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European Assessment Document for

Bound polystyrene bulk material for thermal insulation, sound insulation or both

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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).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD is established for the assessment of in situ formed bound polystyrene bulk material (expanded and extruded), for thermal insulation, sound insulation or both (in the following referred to as the ”insulation product”).

The insulation product is made of expanded polystyrene (EPS) and/or extruded polystyrene (XPS) granules and cement-based binders and it does not contain any other natural or artificial granules. Only cement taking into account the thresholds for chromium VI given in the EU regulation[4] is used for the manufacturing of the binder.

The granules of expanded and/or extruded polystyrene are made from new and/or recycled polystyrene granules with a diameter range 0 to 10 mm. Only material taking into account the threshold for Hexabromocyclododecane (HBCDD) given in EU regulation[5] is used for the manufacturing of the polystyrene granules.

The EAD covers bound EPS (BEPS) and bound XPS (BXPS), where polystyrene granules and binder are premixed in the Manufacturer’s factory and only mixing water is added on site; the EAD covers as well bound EPS (BEPS) and bound XPS (BXPS where polystyrene granules, binder and water are mixed on site by a mobile production unit according to the Manufacturers Product Installation Instruction (MPII). The product is not fully covered by EAD 040635-00-1201. Compared to the previous version of the EAD, the following changes are introduced: extruded polystyrene has been included, reaction to fire of the expanded polystyrene (EPS) and/or extruded polystyrene (XPS) granules, propensity to undergo continuous smouldering, tensile strength, flexural strength, blowing agent (for extruded polystyrene products) and durabilities related to reaction to fire and thermal conductivity.

The in situ formed product is neither covered by EN 13163 nor EN 13164 as these harmonised standards deal with factory made polystyrene products for a broader variety of intended uses.

The products are only partly covered by EN 16025-1[1] which is not a harmonised standard. This standard is applicable for EPS only and is taken into account in this EAD as far as technically appropriate.

The products are not covered by EN 16809-1 which is for loose fill or expanded polystyrene granules bonded by an organic glue limited to the intended use in wall constructions.

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 MPII 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 the EAD are respected.

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

1.2.1 Intended use(s)

The insulation product is intended to be used for thermal insulation, sound insulation or both of building constructions as follows:

- Thermal insulation for ceilings, roofs and floors

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

- Impact sound insulation product under floating floors inside buildings

The insulation product is used only in structures where it is protected from wetting, weathering and moisture.

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 insulation product for the intended use of 50 years when installed in the works. 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[2].

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

2 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

2.1 Essential characteristics of the product

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

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

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire in end use condition (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.1.1	Class
2	Durabilities related to reaction to fire (for bonded EPS and XPS granules as thermal and acoustic insulation)	EN 13163 clause 4.2.7.2 for BEPS EN 13164 clause 4.2.5.2 for BXPS	Level/description
3	Propensity to undergo continuous smouldering (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.1.2	Description
Basic Works Requirement 3: Hygiene, health and the environment			
4	Content of chromium VI (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.2.1	Level/description
5	Content of Hexabromocyclododecane (HBCDD) *(for bonded EPS and XPS granules as thermal and acoustic insulation)*	2.2.2.2	Level/description
6	Water vapour permeability *(for bonded EPS and XPS granules as thermal and acoustic insulation)*	2.2.3	Level/description
Basic Works Requirement 4: Safety and accessibility in use			
7	Compressive stress at 2 % strain, and 10 % strain or at rupture (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.4	Level/description
8	Flexural strength (for bonded EPS and XPS granules as thermal and acoustic insulation)	EN 13163 clause 4.3.5	Level/description

No	Essential characteristic	Assessment method	Type of expression of product performance
9	Tensile strength (for bonded EPS and XPS granules as thermal and acoustic insulation)	EN 13163 clause 4.3.6	Level/description
10	Compressive creep (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.5	Level/description
11	Thickness and compressibility (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.6	Level/description
12	Dimensional stability (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.7	Level/description
13	Point load (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.8	Level/description
14	Alkaline Resistance (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.16	Level
Basic Works Requirement 5: Protection against noise			
15	Impact sound reduction (for bonded EPS and XPS granules as impact sound insulation)	2.2.9	Level/description
16	Dynamic stiffness (for bonded EPS and XPS granules as impact sound insulation)	2.2.10	Level/description
Basic Works Requirement 6: Energy economy and heat retention			
17	Particle size distribution of polystyrene (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.11	Level/description
18	Water absorption (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.12	Level/description

