BS EN 13165:2012

Thermal insulation products for buildings — Factory made rigid polyurethane foam (PU) products — Specification
National foreword

This British Standard is the UK implementation of EN 13165:2012.
It supersedes BS EN 13165:2008, which is withdrawn.

The UK participation in its preparation was entrusted to
Technical Committee PRI/72/4, Polyurethane.

A list of organizations represented on this committee can be
obtained on request to its secretary.

This publication does not purport to include all the necessary
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Produits isolants thermiques pour le bâtiment - Produits manufacturés en mousse rigide de polyuréthane (PU) - Spécification

Wärmedämmstoffe für Gebäude - Werkmäßig hergestellte Produkte aus Polyurethan-Hartschaum (PU) - Spezifikation

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CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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Foreword

This document (EN 13165:2012) has been prepared by Technical Committee CEN/TC 88 “Thermal insulating materials and products”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13165:2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Compared with EN 13165:2008, the main changes are:

a) better harmonisation between the different standards of the package (EN 13162 to EN 13171) on definitions, requirements, classes and levels;

b) new normative annex on multi-layered products;

c) changes on some editorial and technical content and addition of information on some specific items for PU products such as: PU product term, dimensional stability, point load (cancelled), water absorption, water vapour transmission;

d) addition of links to EN 15715, Thermal insulation products — Instructions for mounting and fixing for reaction to fire testing — Factory made products;

e) changes to the Annex ZA.

This standard is one of a series of standards for thermal insulation products used in buildings, but this standard may be used in other areas where appropriate.

In pursuance of Resolution BT 20/1993 Revised, CEN/TC 88 has proposed defining the standards listed below as a package of documents.

The package of standards comprises the following group of interrelated standards for the specifications of factory made thermal insulation products, all of which come within the scope of CEN/TC 88:

EN 13162, Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification

EN 13163, Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification

EN 13164, Thermal insulation products for buildings — Factory made extruded polystyrene foam (XPS) products — Specification

EN 13165, Thermal insulation products for buildings — Factory made rigid polyurethane foam (PU) products — Specification
EN 13166, Thermal insulation products for buildings — Factory made phenolic foam (PF) products — Specification

EN 13167, Thermal insulation products for buildings — Factory made cellular glass (CG) products — Specification

EN 13168, Thermal insulation products for buildings — Factory made wood wool (WW) products — Specification

EN 13169, Thermal insulation products for buildings — Factory made expanded perlite board (EPB) products — Specification

EN 13170, Thermal insulation products for buildings — Factory made products of expanded cork (ICB) — Specification

EN 13171, Thermal insulation products for buildings — Factory made wood fibre (WF) products — Specification

The reduction in energy used and emissions produced during the installed life of insulation products exceeds by far the energy used and emissions made during the production and disposal processes.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.
1 Scope

This European Standard specifies the requirements for factory made rigid polyurethane foam (PU) products, with or without facings or coatings, which are used for the thermal insulation of buildings. PU includes both PIR and PUR products. The products are manufactured in the form of boards.

Products covered by this standard are also used in prefabricated thermal insulation systems and composite panels; the performance of systems incorporating these products is not covered.

This standard describes product characteristics and includes procedures for testing, evaluation of conformity, marking and labelling.

This standard does not specify the required level of a given property to be achieved by a product to demonstrate fitness for purpose in a particular application. The levels required for a given application are to be found in regulations or non-conflicting standards.

Products with a declared thermal resistance lower than 0,25 m²K/W or a declared thermal conductivity greater than 0,060 W/(m·K) at 10 °C are not covered by this European Standard.

This standard does not cover in situ insulation products and products intended to be used for the insulation of building equipment and industrial installations (covered by EN 14308).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 822, Thermal insulating products for building applications — Determination of length and width
EN 823, Thermal insulating products for building applications — Determination of thickness
EN 824, Thermal insulating products for building applications — Determination of squareness
EN 825, Thermal insulating products for building applications — Determination of flatness
EN 826, Thermal insulating products for building applications — Determination of compression behaviour
EN 1604, Thermal insulating products for building applications — Determination of dimensional stability under specified temperature and humidity conditions
EN 1605, Thermal insulating products for building applications — Determination of deformation under specified compressive load and temperature conditions
EN 1606, Thermal insulating products for building applications — Determination of compressive creep
EN 1607, Thermal insulating products for building applications — Determination of tensile strength perpendicular to faces
EN 1609, Thermal insulating products for building applications — Determination of short term water absorption by partial immersion
EN 12086:1997, Thermal insulating products for building applications — Determination of water vapour transmission properties
EN 12087, Thermal insulating products for building applications — Determination of long term water absorption by immersion
3 Terms, definitions, symbols, units and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 9229:2007 apply with exception or in addition of the following:

3.1.1 rigid polyurethane foam (PU)
family of rigid cellular thermoset polymeric insulation products with a substantially closed cell structure including both polymer types based on PIR and PUR

3.1.1.1 PIR
rigid cellular thermoset polymeric insulation product with a substantially closed cell structure based on polymers mainly of polyisocyanurate groups
3.1.1.2

PUR

rigid cellular thermoset polymeric insulation product with a substantially closed cell structure based on
copolymers mainly of polyurethane groups

Note 1 to entry: Regarding the properties described in this standard, PIR and PUR types are not distinguished
between.

3.1.2

level

value which is the upper or lower limit of a requirement and given by the declared value of the characteristic
concerned

3.1.3

class

combination of two levels of the same property between which the performance shall fall

3.1.4

board; slab

rigid or semi-rigid (insulation) product of rectangular shape and cross section in which the thickness is uniform
and substantially smaller than the other dimensions

Note 1 to entry: Boards are usually thinner than slabs. They may also be supplied in tapered form.

3.1.5

facing

functional or decorative surface layer with a thickness of less than 3mm, e.g. paper, plastic film, fabric or metal
foil, which are not considered as separate thermal insulation layer to be added to the thermal resistance of the
product

3.1.6

coating

functional or decorative surface layer with a thickness of less than 3 mm usually applied by painting, spraying,
pouring or trowelling, which is not considered as separate thermal insulation layer to be added to the thermal
resistance of the product

3.1.7

composite insulation product

product which can be faced or coated made from two or more layers bonded together by chemical or physical
adhesion consisting of at least one factory made thermal insulation material layer

3.1.8

multi-layered insulation product

product which can be faced or coated made from two or more layers of a thermal insulation material from the
same European Standard, which are bonded together by chemical or physical adhesion

3.2 Symbols, units and abbreviated terms

For the purposes of this document, the following symbols and units apply.

\[ \alpha_p \]  
is the practical sound absorption coefficient

\[ \alpha_w \]  
is the weighted sound absorption coefficient

\[ b \]  
is the width  \( \text{mm} \)

\[ d \]  
is the thickness  \( \text{mm} \)

\[ d_N \]  
is the nominal thickness of the product  \( \text{mm} \)

\[ d_S \]  
is the thickness of the test specimen  \( \text{mm} \)

\[ \Delta \varepsilon_b \]  
is the relative change in width  \( \% \)
Δε\textsubscript{d} is the relative change in thickness  
Δε\textsubscript{l} is the relative change in length  
X\textsubscript{ct} is the compressive creep  
ε\textsubscript{t} is the total thickness reduction  
k is a factor related to the number of test results  
k\textsubscript{a} is a factor related to the number of aged test results  
k\textsubscript{i} is a factor related to the number of initial test results  
l is the length  
λ\textsubscript{90/90} is the 90 % fractile with a confidence level of 90 % for the thermal conductivity  
λ\textsubscript{D} is the declared thermal conductivity  
λ\textsubscript{i} is one test result of thermal conductivity  
λ\textsubscript{mean} is the mean thermal conductivity  
λ\textsubscript{mean,a} is the mean thermal conductivity of aged values  
λ\textsubscript{mean,i} is the mean thermal conductivity of initial values  
λ\textsubscript{U} is the design thermal conductivity  
Δλ\textsubscript{a} is the ageing increment from measured aged values of thermal conductivity  
Δλ\textsubscript{i} is the fixed ageing increment  
μ is the water vapour diffusion resistance factor  
n is the number of test results  
R\textsubscript{90/90} is the 90 % fractile with a confidence level of 90 % for the thermal resistance  
R\textsubscript{D} is the declared thermal resistance  
R\textsubscript{i} is one test result of thermal resistance  
R\textsubscript{mean} is the mean thermal resistance  
R\textsubscript{U} is the design thermal resistance  
S\textsubscript{b} is the deviation from squareness on length and width  
S\textsubscript{max} is the deviation from flatness  
s\textsubscript{R} is the estimate of the standard deviation of the thermal resistance  
s\textsubscript{λ} is the estimate of the standard deviation of the thermal conductivity  
s\textsubscript{λ,a} is the estimate of the standard deviation of the aged values of the thermal conductivity  
s\textsubscript{λ,i} is the estimate of the standard deviation of the initial values of the thermal conductivity  
σ\textsubscript{c} is the declared compressive stress  
σ\textsubscript{10} is the compressive stress at 10 % deformation  
σ\textsubscript{m} is the compressive strength  
σ\textsubscript{mt} is the tensile strength perpendicular to faces  
W\textsubscript{lt} is the long term water uptake by total immersion  
W\textsubscript{sp} is the short term water uptake by partial immersion  
W\textsubscript{lp} is the long term water uptake by partial immersion  
Z is the water vapour resistance  
λ\textsubscript{90/90} W/(m·K)  
λ\textsubscript{D} W/(m·K)  
λ\textsubscript{i} W/(m·K)  
λ\textsubscript{mean} W/(m·K)  
λ\textsubscript{mean,a} W/(m·K)  
λ\textsubscript{mean,i} W/(m·K)  
λ\textsubscript{U} W/(m·K)  
Δλ\textsubscript{a} W/(m·K)  
Δλ\textsubscript{i} W/(m·K)  
μ –  
n –  
R\textsubscript{90/90} m\textsuperscript{2}·K/W  
R\textsubscript{D} m\textsuperscript{2}·K/W  
R\textsubscript{i} m\textsuperscript{2}·K/W  
R\textsubscript{mean} m\textsuperscript{2}·K/W  
R\textsubscript{U} m\textsuperscript{2}·K/W  
S\textsubscript{b} mm/m  
S\textsubscript{max} mm  
s\textsubscript{R} m\textsuperscript{2}·K/W  
s\textsubscript{λ} W/(m·K)  
s\textsubscript{λ,a} W/(m·K)  
s\textsubscript{λ,i} W/(m·K)  
σ\textsubscript{c} kPa  
σ\textsubscript{10} kPa  
σ\textsubscript{m} kPa  
σ\textsubscript{mt} kPa  
W\textsubscript{lt} % Vol.  
W\textsubscript{sp} kg/m\textsuperscript{2}  
W\textsubscript{lp} kg/m\textsuperscript{2}  
Z m\textsuperscript{2}·h·Pa/mg
AP is the symbol of the declared value of practical sound absorption coefficient
AW is the symbol of the declared value of weighted sound absorption coefficient
CC(i/12/y)σc is the symbol of the declared level for compressive creep
CS(10\Y) is the symbol of the declared level for compressive stress or strength
DLT(i)5 is the symbol of the declared level for deformation under load and temperature at conditions set with a maximum of 5 % deformation
DS(23,90) or DS(70,90) is the symbol of the declared level for dimensional stability under specified temperature and humidity
DS(70,-) or DS(20,-) is the symbol of the declared level for dimensional stability under specified temperature
MU is the symbol of the declared value for the water vapour diffusion resistance factor
FW is the symbol of the declared level for change in deviation from flatness after one-sided wetting
T is the symbol of the declared class for thickness tolerances
TR is the symbol of the declared level for tensile strength perpendicular to faces
WL (T) is the symbol of the declared value for long term water absorption by total immersion
WS (P) is the symbol of the declared value for short term water absorption by partial immersion
WL (P) is the symbol of the declared value for long term water absorption by partial immersion
Z is the symbol of the declared value for water vapour resistance

