

BS EN 826:2013



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Thermal insulating products for building applications — Determination of compression behaviour

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National foreword

This British Standard is the UK implementation of EN 826:2013. It supersedes BS EN 826:1996, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/540, Energy performance of materials components and buildings.

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

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Supersedes EN 826:1996

English Version

**Thermal insulating products for building applications -
Determination of compression behaviour**

Produits isolants thermiques destinés aux applications du
bâtiment - Détermination du comportement en compression

Wärmedämmstoffe für das Bauwesen - Bestimmung des
Verhaltens bei Druckbeanspruchung

This European Standard was approved by CEN on 15 December 2012.

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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 826:2013) 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of an identical text or by endorsement, at the latest by September 2013, and conflicting national standards shall be withdrawn at the latest by September 2013.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 826:1996.

The revision of this standard contains no major changes, only minor corrections and clarifications of an editorial nature.

This European standard has been prepared for building applications, but it may also be used in other areas where it is relevant.

This European test standard is one of the following group of related standards on test methods for determining dimensions and properties of thermal insulation materials and products, all of which fall within the scope of CEN/TC 88:

- 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 the 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*
- EN 1608, *Thermal insulating products for building applications — Determination of tensile strength parallel to faces*

- EN 1609, *Thermal insulating products for building applications — Determination of short-term water absorption by partial immersion*
- 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 12091, *Thermal insulating products for building applications — Determination of freeze-thaw resistance*
- EN 12429, *Thermal insulating products for building applications — Conditioning to moisture equilibrium under specified temperature and humidity conditions*
- EN 12430, *Thermal insulating products for building applications — Determination of behaviour under point load*
- EN 12431, *Thermal insulating products for building applications — Determination of thickness for floating floor insulating products*
- EN 13793, *Thermal insulating products for building applications — Determination of behaviour under cyclic loading*
- EN 13820, *Thermal insulating materials for building applications — Determination of organic content*

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1 Scope

This European Standard specifies the equipment and procedures to be used when determining the compression behaviour of test specimens. It is applicable to thermal insulating products and can be used to determine the compressive stress in compressive creep tests and for applications in which insulation products are only exposed to short-term loads.

The method can be used for quality control purposes. It may also be employed to obtain reference values from which design values can be calculated using safety factors.

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

ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

relative deformation

ε

ratio of the reduction in thickness of the test specimen to its initial thickness, d_0 , measured in the direction of loading

3.2

compressive strength

σ_m

ratio of the maximum compressive force, F_m , reached when the strain, ε , at yield (see Figure 1b)) or rupture (see Figure 1a)) is less than 10 %, to the initial cross-sectional area of the test specimen

3.3

compressive stress at 10 % strain

σ_{10}

ratio of the compressive force, F_{10} , at 10 % strain, ε_{10} , to the initial cross section of the test specimen (see Figures 1c) and 1d)) for products presenting 10 % strain before possible yield or rupture

3.4

compression modulus of elasticity

E

compressive stress divided by the corresponding strain below the proportional limit, when the relationship is linear

Note 1 to entry: See Figure 1.

4 Principle

A compressive force is applied at a given rate of displacement perpendicular to the major faces of a squarely cut test specimen and the maximum stress supported by the specimen calculated.

In case of tapered products, the test specimens should be cut to obtain two parallel faces.

When the value of the maximum stress corresponds to a strain of less than 10 %, it is designated as compressive strength and the corresponding strain is reported. If no failure is observed before the 10 % strain has been reached, the compressive stress at 10 % strain is calculated and its value reported as compressive stress at 10 % strain.

5 Apparatus

5.1 Compression testing machine

Compression testing machine, designed to suit the range of force and displacement involved and having two very rigid, polished, square or circular plane parallel platens with a minimum side length (or diameter) equal to the side length (or diagonal) of the test specimen. One of the plates shall be fixed and the other movable, if appropriate, with a centrally positioned ball joint to ensure that only axial force is applied to the test specimen. The movable plate shall be capable of moving at a constant rate of displacement in accordance with Clause 7.

