BS EN 14707:2012

BSI Standards Publication

Thermal insulating products for building equipment and industrial installations — Determination of maximum service temperature for preformed pipe insulation

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National foreword

This British Standard is the UK implementation of EN 14707:2012. It supersedes BS EN 14707:2005+A1:2007 which is withdrawn.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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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EN 14707

October 2012

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English Version

Thermal insulating products for building equipment and industrial installations - Determination of maximum service temperature for preformed pipe insulation

Produits isolants thermiques pour l'équipement du bâtiment et les installations industrielles - Détermination de la température maximale de service des coquilles isolantes préformées

Wärmedämmstoffe für die Haustechnik und für betriebstechnische Anlagen - Bestimmung der oberen Anwendungsgrenztemperatur von vorgeformten Rohrdämmstoffen

This European Standard was approved by CEN on 24 August 2012.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 14707:2012) has been prepared by Technical Committee CEN/TC 88 “Thermal insulating materials and products”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 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 14707:2005+A1:2007.

The main technical changes that have been made in this new version of EN 14707 are:

a) 6.1, Dimensions of test specimens has been modified;

b) B.3, Dimension of test specimens has been completed.

This European Standard is one of a series of European 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 prepared for products used to insulate building equipment and industrial installations, but it may also be applied to products used in other areas.

A similar standard is available for testing of flat products: EN 14706, *Thermal insulating products for building equipment and industrial installations — Determination of maximum service temperature*.

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 maximum service temperature for preformed pipe insulation. It is applicable to thermal insulating products.

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 12429, *Thermal insulating products for building applications — Conditioning to moisture equilibrium under specified temperature and humidity conditions*

EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*

EN 14706, *Thermal insulating products for building equipment and industrial installations — Determination of maximum service temperature*

3 Terms and definitions

For the purposes of this document, the following term and definition applies.

3.1
maximum service temperature
highest temperature at which the insulation product, when installed a the recommended thickness in a given application, continues to function within specified limits of performance

[SOURCE: EN ISO 9229:2007, 2.6.9.1]

Note 1 to entry: The required performance may be in the areas of dimensional stability, thermal properties, and mechanical properties as well as changes in appearance and resistance against creation of hazards such as internal self-heating (see annexes and requirements in the relevant product standard).

Note 2 to entry: In the present test procedure, which is used as a reference, the test specimen is exposed to a temperature difference going from ambient to the maximum service temperature. This may not reflect the actual application conditions when products are exposed to different temperatures on the two main faces, e.g. in multi-layer systems or for faced products where the facing may limit the maximum service temperature.

4 Principle

Measure thickness and length after one sided heat treatment for a specified time period, at the maximum service temperature, achieved using a specified rate of temperature increase. The thickness of the test specimen is measured during heat treatment and the length only after cooling to ambient temperature.

The procedure may be an iterative process.

Additional requirements for assessing the maximum service temperature of specific materials are described in normative annexes to this European Standard or the relevant product standard or any other European Technical Specification.

5 Apparatus

A general arrangement of the apparatus is indicated in Figure 1 and is comprised of:

5.1 Hot pipe, with a uniform temperature distribution in the measuring zone on the hot surface and a heat flux perpendicular to the surface of the pipe within the measuring zone (two pipes are required, with diameters that fulfil the requirements of 6.1).

The hot pipe shall be linear to within ± 1 mm in the measuring zone at ambient temperature.

The hot pipe shall be capable of being controlled to within ± 2 % of a predetermined temperature ± 10 °C whichever is smaller over the central 60 % of the total pipe length.

The hot pipe shall be capable of being heated at 50 °C/h and/or 300 °C/h.

5.2 End insulation, with a gap as small as possible between end insulation and guard piece of the test specimen (e.g. ≤ 3 mm) which will permit free movement during the test of the test specimen.

5.3 Temperature sensors, (e.g. thermocouples) capable of recording the hot surface temperature of the test pipe to the nearest ± 1 % in centigrade but not less than ± 1 °C, which are placed within grooves on the hot pipe.

