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## EAD 040011-01-1201

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European Assessment Document for

# Vacuum insulation panels with factory-applied protection layers

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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) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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## 1 SCOPE OF THE EAD

#### **1.1** Description of the construction product

The construction product is a thermal insulation board consisting of a vacuum insulation panel (VIP) with optional factory-applied protection layers (in the following referred to as "thermal insulation board").

The VIP is made of an evacuated core of pressed fumed silica and a multilayer high barrier foil. The core is sealed in the high barrier foil under vacuum.

The protection layers (consisting of expanded or extruded polystyrene, polyurethane foam, high pressure laminate, rubber, aluminium, glass-fibre reinforced plastics, glass-fibre reinforced lightweight concrete, plywood, mineral wool, wood wool / wood chips, wood fibre boards, vegetable or animal fibres, cork, pressed perlite or thin flexible polyolefin roofing membranes with inlaid glass-fibre matting) are glued on the top and / or on the bottom side of the VIP (forming a composite product) and provide protection against mechanical damage depending on the intended use. There are no protective layers on the side edges of the VIP.



Figure 1.1.1: Example of the thermal insulation board with (optional) additional protection layers (e.g., 15 mm polyurethane foam)

The product is not covered by a harmonised European standard (hEN) and is not fully covered by EAD 040011-00-1201 because this EAD 040011-01-1201 includes additional essential characteristics (internal pressure, propensity to undergo continuous smouldering, air permeability and tensile strength of the multi-layer high barrier foil) in comparison to the typical European standards for thermal insulation products and in the EAD 040011-00-1201.

Furthermore, some of the given test and assessment methods deviate from the (usual) methods contained in harmonised standards for thermal insulation products (e.g., assessment on thermal conductivity takes into account the ageing and the edge transmittance, and provisions for conditioning and test specimens are more specific).

EN 17140 also applies to vacuum insulation panel (VIP) and contains similar test methods, but it does not provide a basis for drawing up a Declaration of Performance and for CE marking of the products as it is not a harmonised standard.

Furthermore, the product is also not fully covered by EN 17140 because this European standard does not apply to products with protection layers (see EN 17140, clause 1). and does not contain the essential characteristics "resistance to tearing" and "puncture resistance" regarding the multilayer high barrierfoil of the VIP. For other characteristics, the provisions for testing and assessment given in EN 17140 are incomplete, e.g., the rules for the application of test results for reaction to fire are missing in the standard and has therefore been introduced in this EAD. Regarding the content, emission and/or release of dangerous substances EN 17140 contains the determination of SVOC and VOC, but not the determination of the content of PAH, N-Nitrosamine and HBCDD.

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 thermal insulation board is used for insulation of roofs, walls, floors and doors in buildings.

This EAD covers situations when the undamaged product is used in structures where it is protected from wetting, weathering, precipitation, sunlight and against damage by suitable constructional arrangements. Furthermore, the assessment of the product only applies if the manufacturer's product installation instructions (MPII) have been observed.

#### 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 board for the intended use of 25 years when installed in the works (provided that the 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<sup>1</sup>.

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.

<sup>&</sup>lt;sup>1</sup> 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.

### 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

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

## 2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of thermal insulation board 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 expressio product performance performac		Type of expression of product performance
	Basic Works Require	ement 2: Safety in case of fir	е
1	Reaction to fire	2.2.1	Class
2	Propensity to undergo continuous smouldering	2.2.2	Description
3	Content emission and/or release of dangerous substances	2.2.3	Description/Level
	Basic Works Requirement 6	: Energy economy and heat	retention
4	Thermal conductivity	2.2.4	Level
5	Deviation from thickness	2.2.5	Level
6	Deviation from squareness	2.2.6	Level
7	Deviation from flatness	2.2.7	Level
8	Deviation from length and width	2.2.8	Level
9	Compressive strength/stress at 10 % deformation	2.2.9	Level
10	Dimensional stability under specified temperature and humidity	2.2.10	Level
11	Deformation under specified load and temperature	2.2.11	Level
12	Tensile strength of the multilayer high barrier foil of the VIP	2.2.12	Level
13	Tensile strength perpendicular to the faces of the thermal insulation boards	2.2.13	Level
14	Behaviour under point load	2.2.14	Level
15	Shear strength of the thermal insulation boards	2.2.15	Level
16	Resistance to tearing	2.2.16	Level
17	Puncture resistance	2.2.17	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.

The assessment methods as provided for in this EAD are based on the assumption that the insulation boards have not been damaged, neither during transport or installation (e.g., by cutting or drilling), and that they have been protected from humidity, weathering, and sunlight, that the substrate is sufficiently flat, and that they are protected against damage during the working life by suitable constructional arrangements.

The tests and assessments shall be performed on the thermal insulation board unless otherwise stated in the following. For some essential characteristics of the product, VIP without the protection layers is decisive for testing. All tests shall be carried out on undamaged VIPs or thermal insulation boards (the test specimens cannot get cut out from the VIP or thermal insulation board) because the characteristics of the product can change if the vacuum of the VIP is damaged.

The protection layers shall be described in the European Technical Assessment (ETA) concerning material type, apparent density or mass per unit area, geometry or thickness and, if possible, the relevant harmonised specification (e.g., EN standard).

The test specimens shall be chosen to cover the dimensions, density and thickness range of the product as to be covered by the ETA.

The following information shall be given in the ETA:

- minimum and maximum value of the density of the VIP (including the multilayer high barrier foil) in kg/m<sup>3</sup>,
- minimum value of the mass per unit area of the multilayer high barrier foil in kg/m<sup>2</sup>,
- the maximum value of the mass per unit area of the multilayer high barrier foil can be given additionally in the ETA.

#### 2.2.1 Reaction to fire

The thermal insulation boards (including protection layers, where relevant) shall be tested, using the test method(s) according to EN 13501-1 and relevant for the corresponding reaction to fire class. The product shall be classified according to Commission Delegated Regulation (EU) No 2016/364 in connection with EN 13501-1.

For mounting and fixing, Annex C shall be applied which widely complies with Annex H of EN 17140 (only regarding products without protective layers), but additionally contains provisions for the tests of products with factory-applied protection layers (composite products) as well as rules for the application of results from the corresponding reaction to fire tests for both types of the thermal insulation boards (without as well as with protection layers).

The reaction to fire class(es) shall be given in the ETA together with those conditions for which the classification is valid (see parameters addressed in Annex C).

#### 2.2.2 Propensity to undergo continuous smouldering

#### 2.2.2.1 Thermal insulation boards without protective layers

The propensity to undergo continuous smouldering of thermal insulation boards without protective layers shall be tested and assessed in accordance with EN 16733. The provisions of EN 17140, clause 5.2.2,

shall apply for the conditions and parameters which shall be considered within the tests as well as for the extended application of the test results.

The ETA shall specify the results of testing and assessment in accordance with EN 16733, clause 11, in combination with the provisions of EN 17140, clause 4.2.2, together with those conditions and parameters (see clause 5.2.2 of EN 17140) for which the assessment is valid.

2.2.2.2 Thermal insulation boards with protective layers

One of the following options shall be used for the assessment:

a) Testing of the protective layer and the unprotected vacuum insulation core separately as basis for the assessment of the entire thermal insulation board

The propensity to undergo continuous smouldering of a thermal insulation board shall be tested and assessed in accordance with EN 16733. For that, the assessment of the propensity to undergo continuous smouldering shall be carried out by means of the assessment of the propensity to undergo continuous smouldering of the aforementioned protective layer materials as well as of the unprotected vacuum insulation core separately. It is considered as representative for this essential characteristic for such composite products.

The conditions and parameters which shall be considered within the tests of the protective layers as well as the extended application rules for the test results are specified in Annex D.

Note: In case a Declaration of Performance has been drawn up for the protective layer and a performance is indicated for the propensity to undergo continuous smouldering, no retesting or reassessment is necessary.