No	Essential characteristic	Assessment method	Type of expression of product performance
19	Thermal conductivity • Lambda fractile value at 10 °C, at dry conditions • Mass-related moisture conversion coefficient ($f_{u,1}$) • Lambda at 23 °C and 50 % relative humidity $\lambda_{(23,50)}$ • Mass-related moisture conversion coefficient to high moisture content ($f_{u,2}$) • Moisture conversion factor (dry-23/50 and 23/50-23/80) (for bonded EPS and XPS granules as thermal insulation) • Blowing agent for bonded XPS granules as thermal insulation	2.2.13.1 2.2.13.2 2.2.13.3 2.2.13.4 2.2.13.5 2.2.13.6	Level/description
20	Durabilities related to thermal conductivity (for bonded EPS and XPS granules as thermal and acoustic insulation)	EN 13163 clause 4.2.7.3 for BEPS EN 13164 clause 4.2.5.3 for BXPS	Level/description
21	Bulk density of the dry mixture of granulated polystyrene and compound or of the granulated polystyrene (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.14	Level/description
22	Moisture sorption (for bonded EPS and XPS granules as thermal and acoustic insulation)	2.2.15	Level/description

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.

2.2.1 Reaction to fire

2.2.1.1 Reaction to fire in end use condition

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

For reaction to fire testing the mounting and fixing instructions according to EN 16025-1, Annex C, shall be used.

Deviating from Annex C.5 of EN 16025-1 it is necessary to test the highest as well as the lowest thickness of the insulation in case of using a combustible substrate in the SBI test (EN 13823). The test results cover all thicknesses between those assessed.

Annex C of EN 16025-1 and the deviations described above shall although be applied for insulation products made of bonded extruded polystyrene.

The reached class, the product density and the relevant thickness interval shall be given in the ETA taking into account the mounting and fixing of the product.

The reaction to fire class of the product and the used polystyrene shall be stated in the ETA.

2.2.1.2 Propensity to undergo continuous smouldering

The performance of the propensity to undergo continuous smoldering of the insulation products shall be tested and assessed in accordance with EN 16733.

The conditions and parameters which shall be taken into account within the test as well as the rules for the application of the test results are specified in Annex E.

In accordance with EN 16733, clause 11, the ETA shall specify the following information, depending on the outcome of the assessment:

- “The product does not show propensity to undergo continuous smouldering”,
- “The product shows propensity to undergo continuous smouldering”, or
- "Assessment of the propensity to undergo continuous smouldering is not possible".

2.2.2 Content, emission and/or release of dangerous substances

The performance of the product 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[3]

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

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

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

IA2: Product with indirect contact to indoor air (e.g., covered products) but possible impact on indoor air.

2.2.2.1 Content of chromium VI

The content of chromium VI of the binder shall be tested in accordance with EN 196-10.

The content of chromium VI shall be stated in the ETA taking into account Regulation (EC) No. 1907/2006 [4]. If the EU regulation is not complied with the product is out of the scope of this EAD and an ETA cannot be issued.

2.2.2.2 Content of Hexabromocyclododecane (HBCDD)

The content of Hexabromocyclododecane (HBCDD) of the polystyrene granules shall be tested in accordance with Annex B of the EAD.

The content of HBCDD shall be stated in the ETA taking into account Regulation (EC) No. 850/2004 [5]. If the EU regulation is not complied with the product is out of the scope of this EAD and an ETA cannot be issued.

2.2.3 Water vapour permeability

Water vapour permeability shall be tested in accordance with EN 12086 and water vapour diffusion factor μ according to EN 12086 (Table 1, climatic condition C) shall be determined. The minimum specimen size is 100x100x50 mm.

The water vapour diffusion factor μ and the used climatic condition(s) shall be stated in the ETA.

2.2.4 Compressive stress at 2 % strain, and 10 % strain or at rupture

Compressive stress at 2 % strain, 10 % strain or at rupture shall be determined according to EN ISO 29469.

The specimen size shall be 200x200 mm of the highest as well as the lowest thickness. The test shall be performed at least on 5 specimens with the lowest density.

Compressive stress at 2 % strain σ_2 *[kPa]*, 10% strain σ_{10} *[kPa]* or at rupture σ_m *[kPa]* shall be stated in the ETA as an average value.

2.2.5 Compressive creep

The determination of compressive creep χ_t [mm] and the relative deformation ε_t [%] shall be carried out according to EN ISO 16534 over a period of at least 122 days of testing with the imposed load for a compressive stress of $\sigma_c = 0{,}15 \times \sigma_m$ or $\sigma_c = 0{,}15 \times \sigma_{10}$ plus the self-weight of the screed.

Length and width of the specimen is 200x200 mm. The thickness shall be between 50 mm and 100 mm. The test shall be performed at least on 3 specimens with the lowest density.

Any information provided by the manufacturer regarding the chemical composition of the products may not be distributed to EOTA, to other TABs or beyond.

4 Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, as amended.

5 Regulation (EC) No. 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants, as amended by Regulation 2016/460 (page L80/19).