Abbreviated terms used in this standard

PU is rigid PolyUrethane foam including PIR and PUR
ITT is Initial Type Test
FPC is Factory Production Control
MLn is Multi-Layered product (n for number of layers)
RIF is Reaction to Fire

4 Requirements

4.1 General

Product properties shall be assessed in accordance with Clause 5. To comply with this standard, products shall meet the requirements of 4.2, and the requirements of 4.3 as appropriate.

One test result for a product property is the average of the measured values on the number of test specimens given in Table 11.

For multi-layered products, additional requirements are given in Annex D.

NOTE Information on additional properties is given in Annex E.
4.2 For all applications

4.2.1 Thermal resistance and thermal conductivity

Thermal resistance and thermal conductivity shall be based upon measurements carried out in accordance with EN 12667 or EN 12939 for thick products.

The thermal resistance and thermal conductivity shall be determined in accordance with Annex A and Annex C and declared by the manufacturer according to the following:

— the reference mean temperature shall be 10 °C;
— the measured values shall be expressed with three significant figures;
— for products of uniform thickness, the thermal resistance, \( R_D \), shall always be declared. The thermal conductivity, \( \lambda_D \), shall be declared where possible. Where appropriate, for products of non-uniform thickness (e.g. for sloped and tapered products) only the thermal conductivity, \( \lambda_D \), shall be declared;
— the declared thermal resistance, \( R_D \), and the declared thermal conductivity, \( \lambda_D \), shall be given as limit values representing at least 90 % of the production, determined with a confidence level of 90 %;
— the statistical value of thermal conductivity, \( \lambda_{90/90} \), shall be rounded upwards to the nearest 0,001 W/(m·K) and declared as \( \lambda_D \) in levels with steps of 0,001 W/(m·K);
— the declared thermal resistance, \( R_D \), shall be calculated from the nominal thickness, \( d_N \), and the corresponding thermal conductivity \( \lambda_{90/90} \), unless measured directly;
— the statistical value of thermal resistance, \( R_{90/90} \), when calculated from the nominal thickness, \( d_N \), and the corresponding thermal conductivity, \( \lambda_{90/90} \), shall be rounded downwards to the nearest 0,05 m²·K/W, and declared as \( R_D \) in levels with steps of 0,05 m²·K/W;
— the statistical value of thermal resistance \( R_{90/90} \), for those products for which only the thermal resistance is measured directly, shall be rounded downwards to the nearest 0,05 m²·K/W and declared as \( R_D \) in levels with steps of 0,05 m²·K/W.

NOTE \( \lambda_D \) and \( R_D \) (design values) may be determined with reference to EN ISO 10456.

4.2.2 Length and width

Length, \( l \), and width, \( b \), shall be determined in accordance with EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 1.

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>Tolerances (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 000</td>
<td>± 5</td>
</tr>
<tr>
<td>1 000 to 2 000</td>
<td>± 7.5</td>
</tr>
<tr>
<td>2 001 to 4 000</td>
<td>± 10</td>
</tr>
<tr>
<td>&gt; 4 000</td>
<td>± 15</td>
</tr>
</tbody>
</table>

4.2.3 Thickness

Thickness, \( d \), shall be determined in accordance with EN 823. No test result shall deviate from the nominal thickness, \( d_N \), by more than the tolerances given in Table 2 for the declared class.
Table 2 — Classes for thickness tolerances

<table>
<thead>
<tr>
<th>Class</th>
<th>Nominal thickness mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 50</td>
</tr>
<tr>
<td>Tolerance mm</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>± 3</td>
</tr>
<tr>
<td>T2</td>
<td>± 2</td>
</tr>
<tr>
<td>T3</td>
<td>± 1,5</td>
</tr>
</tbody>
</table>

4.2.4 Squareness

Squareness shall be determined in accordance with EN 824. The deviation from squareness on length and width, $S_b$, shall not exceed 5 mm/m.

4.2.5 Flatness

Flatness shall be determined in accordance with EN 825. The deviation from flatness, $S_{max}$, shall not exceed the values given in Table 3.

Table 3 — Deviation from flatness

<table>
<thead>
<tr>
<th>Full-size product</th>
<th>Deviation from flatness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length m</td>
<td>Area $m^2$</td>
</tr>
<tr>
<td>≤ 2,50</td>
<td>≤ 0,75</td>
</tr>
<tr>
<td></td>
<td>&gt; 0,75</td>
</tr>
</tbody>
</table>

A specimen of maximum 2,50 m length shall be cut from longer products.

4.2.6 Reaction to fire of the product as placed on the market

Reaction to fire classification of the product as placed on the market shall be determined in accordance with EN 13501-1 and the mounting and fixing rules given in EN 15715.

NOTE This classification is compulsory and always included in the CE Marking label.

Detailed information about the test conditions and the field of application of the classification as stated in the reaction to fire classification report shall be given in the manufacturer’s literature.

4.2.7 Durability characteristics

4.2.7.1 General

The appropriate durability characteristics have been considered and are covered in 4.2.7.2, 4.2.7.3 and where appropriate in 4.3.6 on compressive creep.

4.2.7.2 Durability of reaction to fire of the product as placed on the market against ageing/degradation

The reaction to fire performance of PU products as declared by 4.2.6 does not change with time.
4.2.7.3 Durability of thermal resistance and thermal conductivity against ageing/degradation

Any change in thermal conductivity of the PU product with time is covered and considered for declaration by 4.2.1 together with Annex C for thermal conductivity and any change in thickness is covered by at least one of the dimensional stability tests in 4.3.2 as relevant, or the deformation test in 4.3.3.

4.3 For specific applications

4.3.1 General

If there is no requirement for a property described in 4.3 for a product in use, then the property does not need to be determined and declared by the manufacturer.

4.3.2 Dimensional stability

Dimensional stability under specified temperature or under specified temperature and humidity conditions shall be determined in accordance with EN 1604. The test shall be carried out for the conditions given in Table 4. The relative changes in length, $\Delta \varepsilon_l$, width, $\Delta \varepsilon_b$, and thickness, $\Delta \varepsilon_d$, shall not exceed the values given in Tables 5 and 6 for the declared level.

Table 4 — Test conditions for dimensional stability under specified temperature and humidity conditions

<table>
<thead>
<tr>
<th>No.</th>
<th>Designation</th>
<th>Test condition</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DS (70,-)</td>
<td>48 h, 70 ºC</td>
<td>EN 1604</td>
</tr>
<tr>
<td>2</td>
<td>DS (23,90)</td>
<td>48 h, 23 ºC, 90 % R.H.</td>
<td>EN 1604</td>
</tr>
<tr>
<td>3</td>
<td>DS (70,90)</td>
<td>48 h, 70 ºC, 90 % R.H.</td>
<td>EN 1604</td>
</tr>
<tr>
<td>4</td>
<td>DS (-20,-)</td>
<td>48 h, -20 ºC</td>
<td>EN 1604</td>
</tr>
</tbody>
</table>

The test DS(70,-) and DS (23,90) need not be performed when the test DS(70,90) is used.

Table 5 — Levels for dimensional stability for test conditions 1, 2, 3

<table>
<thead>
<tr>
<th>Test conditions</th>
<th>Relative changes</th>
<th>Level DS(TH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1, 2, 3</td>
<td>$\Delta \varepsilon_l$, %</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>$\Delta \varepsilon_b$, %</td>
<td>≤5</td>
</tr>
<tr>
<td></td>
<td>$\Delta \varepsilon_d$, %</td>
<td>≤10</td>
</tr>
</tbody>
</table>
4.3.3 Deformation under specified compressive load and temperature conditions

Deformation under specified compressive load and temperature conditions shall be determined in accordance with EN 1605. The relative change in thickness, \( \Delta \varepsilon_d \), shall not exceed the values, given in Table 7, for the declared level.

Table 7 — Levels for deformation under specified compressive load and temperature conditions

<table>
<thead>
<tr>
<th>Level</th>
<th>Test conditions</th>
<th>Requirement %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLT(1)5</td>
<td>load: 20 kPa</td>
<td>≤ 5</td>
</tr>
<tr>
<td></td>
<td>temperature: ((80 \pm 1) ^\circ \text{C})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>time: ((48 \pm 1) \text{h})</td>
<td></td>
</tr>
<tr>
<td>DLT(2)5</td>
<td>load: 40 kPa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature: ((70 \pm 1) ^\circ \text{C})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>time: ((168 \pm 1) \text{h})</td>
<td></td>
</tr>
<tr>
<td>DLT(3)5</td>
<td>load: 80 kPa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature: ((60 \pm 1) ^\circ \text{C})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>time: ((168 \pm 1) \text{h})</td>
<td></td>
</tr>
</tbody>
</table>

4.3.4 Compressive stress or compressive strength

Compressive stress at 10 % deformation, \( \sigma_{10} \), or the compressive strength, \( \sigma_m \), shall be determined in accordance with EN 826. No test result for either the compressive stress at 10 % deformation or the compressive strength, whichever is the smaller, shall be less than the value, given in Table 8, for the declared level.
Table 8 — Levels for compressive stress or compressive strength

<table>
<thead>
<tr>
<th>Level</th>
<th>Requirement kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS(10Y)25</td>
<td>≥ 25</td>
</tr>
<tr>
<td>CS(10Y)50</td>
<td>≥ 50</td>
</tr>
<tr>
<td>CS(10Y)100</td>
<td>≥ 100</td>
</tr>
<tr>
<td>CS(10Y)120</td>
<td>≥ 120</td>
</tr>
<tr>
<td>CS(10Y)130</td>
<td>≥ 130</td>
</tr>
<tr>
<td>CS(10Y)140</td>
<td>≥ 140</td>
</tr>
<tr>
<td>CS(10Y)150</td>
<td>≥ 150</td>
</tr>
<tr>
<td>CS(10Y)175</td>
<td>≥ 175</td>
</tr>
<tr>
<td>CS(10Y)200</td>
<td>≥ 200</td>
</tr>
<tr>
<td>CS(10Y)225</td>
<td>≥ 225</td>
</tr>
<tr>
<td>CS(10Y)250</td>
<td>≥ 250</td>
</tr>
<tr>
<td>CS(10Y)350</td>
<td>≥ 350</td>
</tr>
<tr>
<td>CS(10Y)400</td>
<td>≥ 400</td>
</tr>
<tr>
<td>CS(10Y)800</td>
<td>≥ 800</td>
</tr>
</tbody>
</table>

4.3.5 Tensile strength perpendicular to faces

Tensile strength perpendicular to faces, $\sigma_{mt}$, shall be determined in accordance with EN 1607. No test result shall be less than the value, given in Table 9, for the declared level.