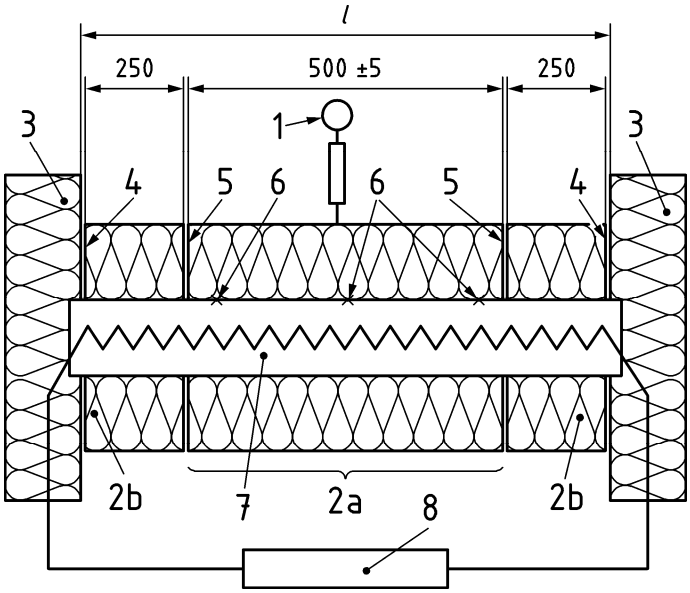
5.4 Flexible metal foil, 3 pieces, (e.g. brass) capable of exerting a uniform pressure of 500 Pa on the upper surface of the test specimen along its testing length of (500 ± 5) mm and the two end guards, length (250 ± 5) mm.

The pressure shall be calculated using the area: e.g. the test length of 500 mm times the diameter of the hot pipe.

5.5 Device, e.g. electromechanical for measuring the thickness of the test specimen during the test to the nearest 0,1 mm.

When determining the thickness of the test specimen, the thermal movement of the apparatus (e.g. quartz rod) shall be taken into account up to the maximum service temperature.

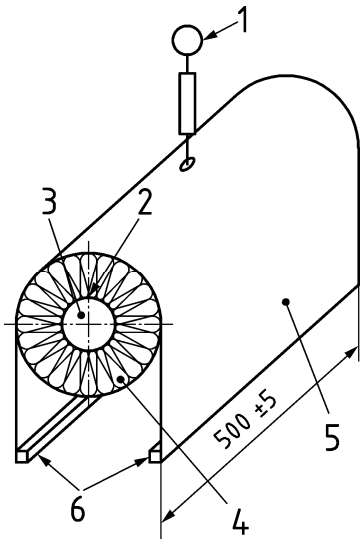
Dimensions in millimetres



Key
1 device for measuring thickness, e. g. electromechanical device
2a test length of the test specimen
2b test specimen end guard
3 end insulation
4 small gap
5 circumferential joints
6 thermocouples
7 hot pipe
8 power supply and temperature control
l length of the hot pipe between the end insulation

a) General arrangement

Dimensions in millimetres



Key

1 device for measuring thickness, e.g. electromechanical device
2 thermocouple
3 hot pipe
4 test specimen
5 flexible metal foil
6 weights for loading

b) Test specimen loading arrangement

Figure 1 — Example of an apparatus for determining maximum service temperature

6 Test specimens

6.1 Dimensions of test specimens

a) **Length:** The test specimen, length (1 000 ± 10) mm, shall be cut at right angles to its length to give two end guards, length each (250 ± 5) mm, and a test length of (500 ± 5) mm.

b) **Thickness:** The thickness shall be 100 mm or the largest thickness below 100 mm available.

c) **Inside diameter:** Two sizes shall be tested, in the range 22 mm to 220 mm.

The dimensions shall be as specified in the relevant product standard or annex to this European Standard.

In the absence of a product standard or any other European Technical Specification, the dimensions may be agreed between parties.

Testing may be performed on multi-layer systems to simulate the conditions existing in the application.

If the pipe insulation is cut from a homogeneous, isotropic flat product, then the maximum service temperature can be obtained from tests carried out on the flat product with similar properties in accordance with EN 14706.

6.2 Number of test specimens

The number of test specimens shall be as specified in the relevant product standard. If the number is not specified, then at least one test specimen for each size 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.

6.3 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 specified in the relevant product standard or at least 24 h.

7 Procedure

7.1 Test conditions

The initial temperature of test specimen and the hot pipe shall be (23 ± 5) °C.

7.2 Test procedure

Measure the length, the inside diameter and the thickness of the test specimen, l_0, D_i, d_0, in accordance with EN 13467 to the nearest 0,5 mm.