5.2 Measurement of displacement

Displacement measuring device, fitted to the compression testing machine, which allows continuous measurement of the displacement of the movable plate to an accuracy of $\pm 5\%$ or $\pm 0,1$ mm, whichever is smaller (see 5.3).

5.3 Measurement of force

Sensor fitted to one of the machine plates to measure the force produced by the reaction of the specimen upon the plates. This sensor shall be such that its own deformation during the measuring operation is negligible compared with that being measured or, if not, it shall be taken into account by calculation. In addition, it shall allow the continuous measurement of the force to an accuracy of $\pm 1\%$.

5.4 Recording device

Device for the simultaneous recording of the force, F , and the displacement, X , which provides a curve of F as a function of X (see 7.2).

NOTE The curve gives additional information on the behaviour of the product and possibly enables the determination of the compression modulus of elasticity.

6 Test specimens

6.1 Dimensions of test specimens

The test specimens shall have the original product thickness. The width of the test specimens shall be not less than their thickness. Products with integrally moulded skins which are retained in use shall be tested with these skins intact.

Test specimens shall not be layered to produce a greater thickness for testing.

Test specimens shall be squarely cut and have the following dimensions:

50 mm $\times$ 50 mm or

100 mm $\times$ 100 mm or

150 mm × 150 mm or
200 mm × 200 mm or
300 mm × 300 mm.

The choice of dimensions to be used shall be specified in the relevant product standard.

In the absence of a product standard, the test specimen dimensions may be agreed between parties.

The linear dimensions shall be determined in accordance with EN 12085, to an accuracy of 0,5 %.

The tolerance on parallelism and flatness between the two faces of the specimen shall be not greater than 0,5 % of the test specimen side length or 0,5 mm, whichever is smaller.

If the specimens are not flat, they shall be ground flat or an adequate coating shall be applied to prepare the surface for the test. No significant deformation shall occur in the coating during the test.

The accuracy of the test result is reduced if the test specimens have a thickness of less than 20 mm.

6.2 Preparation of test specimens

Test specimens shall be cut so that their base is normal to the direction of compression of the product in its intended use. The test specimens shall be cut by methods that do not change the structure with regard to that of the original product. The method of selecting the test specimens shall be as specified in the relevant product standard. In the case of tapered products, the parallelism of the two faces of the test specimen shall be in accordance with 6.1.

In the absence of a product standard, the method of selecting the test specimens may be agreed between parties.

Special methods of preparation, when needed, are given in the relevant product standard.

In cases where a more complete characterisation is desired or where the principal direction of anisotropy is unknown, it may be necessary to prepare additional sets of test specimens.

6.3 Number of test specimens

The number of test specimens shall be as specified in the relevant product standard. In the absence of such a specification, at least five test specimens shall be used.

In the absence of a product standard, the number of test specimens may be agreed between parties.

6.4 Conditioning of test specimens

The test specimens shall be stored for at least 6 h at $(23 \pm 5) ^\circ\text{C}$. In cases of dispute, they shall be stored at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity for the time specified in the relevant product standard.

7 Procedure

7.1 Test conditions

Testing shall be carried out at $(23 \pm 5) ^\circ\text{C}$. In cases of dispute, it shall be carried out at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity.

7.2 Test procedure

Measure the test specimen dimensions in accordance with EN 12085.

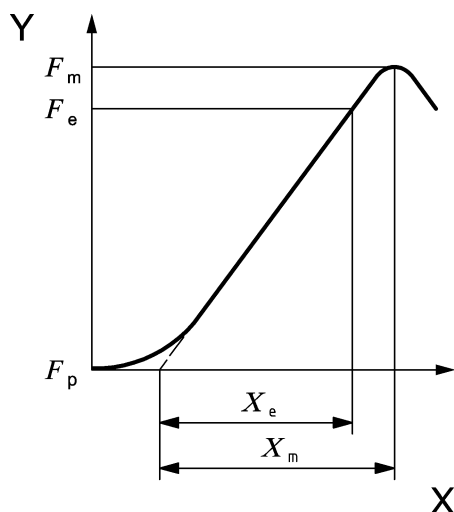
Place the specimen centrally between the two plates of the compression testing machine. Preload with a pressure of (250 ± 10) Pa.

