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Thermal insulating products for building applications — Determination of compressive creep

Produits isolants thermiques destinés aux applications du bâtiment — Détermination du fluage en compression

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 88, *Thermal insulating materials and products,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16546:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

— modification of Figure 1;

— editorial modifications.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Thermal insulating products for building applications — Determination of compressive creep

1 Scope

This document specifies the equipment and test method for determining the compressive creep of specimens under various conditions of stress.

This document is applicable to thermal insulating products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 29469, *Thermal insulating products for building applications — Determination of compression behaviour*

ISO 29768, *Thermal insulating products for building applications — Determination of linear dimensions of test specimens*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
thickness
linear dimension measured perpendicular to the planes of length and width

3.2
compressive stress
σ_c
ratio of the compressive force to the initial cross-sectional surface area of the test specimen

3.3
deformation
X
reduction in *thickness* (3.1) of the test specimen

3.4
relative deformation
ε
ratio of the *deformation* (3.3) of the test specimen X, and its *thickness* (3.1) d_s, measured in the direction of loading

3.5
compressive creep
X_{ct}
increase in *deformation* (3.3) of the test specimen over time whilst under a constant stress, at specified conditions of temperature and humidity
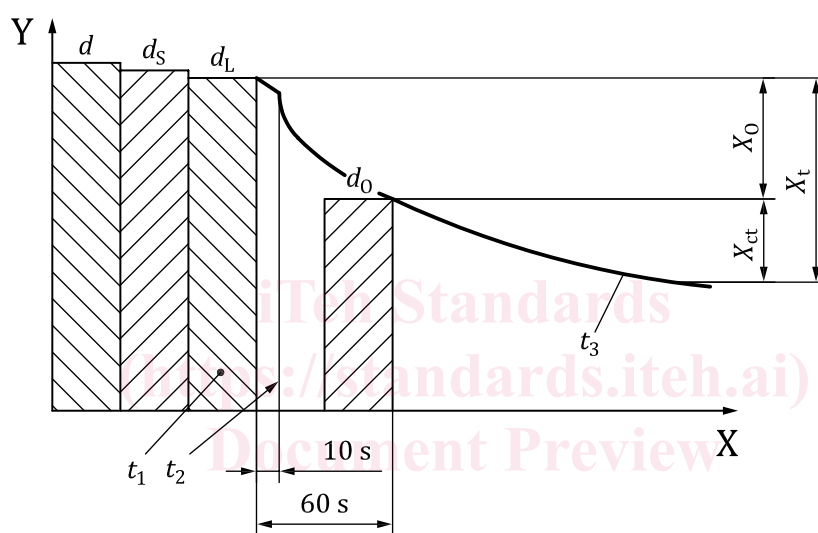
$$X_{ct} = X_t - X_0$$

where

X_t is the deformation at time t;

X_0 is the initial deformation (after 60 s from the beginning of loading).

Note 1 to entry: An illustration of the different *thicknesses* (3.1) and deformations is given in Figure 1.

Key
d original product thickness
d_s initial thickness of the test specimen
d_L thickness of the test specimen under the basic compressive stress of the loading device ('dead weight')
d_0 thickness of the test specimen 60 s after the beginning of the loading process
X_0 the initial deformation (after 60 s from the beginning of loading)
X_{ct} increase in deformation of the test specimen over time whilst under a constant stress, at specified conditions of temperature and humidity
X_t total the deformation at selected time t_3
t_1 time when dead wright is applied
t_2 time when selected load is uniformly applied
t_3 deformation at selected time
Y   thickness
X   time

In the illustration, d_L is used as a reference value for deformation measurements. If d_s is used as the reference value, the illustration can be used, omitting the column for d_L (see 8.3).

Figure 1 — Illustration of the different thicknesses and deformations

4   Symbols

Symbol	Description
d	original product thickness
d_S	thickness of the test specimen
d_L	thickness of the test specimen under the basic compressive stress of the loading device ('dead weight')
d_0	thickness of the test specimen 60 s after the beginning of the loading process
d_t	thickness of the test specimen at a given time, t