The compressive creep χ_t [mm] and the relative deformation ε_t *[%]* shall be determined after 122 days of testing and the measured values shall be extrapolated thirty times in accordance with Annex A of EN ISO 16534, which corresponds to ten years.

The mean compressive creep χ_{3660} [mm] and the relative deformation ε_{3660} *[%]* shall be stated in the ETA (see also the calculation example given in Annex B of EN ISO 16534).

2.2.6 Thickness and compressibility

The determination of thickness d_L and d_B shall be carried out according to EN ISO 29770 at the minimum and maximum insulation product thickness and a time interval of 300 s (see clause 7.2.3) before measuring d_B.

The test shall be performed on 3 specimens with the lowest density and the highest as well as the lowest thickness.

The compressibility *c* is defined as follows:

$c = d_L - d_B$

The mean value c *[mm]* for each thickness shall be stated in the ETA.

2.2.7 Dimensional stability

2.2.7.1 Dimensional stability at 60 °C and/or 70 °C / 90 % RH – 48 hours

The test shall be performed in accordance with EN 1604 compulsory at (70 ± 2) °C and (90 ± 5) % relative humidity and optional for 48 h at (60 ± 2) °C and (90 ± 5) % relative humidity on a 200 x 200 mm sample.

The specimen thickness shall be between 50 mm and 100 mm. The test shall be performed at least on 3 specimens with the lowest density.

The relative changes in length $\Delta\varepsilon_l$ *[%]*, width $\Delta\varepsilon_b$ *[%]* and thickness $\Delta\varepsilon_d$ *[%]* for dimensional stability at 60 °C / 90 % RH and/or 70 °C / 90 % RH shall be stated in the ETA.

2.2.7.2 Deformation under specified compressive load and temperature conditions

Deformation under specified compressive load and temperature conditions shall be determined according to EN 1605 for test conditions given in Table 3 (20 kPa / 80 °C).

Length and width of the specimens shall be 100x100 mm. The thickness shall be between 50 mm and 100 mm. The test shall be performed at least on 3 specimens with the lowest density.

The mean relative change in thickness, ε_2, *[%]* shall be stated in the ETA.

2.2.8 Point load

The behaviour under point load at 5 mm deformation shall be determined according to EN 12430. At least 3 test specimens of 300 mm x 300 mm shall be used for the testing.

The specimen thickness shall be between 50 mm and 100 mm. The test shall be performed at least on 3 specimens with the lowest density.

The mean value of point load F_p *[N]* at 5 mm deformation shall be stated in the ETA.

2.2.9 Impact sound reduction

The impact sound reduction ΔL by floating screeds on a heavyweight standard floor using the insulation product shall be determined according to EN ISO 10140-1 and 3 (category II according to Annex H of EN ISO 10140-1).

Using this data the weighted impact sound reduction ΔL_w shall be calculated according to EN ISO 717-2.

The test shall be performed with the floor build-up representing the worst case for impact sound reduction (minimum mass per unit area of the floating screed and thinnest insulation layer with lowest density to be covered by the ETA). If need be, the tests shall be carried out with several build-ups.

The weighted impact sound reduction ΔL_w *[dB]* (if need be, for different build-ups) shall be given in the ETA.

The assessed floor build-up(s) shall be described in detail in the ETA covering thickness and density of the insulation layer and minimum mass per unit area of the screed. It shall be stated clearly to which floor build-up the measured impact sound reduction applies following the principal that the result of this test setup can be extended to higher mass per unit area of the floating screed and larger thicknesses of the insulation layer with higher densities

2.2.10 Dynamic stiffness (for impact sound insulation only)

The determination of the dynamic stiffness shall be determined according to EN 29052-1.

The highest as well as the lowest thickness of the insulation material shall be tested. The test shall be performed at least on 3 specimens with the highest density.

The mean value of dynamic stiffness s' *[MN/m³]* shall be given in the ETA.

2.2.11 Particle size of the beads and percentage of dust

The determination of the maximum particle size and/or the particle size distribution of the EPS and XPS polystyrene granulate shall be carried out according EN 933-1 without the washing and drying procedure prior to the sieving process.

The preparation of the test specimen shall be based on Table 1 of EN 933-1 using a polystyrene volume of 1 liter.

The percentage by volume of dust particles with a diameter of 0 mm to 0,5 mm shall be determined in accordance with EN 933-1.

At least 3 specimens shall be tested.

The maximum particle size which represents 95% of the beads having this size or smaller and/or the particle size distribution of the polystyrene granulate shall be given in the ETA.

The percentage of dust by volume shall be given in the ETA.

2.2.12 Water absorption

Short-term water absorption by partial immersion shall be determined according to EN ISO 29767, Method A.

The specimen thickness shall be 100 mm. At least 4 specimens shall be tested.

The maximum short-term value of water absorption W_p *[kg/m²]*

shall be stated in the ETA.