For testing and assessment of the unprotected vacuum insulation core, the provisions of clause 2.2.2.1 shall apply.

In accordance with EN 16733, clause 11, the ETA shall specify the following information:

Table 2.2.2.1 Information to be given in the ETA regarding propensity to undergo continuous smouldering

Performance according to EN 16733, clause 11, of the protective layer material as given in its own Declaration of Performance or af- ter testing and/or performance of the unpro- tected vacuum insulation core	Description of the performance of the com- posite complete thermal insulation board re- garding the characteristic Propensity to un- dergo continuous smouldering to be stated in the ETA
The protective layer material and the unpro- tected vacuum insulation core do not show pro- pensity to undergo continuous smouldering (NoS)	The thermal insulation board does not show pro- pensity to undergo continuous smouldering
The protective layer material and/or the unpro- tected vacuum insulation core shows propensity to undergo continuous smouldering (S)	The thermal insulation board shows propensity to undergo continuous smouldering
Assessment of the propensity for continuous smouldering combustion is not possible (ANP)	Assessment of the propensity to undergo contin- uous smouldering is not possible

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b) Testing of composite specimens made of VIP with protective layer(s)

If it is not possible to test the relevant protective layer material(s) separately, 2-layer-composite specimens of the vacuum insulation panel with protective layers shall be tested. In this case, the specimens shall consider the lowest and the highest testable thickness of the thermal insulation board as to be covered by the ETA. Regarding the protective layer of these specimens, the provisions of Annex D apply analogously. Regarding the vacuum insulation core panel, the provisions of clause 2.2.2.1 shall apply.

Testing of such 2-layer-composite specimens shall be performed with flame exposure of the protective layer and with flame exposure of the unprotected rear of the vacuum insulation panel. The results of these tests are also valid for 3-layer-composite insulation panels with

- the same type of protective layers on both surfaces of the vacuum insulation panels, or
- the same type of protective layer as tested on one surface and any other type of protective layers not showing propensity to undergo continuous smouldering (cf. 1<sup>st</sup> and 2<sup>nd</sup> para of clause 2.2.2) on the other surface of the thermal insulation panel.
- parameters of the protective layers as specified in Annex D,
- parameters of the vacuum insulation core as specified in EN 17140, clause 5.2.2.

Depending on the test results, the ETA shall specify one of the following information in accordance with EN 16733, clause 11, together with those conditions and parameters (see provisions directly above) for which the assessment is valid:

- The thermal insulation board does not show propensity to undergo continuous smouldering.
- The thermal insulation board shows propensity to undergo continuous smouldering.
- Assessment of the propensity to undergo continuous smouldering is not possible.

#### 2.2.3 Content, emission and/or release of dangerous substances

The performance of the thermal insulation boards related to the emissions and/or release and, where appropriate, the content of dangerous substances shall be assessed on the basis of the information provided by the manufacturer<sup>2</sup> 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 scenarios for this product and intended uses with respect to dangerous substances are:

- IA2: Product with indirect contact to indoor air (covered products) but possible impact on indoor air.
- IA3: Product with no contact to indoor air (e.g., boards intended for external insulation).

The manufacturer is not obliged to:

<sup>&</sup>lt;sup>2</sup> 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).

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 in accordance with 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.

#### 2.2.3.1 SVOC and VOC

For the intended use covered by the release scenario IA2, semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) shall be determined in accordance with EN 16516. The respective loading factor  $[m^2/m^3]$  used for emission testing shall be taken from the following table:

Table 2.2.3.1.1: Loading factor, depending on the intended use (in accordance with EN 16516)

Intended use	Loading factor [m <sup>2</sup> /m <sup>3</sup> ]
Walls	1,0
Floor, ceiling	0,4

Sampling, transport and storage of the specimen shall be handled in accordance with EN ISO 16000-11. Specimens shall be taken as close as possible to the time of production.

The following product parameters shall be taken into account when testing the boards:

- Each board with a different composition and protection layer shall be tested separately.
- The product with the highest thickness shall be considered.
- In case of doubt, tests shall be performed separately on specimens with different specifications for each characteristic.
- The test specimen shall be prepared by covering the edges and the back of the board.

Once the test specimen has been produced, it shall immediately be placed in the emission test chamber. This time is considered the starting time of the emission test.

The test results shall be reported for the relevant parameters (e.g., chamber size, temperature and relative humidity, air exchange rate, loading factor, size of test specimen, conditioning, production date, arrival date, test period, specimen preparation procedure, test result) after 3 and/or 28 days testing.

The product performance shall be expressed in  $[\mu g/m^3 \text{ or } mg/m^3]$  and given in the ETA.

#### 2.2.3.2 Polycyclic aromatic hydrocarbons (PAH) content

If rubber with e.g., recycled rubber content containing polycyclic aromatic hydrocarbons (PAH) from extender oils or carbon black is used as a protection layer, the additional assessment method for the content of specific organic compounds (PAH and B[a]P) shall be based on the raw material (protection layer) according to the testing method described in Annex A (based on the method for the determination of PAH in polymers published by AfPS (Ausschuss für Produktsicherheit).

The concentration of single PAH and/or the sum of PAH [mg/kg] shall be given in the ETA.

#### 2.2.3.3 N-Nitrosamine content

If rubber with e.g., recycled rubber content is used as a protection layer or nitrosamine forming agents are added to the product the additional assessment method for the content of nitrosamines shall be performed based on the raw material (protection layer) following the method published by DIK (Deutsches Institut für Kautschuktechnologie e.V. in Hannover, Germany).

If the recycled rubber or nitrosamine forming agent is completely and impermeably enclosed, N-Nitrosamine content may not be determined.

The content of nitrosamines shall be determined as follows:

The specimen to be tested shall be a composite, taking at least four incremental specimens collected from different areas of a batch to represent the raw material.

Immediately before analysis, the specimen shall be cut into pieces of about 1 mm<sup>3</sup> particle size. About 2 g of the sample shall be transferred to a 30 ml extraction thimble used for Soxhlet-extraction. Subsequent, extraction shall be performed for 24 hours at  $65 \pm 3$  °C using 75 ml *N*-nitrosamine-free methanol with 0,1 wt% ascorbic acid in a 100 ml round bottom flask containing two boiling stones made of glass.

After cooling down, 2 ml of *N*-nitrosodiisopropylamine solution (NDiPA, approximately 0,2  $\mu$ g/ml) shall be added as internal standard. Following, the extract shall be evaporated with approximately 3,5 ml/min to about 5 ml using a rotary evaporator with a 40 ± 2 °C water bath and 220 ± 10 mbar.

The resulting pre-concentrate shall be transferred to a test tube using a Pasteur pipette. The round bottom flask shall be rinsed twice with 1 ml *N*-nitrosamine-free methanol and the rinse solution shall be mixed with the preconcentrate.

By treatment with a nitrogen stream (0,05 ml/min) the solution shall be adjusted to 2 ml. Extracts with high oil content need chromatographic purification. The sample shall be analysed within 48 hours using packed columns.

The analysis of extracted *N*-nitrosamines shall be achieved by gas chromatography using a thermal energy analyzer (TEA) as detector. The conditions for gas chromatographic analysis are shown in table 2.2.3.3.1.

