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European Assessment Document for

Open-cell factory-made rigid
polyurethane foam (PUR) and
polyisocyanurate foam (PIR) products
for building equipment and
industrial installations



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

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1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers open cell factory-made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products for building equipment and industrial installations (in the following referred to as rigid foam products). The products have a percentage of open cells of at least 90 %, and can be provided with or without facings.

The products are produced by using high molecular weight blowing agents such as hydro fluorocarbons and hydrocarbons (e.g., pentanes) or carbon dioxide. The blowing agents can also be used mixed together.

The products are manufactured in the form of pipe insulation shells (pipe sections).

The product is not fully covered by the following harmonised technical specification: EN 14308¹.

EN 14308 covers products with a closed cell content not less than 90 %, which means an open cell content less than 10 %. In contrast to that, this EAD covers products with an open cell content of at least 90 %. For closed cell products covered by EN 14308 the determination of the thermal conductivity after aging is required and a factor has to be determined as through gas exchange between cells and air by diffusion processes the thermal conductivity can worsen (depending on cell gas). In the case of open cell products, which are covered by this EAD, such an ageing procedure is not relevant, rather the thermal conductivity is measured after complete gas exchange between cells and air. For other relevant characteristics the test procedures do not differ. They are used in general for thermal insulation products.

Since the EAD covers pipe insulation shells (pipe sections) only, the determination of flatness is not relevant. This EAD only covers products which meet the deviations from length, thickness, internal diameter, squareness and linearity given in EN 14308 (table 1, clause 4.2.2.2 and 4.2.2.4).

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

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

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

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

1.2.1 Intended use(s)

The products are intended to be used as thermal insulation for technical building equipment (e.g., sanitary and heating) and industrial installations, with an operating temperature range of approximately -200 °C to + 200 °C.

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.

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 rigid foam products for the intended use of 25 years when installed in the works provided that the rigid foam products are subject to appropriate installation. 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 works².

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 rigid foam products is assessed in relation to the essential characteristics.

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

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
2	Propensity to undergo continuous smouldering	2.2.2	Description
Basic Works Requirement 3: Hygiene, health and the environment			
3	Trace quantities of water-soluble ions and pH-value	EN 14308, clause 4.3.8	Level
Basic Works Requirement 4: Safety and accessibility in use			
4	Deviation from length, thickness, internal diameter	2.2.3.1	Level
5	Deviation from squareness	2.2.3.2	Level
6	Linearity	2.2.3.3	Level
7	Maximum application (service) temperature	EN 14308, clause 4.3.2	Level
8	Minimum application (service) temperature	EN 14308, clause 4.3.3	Level
Basic Works Requirement 6: Energy economy and heat retention			
9	Thermal conductivity	2.2.4	Level
10	Closed cell content	2.2.5	Level
11	Water absorption	EN 14308, clause 4.3.6.1 and clause 4.3.6.2	Level
12	Water vapour transmission	EN 14308, clause 4.3.5	Level

No	Essential characteristic	Assessment method	Type of expression of product performance
13	Compression stress or compressive strength	EN 14308, clause 4.3.4.1	Level
14	Dimensional stability at specified temperature	EN 14308, clause 4.2.3	Level
15	Point load	EN 14308, clause 4.3.4.2	Level
16	Compressive creep	EN 14308, clause 4.3.4.3	Level
17	Release of dangerous substances	EN 14308, clause 4.3.9	Level
18	Durability characteristics	EN 14308, clause 4.2.5	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.

2.2.1 Reaction to fire

The rigid foam products shall be tested, using the test 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.

Analogously to the statement in clause 4.2.4 of EN 14308, table 1 of EN 13501-1 is applicable to products applied to curved surfaces with an outer diameter of the insulation product greater than 300 mm. Table 3 in EN 13501-1 is applicable for products applied with an outer diameter below or equal 300 mm.

Concerning mounting and fixing the provisions of EN 15715 shall apply. The provisions of Annex A.5 of EN 15715 shall be considered for choosing and preparing the test specimens with regard to product and installation parameters, but with the following exception. Deviating from those provisions of EN 15715, Annex A.5, highest and lowest density shall be tested to consider the density range of the product covered by the ETA. Different wall thicknesses of the product shall be taken into account as prescribed in EN 15715, but if these wall thicknesses are not available in combination with an inner diameter of 22 mm, the following rules shall apply for the SBI tests according to EN 13823:

- If an inner diameter of less than 22 mm is available, the largest inner diameter closest to 22 mm shall be used for testing,
- If only larger inner diameters are available, each relevant wall thickness shall be tested in combination with its minimum and maximum inner diameter (at least one single test with each combination and at least two further tests with the most critical case).