If a significant deformation occurs under the preload pressure of 250 Pa, a preload corresponding to 50 Pa may be used if this is specified in the relevant product standard. In this case, the thickness, d_0 , should be determined under the same preload.

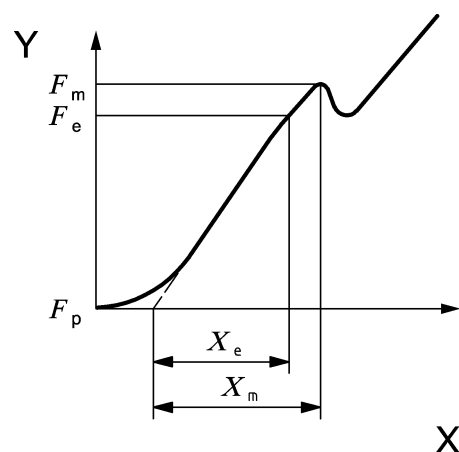
Compress the test specimen with the movable plate at a constant rate of displacement which shall be equal to $0,1 d$ per minute (to within $\pm 25\%$), where d is the thickness of the specimen, expressed in millimetres.

Continue compression until the specimen yields, providing a compressive strength value, or until a strain of 10 % has been reached, providing a compressive stress at 10 % strain.

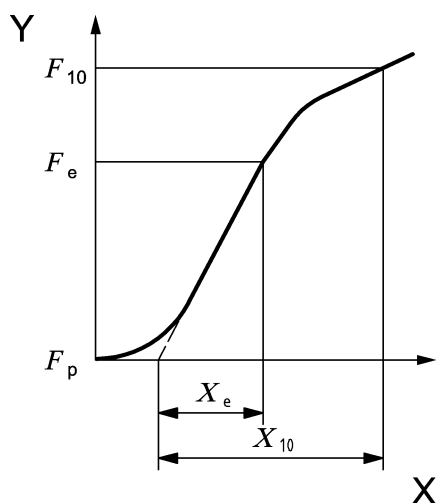
Record the force-displacement curve.



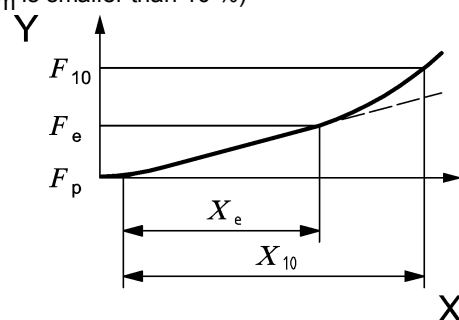
a)



b) (X_m is smaller than 10 %)



c)



d)

Key

- F_p force corresponding to the preload
- F_m maximum force
- X_m displacement at maximum force
- F_{10} force at 10 % strain
- X_{10} displacement at 10 % strain
- F_e force corresponding to X_e (conventional proportional limit)
- X_e displacement in the conventional elastic zone

Figure 1 — Examples of force-displacement curves

8 Calculation and expression of results

8.1 General

The results are the mean values of the measurements which shall be expressed to three significant figures.

Results should not be extrapolated to other thicknesses.

Depending on the load-deformation behaviour (see 7.2), σ_m and ε_m or σ_{10} (see Clause 3) shall be calculated.

8.2 Compressive strength and corresponding strain

8.2.1 Compressive strength

Calculate the compressive strength, σ_m , in kPa, using the following formula:

$$\sigma_m = 10^3 \frac{F_m}{A_0} \quad (1)$$

where

F_m is the maximum force, in newtons;

A_0 is the initial cross-sectional area of the specimen, in square millimetres.

8.2.2 Strain

Determine the zero-deformation point. Extend to the F_p -zero force line the steepest straight portion of the force-displacement curve, using a straight edge, for example (see 5.4).