Nitrosamine	NDMA, NDEA, NDPA, NDBA, NPIP, NPYR, NMOR, NDIPA	NMPA, NEPA		
Column	Silanzed glas colur	nn (l = 2 m, lD = 1 mm)		
Stationary phase	10 % Carbowax 20 M, 2 % KOF on Chromosorb HAW 80/10 mesh	H 10 % OV 101 on Chromosorb D HAW 80/100 mesh		
Carrier gas	H	Helium		
Carrier gas flow	30 ml/min			
Sample injection	On	column		
Injector temperature	2	00 °C		
Temperature program	125 °C 2 min isothermal 125 – 175 °C (10 °C/min) 175 °C 5 min isothermal	100 °C – 200 °C (10 °C/min)		
Sample volume		5 uL		

Table 2.2.3.3.1 Conditions for gas chromatographic analysis of N-nitrosamines

As published in Kautschuk Gummi Kunststoffe; 44, 1991, pp. 514-21, R. Liekefeld, R. H. Schuster, G. Wünsch

The N-nitrosamines to be determined are:

- N-nitrosodibutylamine (NDBA)
- N-nitrosodiethylamine (NDEA)
- N-nitrosodimethylamine (NDMA)
- N-nitrosodipropylamine (NDPA)
- N-nitrosomethylphenylamine (NMPA)
- N-nitrosoethylphenylamine (NEPA)
- N-nitrosomorpholine (NMOR)
- N-nitrosopiperidine (NPIP)
- N-nitrosopyrrolidine (NPYR)

The content of the N-nitrosamines shall be given in the ETA [ $\mu$ g/kg].

2.2.3.4 Hexabromocyclododecane (HBCDD) content

If a protection layer made of polystyrene is used, the content of Hexabromocyclododecane (HBCDD) shall be determined via X-ray fluorescence analysis in accordance with ANNEX B of the EAD 040635-00-1201.

The content of HBCDD [ppm or mg/kg] shall be stated in the ETA.

#### 2.2.4 Thermal conductivity

The thermal conductivity  $\lambda_D$  of the VIP shall be determined and given in the ETA in accordance with EN 17140, clause 5.2.6.1.2.

If the protection layers consist of thermal insulation material according to a harmonised European standard (e.g., expanded polystyrene (EPS) according to EN 13163) the thermal conductivity of these layers can be given additionally in the ETA in accordance with the provisions laid down in that standard (based on the Declaration of Performance (DoP) of this thermal insulation product).

#### 2.2.5 Deviation from thickness

The thickness, d, shall be determined in accordance with EN ISO 29466 at  $(23 \pm 5)$  °C with a pressure of 250 Pa  $(\pm 5 \text{ Pa})$  on at least 3 test specimens.

The mean value of thickness and the maximum deviation shall be given in the ETA in millimetre, rounded up to the nearest millimetre.

#### 2.2.6 Deviation from squareness

The squareness shall be determined in accordance with EN 824 on at least 3 test specimens.

The maximum deviation from squareness on length and width,  $S_b$ , shall be given in the ETA in millimetre per meter [mm/m], rounded up to the nearest millimetre.

#### 2.2.7 Deviation from flatness

The flatness shall be determined in accordance with EN ISO 29468 at  $(23 \pm 5)$  °C on at least 3 test specimens.

The maximum deviation from flatness,  $S_{\text{max}}$ , shall be given in the ETA in millimetre, rounded up to the nearest millimetre.

#### 2.2.8 Deviation from length and width

The length and width shall be determined in accordance with EN ISO 29465 at  $(23 \pm 5)$  °C with at least 3 test specimens.

The mean value of the length and width and the maximum deviations from length and width shall be given in the ETA (in millimetre), rounded up to the nearest millimetre.

#### 2.2.9 Compressive stress or compressive strength at 10 % deformation

The compressive strength at 10 % deformation or compressive stress at failure shall be determined in accordance with EN ISO 29469 at  $(23 \pm 5)$  °C on at least 5 test specimens (dimensions of specimens according to EN 17140, Table 1).

The compressive strength at 10 % deformation or compressive stress at failure shall be given in the ETA in levels using steps of 10 kPa (rounded down) in accordance with EN 17140, clause 4. 4..

#### 2.2.10 Dimensional stability under specified temperature and humidity

The dimensional stability under specified temperature and humidity conditions shall be determined in accordance with EN 1604. The test shall be carried out on at least 3 test specimens (dimensions of specimens according to EN 17140, Table 1) after storage for 48 h at  $(70 \pm 2)^{\circ}$ C and  $(90 \pm 5)^{\circ}$  relative humidity.

The relative changes in length, width and thickness shall be given in the ETA using levels according to EN 13171, clause 4.3.2, i.e., DS (70,90)1, DS (70,90)2 or DS (70,90)3.

#### 2.2.11 Deformation under specified load and temperature

Deformation in thickness under specified load and temperature shall be determined according to EN 1605 on at least 3 test specimens (dimensions of specimens according to EN 17140, Table 1) for test condition 2 (40 kPa / 70 °C / 168 h).

The maximum change of the relative deformation in % is given in the ETA.

#### 2.2.12 Tensile strength of the multilayer high barrier foil of the VIP

The tensile strength of the multilayer high barrier foil is determined with test specimen "type 2" according to EN ISO 527-3. The test shall be carried out before and after ageing (see Annex B of this EAD) with a testing speed of 50 mm/min.

The minimum value of all test results of the tensile strength of the multilayer high barrier foil (before and after ageing) shall be given in the ETA in MPa (rounded down to next whole value).

#### 2.2.13 Tensile strength perpendicular to the faces of the thermal insulation boards

The tensile strength perpendicular to the faces of the thermal insulation boards shall be determined in accordance with EN 1607 with at least 5 test specimens of at least 50 mm x 50 mm. The test shall be carried out with test specimens consisting of VIP and protection layer/s (if existing).

The tensile strength shall be given in the ETA in kPa (rounded down to next whole value).

#### 2.2.14 Behaviour under point load

#### a) Reference method

The point load, Fp, at 5 mm deformation shall be determined with 3 test specimens 300 mm x 300 mm in accordance with EN 12430.

The point load shall be given in the ETA in N (rounded down to next whole value) together with the information about the method used.

#### b) Alternative method

The deformation under a point load of 1000 N shall be determined in accordance with EN 12430.

The deformation shall be given in the ETA in mm (rounded up to next whole value) together with the information about the method used.

#### 2.2.15 Shear strength of the thermal insulation boards

The shear strength of the thermal insulation boards (with protection layers) shall be determined in accordance with EN 12090 (test method with single test specimen). The shear strength shall be determined at least with test specimens of the minimum thickness and the maximum thickness.

For fastening the test specimen in the holding device, adhesives shall be used in which the shear strength and the shear modulus of the adhesive layer are greater than those of the product to be tested.

The shear strength of the thermal insulation board shall be given in the ETA (for each kind of protection layer) in kPa (rounded down to next whole value).

#### 2.2.16 Resistance to tearing

The resistance to tearing (nail shank) of the multilayer high barrier foil shall be determined with at least 5 test specimens according to EN 12310-1. The test shall be carried out before and after ageing of the multilayer high barrier foil (see Annex B of this EAD).

The resistance to tearing (nail shank) of the multilayer high barrier foil (before and after ageing) shall be given in the ETA (in N).

#### 2.2.17 Puncture resistance

The puncture resistance of the multilayer high barrier foil shall be determined with at least 5 test specimens according to EN 14477. The test shall be carried out before and after ageing of the multilayer high barrier foil (see Annex B of this EAD) with a testing speed of 100 mm/min (at least with the external side of the multilayer high barrier foil).

The puncture resistance of the multilayer high barrier foil (before and after ageing) shall be given in the ETA (in N).

## **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 Commission Decision 1999/91/EC, as amended by Commission Decision 2001/596/EC.

The system to be applied is 3 for any use except for uses subject to regulations on reaction to fire.

