

Thermal insulation products for buildings — Factory made products of expanded polystyrene (EPS) — Specification

The European Standard EN 13163:2001 has the status of a
British Standard

ICS 91.100.60

National foreword

This British Standard is the official English language version of EN 13163:2001. EN 13163 is a “harmonized” European Standard and fully takes into account the requirements of the European Commission mandate M/103 “Thermal insulating materials and products”, given under the EU Construction Products Directive (89/106/EEC), and is intended to lead to CE marking. The date of applicability of EN 13163 as a harmonized European Standard, i.e. the date after which this standard may be used for CE marking purposes, is subject to an announcement in the *Official Journal of the European Communities*.

EN 13163 is the subject of transitional arrangements agreed under the European Commission mandate. The Member States have agreed a nominal transition period for the co-existence of EN 13163 and their corresponding national standard(s). It is intended that this period will comprise a nominal nine month period during which any required changes to national regulations are to be made, followed by a further nominal 12 month period for the implementation of CE marking. By the end of this co-existence period, any conflicting national standards will be withdrawn or amended to remove conflicts. In the UK, the corresponding national standard is:

— BS 3837-1:1986, *Expanded polystyrene boards — Specification for boards manufactured from expandable beads*;

and based on this nominal transition period of 21 months, BS 3837-1:1986 will be withdrawn or amended at the latest by March 2003.

The UK participation in the preparation of EN 13163:2001 was entrusted to Technical Committee PRI/72, Rigid cellular materials, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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English version

Thermal insulation products for buildings — Factory made
products of expanded polystyrene (EPS) — Specification

Produits isolants thermiques pour le bâtiment — Produits
manufacturés en polystyrène expansé (EPS) —
Spécification

Wärmedämmstoffe für Gebäude — Werkmäßig hergestellte
Produkte aus expandiertem Polystyrol (EPS) —
Spezifikation

This European Standard was approved by CEN on 16 April 2001.

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 Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Contents

	Page
Foreword	4
1 Scope	5
2 Normative references	6
3 Terms, definitions, symbols, units and abbreviated terms	7
4 Requirements	9
5 Test methods	17
6 Designation code	20
7 Evaluation of conformity	21
8 Marking and labelling	21
Annex A (normative) Determination of the declared values of thermal resistance and thermal conductivity	22
Annex B (normative) Factory production control	24
Annex C (normative) Product classification	31
Annex D (informative) Additional properties	32
Annex ZA (informative) Clauses of this European Standard addressing the provisions of the EU Construction Products Directive	35

Tables

Table 1 — Classes of dimensional tolerances	11
Table 2 — Classes of dimensional stability under constant normal laboratory conditions	11
Table 3 — Levels of dimensional stability under specified temperature and humidity conditions	12
Table 4 — Levels of deformation under specified compressive load and temperature conditions	12
Table 5 — Levels for compressive stress at 10 % deformation	13
Table 6 — Levels for tensile strength perpendicular to faces	13
Table 7 — Levels of bending strength	14
Table 8 — Levels for long term water absorption by total immersion	15
Table 9 — Levels for long term water absorption by diffusion	15
Table 10 — Levels for dynamic stiffness	16
Table 11 — Classes for thickness tolerances	16
Table 12 — Levels for compressibility	17

Table 13 — Test methods, test specimens and conditions	19
Table A.1 — Values for k for one sided 90 % tolerance interval with a confidence level of 90 %.....	23
Table B.1 — Minimum product testing frequencies	24
Table B.2 — Minimum product testing frequencies for the reaction to fire characteristics.....	26
Table B.3 — Thickness effect parameter, L , for the determination of the declared thermal conductivity, λ_D ..	29
Table C.1 — Classification of EPS products	31
Table C.2 — Classification of load bearing EPS products with acoustical properties	31
Table D.1 — Correlation between bending strength and shear strength	32
Table D.2 — Tabulated values of water vapour diffusion resistance index and water vapour permeability ...	33
Table D.3 — Test methods	33
Table ZA.1 — Relevant clauses	35
Table ZA.2.1 — Systems of attestation of conformity of factory made products for any intended use	37
Table ZA.2.2 — Systems of attestation of conformity of factory made products for uses subject to regulations on reaction to fire.....	37
Table ZA.3 — Example CE marking information	39

Foreword

This European Standard 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 November 2001, and conflicting national standards shall be withdrawn at the latest by March 2003.

This European Standard 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 standard.

This European Standard contains five annexes.

Annex A (normative)	Determination of the declared values of thermal resistance and thermal conductivity.
Annex B (normative)	Factory production control.
Annex C (normative)	Product classification.
Annex D (informative)	Additional properties.
Annex ZA (informative)	Clauses of this European Standard addressing the provisions of the EU Construction Products Directive.

This European Standard is one of a series of standards for 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 have proposed defining the standards listed below as a European package of standards, setting (21 months after availability) as the date of withdrawal (dow) of national standards which conflict with the European Standards of this package.

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 products of expanded polystyrene (EPS) — Specification.*

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

EN 13165, *Thermal insulation products for buildings — Factory made rigid polyurethane foam (PUR) products — Specification.*

EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — 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 products of expanded perlite (EPB) — 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.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the requirements for factory made products of expanded polystyrene, with or without facings or coatings, which are used for the thermal insulation of buildings. The products are manufactured in the form of boards or rolls or other preformed ware.

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

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

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

Products with a declared thermal resistance lower than $0,25 \text{ m}^2\cdot\text{K}/\text{W}$ or a declared thermal conductivity at $10 \text{ }^\circ\text{C}$ greater than $0,060 \text{ W}/(\text{m}\cdot\text{K})$ are not covered by this standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 822, *Thermal insulating products for building applications — Determination of length and width.*

EN 823, *Thermal insulating products for building applications — Determination of thickness.*

EN 824, *Thermal insulating products for building applications — Determination of squareness.*

EN 825, *Thermal insulating products for building applications — Determination of flatness.*

EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

EN 1602, *Thermal insulating products for building applications — Determination of apparent density.*

EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C / 50 % relative humidity).*

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.*

prEN ISO 1182, *Reaction to fire tests for building products — Non-combinability test (ISO/DIS 1182:1998).*

prEN ISO 1716, *Reaction to fire tests for building products — Determination of calorific value (ISO/DIS 1716:1998).*

prEN ISO 9229, *Thermal insulation — Definitions of terms (ISO/DIS 9229:1997).*

prEN ISO 11925-2, *Reaction to fire tests for building products — Part 2: Ignitability when subjected to direct impingement of flame (ISO/DIS 11925-2:1998).*

EN 12085, *Thermal insulating products for building applications — Determination of linear dimensions of test specimens.*

EN 12086, *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.*

EN 12088, *Thermal insulating products for building applications — Determination of long term water absorption by diffusion.*

EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

EN 12090, *Thermal insulating products for building applications — Determination of shear behaviour.*

EN 12431, *Thermal insulating products for building applications — Determination of thickness for floating floor insulating products.*

prEN 12667, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

EN 13172:2001, *Thermal insulating products — Evaluation of conformity.*

prEN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item.*

EN 29052-1, *Acoustics — Determination of dynamic stiffness — Part 1: Materials used under floating floors in dwellings.*

3.1 Terms and definitions

For the purpose of this standard, the following terms and definitions apply. Other relevant definitions are to be found in prEN ISO 9229.

expanded polystyrene (EPS)

rigid cellular plastic material, manufactured by moulding beads of expandable polystyrene or one of its copolymers, with an air filled closed cellular structure

expanded polystyrene block

rigid insulation product or material generally of rectangular cross section and with a thickness not significantly smaller than the width

Blocks are supplied trimmed or untrimmed.

expanded polystyrene board

rigid insulation product (cut, moulded, or continuously foamed) of rectangular shape and cross-section in which the thickness is significantly smaller than the other dimensions

Boards may be of uniform thickness or tapered. The board edges may be of various sorts (e.g. square, half lapped, tongue and groove).

expanded polystyrene roll

boards or strips bonded to a flexible facing, supplied in a wound or folded form, which form a continuous insulation layer when unrolled

preformed ware

insulation shapes formed by cutting or grinding from blocks or boards or by shape moulding

3.1.6

level

given value, which is the upper or lower limit of a requirement

The level is given by the declared value of the characteristic concerned.

