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NORMA EUROPEA

Laminati decorativi ad alta pressione (HPL) - Fogli a base di resine termoindurenti (generalmente chiamati laminati) - Parte 2: Determinazione delle proprietà

UNI EN 438-2

APRILE 2016

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

La norma specifica i metodi di prova per la determinazione delle proprietà dei laminati decorativi ad alta pressione come definito nella clausola 3. Questi metodi sono destinati principalmente per prove sui fogli specificati nella norme EN 438-3, EN 438-4, EN 438-5, EN 438-6, EN 438-8 e EN 438-9.
La precisione dei metodi di prova, specificati nella presente norma europea, non è nota perchè i dati inter-laboratorio non sono ancora disponibili. Quando saranno ottenuti i dati tra diversi laboratori, le dichiarazioni di precisione saranno aggiunte al metodo di prova nelle revisioni seguenti. Non è significativo fare una dichiarazione di precisione per quei metodi di prova che hanno una determinazione finale sulla base di un giudizio soggettivo.

TESTO INGLESE

La presente norma è la versione ufficiale in lingua inglese della norma europea EN 438-2 (edizione febbraio 2016)

La presente norma sostituisce la UNI EN 438-2:2005

ICS 83.140.20

ENTE ITALIANO DI NORMAZIONE

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La presente norma costituisce il recepimento, in lingua inglese, della norma europea EN 438-2 (edizione febbraio 2016), che assume così lo status di norma nazionale italiana.

La presente norma è stata elaborata sotto la competenza dell'ente federato all'UNI

UNIPLAST - Ente Italiano di Unificazione nelle Materie Plastiche

La presente norma è stata ratificata dal Presidente dell'UNI ed è entrata a far parte del corpo normativo nazionale il 14 aprile 2016.

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 438-2

February 2016

ICS 83.140.20

Supersedes EN 438-2:2005

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 härtbarer Harze (Schichtpressstoffe) - Teil 2: Bestimmung der Eigenschaften

This European Standard was approved by CEN on 13 December 2015.

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European foreword

This document (EN 438-2:2016) 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 August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

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

This document supersedes EN 438-2:2005.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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1 Scope

This European Standard 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

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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)*

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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.

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.

The daylight shall be unaffected by surrounding trees, etc. 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

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Chart or with an equivalent system[1]. 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.

5.5 Test report

The test report shall include the following information:

a) reference to this European Standard;

[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.

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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.

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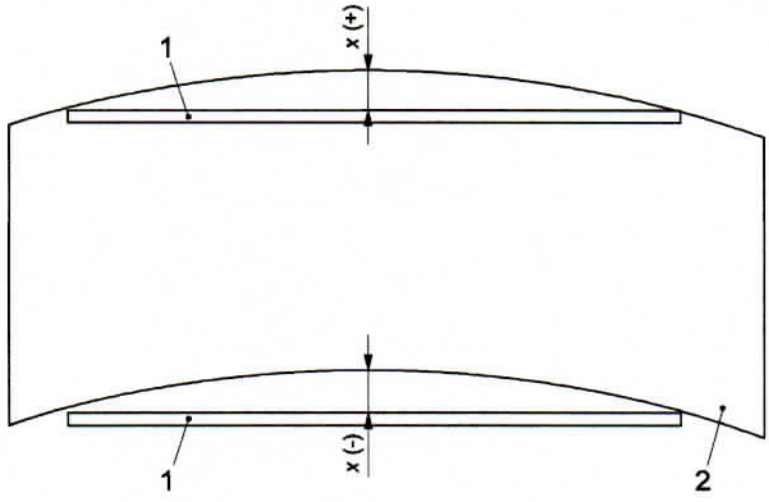
7.2.2 Steel rule, graduated in 0,5 mm divisions.

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.

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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.

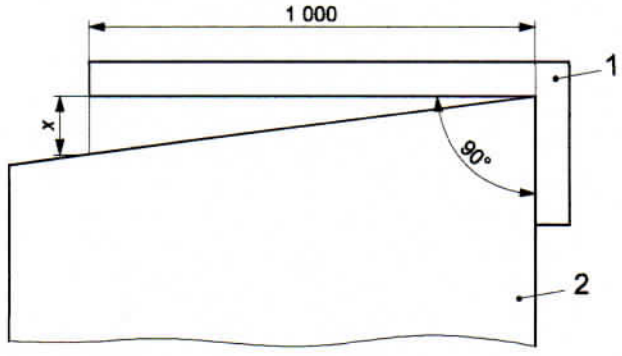
8.3 Test specimen

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:

a) reference to this European Standard;

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b) name, type and nominal thickness of the product;

c) test result;

d) any deviation from the specified test method;

e) 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

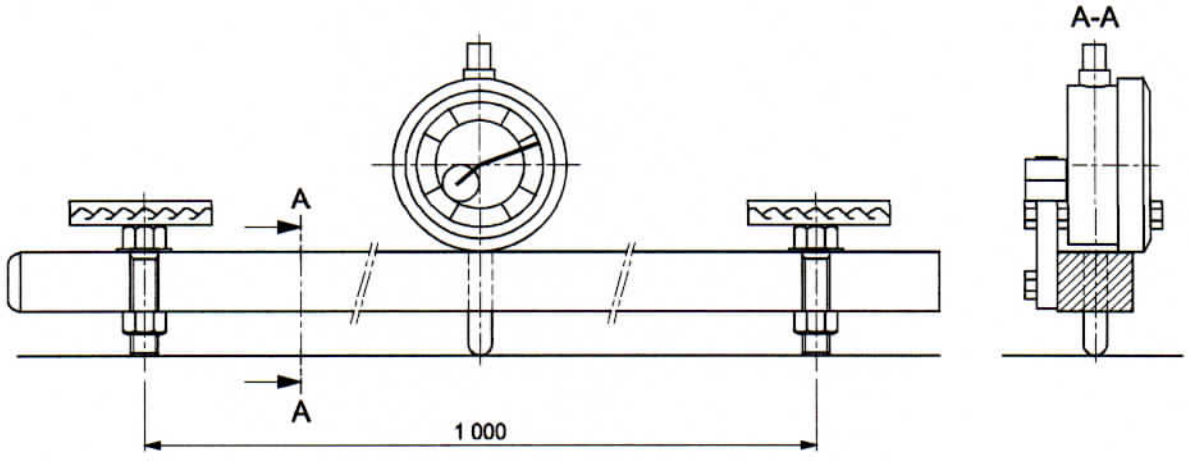

Figure 3 — Bow gauge for measuring flatness

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.

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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 ± 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 (Al_2O_3) 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.

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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 ± 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 ± 0,2) mm apart and equally spaced (26,25 ± 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 ± 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 ± 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.

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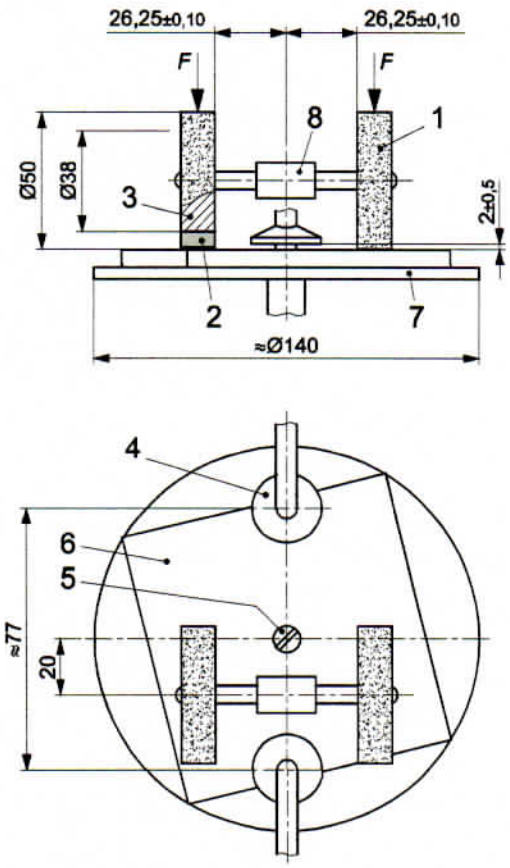
Dimension in millimetres



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 ± 2) °C, relative humidity (50 ± 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

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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 mm^2 wear-through in two quadrants and an area of 0,60 mm^2 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.

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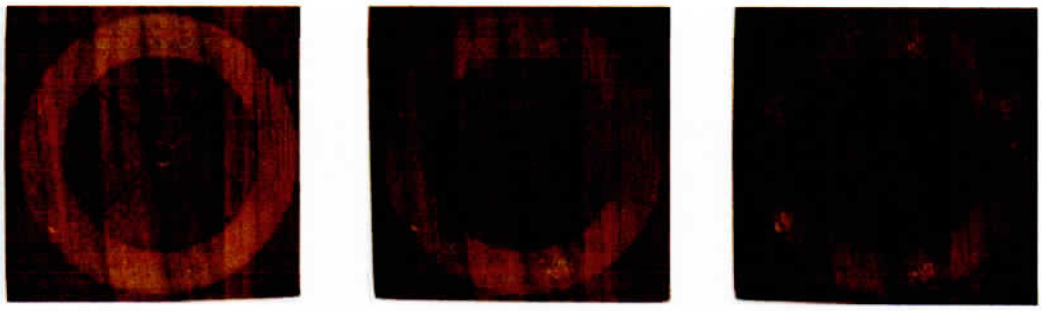

1 2 3

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)

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.

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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 ± 2) °C and relative humidity (50 ± 5) %.

12.2.3 Vessel, containing boiling distilled water.

12.2.4 Vessel, containing distilled water at (23 ± 2) °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.

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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.

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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 ± 0,1) mm and an outside diameter of (42,0 ± 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.

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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).

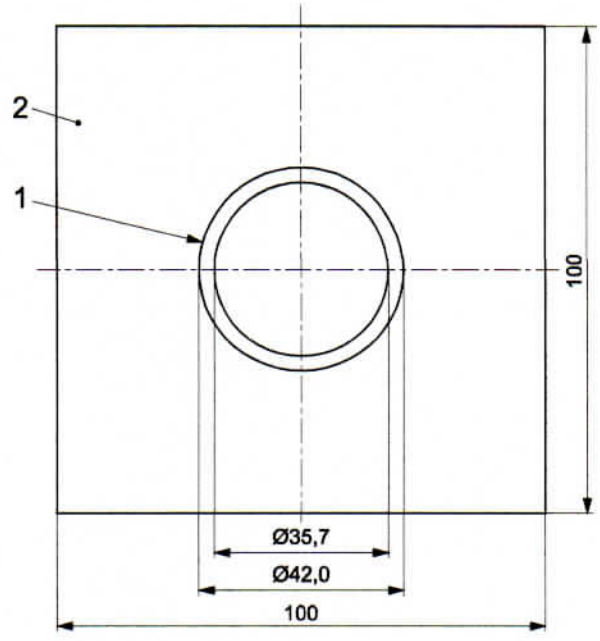
Using the thickness gauge (see 13.2.2) measure the thickness in a position adjacent to the inner edge of the groove to the nearest 0,1 mm and record it as value t_1.

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:

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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 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.

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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.

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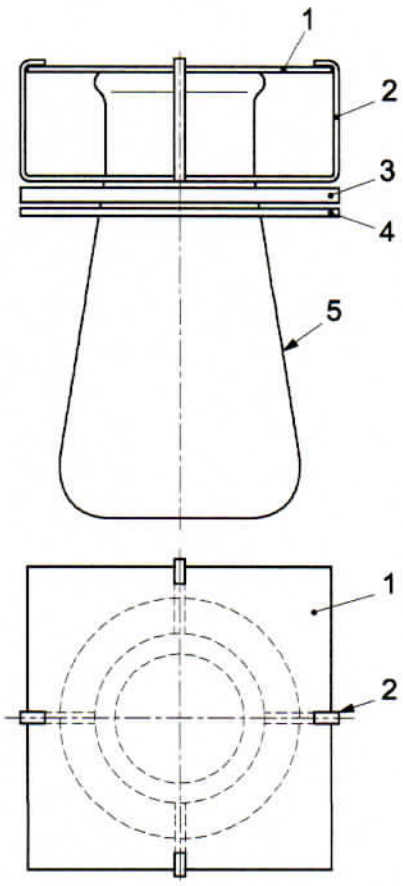

Key

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

15 Resistance to wet conditions (Exterior grade laminates)

15.1 Principle

The effect of immersion in water at 65 °C for 48 h is determined by the increase in mass of the test specimens and by noting any change in appearance. This is an accelerated test to determine the longterm influence of exposure to moisture.

15.2 Apparatus

15.2.1 Water bath, capable of being maintained at (65 ± 2) °C.

15.2.2 Specimen holder, to prevent specimens from touching one another during immersion.

15.2.3 Vessel, containing distilled water at (23 ± 2) °C.

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15.2.4 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

15.2.5 Balance, accurate to 1 mg.

15.3 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. The specimens shall be (150 ± 1) mm square and be of the thickness of the laminate under test. The cut edges shall be smooth and free from cracks.

