BS EN 12089:2013

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Thermal insulating products for building applications — Determination of bending behaviour

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National foreword

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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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EN 12089

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English Version

Thermal insulating products for building applications - Determination of bending behaviour

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

Wärmedämmstoffe für das Bauwesen - Bestimmung des Verhaltens bei Biegebeanspruchung

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

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Foreword

This document (EN 12089:2013) has been prepared by Technical Committee CEN/TC 88 “Thermal insulation 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of an identical text or by endorsement, at the latest by September 2013, and conflicting national standards shall be withdrawn at the latest by September 2013.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 12089:1997.

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

This European Standard is one of a series of standards which specify test methods for determining dimensions and properties of thermal insulating materials and products. It supports a series of product standards for thermal insulating materials and products which derive from the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (Directive 89/106/EEC) through the consideration of the essential requirements.

This European Standard has been drafted for applications in buildings but it may also be used in other areas where it is relevant.

This European test standard is one of the following group of inter-related standards on test methods for determining dimensions and properties of thermal insulation materials and products, all of which come 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*

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

1 Scope

This European Standard specifies the equipment and procedures for determining the bending behaviour of full size products (Method A) and test specimens (Method B) under the action of three-point loading. It is applicable to thermal insulating products.

The test is designed to determine the bending strength of products and their deflection at a given load.

The method can be used to determine the resistance of the product to bending stresses during transport and application.

2 Normative references

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

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

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

EN 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 document, the following terms and definitions apply.

3.1
bending strength
σ_b
maximum stress calculated from the maximum force F_m recorded during the bending procedure

3.2
bending stress
σ_x
stress calculated from the force F_x at the deflection X

3.3
deflection
X
vertical displacement of the test specimen at mid span, at the force F_x, measured at the loading edge

4 Principle

The test method consists of applying, at a given speed, a force by means of a loading edge in an axial direction to the faces of a squarely cut rectangular test specimen, which is placed on two support edges. The force is applied to the test specimen at a position midway between the supporting positions (see Figure 1).

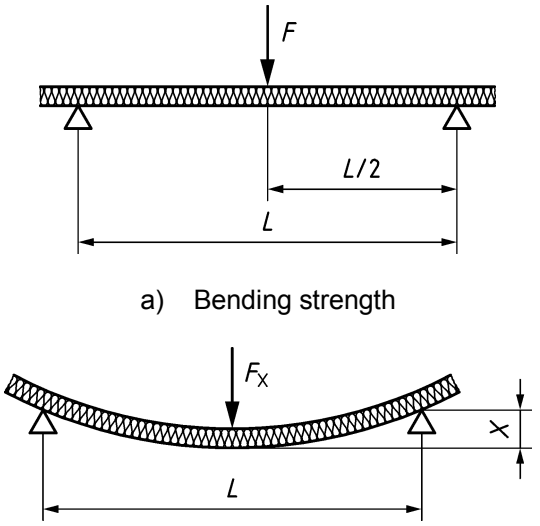


Figure 1 — Principle of test method

5 Apparatus

5.1 Test machine

A test machine suited to the range of force and displacement involved, and with a loading edge and adjustable support edges.

It shall be capable of operating at a constant rate of movement of the movable head.

5.1.1 Support edges

Test specimen supports shall consist of two adjustable cylindrical support edges placed parallel to each other and in the same horizontal plane. The diameter of the supports shall be (80 ± 3) mm or (30 ± 3) mm (see Figure 2). The length of the support edges shall be at least equal to the width of the test specimens.

The span L (see Figure 2) between the support edges shall be adjustable in the range 300 mm to 1 200 mm (method A) or 200 mm to 500 mm (method B).

5.1.2 Loading edge

The test specimen loading edge shall have the same shape and dimensions as the support edges. The loading edge shall be located centrally between and parallel to the supporting edges.

5.1.3 Load distribution plates

For products which may be subject to crushing by the loading and support edges, steel load distribution plates with a thickness of at least 1 mm shall be used. The width of the distribution plates shall be (30 ± 1) mm and their length shall be at least equal to the width of the test specimen.