3.1.7

class

combination of two levels of the same property between which the performance shall fall, where the levels are given by the declared value of the characteristic concerned

3.2 Symbols, units and abbreviated terms

Symbols and units used in this standard:

$1 - \alpha$	is the prediction interval	1
b	is the width	mm
c	is the compressibility	mm
d	is the thickness	mm
δ	is the water vapour permeability	mg/(Pa·h·m)
d_B	is the thickness under a load of 2 kPa after removal of an additional load of 48 kPa	mm
d_L	is the thickness under a load of 250 Pa	mm
d_N	is the nominal thickness of the product	mm
d_s	is the thickness of the test specimen	mm
$\Delta \varepsilon_b$	is the relative change in width	%
$\Delta \varepsilon_d$	is the relative change in thickness	%
$\Delta \varepsilon_l$	is the relative change in length	%
ε_1	is the deformation after step A in accordance with EN 1605	%
ε_2	is the deformation after step B in accordance with EN 1605	%
ε_{ct}	is the compressive creep	%
ε_t	is the total relative thickness reduction	%
E_{dyn}	is the dynamic elasticity modulus	MN/m ²
k	is a factor related to the number of test results available	1
l	is the length	mm
L	is the thickness effect parameter	1
$\lambda_{90, 90}$	is the 90 % fractile with a confidence level of 90 % for the thermal conductivity	W/(m·K)
λ_D	is the declared of thermal conductivity	W/(m·K)
λ_i	is one test result of thermal conductivity	W/(m·K)
λ_i'	is one test result of thermal conductivity for which the thickness effect is not negligible	W/(m·K)
λ_{mean}	is the mean thermal conductivity	W/(m·K)
λ_{pred}	is the predicted thermal conductivity with a prediction interval of 90 %	W/(m·K)
μ	is the water vapour diffusion resistance factor	1
n	is the number of test results	1
ρ_a	is the apparent density	kg/m ³
$R_{90/90}$	is the 90 % fractile with a confidence level of 90 % for the thermal resistance	m ² ·K/W
R_D	is the declared thermal resistance	m ² ·K/W
R_i	is one test result of thermal resistance	m ² ·K/W
R_i'	is one test result of thermal resistance for which the thickness effect is not negligible	m ² ·K/W
R_{mean}	is the mean thermal resistance	m ² ·K/W
s'	is the dynamic stiffness	MN/m ³
σ_{10}	is the compressive stress at 10 % deformation	kPa
$\sigma_{10, mean}$	is the mean compressive stress at 10 % deformation	kPa
$\sigma_{10, pred}$	is the predicted compressive stress at 10 % deformation with a prediction interval of 90 %	kPa
σ_b	is the bending strength	kPa
σ_c	is the compressive stress	kPa
σ_{mt}	is the tensile strength perpendicular to faces	kPa
S_b	is the deviation from squareness	mm/m
s_λ	is the estimate of the standard deviation of the thermal conductivity	W/(m·K)
S_{max}	is the deviation from flatness	mm

s_R	is the estimate of the standard deviation of the thermal resistance	m ² ·K/W
t	is the testing time	d
τ	is the shear strength	kPa
W_{dv}	is the water absorption by diffusion	%
W_{ip}	is the long term water absorption by partial immersion	kg/m ²
W_{it}	is the long term water absorption by total immersion	%
X	is the initial deformation after 60 s from the beginning of the loading	mm
X_{ct}	is the compressive creep	mm
X_t	is the deformation at time t (total thickness reduction)	mm
Z	is the water vapour resistance	m ² ·h·Pa/mg

BS	is the symbol of the declared level for bending strength
CC ($i_1/i_2/y$) σ_c	is the symbol of the declared level for compressive creep
CP	is the symbol of the declared level for compressibility
CS(10)	is the symbol of the declared level for compressive stress at 10 % deformation
DS(N)	is the symbol of the declared class for dimensional stability under constant normal laboratory conditions
DS(TH)	is the symbol of the declared level for dimensional stability under specified temperature and humidity
DLT	is the symbol of the declared level for dimensional stability under load and temperature conditions
L	is the symbol of the declared class for length tolerances
MU	is the symbol of the declared water vapour
P	is the symbol of the declared class for flatness tolerance
S	is the symbol of the declared class for squareness tolerance
SD	is the symbol of the declared level for dynamic stiffness
T	is the symbol of the declared class for thickness tolerance
TR	is the symbol of the declared level for tensile strength perpendicular to faces
W	is the symbol of the declared class for width tolerance
WD(V)	is the symbol of the declared level for water absorption by diffusion
WL(T)	is the symbol of the declared level for long term water absorption by total immersion
Z	is the symbol of the declared water vapour resistance value

Abbreviated terms used in this standard:

EPS	is expanded polystyrene;
ITT	is initial type test.

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.

NOTE Information on additional properties is given in annex D.

One test result for a product property is the average of the measured values on the number of test specimens given in Table 13. Wherever limit values are used, they shall represent the value achieved by at least 90 % of the production with a confidence level of 90 %.

For mechanical properties no single measured value within the consecutive group used for obtaining the test result shall be more than 10 % lower than the limit value defining the level. For non-mechanical properties a deviation from the limit value may be required and where appropriate these are expressed in the text.

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 prEN 12667 or EN 12939 for thick products.

The thermal resistance and the thermal conductivity shall be determined in accordance with annex A 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;

NOTE Zeros on the left hand side are not counted as significant figures.

- the thermal resistance, R_D , shall always be declared. The thermal conductivity, λ_D , shall be declared where possible;
- the declared thermal resistance, R_D , and the declared thermal conductivity, λ_D , shall be given as limit values representing at least 90 % of the production, determined with a confidence level of 90 %;
- the value of thermal conductivity, $\lambda_{90/90}$, shall be rounded upwards to the nearest 0,001 W/(m·K) and declared as λ_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. For products for which compressibility is measured (see 4.3.13) the R_D shall be calculated using d_L instead of d_N . For the calculation of the declared thermal conductivity, λ_D , related to the corresponding nominal thickness, factors for the thickness effect conversions are given in annex B;
- the 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 value of $R_{90/90}$, 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.

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 for the declared class.

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 1, for the declared class.

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 the tolerances given in Table 1, for the declared class.

4.2.5 Flatness

Flatness shall be determined in accordance with EN 825. The maximum deviation from flatness, S_{max} , shall not exceed the tolerances given in Table 1 for the declared class. This test shall not be performed when the tests described in 4.3.13 are used.

Table 1 — Classes of dimensional tolerances

Property	Class	Tolerances	
		Boards	Rolls
Length	L1	$\pm 0,6\%$ or $\pm 3\text{ mm}^a$	-1 % + unrestricted
	L2	$\pm 2\text{ mm}$	
Width	W1	$\pm 0,6\%$ or $\pm 3\text{ mm}^a$	$\pm 0,6\%$ or $\pm 3\text{ mm}^a$
	W2	$\pm 2\text{ mm}$	
Thickness ^b	T1	$\pm 2\text{ mm}$	
	T2	$\pm 1\text{ mm}$	
Squareness	S1	$\pm 5\text{ mm} / 1\ 000\text{ mm}$	
	S2	$\pm 2\text{ mm} / 1\ 000\text{ mm}$	
Flatness ^c	P1	$\pm 30\text{ mm}$	
	P2	$\pm 15\text{ mm}$	
	P3	$\pm 10\text{ mm}$	
	P4	$\pm 5\text{ mm}$	

^a Whichever gives the greatest numerical tolerance.

^b Further classes see 4.3.13.1.

^c Flatness is expressed per metres run.