The reaction to fire class of the product is given in the ETA.

2.2.2 Propensity to undergo continuous smouldering

The performance of the propensity to undergo continuous smouldering of rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) 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 A.

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”.

2.2.3 Geometrical properties (Deviations)

Products with a surface facing or natural skin shall be tested without removing them.

2.2.3.1 Deviation from length, thickness, internal diameter

The length, thickness and internal diameter shall be determined in accordance with EN 13467 with at least 3 test specimens representing the density range of the product to be covered by the ETA. Different dimensions of the product shall be taken into account because depending on the minimum and maximum dimensions, different absolute values of deviations may occur.

The maximum deviations (negative and positive values) from the length, l , thickness, d , and internal diameter, D_i , shall be given in the ETA in millimetres, rounded upwards to the nearest millimetre. No test result shall exceed the deviations given in EN 14308, Table 1.

2.2.3.2 Deviation from squareness

The squareness shall be determined in accordance with EN 13467 with at least 3 test specimens representing the density range of the product covered by the ETA. Different dimensions of the product shall be taken into account because depending on the minimum and maximum dimensions, different absolute values of deviations may occur.

The maximum deviation from squareness, v , shall be given in the ETA in millimetre, rounded upwards to the nearest millimetre. No test result shall exceed the values given in EN 14308, clause 4.2.2.2.

2.2.3.3 Deviation from linearity

The linearity shall be determined in accordance with EN 13467 with at least 3 test specimens representing the density range of the product covered by the ETA. Different dimensions of the product shall be taken into account because depending on the minimum and maximum dimensions, different absolute values of deviations may occur.

The maximum deviation from linearity, L , shall be given in the ETA in millimetre, rounded upwards to the nearest millimetre. No test result shall exceed the values given in EN 14308, clause 4.2.2.4.

2.2.4 Thermal conductivity

As the density has a direct impact on the thermal conductivity the density of the products shall be determined in accordance with EN 13470 with at least 3 test specimens before measuring the thermal conductivity. Different dimensions of the product shall be taken into account because depending on the minimum and maximum dimensions, different ranges of the density may occur. Products with a surface facing shall be tested without them. The range of density shall be given in the ETA in kg/m^3 in conjunction with the corresponding thermal conductivity with the minimum and maximum value of the density of the product as resulted from the 3 specimens to describe the deviations/inhomogeneities of the products.

Before measuring the thermal conductivity, the test according to clause 2.2.5 (closed cell content) has to be carried out. The thermal conductivity is measured after complete gas exchange between cells and air in accordance with EN 14308 Annex D, table D.1³ and as described below. Therefore, a determination of the thermal conductivity after aging is not required.

The cell gas composition is tested with a gas chromatograph after storage of at least 42 days before determination of the thermal conductivity. If a complete gas exchange has not been reached after 42 days the samples are conditioned at (70 ± 2) °C until a complete exchange has been achieved (blowing agent ≤ 2 Vol.-%). The determination of the cell gas composition shall be carried out on the test specimens used for the thermal conductivity measurements. For this purpose, at least 3 gas samples shall be taken from each test specimen using a syringe. To do this, the needle of a gas-tight injection syringe is inserted at least 30 mm deep into the foam material, at an angle to the surface if the layer thickness is too thin. By pulling out the plunger slowly and evenly, around 5 μ l to 8 μ l of pore gas is extracted from the puncture site. Two pore gas samples are used to rinse the syringe. Therefore, three gas samples are taken next to each other puncture sites. If different syringes are not used, they are rinsed with a highly volatile solvent (e.g. methylene chloride) after every third extracting and sucked dry on the vacuum (serves to prevent a blockage of the syringes).

The thermal conductivity λ_D is determined in accordance with EN ISO 8497 respecting the the principles given in EN ISO 13787, clause 5.1 and given in the ETA in accordance with EN ISO 13787. The test specimens shall be stored at (23 ± 2) °C and (50 ± 5) % relative humidity for at least 16 h before testing. The thermal conductivity shall be determined for the full-service temperature range of the product as covered by the ETA. Measurements of thermal conductivity made on two internal diameters of pipe sections at the greatest and smallest insulation thickness for each set of the diameters are deemed to be representative of the total product range.

