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ISO 20392

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Thermal-insulating materials — Determination of compressive creep

Matériaux d'isolation thermique — Détermination du fluage en compression

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20392 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

Thermal-insulating materials — Determination of compressive creep

1 Scope

This International Standard specifies equipment and procedures for determining the compressive creep of test specimens under various conditions of stress. It is applicable to thermal-insulation products.

2 Normative references

The following referenced documents are indispensable for the application 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 844, *Rigid cellular plastics — Determination of compression properties*

ISO 1923, *Cellular plastics and rubbers — Determination of linear dimensions*

3 Terms and definitions

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

3.1
thickness
linear dimension measured perpendicular to the length and width plane

3.1.1
thickness d
original product thickness

3.1.2
thickness d_s
initial thickness of the test specimen

3.1.3
thickness d_L
thickness of the test specimen under the basic compressive stress of the loading device (“dead weight”)

3.1.4
thickness d_0
thickness of the test specimen 60 s after the beginning of loading

3.1.5
thickness d_t
thickness of the test specimen at a given time t

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

3.3
deformation
X
reduction in thickness of the test specimen

3.4
relative deformation
ε
ratio of the deformation X of the test specimen and its thickness d_s, measured in the direction of the load

3.5
compressive creep
X_{ct}
increase, with time, in the deformation of the test specimen under a constant stress under specified conditions of temperature and humidity

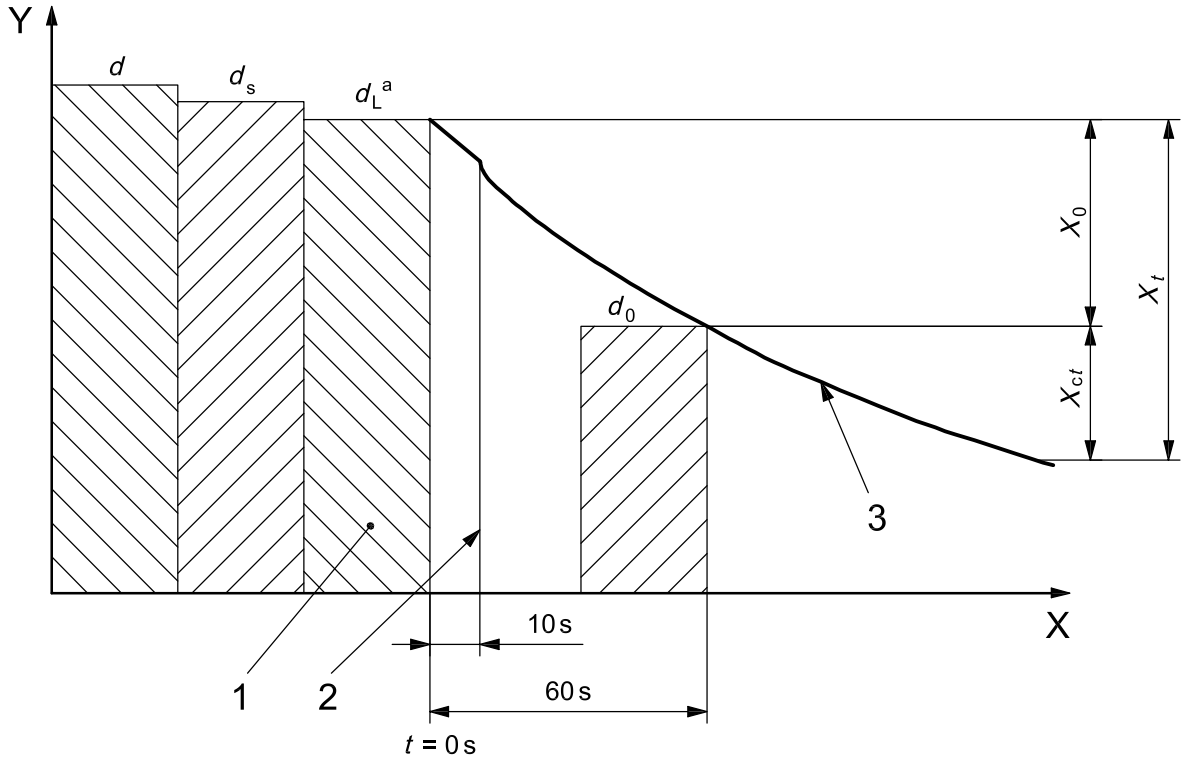
NOTE $X_{ct} = X_t - X_0$

where

X_t is the deformation at time t;

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

An illustration of the different thicknesses and deformations is given in Figure 1.