Table 9 — Levels for tensile strength perpendicular to faces

<table>
<thead>
<tr>
<th>Level</th>
<th>Requirement kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR40</td>
<td>≥ 40</td>
</tr>
<tr>
<td>TR50</td>
<td>≥ 50</td>
</tr>
<tr>
<td>TR60</td>
<td>≥ 60</td>
</tr>
<tr>
<td>TR70</td>
<td>≥ 70</td>
</tr>
<tr>
<td>TR80</td>
<td>≥ 80</td>
</tr>
<tr>
<td>TR90</td>
<td>≥ 90</td>
</tr>
<tr>
<td>TR100</td>
<td>≥ 100</td>
</tr>
<tr>
<td>TR150</td>
<td>≥ 150</td>
</tr>
</tbody>
</table>

4.3.6 Compressive creep

Compressive creep, $X_c$, and total thickness reduction, $\varepsilon_t$, shall be determined after at least one hundred twenty two days of testing at a declared compressive stress, $\sigma_c$, given in steps of at least 1 kPa, and the
results extrapolated thirty times, corresponding to ten years, to obtain the declared levels in accordance with EN 1606. Compressive creep shall be declared in levels, \(i_2\), and the total thickness reduction shall be declared in levels \(i_1\), with steps of 0.5 %, at the declared stress. No test result shall exceed the declared levels at the declared stress.

NOTE 1 Referring to the designation code CC(\(i_1/i_2/y\))\(\sigma_c\), according to Clause 6, a declared level CC(3/2/25)40, for example, indicates a value not exceeding 2 % for compressive creep and 3 % for total thickness reduction after extrapolation at 25 years (i.e. 30 times three hundred and four days of testing) under a declared stress of 40 kPa.

NOTE 2 Testing times. According to EN 1606, the procedure at 10, 25 and 50 years respectively requires the following testing times:

<table>
<thead>
<tr>
<th>Extrapolation time years</th>
<th>Minimum testing time days</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>122</td>
</tr>
<tr>
<td>25</td>
<td>304</td>
</tr>
<tr>
<td>50</td>
<td>608</td>
</tr>
</tbody>
</table>

4.3.7 Water absorption

4.3.7.1 Short term water absorption

Short term water absorption by partial immersion, \(W_{sp}\), shall be determined in accordance with EN 1609. No test result shall exceed the declared value.

4.3.7.2 Long term water absorption

Long term water absorption by partial immersion, \(W_{pp}\), and/or by total immersion, \(W_{tt}\), shall be determined in accordance with EN 12087. No test result shall exceed the declared value.

4.3.8 Flatness after one-sided wetting

Change in deviation from flatness after one-sided wetting shall be determined from measurements of flatness made in accordance with EN 825 before and after conditioning the specimen in accordance with 5.3.3. Both sides of the specimen shall be tested. The change in deviation from flatness for each side shall not exceed the value, given in Table 10, for the declared level.

<table>
<thead>
<tr>
<th>Level</th>
<th>Change in deviation from flatness mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW1</td>
<td>(\leq 20)</td>
</tr>
<tr>
<td>FW2</td>
<td>(\leq 10)</td>
</tr>
</tbody>
</table>

4.3.9 Water vapour transmission

Water vapour transmission properties of the product including facings or coatings shall be determined in accordance with EN 12086 and declared as the water vapour diffusion resistance factor, \(\mu\), for homogeneous products and as the water vapour resistance, \(Z\), for faced or non-homogeneous products. All test results of \(\mu\) and/or all test results of \(Z\) shall be within the range declared by the manufacturer.

Alternatively, for the declaration of the water vapour diffusion resistance factor, \(\mu\), of PU products, the value quoted in EN ISO 10456 may be used.

4.3.10 Sound absorption

Sound absorption coefficient shall be determined in accordance with EN ISO 354. The sound absorption characteristics shall be calculated in accordance with EN ISO 11654 using the values for the practical sound
absorption coefficient, $\alpha_p$, at the frequencies: 125 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz and 4 000 Hz and the single number value for the weighted sound absorption coefficient, $\alpha_w$.

$\alpha_p$ and $\alpha_w$ shall be rounded to the nearest 0,05 ($\alpha_p$ larger than 1 shall be expressed as $\alpha_p = 1$) and declared in levels with steps of 0,05. No result of $\alpha_p$ and $\alpha_w$ shall be lower than the declared level.

4.3.11 Release of dangerous substances

Thermal insulation products shall not release any regulated dangerous substances in excess of the maximum permitted levels specified in relevant European or national regulations.

NOTE 1 European test methods are under development.

NOTE 2 See Annex ZA.

4.3.12 Reaction to fire of the product in standardized assemblies simulating end-use applications

Reaction to fire classification of products in standardized assemblies simulating end-use applications excluding pipe insulation, shall be determined in accordance with EN 13501-1 and the mounting and fixing rules given in EN 15715.

This classification offers the opportunity to give a complementary and optional declaration on reaction to fire for standard test configurations of assemblies, which include the insulation product.

The number of the selected test configuration of assembly (Table 5 of EN 15715:2009), which is used in the test, shall be quoted with the Euroclass.

Detailed information about the test conditions and the field of application of the classification as stated in the reaction to fire classification report shall be given in the manufacturer’s literature.

4.3.13 Continuous glowing combustion

NOTE A test method is under development and the standard will be amended when this is available.

5 Test methods

5.1 Sampling

Test specimens shall be taken from the same sample with a total area not less than 1 $m^2$ and sufficient to cover the needed tests. The shorter side of the sample shall not be less than 300 mm or full size of the product, whichever is the smaller.

5.2 Conditioning

Conditioning of the test specimens shall be at least 6 h at (23 ± 5) °C unless otherwise specified in the test standard. In case of dispute, the test specimens shall be stored at (23 ± 2) °C and (50 ± 5) % relative humidity for 7 days prior to testing. For FPC no special conditioning of the test specimens is needed.

5.3 Testing

5.3.1 General

Table 11 gives the dimensions of the test specimens, the minimum number of measurements required to get one test result and any specific conditions, which are necessary.

The test may be performed on the unfaced/uncoated product, if the facing/coating is known to have no relevance to the test result.
5.3.2 Thermal resistance and thermal conductivity

Thermal resistance and thermal conductivity shall be determined in accordance with EN 12667 or EN 12939 for thick products and under the following conditions:

— at a mean temperature of (10 ± 0.3) °C;
— after conditioning in accordance with 5.2;
— taking into account the effect of ageing according to Annex C.

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

Thermal resistance and thermal conductivity shall be determined directly at measured thickness. In the event that this is not possible, they shall be determined by measurements on other thicknesses of the product providing that:

— the product is of similar chemical and physical characteristics and is produced on the same production unit,
— and it can be demonstrated in accordance with EN 12939 that the thermal conductivity does not vary more than 2 % over the range of thicknesses where the calculation is applied.

When measured thickness is used for testing of thermal resistance and thermal conductivity, the test thickness should be the smallest of the measured points on the test specimen (and not the mean) as far as possible to avoid any air gaps during testing.

5.3.3 Flatness after one-sided wetting – Conditioning procedure

The conditioning procedure referred to in 4.3.8 is as follows:

— place the test specimen in a water tank at (23 ± 5) °C, in such a way that partial immersion is 5 mm;
— dispose a load on the test specimen to avoid floatation;
— remove the test specimen after 15 min and turn it upside down on a dry support, therefore leaving the wetted side upwards;
— allow to dry the test specimen for 30 min at (23 ± 5) °C;
— measure the deviation from flatness in accordance with EN 825.
### Table 11 — Test methods, test specimens and conditions (1 of 2)

Dimensions in millimetres

<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>Test method</th>
<th>Test specimen length and width</th>
<th>Minimum number of measurements to get one test result</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1</td>
<td>Thermal resistance and thermal conductivity</td>
<td>EN 12667 or EN 12939</td>
<td>See Annex C</td>
<td>1</td>
<td>See Annex C</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Length and width</td>
<td>EN 822</td>
<td>Full-size</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Thickness</td>
<td>EN 823</td>
<td>Full-size</td>
<td>1</td>
<td>Load = 50 Pa</td>
</tr>
<tr>
<td>4.2.4</td>
<td>Squareness</td>
<td>EN 824</td>
<td>Full-size</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>4.2.5</td>
<td>Flatness</td>
<td>EN 825</td>
<td>Full-size</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>4.2.6</td>
<td>Reaction to fire of the product as placed on the market</td>
<td></td>
<td></td>
<td></td>
<td>See Clause 5 of EN 15715:2009</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Dimensional stability under specified conditions</td>
<td>EN 1604</td>
<td>200 × 200</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Deformation under specified compressive load and temperature conditions</td>
<td>EN 1605</td>
<td>$d \leq 50$: 50 × 50 $d &gt; 50$: 100 × 100 $d &gt; 150$: 150 × 150</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4.3.4</td>
<td>Compressive stress or compressive strength</td>
<td>EN 826</td>
<td>$d \leq 50$: 50 × 50 $d &gt; 50$: 100 × 100 $d &gt; 150$: 150 × 150</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4.3.5</td>
<td>Tensile strength perpendicular to faces</td>
<td>EN 1607</td>
<td>50 × 50</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4.3.6</td>
<td>Compressive creep</td>
<td>EN 1606</td>
<td>Same as 4.3.4</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>4.3.7.1</td>
<td>Short term water absorption</td>
<td>EN 1609</td>
<td>200 × 200</td>
<td>2</td>
<td>Method A</td>
</tr>
</tbody>
</table>
Table 11 — Test methods, test specimens and conditions (2 of 2)