One specimen is suitable in case of factory production controls, meanwhile three specimens shall be tested in case for assessment of conformity or dispute.

15.4 Procedure

In case of assessment of conformity or dispute place the three specimens for at least 72 h in the conditioning chamber (see 15.2.4). In case of factory production control the conditioning is not necessary.

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

Place the specimens in the specimen holder (see 15.2.2) and place the specimen holder in the water bath (see 15.2.1) so that all specimens are totally immersed in water at (65 ± 2) °C.

After 48 h, remove the specimens from the water bath and immerse for (15 ± 5) min in the vessel (see 15.2.3) containing distilled water at (23 ± 2) °C.

Remove the specimens from the water and use a clean dry cloth or filter paper to remove all surface water.

Weigh the specimens again to the nearest 1 mg (mass m_2) within 1 min of taking them from the water.

Immediately examine each specimen visually with the naked eye, corrected if necessary, for any change in appearance, blistering or delamination.

15.5 Expression of results

15.5.1 Calculation

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

15.5.2 Visual examination

15.5.2.1 General

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

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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.

15.5.2.2 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.

15.5.2.3 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.

15.6 Test report

The test report shall contain 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) result of the examination for change in appearance for surface and edge;

f) any deviation from the specified test method;

g) date of the test.

16 Resistance to dry heat

16.1 Principle

The test is intended to determine the suitability of decorative laminates for use in kitchens where contact with moderately hot cooking utensils is to be expected.

A standard aluminium alloy block at a specified test temperature of 160 °C is placed in contact with a specimen taken from the laminate under test, bonded to wood chipboard. After 20 min of contact the block is removed. Resistance to the test conditions is assessed by visual examination.

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16.2 Apparatus and materials

16.2.1 Thermometer, as specified in ISO 1770 capable of insertion to the bottom of the centre bore of the heat source (16.2.2) or other means of measuring the temperature of the heat source to an accuracy of ± 1 °C.

16.2.2 Heat source consisting of a block as shown in Figure 8 manufactured from aluminium alloy according to ISO 209:2007, Al Mg Si (alloy shall contain more than 94 % aluminium). The roughness of bottom surface shall be (2 ± 1) µm, expressed as *Ra*, according to EN ISO 4287 and EN ISO 4288.

NOTE Alloy 6060 and 64430 are suitable.

For this document, the following tolerances are applicable:

— dimensions: ± 0,2 mm of the nominal dimension;

— angles: ± 2° of the nominal angle.

Dimensions in millimetres

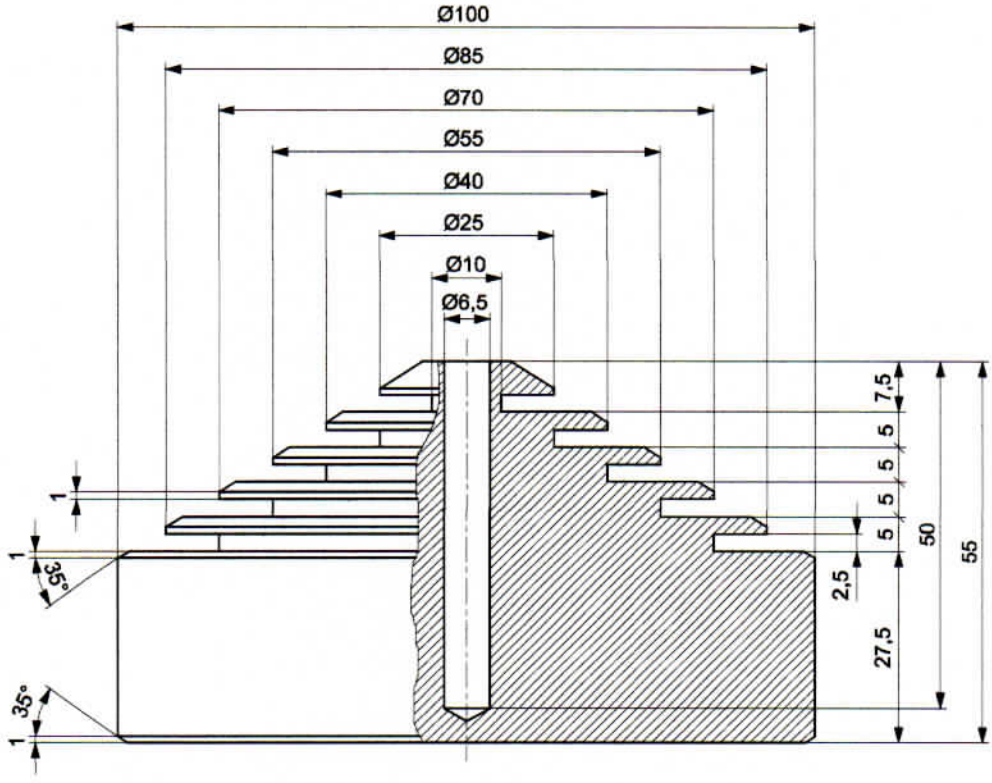

Figure 8 — Aluminium block used as heat source

16.2.3 Fine-faced wood particleboard, complying with EN 312 (for interior fitments), (230 ± 5) mm square, with a nominal thickness of 18 mm to 20 mm (± 0,3 mm), a density of (680 ± 20) kg/m³, and moisture content (10 ± 3) %.

16.2.4 Urea-formaldehyde adhesive, or an equivalent rigid adhesive (e.g. PU, phenol-resorcinol, PF, PVAc, MF)

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16.2.5 Oven, capable of heating the aluminium block to a temperature higher than the test temperature.

16.2.6 Cleaning cloth, consisting of a white soft absorbent cloth.

16.2.7 Heat-insulating foam, consisting of a melamine foam, with the following characteristics: density between 8,5 kg/m³ and 11,5 kg/m³; heat conductivity, less than 0,035 W/mK. The foam shall withstand at a temperature higher than 200 °C.

16.2.8 Diffuse light source, providing evenly diffused light, giving an illumination on the test surface of (1200 ± 400) lx. This may either be diffused daylight or be diffused artificial daylight.

The daylight should be unaffected by surrounding trees, etc. When artificial daylight is used it is recommended that it should have a correlated colour temperature of 5000 K to 6500 K and a *Ra* greater than 92, by using a colour matching booth in accordance with EN ISO 3668.

16.2.9 Fixed frame, to hold the specimen flat.

16.3 Test specimen

The specimen shall be prepared by uniformly bonding a piece of the laminate under test to the wood chipboard (see 16.2.3), using the specified adhesive (see 16.2.4) evenly spread at 80 g/m² to 120 g/m². One specimen (230 ± 5) mm square shall be used. The bonded specimen shall be preconditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test.

For materials of thickness greater than 2 mm, the effect of bonding the specimen is insignificant and the test may be conducted with the specimen resting in close contact with the chipboard. This technique is also acceptable for routine quality control testing of laminates less than 2 mm thick. However, in cases of dispute, laminates less than 2 mm thick shall be bonded to chipboard.

16.4 Test procedure

The test surface shall be placed horizontally. In case of laminates thick 2 mm or greater, without need of gluing on chipboard, hold the specimen in the fixed frame (16.2.9).

It shall accommodate the required number of tests, with at least 15 mm spacing between the perimeter of adjacent test surfaces, and between the perimeters of the test surfaces and the edges of the panel. Where tests are carried out simultaneously, the perimeters of the test surfaces shall be separated by a minimum of 50 mm.

The test surface shall be lightly wiped with a cleaning cloth (16.2.6) before the test.

Using the oven (16.2.5), raise the temperature of the heat source to a temperature higher than the specified test temperature, and transfer it to the heat insulating foam (16.2.7) or on a sufficient large board of wood particleboard (16.2.3).

Place the thermometer (16.2.1) or other means of measuring temperature in the centre bore of the heat source (16.2.2). If the temperature is not higher than the specified test temperature, the heat source shall be placed again in the oven until achieving this higher temperature.

When the heat source reaches the temperature of 160 °C with an accuracy of ± 1 °C, immediately place it on the test surface.

After 20 min in this position, remove the block.

Allow the test surface to stand undisturbed 1 h ± 10 min.

Clean the test surface with the cleaning cloth (16.2.6) and examine the tested area.

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16.5 Examination of the test specimen

Carefully examine the test surface, with light coming from all directions, for damage, e.g. discoloration, change in gloss and colour, blistering, swelling and other defects. For this purpose illuminate the surface separately using the light source (16.2.8) and examine from different angles, including angle combinations such that the light is reflected from the test surface and towards the observer's eye. Viewing distance shall be 0,25 m to 1,0 m.

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.

16.6 Expression of results

The result of the examination for surface disturbance shall be expressed in accordance with the rating scale reported in Table 1, taking into account that the slight surface lowness, due to the hot aluminium block weight, shall not be taken in account in the evaluation.

Table 1 — Resistance to dry heat rating scale

Rating scale	Description
5	No change test area indistinguishable from adjacent surrounding area
4	Minor change test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer's eye, e. g. discoloration, change in gloss and colour
3	Moderate change test area distinguishable from adjacent surrounding area, visible in several viewing directions, e. g. discoloration, change in gloss and colour, no change in the surface structure, e.g. deformation, cracking, blistering
2	Significant change test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e. g. discoloration, change in gloss and colour, and / or structure of the surface slightly changed, e.g. slight cracking, slight blistering
1	Strong change the structure of the surface being distinctly changed e.g. strong cracking, strong blistering and / or discoloration, change in gloss and colour, and / or the surface material being totally or partially delaminated

16.7 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.

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17 Dimensional stability at elevated temperature

17.1 Principle

The test measures the lateral dimensional changes of specimens from the laminate under test over an extreme range of relative humidity at elevated temperatures.

17.2 Apparatus

17.2.1 Oven, capable of being maintained at (70 ± 2) °C.

17.2.2 Conditioning chamber, with an atmosphere of relative humidity within the range 90 % to 95 % and at a temperature of (40 ± 2) °C.

17.2.3 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

17.2.4 Bed plate and mounted dial gauge, or other apparatus capable of measuring lengths, of 200 mm to the nearest 0,02 mm.

17.2.5 Desiccator, of suitable size.

17.3 Test specimens

Each specimen shall be (200 ± 0,8) mm long, (50 ± 1) mm wide and of the thickness of the laminate under test. The edges shall be smooth and free from cracks.

Eight specimens shall be tested, four of them with their major axes parallel to the machine direction of the fibrous sheet material (for example paper) from which the sheet has been made, and four with their major axes at right angles to the machine direction. Two specimens from each direction shall be used for the dry-heat test and two for the high-humidity test.

If the machine direction is not known, carry out flexural strength tests at various angles. The highest value will usually be given by the specimen cut parallel to the machine direction.

Before making the first measurements, all specimens shall be kept for at least 72 h in a standard atmosphere of (23 ± 2) °C and (50 ± 5) % relative humidity.

17.4 Procedure

17.4.1 All measurements of length shall be made to the nearest 0,02 mm with the test specimen kept flat. When any test specimen is measured for the second time, take care that it is kept flat as when it was first measured. Measurements shall be made within 5 min after removal of the specimens from the conditioning atmosphere or the desiccator (see 17.2.5).

17.4.2 Oven (dry-heat) test

Taking two specimens in each direction, measure the length of each of the four specimen (see 17.4.1), and then place them in the oven (see 17.2.1) maintained at (70 ± 2) °C. At the end of 24 h, remove them and allow them to cool to ambient temperature in the desiccator (see 17.2.5) for 1 h, and then re-measure the length between the marks of each specimen.

17.4.3 Conditioning chamber (high-humidity) test

Taking the remaining two specimens in each direction, measure the length and then place them in the conditioning chamber (see 17.2.2) at (40 ± 2) °C and relative humidity within the range 90 % to 95 %. After

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(96 ± 4) h, remove each specimen, wipe it free of surface water with a cloth, and immediately re-measure the length.

17.5 Expression of results

Calculate the change in measured length of each specimen as a percentage of the initial measured length.

Calculate the mean percentage change in measured length for each of the four pairs of specimens, to the nearest 0,05 %.

Calculate the cumulative dimensional change for each direction of the sheet.

The change is the sum of the average absolute dimensional changes in each of the low and high humidity tests if the movements are in opposite directions. If they are in the same direction, the larger of the two average changes shall be taken as the cumulative dimensional change. The absolute figure shall be reported.

An example is reported in Table 2 (using test specimen in one direction only).

