
**Resilient floor coverings —
Determination of dimensional stability
and curling after exposure to heat**

*Revêtements de sol résilients — Détermination de la stabilité
dimensionnelle et de l'incurvation après exposition à la chaleur*

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 219, *Floor coverings*.

This second edition cancels and replaces the first edition (ISO 23999:2008), which has been technically revised.

The main changes compared to the previous edition are as follows:

- cross-references within the document have been updated;
- minor editorial changes have been made;
- the scope has been broadened to allow testing of planks;
- the possibility of additional testing temperatures has been introduced;
- the specimen dimensions have been specified;
- an appendix has been added to allow for dimensional changes immediately after exposure to specified heated exposure conditions.

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.

Resilient floor coverings — Determination of dimensional stability and curling after exposure to heat

1 Scope

This document specifies a method for determining dimensional stability and curling of resilient floor coverings, in the form of sheets, tile or planks after exposure to heat.

2 Normative references

There are no normative references in this document.

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

dimensional stability

ability of a resilient floor covering to retain its original dimensions after exposure to heat, under specified conditions

3.2

curling

vertical deformation appearing on the specimen after exposure to a heat treatment, under specified conditions

3.3

domed material

area of specimen that does not lie flat against support plate when centred

4 Principle

4.1 Dimensional stability

The relative change in distance between marks or a specific location on a test specimen is measured before and after exposure to a heat treatment, under specified conditions. In the case of tiles and planks, measurements may be made using a block and dial gauge assembly and marking of the test specimen is not necessarily required.

4.2 Curling

The vertical deformations are measured in the test specimen after the specified heat treatment.

Test specimens are placed in an oven at an elevated temperature, after which curling and dimensional stability are determined. In the case of domed material or where material exhibits negative curling, turn the test specimen over to measure inverted or with the back of the sample facing up. Measure curling and mark appropriately as negative curling.

5 Apparatus

5.1 Oven.

The oven shall be thermostatically controlled and ventilated, capable of being maintained at a uniform temperature of $80\text{ °C} \pm 2\text{ °C}$. If a temperature setting other than 80 °C is utilized, mark the test sheet as appropriate and verify the oven's capability to maintain a uniform temperature set point.

In operation, ensure that radiation from the heating element does not directly reach the test specimens or support plates.

5.2 Support plates.

The support plates shall be of metal, e.g. aluminium or stainless steel, of dimensions larger than the test specimen and not less than 1,5 mm in thickness. Ensure that the support plates are kept smooth and polished so that surface friction does not interfere with free shrinkage or growth of the test specimens. The plates shall be flat and free of convex or concave warp and fully support the sample (e.g. a wire rack support plate is not acceptable.).

The shapes and dimensions of the apparatus specified in 5.1 and 5.2 shall be such that:

- a) curling can be measured without removing the test specimens from the support plates, except in the case of domed material or where material exhibits negative curling;
- b) the distance between the plates and the vertical walls of the oven is more than 50 mm;
- c) the vertical distance between the support plates and between the plates and the oven is more than 100 mm.

5.3 Measuring device.

5.3.1 Measuring equipment.

For sheet, tile (between 229 mm and 610 mm or partial, for dimensions larger than 610 mm in size) or plank (between 229 mm and 610 mm or partial, for dimensions larger than 610 mm in size) test specimens, the measuring equipment shall preferably be an optical bench, for non-contact measurements. The equipment shall have a range of at least 200 mm and a precision of $\pm 0,02\text{ mm}$. For many types of optical benches, ensure that the test specimen is properly seated against the base horizontal index guide when a specific measurement is being taken. Test specimens with concave or convex edges can be read incorrectly.

5.3.2 Micrometer.

For sheet, tile or plank (partial) specimens, the micrometer shall be pillar-mounted. Alternatively, other suitable device accurate to at least 0,1 mm may be used.

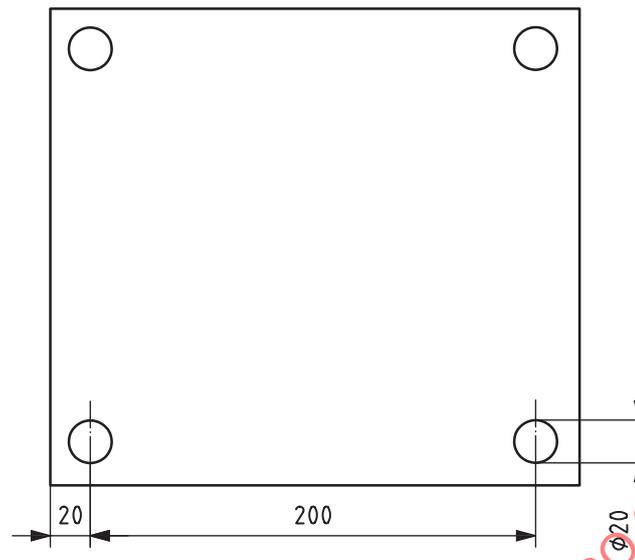
5.3.3 Rigid plate.