Measure all displacements for calculation of strain from this “zero-deformation point” corresponding to

$$F_m = (250 \pm 10) \text{ Pa} \quad (2)$$

NOTE Illustration of this procedure is shown for four examples in Figure 1.

Calculate the strain, ε_m , as a percentage, using the following formula:

$$\varepsilon_m = \frac{X_m}{d_0} 100 \quad (3)$$

where

X_m is the displacement corresponding to the maximum force reached, in millimetres;

d_0 is the initial thickness (as measured) of the specimen, in millimetres.

8.3 Compressive stress at 10 % strain

Calculate the compressive stress at 10 % strain, σ_{10} , in kPa, using the following formula:

$$\sigma_{10} = 10^3 \frac{F_{10}}{A_0} \quad (4)$$

where

F_{10} is the force corresponding to a strain of 10 %, in newtons;

A_0 is the initial cross-sectional area of the specimen, in square millimetres.

If required, the compressive stress for strains lower than 10 % may also be calculated.

8.4 Compression modulus of elasticity

If required, calculate the compression modulus of elasticity, E , in kPa, using the following formula:

$$E = \sigma_e \frac{d_0}{X_e} \quad (5)$$

with

$$\sigma_e = 10^3 \frac{F_e}{A_0}$$

where

F_e is the force at the end of the conventional elastic zone (distinct straight portion of the force-displacement curve), in newtons;

X_e is the displacement at F_e , in millimetres.

If there is no distinct straight portion of the force-displacement curve or if the “zero deformation point” obtained in accordance with 8.2.2 results in a negative value, this procedure shall not be used. In such cases, the “zero deformation point” shall be the deformation corresponding to a stress of (250 ± 10) Pa.

9 Accuracy of measurement

An inter-laboratory test was performed with ten laboratories in 1993. Four products with a different compression behaviour were tested, three of which were used for statistical evaluation of reproducibility (two test results for each product), and one product was used for statistical evaluation of repeatability (five test results).

The results, analysed in accordance with ISO 5725-1 and ISO 5725-2, are given in Tables 1 and 2.

Table 1 — Compressive strength, σ_m , or compressive stress at 10 % strain, σ_{10}

Range	95 kPa to 230 kPa
Estimate of repeatability variance s_r	0,5 %
95 % repeatability limit	2 %
Estimate of reproducibility standard deviation, s_R	3 %
95 % reproducibility limit	9 %

Table 2 — Compression modulus of elasticity, E

Range	2500 kPa to 8500 kPa
Estimate of repeatability variance, s_r	3 %
95 % repeatability limit	8 %
Estimate of reproducibility variance, s_R	10 %
95 % reproducibility limit	25 %

The above-mentioned terms are applied as described in ISO 5725-1 and ISO 5725-2.

10 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) product identification:
 - 1) product name, factory, manufacturer or supplier;
 - 2) production code number;
 - 3) type of product;
 - 4) packaging;
 - 5) the form in which the product arrived at the laboratory;
 - 6) other information as appropriate (e.g. nominal thickness, nominal density);
- c) test procedure:
 - 1) pre-test history and sampling (e.g. who sampled and place of sampling);
 - 2) conditioning;
 - 3) deviations from Clauses 6 and 7, if any;
 - 4) date of testing;
 - 5) dimensions and number of test specimens;
 - 6) kind of surface treatment (grinding or type of coating);
 - 7) general information relating to the test;
 - 8) any occurrences which may have affected the results. Information about the apparatus and identity of the person carrying out the test should be available in the laboratory but it need not be recorded in the test report;
- d) results: all individual values of compressive strength and corresponding strain or compressive stress at 10 % strain, mean value, and the compression modulus of elasticity, if required.

Annex A (normative)

Modifications to the general test method for cellular glass products

A.1 General

For cellular glass products, the test method described in this standard shall be modified in accordance with the following clauses.

A.2 Apparatus

The compression testing machine shall be equipped with a ball joint connected to one of the plates.

