EUROPEAN ASSESSMENT DOCUMENT

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LOW LAMBDA COMPOSITE BOARDS MADE OF MINERAL WOOL FIBRES AND AEROGEL ADDITIVES

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The board is a composite material with an aerogel additive which is providing the thermal performance. The composite consists of mineral wool fibres, an aerogel based low thermal conductivity material, an - optional – additive to enhance the fire properties of the board and a binder compressed to its final thickness, and are produced as flat boards.

The product is defined by the geometry, flatness, density and squareness.

The product is not fully covered by harmonised European standard (hEN) 13162.

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 use(s) of the construction product

1.2.1 Intended use(s)

The board is an insulation board with high thermal insulation properties. The main intended use is energy renovation of existing houses by an internal insulation as described below.

Internal insulation

In this application the thermal insulation is situated on the internal side of the building envelope.

The insulation shall be installed as internal insulation in two different systems with a construction of wood or steel battens and plaster board as covering or with a rendering applied directly to the board.

In one system the boards will be installed between battens, which are fixed to the walls by screws. The finishing to the room will be done by plasterboards.

In another system the slabs will be glued to the substrate and additionally fixed with dowels. The board is fixed to the substrate with a thick mortar. On the room-side a render including a mesh will be applied to the surface of the insulation. The render on the room-side shall have a defined vapour permeability. For this system the insulation has to be able to be glued to the substrate and carry the render on the room-side.

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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 low lambda insulation boards for the intended use of 50 years when installed in the. 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[1].

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 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 above.

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2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of low lambda composite boards is established 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	Expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
2	Continuous glowing combustion	2.2.2	Level
Basic Works Requirement 3: Hygiene, health and the environment			
34	Water vapour permeability - Water vapour transmission	2.2.14	Level
4	Water absorption	2.2.15	Level
Basic Works Requirement 4: Safety and accessibility in use			
5	Compressive stress or compressive strength	2.2.8	Level
6	Compressive creep for boards exposed to compression loads	2.2.9	Level
7	Bending strength	2.2.18	Level
8	Behaviour under point load for boards exposed to compression loads	2.2.10	Level
9	Dimensional stability under specified temperature and humidity	2.2.11	Level
10	Tensile strength perpendicular to faces	2.2.12	Level
11	Shear strength and shear modulus of elasticity of the composite product for use with rendering	2.2.13	Level
13	Dimensional stability under specified temperature and humidity	2.2.12	Level
Basic Works Requirement 5: Protection against noise			
14	Sound absorption	2.2.16	Level
15	Airflow resistivity	2.2.17	Level
Basic Works Requirement 6: Energy economy and heat retention			
16	Thermal conductivity	2.2.7	Level
17	Thickness	2.2.4	Level

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

The assessment of the performances of the product in relation to the essential characteristics as stated below shall be done using a product identified according to the identification parameters given in Annex A.

The basic product is a variation of a mineral wool board covered by EN 13162:2009, and is manufactured with up to ~60 % additives and in a special process to obtain a low lambda board. It thus falls outside the traditional view of mineral and beyond the normal specifications, both in relation to raw materials and performance, addressed in EN 13162.

2.2.1 Reaction to fire

The low lambda composite boards 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 mounting and fixing the board, the provisions in EN 15715 shall be applied.

The product is classified according to EN 13501-1.

2.2.2 Continuous glowing combustion

The low lambda composite boards shall be tested in accordance with EN 16733.

The test results and assessment are expressed in accordance with Clauses 10, 11 and 12 of EN 16733 and stated in the ETA.

2.2.3 Length and width

Length, l, and width, b, shall be determined in accordance with EN 822.

No test result shall deviate from the nominal length and width by more than the tolerances, depending from the stated class.

Tolerances for length and width:

- ± 2 % for length
- ± 1,5 % for width

2.2.4 Thickness

The thickness, d, shall be determined in accordance with the principles of method described in EN 823 with a load of 250 Pa.

The deviation from the nominal thickness, dN, shall not exceed the nominal thickness by more than the tolerances given in table 1 in section 4.2.3 in EN 13162:2009.

2.2.5 Squareness

The squareness shall be determined in accordance with the principles of method described in EN 824.

The deviation from squareness, S_b, in mm/m shall be stated in the ETA.

2.2.6 Flatness

The flatness shall be determined in accordance with the principles of method described in EN 825.