4.2.6 Dimensional stability

4.2.6.1 Dimensional stability under constant normal laboratory conditions

Dimensional stability under constant normal laboratory conditions (23 °C, 50 % relative humidity) shall be determined in accordance with EN 1603. The relative changes in length, $\Delta \varepsilon_l$, and width, $\Delta \varepsilon_b$, shall not exceed the values given in Table 2 for the declared class.

Table 2 — Classes of dimensional stability under constant normal laboratory conditions

Class	Requirement %
DS(N) 5	$\pm 0,5$
DS(N) 2	$\pm 0,2$

4.2.6.2 Dimensional stability under specified temperature and humidity conditions

Dimensional stability under specified temperature and humidity conditions shall be determined in accordance with EN 1604. The test shall be carried out after storage for 48 h at $(23 \pm 2) ^\circ\text{C}$ and $(90 \pm 5) \%$ relative humidity. The relative changes in length, $\Delta \varepsilon_l$, width, $\Delta \varepsilon_b$, and thickness, $\Delta \varepsilon_t$, shall not exceed 1 %. The test shall not be performed when the more severe test, described in 4.3.2, is used for a product in a specific application.

4.2.7 Bending strength

Bending strength, σ_b , shall be determined in accordance with EN 12089. For handling purposes, products shall have a minimum level of bending strength of 50 kPa.

4.2.8 Reaction to fire

Reaction to fire classification (Euroclasses) shall be determined in accordance with prEN 13501-1.

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 under specified temperature and humidity conditions

Dimensional stability 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 3. The relative changes in length, $\Delta\epsilon_l$, width, $\Delta\epsilon_b$, and thickness, $\Delta\epsilon_d$, shall not exceed the values given in Table 3 for the declared level.

Table 3 — Levels of dimensional stability under specified temperature and humidity conditions

Level	Condition	Requirement %
DS(70,-)1	48 h, 70 °C	1
DS(70,-)2	48 h, 70 °C	2
DS(70,-)3	48 h, 70 °C	3
DS(70, 90)1	48 h, 70 °C, 90 %	1

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. For each test condition the difference between the relative deformation, ϵ_1 , after step A and ϵ_2 , after step B as described in EN 1605 shall not exceed the values given in Table 4 for the declared level.

Table 4 — Levels of deformation under specified compressive load and temperature conditions

Level	Condition	Requirement %
DLT(1)5	load: 20 kPa temperature: $(80 \pm 1)^\circ\text{C}$ time: (48 ± 1) h	≤ 5
DLT(2)5	load: 40 kPa temperature: $(70 \pm 1)^\circ\text{C}$ time: (168 ± 1) h	≤ 5
DLT(3)5	load: 80 kPa temperature: $(60 \pm 1)^\circ\text{C}$ time: (168 ± 1) h	≤ 5

4.3.4 Compressive stress at 10 % deformation

Compressive stress at 10 % deformation, σ_{10} , shall be determined in accordance with EN 826. No test result shall be less than the value given in Table 5 for the declared level.

NOTE The compressive stress at 10 % deformation is not a design value.

Table 5 — Levels for compressive stress at 10 % deformation

Level	Requirement kPa
CS(10)30	≥ 30
CS(10)50	≥ 50
CS(10)60	≥ 60
CS(10)70	≥ 70
CS(10)80	≥ 80
CS(10)90	≥ 90
CS(10)100	≥ 100
CS(10)120	≥ 120
CS(10)150	≥ 150
CS(10)200	≥ 200
CS(10)250	≥ 250
CS(10)300	≥ 300
CS(10)350	≥ 350
CS(10)400	≥ 400
CS(10)500	≥ 500

Products for which compressive stress is claimed shall satisfy the bending strength requirements given in Table C.1 (for handling purposes).

4.3.5 Tensile strength perpendicular to faces

Tensile strength perpendicular to faces, σ_{mt} , shall be determined in accordance with EN 1607. No test result shall be less than the value given in Table 6, for the declared level.

Table 6 — Levels for tensile strength perpendicular to faces

Level	Requirement kPa
TR20	≥ 20
TR50	≥ 50
TR80	≥ 80
TR100	≥ 100
TR150	≥ 150
TR200	≥ 200
TR400	≥ 400

4.3.6 Bending strength

Bending strength, σ_b , shall be determined in accordance with EN 12089. No test result shall be less than the value given in Table 7 for the declared level.

Table 7 — Levels of bending strength

Level	Requirement kPa
BS50	≥ 50
BS75	≥ 75
BS100	≥ 100
BS115	≥ 115
BS125	≥ 125
BS135	≥ 135
BS150	≥ 150
BS170	≥ 170
BS200	≥ 200
BS250	≥ 250
BS350	≥ 350
BS450	≥ 450
BS525	≥ 525
BS600	≥ 600
BS750	≥ 750

4.3.7 Point load

For EPS products the effects of foot traffic shall be assessed by means of determination of compressive stress at 10 % deformation in accordance with EN 826, see 4.3.4.

4.3.8 Compressive creep

Compressive creep, ε_{ct} , and the total thickness reduction, ε_t , shall be determined after at least one hundred twenty two days of testing at a declared compressive stress, σ_c , given in steps of at least 1 kPa, and the results extrapolated thirty times 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 Examples for declaration of levels for compressive creep.

Level	Test time t days	Extrapolation time years	Declared stress σ_c kPa	Requirement %
CC($i_1/i_2/10$) σ_c	122	10	σ_c	$i_1 \leq i$ and $i_2 \leq i$
CC($i_1/i_2/25$) σ_c	304	25	σ_c	
CC($i_1/i_2/50$) σ_c	608	50	σ_c	

NOTE 2 Referring to the designation code CC($i_1/i_2/y$) σ_c , according to clause 6, a declared level CC(2,5/2/50)100, for example, indicates a value not exceeding 2 % for compressive creep and 2,5 % for total thickness reduction after extrapolation at 50 years (i. e. 30×608) under a declared stress of 100 kPa.

4.3.9 Water absorption

4.3.9.1 Long term water absorption by immersion

Long term water absorption by immersion shall be determined in accordance with EN 12087. No test result of the water absorption by total immersion, W_{lt} , shall exceed the value given in Table 8 for the declared level. No test result of water absorption by partial immersion, W_{lp} , shall exceed 0,5 kg/m².

Table 8 — Levels for long term water absorption by total immersion

Level	Requirement %
WL(T)5	$\leq 5,0$
WL(T)3	$\leq 3,0$
WL(T)2	$\leq 2,0$
WL(T)1	$\leq 1,0$

4.3.9.2 Long term water absorption by diffusion

Long term water absorption by diffusion shall be determined in accordance with EN 12088. No test result of the water absorption, W_{dv} , shall exceed the value given in Table 9, for the declared level.

Table 9 — Levels for long term water absorption by diffusion

Level	Requirement %
WD(V)15	≤ 15
WD(V)10	≤ 10
WD(V)5	≤ 5
WD(V)3	≤ 3

NOTE The long term water absorption by diffusion is not only used as an accelerated test but can also be used for classification.

4.3.10 Freeze-thaw resistance

Freeze-thaw resistance shall be determined in accordance with EN 12091 using samples prepared by total immersion in accordance with EN 12087. The reduction of compressive stress at 10 % deformation, σ_{10} , shall be less than 10 % after 300 freeze-thaw cycles.

4.3.11 Water vapour transmission

Water vapour transmission properties shall be determined in accordance with EN 12086 and declared as the water vapour diffusion resistance factor, μ , for homogeneous products and as the water vapour resistance, Z , for faced products. No test result of μ shall be greater than the declared value and no test result of Z shall be less than the declared value.

In the absence of measurement data, the water vapour diffusion resistance factor, μ , of EPS products may be chosen from Table D.2.

4.3.12 Dynamic stiffness

Dynamic stiffness, s , shall be determined in accordance with EN 29052-1, without preloading. No test result shall exceed the value given in Table 10, for the declared level.