2.2.13 Thermal conductivity

The determination of the thermal conductivity and the mass-related moisture conversion coefficient to high moisture content based on lambda $\lambda_{(23,50)}$ shall be performed according to Annex A.

The determination of the thermal conductivity for the insulation material using extruded polystyrene shall be performed after ageing the insulation product according to Annex C.

The specimen thickness shall be between 50 mm and 100 mm. The test shall be performed at least on specimens with the highest density.

The following clauses provide instructions for the assessment of the 6 parameters that influence the thermal conductivity.

2.2.13.1 Lambda fractile value at 10 °C, at dry conditions

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

At least 10 specimens shall be tested.

The $\lambda_{10,dry,90/90}$ *[W/(mK)]* value is stated in the ETA.

2.2.13.2 Mass-related moisture conversion coefficient ($f_{u,1}$)

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

2.2.13.3 Lambda at 23 °C and 50 % relative humidity $\lambda_{(23,50)}$

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

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

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

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

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

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

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

2.2.13.6 Blowing agent (for extruded polystyrene products)

The used blowing agent influences the thermal conductivity and shall, therefore, be given in the ETA. The blowing agent shall be determined by a gas chromatography using the method of headspace technique in accordance with EN 13164 (Annex C.5).

For the preparation of gas specimens for analysis XPS granules shall be placed in a vial of 20 cm^3 such that half of the volume of the vial is covered by XPS granules.

The vial shall be tightened afterwards and heated up to 60°C for 30 minutes.

After heating the specimen, the gas phase in the vial shall be introduced to the gas chromatograph using a dosing device.

The blowing agent shall be given as supporting information to the thermal conductivity in the ETA.

2.2.14 Bulk density of the dry mixture of granulated polystyrene and compound or of the granulated polystyrene

The determination of the loose bulk density shall be carried out according to EN 1097-3 using EN 932 clause 6.2 b) to obtain test portions out of the dry mixture. For determining the bulk density a measuring vessel with a volume of at least 5 litres shall be used. No drying of the product at 110 ± 5 °C shall be done.

The range of bulk density *[kg/m³]* (range between minimum and maximum measured bulk density) shall be stated in the ETA.

2.2.15 Moisture sorption

The moisture sorption shall be determined according to one of the two equivalent methods given in EN ISO 12571.

The specimen size is at least 200x200x50 mm. The test shall be performed at least on specimens with the highest density.

The moisture sorption *u [kg/kg]* at 23 °C and 50 % RH and at 23 °C and 80 % RH can be identified from the sorption curve which shall be given in the ETA.

2.2.16 Alkaline resistance

The alkaline resistance of the final product shall be determined in accordance with EN ISO 175.

For the test, 12 cubes with side length of 100 mm shall be used.

The test duration shall be 7 days at a temperature of 23 ± 2°C.

As test solution a one percent sodium hydroxide solution (NaOH) shall be used

The assessment shall be carried out on the basis of the level of mean change of dimensions and mass in % (see EN ISO 175 clause 4.7.1) which shall be given in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance

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 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 plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory and on site in accordance with a test plan]					
1	Characteristics in accordance with the provisions of EN 16025-1 (Annex B)	EN 16025-1	see section 2.2.1 of this EAD and EN 16025-1	EN 16025-1	EN 16025-1
2	Dimensional stability	2.2.7	Control plan	2.2.7	Twice a year
3	Point load	2.2.8	Control plan	2.2.8	Twice a year
4	Impact sound reduction	2.2.9	Control plan	2.2.9	Once a year
5	Moisture sorption	2.2.17	Control plan	2.2.17	Twice a year
6	Chromium VI content check by the manufacturer according to his specifications	2.2.2.1	Control plan	2.2.2.1	Each incoming cement batch
7	HBCDD content check by the manufacturer according to his specifications	2.2.2.2	Control plan	2.2.2.2	Each incoming EPS and XPS batch
8	Reaction to fire of the of expanded polystyrene (EPS) and/or extruded polystyrene (XPS) granules	3.4	Control plan	3.4	Each incoming polystyrene batch

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 the insulation product are laid down in Table 3.3.1.

The involvement of the notified body is required only for reaction to fire and under the conditions defined in 1999/91/EC, as amended by 2001/596/EC.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the product in relation to reaction to fire, taking especially account of a clearly identifiable stage in the production process resulting in an improvement of the reaction to fire classification	Verification of the essential characteristic reaction to fire as described in the control plan agreed between the TAB and the manufacturer	According to Control plan	According to Control plan	When starting the production or a new line, or after its modification
Continuous surveillance, assessment and evaluation of factory production control					
2	The Notified Body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking account of the control plan in relation to reaction to fire and taking especially account of a clearly identifiable stage in the production process resulting in an improvement of the reaction to fire classification	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1 in relation to reaction to fire	According to Control plan	According to Control plan	once/year

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

3.4.1 Reaction to fire of the expanded polystyrene (EPS) and/or extruded polystyrene

The determination of the reaction to fire of the expanded polystyrene (EPS) and/or extruded polystyrene (XPS) granules shall be performed according to Annex D considering the following parameters:

- type of polystyrene granules (expanded or extruded) and
- the highest and lowest bulk density.