<table>
<thead>
<tr>
<th>Clause</th>
<th>Title</th>
<th>Test method</th>
<th>Test specimen length and widtha</th>
<th>Minimum number of measurements to get one test result</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.7.2</td>
<td>Long term water absorption</td>
<td>EN 12087</td>
<td>200 × 200</td>
<td>2</td>
<td>Method 1A or/and Method 2A</td>
</tr>
<tr>
<td>4.3.8</td>
<td>Flatness after one-sided wetting</td>
<td>EN 825</td>
<td>Full-size product or 1 200 × 600</td>
<td>1 per side</td>
<td>Conditioning as in 5.3.3</td>
</tr>
<tr>
<td>4.3.9</td>
<td>Water vapour transmission</td>
<td>EN 12086</td>
<td>See 6.1 in EN 12086:1997</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>4.3.10</td>
<td>Sound absorption</td>
<td>EN ISO 354</td>
<td>Minimum 10 m²</td>
<td>1</td>
<td>To be reported</td>
</tr>
<tr>
<td>4.3.11</td>
<td>Release of dangerous substances</td>
<td>b</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4.3.12</td>
<td>Reaction to fire of the product in standardized assemblies simulating end-use applications</td>
<td>See EN 13501-1 and EN 15715</td>
<td>See Clause 6 of EN 15715:2009</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4.3.13</td>
<td>Continuous glowing combustion</td>
<td>b</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C.5.1</td>
<td>Closed cell content</td>
<td>EN ISO 4590</td>
<td>100 × 30 × 30</td>
<td>3</td>
<td>Method 2, with correction</td>
</tr>
</tbody>
</table>

a Full-size product thickness, except for 4.2.6 when the limits of the test methods are exceeded.

b When drafting this standard, no European harmonised test method was available.

6 Designation code

A designation code for the product shall be given by the manufacturer. The following shall be included except when there is no requirement for a property described in 4.3:

- The rigid polyurethane foam abbreviated term
- This document number
- Thickness tolerances
- Dimensional stability under specified temperature and humidity conditions
  - DS(70,90)i
  - DS(-20,-)i
- Dimensional stability under specified temperature
- Behaviour under load and temperature
- Compressive stress or strength
- Compressive creep
- Tensile strength perpendicular to faces

PU
EN 13165
Ti
DS(23,90)i or DS(70,90)i
DS(70,90)i or DS(70,-)i
DLT(i)5
CS(10\Y)i
CC(i\Y)σc
TRi
Flatness after one-sided wetting \( \text{FWi} \)

Short term water absorption by partial immersion \( \text{WS(P)i} \)

Long term water absorption by partial immersion \( \text{WL(P)i} \)

Long term water absorption by total immersion \( \text{WL(T)i} \)

Water vapour transmission \( \text{MU} \) or \( \text{Zi} \)

Practical sound absorption coefficient \( \text{APi} \)

Weighted sound absorption coefficient \( \text{AWi} \)

Where "i" shall be used to indicate the relevant class or level or the declared value and for compressive creep the term, "\( \sigma_c \)" shall be used to indicate the compressive stress and "y" to indicate the number of years.

The designation code for a rigid polyurethane foam product is illustrated by the following example:

EXAMPLE 1  PU — EN 13165 — T2 — DS(70,90)3 — DS(-20,90)2 — DLT(2)5 — CS(10Y)100 — CC(3/2/25)40 — TR40
— FW1 — WL(T)2 — MU50-100

For the designation code of multi-layered products the following example shall be followed:

EXAMPLE 2  PU-ML2-EN13165—..........for e.g. two layers of PU

NOTE The characteristics determined in 4.2 are not included in the designation code if a limit value (threshold value) is given for the product.

7 Evaluation of conformity

7.1 General

The manufacturer or his authorised representative shall be responsible for the conformity of his product with the requirements of this European Standard. The evaluation of conformity shall be carried out in accordance with EN 13172 and shall be based on initial type testing (ITT) and factory production control (FPC) by the manufacturer, including product assessment and tests on samples taken at the factory.

The compliance of the product with the requirements of this standard and with the stated values (including classes) shall be demonstrated by:

— Initial type testing (ITT),

— Factory production control (FPC) by the manufacturer including product assessment.

If a manufacturer decides to group his products, it shall be done in accordance with EN 13172.

The manufacturer or his authorised representative shall make available, in response to a request, a certificate or declaration of conformity as appropriate.

NOTE For the EC certificate and declaration of conformity, as appropriate, see ZA.2.2.

7.2 Initial type testing

All characteristics defined in 4.2 and those in 4.3, if declared, shall be subject to an initial type testing in accordance with Annex B of this standard.

For the relevant characteristics, ITT on products corresponding also to EN 14308 may be used for the purpose of ITT and declaration according to this standard.
7.3 Factory production control

The minimum frequencies of tests in the factory production control shall be in accordance with Annex B of this standard. When indirect testing is used, the correlation to direct testing shall be established in accordance with EN 13172.

For the relevant characteristics, FPC on products corresponding also to EN 14308 may be used for the purpose of FPC and declaration according to this standard.

8 Marking and labelling

Products conforming to this standard shall be clearly marked, either on the product or on the label or on the packaging, with the following information:

— product name or other identifying characteristic;
— name or identifying mark and address of the manufacturer or his authorised representative;
— shift or time of production and manufacturing plant or traceability code;
— reaction to fire class of the product as placed on the market (RtF). This classification shall be in accordance with 4.2.6.

If reaction to fire tests on standardized assemblies have been performed according to Clause 6 of EN 15715:2009, then the reaction to fire classification shall be added and identified with the designation “standardized assembly no. x” after the classification. This information shall be kept distinct from the CE-Marking. The number of the standardised assembly is taken from Table 5 of EN 15715:2009. Refer to manufacturer’s literature (ML) for further information.

— declared thermal resistance \((R_D)\);
— declared thermal conductivity \((\lambda_D)\);
— nominal thickness \((d_N)\);
— designation code as given in Clause 6;
— nominal length;
— nominal width;
— type of facing, if any;
— number of pieces and area in the package, as appropriate.

NOTE For CE marking and labelling, see ZA.3.

EXAMPLE Additional voluntary information:

Any other voluntary information about the product such as:

— Reaction to fire class for standardized assembly No. 1, 2, 3, 4
— Voluntary marks
Annex A
(normative)

Determination of the declared values of thermal resistance and thermal conductivity

A.1 General

It is the responsibility of the manufacturer to determine the declared values of thermal resistance and thermal conductivity. He will have to demonstrate conformity of the product to its declared values. The declared values of thermal resistance and thermal conductivity of a product are the expected values of these properties during an economically reasonable working life under normal conditions, assessed through measured data at reference conditions.

A.2 Input data

The manufacturer shall have at least ten test results for thermal resistance or thermal conductivity, obtained from internal or external direct measurements in order to calculate the declared values. The direct thermal resistance or thermal conductivity measurements shall be carried out at regular intervals spread over a period of the last twelve months. If less than ten test results are available that period may be extended until ten test results are obtained, but with a maximum period of three years, within which the product and production conditions have not changed significantly.

For new products, the ten thermal resistance or thermal conductivity tests shall be carried out spread over a minimum period of ten days.

The declared value shall be calculated according to the method given in A.3 and shall be recalculated at intervals not exceeding three months of production.

A.3 Declared values

A.3.1 General

The derivation of the declared values, $R_D$ and $\lambda_D$, from the calculated values, $R_{90/90}$ and $\lambda_{90/90}$, shall use the rules given in 4.2.1, which include the rounding conditions.

A.3.2 Case where thermal resistance and thermal conductivity are declared

The declared values $R_D$ and $\lambda_D$ shall be derived from the calculated values $R_{90/90}$ and $\lambda_{90/90}$ which are determined using Formulae (A.1), (A.2) and (A.3).

$$\lambda_{90/90} = \lambda_{\text{mean}} + k \times s_{\lambda}$$  \hspace{1cm} (A.1)

$$s_{\lambda} = \sqrt{\frac{\sum_{i=1}^{n} (\lambda_i - \lambda_{\text{mean}})^2}{n-1}}$$ \hspace{1cm} (A.2)

$$R_{90/90} = d_N / \lambda_{90/90}$$ \hspace{1cm} (A.3)

Values for $k$ shall be taken from Table A.1.
A.3.3 Case where thermal resistance alone is declared

The declared value $R_D$ shall be derived from the calculated value $R_{90/90}$ which is determined using Formulae (A.4) and (A.5).

\[
R_{90/90} = R_{\text{mean}} - k \times s_R
\]  
\[
s_R = \sqrt{\frac{\sum_{i=1}^{n} (R_i - R_{\text{mean}})^2}{n - 1}}
\]

Values for $k$ shall be taken from Table A.1.

Table A.1 — Values for $k$ for one sided 90 % tolerance interval with a confidence level of 90 %

<table>
<thead>
<tr>
<th>Number of test results</th>
<th>$k$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2.07</td>
</tr>
<tr>
<td>11</td>
<td>2.01</td>
</tr>
<tr>
<td>12</td>
<td>1.97</td>
</tr>
<tr>
<td>13</td>
<td>1.93</td>
</tr>
<tr>
<td>14</td>
<td>1.90</td>
</tr>
<tr>
<td>15</td>
<td>1.87</td>
</tr>
<tr>
<td>16</td>
<td>1.84</td>
</tr>
<tr>
<td>17</td>
<td>1.82</td>
</tr>
<tr>
<td>18</td>
<td>1.80</td>
</tr>
<tr>
<td>19</td>
<td>1.78</td>
</tr>
<tr>
<td>20</td>
<td>1.77</td>
</tr>
<tr>
<td>22</td>
<td>1.74</td>
</tr>
<tr>
<td>24</td>
<td>1.71</td>
</tr>
<tr>
<td>25</td>
<td>1.70</td>
</tr>
<tr>
<td>30</td>
<td>1.66</td>
</tr>
<tr>
<td>35</td>
<td>1.62</td>
</tr>
<tr>
<td>40</td>
<td>1.60</td>
</tr>
<tr>
<td>45</td>
<td>1.58</td>
</tr>
<tr>
<td>50</td>
<td>1.56</td>
</tr>
<tr>
<td>100</td>
<td>1.47</td>
</tr>
<tr>
<td>300</td>
<td>1.39</td>
</tr>
<tr>
<td>500</td>
<td>1.36</td>
</tr>
<tr>
<td>2000</td>
<td>1.32</td>
</tr>
</tbody>
</table>

