



BSI Standards Publication

High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates)

Part 2: Determination of properties

National foreword

This British Standard is the UK implementation of EN 438-2:2016+A1:2018. It supersedes BS EN 438-2:2016, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

High-pressure decorative laminates (HPL) - Sheets based
on thermosetting resins (usually called laminates) - Part 2:
Determination of properties

Stratifiés décoratifs haute pression (HPL) - Plaques à
base de résines thermodurcissables (communément
appelées stratifiés) - Partie 2: Détermination des
propriétés

Dekorative Hochdruck-Schichtpressstoffplatten (HPL)
- Platten auf Basis härtpbarer Harze (Schichtpressstoffe)
- Teil 2: Bestimmung der Eigenschaften

This amendment A1 modifies the European Standard EN 438-2:2016; it was approved by CEN on 5 October 2018.

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European foreword

This document (EN 438-2:2016+A1:2018) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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

This document includes Amendment 1 approved by CEN on 28 August 2018.

This document supersedes A1 EN 438-2:2016. A1

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

EN 438, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates)*, consists of the following parts:

- *Part 1: Introduction and general information*
- *Part 2: Determination of properties*
- *Part 3: Classification and specifications for laminates less than 2 mm thick intended for bonding to supporting substrates*
- *Part 4: Classification and specifications for Compact laminates of thickness 2 mm and greater*
- *Part 5: Classification and specifications for flooring grade laminates less than 2 mm thick intended for bonding to supporting substrates*
- *Part 6: Classification and specifications for Exterior-grade Compact laminates of thickness 2 mm and greater*
- *Part 7: Compact laminate and HPL composite panels for internal and external wall and ceiling finishes*
- *Part 8: Classification and specifications for design laminates*
- *Part 9: Classification and specifications for alternative core laminates*

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies the methods of test for determination of the properties of high-pressure decorative laminates as defined in Clause 3. These methods are primarily intended for testing the sheets specified in EN 438-3, EN 438-4, EN 438-5, EN 438-6, EN 438-8, and EN 438-9.

The precision of the test methods, specified in this European Standard, is not known because inter-laboratory data are not yet available. When inter-laboratory data will be obtained, precision statements will be added to the test method at the following revision. For those test methods having an end point determination based on subjective judgement, it is not meaningful to make a statement of precision.

2 Normative references

[A1] 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. **[A1]**

EN 204, *Classification of thermoplastic wood adhesives for non-structural applications*

EN 312, *Particleboards — Specifications*

EN 316, *Wood fibre boards — Definition, classification and symbols*

EN 438-1, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 1: Introduction and general information*

EN ISO 62, *Plastics — Determination of water absorption (ISO 62)*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178)*

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85° (ISO 2813)*

EN ISO 3668, *Paints and varnishes — Visual comparison of the colour of paints (ISO 3668)*

EN ISO 4287, *Geometrical product specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters (ISO 4287)*

EN ISO 4288, *Geometrical product specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture (ISO 4288)*

EN ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance (ISO 4892-1)*

EN ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

EN ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3)*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1)*

EN ISO 12945-2, *Textiles — Determination of fabric propensity to surface fuzzing and to pilling — Part 2: Modified Martindale method (ISO 12945-2)*

EN ISO 12947-1, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 1: Martindale abrasion testing apparatus (ISO 12947-1)*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 209:2007, *Aluminium and aluminium alloys — Chemical composition*

ISO 1770, *Solid-stem general purpose thermometers*

ISO 7267-2, *Rubber-covered rollers — Determination of apparent hardness — Part 2: Shore-type durometer method*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

CIE 85:1989, *Solar Spectral Irradiance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 438-1 apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Assessment of appearance

4.1 Principle

Laminates shall be inspected for surface appearance under standardised conditions of lighting and viewing.

4.2 Apparatus

4.2.1 Horizontal inspection table, of height approximately 700 mm and large enough to accommodate the largest sheets to be inspected.

4.2.2 The light source shall provide a diffused illumination of (1200 ± 400) lx over the whole area of the largest sheets to be inspected. This may be either diffused daylight or diffused artificial daylight.

[A1] Deleted text. **[A1]** When artificial daylight is used, it shall have a correlated colour temperature of 5000 K to 6500 K. Both of them shall be in accordance with EN ISO 3668.

A convenient distance of the lights from the inspection table is approximately 1,5 m.

4.3 Test specimen

The specimen shall be the laminate under test, as supplied by the manufacturer.

4.4 Procedure

Place the laminate, decorative face uppermost, on the inspection table. Wipe it free of any loose contamination with a soft cloth, using a suitable cleaning agent if necessary. Inspect it from the distance required by the relevant part of EN 438 for defects such as smudges, smears, fingerprints, scratches,

foreign particles, damage or any other form of blemish evident within the decorative surface. In case of cut to size panels of high-pressure decorative alternative core laminate(s), the inspection shall be performed on the edges too. The evaluation of the total area of spot-type defects in square millimetres and of the total length of hair-like defects in millimetres may be carried out with the help of the Tappi Size Estimation Chart or with an equivalent system¹⁾. In case of dispute the inspection shall be carried out by three observers using the Tappi Chart or an equivalent system.