3.4.2 Density of fresh mortar

The density of fresh mortar (cement-based binder, water and polystyrene granules) shall be determined on the basis of EN 1015-6. Deviating from EN 1015-6, a measuring vessel (Ø 20 cm) with a volume of at least 5 litres shall be used. The vessel shall be filled in 3 equal layers of 50 mm. After each filling the layer shall be compacted by dropping a stick (Ø 4 cm, 0,3 kg) from a height of 3 cm by 30 times.

The characteristic density ρ_m *[kg/m³]* as the maximum value shall be stated in the ETA.

3.4.3 Bound polystyrene density

The apparent density shall be determined according to EN ISO 29470.

The specimen size is 500x500xmaximum thickness to be covered by the ETA in mm. At least 5 specimens shall be tested.

The mean density ρ_a *[kg/m³]* shall be stated in the ETA.

4. REFERENCE DOCUMENTS

EN 196-10:2016	Methods of testing cement – Part 10: Determination of the water-soluble chromium (VI) content of cement
EN 823:2013	Thermal insulating products for building applications - Determination of thickness
EN 933-1:2012	Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution — Sieving method
EN 932-2:1999	Tests for general properties of aggregates - Part 2: Methods for reducing laboratory samples
EN 1015-6:1998+A1:2006	Methods of test for mortar for masonry — Part 6: Determination of bulk density of fresh mortar
EN 1097-3:1998	Tests for mechanical and physical properties of aggregates - Part 3: Determination of loose bulk density and voids
EN 1602:2013	Thermal insulating products for building applications - Determination of the apparent density
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 12086:2013	Thermal insulating products for building applications — Determination of water vapour transmission properties
EN 12430:2013	Thermal insulating products for building applications — Determination of behaviour under point load
EN 12667:2001	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance
EN 12939:2000	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance
EN 13163:2012+A1:2015	Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification
EN 13164:2012+A1:2015	Thermal insulation products for buildings - Factory made extruded polystyrene foam (XPS) 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 reaction to fire tests
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 16025-1:2013	Thermal and/or sound insulating products in building construction — Bound EPS ballastings — Part 1: Requirements for factory premixed EPS dry plaster
EN 16733:2016	Reaction to fire tests for building products — Determination of a building product's propensity to undergo continuous smouldering
EN 16809-1:2019	Thermal insulation products of buildings in-situ formed products from loose-fill expanded polystyrene (EPS) beads and bonded expanded polystyrene beads - Part 1: Specification for the bonded and loose-fill products before installation”
EN 29052-1:1992	Acoustics – Determination of dynamic stiffness – Part 1: Materials used under floating floors in dwellings
EN ISO 175:2010	Plastics - Methods of test for the determination of the effects of immersion in liquid chemicals (ISO 175:2010)
EN ISO 717-2:2020	Acoustics - Rating of sound insulation in buildings and of building elements – Part 2: Impact sound insulation (ISO 717-2:2020)
EN ISO 9239-1:2010	Reaction to fire tests for floorings - Part 1: Determination of the burning behaviour using a radiant heat source (ISO 9239-1:2010)
EN ISO 10140-1:2021	Acoustics — Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1:2021)
EN ISO 10140-3:2021	Acoustics — Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation (ISO 10140-3:2021)
EN ISO 10456:2007+Cor 1:2009	Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values — Technical Corrigendum 1 (ISO 10456:2007 + Cor 1:2009)
EN ISO 11925-2:2020	Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2:2020)
EN ISO 12571:2021	Hygrothermal performance of building materials and products — Determination of hygroscopic sorption properties (ISO 12571:2021)
EN ISO 16534: 2020	Thermal insulating products for building applications — Determination of compressive creep (ISO 16534:2020)
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 the apparent density (ISO 29470:2020)
EN ISO 29767:2019	Thermal insulating products for building applications - Determination of short-term water absorption by partial immersion (ISO 29767:2019)
EN ISO 29770:2022	Thermal insulating products for building applications — Determination of thickness for floating floor insulating products (ISO 29770:2022)

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

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

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

A.1.1.1 Test specimens for the determination of the thermal conductivity λ at 10 °C shall be conditioned to dryness after storage for at least 72 hours at (65 ± 2)°C in an oven ventilated with air taken at (23 ± 2)°C and (50 ± 5)% relative humidity.