Table 2 — Calculation example of cumulative dimensional change in one direction only

Dry-heat test				
Test specimen	1	2	3	Mean to nearest 0,05 %
Initial length (mm)	139,77	139,85	139,83	
Final length (mm)	139,26	139,22	139,24	
Change in length (mm)	- 0,51	- 0,63	- 0,59	
Change (%)	- 0,36	- 0,45	- 0,42	- 0,4

High-humidity test				
Test specimen	4	5	6	Mean to nearest 0,05 %
Initial length (mm)	139,88	139,80	139,83	
Final length (mm)	140,33	140,21	140,31	
Change in length (mm)	+ 0,45	+ 0,41	+ 0,48	
Change (%)	+ 0,32	+ 0,29	+ 0,34	+ 0,3

The movements in the two tests are in opposite directions; therefore, the cumulative dimensional change is equal to (0,3 + 0,4) % = 0,7 %.

17.6 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) cumulative dimensional change for the machine direction;

d) cumulative dimensional change for the cross-machine direction;

e) any deviation from the specified test method;

f) date of the test.

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18 Resistance to wet heat

18.1 Principle

The test is intended to determine the suitability of decorative laminates for use in kitchens where contact with moderately wet heat is to be expected.

A standard aluminium alloy block at a specified test temperature of 100 °C is placed on a damp cloth in contact with a specimen taken from the laminate under test, bonded to wood chipboard. After 20 min of contact the block is removed. Resistance to the test conditions is assessed by visual examination.

18.2 Apparatus and materials

18.2.1 Thermometer, as specified in ISO 1770, capable of insertion to the bottom of the centre bore of the heat source (18.2.2) or other means of measuring the temperature of the heat source to an accuracy of ± 1 °C.

18.2.2 Heat source, consisting of a block as shown in Figure 8 manufactured from aluminium alloy according to ISO 209:2007, Al Mg Si (alloy shall contain more than 94 % aluminium). The roughness of bottom surface shall be (2 ± 1) µm, expressed as *Ra*, according to EN ISO 4287 and EN ISO 4288.

NOTE Alloy 6060 and 64430 are suitable.

For this document, the following tolerances are applicable:

— dimensions: ± 0,2 mm of the nominal dimension;

— angles: ± 2° of the nominal angle.

18.2.3 Fine-faced wood particleboard, complying with EN 312 (for interior fitments), (230 ± 5) mm square, with a nominal thickness of 18 mm to 20 mm (± 0,3 mm), a density of (680 ± 20) kg/m³, and moisture content (10 ± 3) %.

18.2.4 Urea-formaldehyde adhesive, or an equivalent rigid adhesive (e.g. PU, phenol-resorcinol, PF, PVAc, MF)

18.2.5 Oven, capable of heating the metal block to a temperature higher than the test temperature.

18.2.6 Cleaning cloth, consisting of a white soft absorbent cloth.

18.2.7 White polyamide fibre cloth, a plain weave having approximately 40 threads/cm in both warp and weft direction, weighing approximately 50 g/m², and cut (120 ± 3) mm square.

18.2.8 Deionized or distilled water

18.2.9 Heat-insulating foam, consisting of a melamine foam, with the following characteristics: density between 8,5 kg/m³ and 11,5 kg/m³; heat conductivity, less than 0,035 W/mK. The foam shall withstand at a temperature higher than 200 °C.

18.2.10 Diffuse light source, providing evenly diffused light, giving an illumination on the test surface of (1200 ± 400) lx. This may either be diffused daylight or be diffused artificial daylight.

The daylight should be unaffected by surrounding trees, etc. When artificial daylight is used it is recommended that it should have a correlated colour temperature of 5000 K to 6500 K and an *Ra* greater than 92, by using a colour matching booth in accordance with EN ISO 3668.

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18.2.11 Fixed frame, to hold the specimen flat.

18.3 Test specimens

The specimen shall be prepared by uniformly bonding a piece of the laminate under test to the wood chipboard (see 18.2.3), using the specified adhesive (see 18.2.4) evenly spread at 80 g/m² to 120 g/m². One specimen (230 ± 5) mm square shall be used. The bonded specimen shall be preconditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test.

For materials of thickness greater than 2 mm, the effect of bonding the specimen is insignificant and the test may be conducted with the specimen resting in close contact with the chipboard. This technique is also acceptable for routine quality control testing of laminates less than 2 mm thick. However, in cases of dispute, laminates less than 2 mm thick shall be bonded to chipboard.

18.4 Procedure

The test surface shall be placed horizontally. In case of laminates thick 2 mm or greater, without need of gluing on chipboard, hold the specimen in the fixed frame (18.2.11).

It shall accommodate the required number of tests, with at least 15 mm spacing between the perimeter of adjacent test surfaces, and between the perimeters of the test surfaces and the edges of the panel. Where tests are carried out simultaneously, the perimeters of the test surfaces shall be separated by a minimum of 50 mm.

The test surface shall be lightly wiped with a cleaning cloth (18.2.6) before the test.

Using the oven (18.2.5), raise the temperature of the heat source to a temperature higher than the specified test temperature, and transfer it to the heat insulating foam (18.2.9) or on a sufficient large board of wood particleboard (18.2.3).

Place the thermometer (18.2.1) or other means of measuring temperature in the centre bore of the heat source (18.2.2). If the temperature is not higher than the specified test temperature, the heat source shall be placed again in the oven until achieving this higher temperature.

Place the white polyamide fibre cloth (18.2.7) centrally on the test surface. Spread (2 ± 0,2) cm³ of distilled or deionized water (18.2.8) uniformly over the whole area of the white polyamide fibre cloth.

NOTE A graduated eye dropper is suitable for dispensing the distilled or deionised water.

When the heat source reaches the temperature of 100 °C with an accuracy of ± 1 °C, immediately place it on the test surface.

After 20 min in this position, remove the block.

Wipe the test surface dry with the cleaning cloth when it has cooled.

Allow the test surface to stand undisturbed 1 h ± 10 min.

Wipe each test surface with the cleaning cloth (18.2.6) and examine the test panel.

Carefully examine the test surface, with light coming from all directions, for damage, e.g. discoloration, change in gloss and colour, blistering, swelling and other defects. For this purpose illuminate the surface separately using the light source (18.2.10) and examine from different angles, including angle combinations such that the light is reflected from the test surface and towards the observer's eye. Viewing distance shall be 0,25 m to 1,0 m.

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.

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18.5 Expression of results

The result of the examination for surface disturbance shall be expressed in accordance with the rating scale reported in Table 3, taking into account that the slight surface lowness, due to the hot aluminium block weight, shall not be taken in account in the evaluation.

Table 3 — Resistance to wet heat rating scale

Rating scale	Description
5	No change test area indistinguishable from adjacent surrounding area
4	Minor change test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer's eye, e. g. discoloration, change in gloss and colour
3	Moderate change test area distinguishable from adjacent surrounding area, visible in several viewing directions, e. g. discoloration, change in gloss and colour, no change in the surface structure, e.g. deformation, cracking, blistering
2	Significant change test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e. g. discoloration, change in gloss and colour, and / or structure of the surface slightly changed, e.g. slight cracking, slight blistering
1	Strong change the structure of the surface being distinctly changed e.g. strong cracking, strong blistering and / or discoloration, change in gloss and colour, and / or the surface material being totally or partially removed

18.6 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.

19 Resistance to climatic shock (exterior grade laminates)

19.1 Principle

Specimens taken from the laminate under test are subjected to a cycle of rapid changes in temperature and relative humidity, after which they are visually inspected, and tested to determine any changes in mechanical properties.

19.2 Apparatus

19.2.1 Refrigeration chamber, maintained at (−20 ± 2) °C.

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19.2.2 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

19.2.3 Conditioning chamber, maintained at (80 ± 2) °C, relative humidity (90 ± 5) %.

19.2.4 Oven, capable of being maintained at (80 ± 2) °C.

19.3 Test specimens

8 specimens of the size specified in EN ISO 178 shall be cut in the transverse direction of the laminate under test, i.e. at right angles to the machine direction of the fibrous sheet material from which the laminate has been made.

19.4 Procedure

On day one of the 5 day test cycle shown in Table 4, place 4 specimens in the hot-wet conditioning chamber (see 19.2.3) for 8 h, then follow the procedure described in Table 4.

Table 4 — 5 day test cycle

	Climate conditions			
	Duration h	**Temperature** °C	**Relative humidity** %	**Condition**
First day	8	+80	90	Hot-wet (see 19.2.3)
	16	+80		Hot-dry (see 19.2.4)
Second day	8	+80	90	Hot-wet (see 19.2.3)
	16 [a]	-20		Cold-dry (see 19.2.1)
Third day	8	+80	90	Hot-wet (see 19.2.3)
	16	+80		Hot-dry (see 19.2.4)
Fourth day	8 [a]	-20		Cold-dry (see 19.2.1)
	16	+80		Hot-dry (see 19.2.4)
Fifth day	8	+80	90	Hot-wet (see 19.2.3)
	16 [a]	-20		Cold-dry (see 19.2.1)
[a] Longer durations in cold-dry conditions are permitted to accommodate non-working day				

Continue the transfer of the 4 specimens between climates in this way through four full 5 day cycles, after which the specimens are placed in a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) % (see 19.2.2) for 24 h before inspecting and testing.

The transfer shall be made as quickly as possible so that the specimens experience a rapid change in climatic conditions, and are not allowed to acclimatise slowly.

Throughout the above four week conditioning period, the remaining 4 control specimens shall be kept in the standard atmosphere (see 19.2.2).

Immediately after removal from the standard atmosphere carry out the following inspection and test programme:

a) The surfaces of the 4 specimens which have been subjected to the climatic cycle shall be inspected in accordance with the test method of 19.5.2.

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b) The four cycled specimens plus the four control specimens shall be tested for flexural strength and modulus of elasticity in flexure in accordance with EN ISO 178.

19.5 Expression of results

19.5.1 Flexural strength and modulus of elasticity in flexure

The change in flexural strength (D_s), shall be expressed as the arithmetical mean of the flexural strength values obtained from the four cycled specimens divided by the mean of the values from the four control specimens.

The change in modulus of elasticity in flexure (D_m), shall be expressed as the arithmetical mean of the modulus of elasticity values obtained from the four cycled specimens divided by the mean of the values from the four control specimens.

19.5.2 Appearance

The appearance shall be expressed as the lowest rating of the four cycled specimens assessed in accordance with the following rating scale.

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.

Examine the surface of the test specimen with the naked eye, corrected if necessary, at a distance of approximately 50 cm, assessing the appearance in comparison with the control specimen in accordance with the following rating scale:

Rating 5 No visible change.

Rating 4 Change of gloss only.

Rating 3 Hairline surface cracks and/or erosion of surface.

Rating 2 Surface cracks.

Rating 1 Blistering and/or delamination.

19.6 Test report

The test report shall contain the following information:

a) reference to this European Standard;

b) name, type and nominal thickness of the product;

c) appearance expressed as the lowest rating of the four cycled specimens;

d) change in flexural strength (D_s);

e) change in modulus of elasticity in flexure (D_m);

f) any deviation from the specified test method;

g) date of the test.

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20 Resistance to impact by small-diameter ball

20.1 Principle

A specimen from the laminate under test is bonded to wood chipboard to simulate service conditions and its decorative surface is subjected to the impact of a 5 mm steel ball mounted at one end of a spring-loaded bolt. The maximum spring force for which no visible damage occurs is used as a measure of resistance to impact.

20.2 Materials

20.2.1 Fine-faced wood particleboard, complying with EN 312 (for interior fitments), (230 ± 5) mm square, with a nominal thickness of 18 mm to 20 mm (± 0,3 mm), a density of (680 ± 20) kg/m^3, and moisture content (10 ± 3) %.

Where the specimen is bonded to chipboard, the test actually measures the impact resistance of the whole composite material, i.e. laminate, adhesive and substrate. (The correct choice of chipboard quality is very important in achieving good reproducibility with this test).

20.2.2 Urea-formaldehyde adhesive, or an equivalent rigid adhesive (e.g. PU, phenol-resorcinol, PF, PVAc, MF)

20.2.3 Contrast medium, e.g. graphite, talcum, or solution of dye in alcohol, to contrast with the colour of the sheet under test.

20.3 Apparatus

20.3.1 Impact tester, consisting of an impact bolt with a 5 mm diameter steel spherical ball mounted at one end, which is projected once against the surface under test by the release of a compression spring. The spring compression force before release can be adjusted continuously from 0 N to 90 N by means of a force-setting barrel (see Figure 9).

The Newton metre (Nm) scale also provided on the tester is only to be used for orientation, as the introduction of a non-linear scale involves relatively great inaccuracies.

The compression spring is 100 mm long when released and has a constant of (1962 ± 50) N/m. It is compressed by drawing back the impact bolt and is held in the loaded position by a retainer which engages in the bolt. It is released to deliver the impact blow by a release unit which withdraws the retainer.

20.3.2 Force-producing arrangement, (for example a scale-pan and weights), capable of being suspended from the impact bolt to exert a compressive force on the spring.