The thermal conductivity λ_D , based on $\lambda_{90/90}$ (representing at least 90 % of the production with a confidence level of 90 %), is given in the ETA in levels with steps of 0,001 W/(m·K). The thermal conductivity shall be given in a table in accordance with EN ISO 13787, Annex C. Additionally, a limit curve as defined in EN ISO 13787 can be added.

According to EN ISO 10456 the moisture factor for the conversion of $\lambda_{23/50}$ to $\lambda_{23/80}$ amounts to $F_m = 1.00$. See EN ISO 10456, table 4 for polyurethane foam and equation 5 in EN ISO 10456, clause 7.3.

2.2.5 Closed cell content

The closed cell content (corrected) is determined in accordance with EN ISO 4590, method 1. In accordance with EN 14308 surface facings or natural skins shall be removed. The range of the closed cell content of the products covered by the ETA is given in the ETA using steps of 1 %.

³ S. Lohmeyer, G. Müller, Determination of the cell gas amount and composition in polyurethane foams, Journal of cooling technic and air conditioning (Kältetechnik Klimatisierung), 22nd year, volume 3 (1970), pages 291–295

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 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)					
1	Reaction to fire	2.2.1	According to control plan	EN 13501-1	EN 14308, Table A.2
2	Trace quantities of water-soluble ions and pH-value	EN 14308, clause 4.3.8	According to control plan	EN 14308	EN 14308, Table A.1
3	Geometry	2.2.3	According to control plan	1	Once per day
4	Maximum application (service) temperature	EN 14308, clause 4.3.2	According to control plan	EN 14308	EN 14308, Table A.1
5	Minimum application (service) temperature	EN 14308, clause 4.3.3	According to control plan	EN 14308	EN 14308, Table A.1
6	Thermal conductivity	2.2.4	According to control plan	1	EN 14308, Table A.1
7	Closed cells content	2.2.5	According to control plan	3	2 per year
8	Water absorption	EN 14308, clause 4.3.6.1 and clause 4.3.6.2	According to control plan	EN 14308	EN 14308, Table A.1
9	Water vapour transmission	EN 14308, clause 4.3.5	According to control plan	EN 14308	EN 14308, Table A.1
10	Compression stress or compressive strength	EN 14308, clause 4.3.4.1	According to control plan	EN 14308	EN 14308, Table A.1
11	Dimensional stability at specified temperature	EN 14308, clause 4.2.3	According to control plan	EN 14308	EN 14308, Table A.1
12	Point load	EN 14308, clause 4.3.4.2	According to control plan	EN 14308	EN 14308, Table A.1
13	Compressive creep	EN 14308, clause 4.3.4.3	According to control plan	EN 14308	EN 14308, Table A.1
14	Release of dangerous substances	EN 14308, clause 4.3.9	According to control plan	EN 14308	EN 14308, Table A.1
15	Propensity to undergo continuous smouldering	Indirect - see no. 3 and density acc. to EN 13470	Control plan	1	Once per day
		2.2.2	Control plan	1	Once per two years

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.3.1.

The intervention of the notified body under AVCP system 1 is only necessary for reaction to fire for (including propensity to undergo continuous smouldering) products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g., an addition of fire retardants or a limiting of organic material)⁴.

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	<p>The notified body shall verify the ability of the manufacturer for a continuous and orderly manufacturing of the product according to the European Technical Assessment, taking especially into account a limiting of organic material, the addition of fire retardants and/or another clearly identifiable stage in the production process which results in the improvement of the reaction to fire classification and/or the propensity to undergo continuous smouldering. In particular the following items shall be appropriately considered</p> <ul style="list-style-type: none"> – presence of suitable test equipment – presence of trained personnel – the suitability of the factory production control established by the manufacturer – full implementation of the prescribed test plan 	Verification of the complete FPC, to be implemented by the manufacturer	See control plan	-	Before certification and starting the production process, after its modification and when starting a new production line
Continuous surveillance, assessment and evaluation of factory production control					
2	<p>It shall be verified that the system of factory production control and the specified manufacturing process are maintained, taking into account a limiting of organic material, the addition of fire retardants and/or another clearly identifiable stage in the production process which results in the improvement of the reaction to fire classification and/or the propensity to undergo continuous smouldering. In particular the following items shall be appropriately considered:</p> <ul style="list-style-type: none"> – Inspection of factory, of the production of the product and of the facilities for factory production control – Evaluation of the documents concerning factory production control – Issuing a report of surveillance 	Verification of the controls carried out by the manufacturer on the raw materials, on the process and on the product as indicated in Table 3.2.1	See control plan	-	Annually