A.1.1.2 The thermal conductivity of the test specimens conditioned according to A.1.1.1 shall be measured according to EN 12667 or, for thick products, EN 12939 at a mean temperature of (10 ± 0,3) °C.

During the measurement, precaution shall be taken to avoid moisture absorption by the specimen. It is acceptable, for instance, to put the test specimen into a thin plastic bag.

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

The λ fractile value at 10 °C, at dry conditions ($\lambda_{10,dry,90/90}$) representing at least 90 % of the production with a confidence limit of 90 % shall be calculated using the principles as detailed in EN 13163, Annex A.

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

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

Set 1

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

Set 2

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

A.2.1 Procedure

A.2.1.1 Set 1

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

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

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

A.2.1.2 Set 2

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

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

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

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

where

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

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

A.2.1.2.4 Determine for each test specimen conditioned according to A.2.1.2.1 the λ value in accordance with EN 12667 or EN 12939 for thick products at a mean temperature of (10 ± 0,3) °C.

Average the values to determine $\lambda_{10,(23,50)}$.

A.2.1.3 Calculation of the mass-related moisture conversion coefficient ($f_{u,1}$)

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

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

where

$\lambda_{10,(23,50)}$ is determined according to A.2.1.2.4;

$\lambda_{10,dry}$ is determined according to A.2.1.1.3;

$u_{23,50}$ is determined according to A.2.1.2.3;

u_{dry} is determined according to A.2.1.1.2 and is defined to be 0.

A.3 Calculation of the thermal conductivity λ

The thermal conductivity λ shall be calculated using the following formula:

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

where

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

$f_{u,1}$ is determined according to A.2.1.3;

$u_{23,50}$ is determined according to A.2.1.2.3;

u_{dry} is determined according to A.2.1.1.2 and is defined to be 0.

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

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

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

Set 1

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

Set 2

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

A.4.1 Procedure

A.4.1.1 Set 1

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

A.4.1.2 Set 2

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

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

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

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

where

$m_{23,80}$ is the mass at 23 °C and 80 % relative humidity according to A.4.1.2.2;
m_{dry} is the mass according to A.2.1.1.2.

A.4.1.2.4 Determine for each test specimen conditioned according A.4.1.2.1 the λ value in accordance with EN 12667 or, for thick products, EN 12939 at a mean temperature of (10 ± 0,3) °C. Average the values to determine $\lambda_{10,(23,80)}$.

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

The mass-related moisture conversion coefficient to high moisture content $f_{u,2}$ shall be calculated by the following formula (derived from EN 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
$\lambda_{10,(23,80)}$ is determined according to A.4.1.2.4;
$\lambda_{10,(23,50)}$ is determined according to A.2.1.2;
$u_{23,80}$ is determined according to A.4.1.2.3.
$u_{23,50}$ is determined according to A.2.1.2.

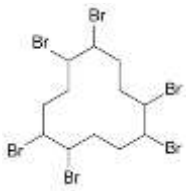
For the determination of the mass-related moisture conversion coefficient $f_{u,1}$ and the mass-related moisture conversion coefficient to high moisture content $f_{u,2}$, the test specimens shall be taken from the same production run.

NOTE 1: Thermal conductivity may also be measured at mean temperatures other than 10 °C, providing that the accuracy of the relationship between the temperature and thermal properties is well documented.

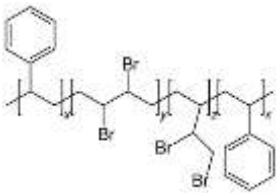
ANNEX B DETERMINATION OF THE HEXABROMOCYCLODODECANE (HBCDD) CONTENT

B.1. General

In the past, 95% of the flame-retardant polystyrene insulation products contained HBCDD.



New insulation products contain other flame retardants based on polymeric bromine (PolyFR) to replace HBCDD in polystyrene insulation materials.



HBCDD versus PolyFR

HBCDD and PolyFR differ in molecular weight (642 Da versus > 100000 Da), vapour pressure and solubility.

B.2. Test principle:

Due to the difference in solubility, a simple method based on quick extraction was established to measure the HBCDD-content of polystyrene.

HBCDD is dissolved in acetone and the related Bromine content of the liquid extract is measured via X-ray fluorescence analysis. Since, PolyFR is insoluble in acetone the measured Bromine content is used to determine the HBCDD content of the original specimen.

B.3. Procedure:

6,0 g of the homogenised specimena shall be weighed in a 500 ml beaker. 15,0 g of acetone shall be added to this beaker (dilution factor 3,5). The mixture shall be homogenised for 10 seconds.
Afterwards, 6.0 ml of the liquid extract (without any solid parts) shall be transferred to an XRF-specimen holder and the EDX-measurement (programme Brom-HBCDD) shall be started immediately.