For uses subject to regulations on reaction to fire (including propensity to undergo continuous smouldering) 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 product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1	Control pla	n for the manu	ufacturer; co	ornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum fre- quency of con- trol
[ir	ncluding testing of sam	Factory production of ples taken at the factory i	control (FPC) n accordance v	vith a prescrit	oed test plan]*
1a	Reaction to fire	EN ISO 11925-2 and clause 2.2.1	Control plan	1	once per month
		EN 13823, EN ISO 1182, EN ISO 1716 and clause 2.2.1 with An- nex C	Control plan	1	once per year (once per 2 years for EN 13823 tests)**
		Indirect measures in ac- cordance with lines 1b (mass loss), 7 and 10 of table 3.2.1	Control plan	lines 1b, 7 and 10 of ta- ble 3.2.1	lines 1b, 7 and 10 of table 3.2.1
1b	Propensity to undergo continuous smoulder- ing	Thickness, density	lines 7 and 10 of table 3.2.1	lines 7 and 10 of table 3.2.1	lines 7 and 10 of table 3.2.1
		Mass loss (where appro- priate), EN 13820	Control plan	1	Once per day
		EN 16733 and clause 2.2.2 with Annex D	Control plan	1	Once per 2 years
2	SVOC and VOC	clause 2.2.3.1	Control plan	1	With production start and every 5 years
3	PAH content	clause 2.2.3.2	Control plan	1	With production start and every batch
4	N-Nitrosamine content	clause 2.2.3.3	Control plan	2	With production start and every batch
5	HBCDD content	clause 2.2.3.4	Control plan	3	With production start and every batch
6	Thermal conductivity	Direct: EN 17140 and clause 2.2.4	Control plan	1	once per month
		Indirect: clause 3.4.3	Control plan	1	once per day
7	Deviation from thick- ness	EN ISO 29466 and clause 2.2.5	Control plan	clause 2.2.5 and EN ISO 29466	twice per day
8	Deviation from square- ness	EN 824 and clause 2.2.66	Control plan	clause 2.2.66 and EN 824	once per day
9	Deviation from flatness	EN ISO 29468 and clause 2.2.7	Control plan	clause 2.2.7 and EN ISO 29468	once per day

r					
No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum fre- quency of con- trol
10	Density	EN ISO 29470 and clause 3.4.1	Control plan	clause 3.4.1 and EN ISO 29470	once per day
11	Deviation from length and width	EN ISO 29465 and clause 2.2.8	Control plan	clause 2.2.8 and EN ISO 29465	once per day
12	Air permeability of the multilayer high barrier foil of the VIP	EN 17140 and clause 3.4.2	Control plan	clause 3.4.2 and EN 17140	once per year
13	Compressive stress / strength at 10 % defor- mation	EN ISO 29469 and clause 2.2.9	Control plan	clause 2.2.9 and EN ISO 29469	once per month
14	Internal pressure	clause 3.4.3	Control plan	clause 3.4.3	once per day
15	Tensile strength per- pendicular to the faces of the thermal insula- tion boards	EN 1607 and clause 2.2.13	Control plan	clause 2.2.13 and EN 1607	once per week
16	Mass per unit area of the multilayer high bar- rier foil	clause 3.4.4	Control plan	clause 3.4.4	once per week
17	Puncture resistance	EN 14477 and clause 2.2.17	Control plan	clause 2.2.17 and EN 14477	once per year
*) In case of discontinuous production these minimum frequencies should be adapted to an equivalent frequency. **) The frequency of tests according to EN 13823 (SBI) within the FPC on specimens randomly taken from the consecutive production process can be reduced to once per 2 years, if the other direct and indirect tests for the relevant reaction to fire class meet the criteria as laid down in the control plan.					

relevant reaction to fire class meet the criteria as laid down in the control plan.

## 3.3 Tasks of the notified body

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire (including propensity to undergo continuous smouldering, where relevant) for products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification or of the performance regarding continuous smouldering (e.g., an addition of fire retardants or a limiting of organic material). The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the product are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; corners
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No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
	Initial inspection of the manufactur	ring plant and	d of factory pr	oduction con	trol
1	Reaction to fire** (including continuous smoul- dering): The notified body shall verify the ability of the manufacturer for manufacturing the product in accordance with the control plan. In particular the following items shall be appropriately con- sidered: - Presence of suitable test equipment - Presence of trained personnel - Presence of an appropriate quality as- surance system and necessary stipula- tions taking especially in account those clearly identifiable stages in the production process - e.g., a limiting of organic materials and/or the addition of flame retardants as essential pa- rameter - which influences and improve the performance with regard to reaction to fire and/or the propensity to undergo continuous smouldering.	Verification of the com- plete FPC as described in the control plan agreed between the TAB and the manufac- turer	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	When starting the produc- tion, after its modification and when starting a new production line
	Continuous surveillance, assessmen	t and evaluat	ion of factory	production c	ontrol
2	Reaction to fire** (including continuous smoul- dering): It shall be verified that the system of factory production control and the specified manufac- turing process are maintained in accordance with the control plan. In particular the follow- ing should be dealt with: - Inspection of factory, of the production of the product and of the facilities for factory production control - Evaluation of the documents concern- ing the factory production control - Issuing a report of surveillance taking especially into account those clearly identifiable stages in the production process - e.g., a limiting of organic materials and/or the addition of flame retardants as essential pa- rameter - which influences and improve the performance with regard to reaction to fire and/or the propensity to undergo including continuous smouldering.	Verification of the con- trols carried out by the manufac- turer as de- scribed in the control plan agreed between the TAB and the manufac- turer with reference to the raw ma- terials, to the process and to the prod- uct as indi- cated in Ta- ble 3.2.1.	As defined in the control plan agreed between the TAB and the manufacturer	As defined in the control plan agreed between the TAB and the manufacturer	Annually

Only relevant for products of class C and higher

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

#### 3.4.1 Density

The density of the VIP shall be determined in accordance with EN ISO 29470 at (23  $\pm$  2) °C and (50  $\pm$  5) % relative humidity.

#### 3.4.2 Air permeability of the multilayer high barrier foil of the VIP

The air permeability of the multilayer high barrier foil shall be determined in accordance with EN 17140, Annex E.3.

#### 3.4.3 Internal pressure

The internal pressure of the VIP shall be determined minimum 24 h after the product has been manufactured using a foil lift-off procedure, in which the VIP is exposed to negative pressure (e.g., in a vacuum chamber or by means of a suction cup) until it is lifted off the VIP core. The distance between the VIP core and the foil shall be measured with the help of a laser distance measuring device and used to determine the internal pressure of the VIP in accordance with the test procedure given in EN 17140 (see G.5.3 of Annex G). The test shall be carried out at a temperature of  $(23 \pm 2)$  °C (see G.5.2 of Annex G, EN 17140) and with a testing apparatus in accordance with EN 17140 (see Figure G.1 of Annex G, EN 17140). The test specimens shall be conditioned for 24 hours at a temperature of  $(23 \pm 2)$  °C and with a relative humidity of  $(50 \pm 10)$  % (see G.4 of Annex G, EN 17140).

#### 3.4.4 Mass per unit area of the multilayer high barrier foil

The mass per unit area of the multilayer high barrier foil shall be determined with a calibrated scale with an accuracy of 0,01 g on at least 3 test specimens of at least 200 mm × 200 mm.