Install the test specimen (the two guards and the test length of the test specimen) on the hot pipe and ensure contact on the upper part of the hot pipe between the test specimen and the hot surface. Avoid any longitudinal gaps and any gaps between the end guards and the test length of the test specimen. The installation practice shall duplicate the practice, if required in the product standard.

In case of gaps of more than two millimetres developing between the end guards and the test length during the test, action should be taken to close the gap without disturbing the measurement.

Place the two pieces of flexible metal foil over the two end guards, length (250 ± 5) mm, and exert a pressure of 500 Pa (see 5.4).

Place the third flexible metal foil, (length (500 ± 5) mm) over the test specimen test length and exert a pressure of 500 Pa (see 5.4).

NOTE For polyethylene foam and flexible elastomeric foam products, see Annex B.

Measure the thickness of the test specimen, d_1, to the nearest 0,1 mm.

Heat the test specimen using a temperature rate of increase between 50 °C/h and 300 °C/h, as specified in the relevant product standard or annex of this European Standard.

Maintain the temperature of the hot side, at the expected maximum service temperature, for 72 hours within ± 2 % of this temperature or ± 10 °C, whichever is smaller.

Record the thickness continuously during the test and at the end of the 72 hour period, d_2, to the nearest 0,1 mm.

Cool the test specimen in the equipment, to a temperature of < 35 °C and re-measure the thickness, d_3, to the nearest 0,1 mm, unless otherwise specified in the relevant product standard or annex of this European Standard.

Observe the presence of any longitudinal gaps and any gaps between the end guards and the test length of the test specimen and measure their width to the nearest 0,1 mm.

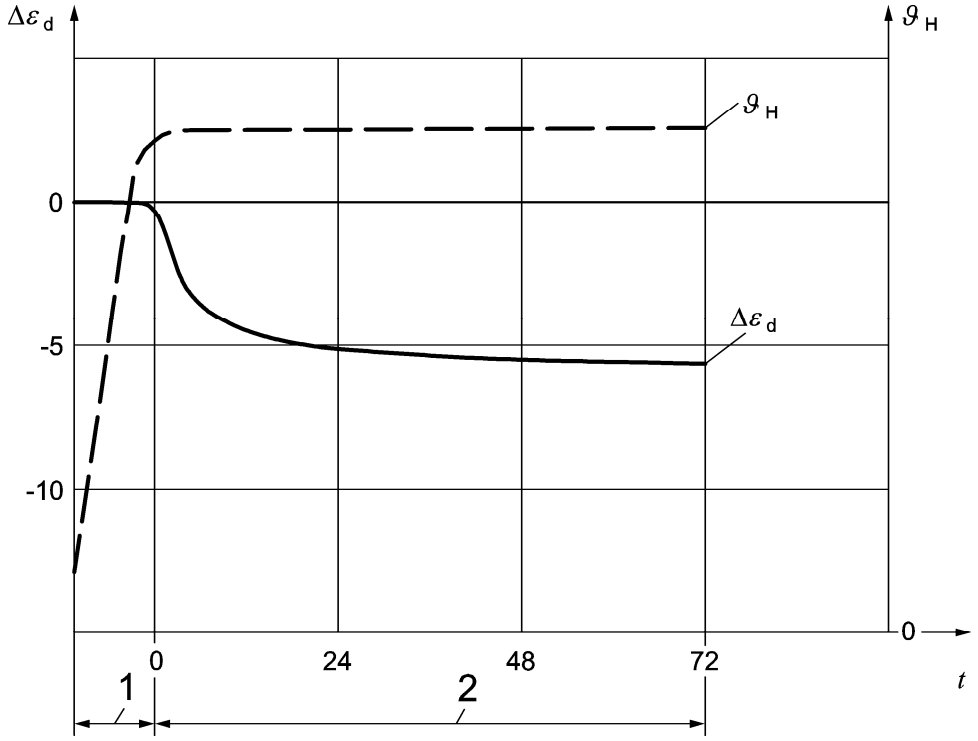
Examine the test specimen visually and note any changes caused by the test.

If the relevant product standard or annex of this European Standard specifies additional requirements, the observations and/or tests shall be performed accordingly.