Key

X time, t

Y thickness

1 thickness under the "dead weight" of the loading device (≤ 10 % of the smallest chosen stress for the creep test)

2 point when load is applied for the compressive-creep test

3 deformation curve

a In the illustration, d_L is used as the reference value for the measurements of deformation. If d_s is used as the reference value, the illustration can be used with the omission of the column for d_L (see 7.3).

Figure 1 — Illustration of the various thicknesses and deformations

4 Principle

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

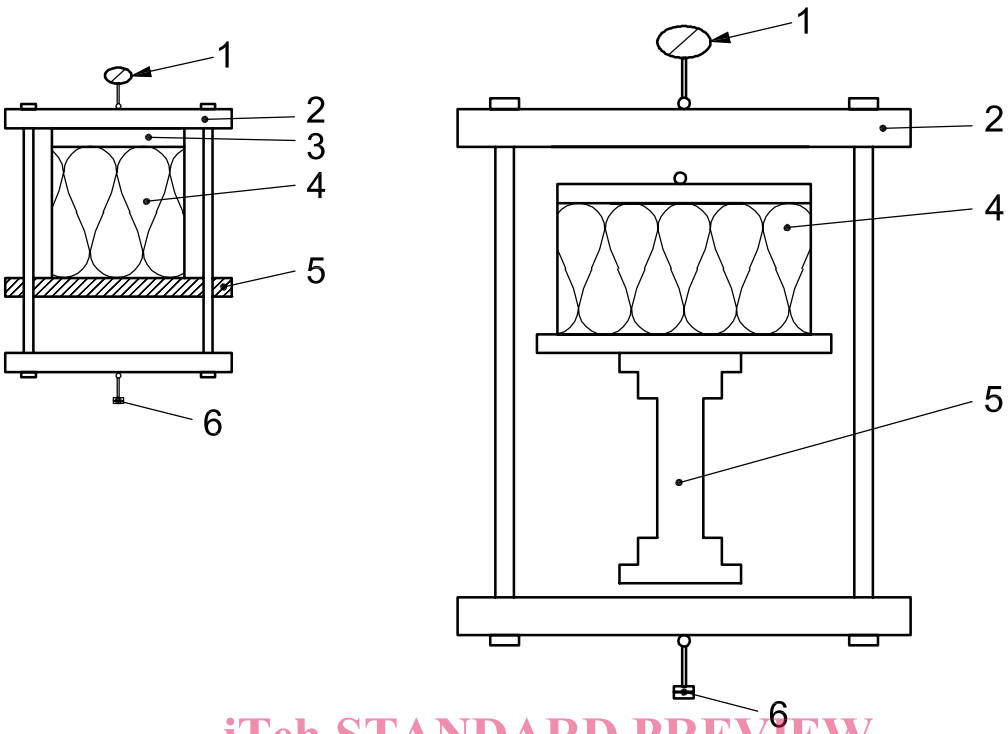
5 Apparatus

5.1 Loading device, consisting of two flat plates, one of which shall be movable, so arranged that they compress the test specimen in the vertical direction. The movable plate shall be mounted 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 %.

5.2 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.

5.3 Suitable damping facilities, to minimize the effects of external vibration, e.g. a substantial base supporting the apparatus.

Examples of test apparatus are given in Figure 2.



Key

1 displacement transducer or dial gauge
2 loading bridge
3 load-distribution plate (movable, self-aligning)
4 test specimen
5 base supporting apparatus
6 weights providing the load

Figure 2 — Examples of test apparatus

6 Test specimens

6.1 Preparation

The test specimens for determining the compressive creep shall be taken from the same test sample, with the same preparation, as the test specimens used for the determination of compression properties in accordance with ISO 844.

NOTE Special methods of preparation, when needed, may be given in the relevant product standard.

6.2 Dimensions

The test specimens shall be right prisms with a square base. The thickness of the specimens shall be the original product thickness. The length and width of the specimen base shall not be less than their thickness. Products with facings or integrally moulded skins which are 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 length and width of the test specimen base are normally specified in the relevant product standard. If not, they shall be agreed between the interested parties, in which case the recommended dimensions are:

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 length and width of the test specimen base shall be measured in accordance with ISO 1923 to an accuracy of 0,5 %.