## 4 REFERENCE DOCUMENTS

EN 323:1993	Wood-based panels; determination of density
EN 824:2013	Thermal insulating products for building applications - Determination of squareness
EN 1604:2013	Thermal insulating products for building applications - Determination of dimensional stability under specified temperature and humidity conditions
EN 1605:2013	Thermal insulating products for building applications - Determination of deformation under specified compressive load and temperature conditions
EN 1607:2013	Thermal insulating products for building applications - Determination of tensile strength perpendicular to faces
EN 12090:2013	Thermal insulation products for building applications – Determination of shear behaviour
EN 12310-1:1999	Flexible sheets for waterproofing – Part 1: Bitumen sheets for roof water- proofing - Determination of resistance to tearing (nail shank)
EN 12430:2013	Thermal insulating products for building applications — Determination of behaviour under point load
EN 13163:2012+A1:2015	Thermal insulation products for buildings – Factory made expanded pol- ystyrene (EPS) products - Specification
EN 13171:2012+A1:2015	Thermal insulation products for buildings – Factory made wood fibre (WF) products – 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 test data from fire reaction to fire tests
EN 13820:2003	Thermal insulating materials for building applications - Determination of organic content
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 14477:2004	Packaging, Flexible packaging material – Determination of puncture re- sistance
EN 16516:2017+A1:2020	Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air
EN ISO 16000-11:2024	Indoor air - Part 11: Determination of the emission of volatile organic com- pounds from samples of building products and furnishing - Sampling, storage of samples and preparation of test specimens
EN 16733:2016	Reaction to fire tests for building products - Determination of a building product's propensity to undergo continuous smouldering
EN 17140:2020	Thermal insulation products for buildings – Factory made vacuum insulation panels (VIP) – Specification
EN ISO 527-1:2019	Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:2019)

EN ISO 527-3:2018	Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3:2018)		
EN ISO 1182:2020	Reaction to fire tests for products - Non-combustibility test (ISO 1182:2020)		
EN ISO 1716:2018	Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value) (ISO 1716:2018)		
EN ISO 11925-2:2020	Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test (ISO 11925-2:2020)		
EN ISO 29465:2022	Thermal insulating products for building applications - Determination of length and width (ISO 29465:2022)		
EN ISO 29466:2022	Thermal insulating products for building applications - Determination of thickness (ISO 29466:2022)		
EN ISO 29468:2022	Thermal insulating products for building applications - Determination of flatness (ISO 29468:2022)		
EN ISO 29469:2022	Thermal insulating products for building applications - Determination of compression behaviour (ISO 29469:2022)		
EN ISO 29470:2020	Thermal insulating products for building applications - Determination of apparent density (ISO 29470:2020)		
AfPS GS 2019:1	PAK – Testing and assessment of polycyclic aromatic hydrocarbons (PAH) in the course of awarding the GS mark (see https://www.baua.de/DE/Aufgaben/Geschaeftsfuehrung-von- Ausschuessen/AfPS/pdf/AfPS-GS-2019-01-PAK-EN.pdf?blob=publi- cationFile&v=5/1000)		
KGK, 1991 (see DIK)	Kautschuk Gummi Kunststoffe; 44, 1991, pp. 514-21, R. Liekefeld, R. H. Schuster, G. Wünsch		
EAD 040635-00-1201	Thermal and/or sound insulation based on bound expanded polystyrene bulk material		
EAD 040011-00-1201	Vacuum insulation panel (VIP) with factory applied protection layers		

## ANNEX A: TESTING INSTRUCTIONS FOR THE DETERMINATION OF POLYCY-CLIC AROMATIC HYDROCARBONS (PAHS) IN POLYMERS

#### A.1 Method

#### A.1.1 Brief description

#### A.1.1.1 Standard method

A representative partial specimen of rubber shall be taken and mixed to represent a homogeneous mixture. Then, 500 mg of the sample shall be weighed into a container and extracted with 20 ml of toluene (to which an internal standard shall be added) for 1 h at  $60 \pm 2$  °C in an ultrasonic bath. An aliquot shall be taken from the extract once it has cooled down to  $23 \pm 2$  °C. In the case of polymers (e.g., plastics or rubber products) for which matrix problems arise throughout the analysis, an additional purification step shall be carried out using column chromatography. Quantification shall be performed on a gas chromatograph with a mass-selective detector (GC/MSD) using the SIM (selected ion monitoring) method.

#### A.1.1.2 Method for insufficient quantities

If the total mass of material to be analysed is less than 500 mg, the procedure shall be as follows: Identical materials from the product shall be combined and considered as one specimen. Additional product specimens shall not be used.

The mass of chopped-up material shall be between 50 mg and 500 mg, the sample shall be tested according to A.1.1.1 and the quantity of toluene converted or adapted in proportion. The actual mass of the specimen shall be recorded in the test report accordingly.

#### A.1.2 Utensils

- Ultrasonic bath with a minimum power of 200 W and a bath area of 706 cm<sup>2</sup>, corresponding to 0,28 W/cm<sup>2</sup>, without a basket and with an internal or external thermostat,
- Gas chromatograph with a mass-selective detector.

#### A.1.3 Chemicals and solutions

#### A.1.3.1 Chemicals

- Toluene
- Internal standards
  - Standard 1: Naphthalene-d8
  - Standard 2: Pyrene-d10 or anthracene-d10 or phenanthrene-d10
  - Standard 3: Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene

At least three internal standards shall be used; these shall be added to the extraction solvent (toluene).

• External standard: 18 PAH substances according to the list under no. 2.3, as a mix or individually

- Petroleum ether
- Silica gel
- Sodium sulfate

#### A.1.3.2 Calibration solutions

The concentrations of the calibration solutions shall be chosen as follows: A three-point calibration covers a working range of 0,1 to 10 mg/kg in the specimens. This corresponds to a concentration range of 2,5 to 250 ng/ml in the calibration solutions.

#### A.2 Specimen preparation and execution

#### A.2.1 Extraction

500 mg of the specimen shall be placed in a vial. 20 ml of toluene, previously amended with internal standards, shall be added. The sample extraction shall take place for 1 h in the ultrasonic bath at a temperature of  $60 \pm 2$  °C. For this purpose, the vials shall be placed or suspended in the ultrasonic bath without using a basket. The vials shall then be removed, the extract shall be left to cool to  $23 \pm 2$  °C and shaken briefly, and an aliquot shall be taken from the extract and measured either directly or following dilution with toluene.

#### A.2.2 Column chromatography extraction step

For some polymers (e.g., plastic or rubber products), especially those that dissolve well in toluene under the described extraction conditions, it is necessary to clean the extract using adsorption chromatography on silica gel.

For this purpose, a clean-up column with "Hahnschliff" ("stopcock") (approximately 220 mm x 15 mm) shall be filled with glass wool, 4 g of silica gel and 1 cm of sodium sulfate.

The silica gel shall be deactivated previously by adding 10% water (the corresponding volume of water shall be added to the silica gel in a glass flask, and the mixture shall be homogenised on the rotary evaporator for 1 h at standard pressure and room temperature. The silica gel shall then be stored in the sealed glass flask at room temperature).

The packed column shall be conditioned with 10 ml of petroleum ether.

The aliquot of toluene extract shall then be evaporated to a volume of approximately 1 ml on the rotary evaporator and poured into the column. The pointed flask shall be rinsed out with approximately 20 ml of eluent, which shall then also be transferred to the clean-up column. Elution shall be performed with 50 ml of petroleum ether. The collected petroleum ether eluate shall be amended with 1 ml of toluene and evaporated to a volume of approximately 1 ml under a nitrogen stream (e.g., on the TurboVap). This shall then be made up to a defined volume with toluene, and the extract shall be analysed by GC-MS.

#### A.2.3 Measuring procedure

The method of determination to be applied shall be gas chromatography with a mass-selective detector in the SIM mode.

The following 18 PAHs shall be determined:

- Naphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- Fluoranthene
- Pvrene
- Chrysene
- Benzo[a]anthracene
- Benzo[b]fluoranthene
- Benzo[k]fluoranthene
- Benzo[j]fluoranthene
- Benzo[a]pyrene
- Benzo[e]pyrene
- Indeno[1,2,3-cd]pyrene
- Dibenzo[a,h]anthracene
- Benzo[g,h,i]perylene

#### A.2.3.1 Measuring conditions for gas chromatography

The equipment parameters (temperatures, columns, mass traces) may be chosen by the individual laboratory or are determined by the analytes.