For sheet or tile test specimens, a rigid plate of steel, squared and finished, of dimensions 240 mm × 240 mm with holes for the scores (see [Figure 1](#)) shall be used. For planks, especially more rigid planks, the preferred method to measure dimensional stability is with a block and dial setup, although a rigid plate set up could be utilized.

5.3.4 Square template.

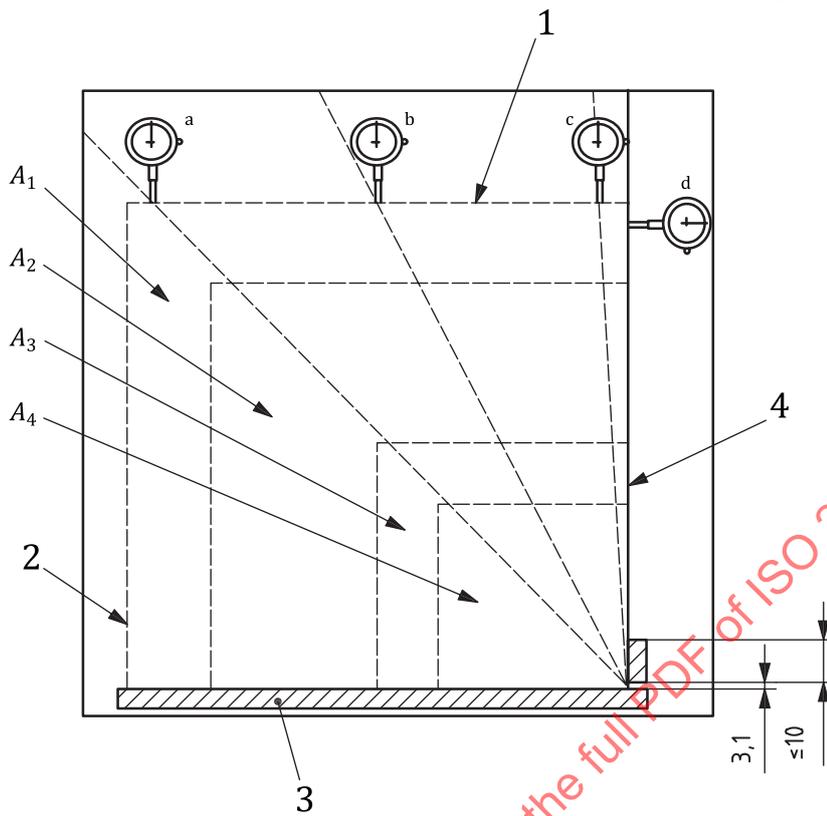
For sheet or tile specimens, a square template, of side 610 mm, 508 mm, 305 mm or 229 mm for example, shall be used.

Dimensions in millimetres

**Figure 1 — Rigid steel plate**

5.3.5 Block and dial gauge.

For tile or plank (partial) test specimens only, a block and dial gauge as shown in [Figure 2](#) shall be used.



Key

- | | | | |
|---|---|----------------|--------------------------|
| 1 | edge 1 | A ₁ | template 610 mm × 610 mm |
| 2 | edge 2 | A ₂ | template 508 mm × 508 mm |
| 3 | edge 3 | A ₃ | template 305 mm × 305 mm |
| 4 | edge 4 | A ₄ | template 229 mm × 229 mm |
| a | Within 10 % of the corner of the tile edge. | | |
| b | Within the central 10 % of the tile edge. | | |
| c | Within 10 % of the corner of the tile edge. | | |
| d | Within 10 % of the corner of the tile edge. | | |

Figure 2 — Apparatus for measuring side length, straightness and squareness

5.3.6 Calibrated shim or spacer block.

The calibrated shim or spacer block allows to measure plank width differences utilizing the block and dial gauge apparatus.

