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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

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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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For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 219, *Floor coverings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 134, *Resilient, textile and laminate floor coverings,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 23999:2018), which has been technically revised.

The main changes are as follows:

— cross-references within the document have been updated;

— update to the dimensional stability and curling calculation sections of the method;

— update of Annex A with more detailed calculation.

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, tiles 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 terminology 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.

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 °C ± 2 °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 distortion 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 shall be more than 50 mm;

c) the vertical distance between the support plates and between the plates and the oven shall be more than 100 mm.

5.3 Measuring device

5.3.1 Measuring equipment

The measuring equipment for sheet, tile and plank products, shall preferably be an optical bench for non-contact dimensional stability measurements or block and dial gauge apparatus, see examples shown in Figure 2, Figure 3 and Figure 4. The equipment shall have a range of at least 200 mm and a precision of ± 0,02 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 drop gauge device. Alternative measurement systems may be used provided they are accurate to at least 0,1 mm e.g. feeler gauges.

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 set-up, although a rigid plate set-up can be utilized.

5.3.4 Square template

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

Dimensions in millimetres

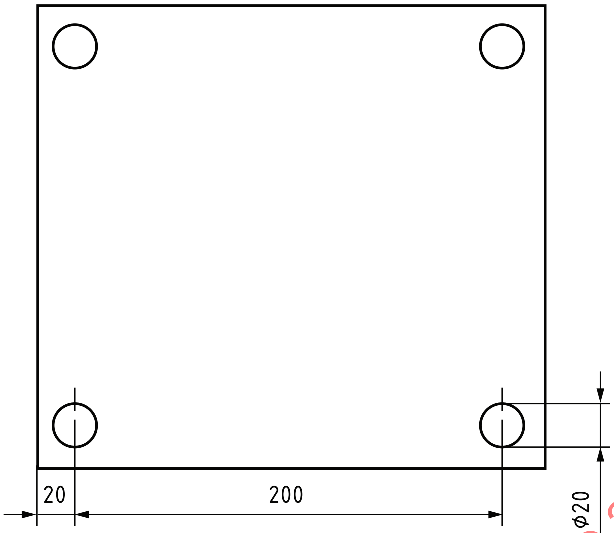
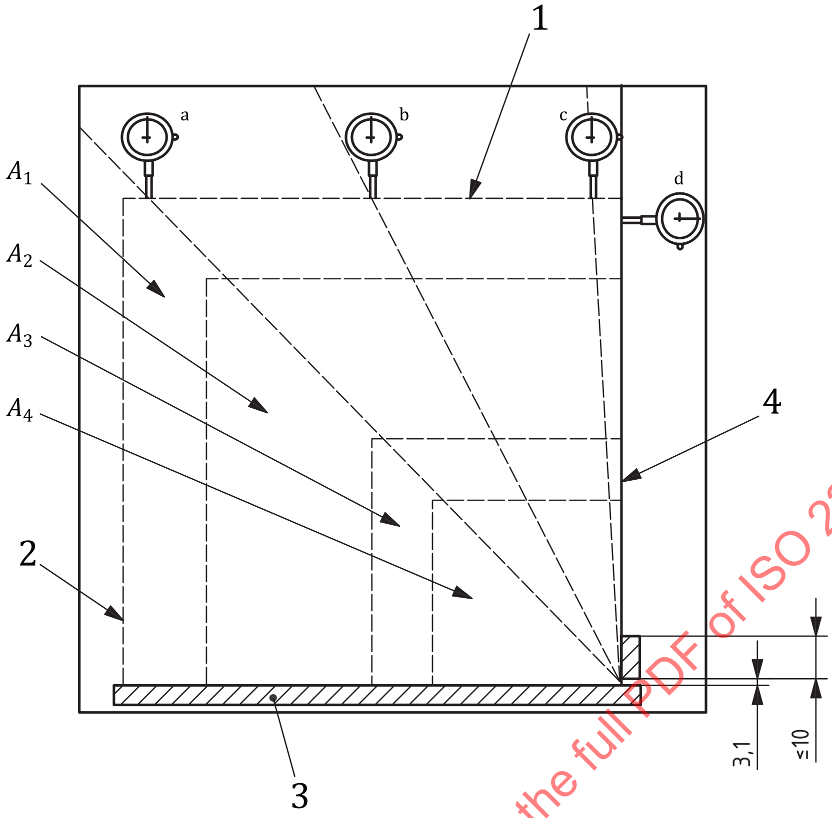


Figure 1 — Rigid steel plate example

5.3.5 Block and dial gauge (appropriate for tile or plank size to be measured)

For tile or plank (partial) test specimens only, a block and dial gauge as shown in Figure 2, Figure 3 or Figure 4 examples, shall be used.