20.3.3 Support fixture, which clamps to the shaft of the impact tester and provides a convenient mounting of sufficient mass for the tester to be held at right angles to the surface of the specimen and to avoid recoil following the release of the impact bolt (see Figure 10).

20.3.4 Steel plate, having dimensions of approximately 300 mm × 300 mm × 50 mm.

20.3.5 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C, relative humidity (50 ± 5) %.

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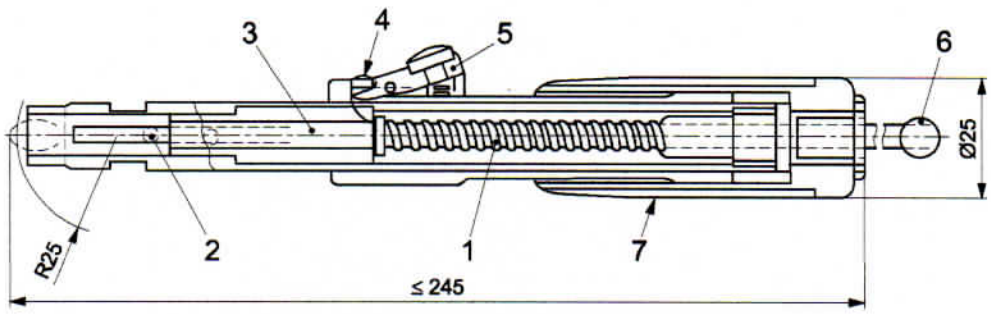
Dimensions in millimetres



Key

1 compression spring
2 steelball
3 impact bolt
4 retainer
5 release lever
6 knob
7 force-setting barrel (housing)

Figure 9 — Impact tester (shown with spring compressed)

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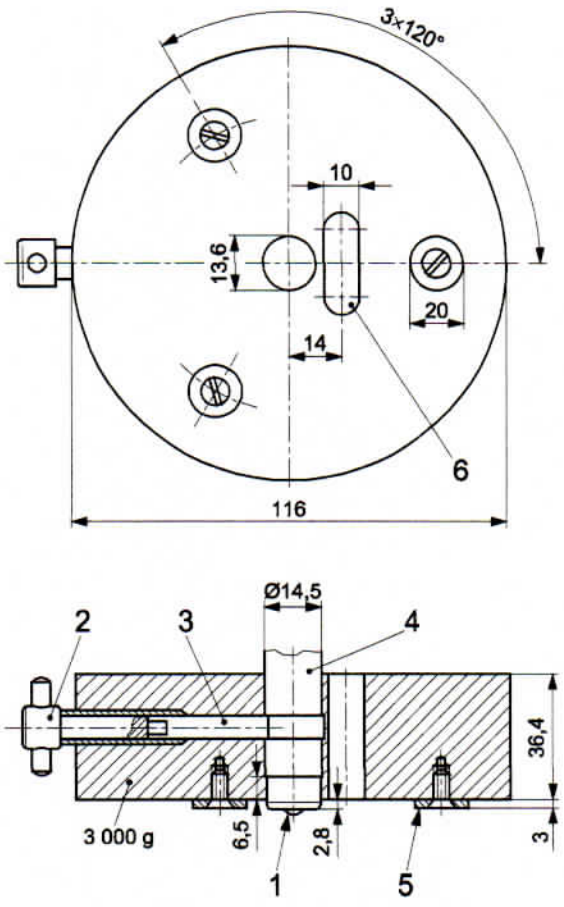
Dimensions in millimetres



Key

1 steel ball
2 clamp screw
3 pressure bolt
4 shaft of impact tester
5 foot
6 observation slot

Figure 10 — Support fixture for impact tester

20.3.6 Calibration device (example)

Tripod with upper support that allows tester to be kept suspended by the gravity, see Figure 11 for the example.

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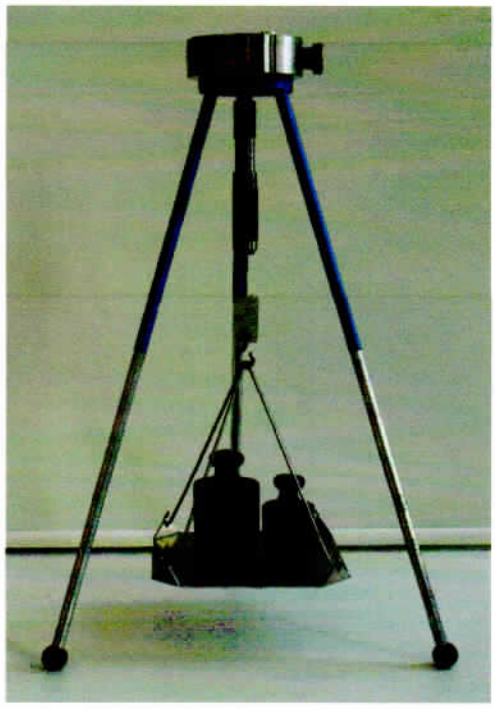

Figure 11 — Example of calibration device

20.4 Test specimens

Specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (see 20.2.1), using the specified adhesive (see 20.2.2) evenly spread at 80 g/m² to 120 g/m². Sufficient specimens, each (230 ± 5) mm square, shall be prepared to obtain a final result (about three is usually sufficient). The bonded specimens shall be preconditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test.

20.5 Calibration of the impact tester

Suspend the tester (see 20.3.1) using the calibration device (20.3.6) with the impact bolt pointing upwards so that its longitudinal axis is free to hang vertically under gravity.

Set the force-setting barrel, which serves to vary the impact force, to zero on the scale. Compress the spring by a force F_e (calibration force) using a suitable arrangement (for example weights in a scale-pan) (see 20.3.2) suspended from the knob used to draw back the impact bolt, ensuring that the bolt is clear of the retainer of the release unit.

Turn the force-setting barrel until the retainer of the release unit is just in contact with the impact bolt. This position can be determined by increasing or decreasing the compressing force very slightly to observe whether the retainer is just in contact. Record the indicated force F_x on the scale of the instrument corresponding to the calibration force F_e.

Repeat this calibration procedure for various values of F_x in the range required, and draw a calibration graph relating values of the scale reading F_x to values of the calibration force F_e using a linear regression program (see Figure 12 as an example).

This calibration graph is valid if $R^2 \geq 0{,}98$, where R is the regression coefficient.

Use the following specific *formula* to correct the indicated force F_x used in the testing:

$y = mx + n$

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where

x = Calibration force F_e

y = Scale reading F_x on instrument

m = Slope of calibration graph

n = distance of calibration graph to 0 in the intercept point with y-axis

Calculate the regression coefficient R.

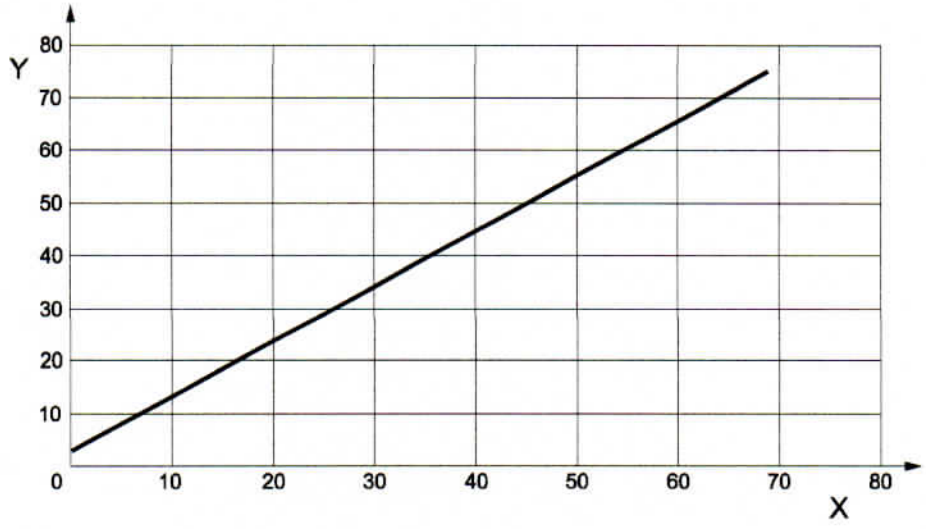
NOTE A suitable software is the function of Microsoft Excel "trend line / linear regression" or equivalent.

The Figure 12 is an example.

The calculation for formula of the line in Figure 12 is:

$Y = 1{,}0479\,x + 2{,}8533$

$R^2 = 0{,}9998$



Key

X calibration force F_e (N)

Y scale reading on instrument F_x (N)

Figure 12 — Example of calibration graph

Prepare a new calibration graph after every 500 tests.

20.6 Procedure

The test shall be carried out in the laboratory atmosphere.

Place the steel plate (see 20.3.4) on a convenient rigid horizontal surface and locate the specimen on it with its decorative surface uppermost. Fix the impact tester in its support fixture (see 20.3.3), load the tester, place the assembly on the specimen and release the impact bolt. Start preliminary test with a spring force of 10 N and increase by 5 N on each occasion to determine the minimum spring force at which the surface of the specimen shows damage due to impact stress.

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Test further specimens for the final determination of the maximum force at which no damage occurs. For this purpose, start with the spring force determined in the preliminary test and reduce it in suitable stages, for example 1 N, after every five strikes.

To make any damage more easily visible, the surface of the specimen shall be rubbed with a contrast medium (see 20.2.3) after the test.

The distance between points of impact shall be at least 20 mm and between points of impact and the edge of the specimen at least 30 mm.

Examine the surface tested for damage at the points of impact. For the purpose of this test, damage is defined by the presence of fine hairline cracks (which are frequently concentric), continuous cracks or flaking of the decorative surface. Indentations without cracks do not count as damage.

If the test is conducted only to determine whether the impact strength of a material exceeds a limiting value, the specimen shall sustain no damage after five successive individual impact strikes with the prescribed spring force.

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.

20.7 Expression of results

The impact resistance of the laminate under test is the maximum value of the spring force, in Newton, for which no damage occurs in a series of five strikes.

To prove compliance with a specified limit value it is only necessary to carry out the test at the specified force.

NOTE For the expression of the result, it is advised to keep into account the surface finish and colour influence as described in Annex A.

20.8 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) impact resistance, in Newton;

d) any deviation from the specified test method;

e) date of the test.

21 Resistance to impact by large diameter ball

21.1 Principle

A specimen from the laminate under test (bonded to wood chipboard if specified) is covered with a sheet of carbon paper and subjected to the impact of a steel ball which is allowed to fall from a known height. Impact resistance is expressed as the maximum drop height which can be achieved without incurring visible cracking only on the tested face or producing an imprint greater than a specified maximum diameter.

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21.2 Materials

21.2.1 Fine-faced wood particleboard, complying with EN 312 (for interior fitments), (230 ± 5) mm square, with a nominal thickness of 18 mm to 20 mm (± 0,3 mm), a density of (680 ± 20) kg/m³, and moisture content (10 ± 3) %.

Where the specimen is bonded to chipboard, the test actually measures the impact resistance of the whole composite material, i.e. laminate, adhesive and substrate. (The correct choice of chipboard quality is very important in achieving good reproducibility with this test).

21.2.2 Urea-formaldehyde adhesive, or an equivalent rigid adhesive (e.g. PU, phenol-resorcinol, PF, PVAc, MF)

21.3 Apparatus

21.3.1 Free-fall test apparatus, of the type shown in Figure 13, or an equivalent which will produce the same results.

21.3.2 Polished steel ball, of mass (324 ± 5) g and diameter (42,8 ± 0,2) mm, having no damaged or flattened areas on its surface.

21.3.3 Specimen clamping frame, conforming to Figure 14.

21.3.4 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

21.4 Test specimens

Specimens shall be (230 ± 5) mm square. For laminates of thickness less than 2,0 mm, specimens shall be prepared by uniformly bonding a piece of the laminate under test to the wood chipboard (see 21.2.1) using the specified adhesive (see 21.2.2) evenly spread at 80 g/m² to 120 g/m². The bonded specimens shall be preconditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test.

For laminates of thickness ≥ 2,0 mm and < 6,0 mm, the effect of bonding the specimen is insignificant and the test may be conducted with the laminate clamped in the frame in contact with the chipboard.

Laminates of thickness ≥ 6,0 mm shall be tested clamped in the frame without the chipboard support.

Sufficient specimens shall be prepared to obtain a final result (about five is usually sufficient).

21.5 Procedure

The test shall be carried out in the laboratory atmosphere.

Clamp the specimen in the clamping frame (see 21.3.3) and place the assembly on the solid base of the free-fall test apparatus (see 21.3.1). Cover the specimen with a sheet of carbon paper with its coated face in contact with the decorative surface. Adjust the height scale so that its base is touching the face of the specimen.

Position the electromagnet at any arbitrary height (the specification limit for the material under test is a useful starting point).

