currently not available for insulation products covered by this EAD. Therefore the value of 75 % shall at present be stated as the critical moisture content.

NOTE: The critical moisture content is required according to the Swedish building regulations.
NOTE: A development of testing and assessing procedures is intended for a future version of this EAD.

The critical moisture content shall be stated in the ETA.

2.2.10 Specific airflow resistivity

The determination of the specific airflow resistivity shall be carried out according to EN 29053 (ISO 9053):1993, method A.

The airflow resistance shall be given in the ETA in levels using steps of 1 kPa·s/m².

NOTE: The specific airflow resistivity is determined for quality control reasons to ensure that the acoustic properties (determined by national test methods) of the building elements incorporating vegetable fibres remain the same.

2.2.11 Hygroscopic sorption properties

The hygroscopic sorption properties shall be carried out according to EN ISO 12571:2013 for the standard humidities nr. 2 to 6 according to table 1 of EN ISO 12571:2013.

The hygroscopic sorption and desorption curves shall be given in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is: Decision 1999/91/EC

The system is: **3**

In addition, with regard to reaction to fire the applicable European legal act is: Decision 2001/596/EC for products covered by this EAD.

The systems are: **1** or **3**

3.2 Tasks of the manufacturer

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

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control		Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control *
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]						
1	Reaction to fire		EN ISO 11925-2	See clause 2.2.1.	1	Once a week
			EN 13823 (for class D or higher)			Once a year
2	Biological resistance (growth of mould fungus)		See clause 2.2.5.	See clause 2.2.5.	See clause 2.2.5.	Once a year
3	Specific airflow resistivity		See clause 2.2.10	See clause 2.2.10	See clause 2.2.10	Once a year
4	Thermal conductivity		See clause 2.2.3	See clause 2.2.3	1	Once a month
5	Water absorption		See clause 2.2.6	See clause 2.2.6	See clause 2.2.6	Quarterly
6	Settlement	Method acc. to clause 2.2.8.1	See clause 2.2.8.1	See clause 2.2.8.1	See clause 2.2.8.1	Twice a week
		Method acc. to Annex B3, EN 15101-1	See clause 2.2.8.3	See clause 2.2.8.3	See clause 2.2.8.3	Semi-yearly
7	Bulk density		See clause 2.2.8.1	See clause 2.2.8.1	See clause 2.2.8.1	Twice a week
8	Hygroscopic sorption properties		See clause 2.2.11	See clause 2.2.11	5	Once a year

* In case of discontinuous production these minimum frequencies should be adapted to an equivalent frequency.

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1 only)*					
1	Reaction to fire**	Presence of suitable test equipment			Annually
		Presence of trained personnel			Annually
		Presence of an appropriate quality assurance system an necessary stipulations			Annually
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1 only)*					
2	Reaction to fire**	Inspection of factory, of the production of the product and of the facilities for factory production control			Annually
		Evaluation of the documents concerning the factory production control			Annually
		Issuing a report of surveillance			Annually

** Only relevant for products of class C and higher

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance, unless a dated reference is given in clause 2.2 of this EAD.

EN ISO 354	Acoustic measurement of sound absorption in a reverberation room
EN 1609	Thermal insulating products for building applications - Determination of short term water absorption by partial immersion
EN ISO 10456	Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values
EN ISO 11654	Sound absorbers for use in buildings - Rating of sound absorption
EN ISO 11925-2	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test
EN 12086	Thermal insulating products for building applications - Determination of water vapour transmission properties
EN 12667	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 ISO 12571	Hygrothermal performance of building materials and products - Determination of hygroscopic sorption properties
EN 12939	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 13501-1	Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests
EN 13823	Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item
EN 15101-1	Thermal insulation products for buildings - In-situ formed loose fill cellulose (LFCI) products - Part 1: Specification for the products before installation;
EN 15715	Thermal insulation products - Instructions for mounting and fixing for reaction to fire testing - Factory made products
ISO/CD 18393	Thermal insulation — Accelerated ageing of thermal insulation materials — Assessment of settlement of loose-fill thermal insulation used in attic and closed cavity applications (*Reference number of working document: ISO/TC 163/SC 1N 354 E)*

ANNEX A: DETERMINATION OF THE DECLARED THERMAL CONDUCTIVITY AND THE MASS-RELATED MOISTURE CONVERSION COEFFICIENT TO HIGH MOISTURE CONTENT

A.1 Determination of the λ fractile value at 10 °C, at dry conditions ($\lambda_{10,dry,90/90}$)

A.1.1 Measurement of the λ_{dry} at 10 °C

A.1.1.1 Test specimens for the determination of the thermal conductivity λ at 10 °C shall be conditioned to dryness after storage for at least 72 hours at (70 ± 2) °C in an oven ventilated with air taken at (23 ± 2) °C and (50 ± 5) % relative humidity.