5.4 Scoring device.

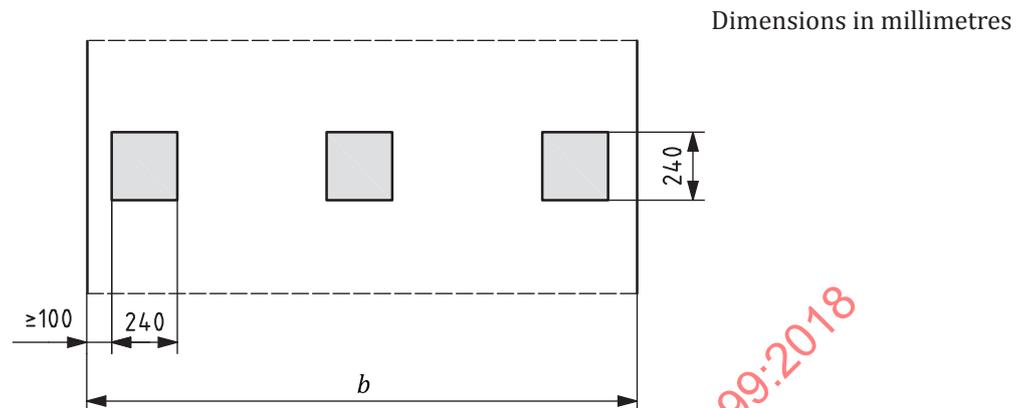
A scoring device, e.g. a single edge razor blade, scalpel or scribe point, can be used.

6 Test specimens

For sheet material, before cutting the test specimens, lay out the product as flat as possible and mark the direction of manufacture.

Cut out three (3), nominal 240 mm square test specimens, at equal distance, from the sample material (see [Figure 3](#)). The distance between the outer edge of the sample and nearest edge of the test specimen

shall be at least 100 mm. The test specimen edges shall be parallel/transverse to the direction of manufacture.



Key

b total width

Figure 3 — Cutting of test specimens from sheet or roll product

For tiles and planks, remove product from package, discard top and bottom tile or plank, spread them out, then randomly select three test specimens. The direction of manufacture shall, if possible, be marked on each test specimen. Tiles and planks, if less than 610 mm in width and or length, should be tested as manufactured. If testing samples have profiled edges, it can be easier to cut the profiled edging off, making sure to achieve clean, straight and squared cut edges for testing purposes. Make every effort to not distort or excessively stress samples during cutting process. For tiles and/or planks longer and/or wider than 610 mm, the dimension(s) over 610 mm shall be cut down to 610 mm for testing using this method. Take precaution to achieve a clean, straight cut if testing using a block and dial gauge setup.

7 Conditioning

Condition the test specimens on a flat surface, such as a table surface, to ensure that they are in contact with the support plate uniformly during the measurements.

Condition the test specimens at a temperature of $23\text{ °C} \pm 2\text{ °C}$ and relative humidity of $50\% \pm 5\%$ for a minimum of 24 h.

8 Test procedure

8.1 Test specimen preparation

Make eight scores (5.3, 5.4) on each sheet or tile test specimen approximately 20 mm from the edges. Make four scores in each direction to form four crosses, at a distance of $200\text{ mm} \pm 1\text{ mm}$ (see Figure 4). If utilized for planks, a different spacing is required for width.

Mark the two reference points for measurement on the top of the test specimen and measure, with the wear surface up, on the block and the optical bench assembly (5.3.1), to ensure that any embossing along the edge of the test specimen wear surface does not affect the measurements.

To make the scores more easily visible, the scores may be marked with a solution of dye in aqueous alcohol (i.e. whiteboard marker or equivalent).

Place each test specimen on a support plate (5.2) with its surface facing upward. Condition the test specimen (see Clause 7).

Dimensions in millimetres

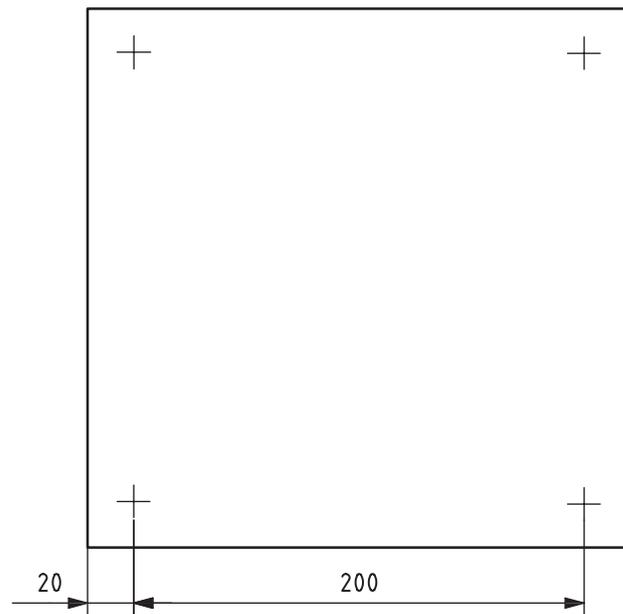


Figure 4 — Scoring of test specimens

8.2 Initial measurement

8.2.1 Curling

Measure the vertical distance between the support plate (5.2) and the wear surface of the test specimen in four places around the edge (usually the corners), where the distance is greatest. Carry out the measurements with the micrometer (5.3.2).