#### A.2.3.2 Analysis

At least three internal standards shall be used. For these three standards, the internal standards and the correction ranges are defined as follows:

#### Parameter Internal standards with recommended reference

<ul> <li>Naphthalene</li> </ul>	Naphthalene-d8
<ul> <li>Acenaphthylene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Acenaphthene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
Fluorene	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Phenanthrene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Anthracene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Fluoranthene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
Pyrene	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Benzo[a]anthracene</li> </ul>	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
Chrysene	Pyrene-d10 or anthracene-d10 or phenanthrene-d10
<ul> <li>Benzo[b]fluoranthene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Benzo[k]fluoranthene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Benzo[j]fluoranthene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Benzo[a]pyrene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Benzo[e]pyrene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Indeno[1,2,3-cd]pyrene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Dibenzo[a,h]anthracene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene
<ul> <li>Benzo[g,h,i]perylene</li> </ul>	Benzo[a]pyrene-d12 or perylene-d12 or triphenylbenzene

External calibration: for each individual PAH, at least a three-point calibration shall be carried out with reference to the internal standardisation set out above. A working range of 0,1 to 10 mg/kg shall be achieved.

Concentrations above the calibration range can be determined by diluting the extract.

Concentrations of the individual PAH shall be given in mg/kg. The sum of quantified PAH, P, shall be calculated by addition of the individual PAH concentrations, p<sub>i</sub>, following equation A.I:

$$\sum p_i = P \tag{B.2.3.2.1}$$

#### A.2.3.3 Limit of quantification

The limit of quantification for material samples shall be 0,2 mg/kg per parameter.

#### A.2.4 Special characteristics

Naphthalene is a parameter hard to assess in products that come into contact with the skin. Experience indicates that it is possible to identify instances of both naphthalene depletion in materials and secondary contamination. The result obtained for naphthalene therefore only ever reflects the test specimen's current situation at the time of measurement.

#### A.2.5 Measuring conditions for gas chromatography

Injected volume: 1 µl pulsed splitless Column: Rxi-PAH, 40 m, ID0.18 mm, film thickness 0,07 µm Injector temperature: 290 °C Transfer-line temperature: 340 °C Initial temperature: 90 °C Initial time: 0,7 min Heating rate: 15 °C/min.  $\rightarrow$  120 °C 40 °C/min.  $\rightarrow$  170 °C 20 °C/min.  $\rightarrow$  340 °C

# ANNEX B - AGEING METHOD FOR THE MULTILAYER HIGH BARRIER FOIL OF THE VIP

#### B.1 Measurement of initial characteristics (without ageing)

The following measurements shall be made:

Determination of tensile strength and elongation of the multilayer high barrier foil (of the VIP) which is relevant to avoid internal pressure and oxygen permeability (in accordance with EN ISO 527-3) with at least 5 test specimens.

The test shall be done by 23 °C and 50 % relative humidity (in accordance with EN ISO 527-1).

#### B.2 Exposure conditions

After the measurement of the initial characteristics (see B.1) five additional series of test specimens shall be exposed at 70 °C for 3 days, 7 days, 14 days, 30 days and 90 days (each test series with at least 5 test specimens).

After the exposure the tensile strength and elongation shall be determined in accordance with the mentioned time steps.

## ANNEX C - MOUNTING AND FIXING PROCEDURE FOR REACTION TO FIRE TESTS

#### C.1 Principle

The reaction to fire classification shall be determined in accordance with EN 13501-1, respecting the test conditions laid down in this EAD.

The classification for the product as placed on the market is without any non-integrated installation means, e.g., glues, sealants.

#### C.2 Instructions for mounting and fixing of test specimens

#### C.2.1 General

This clause gives instructions for mounting and fixing for reaction to fire testing of the product considering the intended uses (see clause 1.2) and includes the field of application of the test results. This Annex is related to clause 2.2.1.

#### C.2.2 Product and installation parameters

The Tables C.2.2.1 and C.2.2.2 give the parameters that shall be taken into account when determining a reaction to fire performance of the thermal insulation board and the field of application of the test results. The following tables are valid for flat products.

Product Parameters	EN ISO 1182 (class A1 and A2)	EN ISO 1716 (class A1 and A2)	EN 13823 (class A1 to D)	EN ISO 11925-2 (class B to E)
Thickness	_	*	Х	Х
Density / Area weight	Х	*	Х	Х
Type of product / As- sembly	Х	Х	Х	Х
Type of facing(s) / Protective layers	X (if substantial as defined by EN 13501-1, clause 3.1.5)	х	х	х
Thickness/area weight of facing(s) / Protective layers	_	Х	х	Х
Type and amount of adhesive for facing(s) / Protective layers	_	Х	Х	Х
Asymmetry	_	—	Х	Х
* Thickness and density are relevant parameters in case of non-homogenous products. They are needed for the calculation of the total PCS value of the entire product (including the PCS values per unit area of the various components).				

 Table C.2.2.1:
 Product parameters

Parameter	EN 13823 (class A1 to D)	EN ISO 11925-2 (class B to E)
Exposure to thermal attack	Х	Х
Substrate	X	
Air gaps/Cavities	Х	_
Joints/edges	Х	X
Size and specimen positioning of test	Х	_
Product orientation and geometry	X	X
Fixing of test specimen	Х	-

 Table C.2.2.2:
 Installation parameters

#### C.2.3 Mounting and fixing

Due to the specific nature of the vacuum insulation panels all product samples which are required for the specific test methods shall be purpose-built regarding size and shape for testing. For that a prior consultation with the applicant/manufacturer is mandatory.

The samples should have the same properties (e.g., facings and/or coatings) as the original product.

#### C.2.3.1 Ignitability, EN ISO 11925-2 Exposure to thermal attack

The product shall be tested directly exposed to the thermal attack. Tests shall be done with surface flaming as well as with edge flaming on the frontside of the specimens in accordance with clauses 7.3.3.1 and 7.3.3.2 of the test standard.

Products with protective layers and products with the closure of the barrier foil at the lateral edges shall be additionally tested in accordance with clause 7.3.3.2.3 of the test standard with edge exposure of the specimens turned 90 degrees on their vertical axis.

#### C.2.3.1.1 Substrate

The test specimen shall be mounted in the test apparatus without a substrate.

C.2.3.1.2 Product orientation and geometry

Products without additional protective layers and products with the same facing by protective layers on both sides shall be tested on one face only.

If the product surfaces are not the same or the product is asymmetrical the worse test result shall be used to indicate the reaction to fire class of the product (valid for both faces exposed) or an indication of the reaction to fire class of each face shall be made, provided that the identification of the faces is clearly visible in the marking and labelling of the product.

#### C.2.3.2 Single Burning Item (SBI), EN 13823

#### C.2.3.2.1 Exposure to thermal attack

The product shall be tested directly exposed to the thermal attack.

#### C.2.3.2.2 Substrate

The type of the substrate is defined in EN 13238.

The general substrate to be used to test the product as placed on the market shall be made of calcium silicate. Gypsum plaster board, steel, and wooden particle board substrates such as defined in EN 13238 are permitted to be used instead.

For class A1 classification a calcium silicate substrate is compulsory.

C.2.3.2.3 Air gaps/cavities

The test specimen (product itself) shall be mounted in the test apparatus without an air gap/cavity (neither between the product and substrate nor between substrate and backing board).

#### C.2.3.2.4 Joints/edges

The general test shall be done with one vertical and one horizontal joint in the long wing. Alternatively, testing shall be done either with a horizontal or a vertical joint, if it is impossible to produce the various pieces of the specimens in such dimensions then a vertical and a horizontal joint can be considered at once on the long wing. Positioning of the joints shall be in accordance with EN 13823. Testing with a vertical and a horizontal joint in the same test reflects a worst-case situation and gives the widest field of application.

Test specimens taken from product samples that are small shall be arranged in the test apparatus such that both the vertical and horizontal joints required by EN 13823 are in the correct places. Other joints, resulting from the product size, may also be present. All joints (in the corner and at the long wing) shall be installed without a flashing or a sealant and tightly closed.

Products shall be mounted with the edges as existing; results from testing with butt edges are valid for all types of edges.