Table 10 — Levels for dynamic stiffness

Level	Requirement MN/m ³
SD50	≤ 50
SD40	≤ 40
SD30	≤ 30
SD20	≤ 20
SD15	≤ 15
SD10	≤ 10
SD7	≤ 7
SD5	≤ 5

For products in level CP2 (see 4.3.13.3), if the imposed load exceeds 5,0 kPa, the dynamic stiffness, s' , shall be determined under the imposed load plus the self-weight of the screed.

4.3.13 Compressibility

4.3.13.1 Thickness, d_L

The thickness, d_L , shall be determined in accordance with EN 12431 under a load of 250 Pa. No test result shall deviate from the declared thickness, d_L , by more than the tolerances given in Table 11 for the labelled class.

Table 11 — Classes for thickness tolerances

Class	Tolerances	
T3	-5 % or -1 mm ^a	+15 % or +3 mm ^a
T4	0	+10 % or +2 mm for $d_L < 35$ mm ^a +15 % or +3 mm for $d_L \geq 35$ mm ^a
^a Whichever gives the greatest numerical tolerance.		

NOTE The declared value of d_L should preferably be indicated in steps of 5 mm, the smallest value of d_L being 15 mm.

4.3.13.2 Thickness, d_B

The thickness, d_B , shall be determined in accordance with EN 12431 with a pause of 300 s before measuring d_B .

4.3.13.3 Compressibility, c

Compressibility, c , shall be determined as the difference between d_L and d_B . No test result shall exceed the values given in Table 12 for the declared level.

Table 12 — Levels for compressibility

Level	Imposed load on the screed kPa	Requirement mm	Tolerance mm
CP5	≤ 2,0	≤ 5	≤ 2 for $d_L < 35$ ≤ 3 for $d_L ≥ 35$
CP4	≤ 3,0	≤ 4	
CP3	≤ 4,0	≤ 3	
CP2	≤ 5,0	≤ 2	≤ 1 for $d_L < 35$ ≤ 2 for $d_L ≥ 35$

NOTE The levels of the imposed load on the screed are taken from ENV 1991-2-1, *Eurocode 1 — Basis of design and actions on structures — Part 2.1: Actions on structures — Densities, self-weight and imposed loads*.

4.3.13.4 Long term thickness reduction

If the imposed load on the screed exceeds 5 kPa only products having a declared level of compressibility of CP2 may be used and their long term thickness reduction shall be determined.

The total thickness reduction, $X_t = X_0 + X_{ct}$, shall be determined after one hundred and twenty two days of testing at the imposed load plus the self-weight of the screed, in accordance with EN 1606 and extrapolated thirty times, corresponding to ten years. The ten years value shall not exceed the declared level of compressibility c (see 4.3.13).

4.3.14 Apparent density

Apparent density, ρ_a , shall be determined in accordance with EN 1602 when it is needed for indirect testing.

4.3.15 Release of dangerous substances

NOTE See annex ZA.

5 Test methods

5.1 Sampling

Test specimens shall be taken from the same sample with a total area not less than 1 m² and sufficient to cover the needed tests. The shorter side of the sample shall not be less than 300 mm or a full size of the product, whichever is smaller.

5.2 Conditioning

Conditioning of the test specimens shall be carried out for 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 at least fourteen days prior to testing.

5.3 Testing

5.3.1 General

Table 13 gives the dimensions of test specimens and the minimum number of measurements required to get one test result and any specific conditions, which are necessary.

5.3.2 Thermal resistance and thermal conductivity

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

- at a mean temperature of $(10 \pm 0,3) ^\circ\text{C}$;
- after conditioning in accordance with 5.2;
- after preparation in accordance with the procedure in Table 13.

NOTE Thermal resistance and the thermal conductivity may also be measured at mean temperatures other than $10 ^\circ\text{C}$, providing that the accuracy of the relationship between temperature and thermal properties is sufficiently 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 the thickness where the calculation is applied.

Table 13 — Test methods, test specimens and conditions

Dimensions in millimetres

Clause		Test method	Test specimen Length and width _{a, b}	Minimum number of measurements to get one test result ^c	Specific conditions
No.	Title				
4.2.1	Thermal resistance and thermal conductivity	prEN 12667 or EN 12939	See prEN 12667 or EN 12939	1	—
4.2.2	Length and width	EN 822	Full-size	1	—
4.2.3	Thickness	EN 823	Full-size	1	Load of (250 ± 5) Pa
4.2.4	Squareness	EN 824	Full-size	1	—
4.2.5	Flatness	EN 825	Full-size	1	—
4.2.6.1	Dimensional stability under constant normal laboratory conditions	EN 1603	Full-size	3	—
4.2.6.2	Dimensional stability under specified temperature and humidity conditions	EN 1604	200 × 200	3	—
4.2.7 and 4.3.6	Bending strength	EN 12089	300 × 150 × 50 ^d or (5 × d + 50) × 150 × d ^e	3	Method B
4.2.8	Reaction to fire	See prEN 13501-1			—
4.3.2	Dimensional stability under specified temperature and humidity	EN 1604	200 × 200	3	—
4.3.3	Deformation under specified compressive load and temperature conditions	EN 1605	50 × 50 × 50	3	Layers or coverings have to be cut off
4.3.4	Compressive stress at 10 % deformation	EN 826	50 × 50 × 50	3	Grinding
4.3.5	Tensile strength perpendicular to faces	EN 1607	50 × 50 × 50	3	—
4.3.8	Compressive creep	EN 1606	50 × 50 × 50 ^f	2	Grinding
4.3.9.1	Long term water absorption by immersion	EN 12087	200 × 200	3	Total: Method 1A and 2A

Table 13 — Test methods, test specimens and conditions *(continued)*

Clause		Test method	Test specimen Length and width _{a, b}	Minimum number of measurements to get one test result ^c	Specific conditions
No.	Title				
4.3.9.2	Long term water absorption by diffusion	EN 12088	500 × 500	2	—
4.3.10	Freeze-thaw resistance	EN 12091	200 × 200	6	Preparation by EN 12087
4.3.11	Water vapour transmission	EN 12086	100 × 100	5	Set B
4.3.12	Dynamic stiffness	EN 29052-1	200 × 200	3	—
4.3.13	Thickness, d_L	EN 12431	200 × 200	3	—
	Thickness, d_B	EN 12431			Measured 300 s after the preload has been removed
	Long term thickness reduction	EN 1606			—
4.3.14	Apparent density	EN 1602	Full-size	5	—
4.3.15	Release of dangerous substances	^g	—	—	—

^a Full-size product thickness, except for 4.2.7, 4.3.3, 4.3.4, 4.3.5, 4.3.6 and 4.3.8.
^b Test specimen dimensions shall be determined in accordance with EN 12085.
^c For calculation of the 90 % fractile and 90 % confidence level, the individual measurement shall be used.
^d Sample size used for boards of 50 mm and above.
^e For boards of thickness $d < 50$ mm.
^f Or otherwise agreed by parties concerned.
^g Not yet 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 expanded polystyrene abbreviated term	EPS
— This European Standard number	EN 13163
— Thickness tolerance	Ti
— Length tolerance	Li
— Width tolerance	Wi
— Squareness tolerance	Si
— Flatness tolerance	Pi
— Dimensional stability under specified temperature and humidity	DS(TH)i
— Bending strength	BSi
— Compressive stress at 10 % deformation	CS(10)i
— Dimensional stability under laboratory condition	DS(N)i
— Deformation under specific compressive load and temperature	DLT(i)5
— Tensile strength perpendicular to faces	TRi
— Compressive creep	CC($i_1/i_2/y$) σ_c
— Long term water absorption	WL(T)i
— Water absorption by diffusion	WD(V)i
— Water vapour diffusion transmission	MUi or Zi
— Dynamic stiffness	SDi
— Compressibility	CPi

where “i” shall be used to indicate the relevant class or level, “ σ_c ” shall be used to indicate the compressive stress and “y” to indicate the number of years.