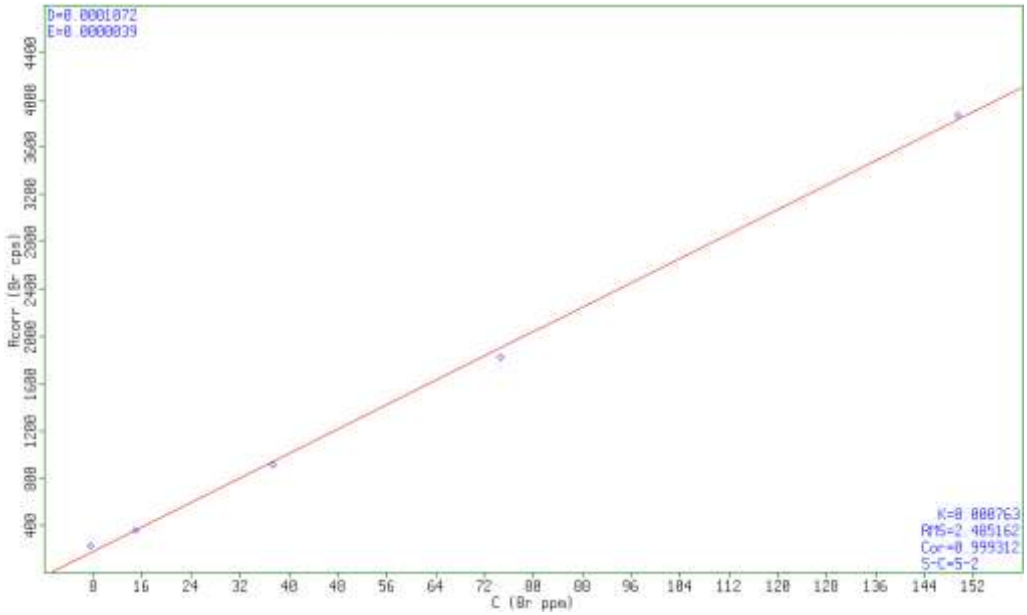
Device parameter and calibration:

The XRF analysis shall be performed on an, e.g., PANalytical Epsilon 3^{XLE} energy dispersive X-ray spectrometer, equipped with a Silver-Anode and a high-resolution Si-drift detector. The liquid samples shall be placed in sample holders with a bottom out of mylarfoil (Biaxially-oriented polyethylene terephthalate; 6µm thickness). For the measurement of Bromine, the intensity of the Br-K_α line shall be evaluated. Measurements shall take place under air-atmosphere for 60 seconds. Adjustments shall be set to 50 kV and 67 µA, additionally a 100 µm Ag-filter shall be used.

For the quantification of the measured peak intensities a calibration curve based on five standard samples was constructed.

[HBCDD]/ppm	[Br]/ppm	Measured Intensity/cps*
10	7,47	226,73
20	14,94	355,66
50	37,35	915,50
100	74,71	1822,40
200	149,42	3873,84

* counts per second



Calibration data:

Channel	Br (Brom)
K-factor	0,00076
RMS	2,49 ppm
Correlation	0,99931
No std – coeff	5 – 2
Concentration Range (Br)	7,47 – 149,42 (ppm)
Relative RMS	3,17 %
Matrix correction	No correction
D value	0,000107
E value	0,000004
F value	0,000000
sensitivity	25,8 cps/ppm

Calculation:

The measured intensity of the Br-K_α line shall be quantified according to the calibration curve shown above. The content of HBCDD in the original specimen is related to the Bromine concentration according to the following equation:

$$[HBCDD] = [Br] * \frac{M(HBCDD)}{6 * M(Br)} * d \; = \; [Br] * \frac{641{,}7}{6 * 79{,}9} * 3{,}5 \approx [Br] * \; 4{,}7$$

[HBCDD] concentration of HBCDD (ppm)

[Br] concentration of Bromine (ppm)

M () molecular mass of () (g/mol)

d dilution factor

The measurement programme includes the calculation above and directly shows the concentration of HBCDD as a result.

B.4. Test accuracy:

The LOD (limit of detection) of the method can be calculated as 35 ± 7 ppm Bromine, which corresponds to 47 ± 9 ppm HBCDD in the original specimen. The method promises high accuracy and reproducibility.

If PolyFR and HBCDD are present in one specimen at the same time, some small amounts of Bromine may be extracted from oligomers of PolyFR (maximum 50 ppm). However, the major portion of the brominated additive remains in the PolyFR polymer matrix.

ANNEX C DETERMINATION OF THE THERMAL CONDUCTIVITY AFTER AGEING FOR INSULATION MATERIAL USING EXTRUDED POLYSTYRENE

For the initial test and determination of the nominal value, based on Annex C of EN 13164:
Testing of the thermal conductivity of the **BXPS BULK MATERIAL** on uncut test specimens with a thickness between 50 mm and 100 mm conditioned after the standardized drying time of 28 days and further not until 62 days after the production of the granules.