#### C.2.3.2.5 Size and positioning of the test specimen

The size of the test specimens is given in EN 13823. Positioning of the test specimens shall meet the following conditions:

- Joints/edges shall be taken into account.
- Products having smaller dimensions than the SBI test specimen shall be mounted in such a way that installation of full size products is started at the bottom corner line between both wings and joints.
- The specimens installed on the short wing shall cover (on their thickness) those installed at the long wing with a butt joint.
- The maximum thickness of the test specimen including the substrate that can be installed in the SBI shall be 200 mm.

#### C.2.3.2.6 Product orientation and geometry

Homogeneous products and products with the same facing on both sides shall be tested on one face only.

If the product surfaces are not the same or the product is asymmetrical the worse test result will be used to indicate the reaction to fire class of the product (valid for both faces exposed); or an indication of the reaction to fire class of each face is made, provided that the identification of the faces is clearly visible in the marking and labelling of the product.

#### C.2.3.2.7 Fixing of flat test specimens

The thermal insulation boards shall be fixed to the substrate using screws and washers and the following rules shall be respected:

- The minimum fixing distance from any edge (of the parts that form the specimen) shall be 25 mm.
- Position and number of fasteners shall be chosen to achieve sufficient stabilisation.
- The fastener shall be composed of a screw having a diameter of 2.5 mm to 5 mm, and a washer, with thickness up to 1.2 mm and a diameter of 20 mm to 70 mm.
- No fixing shall be positioned below the U profile in the EN 13823 (SBI) test apparatus.

If perforation of the specimens of the thermal insulation boards to be tested (damage of the vacuum core) by the mechanical fixing with screws and washers shall be avoided, the thermal insulation board shall be fixed on the substrate with an inorganic adhesive mortar of class A1 according to EN 13501-1 as specified in the manufacturer's product installation instructions.

## C.2.4 Extended application rules for test results

Table C.2.4.1 Extended application rule	able C.2.4.1	.1 Extende	d application	rules
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Product pa-	pa- Test method and validity of test results			
rameters	EN ISO 1182	EN ISO 1716	EN 13823 (SBI)	EN ISO 11925-2
Thickness	Not relevant	Not relevant	<ul> <li>Range between highest and low- est total thickness evaluated in case of using standard substrates of class D.</li> <li>Equal or lower to- tal thickness than tested in case of using standard substrates of class A1/A2.</li> <li>Any higher thick- ness if 200 mm thick specimens (including sub- strate) were tested.</li> <li>Range between highest and low- est thickness of any substantial layers of boards with protective layers than tested</li> </ul>	<ul> <li>Equal or lower thickness than tested of boards without protective layers and of sub- stantial layers of boards with pro- tective layers than tested</li> <li>Any higher thick- ness if 60 mm thick specimens were tested.</li> </ul>
Density / Weight per unit area	Highest and lowest density of boards without protective layers as well as of each substantial components of boards with protec- tive layers shall be tested	Density: not rele- vant, but: Highest and lowest weight per unit area (taking into account the range of thick- ness and density) of each component shall be considered when calculating the total PCS value of composite boards.	For boards without protective layers as well as for components of non-homoge- nous boards with protective layers: The result is valid for the tested density ± 10 %. or The result is valid for the range between tested highest and lowest density.	
Type / As- sembly	Each type of boards without pro- tective layers and substantial compo- nents of boards with protective lay- ers shall be tested.	Each different type of boards without protective layers as well as assembly of composite boards with protective lay- ers shall be consid- ered when calculat- ing the total PCS- value of the prod- uct.	For the tested type a	nd assembly only

Product pa-	pa- Test method and validity of test results			
rameters	EN ISO 1182	EN ISO 1716	EN 13823 (SBI)	EN ISO 11925-2
Facings / Protective layers	Not relevant, if the requirements for non-substantial components are ful- filled. For the tested type only, if the require- ments for substan- tial components are fulfilled	For the tested type only.	For the tested type only with the same thickness and weight per unit area. Re- sults obtained for facings / protective lay- ers of class A1 and A2 are also valid for facings / protective layers of the same type with greater thickness.	
Adhesive for facings / Pro- tective layers	Not relevant – if the requirements for non-substantial components are ful- filled.	For the tested type only.	For the tested type and the same or lower applied quantity per unit area only and for adhesives too, where PCS-value (per mass as well as per unit area) is equal or lower than the value of the adhesive used in the tests.	
Asymmetry	Not relevant	Not relevant	See clause C.2.3.2.6	See clause C.2.3.1.2

	Test method and validity of test results		
Installation parameter	EN 13823 (SBI)	EN ISO 11925-2 (Ignitability)	
Type of exposure to thermal attack	See test standard	<ul> <li>surface flame exposure</li> <li>edge flame exposure</li> <li>additionally, edge flame exposure of each layer of specimens turned 90° on their vertical axis in case of boards as prescribed in clause C.2.3.1</li> </ul>	
Substrate	See EN 13238 and clause C.2.3.2.2		
Air gaps/cavities	For applications without any air gap / cavi- ties behind – see clause C.2.3.2.3		
Joints/edges	See clause C 2.3.2.4 - vertical and hori- zontal joints shall be considered as pre- scribed in EN 13823.	Not applicable	
	When tested with butt edges, the test result is valid for all edge types. If tested with any other type of edge the test result is valid for that type only.		
Size and positioning of test specimen	valid for all products sizes.		
Product orientation and geometry	See clause C.2.3.2.6 For consideration of the orientation of wood chips as well as fibres of additional layers of composite boards the specimens shall be cut and tested in length and cross direction	See clause C.2.3.1.2	
Fixing of test speci- men	Test results being obtained for mechanical fixed specimens are valid for the product as placed on the market and for the use of mechanical, metal fixing means. Test results being obtained for specimens glued onto the substrate with an inorganic adhesive mortar (see clause C 2.3.2.7) are valid for fixing with any inorganic adhesive mortar of class A1 according to EN 13501-1 as well as with mechanical metal fixing means.	Not applicable.	

## Table C.2.4.2 Test method and validity of test results

# ANNEX D – DETERMINATION OF THE PROPENSITY TO UNDERGO CONTINUOUS SMOULDERING

#### D.1 Provisions for factory-made products made of mineral wool <sup>3</sup>

#### D.1.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- the product-variations of a product family (as defined by a certain combination of raw materials and other additives and produced in a certain production process)<sup>4</sup>;
- at least the product or product variant with the highest organic content (in percentage per mass), determined according to EN 13820 shall be taken as the critical case for testing;
- at least the product or product variant with the highest density shall be tested as well as a density of about 100 kg/m<sup>3</sup> (± 15 %); if the highest density is lower than 115 kg/m<sup>3</sup>, then only the product or product variant with the highest density shall be tested (density determined in accordance with EN ISO 29470);
- at least the product or product variant with the highest thickness shall be tested or if greater than 100 mm highest testable thickness of 100 mm; determined in accordance with EN ISO 29466 on at least three specimens;
- each different produced fibre orientation, i.e., lengthwise and crosswise to the length direction of the specimen as well as perpendicular to the surface of the specimen front side shall be tested;
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>3</sup>) shall be taken for testing; otherwise, clause D.1.2 applies.

#### D.1.2 Preparation of test specimen

The tests shall be done on free-hanging specimens without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions, and without any joints (see further).

If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the reverse (non-exposed) side to the maximum testable thickness of about 100 mm.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be removed when preparing the test specimens.

If clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.1.3 Extended application of test results

The test results considering the aforementioned parameters are also valid for products:

- of the same defined product- family,
- with lower organic content,
- with lower densities,
- with lower thickness and also with higher thickness if 100 mm thick specimens were tested,
- with all the tested fibre orientation,

<sup>&</sup>lt;sup>3</sup> For products made of mineral wool fibres and aerogel the same provisions shall apply as given in clause D.1 for factory-made products made of mineral wool.