5.2 Measuring devices for displacement and force

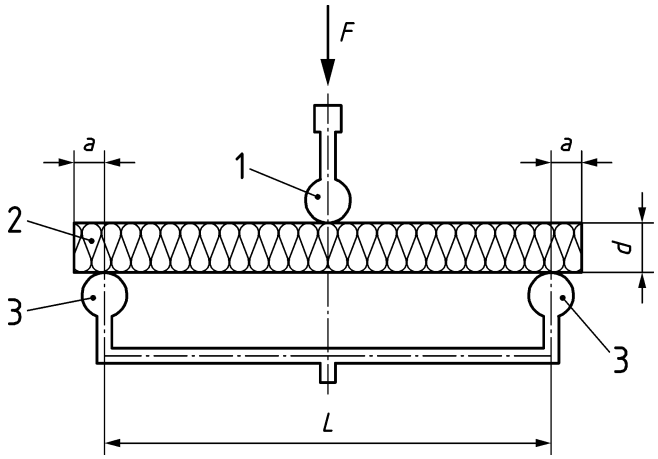
5.2.1 Measurement of displacement

The test machine shall be fitted with a system that allows continuous measurement of the displacement of the movable loading edge with an accuracy of $\pm$ 5 % or $\pm$ 0,1 mm, whichever is the smaller. The measured displacement corresponds to the deflection, X, of the test specimen.

5.2.2 Measurement of force

A force sensor shall be fixed to the loading edge in order to measure the force F produced by the reaction of the test specimen upon the edges during the test. This sensor shall be such that its own deformation during the course of the measuring operation is negligible compared with that being measured or may be taken into account by calculation. In addition, it shall allow the continuous measurement of the force at all times permitting reading to $\pm$ 1 %.

A device shall be used for the simultaneous recording of the force, F, and the deflection, X, to provide the force-deflection curve, required in Clause 7.



1 loading edge
2 test specimen with the thickness d
3 support edges
a 50 mm for method A, 25 mm for method B

Figure 2 — Principles of apparatus for testing of bending behaviour

6 Test specimens

6.1 Dimensions of test specimens

6.1.1 Method A

The test specimen is a full size product. It shall be a squarely cut rectangle having the following dimensions:

Thickness: Original product thickness;

Length: Length of the full size product, with a maximum of 1 300 mm;

Width: Width of the full size product. If this is impossible because of limitations caused by the testing machine, the width shall be at least 300 mm.

6.1.2 Method B

The test specimen shall be a squarely cut rectangle having the following dimensions:

Thickness: Original product thickness of the product with a maximum of 100 mm;

Length: 5 times the nominal thickness plus 50 mm (but not greater than 550 mm;

Width: 150 mm.

Other dimensions of the test specimen may be given in the relevant product standard or any other European Technical Specification or agreed between parties.

6.2 Number of test specimens

The number of test specimens shall be as specified in the relevant product standard or any other European Technical Specification. In the absence of such a specification at least three test specimens shall be used.

In the absence of a product standard or any other European Technical Specification the number of test specimens may be agreed between parties.

If the direction of the bending force on the product in its application is not known, and/or the product has different surface skins, facings and/or coatings on its two main faces, then additional sets of test specimens shall be used.

6.3 Preparation of test specimens

Cutting of the test specimens shall be by methods that do not change the original structure of the product. Any skins, facings and/or coatings shall be retained.

6.4 Conditioning of test specimens

The test specimens shall be stored for at least 6 h at (23 ± 5) °C. In case of dispute they shall be stored at (23 ± 2) °C and (50 ± 5) % relative humidity for the time stated in the relevant product standard with a minimum of 6 h.

7 Procedure

7.1 Test conditions

The test shall be carried out at (23 ± 5) °C. In case of dispute it shall be carried out at (23 ± 2) °C and (50 ± 5) % relative humidity.

7.2 Test procedure

Measure the length and width for full size products (method A) in accordance with EN 822 and the thickness in accordance with EN 823.