A.3 Test specimen

A.3.1 Dimensions of test specimens

The test specimens shall be a quadrant of an original full-size slab (e.g. in the case of 600 mm × 450 mm slabs, test specimens shall be 300 mm × 225 mm in size, with two edges from the original slab). Where this is not possible, each test specimen 200 mm × 200 mm in size shall be taken from any one of four quadrants of the slab, in a way which respects the symmetry of the quadrant taking only one test specimen per slab.

A.3.2 Preparation of test specimens

A.3.2.1 The bearing surfaces of the test specimen shall be parallel and flat (see 6.1). If necessary, they shall be rubbed with a suitable abrasive surface to produce the required flat surface.

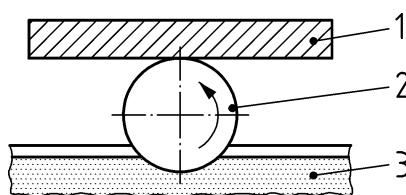
A.3.2.2 To smooth the bearing surfaces, apply a layer of hot bitumen of type R 85/25 that has been heated to $(170 \pm 10) ^\circ\text{C}$, to completely fill the open surface cells; use a small excess.

The mass per unit area of bitumen shall be approximately $(1 \pm 0,25) \text{ kg/m}^2$.

Tilt the test specimen slightly and either dip the bearing surface into a bitumen bath, or preferably place the bearing surface on a horizontal roller turning into the bitumen bath (see Figure A.1). Scrape off any surplus bitumen. If the open surface cells have not been adequately filled, repeat the process. Dip the test specimen again with the coated bearing surface down or repeat the treatment with the horizontal roller. Allow any surplus bitumen to drip off the treated surface. Turn the test specimen up and shake it slightly in horizontal position to ensure uniform distribution of the bitumen.

It has been found convenient to employ a partially submerged roller for applying the bitumen (see Figure A.1).

If hot bitumen is not available, a layer of plaster having a thickness of $(2 \pm 1) \text{ mm}$ may be applied to the surface. The compression test shall only be carried out when the plaster is dry.

**Key**

- 1 test specimen
- 2 roller
- 3 bitumen

Figure A.1 — Application of hot bitumen to the test specimen surface

A.3.2.3 Place the test specimen with the treated bearing surface on a sheet, which extends beyond the slab on all sides, and which rests on a flat steel plate. The sheet shall be thin, flexible, homogenous and compatible with hot bitumen (e.g. a thin bitumen roofing felt having a mass per unit area of $(1 \pm 0,25)$ kg/m² or a lightweight kraft paper or a plastic film, possibly reinforced by nonwoven glass fibre, having a mass of $(0,15 \pm 0,08)$ kg/m²). Apply a load of (200 ± 25) N by means of a load distribution plate with a size not smaller than the test specimen.

After about 1 min, remove the load.

After 15 min, coat the second bearing surface as before.

NOTE The purpose of the thin flexible sheeting is to prevent that the bitumen applied on the test specimen face stick to the compression plates during the test.

A.3.2.4 Set the test specimen on edge, supporting only the core of the cellular glass (e.g. with a small piece of wood), exposing both capped surfaces to ambient temperature for a minimum of 15 min to allow the bitumen to harden before testing.

A.3.2.5 The bitumen shall not be subjected to excessive temperatures which may cause oxidation.

A.3.2.6 In the case of cellular glass board, one of the full slabs composing the board shall be identified and the test specimen shall be cut in accordance with A.3.1.

The preparation with hot bitumen shall not be carried out in the case of cellular glass board.

If the surface of the facing is not flat enough, a layer of plaster having a thickness of (2 ± 1) mm shall be applied to the surface. The compression test shall only be carried out when the plaster is dry.

A.4 Test procedure

The rate of displacement of the movable plate shall be equal to $0,01 d$ per minute (to within $\pm 25\%$), where d is the thickness of the test specimen, expressed in millimetres.

Run the test until the test specimen yields, usually with a marked drop in load accompanied by a loud noise.

NOTE Given the test specimen surface preparation, the method is not suitable for determining the strain and the compression modulus of elasticity by measuring the displacement of the plates of the compression testing machine. An alternative method consists in fixing reference points on the edges of the test specimen and in measuring their relative displacement.

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