8 Calculation and expression of results

8.1 Thickness deformation versus time

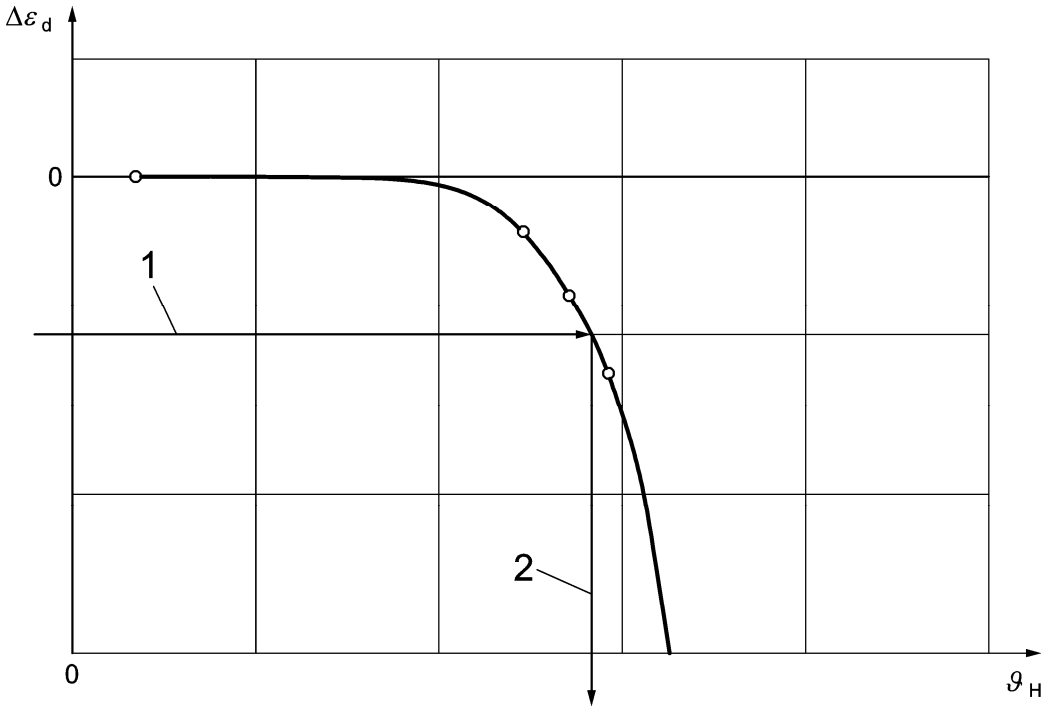
The curves thickness deformation versus time and temperature versus time recorded during testing shall be given. An example is shown in Figure 2.



Key

1 period of heating
2 period of testing
$\Delta\varepsilon_d$ change in thickness in percentage
ϑ_H temperature of the hot tube in centigrade
t time in hours

Figure 2 — Example of hot tube temperature and thickness change versus time curves



Key

(1) maximum change of thickness of the relevant product standard in percentage
(2) maximum service temperature in centigrade
$\Delta\varepsilon_d$ change in thickness in percentage
ϑ_H temperature of the hot pipe in centigrade

Figure 3 — Example of determination of the maximum service temperature (after 72 h)

Calculate the thickness change, $\Delta\varepsilon_d$, in percentage, using the following formula:

$$\Delta\varepsilon_d = 100 \times \frac{d_{2(or3)} - d_1}{d_1} \quad (1)$$

where

d_1 is the measured thickness installed on the heating pipe before heating, in millimetres;

d_2 is the measured thickness installed on the heating pipe after 72 h at constant temperature, in millimetres.

d_3 is the measured thickness after cooling down to a temperature of < 35 °C, in millimetres.

If the change in thickness is larger by using d_3 instead of d_2 in Formula (1), this thickness shall be used in the calculation of the test result.

Calculate the test result as the mean value of the thickness change, $\overline{\Delta\varepsilon_d}$, in percentage rounded to the nearest 0,5 % from the test results of the individual test specimens.

If the change in the mean thickness exceeds the value specified in the relevant product standard the test shall be repeated at a lower temperature until the thickness change is smaller than or equal to the specified value. This temperature is then considered as the maximum service temperature (see Figure 3), providing that the requirements given in 8.2 and 8.3 are also fulfilled.

The steps in centigrade for the indication of the maximum service temperature shall be as specified in the relevant product standard or annex to this European Standard. If the steps are not specified the maximum service temperature shall be declared in steps of not less than 5 °C for temperatures up to 100 °C and in steps of not less than 10 °C for temperatures above 100 °C.