Dimensions in millimetres



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.

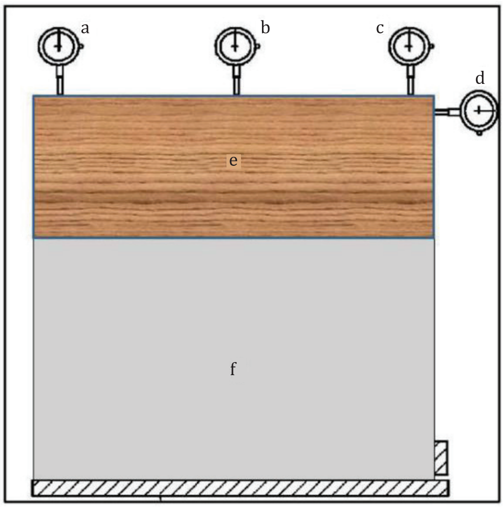
[c] Within 10 % of the corner of the tile edge.

[d] Within 10 % of the corner of the tile edge.

Figure 2 — Example apparatus for measuring tile 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.



Key

a dial micrometer

b dial micrometer

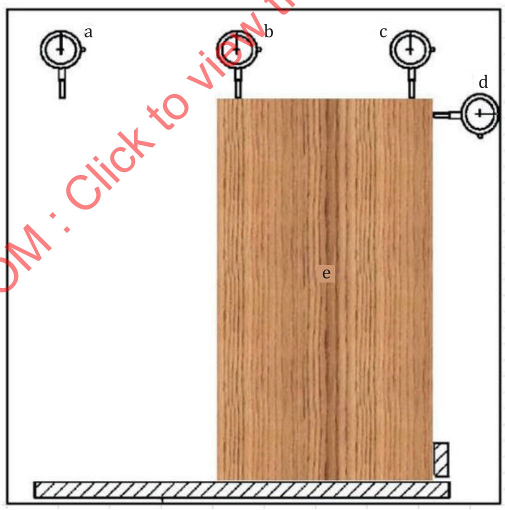
c dial micrometer

d dial micrometer

e example plank, e.g. 152,4 mm × 609,6 mm

f example plank, e.g. 457,2 mm × 609,6 mm

Figure 3 — Example shim block/plank measurement set-up — width



Key

a dial micrometer

b dial micrometer

c dial micrometer

d dial micrometer

e example plank

Figure 4 — Example plank measurement set-up — length

5.4 Scoring device

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

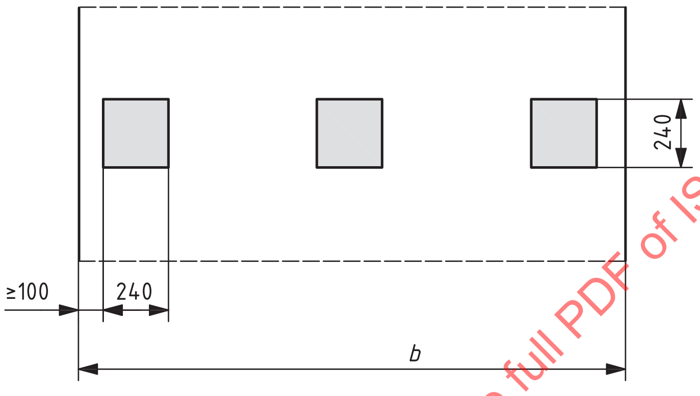
6 Test specimens

6.1 General

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, nominal 240 mm square test specimens, at equal distance, from the sample material (see Figure 5). 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.

Dimensions in millimetres



Key

b total width

Figure 5 — Cutting of test specimens from sheet or roll product

6.2 Plank width

Specimen(s) shall have sufficient width to permit use of a minimum of two micrometers when taking measurements (see Figure 4).

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 set-up.

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 °C ± 2 °C and relative humidity of 50 % ± 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 (see Figure 6). 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 (e.g. whiteboard marker or equivalent).

For specimens using block and dial measurement apparatus, specimens shall be or cut to be a specific size. Make sure edges are smooth and clean.