Place the steel ball (see 21.3.2) on the energised electromagnet. Operate the release mechanism so that the ball fails on the specimen, catching the ball on the first rebound so that multiple impacts do not occur.

Examine only the face tested for damage at the point of impact. If cracking is evident, or the carbon imprint is greater than the diameter specified, lower the electromagnet and repeat the test. If no cracking is evident and the imprint is smaller than the specified diameter, raise the electromagnet and repeat the test. The

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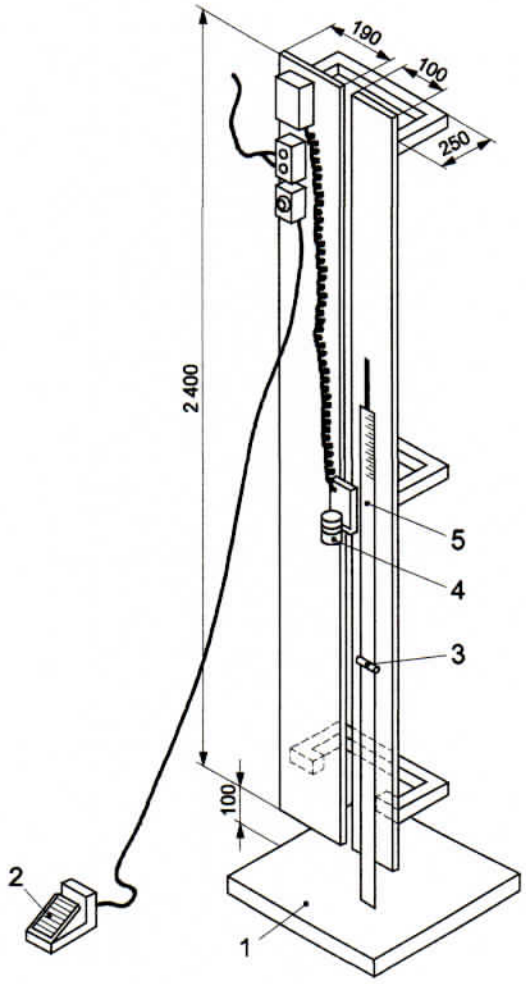
distance between points of impact, and between points of impact and the edge of the specimen, shall be at least 50 mm. For referee purposes, only one impact per specimen shall be made, with the point of impact as near as possible to the centre of the specimen.

Repeat the above procedure, to determine the impact resistance of the laminate under test on five different specimen.

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.

Dimensions in millimetres



Key

1 steel base plate levelled and set firmly to the floor

2 foot treadle switch

3 wing nut (to lock adjustable scale)

4 electromagnet on sliding mount

5 adjustable scale

Figure 13 — Free-fall test apparatus

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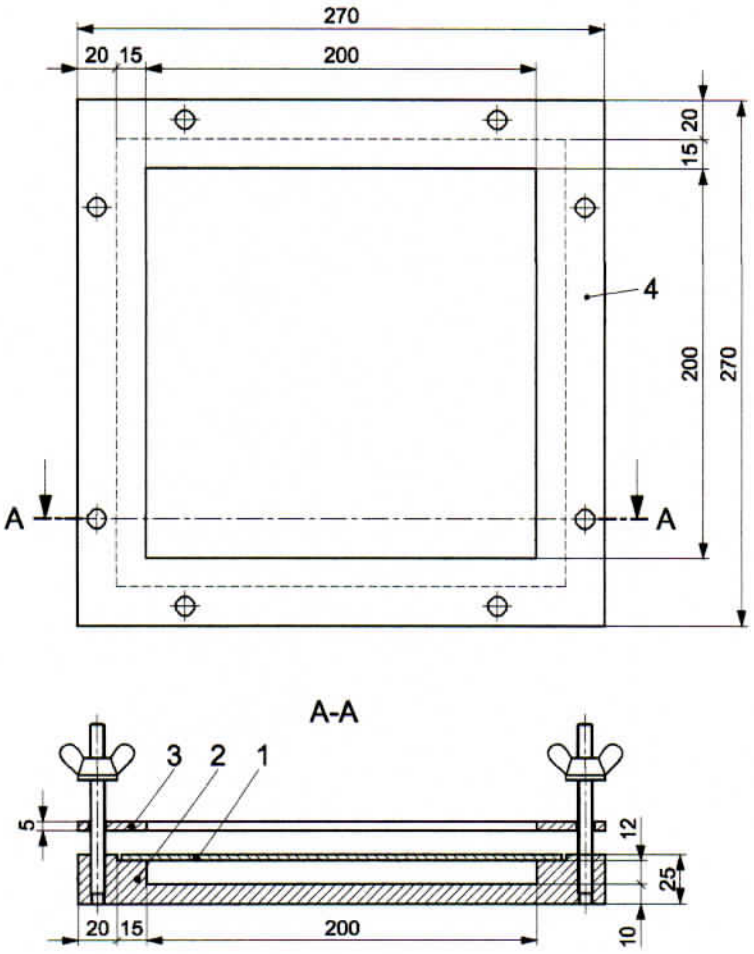
Dimensions in millimetres



Key

1 test specimen

2 lower metallic frame

3 upper metallic frame

Figure 14 — Specimen clamping frame

21.6 Expression of results

The impact resistance of the laminate under test is defined as the maximum height for which no visible surface cracking, or imprint greater than the specified diameter, occurs in five successive strikes on five different specimen.

To prove compliance with a specified limit value it is only necessary to carry out the test at the specified drop height.

NOTE For the expression of the result, it is advised to keep into account the surface finish and colour influence as described in Annex A.

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21.7 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) impact resistance, expressed in centimetres;

d) indentation diameter, expressed in millimetres;

e) any deviation from the specified test method;

f) date of the test.

22 Resistance to impact by large diameter ball (flooring grade laminates)

22.1 Principle

A specimen from the laminate under test, bonded to dry process fibreboard, is covered with a sheet of carbon paper and subjected to the impact of a steel ball which is allowed to fall from a known height.

Impact resistance is expressed as the maximum drop height which can be achieved without incurring visible surface cracking or producing an imprint greater than a specified maximum diameter. This test is applicable only to flooring grade laminates.

22.2 Materials

22.2.1 Dry process fibreboard (MDF), complying with EN 316, (230 ± 5) mm square, with a nominal thickness of (6,0 ± 0,3) mm, and a density of (850 ± 50) kg/m³.

The test actually measures the impact resistance of the whole composite material, i.e. laminate, adhesive and substrate.

22.2.2 PVAc adhesive class D2 or D3 according to EN 204.

22.2.3 Flexible extruded polyethylene foam, of thickness (3,0 ± 0,5) mm and density (25 ± 5) kg/m³.

22.3 Apparatus

22.3.1 Free-fall test apparatus, of the type shown in Figure 13, or an equivalent which will produce the same results.

22.3.2 Polished steel ball, of mass (324 ± 5) g and diameter (42,8 ± 0,2) mm, having no damaged or flattened areas on its surface.

22.3.3 Specimen clamping frame, conforming to Figure 14.

22.3.4 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

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22.4 Test specimens

Specimens shall be (180 ± 5) mm square, prepared by uniformly bonding a piece of the laminate under test to the fibreboard (see 22.2.1) using the specified adhesive (see 22.2.2) evenly spread at 80 g/m² to 120 g/m².

The bonded specimens shall be preconditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test.

Sufficient specimens shall be prepared to obtain a final result (about five is usually sufficient).

22.5 Procedure

The test shall be carried out in the laboratory atmosphere.

Place the test specimen on a sub-layer of polyethylene foam (see 22.2.3), and place the specimen plus the sub-layer on the solid base of the free-fall test apparatus (see 22.3.1). Cover the specimen with a sheet of carbon paper with its coated face in contact with the decorative surface. Adjust the height scale so that its base is touching the face of the specimen.

Position the electromagnet at any arbitrary height (the specification limit for the material under test is a useful starting point).

Place the steel ball (see 22.3.2) on the energised electromagnet. Operate the release mechanism so that the ball fails on the specimen, catching the ball on the first rebound so that multiple impacts do not occur.

Examine the surface tested for damage at the point of impact. If cracking is evident, or the carbon imprint is greater than the diameter specified, lower the electromagnet by 50 mm and repeat the test. If no cracking is evident and the imprint is smaller than the specified diameter, raise the electromagnet by 50 mm and repeat the test.

The distance between points of impact, and between points of impact and the edge of the specimen, shall be at least 50 mm. For referee purposes, only one impact per specimen shall be made, with the point of impact as near as possible to the centre of the specimen. Repeat the above procedure, as necessary, to determine the impact resistance of the laminate under test.

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.

22.6 Expression of results

The impact resistance of the laminate under test is defined as the maximum height for which no visible surface cracking, or imprint greater than the specified diameter, occurs in five successive strikes.

To prove compliance with a specified limit value it is only necessary to carry out the test at the specified drop height.

NOTE For the expression of the result, it is advised to keep into account the surface finish and colour influence as described in Annex A.

22.7 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) impact resistance, expressed in centimetres;

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d) indentation diameter, expressed in millimetres;

e) any deviation from the specified test method;

f) date of the test.

23 Resistance to cracking under stress (laminates ≤ 2 mm thick)

23.1 Principle

A specimen, with a drilled hole, taken from the laminate under test is rigidly clamped in a steel fixture. After imposing additional stress by heating at 50 °C for 6 h, the resistance of the specimen to cracking is assessed by visual examination.

23.2 Apparatus

23.2.1 Clamping device, as shown in Figure 15.

23.2.2 Drilling jig, to facilitate drilling of accurate holes which are free from chipping or cracking. A suitable jig is as shown in Figure 16.

23.2.3 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

23.2.4 Electrically heated oven, provided with air circulation and capable of being maintained at (50 ± 2) °C.

23.2.5 Hand lens, with approximately × 6 magnification.

23.2.6 Lighting, of intensity (1200 ± 400) lx.

23.2.7 Drilling machine, operating at less than 400 min^{-1}.

23.2.8 Micrometer thickness gauge, as described in 5.2.

23.3 Test specimens

Four specimens shall be prepared, of which three shall be tested and the fourth used as a drill backing piece.

Each specimen shall be (150 ± 1) mm long, (50 ± 0,5) mm wide, and of the thickness of the sheet under test. The length of the specimen shall correspond to the cross direction of the sheet.

The specimens shall have a (10 ± 0,5) mm diameter hole drilled in their centres using a drilling jig (see 23.2.2), the four specimens being clamped together with the decorative surfaces face to face. During the drilling operation, care shall be taken to avoid chipping, cracking or burning around the edge of the holes.

The drill shall be sharp, and the speed of the drilling machine shall not exceed 400 min^{-1}. After the drilling has been carried out, the specimen used as a backing piece (i.e. the bottom specimen) shall be discarded.

Any specimen showing cracking, chipping or burning around the edge of the hole shall be discarded, and a replacement prepared. Replacement specimens will also be needed if any specimen movement occurs during the test (see 23.4).