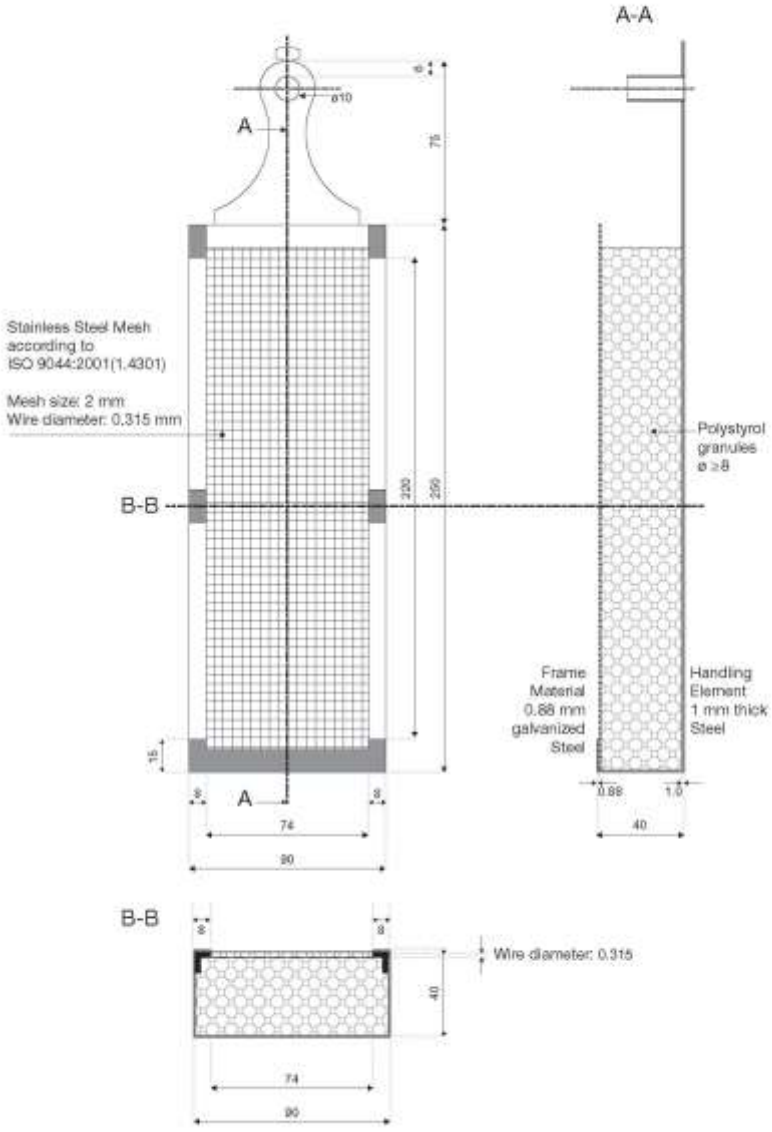
In the prescribed time, the gases have escaped from the granulate and the thermal conductivity remains stable.

ANNEX D REACTION TO FIRE OF THE EXPANDED POLYSTYRENE (EPS) AND/OR EXTRUDED POLYSTYRENE (XPS) GRANULES

Mounting and fixing of loose fill material in EN ISO 11925-2 test configuration

A specimen holder 250mm x 90 mm x 40 mm as shown below shall be used.

1. When making the specimens the surface shall be as even as possible.
2. It is deemed sufficient to carry out the tests with a surface flame attack. Edge flame attack tests are not necessary.



The same mesh as for the front sash shall be used for backside and lateral sides of the specimen holder.

The ground of the holder shall be made of a 0,88 mm thick non-galvanized steel sheet. Front sash can be removed for filling and cleaning the specimen holder. A handling element made of 1 mm thick steel is welded to the specimen holder with fixing element to the EN ISO 11925-2 test apparatus.

ANNEX E ADDITIONAL PROVISIONS FOR THE DETERMINATION OF THE PROPENSITY TO UNDERGO CONTINUOUS SMOULDERING

E.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 polystyrene as well as produced in a certain production process);
- type of production process;
- the product or product variant with the highest and lowest density, determined by tests according to EN 1602;
- the product or product variant with the highest thickness, determined by tests according to EN 823 on at least three specimens;
- without any non-substantial facings, coatings (1 mm and < 1 kg/m²) or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

E.2 Preparation of tests specimens

If the total thickness of taken samples is higher than 100 mm, the thickness of the specimens shall be reduced from their unexposed backside to obtain the maximum testable thickness of 100 mm.

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

E.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. binder type and polystyrene, 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 any non-substantial facings or coatings (1 mm and < 1 kg/m²) or suchlike,
- for any end-use conditions.