A.1.1.2 The thermal conductivity of the test specimens conditioned according to A.1.1.1 shall be measured according to EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3) °C.
During the measurement, precaution shall be taken to avoid moisture absorption by the specimen. It is acceptable, for instance, to put the test specimen into a thin plastic bag.

A.1.2 Calculation of the λ fractile value at 10 °C, at dry conditions ($\lambda_{10,dry,90/90}$)

A.1.2.1 The λ fractile at 10 °C, at dry conditions ($\lambda_{10,dry,90/90}$) representing at least 90 % of the production with a confidence limit of 90 % shall be calculated using the principles as detailed in EN 13162:2013 Annex A. It shall be noted that the λ_D shall be calculated in accordance with A.3.

A.2 Determination of the mass-related moisture conversion coefficient ($f_{u,1}$)

For the determination of the mass-related moisture conversion coefficient $f_{u,1}$, two sets of measurements are needed.

Set 1
At least three measurements on dry test specimens, to determine $\lambda_{10,dry}$ and u_{dry} (moisture content mass by mass).

Set 2
At least three)measurements on test specimens conditioned at
(23 ± 2) °C and (50 ± 5) % relative humidity, to determine $\lambda_{10,(23,50)}$ and $u_{23,50}$ (moisture content mass by mass).

A.2.1 Procedure

A.2.1.1 Set 1

A.2.1.1.1 Dry the test specimens following the procedure in A.1.1.1.

A.2.1.1.2 Determine for each test specimen the mass in dry condition. Average the values to determine the m_{dry}. The u_{dry}, being the moisture content in dry condition, is by definition set to 0.

A.2.1.1.3 Determine for each test specimen the λ value at 10 °C following the procedure in A.1.1.2. Average the values to determine the $\lambda_{10,dry}$.

A.2.1.2 Set 2

A.2.1.2.1 Condition the test specimens at (23 ± 2) °C and (50 ± 5) % relative humidity following the procedures detailed in EN 13171:2013, clause 5.2, step 2.

A.2.1.2.2 Determine for each test specimen the mass at (23 ± 2) °C and (50 ± 5) % relative humidity. Average the values to determine the mass at 23 °C and 50 % relative humidity as $m_{23,50}$.

A.2.1.2.3 Calculate $u_{23,50}$ by the following formula:

$$u_{23,50} = \frac{m_{23,50} - m_{dry}}{m_{dry}}$$

where,

$m_{23,50}$ is the mass at 23 °C and 50 % relative humidity according to A.2.1.2.2
m_{dry} is the mass according to A.2.1.1.2

A.2.1.2.4 Determine for each test specimen conditioned according to A.2.1.2.1 the λ value in accordance with EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3) °C.
Average the values to determine $\lambda_{10,(23,50)}$.

A.2.1.3 Calculation of the mass-related moisture conversion coefficient ($f_{u,1}$)
The mass-related moisture conversion coefficient $f_{u,1}$ shall be calculated by the following formula (derived from ISO 10456:2010, formula 4):

$$f_{u,1} = \frac{\ln \frac{\lambda_{10,(23,50)}}{\lambda_{10,dry}}}{u_{23,50} - u_{dry}}$$

where,

$\lambda_{10,(23,50)}$ is determined according to A.2.1.2.4;
$\lambda_{10,dry}$ is determined according to A.2.1.1.3;
$u_{23,50}$ is determined according to A.2.1.2.3;
u_{dry} is determined according to A.2.1.1.2 and is defined to be 0.

A.3 Calculation of the declared thermal conductivity λ_D

The declared thermal conductivity λ_D shall be calculated using the following formula:

$$\lambda_{(23,50)} = \lambda_{10,dry,90/90} * e^{f_{u,1}(u_{23,50} - u_{dry})}$$

where,

$\lambda_{10,dry,90/90}$ is determined according to A.1.2;

$f_{u,1}$ is determined according to A.2.1.3;
$u_{23,50}$ is determined according to A.2.1.2.3;
u_{dry} is determined according to A.2.1.1.2 and is defined to be 0.

The calculated value $\lambda_{(23/50)}$ shall be rounded upwards to the nearest 0,001W/(m·K) and declared as $\lambda_{D(23,50)}$.