NOTE Results may not be comparable for a product tested at different thicknesses and/or different loads.

8.2 Additional tests and/or observations

The result of the visual examination shall be noted.

If a relevant annex of this European Standard and/or the relevant product standard specifies additional requirements, the calculations and/or observations shall be noted accordingly.

8.3 Internal self heating

Evidence of internal self heating is found when the test specimen temperature at any time during the test exceeds the temperature of the hot pipe.

The test procedure is described in the relevant annexes of this European Standard.

9 Accuracy of measurement

NOTE It has not been possible to include a statement on the accuracy of the method in this edition of this European Standard, but it is intended to include such a statement when this European Standard is next revised.

10 Test report

The test report shall include the following information:

a) reference to this European Standard (EN 14707);

b) product identification:

   1) product name, factory, manufacturer or supplier;

   2) production code number;

   3) type of product;

   4) packaging;

   5) form in which the product arrived at the laboratory;

   6) other information as appropriate, e.g. nominal dimensions, nominal density;

c) test procedure

   1) pre-test history and sampling, e.g. who sampled and where;

   2) conditioning;

   3) if any deviation from Clauses 6 and 7;

   4) date of testing;

   5) dimensions and number of test specimens;

6) chosen temperature increase rate;

7) general information relating to the test;

8) events which may have affected the results;

NOTE 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 curves deformation and temperature versus time;

2) all individual values and the mean value of the thickness change; note if the thickness change in shrinkage or expansion);

3) all individual values and the mean value of the maximum service temperature;

4) presence of longitudinal gaps and their width;

5) note the visual evaluation;

6) additional results as specified in the annexes of this European Standard or the relevant product standard or any other European Technical Specification.

Annex A
(normative)

Modifications of and additions to the general test method for mineral wool products

A.1 Introduction

For mineral wool products, the test method described in the standard shall be modified in accordance with the following clauses.

A.2 Dimensions of test specimens

The installed thickness, d_1, shall not deviate by more than 5 mm from the measured test specimen thickness, d_0. Facings are not removed.

A.3 Procedure

A.3.1 Test conditions

The test shall be started at an initial temperature of the test specimen and the hot pipe between 20 °C and 50 °C. In case of dispute, the test shall be started at (23 ± 5) °C.

A.3.2 Test procedure

Heat the test specimen using a temperature rate of increase of 300 °C/h.

The thickness d_3 after cooling the test specimen down to a temperature of less than 35 °C need not be measured.

A.4 Additional tests and/or observations

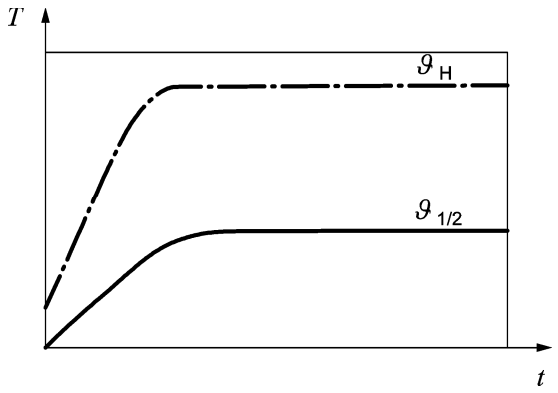
After the measurement of d_2 and cooling down, remove the test specimen, cut the test specimen in half and examine visually the cut edges to establish if the fibrous structure has deteriorated. If cavities have been formed or if the test specimen has visually collapsed then this shall be reported as evidence of failure.

If failure occurs, the test shall be repeated at a lower temperature.

NOTE Any organic binder present is likely to have been removed from parts of the test specimen that have exceeded about 250 °C. This in itself does not impair the thermal performance of the product and is not a cause of failure in the test.