5   Principle

The compressive creep is determined by measuring the increase in deformation of a test specimen under constant compressive stress and specified conditions of temperature, humidity and time.
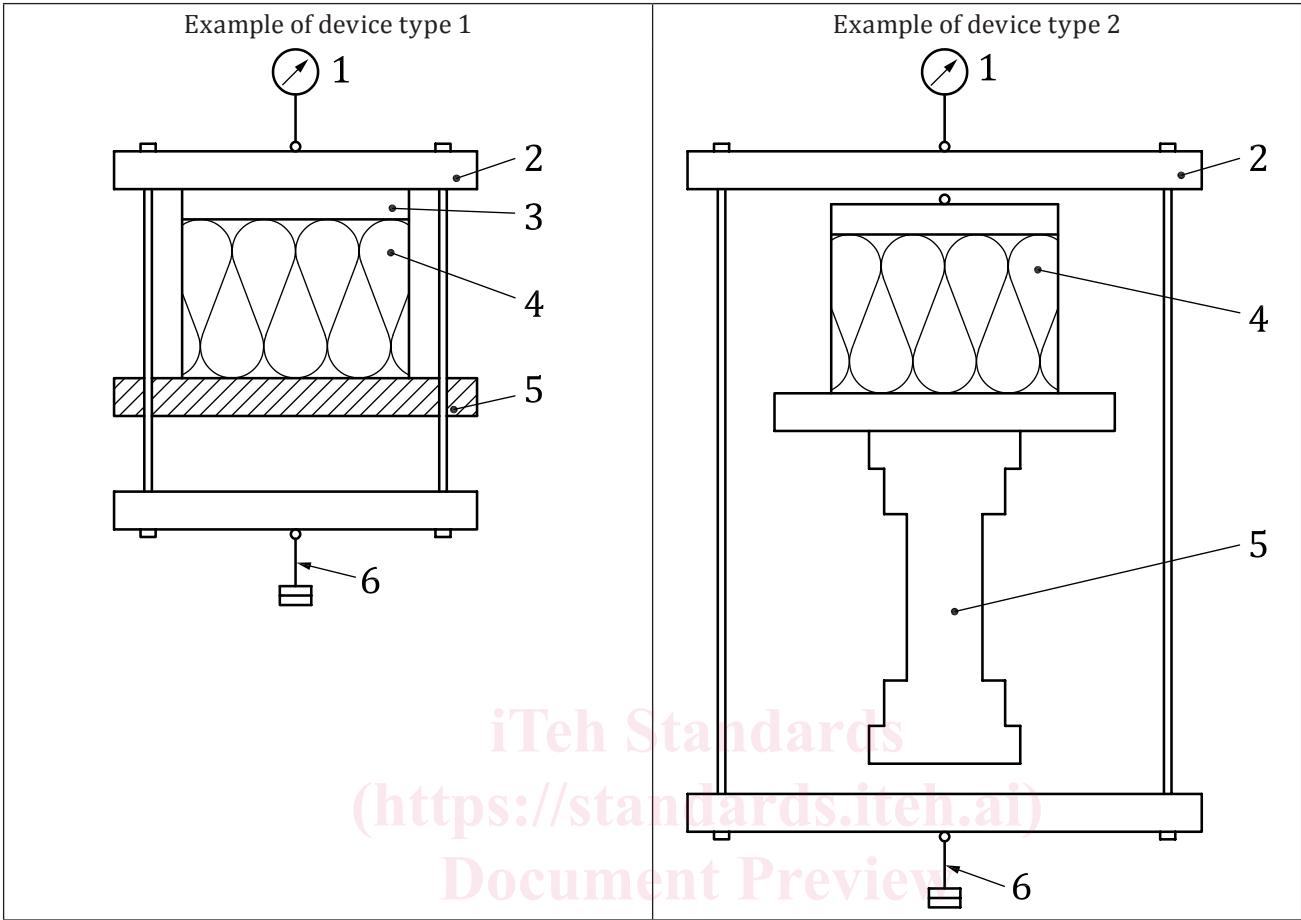
6   Apparatus

6.1   Loading device, consisting of two flat plates, one of which shall be movable, arranged so that they compress the test specimen in a vertical direction. The movable plate shall be guided in such a manner as to be self-aligning. The plates shall be capable of being loaded smoothly and without distortion so that, during the test, the static stress does not change by more than +5 %.

6.2   Measuring device (e.g. dial gauge), capable of determining the distance between the two plates, i.e. the deformation of the test specimen, to an accuracy of 0,01 mm.

6.3   Suitable damping measures, to ensure the effects of external vibration are minimized (e.g. a substantial foundation and anchoring of the apparatus support).

Examples of the testing apparatus are given in Figure 2.

Key

1	displacement transducer or dial gauge	4	test specimen
2	loading bridge	5	support beam
3	load distribution plate (movable, self-aligning)	6	loading by weights

Figure 2 — Examples of test apparatus

7 Test specimens

7.1 Selection of test specimens

The test specimens for determining the compressive creep shall be taken from the same sample, with the same preparation as the test specimens used for the compression test as specified in ISO 29469.

The method for selecting the test specimens shall be as specified in the relevant product standard.

NOTE   In the absence of a product standard or any other technical specification, the method for selection of the test specimens can be agreed between parties.

7.2 Dimensions of test specimens

The thickness of test specimens shall be equal to the original product thickness. The width of the test specimens shall not be less than their thickness. Products with facings or integral moulded skins which are intended to be retained in use shall be tested with these faces or skins intact.