The inspector shall use normal vision, corrected if necessary. In cases of doubt or dispute, three observers shall be required for the visual assessment. All observers shall have good colour vision. In case of three observers, the reported rating for the test surface shall be the average to the nearest nominal value.

4.5 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) size of the laminate under test;
- d) viewing distance;
- e) total area of spot-type defects in square millimetres;
- f) total length of hair-like defects in millimetres;
- g) any deviation from the specified test method;
- h) date of the test.

5 Determination of thickness

5.1 Principle

The thickness of a laminate is measured using a micrometer or a dial gauge indicator.

5.2 Apparatus

Thickness gauge, (ratchet-type micrometer or dial gauge indicator), having two flat parallel measuring surfaces of diameter 6 mm and capable of being read to 0,01 mm. When the thickness of a decorative laminate is being measured, the two surfaces shall exert a pressure of 10 kPa to 100 kPa upon each other.

5.3 Test specimen

The specimen shall be the laminate under test, as supplied by the manufacturer.

5.4 Procedure

Check the gauge for accuracy and then determine the thickness of the laminate to the nearest 0,01 mm. The thickness shall be measured at the centre of each edge, at a distance of at least 20 mm from the edge of the sheet.

¹⁾ Dirt size estimation chart (transparency) to evaluate the surface defects size. The chart product 0109DIRTT is recommended by both ISO/TC 219 and CEN/TC 134, and is available from TAPPI, Technology Park, P.O. Box 105113, Atlanta, GA 30348-5113, USA, www.tappi.org.

5.5 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) all values measured;
- d) any deviation from the specified test method;
- e) date of the test.

6 Determination of length and width

6.1 Principle

Measuring the length and width of the laminate using a metal tape or rule.

6.2 Apparatus

Steel tape or rule, of sufficient length to measure the greatest dimension of the laminate, and graduated to allow a reading accuracy of 1 mm.

6.3 Test specimen

The specimen shall be the laminate under test, as supplied by the manufacturer.

6.4 Procedure

Apply the steel tape or rule (see 6.2) to each edge of the laminate in turn, on a line approximately 25 mm from and parallel to the edge. Measure the length on each edge to the nearest 1 mm.

6.5 Expression of results

The arithmetical means of the pairs of length and width measurements shall be calculated and expressed to the nearest 1 mm as the length and width of the laminate.

6.6 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) length and width values;
- d) any deviation from the specified test method;
- e) date of the test.

7 Determination of edge straightness

7.1 Principle

Applying a metal straightedge to the edge of the laminate and measuring the deviation of the sheet edge from the metal straightedge using a steel rule.

7.2 Apparatus

7.2.1 Metal straightedge, of 1000 mm length and having a maximum straightness deviation of 0,1 mm over 1000 mm.

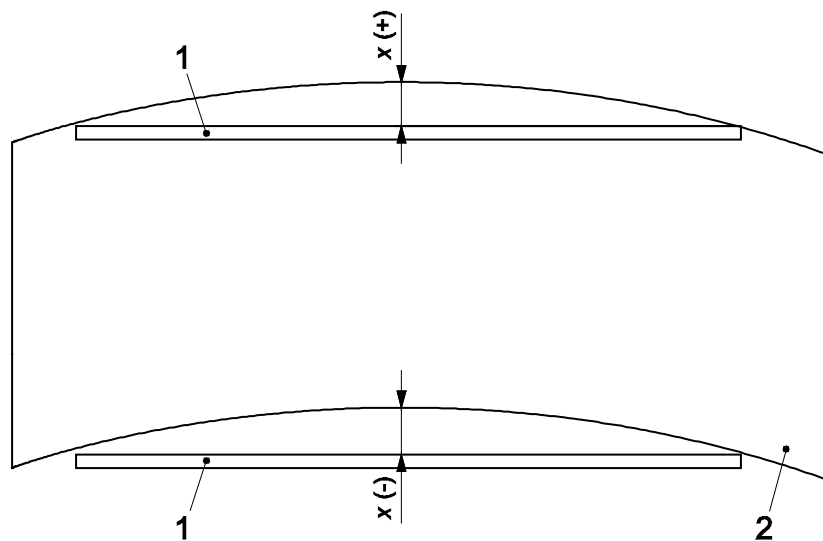
7.2.2 Steel rule, graduated in 0,5 mm divisions.

7.3 Test specimen

The specimen shall be the laminate under test, as supplied by the manufacturer.