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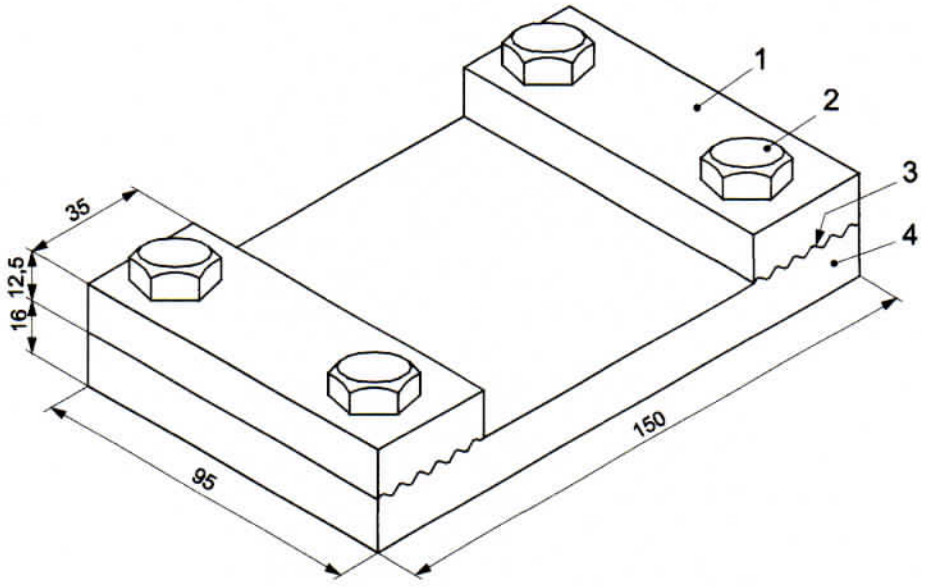
Dimensions in millimetres



Key

1 clamping block
2 nut
3 serrated surfaces
4 base plate

Figure 15 — Clamping device

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Dimensions in millimetres

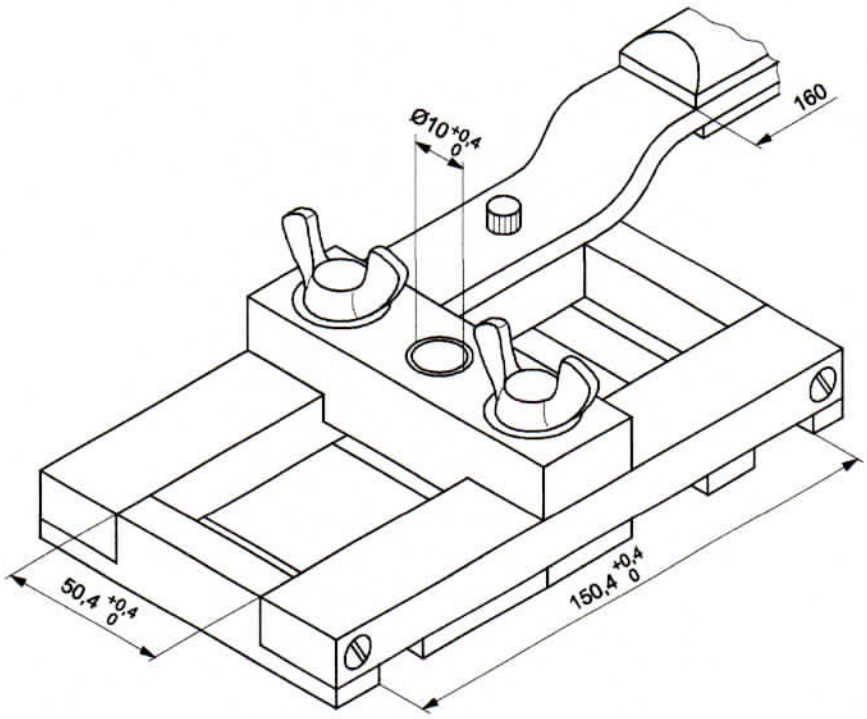

Figure 16 — Drilling

23.4 Procedure

Measure the thickness of the laminate under test in accordance with Clause 5.

Pre-condition the specimens for 72 h in a standard atmosphere of (23 ± 2) °C and (50 ± 5) % relative humidity.

Pre-heat the clamping device (see 23.2.1) in the oven (see 23.2.4) for 2 h at (50 ± 2) °C.

Take the specimen under test from the conditioning chamber (see 23.2.3), place it immediately in the preheated clamping device, and tighten the nuts firmly to prevent movement of the specimen. Make reference marks on the surface of the specimen adjacent to each clamping block to confirm absence of movement.

Place the clamping device containing the specimen in the oven at (50 ± 2) °C.

After (6 ± 0,25) h, remove the device from the oven, check the reference marks to ensure that the specimen has not moved, and immediately examine the specimen (while still hot and clamped in the device) with the naked eye and under x6 magnification for signs of cracking around the hole. The light intensity during the examination shall be (1200 ± 400) lx.

If there is any evidence of movement of the specimen in the clamps during the 6 h test period, discard the specimen without examination and repeat the whole procedure using a new specimen.

Test two further specimens using the same procedure.

23.5 Expression of results

The resistance to cracking under stress is the lowest rating of the three specimens assessed in accordance with the following rating scale (see also Figure 17).

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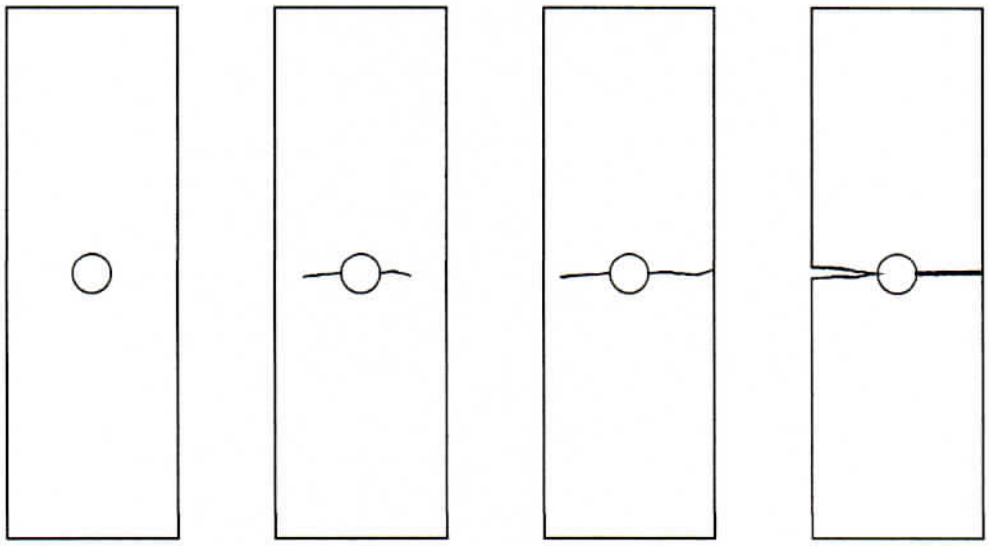
Rating 5: No evidence of cracking.

Rating 4: Hairline cracks only visible under × 6 magnification.

Rating 3: Cracks visible with normal vision (corrected if necessary) from the edge of the hole, but not extending to either edge of the specimen.

Rating 2: A crack visible with normal vision (corrected if necessary) from the edge of the hole, extending to one edge of the specimen such that the specimen is not broken into two pieces.

Rating 1: Specimen broken into two pieces.



(hairline cracks only visible under 6x magnification)

Figure 17 — Rating scale

23.6 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) thickness of the sheet under test;

d) resistance to cracking under stress expressed as the lowest rating obtained from the three specimens;

e) any deviation from the specified test method;

f) date of the test.

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24 Resistance to crazing (Compact laminates)

24.1 Principle

A specimen from the laminate under test is exposed to dry heat at 80 °C for 20 h and resistance to crazing is assessed by visual examination after cooling.

24.2 Apparatus

24.2.1 Specimen holder, suitable for holding the specimens vertically during the test and prevent contact with other specimens or the oven.

24.2.2 Electrically heated oven, provided with air circulation and capable of being maintained at (80 ± 2) °C.

24.2.3 Lighting, of intensity (1200 ± 400) lx.

24.2.4 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

24.3 Test specimens

The specimens shall be (250 ± 2) mm square and of the thickness of the sheet under test and shall be sanded smooth at the edges to remove any hairline cracks.

Two specimens shall be used and shall be conditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing.

24.4 Procedure

Place the specimens in the holder (see 24.2.1) and then place the holder in the oven (see 24.2.2), maintained at (80 ± 2) °C, and leave for (20 ± 1) h.

At the end of (20 ± 1) h, remove the holder and specimens and allow to cool for 3 h at ambient temperature.

After the cooling period, examine the surfaces and edges with the naked eye, corrected if necessary, to determine the presence and extent of any cracking. The light intensity during the examination shall be (1200 ± 400) lx.

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.

24.5 Expression of results

The results of the examination shall be expressed in accordance with the rating scale in Figure 18.

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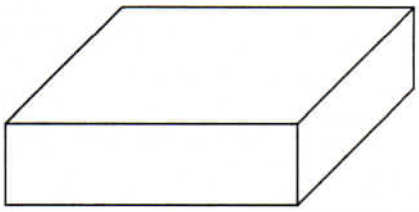
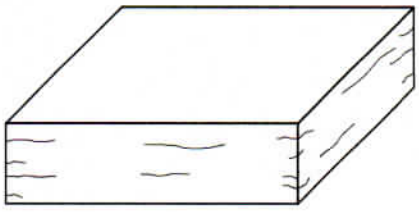
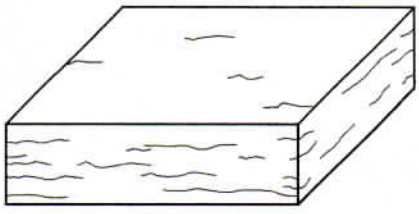
Rating 5: Surfaces and edges unchanged from 'as received' condition.



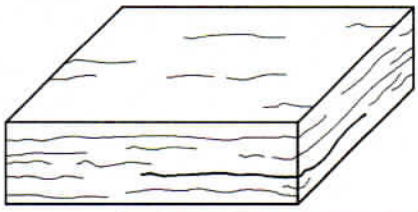
Rating 4: Surfaces unchanged with slight hairline edge cracks visible to the naked eye.



Rating 3: Surface cracks visible to the naked eye, and/or moderate edge cracks.



Rating 2: Moderate surface cracks and/or severe edge cracks.



Rating 1: Severe surface cracks and/or delamination.

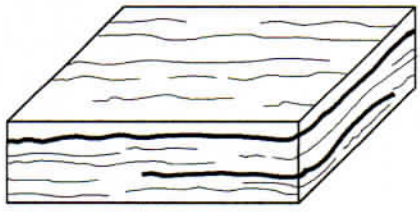


Figure 18 — Resistance to crazing rating scale

The resistance to crazing is the lowest of the two ratings obtained from the test.

24.6 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) lower result of the tests on the two specimens, expressed in accordance with the rating scale;

d) any deviation from the specified test method;

e) date of the test.

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25 Resistance to scratching

25.1 Principle

Increasing loads are applied in specified steps to a diamond scratching point of defined geometry.

The resistance to scratching of the decorative laminate sheet under test is expressed as a numerical rating which defines the maximum applied load which does not produce a continuous surface scratch. The test result is verified by visually confirming that the next higher load-step produces a continuous scratch.

25.2 Materials

25.2.1 Contrast medium, e.g. blue methylene 0,1 % solution in alcohol or graphite powder for light colour and titanium dioxide 50 % suspension in paraffin oil or talcum powder for dark colour, to contrast with the colour of the sheet under test.

25.2.2 Supply of cotton fabric.

25.3 Apparatus

25.3.1 Scratch testing apparatus, (see Figure 19), consisting of the following parts:

25.3.1.1 Stand, with a device to indicate the horizontal, for example a spirit level.

25.3.1.2 Motor driven turntable, able to rotate about a vertical axis without play. The rotational frequency shall be (5 ± 1) min^{-1}.

25.3.1.3 Arm, carrying the holder for the diamond, mounted on a ball bearing, with a horizontal axis.

The height of this axis shall be adjustable so that the arm is exactly horizontal when the scratching point rests on the test specimen.

25.3.1.4 Means of applying a known load, with an accuracy of ± 0,1 N to the scratching point.

25.3.1.5 Hemispherical diamond scratching point [3], with a point radius of (0,090 ± 0,003) mm and an included angle of (90 ± 1) ° (see Figure 20). (The diamond shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction.) The crystal axis of the diamond shall be parallel to the longitudinal axis of the diamond holder.

25.3.1.6 Clamping disc, to keep the test specimen flat.

25.3.2 Viewing enclosure, having a matt black interior and a light source (defined below) located at the top. Its dimensions shall be such that the test specimen is located vertically below the light source and at a distance of 600 mm. An aperture in the front shall allow inspection of the test specimen at various angles from a distance of (400 ± 10) mm. A diagram of a suitable enclosure is shown in Figure 21.

The light source consist of a 70 W halogen lamp with a luminous flow of 1200 lm, colour temperature of 2800 K and colour rendering index of 100, mounted in a white reflector having an aperture of approximately 140 mm diameter and producing an illumination of 800 lx to 1000 lx at the test surface.

[3] Diamond points conforming with these dimensions and profile are available from: Cie Weinz, Industrie Edelstein Fabrik, Postfach 2740, D-55743 Idar-Oberstein, Germany; and through Erichsen GmbH & Co. KG, D-58675 Hemer-Sundwig/Westfalien, Germany. This is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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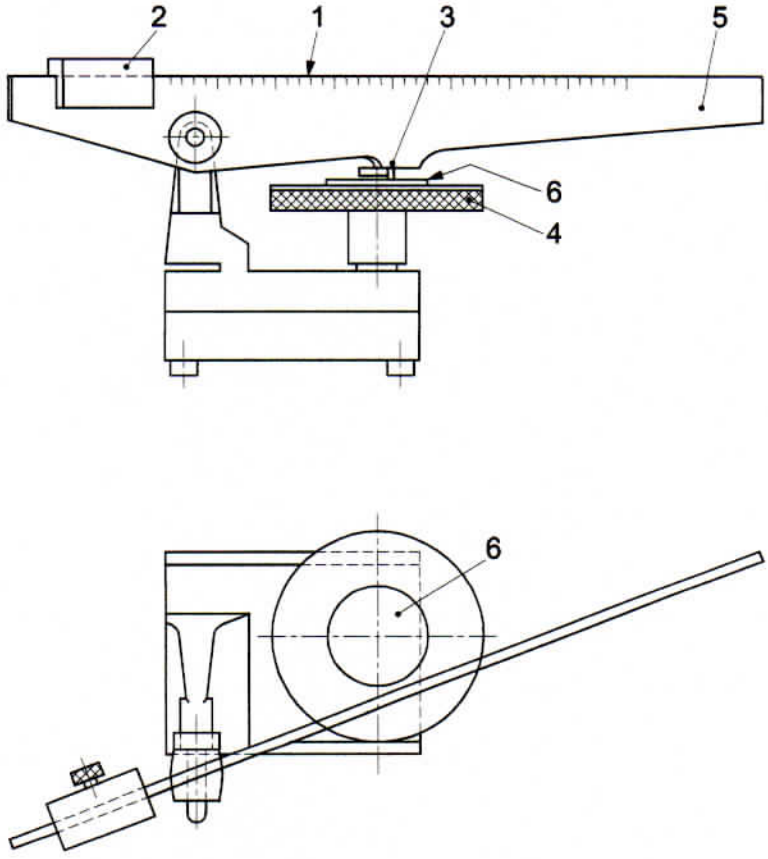
NOTE OSRAM code 64547 A ECO[4].