For other numbers of test results use Table D.31 of ISO 16269-6:2005, or linear interpolation.
### Table B.1 — Minimum number of tests for ITT and minimum product testing frequencies (1 of 2)

<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>ITT a, b, d Minimum number of tests</th>
<th>FPC a Minimum testing frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1</td>
<td>Thermal resistance and thermal conductivity</td>
<td>A minimum of 10 tests are needed statistically with a minimum of 4 from the ITT</td>
<td>1 per 24 h (initial value)</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Length and width</td>
<td>4</td>
<td>1 per 2 h</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Thickness</td>
<td>4</td>
<td>1 per 2 h</td>
</tr>
<tr>
<td>4.2.4</td>
<td>Squareness</td>
<td>4</td>
<td>1 per 8 h</td>
</tr>
<tr>
<td>4.2.5</td>
<td>Flatness</td>
<td>4</td>
<td>1 per 8 h</td>
</tr>
<tr>
<td>4.2.6</td>
<td>Reaction to fire of the product as placed on the market</td>
<td>1</td>
<td>See Table B.2</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Dimensional stability under specified conditions</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Deformation under specified compressive load and temperature conditions</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.4</td>
<td>Compressive stress or compressive strength</td>
<td>4</td>
<td>1 per 24 h</td>
</tr>
<tr>
<td>4.3.5</td>
<td>Tensile strength perpendicular to faces</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.6</td>
<td>Compressive creep</td>
<td>4</td>
<td>1 per 10 years</td>
</tr>
<tr>
<td>4.3.7.1</td>
<td>Short term water absorption</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.7.2</td>
<td>Long term water absorption</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.8</td>
<td>Flatness after one-sided wetting</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.9</td>
<td>Water vapour transmission</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.10</td>
<td>Sound absorption</td>
<td>4</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.11</td>
<td>Release of dangerous substances</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>4.3.12</td>
<td>Reaction to fire of the product in standardized assemblies simulating end-use applications h</td>
<td>1</td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>4.3.13</td>
<td>Continuous glowing combustion</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>Annex C</td>
<td>Accelerated aged value of thermal conductivity in accordance with C.4.2 f</td>
<td>4</td>
<td>1 per 2 years</td>
</tr>
<tr>
<td></td>
<td>Acceleration test in accordance with C.4.4 f</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diffusion tightness of facing in accordance with C.5.1 g</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed cell content in accordance with C.5.1 a</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normality test acc. in accordance with C.5.2 g</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Table B.1 — Minimum number of tests for ITT and minimum product testing frequencies (2 of 2)

<table>
<thead>
<tr>
<th>NOTE</th>
<th>Indirect testing is used for reaction to fire (see Table B.2).</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>In line with EN 13172, the minimum testing frequencies, expressed in test results, shall be understood as the minimum for each production unit under stable conditions. In addition to the testing frequencies given above, testing of relevant properties of the product shall be repeated when changes or modifications are made that are likely to affect the conformity of the product.</td>
</tr>
<tr>
<td>b</td>
<td>ITT, see EN 13172, and is only relevant when properties are declared.</td>
</tr>
<tr>
<td>c</td>
<td>Frequencies are not given. When drafting this standard, no European harmonised test method was available.</td>
</tr>
<tr>
<td>d</td>
<td>Minimum number of tests may be reduced according to EN 13172. For initial type testing of long term thermal and mechanical properties test results of similar products produced at different plants will be recognised until testing for a new plant is complete.</td>
</tr>
<tr>
<td>e</td>
<td>Only for (100%) CO\textsubscript{2} blown products and if the “fixed increment procedure” is applied.</td>
</tr>
<tr>
<td>f</td>
<td>Only relevant if declaration of thermal conductivity is based on C.4.</td>
</tr>
<tr>
<td>g</td>
<td>Only relevant if declaration of thermal conductivity is based on C.5.</td>
</tr>
<tr>
<td>h</td>
<td>1 per 5 years and indirect testing on the product as such (see Table B.2).</td>
</tr>
</tbody>
</table>
Table B.2 — Minimum product testing frequencies for the reaction to fire characteristics (1 of 2)

<table>
<thead>
<tr>
<th>Clause</th>
<th>No</th>
<th>Title</th>
<th>Direct testing</th>
<th>Minimum testing frequency</th>
<th>Indirect testing&lt;sup&gt;3, 4&lt;/sup&gt;</th>
<th>Components&lt;sup&gt;5&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reacton to fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2.6 class</td>
<td>Test method</td>
<td>Frequency</td>
<td>Test method</td>
<td>Frequency</td>
<td>Test method</td>
<td>Frequency</td>
</tr>
<tr>
<td>A1 without testing&lt;sup&gt;a&lt;/sup&gt;</td>
<td>EN 13820</td>
<td>1 per 3 months&lt;sup&gt;b&lt;/sup&gt; or</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 per 2 years and indirect testing</td>
<td>-</td>
<td>-</td>
<td>check of raw material formulation and density</td>
<td>1 per day manufacturer’s method</td>
</tr>
<tr>
<td>A1</td>
<td>EN ISO 1182 and EN ISO 1716 (and EN 13823)</td>
<td>1 per 2 years and indirect testing</td>
<td>-</td>
<td>-</td>
<td>check of raw material formulation and density</td>
<td>1 per day manufacturer’s method</td>
</tr>
<tr>
<td>A2</td>
<td>EN ISO 1182 or EN ISO 1716 and EN 13823</td>
<td>1 per 2 years and indirect testing</td>
<td>-</td>
<td>-</td>
<td>check of raw material formulation and density</td>
<td>1 per day manufacturer’s method</td>
</tr>
<tr>
<td>B</td>
<td>EN 13823</td>
<td>1 per 2 years and indirect testing</td>
<td>manufacturer’s method</td>
<td>1 per week</td>
<td>check of raw material formulation and density</td>
<td>1 per day manufacturer’s method</td>
</tr>
<tr>
<td>C</td>
<td>and EN ISO 11925-2</td>
<td>1 per week or 1 per 2 years and indirect testing</td>
<td>manufacturer’s method</td>
<td>1 per week</td>
<td>check of raw material formulation and density</td>
<td>1 per day manufacturer’s method</td>
</tr>
</tbody>
</table>
### Table B.2 — Minimum product testing frequencies for the reaction to fire characteristics (2 of 2)

<table>
<thead>
<tr>
<th>Clause</th>
<th>Minimum testing frequency&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Indirect testing&lt;sup&gt;c, d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction to fire</td>
<td>Direct testing&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Product</td>
</tr>
<tr>
<td>4.2.6</td>
<td>Test method</td>
<td>Frequency</td>
</tr>
<tr>
<td>E</td>
<td>EN ISO 11925-2</td>
<td>1 per week or 1 per 2 years and indirect testing</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**NOTE** Not all Euroclasses may apply for the products conforming to this standard.

- The minimum testing frequencies, expressed in test results, shall be understood as the minimum for a product or product group for each production line under stable conditions. In addition to the testing frequencies given above, testing of relevant properties of the product shall be repeated when changes or modifications are made that are likely to affect the conformity of the product.
- Direct testing may be conducted either by third party or by the manufacturer.
- Indirect testing may be conducted either on the product or on its components.
- Indirect testing is only possible in the case of products falling within the system 1 for attestation of conformity of reaction to fire or by having a notified body verifying the correlation to the Direct testing.
- European Decision 96/603EC: Materials to be considered as reaction to fire class A provided for in Decision 94/611/EC without the need for testing (of reaction to fire characteristics).
- In case of certified components no testing is required.
- Only for unfaced products.
Annex C  
(normative)

Determination of the aged values of thermal resistance and thermal conductivity

C.1 General

This annex describes methods which are used to take account of the ageing effect, which when it occurs is due to changes in the cell gas composition with time. These methods give a prediction of the time averaged aged value over 25 years.

The determination of the aged value shall be made either by the direct measurement method (accelerated ageing procedure, C.4) or by a combination of the normality test and the calculation method (fixed increment procedure, C.5). For both methods the sampling and test specimen preparation procedure shall be as described in C.2.

NOTE  See Figure C.1 for a flow chart of the alternative ageing procedures.

The ageing methods are valid for closed cell PU products produced by using high molecular weight blowing agents such as hydrocarbons (namely pentanes) and hydro fluorocarbons (namely: HFC 134a, 245fa, 227ea, 365mfc), which substantially stay in the products for time periods well in excess of those required for an economically reasonable life. These blowing agents are therefore called 'permanent'. They can be used mixed together with each other and with carbon dioxide (CO₂). CO₂ is a 'non-permanent' blowing agent, which may readily diffuse out of the product. Ageing of the thermal properties of PU products is therefore predominantly caused by the inward diffusion of air into the product and outward diffusion of CO₂, if diffusion tight facings do not prevent both.

PU products blown only with CO₂ are also covered by these ageing methods.

For mixtures of permanent blowing agents the following procedures shall be followed:

— If the accelerated ageing procedure of C.4 is used, the safety increment in accordance with Table C.1 for that blowing agent in the mixture with the highest value shall be used.

— If the fixed increment procedure of C.5 is used, the normality test shall be performed first. The result from the normality test will give the decision, which increment shall be taken. If the test result is not higher than the required limit value in C.5.2 for a certain blowing agent in the mixture, the increment in accordance with Table C.2 for this blowing agent shall be taken to determine the aged value of thermal conductivity.

— If new blowing agents are shown to be ‘permanent types’ (meaning having diffusion coefficients similar to the established values for pentanes and hydro fluorocarbons), the ageing methods defined in this annex can be used. New limit values for the fixed increment procedure (C.5) and different safety increments for the accelerated ageing procedure (C.4) may be required.

C.2 Sampling and test specimen preparation

Select a product sample including any product facings such that the area dimensions of the product sample shall not be less than those specified in Table A.1 of EN 12667:2001 which correspond to the product thickness, or shall be equal to the maximum product dimensions.

Condition the product sample at (23 ± 3) °C and (50 ± 10) % relative humidity for at least 16 h before cutting the test specimen.
Cut the test specimen from the central area of the product sample. The test specimens shall conform to those specified in Table A.1 of EN 12667:2001. The facings shall be left in position provided they do not interfere with the thermal resistance measurements.

C.3 Determination of the initial value of thermal conductivity

The initial value of the thermal conductivity shall be derived from the measurement of the thermal resistance made one day to eight days after manufacture.

Prepare the test specimen for thermal resistance measurements in accordance with C.2.

Measure the thermal resistance of the test specimen in accordance with EN 12667, EN 12939 and 5.3.2.

Calculate and report the initial value of thermal conductivity to the nearest 0,0001 W/(m·K).