The deviation from flatness in mm / m shall be stated in the ETA.

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2.2.7 Thermal conductivity

The thermal conductivity shall be determined in accordance with the principles of method described in EN 12667 with simultaneous consideration of EN 13162:2009, clause 4.2.1.

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

For hygroscopic materials the verification shall take into account the influence of the moisture content of the boards as defined in Annex A.

The thermal conductivity mentioned above shall be given in the ETA.

2.2.8 Compressive stress or compressive strength

The compressive strength at 10% deformation or compressive stress shall be determined in accordance with the principles of method described in EN 826.

The compressive strength at 10% deformation or compressive stress shall be stated in levels, no result of compressive strength at 10% deformation or compressive stress shall be lower than the stated level.

Table of levels for compressive stress or compressive strength:

Level	Requirement [kPa]
CS(10/Y)20	≥ 20
CS(10/Y)30	≥ 30
CS(10/Y)50	≥ 50
CS(10/Y)70	≥ 70
CS(10/Y)100	≥ 100
CS(10/Y)150	≥ 150
CS(10/Y)200	≥ 200
CS(10/Y)300	≥ 300
CS(10/Y)500	≥ 500
CS(10/Y)1000	≥ 1000
CS(10/Y)2000	≥ 2000

2.2.9 Compressive creep (for boards exposed to compression loads only)

The compressive creep for boards exposed to compression loads shall be determined in accordance with the principles of method described in EN 1606.

The compressive creep, Xct, and the total thickness reduction, Xt, shall be determined after at least 122 days based on test results of the compressive strength at 10% deformation or compressive stress with 3 test specimens of a minimum area 300 mm x 300 mm.

NOTE: The load that was used during the testing shall be indicated in the ETA.

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2.2.10 Behaviour under point load (for boards exposed to compression loads only)

The point load, Fp, at 5 mm deformation shall be determined in accordance with the principles of method described in EN 12430.

NOTE: *The deformation of 5mm is the preferred deformation. Other deformations can be agreed between the applicant and the assessment body. The deformation that was used during the testing shall be indicated in the ETA.*

The point load Fp at 5 mm deformation shall be tested with 3 test specimens 300mm x 300mm. No test result shall be less than the stated level.

2.2.11 Dimensional stability

NOTE: The test conditions that are given in this clause are the preferred ones. Other test conditions can be agreed between the applicant and the assessment body. The test conditions that were used during the testing shall be indicated in the ETA.

Dimensional stability under specified temperature and humidity

The dimensional stability under specified temperature and humidity conditions shall be determined in accordance with EN 1604 under the following conditions:

The test shall be carried out after storage for 48 H exposure at (23±2)°C and (90 ±5) % relative humidity.

The relative reduction in thickness, $\Delta\varepsilon_d$ shall not exceed 1 mm.

2.2.12 Tensile strength perpendicular to the faces

The tensile test perpendicular to the faces shall be determined in accordance with the principles of method described in EN 1607.

The value shall be stated in accordance with EN 13162. During testing no single value shall be lower than the stated value.

2.2.13 Shear strength and shear modulus of elasticity of the board for use with rendering

The shear strength and shear modulus of elasticity of the board shall be determined in accordance with the principles of method described in EN 12090.

The value shall be stated in accordance with EN 13162. During testing no single value shall be lower than the stated value.

2.2.14 Water vapour transmission

Water vapour transmission properties of the board shall be determined in accordance with EN 12086 and stated as the water vapour diffusion resistance factor, μ for homogeneous products and as the water vapour resistance, *Z*, for faced or non-homogeneous products.

No test result of μ shall be greater than the stated value and no test result of *Z* shall be less than the stated value.

2.2.15 Water absorption

The Short-term water absorption by partial immersion, *W*p, shall be determined in accordance with EN 1609, method A.

No test result shall exceed the stated level.

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2.2.16 Sound absorption

Sound absorption coefficient shall be determined in accordance with EN ISO 354. The sound absorption characteristics shall be calculated in accordance with EN ISO 11654 using the values for the practical 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. α_p and α_w shall be rounded to the nearest 0,05 (α_p larger than 1 shall be expressed as α_p = 1) and stated in levels with steps of 0,05.

No result of α_p and α_w shall be lower than the stated level.

2.2.17 Air flow resistivity

in accordance with EN 29053. The value of air flow resistivity shall be stated in levels with steps of 1 kPa×s/m^2.