The tolerance on parallelism between the upper and lower faces of the test specimens and the tolerance on the flatness of the upper and lower faces shall not be greater than 0,5 % of the test specimen length or width, with a maximum of 0,5 mm.

If a test specimen is not flat, it shall be ground flat or a suitable coating applied to prepare the surface for the test. If it is coated, no significant creep shall occur in the coating or, if creep does occur in the coating, this shall be taken into account by deducting it from the measurements.

6.3 Number

The number of test specimens shall be as specified in the relevant product standard. If the number is not specified, then at least three test specimens shall be used for each of the compressive stresses selected in 7.2.

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

6.4 Conditioning

The test specimens shall be conditioned for at least 24 h under the test conditions. In cases of dispute, the time for conditioning (equilibration of moisture content) shall be as specified in the relevant product standard.

7 Procedure

7.1 Test conditions

The test shall be carried out at

(23 ± 2) °C and (50 ± 10) % relative humidity

or

(23 ± 5) °C and 50^{+20}_{-10} % relative humidity

or

(27 ± 5) °C and 65^{+20}_{-10} % relative humidity

unless other conditions are given in the relevant product standard.

7.2 Stress selection

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

The alternative stresses, σ_c, for the creep investigation shall be based on either the compressive strength, σ_m, or the compressive stress, σ_{10}, at 10 % deformation measured in accordance with ISO 844, 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.

7.3 Test procedure

If the thickness of a test specimen, d_s, is determined without using the loading device, it shall be measured to the nearest 0,1 mm in accordance with ISO 1923.

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

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

If the thickness of the test specimen, d_s, is determined using the loading device, the specimen shall be preloaded with a pressure of (250 ± 10) Pa and the thickness measured to the nearest 0,01 mm. This value shall then be used as the reference value for measurements of deformation. If significant deformation occurs under the pressure of 250 Pa, then a load corresponding to 50 Pa may be used assuming it is specified in the relevant product standard. In this case, the thickness d_s shall be determined under the same load.

Apply the first of the selected stresses 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 the beginning of loading.

Determine the deformation, X_t, to the nearest 0,01 mm at the following times after loading: 0,1 h, 1 h, 5 h and then at 1 day, 2 days, 4 days, 7 days, 9 days, 11 days, 14 days, 18 days, 24 days, 32 days, 42 days, 53 days, 65 days, 80 days and at at least one additional time between 90 days and 100 days.

NOTE These times, when expressed in hours, give equal time increments on a logarithmic time scale.

If the test is continued after 90 days, readings shall be made at equal time increments (on a logarithmic scale). An example of a suitable test schedule is given in Table 3 and shown in Figure 3.

If a coating has been added for test purposes, the compressive creep may be measured by the relative movement of the flat plates of the loading device. Alternatively, it may be measured from the relative movement of reference points on the edges of the specimen.

Tabulate the measured deformation values, X_t, for each test specimen separately.

Table 1 — Example of schedule for taking deformation readings

Day	Time	Test duration h	Day of week
0	10:00 a.m.	0 (loading)	Mon
0	10:01 a.m.	0,017	Mon
0	11:00 a.m.	1,0	Mon
0	3:00 p.m.	5,0	Mon
1	10:00 a.m.	24	Tues
2	10:00 a.m.	48	Wed
4	2:00 p.m.	100	Fri
7	10:00 a.m.	168	Mon
9	10:00 a.m.	216	Wed
11	10:00 a.m.	254	Fri
14	10:00 a.m.	336	Mon
18	10:00 a.m.	432	Fri
24	10:00 a.m.	576	Thurs
32	10:00 a.m.	768	Fri
42	10:00 a.m.	1 008	Mon
53	10:00 a.m.	1 272	Fri
65	10:00 a.m.	1 560	Wed
80	10:00 a.m.	1 920	Thurs
100	10:00 a.m.	2 400	Wed
123	10:00 a.m.	2 952	Fri
156	10:00 a.m.	3 744	Wed
190	10:00 a.m.	4 560	Tues
231	10:00 a.m.	5 544	Mon
295	10:00 a.m.	7 080	Tues
365	10:00 a.m.	8 760	Tues