⁴

Only relevant for products of class C and higher (cf. Commission Decisions mentioned in clause 3.1)

4 REFERENCE DOCUMENTS

EN ISO 4590:2016	Rigid cellular plastics – Determination of the volume percentage of open cells and of closed cells (ISO 4590:2016)
EN ISO 8497:1996	Thermal insulation – Determination of steady-state thermal transmission properties of thermal insulation for circular pipes (ISO 8497:1994)
EN ISO 10456:2007 + AC:2009	Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007+Cor. 1:2009)
EN 13467:2018	Thermal insulating products for building equipment and industrial installations – Determination of dimensions, squareness and linearity of preformed pipe insulation
EN 13468:2001	Thermal insulating products for building equipment and industrial installations - Determination of trace quantities of water-soluble chloride, fluoride, silicate, and sodium ions and pH
EN 13470:2001	Thermal insulating products for building equipment and industrial installations – Determination of the apparent density of preformed pipe insulation
EN 13501-1:2018	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests
EN 13823:2020+A1/2023	Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning
EN ISO 13787:2003	Thermal insulation products for building equipment and industrial installations - Determination of declared thermal conductivity (ISO 13787:2003)
EN 14308:2009+A1:2013	Thermal insulation products for building equipment and industrial installations – Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products - Specification
EN 14707:2012	Thermal insulating products for building equipment and industrial installations – Determination of maximum service temperature for preformed pipe insulation
EN 15715:2009	Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products
EN 16733:2016	Reaction to fire tests for building products - Determination of a building product's propensity to undergo continuous smouldering
Additional information: Gas chromatograph	S. Lohmeyer, G. Müller, Determination of the cell gas amount and composition in polyurethane foams, Journal of cooling technic and air conditioning (Kältetechnik Klimatisierung), 22nd year, volume 3 (1970), pages 291–295

ANNEX A - ADDITIONAL PROVISIONS FOR THE DETERMINATION OF THE PROPENSITY TO UNDERGO CONTINUOUS SMOULDERING OF THE THERMAL INSULATION BOARDS

A.1 Sample input data

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 / treatment, and produced in a certain type of production process)⁵;
- the product or product variant with the highest and lowest density, determined by tests according to EN 13470 on at least 3 test specimens,
- the product or product variant with the highest wall thickness of the pipe insulation sections, determined by tests according to EN 13467 on at least three specimens,
- the product or product variant with the highest outer diameter of the pipe insulation section according to manufacturer's specification,
- without any non-substantial facings, coatings (< 1 mm or < 1 kg/m²) or suchlike – existing facings or coatings shall be removed when preparing the test specimens.

If the highest insulation thickness of linear pipe insulation material is higher than 100 mm, the above-mentioned rule shall apply.

A.2 Preparation of tests specimens

The specimens shall be prepared and tested in length direction of the pipe insulation sections.

If the highest available wall thickness is greater than 100 mm, either the thickness shall be reduced from the inside (facing the pipes in practice) to a thickness of 100 mm or, as equivalent alternative, the specimens shall be taken from a pipe insulation section with a wall thickness of 100 mm.

In case that the highest outer diameter of the product is too large for the test apparatus, cut sections with the highest wall thickness (see before) shall be prepared for testing.

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

A.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 or the tested density (with a tolerance of $\pm 10\%$), if only one was tested,
- with lower wall thickness and also with greater wall thickness when 100 mm thick specimens were tested,
- without or with any non-substantial facings or coatings (< 1 mm and < 1 kg/m²) or suchlike and
- for any end-use conditions.

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To permit the TAB to apply EXAP-rules for test results within the assessment, it is recommended that the manufacturer provides sufficient information (e.g., on the basis of the composition of the product in question), allowing the TAB to determine which products or product variants shall be submitted to testing and to reduce the number of tests required.