7.4 Procedure

Apply the metal straightedge (see 7.2.1) to each edge of the laminate in turn, and use the steel rule (see 7.2.2) to measure the maximum deviation of the edge of the laminate from the metal straightedge (x in Figure 1) to the nearest 0,5 mm



Key

- 1 metal straightedge
- 2 laminate
- x maximum deviation

Figure 1 — Edge straightness measurement

7.5 Expression of results

The maximum deviation from the metal straightedge shall be recorded for each of the four edges. Results shall be designated (+) if the edge is convex, and (-) if the edge is concave.

7.6 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) test result for each of the four edges;
- d) any deviation from the specified test method;
- e) date of the test.

8 Determination of edge squareness

8.1 Principle

Applying a right-angled square to the corner of the laminate and measuring the deviation of the edge from the square using a steel rule.

8.2 Apparatus

8.2.1 Right-angled square, with one arm of at least 1000 mm long and the other arm of at least 300 mm, having a maximum angular deviation of 0,1 mm over 1000 mm (see Figure 2).

8.2.2 Steel rule, graduated in 0,5 mm divisions.

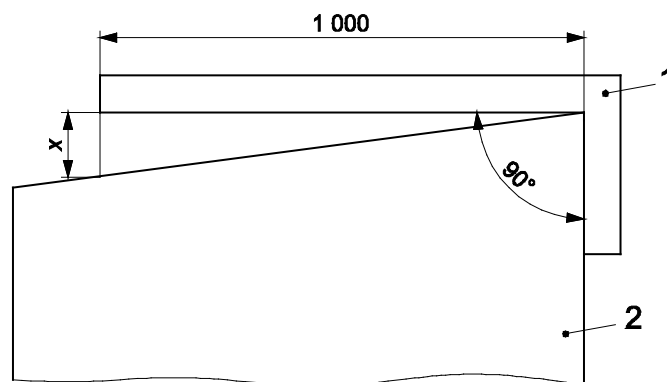
8.3 Test specimen

The specimen shall be the laminate under test as supplied by the manufacturer.

8.4 Procedure

Apply the right-angled square (see 8.2.1) to one corner of the laminate and measure the deviation of the edge of the laminate from the arm of the square at a distance of 1 metre from the corner. Record the results to the nearest 0,5 mm. Repeat the procedure with the square applied to the diagonally opposite corner of the laminate.

Dimension in millimetres



Key

- 1 right-angled square
- 2 laminate

x deviation of the edge

Figure 2 — Edge squareness measurement

8.5 Expression of results

The maximum deviation from the square shall be recorded for the two diagonally opposite corners (x in Figure 2).

8.6 Test report

The test report shall include the following information:

- reference to this European Standard;
- name, type and nominal thickness of the product;
- test result;
- any deviation from the specified test method;
- date of the test.

9 Determination of flatness

9.1 Principle

Measuring the bow (flatness deviation) of the laminate using a bow gauge placed at the position of greatest deformation.

9.2 Apparatus

9.2.1 Bow gauge, of length 1 000 mm graduated to permit a reading accuracy of 0,1 mm (see Figure 3).

Dimension in millimetres

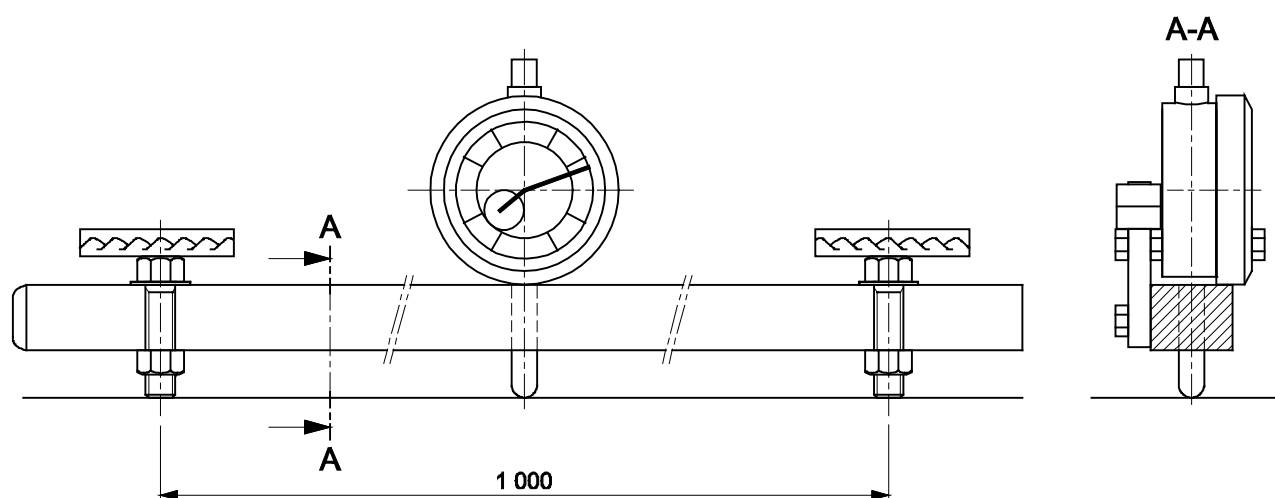


Figure 3 — Bow gauge for measuring flatness

9.3 Test specimens

The specimen shall be the laminate as supplied by the manufacturer. In cases of dispute the laminate shall be pre-conditioned in accordance with the manufacturer's recommendations until equilibrium is reached.