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

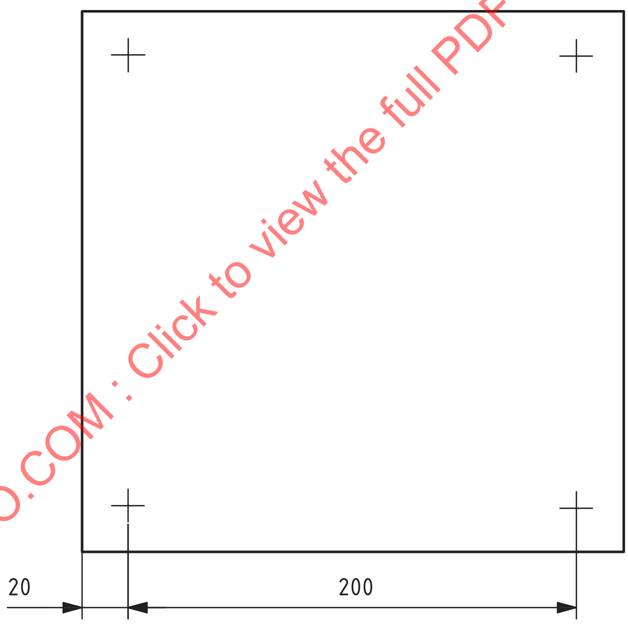


Figure 6 — Scoring of test specimens

8.2 Initial measurement

8.2.1 Curling

There are two basic ways to measure curl:

a) use feeler gauges and measure the gap between the bottom of the product, and the surface of the support plate; or

b) use a pillar mounted drop gauge to measure height of the specimen above the support surface then subtract the thickness of the product.

If using a drop gauge, measure the vertical distance between the support plate (5.2) and the top 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).

If using a feeler gauge to measure curling, the same measurement locations would apply but measurements would be the gap between the surface support and the bottom of the product. Mark or note measurement location for specimen 1. Repeat for specimens 2 and 3.

Some samples may exhibit initial curling after conditioning but prior to specimen seeing test exposure conditions.

Measure curling for specimen 1 and record the highest curling value for each side (sides a, b, c and d). Repeat for specimens 2 and 3.

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 across-manufacturing direction (AMD).

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).

For specimens using block and dial measurement apparatus, determine the length and width as outlined in 5.3.5 and 8.5.3.2.

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 $6\ \text{h}^{+15}_{\ 0}$ 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. Note if the final curling measurement is in a different location from where the initial measurement was taken for any specimens.

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, e.g. 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

Re-measure linear dimensions as described in 8.2.2.

Place the tile specimen on the block and dial gauge (5.3.5). Record the length at the specified location (see Figure 2). For planks specimens, use the calibrated shim or spacer block to allow the measurement of plank width differences with the block and dial gauge apparatus (See Figure 3 and Figure 4).

9 Calculation and expression of results

9.1 For curling

9.1.1 Calculate the curling value(s) 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 0,1 mm.

Initial curling values are measured and reported for information only. If curling is referenced in any specification, it is recommended to only reference the final mean average curling value.

9.1.2 Calculate the initial and final curling values for each sample, in accordance with Formula (1):

$$C_1 = \left(\overline{C_{1a} + C_{1b} + C_{1c} + C_{1d}}\right) \tag{1}$$

where

C_1 is the average of the maximum or highest curling value measurement from each side, for specimen 1 after heat exposure and reconditioning for each specimen;

C_{1a}, C_{1b}, C_{1c}, C_{1d} are the respective curling values measured for each respective side for the specimens 1, 2 and 3 (see 8.2.1).

Repeat the calculation for C_2 and C_3 and then calculate the mean curling value using Formula (2):

$$C_m = \left(\overline{C_1 + C_2 + C_3}\right) \tag{2}$$

where

C_1 is the average of the maximum or highest curling value measurement from each side, for specimen 1 after heat exposure and reconditioning for each specimen;

C_2 is the average of the maximum or highest curling value measurement from each side, for specimen 2 after heat exposure and reconditioning for each specimen;

C_3 is the average of the maximum or highest curling value measurement from each side, for specimen 3 after heat exposure and reconditioning for each specimen;

C_m is the average curling value, for the three specimens tested, measured after conditioning but prior to specimens going through test exposure conditions.

The initial curling value, $C_{m,initial,}$ and final curling value, $C_{m,final,}$ are calculated in same manner as C_m, with the only difference being when the curling measurements are taken. Initial values are taken after conditioning but before exposure to test conditions. $C_{m,final}$ is the average curling value, for the three specimens tested, measured after conditioning back to room temperature, and after specimens have gone through test exposure conditions.

9.1.3 Upward curling is expressed as a positive value and downward curling (sometimes referred to as doming) is expressed as a negative value.

9.1.4 The curling values are recorded and reported in millimetres to the nearest 0,5 mm.

9.2 For dimensional stability

9.2.1 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. See 9.3.

9.2.2 Calculate the dimensional stability for each test specimen (MD and AMD). The initial and final values are expressed separately.

9.2.3 Calculate the mean value for the test specimens.

9.2.4 The initial AMD average measurements are subtracted from final AMD average measurements. A negative value indicates shrinkage and a positive value indicates growth.