No test result shall be lower than the stated value

2.2.18 Bending strength

The bending strength, σ_b, shall be determined in accordance with EN 12089, method A.

The bending strength shall be stated in the ETA.

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3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

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

For the products covered by this EAD the applicable European legal act is Decision 1999/91/EC as amended by 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 systems regarding reaction to fire are 1, or 3, or 4 depending on the conditions defined in the said Decision.

3.2 Tasks of the manufacturer

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

Table 2 Control plan for the manufacturer; corner stones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2 or 3.4)*	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*			
1	Thermal resistance / conductivity	EN 12667 or EN 12939	once per day or once per 3 months and indirect testing once per 2 h
2	Dimensions (length and width)	EN 822	once per 2 h
3	Thickness	EN 823	once per 2 h
4	Squareness	EN 824	once per 2 h
5	Flatness	EN 825	once per day
6	Apparent Density	EN 1602	once per 2 h
7	Compressive stress	EN 826	once per 8 h and indirect testing
8	Tensile strength where relevant	EN 1607	once per day
9	Bending strength	EN 12089	once per day
10	Shear strength where relevant	EN 12090	once per day
11	Water absorption	EN 1609	once per month and indirect testing
12	Reaction to fire (class E)	EN 11925-2	once per week, or [1)]
	Reaction to fire (class B,C or D)	EN 13823 and EN 11925-2	once per two years, and indirect testing [2)]
	Reaction to fire (class A2) [3)]	EN ISO 1182 or EN ISO 1716 and EN 13823	once per two years, and indirect testing [2)]
	Reaction to fire (class A1)	EN ISO 1182 and EN ISO 1716 (and EN 13823)	once per two years, and indirect testing [2)]

1) once per two years and indirect testing in accordance to the manufactures methods once per day, whereat Indirect testing is only possible in the case of products falling within the system 1 for attestation of conformity of reaction to fire, or by having a notified body verifying the correlation to the direct testing

2) once per day loss ignition and once per four hour weight per unit area

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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 for low lambda composite boards are laid down in Table 3.

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for products for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material).

In this case the cornerstones of the tasks to be undertaken by the notified body under AVCP system 1 are laid down in Table 3.

Table 3: Tasks for the notified body;

Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	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				
Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants.	As defined in clause 2.2.1 of the EAD	As defined in clause 2.2.1 of the EAD	As defined in clause 2.2.1 of the EAD	When starting the production
Continuous surveillance, assessment and evaluation of factory production control				
Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardants.	As defined in clause 2.2.1 of the EAD	As defined in clause 2.2.1 of the EAD	As defined in clause 2.2.1 of the EAD	2 times per year

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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.

EN 822	Thermal insulating products for building applications - Determination of length and width
EN 823	Thermal insulating products for building applications - Determination of thickness
EN 824	Thermal insulating products for building applications - Determination of squareness
EN 825	Thermal insulating products for building applications - Determination of flatness
EN 826	Thermal insulating products for building applications - Determination of compression behaviour
EN 1602	Thermal insulating products for building applications - Determination of the apparent density
EN 1604	Thermal insulating products for building applications - Determination of dimensional stability under specified temperature and humidity conditions
EN 1605	Thermal insulating products for building applications - Determination of deformation under specified compressive load and temperature conditions
EN 1606	Thermal insulating products for building applications — Determination of compressive creep
EN 1607	Thermal insulating products for building applications - Determination of tensile strength perpendicular to faces
EN 11925-2	Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test
EN 12089	*Thermal insulating products for building applications — Determination of bending behaviour*
EN 12090	Thermal insulation products for building applications – Determination of shear behaviour
EN 12430	Thermal insulating products for building applications — Determination of behaviour under point load
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 13162	Thermal insulation products for buildings – Factory-made products of mineral wool (MW) – Specification
EN 13501-1	Fire classification of construction products and building elements - Part 1: Classification using test data from fire 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 15715	Thermal insulation products - Instructions for mounting and fixing for reaction to fire testing - Factory made products
EN 29053	Acoustics - Materials for acoustical applications - Determination of airflow resistance
EN 16733	Reaction to fire tests for building products – Determination of a building product's propensity to undergo continuous smouldering

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ANNEX A DETERMINATION OF THE STATED THERMAL CONDUCTIVITY AND THE CONVERSION FACTOR TO MOISTURE CONTENT

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

Tests and calculation of the thermal conductivity shall be done in accordance with EN 13162:2008, clause 4.2.1 with possible additions on hygroscopic materials according to EN ISO 10456.