9.4 Procedure

Place the laminate concave side up without restraint on a flat horizontal surface.

Place the bow gauge (see 9.2.1) so that the three feet (two fixed and one movable) are lightly touching the surface of the laminate in the area of greatest deformation, and measure the flatness deviation (shown on the dial gauge) to the nearest 0,1 mm.

9.5 Expression of results

The maximum flatness deviation measured using the bow gauge shall be recorded.

9.6 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) maximum flatness deviation;
- d) any deviation from the specified test method;
- e) date of the test.

10 Resistance to surface wear

10.1 Principle

The test measures the ability of the decorative surface of the laminate under test to resist abrasive wear through to the sub-layer. Abrasion is achieved by rotating a specimen in contact with a pair of loaded cylindrical wheels covered with abrasive paper. The wheels are positioned so that their cylindrical faces are equidistant from the specimen's axis of rotation but not tangential to it. As they are turned by the rotating specimen they abrade an annular track on the specimen's surface. The numbers of revolutions of the specimen required to cause defined degrees of abrasion are used as measures of resistance to surface wear. This test is not applicable to flooring grade laminates.

10.2 Materials

10.2.1 Calibration plates of rolled zinc sheet, (Taber S-34 or equivalent), having a thickness of $(0,8 \pm 0,1)$ mm and a Brinell hardness of (48 ± 2) when tested in accordance with EN ISO 6506-1, except that the ball diameter shall be 5 mm and the load 360 N.

The zinc plate shall not be used for more than 10 calibrations per side.

10.2.2 Abrasive paper strips, (Taber S-42 or equivalent), of width 12,7 mm and length about 160 mm, having the following composition:

- a) paper of grammage 70 g/m² to 100 g/m²;
- b) open coated 180 grit powdered aluminium oxide (Al₂O₃) having a particle size such that it will pass through a sieve of aperture 100 µm and remain on a sieve having an aperture of 63 µm;

- c) adhesive backing (optional).

10.2.3 Double-sided adhesive tape, required only if the abrasive paper has no adhesive backing.

10.2.4 Dirt size estimation chart (transparency), evaluate the wear through size. The chart, product code 0109DIRTT, is recommended by both ISO/TC 219 and CEN/TC 134 and is available from TAPPI, Technology Park, P.O. Box 105113, Atlanta, GA 30348-5113, USA, www.tappi.org.

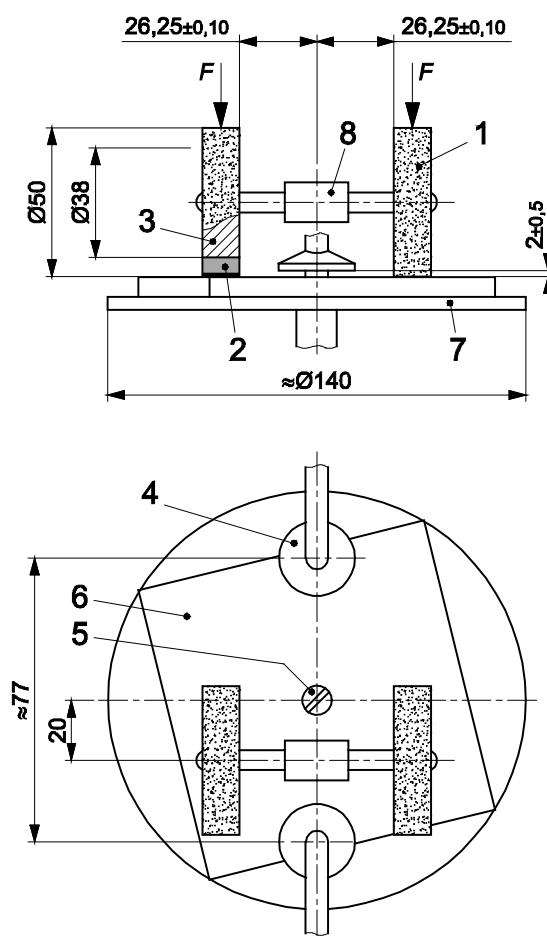
10.3 Apparatus

10.3.1 Abrasion resistance testing machine

The test machine ²⁾ consists of the following items, see Figure 4:

- a) test specimen holder in the form of a disc (key 7) which rotates in a horizontal plane at a frequency of 58 rpm to 62 rpm and to which the test specimen (key 6) can be clamped with a clamping screw (key 5);
- b) abrasive wheels (3), two cylindrical rubber-covered wheels of width $(12,7 \pm 0,1)$ mm and diameter 50 mm which rotate freely about a common axis. The curved surface of the wheels, to a depth of 6 mm, shall be of rubber (2) of hardness (65 ± 3) IRHD when tested according to ISO 48 or (65 ± 3) Shore A when tested according to ISO 7267-2 (see Annex C). The inside faces of the wheels shall be $(52,5 \pm 0,2)$ mm apart and equally spaced $(26,25 \pm 0,10)$ mm from the centre-line of the abrader head and their common axis of the wheels shall be 20 mm from the vertical axis of the test specimen holder; It is important to ensure that the abrasive wheels are in good condition, as variations in flatness, hardness, regularity, roundness and width can significantly affect the test result;
- c) holding and lifting device (key 8), for the abrasive wheels, so constructed that each wheel exerts a force of $(5,4 \pm 0,2)$ N on the test specimen;
- d) revolution-counter;
- e) suction device, so fitted that two nozzles (4) are over the abraded area of the test specimen. One nozzle shall be situated between the wheels, the other diametrically opposite. The centres of the nozzles shall be 77 mm apart and $(2 \pm 0,5)$ mm from the surface of the test specimen. When the nozzles are closed there shall be a vacuum of 1,5 kPa to 1,6 kPa.

²⁾ A suitable machine is available from Taber Acquisition Corp., Taber Industries, 455 Bryant St, P.O. Box 164, North Tonawanda, NY 14120, USA. This test machine is an example of a suitable machine available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the machine.

**Key**

- 1 abrasive paper
- 2 rubber
- 3 abrasive wheel
- 4 suction nozzle
- 5 clamping screw
- 6 specimen
- 7 specimen holder disc
- 8 holding and lifting device

Figure 4 — Abrasion resistance testing machine

The dimensions listed above and in Figure 4 are followed as deviations can lead to errors exceeding 100 %. See Annex B for more information.

10.3.2 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of $(23 \pm 2) ^\circ\text{C}$, relative humidity $(50 \pm 5) \%$.

10.4 Test specimens

Each specimen shall be a piece of the laminate under test, shaped to fit the type of clamping device used. It will usually be a disc of diameter about 130 mm, or a square of about 100 mm with its corners rounded to give a diagonal of about 130 mm, and it will usually have a hole of diameter 6 mm in its centre. Three specimens shall be prepared. One specimen is suitable in case of factory production controls, meanwhile all the three specimens shall be tested in case for assessment of conformity or dispute.

10.5 Preparation of specimens and abrasive paper

Clean the surface of the specimens with a non-hazardous organic solvent which is immiscible with water. Using a suitable marker pen, mark the surface of each specimen with two lines mutually at right angles so that the surface area is divided into quadrants.

Precondition the specimens and the abrasive strips for at least 72 h in the conditioning atmosphere (see 10.3.2) before testing. After preconditioning seal the paper strips in suitable polythene bags (maximum 10 strips per bag) until required for immediate use.

10.6 Procedure

10.6.1 Preparation of abrasive wheels

Bond a strip of preconditioned unused abrasive paper (see 10.2.1) to each of the rubber covered wheels, using either the adhesive backing, if present, or the double-sided adhesive tape (see 10.2.2). Ensure that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper.

10.6.2 Calibration of abrasive paper

Prepare two abrasive wheels with preconditioned unused strips of abrasive paper from the batch to be used for testing (see 10.6.1).

Clamp a zinc plate (see 10.2) in the specimen holder, start the suction device, set the revolution-counter to zero, lower the wheels and abrade the zinc plate for 500 revolutions. Wipe the zinc plate clean and weigh to the nearest 1 mg. Replace the abrasive paper on the wheels with preconditioned unused strips from the same batch, clamp the same zinc plate in the specimen holder, lower the abrasive wheels and operate the suction device. Abrade the zinc plate for an additional 500 revolutions, then wipe it clean and reweigh it to the nearest 1 mg. Its loss in mass shall be (120 ± 20) mg.

Any batch of abrasive paper which causes a loss in mass of the zinc plate outside this permitted range shall not be used for testing.

10.6.3 Abrasion of specimen

Perform the test immediately after removal of the specimen and calibrated abrasive paper from the preconditioning atmosphere.

Prepare two wheels with preconditioned unused abrasive paper from the same batch previously approved by calibration. Fit the wheels to the machine and set the revolution counter to zero.

Clamp the specimen in the holder, ensuring that the surface of the specimen is flat. Lower the abrasive wheels on to the specimen, start the suction device and begin abrading the specimen.

Replace the abrasive paper after 500 revolutions.

At the beginning of the test, examine the specimen for wear after each 25 revolutions. When coming close to the IP, the assessment shall be carried out every 10 revolutions.