The designation code for an EPS product is illustrated by the following example:

EPS – EN 13163 – T1 – L1 – W1 – S1 – P1 – BS100 – CS(10)60 – DS(N)5 – DLT(1)5 – TR50 – WL(T)5 – WD(V)15

7 Evaluation of conformity

The manufacturer or his authorized 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 factory production control and tests on samples taken at the factory.

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

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.

NOTE 1 The system of attestation of conformity for the CE marking of the product is chosen in accordance with annex ZA of this standard (see ZA.2.2). For products of expanded polystyrene (EPS) the footnote * of Table ZA.2.2 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.2.2, footnote **).

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

NOTE 2 For the CE certificate and declaration of conformity, as appropriate, see annex ZA.2.3.

8 Marking and labelling

Products conforming with 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 authorized representative;
- year of manufacture (the last two digits);
- shift or time of production and manufacturing plant or traceability code;
- reaction to fire class;
- declared thermal resistance;
- declared thermal conductivity;
- nominal thickness;
- designation code as given in clause 6;
- type of facing, if any;
- nominal length, nominal width;
- number of pieces and area in the package, as appropriate.

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

Annex A (normative)

Determination of the declared values of thermal resistance and thermal conductivity

A.1 Introduction

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 and 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 month. 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 test results shall be carried out spread over a minimum period of ten days.

The declared values 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

The derivation of the declared values, R_D and λ_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.3.1 Case where thermal resistance and thermal conductivity are declared

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

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

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

$$R_{90/90} = d_N / \lambda_{90/90} \quad (\text{A.3})$$

A.3.2 Case where thermal resistance is declared

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

$$R_{9/90} = R_{\text{mean}} - k \times s_R \quad (\text{A.4})$$

$$s_R = \sqrt{\frac{\sum_{i=1}^n (R_i - R_{\text{mean}})^2}{n-1}} \quad (\text{A.5})$$

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

Number of test results n	k
10	2,07
11	2,01
12	1,97
13	1,93
14	1,90
15	1,87
16	1,84
17	1,82
18	1,80
19	1,78
20	1,77
22	1,74
24	1,71
25	1,70
30	1,66
35	1,62
40	1,60
45	1,58
50	1,56
100	1,47
300	1,39
500	1,36
2000	1,32
For other numbers of test results use ISO 12491 or linear interpolation.	

Annex B (normative)

Factory production control

B.1 Testing frequencies

Table B.1 — Minimum product testing frequencies

Clause		Minimum testing frequency ^a		
No	Title	Direct testing	Indirect testing	
			Test method	Frequency
4.2.1	Thermal resistance and thermal conductivity ^b	1 per 24 h or	—	—
		1 per 3 month or	and weight per moulded item or density (using a manufacturer correlation)	1 per 2 h
		1 per 3 month or	and other test method for thermal conductivity	1 per week
		1 per year	and density (using the correlation given in Figure B.2)	1 per 2 h
4.2.2	Length and width	1 per 2 h	—	—
4.2.3	Thickness	1 per 2 h	—	—
4.2.4	Squareness	1 per 4 h	—	—
4.2.5	Flatness	1 per 8 h	—	—
4.2.6	Dimensional stability	ITT ^c	—	—
4.2.7 and 4.3.6	Bending strength	1 per day or	—	—
		1 per 3 month	and manufacturer's method	1 per day
4.2.8	Reaction to fire	See Table B.2		
4.3.2	Dimensional stability under specified temperature and humidity conditions	ITT ^c	—	—
4.3.3	Deformation under specified compressive load and temperature conditions	ITT ^c	—	—
4.3.4	Compressive stress at 10 % deformation	1 per day or	—	—
		1 per 3 month or	and weight per moulded item or density (using a manufacturer correlation)	1 per 2 h
		1 per year	and weight per moulded item or density (using the correlation given in Figure B.1)	1 per 2 h
4.3.5	Tensile strength perpendicular to faces	1 per week or	—	—
		1 per 3 month	and bending strength	1 per day
4.3.8	Compressive creep	ITT ^c	—	—
4.3.9.1	Long term water absorption by immersion	ITT ^c	—	—
4.3.9.2	Long term water absorption by diffusion	ITT ^c	—	—

Table B.1 — Minimum product testing frequencies (*continued*)

4.3.10	Freeze-thaw resistance	ITT ^c	—	—
4.3.11	Water vapour transmission	ITT ^c	—	Tabulated values
4.3.12	Dynamic stiffness	1 per week	—	—
4.3.13	Thickness, d_L	1 per day	—	—
	Compressibility	1 per week	—	—
4.3.15	Release of dangerous substances ^d	—	—	—
^a The minimum testing frequencies expressed in test results shall be understood as the minimum for each production unit 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. ^b For factory production control one measurement shall always be one test result. ^c ITT, see EN 13172. ^d Frequencies are not given, as test methods are not yet available.				

Table B.2 — Minimum product testing frequencies for the reaction to fire characteristics

Clause		Minimum testing frequency ^a							
No	Title	Direct testing ^{b, c}		Indirect testing ^{d, e}					
4.2.8	Reaction to fire class			Product		Components ^{f, g}			
						Substantial (EPS)		Non-substantial (Layers)	
		Test method	Frequency	Test method	Frequency	Test method	Frequency	Test method	Frequency
	A1	prEN ISO 1182 and prEN ISO 1716 (and prEN 13823)	1 per 2 years and indirect testing	–	–	Loss on ignition	1 per 4 h	Loss on ignition or calorific potential	1 per 4 h
						Apparent density	1 per 1 h	Weight unit per area	1 per 1 h
	A2	prEN ISO 1182 or prEN ISO 1716 and prEN 13823	1 per 2 years and indirect testing	–	–	Loss on ignition	1 per 4 h	Loss on ignition or calorific potential	1 per 4 h
						Apparent density	1 per 1 h	Weight per unit area	1 per 1 h
B, C, D	prEN 13823 and prEN ISO 11925-2	1 per month or 1 per 2 years and indirect testing	–	–	–	–	–	–	
			prEN ISO 11925-2	1 per day ^h	Apparent density and thickness	1 per 2 h	weight per unit area	1 per day	
									–
E	prEN ISO 11925-2	1 per day ^h	–	–	–	–	–	–	
F	–	–	–	–	–	–	–	–	

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

^a The minimum testing frequencies, expressed in test results, shall be understood as the minimum for a product or product group for each production unit/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.

^b Direct testing may be conducted either by third party or by the manufacturer.

^c Direct testing may also be the reference scenario room-corner test ISO 9705:1993 *Fire tests — Full scale room test for service products*.

^d 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.

^e Indirect testing may be either on the product or on its components.

^f Definition as given in the Euroclasses Decision 2000/147/EC:

Substantial component: A material that constitutes a significant part of a non-homogeneous product. A layer with a mass per unit area $\geq 1,0 \text{ kg/m}^2$ or a thickness $\geq 1,0 \text{ mm}$ is considered to be a substantial component.

Non-substantial component: A material that does not constitute a significant part of a non-homogeneous product. A layer with a mass per unit area $< 1,0 \text{ kg/m}^2$ and ^a thickness $< 1,0 \text{ mm}$ is considered to be a non-substantial component.

^g In case of certified component, the frequency is once per delivery of the component.

^h In case of certified raw material the frequency is once per week.