---

**Figure C.1 — Flow chart of the alternative ageing procedures**
C.4 Determination of the accelerated aged value of thermal conductivity

C.4.1 Procedure

The accelerated aged value of thermal conductivity shall be determined according to the following procedure:

- measure the accelerated aged value in accordance with C.4.2;
- add safety increment in accordance with C.4.3.

For diffusion open products, it is allowed to carry out an acceleration test in accordance with C.4.4. Depending on the outcome of this acceleration test, the safety increments of C.4.3 may be reduced in accordance with C.4.5.

C.4.2 Measurement of the accelerated aged value of thermal conductivity

The full product, including any facings, shall be tested. The area dimensions of the product sample shall not be less than those specified in Table A.1 of EN 12667:2001 which correspond to the product thickness, or shall be equal to the product dimensions. For products with diffusion tight facings, the maximum size of the product sample shall be 800 mm × 800 mm.

The measured accelerated aged value of thermal conductivity shall be derived from the aged thermal resistance obtained after subjecting the product sample to the accelerated ageing treatment. The ageing treatment shall begin not earlier than one day after manufacture and preferably not later than 50 days after manufacture.

Store the product sample at (70 ± 2) °C for (175 ± 5) days.

Prepare the test specimen for thermal resistance measurement in accordance with C.2. Measure the thermal resistance of the test specimen in accordance with EN 12667, EN 12939 and 5.3.2.

Calculate and report the measured accelerated aged thermal conductivity value to the nearest 0.0001 W/(m·K).

C.4.3 Addition of the safety increments (to be used with the accelerated ageing procedure only)

The value obtained under C.4.2 shall be increased with the safety increments as shown in Table C.1.
Table C.1 — Safety increments to be added to the measured accelerated aged value of thermal conductivity

<table>
<thead>
<tr>
<th>Type of product/facing</th>
<th>Blowing agent technology&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Safety increment in W/(m·K) for products with nominal thickness $d_N \leq 80$ mm</th>
<th>Safety increment in W/(m·K) for products with nominal thickness $d_N &gt; 80$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut foam without facing</td>
<td>Pentane, HFC 245fa, 227ea, 365mfc</td>
<td>0,001 0</td>
<td>0,002 0</td>
</tr>
<tr>
<td></td>
<td>HFC 134a</td>
<td>0,001 5</td>
<td>0,002 5</td>
</tr>
<tr>
<td>Faced with diffusion open facings</td>
<td>Pentane, HFC 245fa, 227ea, 365mfc</td>
<td>0,001 0</td>
<td>0,001 5</td>
</tr>
<tr>
<td></td>
<td>HFC 134a</td>
<td>0,001 5</td>
<td>0,002 0</td>
</tr>
<tr>
<td>Faced with diffusion tight facings&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Pentane, HFC 134a, 245fa, 227ea, 365mfc</td>
<td>0,001 0</td>
<td>0,001 0</td>
</tr>
</tbody>
</table>

<sup>a</sup> Safety increments for 100 % CO2 – blown products will be determined when sufficient information is available.

<sup>b</sup> See section C.5.1 for the definition of diffusion tight facings.

When requested the manufacturer shall state the type of blowing agent used for the product.

Report the value to the nearest 0,0001 W/(m·K). This value shall be used to determine the aged value of thermal conductivity, if no acceleration test data provides additional information (see C.4.4 and C.4.5).

C.4.4 Acceleration test (optional and for diffusion open products only, in combination with the accelerated ageing procedure)

Select a product sample (one to eight days after manufacture) and condition it for 16 h at (23 ± 3) °C and (50 ± 10) % relative humidity.

Cut two test specimens adjacent to each other of minimum dimensions 200 mm length and width $\times$ 20 (± 2/– 0) mm thickness from the central area of the product sample.

Determine the initial values of thermal conductivity of the two test specimens in accordance with C.3. The determined initial values of thermal conductivity shall not differ by more than 0,0005 W/(m·K). In case of larger differences, new test specimens shall be sampled.

Store one test specimen at (70 ± 2) °C and the other test specimen at (23 ± 3) °C for such a time that the increase of the value of thermal conductivity has reached in both cases 0,003 W/(m·K) to 0,004 W/(m·K). Determine at least six values of thermal conductivity of each specimen within this range of thermal conductivity increase.

If the test specimen is reconditioned at room temperature for measurement of the value of thermal conductivity between subsequent accelerated ageing treatment at 70 °C, the time of conditioning shall be between 1 h to 2 h. The actual time of accelerated ageing at 70 °C shall be recorded.

Make plots of the values of thermal conductivity with time for ageing at 70 °C and at 23 °C and shift the time axis with a factor such that the two curves overlap. The time shift factor used to ensure best overlap of the curves is the acceleration factor. This factor shall be reported to the first decimal digit.
C.4.5 Determination of the accelerated aged value of thermal conductivity considering the acceleration factor (optional method and for diffusion open products only, in combination with the accelerated ageing procedure)

If a manufacturer chooses to carry out the acceleration test given in C.4.4 then the thermal conductivity determined for a product in C.4.3 may be amended as follows:

- if an acceleration factor of greater than 12 has been found, the appropriate safety increment derived from Table C.1 shall be removed;
- if an acceleration factor of 8 to 12 inclusive has been found, the value of thermal conductivity obtained in C.4.3 shall be reduced by 0.001 W/(m·K);
- in all other cases the value from C.4.3 shall remain unchanged.

Report the aged value of thermal conductivity to the nearest 0.0001 W/(m·K).

C.5 Fixed increment procedure

C.5.1 Conditions

The fixed increment procedure described below shall only be used if:

- the product has fulfilled the requirements of the normality test given in C.5.2, except for CO2 blown only products;
- (100%) CO2 blown only products have a closed cell content, determined according to EN ISO 4590, of not less than 90 %;
- the product contains any of the blowing agents such as pentanes and/or hydro fluorocarbons or a mixture of these with CO2, or only CO2;
- for products with diffusion tight facings, these facings shall consist of a metal sheet with thickness not less than 50 µm or the facings shall show an equivalent performance. Faced products, which do not show an increase of the thermal conductivity of more than 0.001 W/(m·K) when tested for (175 ± 5) days at (70 ± 2) °C are considered to be covered with diffusion tight facings (maximum size of the sample 800 mm × 800 mm and maximum thickness 50 mm);

NOTE The diffusion tight property of a facing can also be proven, if the oxygen transmission rate is less than 4.5 ml per 24 h per m² when measured at (23 ± 3) °C in accordance with ASTM D 3985 [1]. It will be demonstrated by taking ten facing specimens at the production site of the facing or the insulation manufacturer to be tested with no single result exceeding the limit value of 4.5 ml per 24 h per m². The specimens are placed in the test apparatus at (23 ± 3) °C and (50 ± 10) % relative humidity with the side, on which the foam will be applied, facing towards the nitrogen chamber and with the edges of the facing unsealed against lateral air infiltration.

- the dimensions of rectangular products which have diffusion tight facings are not less than 600 mm × 800 mm. If both longitudinal edges of products with min. length of 800 mm or longer are covered by the gastight facings, the width of the product can be less than 600 mm.

For products with diffusion tight facings which have smaller dimensions than these limit values, either the procedure given in C.4 should be followed or the fixed increments for diffusion open facings given in Table C.2 should be used.

C.5.2 Normality test

Products blown with ‘permanent’ blowing agents shall fulfil the requirements of the following procedure:
select a product sample (one to eight days after manufacture) and condition it for 16 h at (23 ± 3) °C and (50 ± 10) % relative humidity;

cut a test specimen of minimum dimensions 200 mm length and width x 20 (+ 2/- 0) mm thickness from the central area of the product sample;

determine the initial value of thermal conductivity of the test specimen in accordance with C.3;

store the test specimen at (70 ± 2) °C for (21 ± 1) days;

after reconditioning for 16 h at (23 ± 3) °C and (50 ± 10) % relative humidity determine the aged value of thermal conductivity of the test specimen in accordance with EN 12667, EN 12939 and 5.3.2.

The difference between the aged and the initial values of thermal conductivity shall not be more than 0,0060 W/(m·K) for pentane blown and for 245fa, 227ea, 365mfc blown products and 0,0075 W/(m·K) for 134a blown products.

If the difference is more than the values stated herein, the fixed increment method cannot be used and the aged thermal conductivity shall be obtained in accordance with C.4.

C.5.3 Calculation of the aged value of thermal conductivity

The aged value of thermal conductivity shall be determined by adding fixed increments to the initial value of thermal conductivity.

Determine the initial value of thermal conductivity in accordance with C.3.

Add the relevant increment given in Table C.2 to the initial value.

Report the calculated aged value of thermal conductivity to the nearest 0,0001 W/(m·K).

<table>
<thead>
<tr>
<th>Blowing agent</th>
<th>Increment W/(m·K)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type of facing</td>
</tr>
<tr>
<td></td>
<td>None or diffusion open</td>
</tr>
<tr>
<td></td>
<td>Nominal thickness</td>
</tr>
<tr>
<td></td>
<td>$d_h &lt; 80$ mm</td>
</tr>
<tr>
<td>Pentane</td>
<td>0,005 8</td>
</tr>
<tr>
<td>HFC 245fa, 227ea, 365mfc</td>
<td>0,006 0</td>
</tr>
<tr>
<td>HFC 134a</td>
<td>0,007 5</td>
</tr>
<tr>
<td>100 % CO$_2$</td>
<td>0,010 0</td>
</tr>
</tbody>
</table>

$^a$ If in a blowing agent mixture pentane is used together with HFC 245fa or/and 227ea or/and 365mfc, the increment of 0,0060 W/(m·K) for $d_h < 80$ mm shall be used for such a blowing agent mixture.

When requested the manufacturer shall state the type of blowing agent used for the product.
C.6 Declaration of the aged values of thermal resistance and thermal conductivity

C.6.1 General
The statistical variation as required in Annex A for the declaration of thermal resistance and thermal conductivity shall be calculated using either the initial or the aged values of thermal conductivity.

The initial values shall be determined in accordance with C.3 and the aged values in accordance with C.4 or C.5.

C.6.2 Product grouping
The manufacturer shall declare either:

— separate thermal values for each single product and each single thickness and then determine the $\lambda_{90/90}$ value on each thickness for each product; or

— a thermal value for a product group including all or a range of thicknesses using the $\lambda_{90/90}$ value of this product group for the corresponding thickness range. Separate product groups shall be established for products without facing, for products with diffusion open facing and for products with diffusion tight facing.

The manufacturer shall decide whether to create groups and the size of the groups. The determined thermal values of thin, medium and thick products shall be included in the statistics of a product group which covers all thicknesses or a range of thicknesses.

A minimum of ten initial or aged values shall be determined for each product group.