Continue the test until the initial wear point (IP) is reached.

The initial wear point (IP) is that point at which the first clearly recognisable wear-through of the print, pattern or plain colour appears and the sub-layer becomes visible in three quadrants. The initial wear

point is reached when there are areas of at least 0,60 mm² wear-through in two quadrants and an area of 0,60 mm² wear-through becomes visible in a third quadrant, using the size estimation chart (see 10.2.4) or the Figure 5 estimation picture. The sub-layer for printed patterns is the background on which the pattern is printed; for plain colours and wood veneer surfaces it is the first sub-layer of different colour.



1

2

3

Key

- 1 IP not yet reached
- 2 IP reached
- 3 exceeded IP

Figure 5 — IP estimation picture

Record the IP as the number of revolutions.

Repeat the test immediately using the two remaining test specimens, in case of assessment of conformity or dispute.

In cases of doubt or dispute, three observers shall be required for the visual assessment. All observers shall have good colour vision. In case of three observers, the reported rating for the test surface shall be the average to the nearest nominal value.

10.7 Expression of results

The resistance to surface wear of the laminate under test shall be the IP rounded to the nearest 50 revolutions or, in case of complaints, the average of the three specimen IP, rounded to the nearest 50 revolutions.

10.8 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) resistance to surface wear for the sample under test, in revolutions;
- d) any deviation from the specified test method;
- e) date of the test.

11 Resistance to abrasion (flooring grade laminates)

A1 The resistance to abrasion for flooring grade laminates shall be determined according to Clause 10 with the following changes:

- in 10.6.3, replace the fourth and fifth paragraphs by:

Replace the abrasive paper after 200 revolutions.

At the beginning of the test, examine the specimen for abrasion after each 100 revolutions. When coming close to the IP, the assessment shall be carried out every 50 revolutions.

- replace 10.7 by:

The resistance to abrasion of the laminate under test shall be the average of the initial wear-point (IP) values obtained on the three specimens, rounded to the nearest 100 revolutions. **A1**

12 Resistance to immersion in boiling water

12.1 Principle

The effect of immersion in boiling water for 2 h is determined by the increase in mass and thickness of test specimens and by noting any change in appearance.

The test is generally in accordance with EN ISO 62, except for a longer period of immersion in the boiling water and the requirement for thickness measurements.

12.2 Apparatus

12.2.1 Balance, accurate to 1 mg.

12.2.2 Conditioning chamber, with a standard atmosphere of $(23 \pm 2) ^\circ\text{C}$ and relative humidity $(50 \pm 5) \%$.

12.2.3 Vessel, containing boiling distilled water.

12.2.4 Vessel, containing distilled water at $(23 \pm 2) ^\circ\text{C}$.

12.2.5 Micrometer thickness gauge, as described in 5.2. If curvature of the specimen prevents accurate thickness measurement, then a suitable ball-ended micrometer thickness gauge shall be used.

12.2.6 Suitable heating apparatus, (for example an electric hotplate).

12.2.7 Specimen holder, to hold specimens vertically during immersion and prevent contact with other specimens or the vessel.

12.3 Test specimens

Four specimens shall be taken from the same laminate, cut from positions greater than 50 mm from the edge of the sheet. Three specimens shall be used for testing and one as reference. Each specimen shall be (50 ± 1) mm square, and of the thickness of the laminate under test; and cut in such a way that no appreciable heat is generated and the edges are free from cracks. Cut edges shall be smooth.

12.4 Procedure

In case of assessment of conformity or dispute place the three specimens for at least 72 h in the conditioning chamber (see 12.2.2). In case of factory production control the conditioning is not necessary.

Weigh each specimen to the nearest 1 mg (mass m_1).

Measure the thickness of each specimen as specified in Clause 5, but at the middle of each of the four cut edges (t_1, t_2, t_3, t_4) and with the external edge of the micrometer anvil positioned approximately 5 mm from each edge. Mark the measuring points so that subsequent measurements can be made in the same places.

Place the specimens in the vessel of boiling distilled water (see 12.2.3). Take care to prevent the specimens from making contact over any substantial area with one another or with the vessel.

After (120 ± 5) min, remove the specimens from the boiling water and allow to cool for (15 ± 5) min in the vessel of distilled water maintained at (23 ± 2) °C (see 12.2.4). Take them from the water and remove all surface water with a clean dry cloth or with filter paper. Weigh the specimens again to the nearest 1 mg (mass m_2) within 1 min of taking them from the water.

Determine the thickness of each specimen to the nearest 0,01 mm at the same points as before (t_5, t_6, t_7, t_8).

Examine each specimen visually for change in appearance comparing with the reference sample.

12.5 Expression of results

12.5.1 Calculation

The boiling water absorbed by each specimen is given, as a percentage by mass, by the formula

$$\frac{m_2 - m_1}{m_1} \times 100$$

where

m_1 is the mass of the specimen before immersion;

m_2 is the mass of the specimen after immersion.