<sup>&</sup>lt;sup>4</sup> To permit the TAB to apply EXAP-rules for test results within the assessment, it is recommended that the manufacturer should provide (but he is not obliged to do it) sufficient information (e.g., on the basis of the composition of the products in question), allowing the TAB to determine which products or product variants should be submitted to testing and to reduce the number of tests required.

- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5, < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.

#### D.2 Provisions for factory-made products made of cork

#### D.2.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of binder and additives etc., and produced in a certain production process)<sup>4</sup>;
- at least the product or product variant with the highest and lowest density, determined by tests according to EN ISO 29470;
- the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm, determined by tests according to EN ISO 29466 on at least three specimens;
- each different produced orientation, if relevant (i.e., lengthwise and crosswise to the length direction of the product);
- specimens without any non-substantial (by EN 13501-1, clause 3.1.5, < 1 mm and < 1 kg/m<sup>2</sup>) facings, coatings or suchlike shall be taken for testing; otherwise, clause D.2.2 applies.

#### D.2.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the reverse (non-exposed) side to the maximum testable thickness of about 100 mm.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>3</sup>) shall be removed when preparing the test specimens.

If the paragraph 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.2.3 Extended application of test results

The results of tests considering the aforementioned parameters are also valid for products:

- of the same defined product-family,
- with all densities between those evaluated,
- with lower thickness and also with higher thickness if 100 mm thick specimens were tested,
- with all orientations, if all relevant orientations (lengthwise and crosswise) had been tested,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5,
  - < 1 mm and < 1 kg/m<sup>2</sup>) or suchlike and
- for any end-use conditions.

#### D.3 Provisions for factory-made products made of wood fibre

#### D.3.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of binder and additives, and produced in a certain production process) <sup>4</sup>;
- each wood type of the wood fibres;
- each type of production process;
- at least the product or product variant with the highest and lowest density, determined by tests according to EN ISO 29470;
- at least the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm, determined by tests according to EN ISO 29466 on at least three specimens;

- each different produced fibre orientation (i.e., lengthwise and crosswise to the length direction of the product);
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be taken for testing; otherwise, clause D.1.2 applies.

#### D.3.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the reverse (non-exposed) side to the maximum testable thickness of about 100 mm.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be removed when preparing the test specimens.

If the paragraph 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.3.3 Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family (as defined by, e.g., binder type and additives, wood type of the fibres, including the production process),
- with all densities between those evaluated with lower thickness and also with higher thickness when 100 mm thick specimens were tested,
- with all fibre orientations, if all relevant orientations had been tested,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5, < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.

## D.4 Provisions for factory-made products made of wood wool or wood chips as homogenous products

#### D.4.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., the type of wood, binder and additives, and produced in a certain production process)<sup>4</sup>;
- at least the product or product variant with the highest organic content (in percentage per mass), determined according to EN 13820 is to be taken as the critical case for testing;
- at least the product or product variant with the highest density as well as the lowest density, determined by tests according to EN ISO 29470;
- at least the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm, determined according to EN ISO 29466 on at least three test specimens;
- each different produced orientation of the wood wool / wood chips (i.e., lengthwise and crosswise to the length direction of the specimen) shall be tested;
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>3</sup>) shall be taken for testing; otherwise, clause D.1.2 applies.

#### D.4.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the reverse (non-exposed) side to the maximum testable thickness of about 100 mm.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>3</sup>) shall be removed when preparing the test specimens. If clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.4.3 Extended application of test results

The determined performance of the tested product shall be expressed in accordance with clause 11 of EN 16733. The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family (as defined by, e.g., type of wood, binder and additives),
- with lower organic content of the wood wool / wood chip layer,
- with all densities of the wood wool / wood chip layers between those evaluated,
- with lower thickness of the wood wool / wood chip layer and also with higher thickness of the layers if the layer thickness of the tested specimen was 100 mm,
- with all orientations of the wood wool / wood chips,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5, < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.

#### D.5 Provisions for wood-based boards / panels

#### D.5.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw material, e.g., binder, additives, wood type of the wood shapes / wood fibres etc., and produced in a certain production process)<sup>4</sup>;
- at least the product or product variant with the highest as well as the lowest density of the wood-based board / panel, determined by tests according to EN 323;
- at least the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm of the wood-based board / panel, determined by tests according to EN ISO 29466 on at least three specimens;
- each different produced shape / fibre orientation (i.e., lengthwise and crosswise to the length direction of the specimen);
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>3</sup>) shall be taken for testing; otherwise, clause D.1.2 applies.

#### D.5.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

If the highest thickness is greater than 100 mm, then the specimen thickness shall be reduced from the reverse (non-exposed) side to the maximum testable thickness of about 100 mm.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be removed when preparing the test specimens.

If clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.5.3 Extended application of test results

The results of tests considering the aforementioned parameters are also valid for products:

- of the same defined product-family,
- with all densities of wood-based boards / panels between those evaluated,

- with lower thickness of wood-based boards / panels and also with higher thickness if 100 mm thick specimens were tested,
- with all shapes / fibre orientations, if all relevant orientations tested,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5,
   < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.

## D.6 Provisions for factory-made products made of any other vegetable fibre (than wood fibre) or animal fibre

#### D.6.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of fibres, type of binder and additives / treatment, and produced in a certain type of production process)<sup>4</sup>;
- at least the product or product variant with the highest and lowest density, determined by tests according to EN ISO 29470;
- at least the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm, determined by tests according to EN ISO 29466 on at least three specimens;
- each different produced fibre orientation (i.e., lengthwise and crosswise to the length direction of the specimen) shall be tested;
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be taken for testing; otherwise, clause D.1.2 applies.

#### D.6.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be removed when preparing the test specimens.

If clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.6.3 Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with all densities between those evaluated,
- with lower thickness and also with higher thickness if 100 mm thick specimens were tested,
- with all the tested fibre orientations,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5,
   < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.

## D.7 Provisions for factory-made products from materials other than those covered by clauses D.1 to D.6

#### D.7.1 Sample taking

In addition to EN 16733, the following conditions and parameters shall be considered when performing sampling and preparing test samples:

- product-variations of a product family (as defined by a certain combination of raw materials, e.g., type of fibres, type of binder and additives / treatment, and produced in a certain type of production process)<sup>4</sup>;
- if applicable, at least the product or product variant with the highest organic content (in percentage per mass) determined according to EN 13820 shall be taken as the critical case for testing;
- at least the product or product variant with the highest and lowest density, determined by tests according to EN ISO 29470;
- at least the product or product variant with the highest thickness or if greater than 100 mm highest testable thickness of 100 mm, determined by tests according to EN ISO 29466 on at least three specimens;
- if relevant, each different product orientation, (i.e., lengthwise and crosswise to the length direction of the specimen) shall be tested;
- specimens without any non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be taken for testing; otherwise, clause D.6.2 applies.

#### D.7.2 Preparation of tests specimens

The tests shall be done without consideration of the intended end-use conditions, because propensity to undergo continuous smouldering is hardly affected by end-use conditions.

Existing non-substantial facings, coatings or similar (< 1 mm and < 1 kg/m<sup>2</sup>) shall be removed when preparing the test specimens.

If clause 6.2.5 of EN 16733 applies, a permanent contact between the pieces shall be assured.

#### D.7.3 Extended application of test results

The results of tests considering the aforementioned parameters in fully are also valid for products:

- of the same defined product-family,
- with lower organic content,
- with all densities between those evaluated,
- with lower thickness and also with higher thickness if 100 mm thick specimens were tested,
- with all the tested product orientations,
- with any external non-substantial facings or coatings (as defined by EN 13501-1, clause 3.1.5,
   < 1 mm and < 1 kg/m<sup>2</sup>),
- for any end-use conditions.