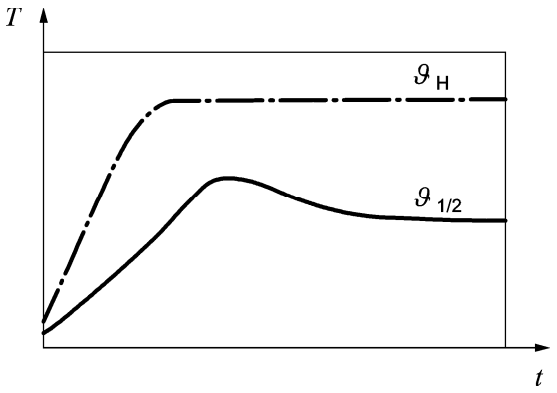
A.5 Test for internal self-heating

If required, the test for internal self-heating has to be carried out. For that purpose, an additional thermocouple has to be installed at half the thickness of the test specimen. The temperature $\vartheta_{1/2}$, in the middle of the thickness of the test specimen below the device for measuring the thickness, during the test of the maximum service temperature should not exceed the temperature of the heated pipe ϑ_H. The appraisal of the test results is carried out according to Figure A.1 a) to c). The test has failed if $\vartheta_{1/2} > \vartheta_H$ (Figure A.1 c) extensive internal self-heating). If failure occurs, the test shall be repeated at a lower temperature.



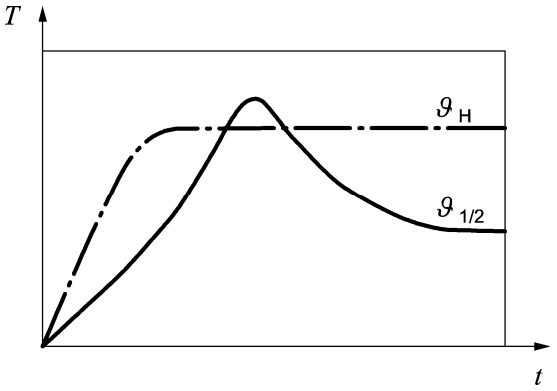
a) no internal self-heating

$\vartheta_{1/2} < \vartheta_H$



b) minor amount of internal self-heating

$\vartheta_{1/2} < \vartheta_H$



c) extensive internal self-heating

$\vartheta_{1/2} > \vartheta_H$

Key

T temperature in centigrade
t time

Figure A.1 — Typical temperature profiles during the test for the internal self-heating versus time

Annex B
(normative)

Modifications of and additions to the general test method for polyethylene foam (PEF) and flexible elastomeric foam (FEF) products

B.1 Introduction

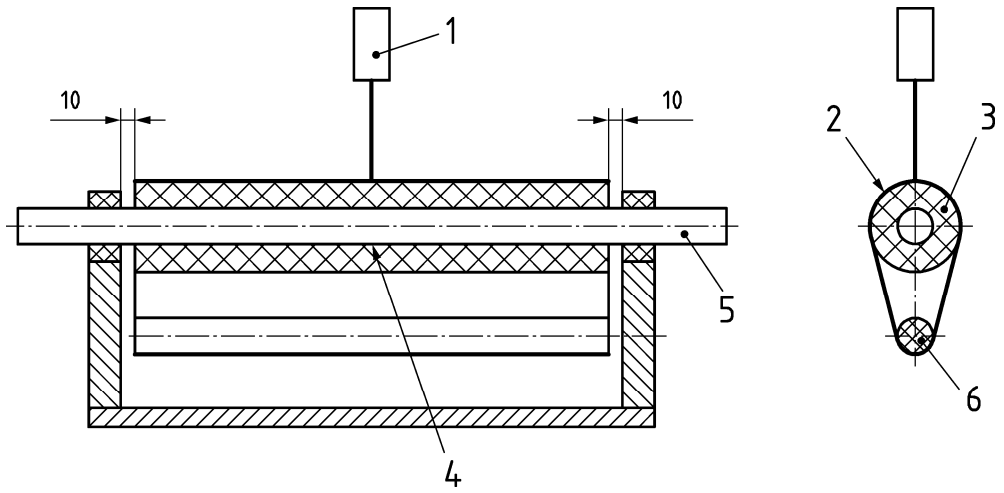
For polyethylene foam and flexible elastomeric foam products, the test method described in this European Standard shall be modified in accordance with the following clauses.

B.2 Apparatus

The hot pipe material is steel, one side is fixed with an insulated pipe hanger, the other side is only guided on an insulated support (for free thermal extension).

The distance between the pipe hanger and the pipe support shall be 320 mm for the pipe diameter less than or equal to 30 mm and 1 020 mm for larger pipe diameters; see Figure B.1.

Dimensions in millimetres



Key

1 device for contact less measuring thickness
2 200 *m thick HDPE film
3 test specimen
4 thermocouple
5 hot pipe
6 weights for loading

Figure B.1 — Example of suitable equipment for maximum service test

B.3 Dimensions of test specimens

The length of test specimens with inside diameter less than or equal 30 mm shall be 300 mm, for larger diameters 1 000 mm.