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

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.

1.1.2 The thermal conductivity of the test specimens conditioned according to above 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.

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

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

2 Determination of the moisture conversion factor ($f_{u,1}$)

For the determination of the moisture conversion factor $f_{u,1}$, two sets of measurements are needed.

2.1 Set 1

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

Procedure Set 1

- Dry the three specimens following the procedure in 1.1.1.
- Determine for each test specimen the mass in dry condition. Average the three values to determine the m_{dry}.
- The u_{dry}, being the moisture content in dry condition, is by definition set to 0.
- Determine for each test specimen the λ value at 10°C following the procedure in 1.1.2. Average the three values to determine the $\lambda_{10,dry}$.

2.2 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).

Procedure Set 2

- Condition the three test specimens at (23 ± 2)°C and (50 ± 5)% relative humidity following the procedures detailed in EN 13169 clause 5.2, step 2.
- Determine for each test specimen the mass at (23 ± 2)°C and (50 ± 5)% relative humidity. Average the three values to determine the mass at 23°C and 50% relative humidity as $m_{23,50}$. Calculate $u_{23,50}$ by the following formula (A.1)

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

where,

$m_{23,50}$ (Average) is the mass at 23°C and 50% relative humidity
m_{dry} (Average) is the mass according to *clause 2, Procedure Set 1*

Determine for each test specimen 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 three values to determine $\lambda_{10,(23,50)}$.

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Conditioning of the specimen should be done according to the procedures detailed in EN 13169 clause 5.2, step 2.

2.3 Calculation of the moisture conversion factor ($f_{u,1}$)

The moisture conversion factor $f_{u,1}$ shall be calculated by the formula (A.2), derived from ISO 10456, formula 4:

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

where,

$\lambda_{10,(23,50)}$ (Average)
$\lambda_{10,dry}$ (Average) according to *clause 2.1, Procedure Set 1;*
$u_{23,50}$ is determined according to formula A.1;
u_{dry} is described in *clause 2.1, Procedure Set 1* and is defined to be 0.

3 Calculation of the stated thermal conductivity λ_D

The stated thermal conductivity λ_D shall be calculated using the following formula (A.3):

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

where,
$\lambda_{10,dry,90/90}$ is determined according to *clause 2.1*;
$f_{u,1}$ is determined according to *formula A.2*;
$u_{23,50}$ is determined according to *formula A.1*;
u_{dry} is determined according to *clause 2.1, Procedure Set 1* and is defined to be 0.

The calculated value $\lambda_{10(23/50)}$ shall be rounded upwards to the nearest 0,001W/(m.K) and stated as $\lambda_{D(23,50)}$.

4 Determination of the conversion factor ($f_{u,2}$) to high moisture content

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

4.1 Set 1

At least two 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).

Procedure Set 1
- Determine the $\lambda_{10,(23,50)}$ and $u_{23,50}$ in accordance with formula B.3

4.2 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).

Procedure Set 2
- Condition the three test specimens at (23 ± 2)°C and (80 ± 5)% relative humidity following the procedures detailed in EN 13169 clause 5.2, step 2.
- Determine for each test specimen the mass at (23 ± 2)°C and (80 ± 5)% relative humidity. Average the three values to determine the mass at 23°C and 80% relative humidity as $m_{23,80}$.
- Calculate $u_{23,80}$ by the following formula A.4:

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

where,

$m_{23,80}$ (Average) is the mass at 23°C and 80% relative humidity according to *clause 4.2*
m_{dry} is the mass according to clause *2, Procedure Set 1*

Determine for each test specimen conditioned according B.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 three values to determine $\lambda_{10,(23,80)}$.

4.3 Calculation of the conversion factor to high moisture content ($f_{u,2}$)

The conversion factor to high moisture content $f_{u,2}$ shall be calculated by the formula A.5, derived from ISO 10456, formula 4:

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

where,

$\lambda_{10,(23,80)}$ (Average);
$\lambda_{10,(23,50)}$ is determined according to *formula A.3*;
$u_{23,80}$ is determined according to *formula A.4*
$u_{23,50}$ is determined according to *formula A.1*

NOTE 1: For the determination of the moisture conversion factor $f_{u,1}$ and the conversion factor 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.

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