C.6.3 Initial values of thermal conductivity used to calculate the $\lambda_{90/90}$ and $R_{90/90}$ value

\[
\lambda_{90/90} = \lambda_{\text{mean},i} + k_i \times s_{\lambda,i} + \Delta \lambda_a
\]  

(C.1)

or

\[
\lambda_{90/90} = \lambda_{\text{mean},i} + k_i \times s_{\lambda,i} + \Delta \lambda_f
\]  

(C.2)

\[
R_{90/90} = \frac{d}{\lambda_{90/90}}
\]  

(C.3)

where $\lambda_{\text{mean},i}$, $k_i$ and $s_{\lambda,i}$ are calculated from the measured initial values of thermal conductivity in accordance with Annex A.

The ageing increment, $\Delta \lambda_a$, is determined as mean value of the thermal conductivity increase from measurements of two specimens by taking the difference between the measured aged value in accordance with C.4 and the measured initial value in accordance with C.3. The two specimens shall be taken from the same product, which is identified as the worst-case in a product group (e.g. the thinnest product).

The fixed ageing increment, $\Delta \lambda_f$, is the increment in accordance with C.5. For a product group the fixed ageing increment of the worst-case product within the group shall be taken.

C.6.4 Aged values of thermal conductivity used to calculate the $\lambda_{90/90}$ and $R_{90/90}$ value

\[
\lambda_{90/90} = \lambda_{\text{mean},a} + K_a \times s_{\lambda,a}
\]  

(C.4)

\[
R_{90/90} = \frac{d}{\lambda_{90/90}}
\]  

(C.5)

where $\lambda_{\text{mean},a}$, $K_a$ and $s_{\lambda,a}$ are calculated from the measured aged values of thermal conductivity in accordance with Annex A.
PU multi-layered insulation products

D.1 General

PU multi-layered insulation products are made from two or more layers of PU thermal insulation material, which are bonded together horizontally.

Bonding includes both chemical and physical adhesion. The product may be faced or coated.

Declaration of the product shall follow the instructions of this standard with additional consideration of the following items of this annex.

Ascertain if orientation is important for a property. If it has no effect, no extra test has to be done. The orientation has to be mentioned if an effect is seen.

D.2 Requirements

D.2.1 For all applications

D.2.1.1 General

Integrity is a basic requirement of a multi-layered product, which shall not delaminate at the bond layer.

When required adhesion of the layers shall be checked by tensile strength test.

D.2.1.2 Thermal resistance

Thermal resistance, $R_D$, of the multi-layered insulation product shall be declared either by using results from direct measurement of the multi-layered product or by calculation with addition of the thermal resistances of each of the layers.

For calculation the manufacturer shall take:

— the 90/90 measured values of the thermal resistance of each of the single layers,

— or the 90/90 measured thermal conductivity of each of the single layers together with the measured thickness.

If the bonding changes the R-value of the multi-layered product by more than 2% the total thermal resistance of the multi-layered product shall be determined by direct measurement only or the deviation caused by the bonding shall be considered by adding an increment, if the calculation method with the single layers is used.

D.2.1.3 Length and width, thickness, squareness, flatness

Requirements for dimensional tolerances shall be valid for the multi-layered product as given in 4.2.2, 4.2.3, 4.2.4 and 4.2.5 of this standard.
D.2.1.4 Reaction to fire

Reaction to fire classification of the product shall be determined for the total multi-layered product in accordance with EN 13501-1 and with the mounting and fixing rules given in EN 15715.

D.2.1.5 Durability characteristics

Statements are valid for multi-layered products as given in 4.2.7 of this standard.

D.2.1.6 Tensile strength perpendicular to faces

Tensile strength perpendicular to faces for the multi-layered product shall be determined as given in 4.3.5.

D.2.2 For specific applications

Instructions shall be followed as given in 4.3 of this standard.

Properties shall be determined and declared for the total multi-layered product.

D.3 Test methods

Instructions shall be followed as given in Clause 5 of this standard.

The multi-layered product shall be tested with all layers included. If the dimensions (e.g. thickness) of the total multi-layered product are too large for the test apparatus, a representative smaller (e.g. thinner) specimen may be cut, which shall include at least one bond layer.

D.4 Evaluation of conformity

Instructions shall be followed as given in Clause 7 of this standard.

Specials attention shall be given to the bonding (e.g. the selection of bonding products and processing).
Annex E
(informative)

Additional properties

E.1 General

The manufacturer may choose to give information on the following additional properties (see Table E.1).

When used, the instructions of this annex are mandatory. For this reason the text of this annex is written in the imperative form.

This information, where appropriate for the product and the application, shall be given as limit values for each test result obtained from the referenced test method, with sampling and conditioning as given in Table E.1.

E.2 Bending strength

Bending strength, $\sigma_b$, shall be determined in accordance with EN 12089. If the bending strength is declared, no test result shall be lower than the declared level, BS.

E.3 Shear behaviour

Shear strength, $\tau$, and/or shear modulus, $G$, shall be determined in accordance with EN 12090. If the shear strength is declared, no test result shall be lower than the declared level, SS. If the shear modulus is declared, no test result shall be lower than the declared level, SM.

E.4 Compressive stress at 2% deformation

Compressive stress at 2% deformation, $\sigma_2$, shall be determined in accordance with EN 826. If the compressive stress at 2% deformation is declared, no test result shall be lower than the declared level, CS(2\%Y), given in Table 8.

E.5 Long term water absorption by diffusion

Water absorption by diffusion, $W_{dv}$, shall be determined in accordance with EN 12088. If the water absorption by diffusion is declared, no test result shall exceed the declared value, WD(V).

E.6 Freeze-thaw resistance

E.6.1 General

Freeze-thaw resistance after water absorption by diffusion or total immersion shall be determined in accordance with EN 12091. After the followed 300 freeze-thaw cycling test the reduction in compressive stress at 10 % deformation, $\sigma_{10}$, or the compressive strength, $\sigma_m$, of the re-dried specimens, when tested in accordance with EN 826, shall not exceed 10 % of the initial value.

NOTE Freeze-thaw cycling tests are necessary to determine the durability of an insulation product when it is directly exposed to the combined action of water and freeze-thaw cycles.
E.6.2 Freeze-thaw resistance after long term water absorption by diffusion

Freeze-thaw resistance after long term water absorption test by diffusion shall be determined using the wet test specimen from having done the water diffusion test in accordance with EN 12088.

If the freeze-thaw resistance after long term water diffusion test, \( FTCDi \), is declared, the additional water absorption, \( W_v \), from the 300 freeze-thaw cycling test is given in levels with steps of 1% by volume. No test result shall exceed the declared level.

E.6.3 Freeze-thaw resistance after long term water absorption by total immersion

Freeze-thaw resistance after long term water absorption test by total immersion shall be determined using the wet test specimen from having done the water absorption test in accordance with EN 12087.

If the freeze-thaw resistance after long term water absorption by total immersion test, \( FTCi \), is declared, the additional water absorption, \( W_v \), from the 300 freeze-thaw cycling test is given in levels with steps of 1% by volume. No test result shall exceed the declared level.

E.7 Apparent density

Apparent overall density, \( \rho_a \), or apparent core density, \( \rho_c \), shall be determined in accordance with EN 1602. If the apparent density is declared, no test result shall be lower than the declared level, AD(A) for the overall density or the declared level AD(C) for the core density.

Table E.1 — Test methods, test specimens, conditions and minimum testing frequencies

<table>
<thead>
<tr>
<th>Clause</th>
<th>Test method</th>
<th>Test specimen length and width</th>
<th>Minimum number of measurements to get one test result</th>
<th>Specific conditions</th>
<th>Factory production control</th>
<th>Minimum product testing frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.2</td>
<td>Bending strength</td>
<td>EN 12089</td>
<td>Length: 5 d Width: 150</td>
<td>1 Method A</td>
<td></td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>E.3</td>
<td>Shear behaviour</td>
<td>EN 12090</td>
<td>250 × 50 200 × 100</td>
<td>3 Single test specimen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.4</td>
<td>Compressive stress at 2% deformation</td>
<td>EN 826</td>
<td>d ≤ 50: 50 × 50 100 × 100</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.5</td>
<td>Compressive stress at 2% deformation</td>
<td>EN 12088</td>
<td>200 x 200</td>
<td>2</td>
<td></td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>E.6</td>
<td>Freeze thaw resistance</td>
<td>EN 12091</td>
<td>500 x 500 150 x 150</td>
<td>1 Set A 3 Set B</td>
<td></td>
<td>1 per 5 years</td>
</tr>
<tr>
<td>E.7</td>
<td>Apparent density</td>
<td>EN 1602</td>
<td>Full-size</td>
<td>1</td>
<td></td>
<td>1 per 1 day</td>
</tr>
</tbody>
</table>

a Full-size product thickness.
b Only relevant in case of declaration of the property.
Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandate M/103 \(^1\) "Thermal insulation products" given to CEN by the European Commission and the European Free Trade Association.

The clauses of this document, shown in Table ZA.1 below, meet the requirements of the Mandate M/103 given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the factory made rigid Polyurethane foam products covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING — Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the factory made rigid Polyurethane foam products falling within the scope of this European Standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://ec.europa.eu/enterprise/construction/cpd-ds/).

This annex establishes the conditions for the CE marking of the factory made rigid Polyurethane foam products intended for the uses indicated in Table ZA.1 and shows the relevant clauses applicable.

This annex has the same scope as Clause 1 of this standard and is defined by Table ZA.1.