The largest product thickness shall be tested. Multilayered products may be used for thickness up to 100 mm.

B.4 Test procedure

Measure the dimensional changes in thickness only.

The thickness shall be measured with d_1 being the thickness taken at ambient temperature 24 h after the pressure film has been applied to flatten the surface (at room temperature 23 °C). d_2 is the thickness as stated in 7.2 of this European Standard. d_3 shall not be measured.

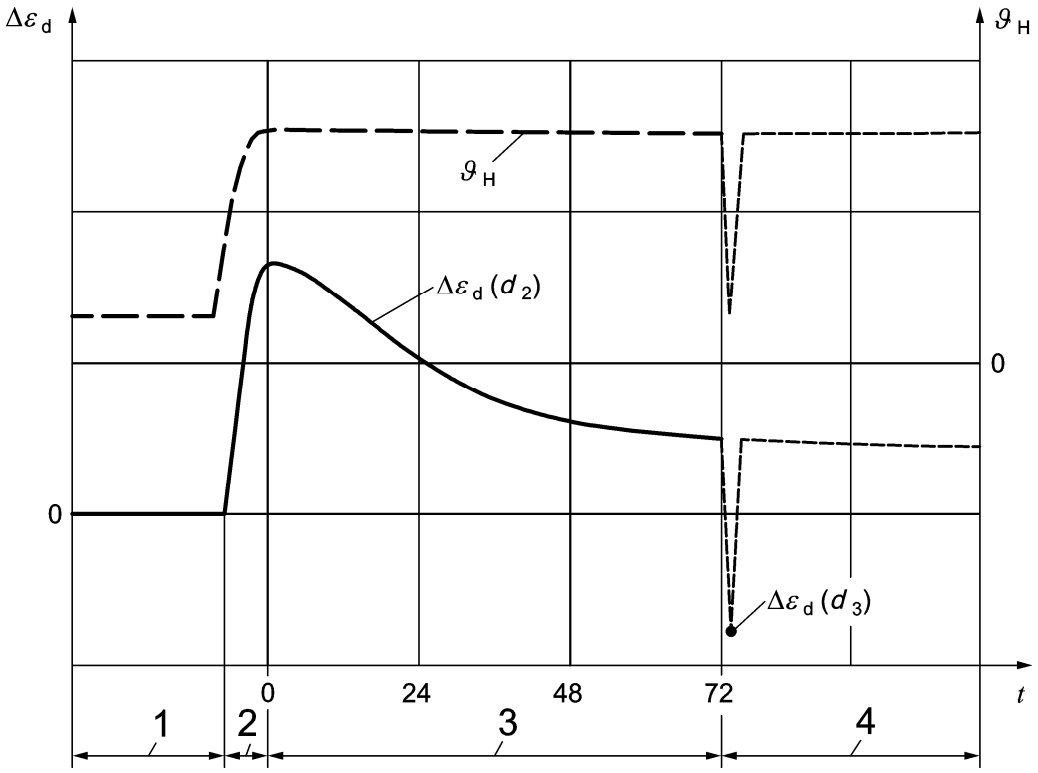
Install the test specimen. Place a 200 m thick HDPE film over the test specimen length and exert the load 50 Pa for FEF or 250 Pa for PEF. Leave the test specimen for 24 h at ambient temperature to ensure that small initial surface unevenness is flattened out. Measure d_1.

Heat the test specimen using a temperature rate of 50 °C/h.

Maintain the temperature of the hot side, at the expected maximum service temperature, for 72 h within $\pm$ 2 % of the temperature or $\pm$ 10 °C, whichever is smaller.

Record the thickness continuously during the test and at the end of the 72 h period, d_2, to the nearest 0,1 mm (at least after 0 h, 0,5 h, 1 h, 6 h, 24 h, 48 h, 72 h).

NOTE Because of the thermal expansion of the entrapped cell gas when heating the foam from the start to the expected maximum service temperature (gas law), the thickness of the test specimen may initially increase (typical curve; see Figure B.2).



Key

1 ambient conditions, load installed
2 period of heating
3 period of testing
4 extra period of cooling down and heating up (exemplary only)
$\Delta\varepsilon_d$ change of thickness in %
ϑ_H temperature of the hot pipe in °C
t time in h

Figure B.2 — Typical example of temperature and thickness deformation versus time curves

B.5 Dimensional changes

Calculate the dimensional changes using Formula (1) of Clause 8 of this European Standard.