25.3.3 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

25.3.4 Electronic balance, suitable for verifying the force applied to the diamond point. The balance accuracy shall be 0,1 g.



Key

1 scale
2 moveable weight.
3 hemispherical diamond scratching point.
4 motor driven turntable.
5 arm
6 clamping disc

Figure 19 — Type of apparatus for measuring resistance to scratching

[4] OSRAM code 64547 A ECO is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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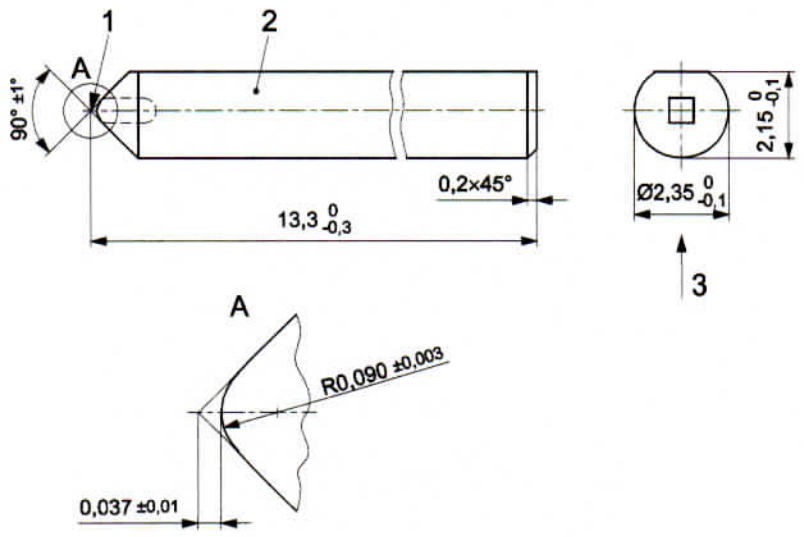
Dimensions in millimetres



Key

1 diamond point

2 diamond holder

3 optical axis of projector

NOTE The dimensions of the diamond holder are approximate and are for information only.

Figure 20 — Diamond scratching point

25.4 Calibration of apparatus

Weight the arm with the electronic balance (see 25.3.4) in a horizontal position at the diamond point. Verify that the position marks for sliding weight correspond to the load values shown in Table 5. If not, move weight as necessary to achieve the correct loads, and mark the correct positions on arm.

Table 5 — Load values

Position mark	1,0 N	2,0 N	4,0 N	6,0 N
Load (grams force)	102 ± 1	204 ± 1	408 ± 1	612 ± 1

25.5 Test specimen

The test specimen shall be a square of side (100 ± 1) mm cut from the sheet under test.

One specimen shall be tested.

Wipe the specimen surface using cotton fabric (see 25.2.2) impregnated with a solvent such as acetone. It is important that, once cleaned, the surface is not fingered in the test area.

Before making the scratch test, store the specimen for 72 h in the standard atmosphere specified in 25.3.3.

25.6 Procedure

Make sure that the stand of the test apparatus is standing horizontally. Adjust the height of the arm so that it is horizontal when the diamond point rests on the test specimen.

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Start the test by making two scratches at 1,0 N load with a spacing of 1 mm to 2 mm between the scratch marks.

On the same specimen repeat this procedure with loads of 2,0 N, 4,0 N, and 6,0 N, leaving a space of 3 mm to 5 mm between each pair of scratches.

Remove the specimen from the apparatus and rub the entire scratched area of the surface with a suitable contrast medium (see 25.2.1) so that it is engrained in any scratches.

Carefully wipe the surface with clean cotton fabric (see 25.2.2) to remove any excess contrast medium which is not engrained in a scratch. This procedure is necessary to ensure that only true scratches are considered, and superficial hairline polish marks are ignored.

Place the specimen against the centre support in the viewing enclosure (see 25.3.2) in a position so that the specimen can be viewed at right angles to the plane of the surface.

Examine the surface to determine the lowest load for which an almost continuous (i.e. > 90 %) double circle of scratch marks can be seen. The examples shown in Figure 22 can be used as a guide.

For the expression of the result keep in account the surface finish and colour influence as described in Annex A.

A scratch mark is where the contrast medium is engrained in the scratch, and is clearly visible as a line of colour contrasting with the colour of the specimen. In case of metal surfaces the contrast medium is normally not necessary to evaluate the scratch marks.

Superficial polish marks (i.e. where there is a change in gloss level but no continuous engrained contrast medium) shall be ignored.

The examination of the surface shall take no longer than 10 seconds, and the operator shall ensure that the double circle of scratch marks selected is truly > 90 % continuous.

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.

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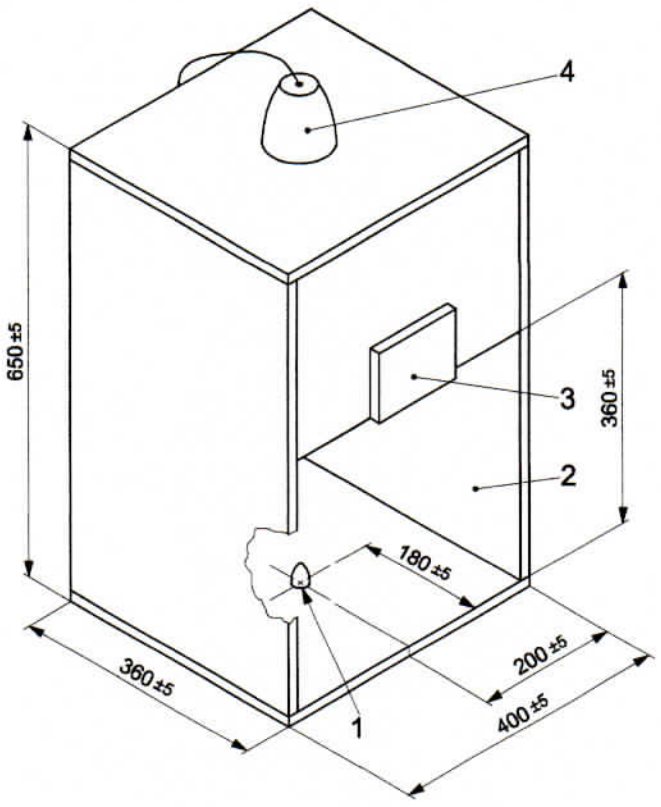
Dimensions in millimetres



Key

1 device for centering test specimen
2 inside wall mat black
3 forehead rest (foam-rubber pad)
4 lamp holder

Figure 21 — Example of suitable viewing enclosure

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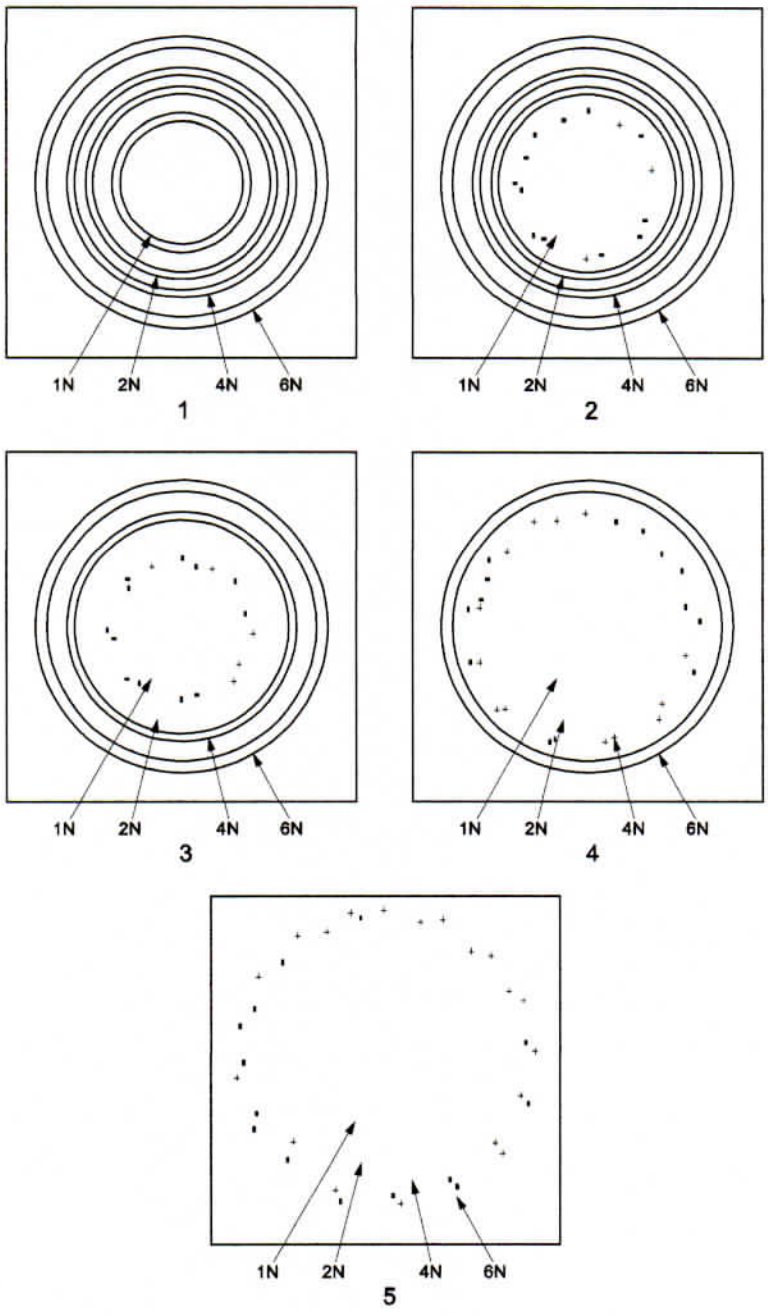

Key

1 rating 1
2 rating 2
3 rating 3
4 rating 4
5 rating 5

Figure 22 — Rating 1 to Rating 5

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25.7 Expression of results

The scratch resistance of the laminate under test shall be expressed in accordance with the rating scale shown in Table 6 (see also Figure 22):

Table 6 — Scratch resistance rating scale

Rating scale	Discontinuous scratches, or faint superficial marks, or no visible marks	≥ 90 % continuous double circle of scratch marks clearly visible
Rating 5	6 N	> 6 N
Rating 4	4 N	6 N
Rating 3	2 N	4 N
Rating 2	1 N	2 N
Rating 1	-	1 N

25.8 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) scratch resistance, expressed in accordance with the rating scale;

d) any deviation from the specified test method;

e) date of the test.

26 Resistance to staining

26.1 Principle

Test specimens are left in contact with a series of staining agents which are likely to be encountered in everyday use. The time and conditions of contact are specified for each staining agent. At the end of the specified contact period, the specimens are washed and examined for residual surface marks.

If the laminate under test meets specification requirements when tested with each of the five staining agents marked with an asterisk (*) and underlined, then it is deemed to comply with the specification for stain resistance. The other staining agents are included for information only. In the case of a specific complaint, the staining agent in question (selected from Group 1, 2 or 3) shall be used to verify the quality of the laminate. This test method may also be used using other staining agents to cover specific requirements if agreed between supplier and purchaser.

26.2 Staining agents

The list of staining agents and the test conditions are reported in Table 7.