A.4 Determination of the mass-related moisture conversion coefficient ($f_{u,2}$) to high moisture content

For the determination of the mass-related moisture conversion coefficient to high moisture content $f_{u,2}$, two sets of measurements are needed.

Set 1
At least three measurements on test specimens conditioned at
(23 ± 2) °C and (50 ± 5) % relative humidity, to determine $\lambda_{10,(23,50)}$ and $u_{23,50}$ (moisture content mass by mass).

Set 2
At least three measurements on test specimens conditioned at
(23 ± 2) °C and (80 ± 5) % relative humidity, to determine $\lambda_{10,(23,80)}$ and $u_{23,80}$ (moisture content mass by mass).

A.4.1 Procedure

A.4.1.1 Set 1

Determine the $\lambda_{10,(23,50)}$ and $u_{23,50}$ in accordance with A.2.1.2

A.4.1.2 Set 2

A.4.1.2.1 Condition the test specimens at (23 ± 2) °C and (80 ± 5) % relative humidity following the procedures detailed in EN 13171:2013, clause 5.2, step 2.

A.4.1.2.2 Determine for each test specimen the mass at (23 ± 2) °C and (80 ± 5) % relative humidity. Average the values to determine the mass at 23 °C and 80 % relative humidity as $m_{23,80}$.

A.4.1.2.3 Calculate $u_{23,80}$ by the following formula:

$$u_{23,80} = \frac{m_{23,80} - m_{dry}}{m_{dry}}$$

where,

$m_{23,80}$ is the mass at 23 °C and 80 % relative humidity according to A.4.1.2.2

m_{dry} is the mass according to A.2.1.1.2

A.4.1.2.4 Determine for each test specimen conditioned according A.4.1.2.1 the λ value in accordance with EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3) °C.

Average the values to determine $\lambda_{10,(23,80)}$.

A.4.1.3 Calculation of the mass-related moisture conversion factor to high moisture content ($f_{u,2}$)

The mass-related moisture conversion coefficient to high moisture content $f_{u,2}$ shall be calculated by the following formula (derived from ISO 10456:2010, formula 4):

$$f_{u,2} = \frac{\ln \frac{\lambda_{10,(23,80)}}{\lambda_{10,(23,50)}}}{u_{23,80} - u_{23,50}}$$

where,

$\lambda_{10,(23,80)}$ is determined according to A.4.1.2.4;

$\lambda_{10,(23,50)}$ is determined according to A.2.1.2;

$u_{23,80}$ is determined according to A.4.1.2.3;

$u_{23,50}$ is determined according to A.2.1.2.

Note 1: *For the determination of the mass-related moisture conversion coefficient $f_{u,1}$ and the mass-related moisture conversion coefficient to high moisture content $f_{u,2}$, the test specimens shall be taken from the same production run.*

Note 2: *Thermal conductivity may also be measured at mean temperatures other than 10 °C, providing that the accuracy of the relationship between the temperature and thermal properties is well documented.*

ANNEX B: DETERMINATION OF RESISTANCE TO MOULD FUNGUS

Resistance to mould fungus

Note: *The determination method is taken from the Austrian Standard ÖNORM B 6010, clause 3.22.*

B.1 Principle

A test specimen is exposed for a defined period of time at a constant temperature to a high moisture climate.

After this period of time the test specimen is visually inspected for the presence of mould fungus.

B.2 Apparatus

B.2.1 Desiccator, of sufficient size, that can contain a cage of wire according to B.2.2.

B.2.2 Cage made of stainless steel with an internal volume of approx. 0,05 litres.

Cage A, for large fibres, with a mesh size of 10 mm x 10 mm and a wire thickness of 0,4 mm.

Cage B, for small fibres, with a mesh size of 1 mm x 1 mm and a wire thickness of 0,25 mm.

B.3 Testing conditions

The exposure shall be performed at a constant temperature of (23 ± 2) °C.

Note: *This constant temperature is necessary to avoid any condensation during the exposure period.*

B.4 Sample preparation for loose fill materials

The loose fill material shall be put in either cage A or cage B, depending to the fibre length.

Care shall be taken that the density in the cage is the declared bulk density.

B.5 Procedure

- The desiccator is filled at the bottom with water;
- The sample is then put in the desiccator, taking care that no part of the sample can come into contact with the water;
- The desiccator is then closed tightly and put in the temperature-conditioned room for a period of four weeks;
- After four weeks the desiccator is opened and the sample visually inspected on the presence of mould fungus according to EN ISO 846 clause 9.1.

B.6 Expression of results

The presence of mould fungus is expressed in classes of intensity of growth according to Table 4 of EN ISO 846:1997.