Measure the length, width and thickness of test specimens (method B) in accordance with EN 12085 with an accuracy of $\pm$ 1 %.

The span, L, between the support edges shall be within $\pm$ 0,5 % of the following:

Method A: The length of the full size product minus 100 mm.

Method B: Five times the nominal thickness.

Other spans may be given in the relevant product standard or agreed between parties.

Place the test specimen symmetrically upon the support edges so that the direction of loading is perpendicular to the longitudinal axis of the test specimen.

Adjust the speed of the test machine to 10 mm/min, with a tolerance of ± 10 %.

Record the force-deflection curve and note the maximum force F_m obtained (see Figure 3). Record the way in which the product failed.

8 Calculation and expression of results

8.1 General

The results shall be the mean values of the individual values and shall be expressed to three significant figures.

Results shall not be extrapolated to other thicknesses.

8.2 Bending strength

Calculate the bending strength, σ_b, in kilopascals using Formula (1):

$$\sigma = 3 \times 10^3 \times \frac{F_m \times L}{2 \times b \times d^2} \quad (1)$$

where

F_m is the maximum applied force, in Newtons;

L is the span between support edges, in millimetres;

b is the width of the test specimen, in millimetres;

d is the thickness of the test specimen, in millimetres.

8.3 Bending stress and deflection

All displacements, X, and the corresponding force, F_x, can be derived from the force-deflection curve. This procedure is illustrated in Figure 3.

Bending stress, σ_x, can be calculated in kilopascals using Formula (2):

$$\sigma_x = 3 \times 10^3 \times \frac{F_x \times L}{2 \times b \times d^2} \quad (2)$$

where

F_x is the applied force corresponding to the displacement X, in Newtons;

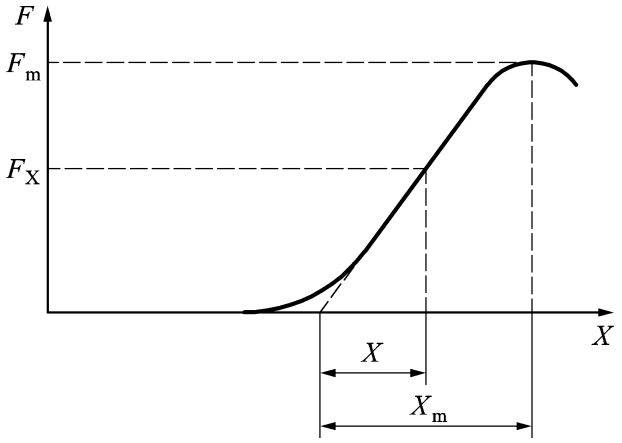
L is the span between support edges, in millimetres;

b is the width of the test specimen, in millimetres;

d is the thickness of the test specimen, in millimetres.

NOTE 1 This method is not intended for the calculation of the bending modulus of elasticity.

NOTE 2 The calculated stress, σ_x, is not a material constant, it is dependent on the test and product parameters and cannot be compared with other mechanical properties.



Key

F_m maximum force
F_x force corresponding to the displacement X
X_m displacement for maximum force F_m
X displacement for force F_x

Figure 3 — Example of a force-deflection curve

9 Accuracy of measurement

Following the experience of a “round robin test”, where comparable test equipment and test specimen preparation were used, the accuracy for bending strength, σ_b, can be estimated as given below.

95 % repeatability limit: Approximately 5 %

95 % reproducibility limit: Approximately 15 %

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) presence of facing or coating;

7) 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) deviation from Clauses 6 and 7, if any;

4) date of testing;

5) general information relating to the test:

i) method A or B used;

ii) the direction of application of the force during the test;

iii) the dimensions of the test specimens;

iv) the span used;

v) load distribution plates, if any;

vi) position of the facing (or coating) in relation to the loading edge;

6) events which may have affected the results. Information about the apparatus and identity of the technician should be available in the laboratory, but it need not be recorded in the report;

d) results:

1) all individual values of the bending strength and the corresponding deflection or the bending stress at a given deflection or the deflection corresponding to a given load, mean values;

2) all force-deflection curves.

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