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

The test specimens shall be cut squarely and have sides with the following recommended dimensions:

— 50 mm × 50 mm; or

— 100 mm × 100 mm; or

— 150 mm × 150 mm; or

— 200 mm × 200 mm or

— 300 mm × 300 mm.

The dimensions of test specimens shall be the same as used in the compression test as described in ISO 29469. These are specified in the relevant product standard or agreed between parties.

The linear dimensions shall be determined in accordance with ISO 29768, to an accuracy of 0,5 %.

The upper and lower faces of each test specimen shall be flat and parallel with a tolerance no greater than 0,5 % of its side length, up to a maximum of 0,5 mm.

7.3 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 three specimens shall be used for each compressive stress selected from 8.2.

NOTE   In the absence of a product standard or any other technical specification, the number of specimens can be agreed between parties, provided the minimum requirement of three specimens are met.

7.4 Preparation of test specimens

The specimens shall be cut so that the direction of loading applied to the product will correspond to the direction in which the compressive forces are applied to the product in use.

The test specimens shall be cut by methods that do not change the original structure of the product.

If the test specimen is not flat and parallel, it shall be ground flat and parallel or a suitable coating shall be applied to prepare the surface for the test. If a coating is applied, any creep which occurs within the coating shall be taken into account by deducting the creep of the coating.

Special methods of preparation, when needed, can be provided in the relevant product standard.

7.5 Conditioning of test specimens

The test specimens shall be conditioned for at least 24 h at (23 ± 2) °C and (50 ± 5) % relative humidity (RH). In case of dispute, the time for conditioning (equilibrium of moisture content) shall be as specified in the relevant product standard.

In tropical countries, the local environment can necessitate different conditioning and testing conditions. In such cases, the conditioning shall be performed at (27 ± 2) °C and (65 ± 5) % RH and be stated clearly in the test report.

8 Procedure

8.1 Test conditions

The test shall be carried out at (23 ± 2) °C and (50 ± 5) % RH.

Other conditions can be given in the relevant product standard or can be agreed between parties.

In tropical countries, the local environment may necessitate different conditioning and testing conditions. In such cases, the testing shall be performed at (27 ± 2) °C and (65 ± 5) % RH and be stated clearly in the test report.

8.2   Stress selection

The test shall be carried out at three or more different stresses.

To verify one defined level of stress only this level shall be used.

The alternative stresses for the creep test, σ_c, shall be based on the compressive strength, σ_m, or on the compressive stress, σ_{10}, at 10 % strain measured in accordance with ISO 29469, and shall be calculated as follows:

— $\sigma_c = 0{,}15 \times \sigma_m$ or $\sigma_c = 0{,}15 \times \sigma_{10}$

— $\sigma_c = 0{,}20 \times \sigma_m$ or $\sigma_c = 0{,}20 \times \sigma_{10}$

— $\sigma_c = 0{,}25 \times \sigma_m$ or $\sigma_c = 0{,}25 \times \sigma_{10}$

— $\sigma_c = 0{,}30 \times \sigma_m$ or $\sigma_c = 0{,}30 \times \sigma_{10}$

— $\sigma_c = 0{,}35 \times \sigma_m$ or $\sigma_c = 0{,}35 \times \sigma_{10}$

If appropriate, other values of σ_c may be chosen.

8.3   Test procedure

If the thickness of a test specimen, d_s, is to be determined without using the loading device, it shall be measured to an accuracy of 0,1 mm, in accordance with ISO 29768.

Place the test specimen carefully in the test apparatus, under the 'dead weight' of the loading device. The thickness under this load, d_L, is the reference value for the deformation measurements. Determine d_L to the nearest 0,01 mm.

The stress imposed by the 'dead weight' shall be less than 10 % of the minimum stress selected for the test.

If the thickness of the test specimen, d_s, is determined using the loading device, the specimen should be preloaded by applying a pressure of (250 ± 10) Pa and the thickness measured to an accuracy of 0,01 mm. This value shall then be used as the reference value for the deformation measurements.

If a significant deformation occurs under the pressure of 250 Pa, then a load corresponding to 50 Pa may be used, assuming that such load is specified in the relevant product standard. In this case the thickness, d_s, should be determined under the same load.

Apply the selected stress uniformly to the test specimen within (10 ± 5) s.

Determine the initial deformation, X_0, to the nearest 0,01 mm (60 ± 5) s after loading has started.

Determine the deformation, X_t, to the nearest 0,01 mm at the following times after loading:

1 min, 1 h, 5 h, and then at the following intervals after loading has started: (1, 2, 4, 7, 9, 11, 14, 18, 24, 32, 42, 53, 65 and 80) days, and once between 90 days and 100 days.

NOTE   These times, expressed in hours, are equidistant time increments in a logarithmic time scale.

If the test is continued after 90 days (see 8.4), readings shall be made at equidistant time increments (logarithmic scale). An example for appropriate reading time increments is given in Figure 3 and Table 1.