NOTE The wall thickness d_3 at room temperature is not of interest for this kind of product because the reduction in temperature causes a reduction of the pressure inside the cells which leads to a reversible reduction in wall thickness. Heating up again leads to a similar thickness as before under temperature load.

Annex C
(normative)

Modifications of and additions to the general test method for phenolic foam products

C.1 Introduction

For phenolic foam products, the test method described in this European Standard shall be modified in accordance with the following clauses.

C.2 Conditioning of test specimens

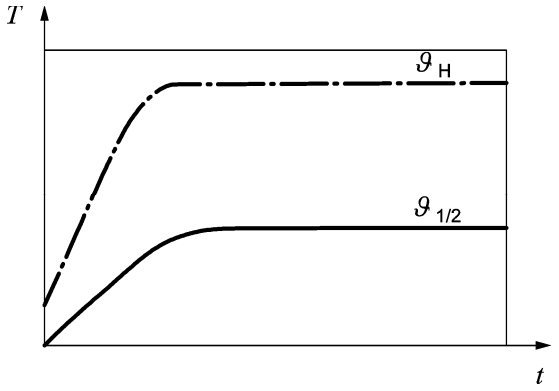
The test specimens shall be conditioned in accordance with EN 12429 at (70 ± 2) °C and then at (23 ± 2) °C and (50 ± 5) % relative humidity prior to test.

C.3 Test procedure

During the test, the test specimens shall be heated at a temperature rate of 50 °C/h up to the manufacturer's claimed maximum service temperature.

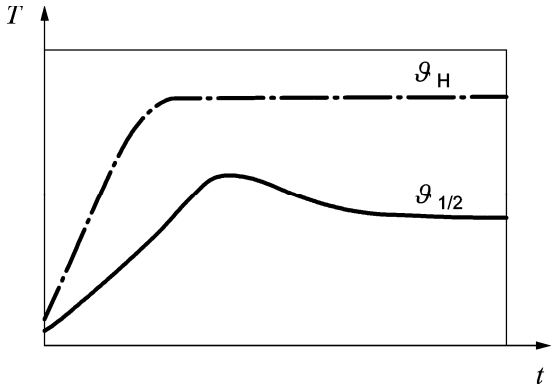
C.4 Additional tests and/or observations

If required, the test for internal self-heating has to be carried out. For that purpose, an additional thermocouple has to be installed at half the thickness of the test specimen. The temperature $\vartheta_{1/2}$, in the middle of the thickness of the test specimen below the device for measuring the thickness, during the test of the maximum service temperature should not exceed the temperature of the heated pipe ϑ_H. The appraisal of the test results is carried out according to Figure C.1 a) to c). The test has failed if $\vartheta_{1/2} > \vartheta_H$ (Figure C.1 c) extensive internal self-heating). If failure occurs, the test shall be repeated at a lower temperature.



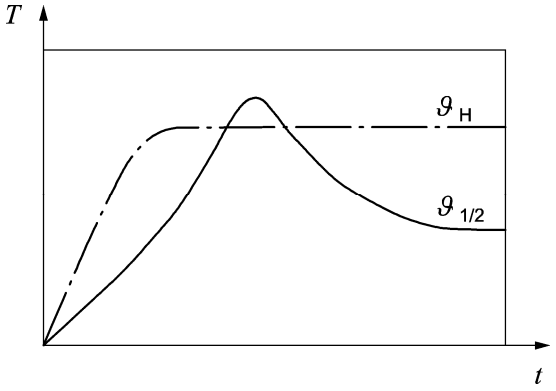
a) no internal self-heating

$\vartheta_{1/2} < \vartheta_H$



b) minor amount of internal self-heating

$\vartheta_{1/2} < \vartheta_H$



c) extensive internal self-heating

$\vartheta_{1/2} > \vartheta_H$

Key

T temperature in centigrade
t time

NOTE Discoloration/change of colour do not impair the thermal performance of the product and is not a cause of failure in the test.

Figure C.1 — Typical temperature profiles during the test for the internal self-heating versus time

Bibliography

[1] EN ISO 9229:2007, *Thermal insulation — Vocabulary (ISO 9229:2007)*

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