CAUTION — When handling test specimens and making measurements, to avoid distortion, do not apply undue force to the test specimen.

8.2.2 Linear dimensions

On each test specimen, determine the length of four measurement sections: two in the manufacturing direction (MD) of the flooring material and two in the transverse or across-manufacturing (TD or AMD) direction.

Put the rigid plate (5.3.3) on top of the test specimen and measure the length between the crosses formed by the scores (see Figure 1).

Start the heat exposure portion of the test within 1 h of making the initial dimensional measurements.

8.3 Heat exposure

Place the test specimens horizontally onto support plates (5.2), previously placed in the oven (5.1). Allow to come to test temperature (80 ± 2) °C (standard default temperature unless otherwise cited in a flooring specification document). Maintain the test specimens at this temperature for $6\text{ h }^{+15}_0\text{ min}$ (standard default time, unless otherwise cited in a flooring specification document) in the oven. If a different temperature and/or time is utilized, the test sheet shall accurately reflect the conditions used to test the curling and dimensional stability. The same tolerances for temperature and time, as required for default conditions, apply to any different set of temperature/time conditions utilized.

[Annex A](#) provides information on measurement of size change due to heat exposure and prior to reconditioning.

8.4 Reconditioning

Remove the test specimens from the oven. Allow the test specimens to recondition (see [Clause 7](#)) for 24 h (unless otherwise specified for the product). Do not remove the test specimens from the metal plate until the reconditioning time has elapsed and the measurements are to be performed.

8.5 Final measurement

8.5.1 General

After reconditioning, measure the dimensional changes to the test specimen.

8.5.2 Curling

Re-measure curling as described in [8.2.1](#). Make sure that the optical device ([5.3.1](#)) is at the same reference points for both the initial and final measurements.

8.5.3 Linear dimensions

8.5.3.1 For sheet, tile and if utilized on plank test specimens

Make sure to place the rigid metal plate on top of the specimens and re-measure the length between the crosses formed by the scores, i.e. the new distance of each measurement section (see [Figure 1](#)). Make sure that the optical device ([5.3.1](#)) is at the same reference points for both the initial and final measurements.

8.5.3.2 For tile and plank (partial) test specimens measured using block and dial gauge

Place the test specimen on the block and dial gauge ([5.3.5](#)). Record the length at the specified location (see [Figure 2](#)). For planks, use the calibrated shim or spacer block to allow the measurement of plank width differences with the block and dial gauge apparatus.

9 Calculation and expression of results

9.1 For curling

Calculate the mean value of the four measurements for each test specimen. The initial and final values are expressed separately. Calculate the mean value for the three test specimens. Express the results in millimetres to the nearest 0,5 mm.

9.2 For dimensional stability

For each of the test directions (machine direction and across machine direction), record the variations for the six length measurements (two readings from three test specimens). Calculate the dimensional change for each measurement section related to the initial length. The linear change, dL_{complete} , expressed as a percentage, is given by the following formula:

$$dL_{\text{complete}} = \frac{(L_0 - L_1)}{L_0} \times 100$$

where

dL_{complete} is the linear change in dimension(s) after complete test, expressed as a percentage;

L_0 is the initial length;

L_1 is the length after complete test.

For each of the test directions, calculate the mean value of the six results and express it both as a percentage to the nearest 0,05 % and as the change in length in millimetres.

10 Test report

The test report shall include at least the following information:

- a) the test method used, together with reference to this document, i.e. ISO 23999:2018;
- b) the date(s) on which the tests were carried out;
- c) all the information required for the complete identification of the product tested, including type, source, colour and manufacturer's reference number(s);
- d) the history of the sample from which the test specimens were drawn;
- e) all operating details not specified in this document, or regarded as optional, together with details of any incident that is likely to have influenced the result(s);
- f) the test results obtained, as changes in dimensions:
 - 1) the mean value of linear change in dimension, for each direction;
 - 2) the maximum value of linear change in dimension, for each direction;
 - 3) the mean value for final curling;
 - 4) the mean value for initial curling, if any;
- g) If normal change in dimensions did not occur, describe any deviation from the method specified in this document which is likely to have affected the results.