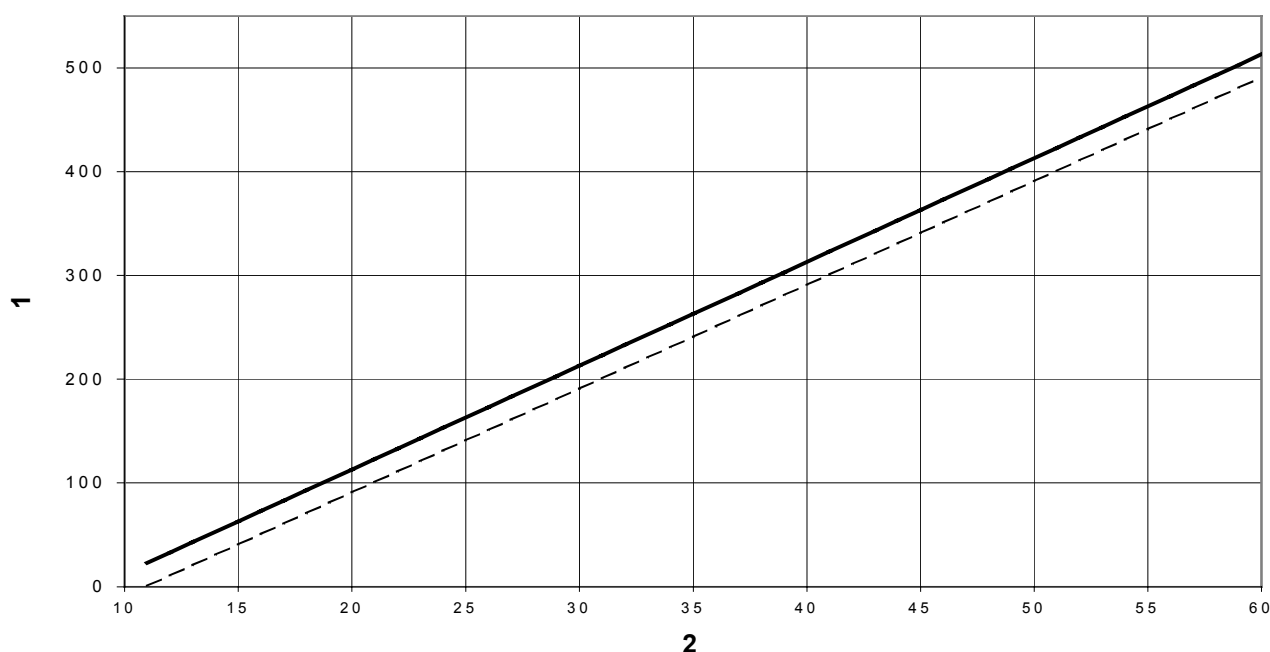
B.2 Indirect testing

B.2.1 General

If indirect testing is used, the correlation between the directly tested and the indirect property shall be known and the approach shall be calculated on a one sided 90 % prediction interval.

NOTE In this context compressive stress by 10 % deformation and thermal conductivity may be evaluated indirectly using the apparent density and its established mathematical correlation to these properties. For the relationship between compressive stress at 10 % deformation and apparent density and thermal conductivity and apparent density there is a large amount of data collected in Europe. The curves in Figures B.1 and B.2 have been calculated on this European data to which every manufacturer may refer. If a manufacturer wants to use his own data, he has to calculate and to record the approach for a prediction interval, $1 - \alpha$, of 90 %.

B.2.2 Compressive stress at 10 % deformation



Key

1 Compressive stress σ_{10} [kPa]

2 Apparent density ρ_a [kg/m³]

———— Compressive stress

----- Predicted compressive stress

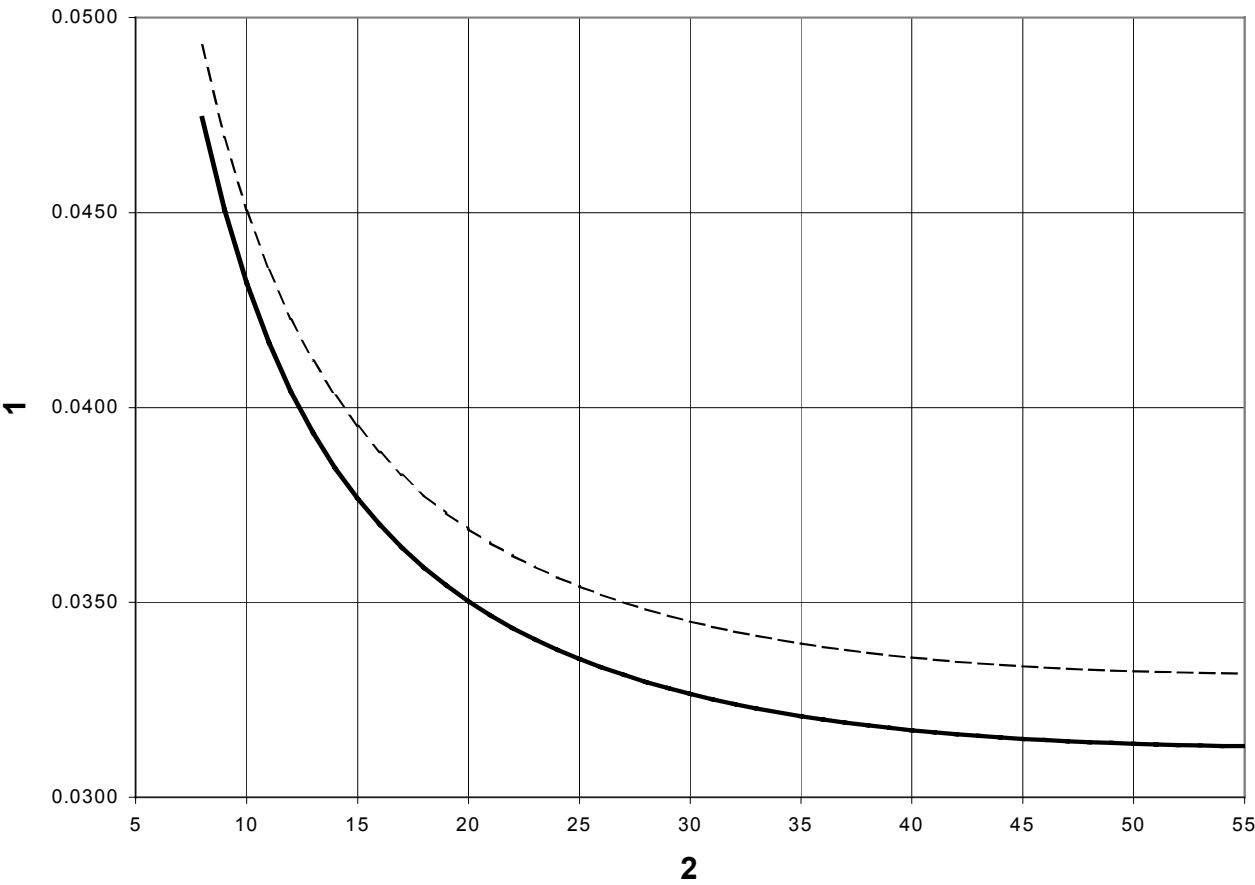
Figure B.1 — Relationship between compressive stress at 10 % deformation and apparent density for indirect testing; $1 - \alpha = 0,90$; $n = 495$

Regression for $\rho_a \geq 11 \text{ kg/m}^3$:

$$\sigma_{10, \text{mean}} = 10,0 \text{ kPa} \cdot \text{m}^3/\text{kg} \times \rho_a - 81,0 \text{ kPa} \quad [\text{kPa}] \quad (\text{B.1})$$

$$\sigma_{10, \text{pred}} \approx 10,0 \text{ kPa} \cdot \text{m}^3/\text{kg} \times \rho_a - 109,1 \text{ kPa} \quad [\text{kPa}] \quad (\text{B.2})$$

B.2.3 Thermal conductivity



Key

1 Thermal conductivity λ [W/m·K]

2 Apparent density ρ_a [kg/m³]

————— Mean thermal conductivity

----- Predicted thermal conductivity

Figure B.2 — Relationship between thermal conductivity (at 50 mm reference thickness and 10 °C mean temperature) apparent density for indirect testing; 1 - $\alpha = 0,90$; $n = 3873$

Regression for $8 \text{ kg/m}^3 \leq \rho_a \leq 55 \text{ kg/m}^3$:

$$\lambda_{\text{mean}} = 0,025\,314 \text{ W/(m·K)} + 5,174\,3 \times 10^{-5} \text{ Wm}^2/(\text{kgK}) \times \rho_a + 0,173\,606 \text{ Wkg}/(\text{m}^4\text{K}) / \rho_a \text{ [W/(m·K)]} \quad (\text{B.3})$$

$$\lambda_{\text{pred}} \approx 0,027\,174 \text{ W/(m·K)} + 5,174\,3 \times 10^{-5} \text{ Wm}^2/(\text{kgK}) \times \rho_a + 0,173\,606 \text{ Wkg}/(\text{m}^4\text{K}) / \rho_a \text{ [W/(m·K)]} \quad (\text{B.4})$$

B.2.4 Thickness effect

For boards of a thickness of 50 mm with a declared thermal conductivity equal or less than 0,038 W/(m·K) the thickness effect is negligible.