\(^1\) As amended by mandates M126, M130 and M367.
### Table ZA.1 — Relevant clauses for factory made rigid Polyurethane foam products and intended use

<table>
<thead>
<tr>
<th>Requirement/Characteristic from the mandate</th>
<th>Requirement clauses in this document</th>
<th>Levels and/or classes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction to fire</td>
<td>4.2.6 Reaction to fire</td>
<td>Euroclasses</td>
<td>–</td>
</tr>
<tr>
<td>Water permeability</td>
<td>4.3.7 Water absorption</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td></td>
<td>4.3.8 Flatness after one sided wetting</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Release of dangerous substances to the indoor environment</td>
<td>4.3.11 Release of dangerous substances</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Acoustic absorption index</td>
<td>4.3.10 Sound absorption</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Direct airborne sound insulation index</td>
<td>4.3.10 Sound absorption</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Continuous Glowing combustion</td>
<td>4.3.13 Continuous Glowing combustion</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>4.2.1 Thermal resistance – thermal conductivity</td>
<td>–</td>
<td>Levels of λ</td>
</tr>
<tr>
<td></td>
<td>4.2.3 Thickness</td>
<td>–</td>
<td>Classes</td>
</tr>
<tr>
<td>Water vapour permeability</td>
<td>4.3.9 Water vapour transmission</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>4.3.4 Compressive stress or compressive strength</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Tensile/flexural strength</td>
<td>4.3.5 Tensile strength perpendicular to faces</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Durability of reaction to fire against heat, weathering, ageing/degradation</td>
<td>4.2.7.2 Durability of reaction to fire of the product as placed on the market against ageing/degradation</td>
<td>–</td>
<td>b</td>
</tr>
<tr>
<td>Durability of thermal resistance against heat, weathering, ageing/degradation</td>
<td>4.2.1 Thermal resistance and thermal conductivity</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td></td>
<td>4.2.7.3 Durability of thermal resistance against ageing/degradation</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>4.3.2 Dimensional stability under specified temperature and humidity conditions</td>
<td>–</td>
<td>Levels^c</td>
</tr>
<tr>
<td></td>
<td>4.3.3 Deformation under specified compressive load and temperature conditions</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td></td>
<td>Annex C Methods for the determination of the aged value of thermal resistance and thermal conductivity</td>
<td>–</td>
<td>Levels</td>
</tr>
<tr>
<td>Durability of compressive strength against ageing/degradation</td>
<td>4.3.6 Compressive creep</td>
<td>–</td>
<td>Levels</td>
</tr>
</tbody>
</table>

^a This characteristic also covers handling and installation.

^b No change in Reaction to fire properties for rigid polyurethane foam products.

^c For dimensional stability thickness only.

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case,
manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the
performance of their products with regard to this characteristic and the option “No performance determined”
(NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be
used, however, where the characteristic is subject to a threshold level (thermal resistance/thermal conductivity
and thickness).

**ZA.2 Procedures for attestation of conformity of factory made rigid polyurethane foam products**

**ZA.2.1 Systems of attestation of conformity**

For products having more than one of the intended uses specified in the following families, the tasks for the
approved body, derived from the relevant systems of attestation of conformity, are cumulative.

The system of attestation of conformity for the factory made rigid polyurethane foam products indicated in
Table ZA.1 in accordance with the Decision of the European Commission 95/204/EC of 31.04.95 revised by
decision 99/91/EC of 25.01.99 amended by the decision 01/596/EC of 8th January and as given in Annex III of
the mandate M103 as amended by mandates M126, M130 and M367 is shown in Table ZA.2 for the indicated
intended use(s).

<table>
<thead>
<tr>
<th>Table ZA.2 — Systems of attestation of conformity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product(s)</strong></td>
</tr>
<tr>
<td>Thermal insulation products (Factory made products)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Any</td>
</tr>
</tbody>
</table>

System 1: See Directive 89/106/EEC (CPD) Annex III.2.(i), without audit-testing of samples

a 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).

b Products/materials not covered by footnote (⁹).

c Products/materials that do not require to be tested for reaction to fire (e.g. Products/materials of classes A1
according to Commission Decision 96/603/EC, as amended).

The system of attestation of conformity for the CE marking of the factory made rigid polyurethane foam
product is defined in accordance with Annex ZA (see ZA.2.1). For rigid polyurethane foam (PU) products the
footnote a of Table ZA.2 applies except when it can be demonstrated to the notified body for a particular
product that no stage in the production process will result in an improvement of the reaction to fire
classification (see Table ZA.2, footnote ⁹).

The attestation of conformity of the factory rigid polyurethane foam products in Table ZA.1 shall be based on
the evaluation of conformity procedures indicated in Tables ZA.3 to ZA.4 resulting from application of the
clauses of this or other European Standard indicated therein.

Where more than one table applies for the product (i.e. because its intended use makes different
characteristics relevant), Table ZA.3 has to be read in conjunction with subsequent tables in order to
determine which characteristics assigned to the manufacturer in Table ZA.3 are type tested by a notified test
lab (system 3) and which by the manufacturer (system 4).
### Table ZA.3.1 — Assignment of evaluation of conformity tasks for products under system 1 for reaction to fire and system 3 for other characteristics

<table>
<thead>
<tr>
<th>Tasks under the responsibility of the manufacturer</th>
<th>Content of the task</th>
<th>Evaluation of conformity clauses to apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory production control (FPC)</td>
<td>Parameters related to all relevant characteristics of Table ZA.1</td>
<td>Clauses 1 to 5, Annexes B and C of EN 13172:2012 7.3 of this standard</td>
</tr>
<tr>
<td>Further testing of samples taken at factory</td>
<td>All relevant characteristics of Table ZA.1</td>
<td>Annex B of this standard</td>
</tr>
<tr>
<td>Initial type testing by the manufacturer</td>
<td>Those relevant characteristics of Table ZA.1 not tested by the notified laboratory and certification body</td>
<td>Clause 6 of EN 13172:2012 7.2 of this standard</td>
</tr>
</tbody>
</table>

**Tasks under responsibility of a notified laboratory**

| Initial type testing<sup>b</sup> | Thermal resistance  
Release of dangerous substances<sup>a</sup>  
Compressive strength (for load bearing applications)  
Water permeability *(if relevant)* | Clause 6 of EN 13172:2012 7.2 of this standard |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial type testing&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Reaction to fire</td>
</tr>
</tbody>
</table>

**Tasks under the responsibility of the notified certification body**

| Initial inspection of factory and of FPC  
Continuous surveillance, assessment and approval of FPC | Parameters related to all relevant characteristics of Table ZA.1, namely reaction to fire | Annex B and C of EN 13172:2012 7.3 of this standard |

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<sup>a</sup> No test method available as yet.

<sup>b</sup> Sampling shall be carried out as defined in 5.1.
Table ZA.3.2 — Assignment of evaluation of conformity tasks for products under system 3 or system 3 combined with system 4 for reaction to fire

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Content of the task</th>
<th>Evaluation of conformity clauses to apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory production control (FPC)</td>
<td>Parameters related to all characteristics of Table ZA.1 relevant for the intended use</td>
<td>7.3 of this standard and Clauses 1 to 5 of EN 13172:2012 and: For system 3 Annex C of EN 13172:2012. For system 3 (with 4 for RIF) Annex C and D of EN 13172:2012</td>
</tr>
<tr>
<td>Initial type testing by the manufacturer</td>
<td>Those relevant characteristics of Table ZA.1 not tested by the notified test lab including reaction to fire for system 4</td>
<td>7.2 of this standard and Clause 6 of EN 13172:2012</td>
</tr>
<tr>
<td>Initial type testing by a notified test laboratory</td>
<td>— Reaction to fire (system 3) — Thermal resistance — Release of dangerous substances (^a) — Compressive strength \textit{for load bearing applications} — Water permeability \textit{if relevant}</td>
<td>7.2 of this standard and Clause 6 of EN 13172:2012</td>
</tr>
</tbody>
</table>

\(^a\) When drafting this standard, no European harmonised test method was available.

**ZA.2.2 EC certificate and declaration of conformity**

\textit{(In case of products under system 1 combined with system 3 according to Table ZA.3.1): When compliance with the conditions of this annex is achieved, the certification body shall draw up a certificate of conformity (EC Certificate of conformity), which entitles the manufacturer to affix the CE marking. The certificate shall include:}

— name, address and identification number of the certification body;
— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

\textit{NOTE 1} The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.);
— provisions to which the product conforms (e.g. Annex ZA of this European Standard);
— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);
the number of the certificate;

— conditions of validity of the certificate, where applicable;

— name of, and position held by, the person empowered to sign the certificate.

In addition, the manufacturer shall draw up and retain a declaration of conformity (EC Declaration of conformity) including the following:

— name and address of the manufacturer, or his authorised representative established in the EEA;

— name and address of the certification body;

— description of the product (type, identification, use, etc.), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (e.g. Annex ZA of this European Standard);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

— number of the accompanying EC Certificate of conformity;

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

(In case of products under system 3 or (3 and 4)): When compliance with the conditions of this annex is achieved, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity (EC Declaration of conformity), which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;

NOTE 3 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.), and a copy of the information accompanying the CE marking;

NOTE 4 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (e.g. Annex ZA of this European Standard),

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc);

— name and address of the notified laboratory(ies);

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The above mentioned declaration and certificate shall be presented in the language or languages accepted in the Member State in which the product is to be used.

The validity of the declaration/certificate shall be verified at least once a year.
From 1 July 2013, the manufacturer should issue a declaration of performance in accordance with the Construction Product Regulation n° 305/2011.

**ZA.3 CE Marking and labelling**

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking.

The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the product itself, or on the accompanying label or on the packaging. The following information shall accompany the CE marking symbol:

- identification number of the certification body (only for products under systems 1);
- name or identifying mark and registered address of the manufacturer (see Note 1 in ZA.2.2);
- the last two digits of the year in which the marking is affixed;
- number of the EC Certificate of conformity (if relevant);
- reference to this European Standard with date of version;
- description of the product: generic name, material, dimensions, etc. and intended use;
- information on those relevant essential characteristics listed in Table ZA.1 which are to be declared presented as:
  - standard designation(s) in combination with declared values as described in Clauses 8 and 6 (covering only the characteristics of Table ZA.1);
  - “No performance determined” for characteristics where this is relevant.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the product, label, packaging and/or commercial documents.
<table>
<thead>
<tr>
<th>Identification number of the certification body (for products under system 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Co Ltd, PO Box 21, B-1050</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>01234-CPD-00234</td>
</tr>
<tr>
<td>Name or identifying mark and registered address of the producer</td>
</tr>
<tr>
<td>EN 13165:2012</td>
</tr>
<tr>
<td>PU</td>
</tr>
<tr>
<td>RtF C-s2,d0</td>
</tr>
<tr>
<td>$R_{D}$ 4,2 m$^2$ K/W</td>
</tr>
<tr>
<td>$\lambda_{D}$ 0,024 W/m·K</td>
</tr>
<tr>
<td>$d_N$ 100 mm</td>
</tr>
<tr>
<td>PU — EN 13165 — T2 — DS(70,90)3 — CS(10\Y)100</td>
</tr>
</tbody>
</table>

**Figure ZA.1 — Example CE marking information**

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

**NOTE 1** European legislation without national derogations need not be mentioned.

**NOTE 2** Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.
Bibliography

[1] ASTM D 3985, Standard test method for oxygen gas transmission rate through plastic film and sheeting using a coulometric sensor

[2] EN 1602, Thermal insulating products for building applications — Determination of the apparent density


[4] EN 12089, Thermal insulating products for building applications — Determination of bending behaviour

[5] EN 12090, Thermal insulating products for building applications — Determination of shear behaviour


[7] EN 14308, Thermal insulation products for building equipment and industrial installations — Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products — Specification

[8] EN ISO 10456, Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values (ISO 10456)
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