The percentage increase in thickness at the measuring points of each specimen is given by the formulae:

$$\frac{t_5 - t_1}{t_1} \times 100$$

$$\frac{t_6 - t_2}{t_2} \times 100$$

$$\frac{t_7 - t_3}{t_3} \times 100$$

$$\frac{t_8 - t_4}{t_4} \times 100$$

where

t_1, t_2, t_3 and t_4 are the thicknesses measured before immersion;

t_5, t_6, t_7 and t_8 are the thicknesses measured after immersion.

The percentage by mass of boiling water absorbed by the laminate under test shall be the average of the values obtained on the three specimens.

The percentage increase in thickness of the laminate under test shall be the average of the twelve values obtained at the four measuring points on all three specimens.

The result of the examination for change in appearance shall be the lowest rating of the three specimens assessed in comparison with the reference sample, in accordance with the following two rating scales.

In cases of doubt or dispute, three observers shall be required for the visual assessment. All observers shall have good colour vision. In case of three observers, the reported rating for the test surface shall be the average to the nearest nominal value.

12.5.2 Surface rating scale

Rating 5: No visible change.

Rating 4: Slight change of gloss and/or colour, only visible at certain viewing angles.

Rating 3: Moderate change of gloss and/or colour.

Rating 2: Marked change of gloss and/or colour or surface blistering.

Rating 1: Surface layers delamination.

12.5.3 Edge rating scale

Rating 5: No visible change.

Rating 4: Slight hairline edge cracks visible to the naked eyes.

Rating 3: Moderate edge cracks.

Rating 2: Severe edge cracks.

Rating 1: Core layers delamination.

NOTE The fail value indicated in EN 438-8:2009, Table 9 and Table 10 corresponds to rating 1.

12.6 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) conditioning time;
- d) average percentage increase in mass;
- e) average percentage increase in thickness;
- f) result of the examination for change in appearance for surface and edge;
- g) any deviation from the specified test method;
- h) date of the test.

13 Substrate protection against water vapour

13.1 Principle

Measuring the increase in thickness of the specimen resulting from exposure of the surface, which has been cut (vandalism for example), to water vapour for a prescribed duration.

13.2 Apparatus

13.2.1 Milling tool, capable of producing a circular groove having an inside diameter of $(35,7 \pm 0,1)$ mm and an outside diameter of $(42,0 \pm 0,1)$ mm.

13.2.2 Thickness gauge, as specified in 5.2.

13.2.3 Wide-necked Erlenmeyer flask, of capacity 250 ml and mouth diameter 50 mm.

13.2.4 Electric hot-plate, or other suitable heat source.

13.3 Test specimens

Each specimen shall be a square of side approximately 100 mm, cut from the laminate under test. Two specimens shall be tested.

13.4 Procedure

Using the milling tool (see 13.2.1) cut a circular groove in the centre of the specimen as shown in Figure 6, to a depth which is just sufficient to expose the first sub-layer (i.e. the layer immediately beneath the decorative surface).

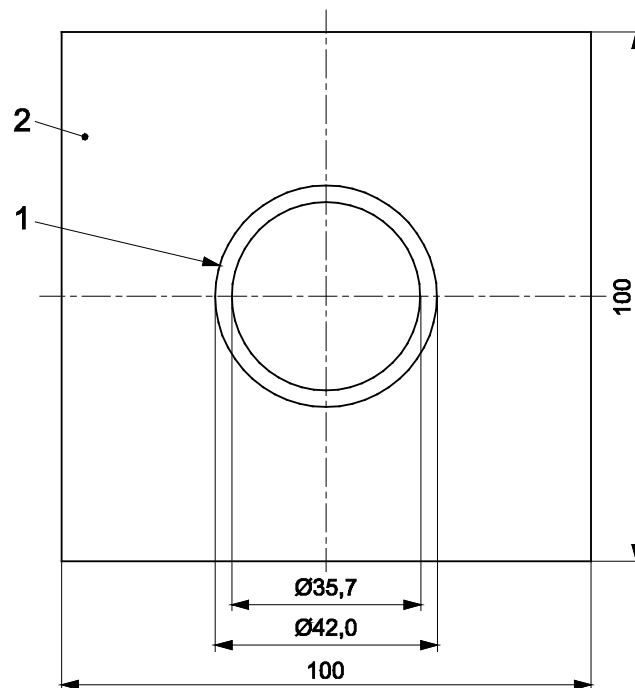
Using the thickness gauge (see 13.2.2) measure the thickness in a position adjacent to the inner edge of the groove to the nearest 0,1 mm and record it as value t_1 .

Place approximately 200 ml of water in the flask (see 13.2.3) and bring it to the boil on the hot-plate (see 13.2.4). Place the specimen, with the cut decorative surface face down, centrally over the mouth of the flask.