To assess the relevance of the thickness effect, a conversion of the measured thermal conductivity, λ'_i , or the thermal resistance, R'_i , into the values λ_i or R_i has to be carried out according to the following equations:

$$\lambda_i = \lambda'_i / L \quad (\text{B.5})$$

$$R_i = R'_i \times L \quad (\text{B.6})$$

Table B.3 — Thickness effect parameter, L , for the determination of the declared thermal conductivity, λ_D

Declared thermal conductivity λ_D at reference thickness of 50 mm W/(m·K)	Thickness of the test specimen d mm	Thickness effect parameter L 1
0,046	20	0,90
	30	0,92
	40	0,93
	50	0,95
	100	0,98
	200	1,00
0,043	20	0,91
	30	0,93
	40	0,94
	50	0,97
	100	1,00
0,040	20	0,92
	30	0,95
	40	0,96
	50	0,97
	100	1,00
0,038	20	0,93
	30	0,96
	40	0,97
	50	0,99
	100	1,00
0,035	20	0,94
	30	0,97
	40	0,98
	50	1,00
	100	1,00
0,032	20	0,96
	30	0,97
	40	0,98
	50	1,00
	100	1,00
Parameters shall be obtained from linear interpolation(s) for intermediate values of thermal conductivity and/or thickness.		

NOTE The values in Table B.3 are taken from measured values from Forschungsinstitut für Wärmeschutz e.V. (FIW), Munich and Laboratoire Nationale D'Essais (LNE), Paris.

B.2.5 Dynamic stiffness

Dynamic stiffness is dependent upon the thickness of a product.

$$E_{\text{dyn}} \approx s' \times d_B \quad (d_B \text{ for the purpose of this equation is given in metres}) \quad (\text{B.7})$$

If a certain product is provided with different levels of dynamic stiffness at different thicknesses, it is sufficient to control the dynamic stiffness at that thickness which gives in conjunction with the dynamic stiffness the lowest value of the dynamic elasticity modulus, E_{dyn} . If the requirement of the most stringent combination of thickness and dynamic stiffness is fulfilled, all other combinations of the same product are covered, too.

NOTE If a product is manufactured under stable conditions with e.g. the following parameters:

d_B	s'	E_{dyn}
20 mm	20 MN/m ³	400 kN/m ²
30 mm	15 MN/m ³	450 kN/m ²
35 mm	10 MN/m ³	350 kN/m ²

it is sufficient to test whether the dynamic stiffness at the thickness $d_B = 35$ mm is equal or lower than 10 MN/m³.

Annex C (normative)

Product classification

EPS-Products are divided into types as shown in Table C.1 and C.2. Type EPS T has specific impact sound insulation properties. Each type, except EPS S, which is not used in load bearing applications, shall satisfy two different conditions at the same time in order to ensure adequate product performance.

Table C.1 — Classification of EPS products

Type	Compressive stress at 10 % deformation kPa	Bending strength kPa
EPS S	—	50
EPS 30	30	50
EPS 50	50	75
EPS 60	60	100
EPS 70	70	115
EPS 80	80	125
EPS 90	90	135
EPS 100	100	150
EPS120	120	170
EPS 150	150	200
EPS 200	200	250
EPS 250	250	350
EPS 300	300	450
EPS 350	350	525
EPS 400	400	600
EPS 500	500	750

NOTE Only if the classification requirements given in Table C.1 are fulfilled do the properties given in D.2, D.3 and D.4 apply.

Table C.2 — Classification of load bearing EPS products with acoustical properties

Type	Compressibility	Dynamic stiffness
EPS T	Level taken from Table 12	Level taken from Table 10

Annex D (informative)

Additional properties

D.1 General

In addition to the product characteristics given in clause 4 of this standard, designers and users of materials may also require additional information of relevance to their proposed application.

The design thermal conductivity, λ_d , should be calculated from the declared thermal conductivity, λ_D , using EN ISO 10456, *Building materials and products — Procedures for determining declared and design values* for different temperatures and moisture contents.

The following information and product requirements may be useful in providing standardized assessment procedures.

D.2 Long term compressive behaviour

EPS products meeting the requirements of Table C.1 are expected to have a compressive creep deformation of 2 % or less after 50 years, when subjected to a permanent compressive stress of 0,30 σ_{10} .

NOTE See literature *Struik, L. C. E., Physical aging in amorphous polymers and other materials, Elsevier Scientific Publishing Company, 1978.*

D.3 Shear behaviour

A correlation between bending strength and the shear strength, τ , is given in Table D.1. To measure the shear strength it should be determined in accordance with EN 12090, *Thermal insulating products for building applications — Determination of shear behaviour*.

Table D.1 — Correlation between bending strength and shear strength

Bending strength σ_b requirement kPa	Shear strength τ correlation kPa
50	25
75	35
100	50
115	55
125	60
135	65
150	75
170	85
200	100
250	125
350	170
450	225
525	260
600	300
750	375

D.4 Water vapour diffusion resistance factor

Instead of testing the water vapour diffusion resistance factor, μ , in accordance with EN 12086, tabulated values according to Table D.2 may be used.

Table D.2 — Tabulated values of water vapour diffusion resistance index and water vapour permeability

Type	Water vapour diffusion resistance factor μ 1	Water vapour permeability δ mg/(Pa·h·m)
EPS 30	20 to 40	0,018 to 0,036
EPS 50	20 to 40	0,018 to 0,036
EPS 60	20 to 40	0,018 to 0,036
EPS 70	20 to 40	0,018 to 0,036
EPS 80	20 to 40	0,018 to 0,036
EPS 90	30 to 70	0,010 to 0,024
EPS 100	30 to 70	0,010 to 0,024
EPS 120	30 to 70	0,010 to 0,024
EPS 150	30 to 70	0,010 to 0,024
EPS 200	40 to 100	0,007 to 0,018
EPS 250	40 to 100	0,007 to 0,018
EPS 300	40 to 100	0,007 to 0,018
EPS 350	40 to 100	0,007 to 0,018
EPS 400	40 to 100	0,007 to 0,018
EPS 500	40 to 100	0,007 to 0,018
EPS T	20 to 40	0,018 to 0,036

D.5 Behaviour under cyclic loading

Dynamic load resistance should be determined in accordance with prEN 13793:1999, *Thermal insulating products for building applications — Determination of behaviour under cyclic loading*. The deformation, in percent, the number of the load cycles and the stress, in kilopascals, should be declared.

D.6 Test methods

Table D.3 — Test methods

Clause	Property	Test method	Test specimens	
			Dimensions	Minimum number of measurements to get one test result
D.3	Shear strength	EN 12090	100 mm × 200 mm × d^a	3
D.5	Dynamic load resistance	prEN 13793:1999	150 mm × 150 mm	1

^a If d is greater than 100 mm the sample has to be cut to dimensions of 100 mm × 100 mm × 100 mm.

D.7 Additional information

EPS and any laminates containing it should not come into contact with any materials in the building which reacts with the EPS causing it to dissolve or swell as can be the case with e.g. some solvent based adhesives, wood preservatives and other substances.

EPS is non-toxic and inert, and contains no chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or formaldehyde.

When installing EPS products, no special precautions need to be taken by the operatives as they are non irritant and non toxic.

EPS products can easily be trimmed on site using normal cutting tools.