9.2.5 The MD and AMD dimensional stability results are calculated, recorded, and reported as individual measurements.

9.2.6 On an applicable characteristic chart or report form, the results can be expressed in per cent (%) or reported directly in mm, depending on how the specification requirements may request data reported.

9.3 For linear dimensions

Formulae (3) to (6) show the calculations for linear dimensions represented as a percentage change both in the machine direction (MD) and across machine direction (AMD):

$$\delta L_S = (D_f - D_i) \tag{3}$$

where

δL_S is the linear change in dimension(s) after complete test;

D_f is the length after complete test when the specimen has reacclimated (in mm);

D_i is the initial length, after conditioning but before heat exposure (in mm).

$$\delta L_{\mathrm{S\%}} = \left[\frac{(D_{\mathrm{f}} - D_{\mathrm{i}})}{D_{\mathrm{i}}}\right] \times 100 \qquad (4)$$

where

$\delta L_{\mathrm{S\%}}$ is the linear change in dimension(s) after complete test (in %).

The average % for the individual specimen tested is calculated by Formula (5):

$$\delta L_{\mathrm{S1,avg,MD\%}} = \left(\overline{\delta L_{\mathrm{S1,1MD\%}} + \delta L_{\mathrm{S1,2MD\%}}}\right) \qquad (5)$$

where

$\delta L_{\mathrm{S1,1MD\%}}$ is the linear change in dimension(s) after complete test, for a particular specimen, in this case specimen 1, location 1 in machine direction (in %);

$\delta L_{\mathrm{S1,2MD\%}}$ is the linear change in dimension(s) after complete test, for a particular specimen, in this case specimen 1, location 2 in machine direction (in %).

Repeat for each specimen to calculate $\delta L_{\mathrm{S1,avg,MD\%}}$, $\delta L_{\mathrm{S2,avg,MD\%}}$ and $\delta L_{\mathrm{S3,avg,MD\%}}$. The final average per cent for all specimens tested is calculated by Formula (6):

$$\delta L_{\mathrm{f,avg,MD\%}} = \left(\overline{\delta L_{\mathrm{S1,avg,MD\%}} + \delta L_{\mathrm{S2,avg,MD\%}} + \delta L_{\mathrm{S3,avg,MD\%}}}\right) \qquad (6)$$

Repeat the same calculations in Formulae (3) to (6) for AMD measurements.

For each of the test directions (MD and AMD), calculate the mean value of the six results for each direction (3 specimens, 2 measurements in each direction). Express it as the change in length in millimetres (mm), to the nearest 0,05 mm (2 mm), or as a percentage to the nearest 0,05 %, as noted above.

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 23999:2021;

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 (mm or %), for each direction;

   2) the mean value for final curling (mm);

   3) the mean value for initial curling (mm), if any;

g) any deviation from the specified procedure which is likely to have affected the results;

h) the hot test results obtained, as changes in dimensions, if measured per Annex A, i.e. the mean value of linear change in dimension (mm or %), for each direction.

Annex A
(informative)

Measurement of size change due to heat

A.1 General

Some companies have found it useful to measure linear dimensional size changes for a specimen immediately following the hot exposure condition. This includes, for example, measuring the size change on a specimen using a block and dial gauge or calliper apparatus when going from room temperature conditions then measuring the specimen while still hot, after being exposed to a particular set of time/temperature conditions. This annex details the method to obtain hot linear dimensional size change of the specimen upon reaching the proper time/temperature conditions.

A.2 Conditioning time

Refer to Clause 7.

A.3 Initial measurement

Refer to 8.2.

A.4 Default time temperature exposure conditions

As specified in 8.3.

A.5 Hot size measurement

a) It is critical that the sample be measured for linear size change within one minute from coming out of the oven. Because specimens are hot, they can be very soft or flimsy; great care shall be taken in taking contact measurements.

b) If measurement is made using a calliper device or a block and dial gauge, the sample will be left on the hot rigid steel plate on which it was during heated oven exposure conditions.

c) As soon as the sample comes out of the oven and is positioned for measurements, place a cover plate (conditioned at the same hot exposure conditions) on the sample.

d) The mass of the heated cover plate plus weight (to insure specimen lay flat on the hot rigid steel plate) should not exceed 0,12 g/mm^2 (e.g. by using a 210 mm × 210 mm cover plate and a 5 kg weight).

e) Take linear measurements (mm) and record them. Refer to 8.5.3.2.

A.6 Hot linear dimensional change

For each of the test directions (MD and AMD), 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, $\delta L_{h,S}$, can be expressed in per cent (%) or reported directly in mm, see Formulae (A.1) to (A.4).