After 1 h, remove the specimen and remove excess water from the surfaces and edges using absorbent paper.

Re-measure the thickness in the same position as measurement t_1 , and record it as value t_2 . Repeat the procedure using the second specimen.

Dimensions in millimetres

**Key**

- 1 circular groove
- 2 test specimen

Figure 6 — Specimen for substrate protection test**13.5 Expression of results**

The substrate protection against water vapour shall be expressed as the difference between the final thickness and the corresponding initial thickness ($t_2 - t_1$).

13.6 Test report

The test report shall include the following information:

- a) reference to this European Standard;
- b) name, type and nominal thickness of the product;
- c) higher of the two test values;
- d) any deviations from the specified test method;
- e) date of the test.

14 Resistance to water vapour**14.1 Principle**

A specimen from the laminate under test is held in place over the neck of a flask containing boiling water, so that the decorative surface of the specimen is exposed to the water vapour. After 1 h, the specimen is

removed and allowed to recover for 24 h in normal ambient conditions before examination for any change in appearance.

14.2 Apparatus

14.2.1 Wide-necked Erlenmeyer flask, of capacity 250 ml and mouth diameter 50 mm (or equivalent apparatus).

14.2.2 Specimen holder, and heat screen, (see Figure 7).

14.2.3 Filter paper, or tissue.

14.2.4 Electric hotplate, or other suitable heat source.

14.3 Test specimen

The specimen shall be a square of side approximately 100 mm, cut from the laminate under test. One specimen shall be tested.

14.4 Procedure

Place approximately 200 ml of water in the flask (see 14.2.1) and bring it to the boil on the electric hotplate (see 14.2.4). Place the heat screen (see 14.2.2) in position around the neck of the flask. Place the specimen, decorative face down, centrally over the mouth of the flask and fix it in position with the wire specimen holder (see 14.2.2 and Figure 7).

The specimen holder shall be heavy enough to prevent the specimen from curling away from the mouth of the flask.

After the decorative face has been exposed for 1 h to the vapour from the boiling water, remove the specimen and use the filter paper or tissue (see 14.2.3) to remove excess water from the surface of the specimen.

Allow the specimen to recover for 24 h in normal ambient conditions and then examine the central area of the specimen with the naked eye, corrected if necessary, for any change in appearance. The circular area where the specimen is in direct contact with the flask neck shall be excluded from the judgement.

In cases of doubt or dispute, three observers shall be required for the visual assessment. All observers shall have good colour vision. In case of three observers, the reported rating for the test surface shall be the average to the nearest nominal value.

14.5 Expression of results

The result of the examination for change in appearance shall be expressed in accordance with the following rating scale:

Rating 5: No visible change.

Rating 4: Slight change of gloss and/or colour, only visible at certain viewing angles.

Rating 3: Moderate change of gloss and/or colour.

Rating 2: Marked change of gloss and/or colour.

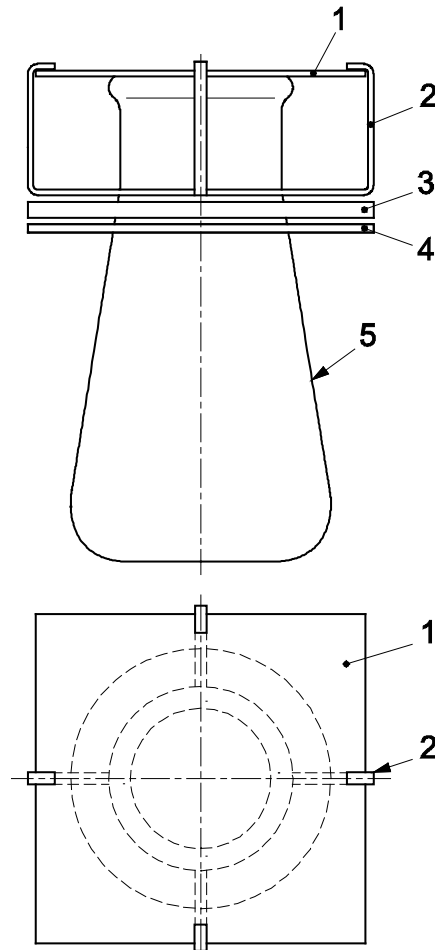
Rating 1: Blistering and/or delamination.

14.6 Test report

The test report shall include the following information:

a) reference to this European Standard;

- b) name, type and nominal thickness of the product;
- c) effect on the surface of the specimen, expressed in accordance with the rating scale;
- d) any deviation from the specified test method;
- e) date of the test.



Key

- 1 test specimen
- 2 wire specimen holder.
- 3 heat-resistant screen.
- 4 aluminium ring.
- 5 erlenmeyer flask, wide necked 250 ml

Figure 7 — Apparatus for resistance to water vapour