Annex ZA (informative)

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

ZA.1 Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard, shown in the table 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 construction product covered by this European Standard for its intended use (thermal insulation for buildings).

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

NOTE In addition to the 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. An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (CREATE, accessed through <http://europa.eu.int>).

Table ZA.1 — Relevant clauses

Construction Products: Factory made products of expanded polystyrene as covered by the scope of this standard			
Intended use: Thermal insulation for buildings			
Requirement / characteristic from the mandate	Requirement clauses in this European Standard	Mandated classes or levels	Technical classes/levels/limit values ^a
Reaction to fire Euroclass characteristics	4.2.8 Reaction to fire	Euroclasses	—
Water permeability	4.3.9 Water absorption	—	Levels
Release of dangerous substances to the indoor environment	4.3.15 Release of dangerous substances	—	—
Direct airborne sound insulation index	4.3.12 Dynamic stiffness	—	Levels
Acoustic absorption index	^b	—	—
Impact noise transmission index (for floors)	4.3.12 Dynamic stiffness	—	Levels
	4.3.13.1 Thickness, d_L	—	Classes
	4.3.13.3 Compressibility	—	Levels
Thermal resistance	4.2.1 Thermal resistance and thermal conductivity	—	Limit values
	4.2.3 Thickness	—	Classes

Table ZA.1 — Relevant clauses (*continued*)

Requirement / Characteristic from the mandate	Requirement clauses in this European Standard	Mandated classes or levels	Technical classes/levels/limit values ^a
Water vapour permeability	4.3.11 Water vapour transmission	—	Tabulated values
Compressive strength	4.3.4 Compressive stress at 10 % deformation	—	Levels
	4.3.3 Deformation under specified compressive load and temperature conditions	—	Levels
Tensile/Flexural strength	4.2.7 Bending strength ^c	—	Limit value
	4.3.6 Bending strength	—	Levels
	4.3.5 Tensile strength perpendicular to faces	—	Levels
Durability of reaction to fire against heat, weathering, ageing/degradation	— ^d	—	
Durability of thermal resistance against heat, weathering, ageing/degradation	4.2.1 Thermal resistance – thermal conductivity	—	Limit values
	4.2.6 Dimensional stability	—	Classes ^e
	4.3.2 Dimensional stability under specified temperature and humidity conditions	—	Levels ^e
	4.3.3 Deformation under specified compressive load and temperature conditions	—	Levels ^e
	4.3.10 Freeze-thaw resistance	—	Limit value
Durability of compressive strength against ageing and degradation	4.3.8 Compressive creep	—	Levels
	4.3.10 Freeze-thaw resistance	—	Limit value
	4.3.13.4 Long term thickness reduction	—	Levels
^a The 'no performance determined' (NPD) option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements, except in relation to thermal resistance (thermal conductivity and thickness), for which threshold levels are compulsory. ^b EPS products have no significant acoustic absorption properties. ^c For handling and installation. ^d No change in reaction to fire properties for EPS products. ^e For thickness only.			

ZA.2 Systems for attestation of conformity

ZA.2.1 General

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 EPS products indicated in Table ZA.1 in accordance with the decision of the European Commission of 95/204/EC of 31.04.95 revised by decision 99/91/EC of 25.01.99 as given in Annex III of the mandate M103 as amended by mandates M126 and M130 is shown in Tables ZA.2.1 and ZA.2.2 for the indicated intended use(s).

ZA.2.2 Systems of attestation of conformity and assignment of evaluation of conformity tasks

Table ZA.2.1 — Systems of attestation of conformity of factory made products for any intended use

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Thermal insulation products (Factory made products)	Any	-	3
System 3: See CPD Annex III.2.(ii), Second possibility.			

For products falling under system 3 for the initial type testing of the product [see Annex III.1.a) of the CPD] the task for the approved body will be limited to the following characteristics, where relevant:

- thermal resistance;
- release of dangerous substances;
- compressive strength (for load-bearing applications);
- water permeability;

the rest of the characteristics in Table ZA.1 being under the responsibility of the manufacturer.

Additionally, for products to be applied in uses subject to regulations on reaction to fire, the following applies.

Table ZA.2.2 — Systems of attestation of conformity of factory made products for uses subject to regulations on reaction to fire

Product(s)	Intended use(s)	Level(s) or class(es) (reaction to fire)	Attestation of conformity system(s)
Thermal insulation products (Factory made products)	For uses subject to regulations on reaction to fire	(A1, A2, B, C)*	1
		-----	-----
		(A1, A2, B, C)**, D, E	3
		-----	-----
		(A1 to E)***, F	4

System 1: See CPD Annex III.2.(i), without audit-testing of samples

System 3: See CPD Annex III.2.(ii), Second possibility

System 4: See CPD Annex III.2.(ii), Third possibility

* 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).

** Products/materials not covered by footnote (*).

***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).

For products falling under system 1 for the initial type testing of the product [see Annex III.1.a) of the CPD] the task for the approved body will be additionally limited to the following characteristics, where relevant:

Euroclasses characteristics for reaction to fire as indicated in Commission Decision 2000/147/EC.

For products falling under system 1, for the initial inspection of the factory and of the factory production control [see Annex III.1.f) of the CPD], and for the continuous surveillance, assessment and approval of the factory production control [see Annex III.1.g) of the CPD], parameters related to all relevant characteristics (see Table ZA.1) shall be of the interest of the approved body, in particular:

Euroclasses characteristics for reaction to fire as indicated in Commission Decision 2000/147/EC.

For products falling under system 3 for the initial type testing of the product [see Annex III.1.a) of the CPD] the task for the approved body will be additionally limited to the following characteristics, where relevant:

Euroclasses characteristics for reaction to fire as indicated in Commission Decision 2000/147/EC.

The evaluation of conformity shall be carried out in accordance with clauses 1 to 6 of EN 13172:2001 including its annexes B and C for products of reaction to fire classes under system 1, its annex C for products under system 3 and its annexes C and D for products of reaction to fire classes under system 4.

ZA.2.3 EC certificate and declaration of conformity

(In case of products under system 1 or (1 and 3): 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 of the CE marking. The certificate shall include:

- name, address and identification number of the certification body;
- name and address of the manufacturer, or his authorized representative established in the EEA, and place of production;
- description of the product (type, identification, use, ...);
- provisions to which the product conforms (e.g. annex ZA of this EN);
- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);
- the number of the certificate;
- conditions and period 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 a declaration of conformity (EC Declaration of conformity) including the following:

- name and address of the manufacturer, or his authorized representative established in the EEA;
- name and address of the certification body;
- description of the product (type, identification, use, ...), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (e.g. annex ZA of this EN);
- 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 authorized 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 authorized representative established in the EEA, and place of production;
- description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (e.g. annex ZA of this EN);
- 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 authorized representative.

The above mentioned declaration and certificate shall be presented in the official language or languages of 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.

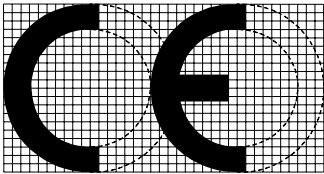
ZA.3 CE Marking and labelling

The manufacturer or his authorized representative within the EEA is responsible for the affixing of the CE marking. The affixing shall be done on the product itself, on a label attached to it or on its packaging.

The CE marking consists exclusively of the letters "CE" in the specified form of the directive 93/68/EC followed by the identification number of the notified body in the case of products under system 1.

CE marking for EPS products shall be accompanied by the information shown below:

Table ZA.3 — Example CE marking information

 Number of notified body (for products under system 1)
Name or identifying mark and registered address of the manufacturer Two last digits of year of affixing CE marking Number of EC certificate of conformity (where appropriate)
EN number of this product standard Product identity Reaction to fire – Class Thermal resistance – Thermal conductivity Thickness Designation code (in accordance with clause 6 of this standard for the relevant characteristics according to Table ZA.1)

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 European legislation without national derogations need not be mentioned.

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