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Table 7 — Staining agents and test conditions

Group I - Staining agent	Test conditions	Contact time
* Acetone Other organic solvents Toothpaste Hand cream Urine Alcoholic beverages Natural fruit and vegetable juices Lemonade and fruit drinks Meats and sausages Animal and vegetable fats and oils Water Yeast suspension in water Salt (NaCl) solutions Mustard Lyes, soap solutions Cleaning solution consisting of: - 23 % dodecylbenzene sulfonate - 10 % alkyl aryl polyglycol ether - 67 % water Commercial disinfectants Stain or paint removers based on organic solvents Citric acid (10 % solution)	Apply staining agent at ambient temperature	16 h
Group 2 - Staining agent	**Test conditions**	**Contact time**
* Coffee (120 g of coffee per litre of water) Black tea (9 g of tea per litre of water) Milk (all types)	Apply staining agent at approximately 80 °C	16 h
Wine vinegar Alkaline-based cleaning agents (to 10 % concentration with water) Hydrogen peroxide (3 % solution) Ammonia (10 % solution of commercial concentrate) Nail varnish Nail varnish remover Lipstick Water colours Laundry marking inks Ball point inks	Apply staining agent at ambient temperature	16 h
Group 3[a] - Staining agent	**Test conditions**	**Contact time**

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* Sodium hydroxide (25 % solution) * Hydrogen peroxide (30 % solution) Concentrated vinegar (30 % acetic acid) Bleaching agents and sanitary cleaners containing them Hydrochloric acid based cleaning agents (≤ 3 % HCl) Acid-based metal cleaners Mercurochrome (2,7-dibromo-4-hydroxymercurifluoresein, disodium salt) * Carbon black suspension in paraffin oil (Shoe polish simulant) Hair colouring and bleaching agents Iodine Boric acid Lacquers and adhesives - (except fast curing materials) Amidosulfonic acid descaling agents (< 10 % solution)	Apply staining agent at ambient temperature	10 min
[a] Some commercial cleaning agents contain acids and alkalis in concentrations stronger than those shown in Group 3, and can cause surface marking or damage. Any spillage of such materials shall be washed off immediately.		

26.3 Apparatus and Materials

26.3.1 Discs

Discs with a diameter of (25 ± 2) mm, of soft filter paper with a grammage of 400 g/m² to 500 g/m², without colouring agent and glue.

26.3.2 Glass Petri dish

Glass Petri dish with ground edges and without lips, external diameter (40 ± 2) mm, and height (25 ± 2) mm.

26.3.3 Tweezers

26.3.4 Absorbent paper or tissue

26.3.5 Cleaning cloth

White soft absorbent cloth.

26.3.6 Diffuse light source

Light source providing evenly diffused light giving an illumination on the test surface of (1200 ± 400) lx. This may either be diffused daylight or be diffused artificial daylight.

The daylight should be unaffected by surrounding trees, etc. When artificial daylight is used it is recommended that it should have a correlated colour temperature of (5000 to 6500) K and a *Ra* greater than 92, by using a colour matching booth in accordance with EN ISO 3668.

26.3.7 Solvents: ethanol, acetone, butyl acetate and methyl ethyl ketone.

26.3.8 Vessel, suitable for heating coffee, tea and milk.

26.3.9 Thermometer, range 0 °C to 100 °C.

26.3.10 Hotplate, or other suitable heat source.

26.3.11 Hard nylon bristle brush (for example a nail brush).

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26.3.12 Deionized or distilled water

26.3.13 Cleaning solution

Solution containing 15 ml/l of the cleansing agent (26.3.14) in water (26.3.12). The solution shall be discarded after one day.

26.3.14 Cleansing agent

Cleansing agent of the following composition:

a) 12,5 % by weight of a sodium primary C10 to C14 polymer alkyl aryl sulphonate,

b) 12,5 % by weight of polyethoxylated derivatives of primary or secondary C8 to C16 alcohols with 5 to 15 ethoxylated groups having a cloud point of 25 °C to 75 °C in 1 % (*m/m*) aqueous solution (determination of cloud point is described in ISO 1065:1991),

c) 5,0 % by weight of ethanol,

d) 70 % by weight of water (26.3.12).

The cleansing agent shall be stored in a glass bottle in a cool dark place and shall be used within one year of the day of preparation.

26.3.15 Paraffin oil

Paraffin medical grade FU. CAS no. 8012-95-1

26.3.16 Carbon black suspension in paraffin oil

Carbon black, in total suspension in paraffin oil. The suspension shall be prepared using 100 parts in weight of paraffin oil and 5 parts in weight of carbon powder (Carbon Black 7. Specific surface: 460 ± 100 m^2 / g).

NOTE A commercial product suitable for this purpose is the Carbon Black FW200 Russ Farb (Degussa)[5)].

26.4 Test specimens

Individual specimens of any suitable size shall be used, cut from the sheet under test. Alternatively, a single piece of laminate, large enough to allow the staining agents to be applied side by side, can be used. Keep the specimen flat during the test.

26.5 Test procedure

Immediately after conditioning, the test shall be carried out in a test at ambient temperature.

The test surface shall be placed horizontally. It shall be tested with the chosen test liquids at points which shall be not less than 60 mm apart, from centre to centre, and if possible, with centres not less than 40 mm from any edge of the test surface.

The test surface shall be lightly wiped with a cleaning cloth (26.3.5) before testing.

Use clean tweezers for each type of liquid.

Immerse a disc (26.3.1) into the staining agent (26.2) between 30 s and 60 s, lift with the tweezers (26.3.3) and quickly wipe off the edge of the disc once against the edge of the vessel. Quickly place it on the test

5) Carbon Black FW200 Russ Farb (Degussa) is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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surface and immediately cover with an inverted glass Petri dish (26.3.2). The filter paper shall not be in contact with the edge of the glass Petri dish.

Record the position of each test liquid.

After the test period (see Table 7), remove the glass Petri dish and lift off the disc with the tweezers. Soak up any remaining test liquid with the absorbent paper (26.3.4) without rubbing.

Then wash the test surface by lightly rubbing it with the cleaning cloth (26.3.5) soaked first in cleansing solution (26.3.13) and then only water (26.3.12). If necessary use a suitable solvent (26.3.7) to remove the staining agent, e.g. butyl acetate to remove nail varnish, and then wash with the cleansing solution (26.3.13). A suitable brush (26.3.11) may be used to remove staining agent from textured surfaces. Finally wipe the surface lightly with a dry cleaning cloth (26.3.5).

Leave the test surface undisturbed, without covering it, for 30 min.

26.6 Examination of the test panel

Carefully examine the test surface under the light source (26.3.6), for changes caused by the test liquids, e. g. discoloration, change in gloss and colour, blistering and other defects. For this purpose illuminate the surface separately and examine from different angles and directions, including angle combinations such that the light is reflected from the test surface and towards the observer's eye. The viewing distance shall be 0,25 m to 1,0 m.

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.

26.7 Assessment of results

Rate the test surfaces by comparing the test area with the area surrounding it for each liquid according to Table 8:

Table 8 — Descriptive numerical rating code

Numerical rating	Description
5	No change test area indistinguishable from adjacent surrounding area
4	Minor change test area distinguishable from adjacent surrounding area, only when the light source is mirrored on the test surface and is reflected towards the observer's eye, e. g. discoloration, change in gloss and colour
3	Moderate change test area distinguishable from adjacent surrounding area, visible in several viewing directions, e. g. discoloration, change in gloss and colour
2	Significant change test area clearly distinguishable from adjacent surrounding area, visible in all viewing directions, e. g. discoloration, change in gloss and colour, and / or structure of the surface slightly changed, e.g. cracking, blistering
1	Strong change the structure of the surface being distinctly changed and / or discoloration, change in gloss and colour, and / or the surface material being totally or partially delaminated

NOTE For the expression of the result, it is advised to keep into account the surface finish and colour influence as described in Annex A.

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26.8 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) assessment of stain resistance for each staining agent applied, expressed in accordance with the rating scale;

d) any deviation from the specified test method;

e) date of the test.

27 Light fastness (Xenon arc)

27.1 Principle

A test specimen taken from the laminate under test is exposed to daylight simulated by the filtered light of one or more xenon arc lamp(s). The effect on the colour of the specimen, at a specified radiant exposure, is assessed by the contrast between the exposed specimen and unexposed specimen of the test sample. The radiant exposure is instrumentally determined.

Daylight spectral distribution is specified as decorative laminates may, in certain applications, be exposed to direct daylight through open windows.

27.2 Apparatus

27.2.1 A test device, as specified in EN ISO 4892-1 and EN ISO 4892-2, equipped with:

— one or more xenon arc lamp(s) filtered to provide a spectral energy distribution which closely approximates to that of solar irradiance as described in CIE 85:1989, Table 4 and EN ISO 4892-2:2013, 4.1.1 Method A;

— stainless steel specimen holders, in the form of an open frame, which provide the test specimens with a solid backing;

— black-standard thermometer according to EN ISO 4892-1;

— photoelectronic sensor according to ISO 9370 to measure the irradiance and the radiant exposure at the specimen surface in the wavelength range 300 nm to 400 nm, or 340 nm.

27.2.2 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

27.2.3 Viewing enclosure, having a matt interior colour corresponding approximately to Munsell N5. It shall be equipped with an artificial light source, located at the top, simulating average north sky daylight. The viewing enclosure shall be placed in a position where the surrounding lighting conditions will not affect the visual assessment of the specimen.

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The light source [6]consist of a 70 W halogen lamp with a luminous flow of 1200 lm, colour temperature of 2800 K and colour rendering index of 100, mounted in a white reflector having an aperture of approximately 140 mm diameter and producing an illumination of 800 lx to 1000 lx at the test surface.

27.3 Test specimen

Two test specimens shall be prepared in accordance with EN ISO 4892-1. They shall be representative of the laminate under test, cut to the size required by the specimen holder used, and appropriate for the assessment after exposure.

One specimen shall be exposed, and the other (control specimen) shall be kept in dark conditions in the conditioning chamber (see 27.2.2).

It is possible to carry out the test on the surface and/or the core of the laminate. In the case of the test on the core, the specimen shall be prepared in order to have an exposed and an unexposed core area wide enough to be easily compared and suitable to be fixed on the specimen holder with the core side oriented toward the xenon lamp.

27.4 Procedure

One test specimen shall be exposed to xenon arc lamps and another one shall be kept in dark conditions as reference for the final comparison.

Carry out the test in accordance with EN ISO 4892-2 with the following operating conditions:

— irradiance at the test specimen surface in the wavelength range 300 nm to 400 nm :(60 ± 3) W/m²; or at wavelength 340 nm: (0,5 ± 0,03) W/m²

— black-standard temperature: (65 ± 3) °C

— relative humidity: (50 ± 5) %

Discontinue the exposure after the following irradiance doses: radiant exposure dose 306 KJ/m² at devices with an irradiance at wavelength 340 nm (0,5 ± 0,03) W/m² or radiant exposure of 36720 KJ/m² for devices with an irradiance at wavelength range 300 nm to 400 nm (60 ± 3) W/m²

The measurement of the radiant exposure shall be in accordance with the reference method EN ISO 4892-2. Even if the use of blue wool is no longer the preferred method of measuring radiant exposure, and blue wool standards are no longer commercially available in some countries, the method is still in common use and is therefore permitted. The mentioned irradiance doses are equivalent to blue scale 6 when the contrast between the exposed and unexposed blue wool reference 6 is equal to rating 4 on the grey scale, as defined in ISO 105-A02.

Measure and record the radiant exposure (300 nm to 400 nm, or 340 nm).

Remove the test specimen from the apparatus, take off the cover, and leave the specimen for (24 ± 2) h in dark conditions in the conditioning chamber (see 27.2.2) to prevent extraneous darkening and/or photochromism (see the following note).

NOTE Extraneous darkening and/or photochromism are due to the shock effect of accelerated exposure, and are not characteristics of natural exposure. Keeping the specimens in dark conditions for 24 h allows recovery from these effects.

27.5 Assessment and expression of results

Place the test specimen in the viewing enclosure (see 27.2.3).

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[6] OSRAM code 64547 A ECO is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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Examine the surface of the test specimen with the naked eye, corrected if necessary, at a distance of approximately 50 cm for any change in colour, assessing the contrast between the test specimen and the control specimen in terms of a grade on the grey scale according to ISO 105-A02.

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.

27.6 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) details of the apparatus used;

d) irradiance at the test specimen surface;

e) radiant exposure;

f) exposure time;

g) lightfastness of the test specimen;

h) any deviation from the specified test method;

i) date of the test.

28 Resistance to UV light (Exterior grade laminates)

28.1 Principle

A test specimen taken from the laminate under test is exposed to UV-light and humidity. The test procedure simulates the degradation of the polymer matrix on the sheet surface by exposure to high levels of UV radiation.

The effect on the test specimen is assessed after a specified light dosage, by comparing the exposed test specimen with an unexposed specimen taken from the same sheet.

28.2 Apparatus

The apparatus shall be as specified in EN ISO 4892-3. The test chamber enclosing 8 fluorescent UV-lamps, a heated water pan, test specimen rack and provisions for controlling and indicating operation times and temperatures.

The lamps shall be UV-B lamps of 40 W with a peak emission at 313 nm and a spectral energy distribution as specified in EN ISO 4892-3.

28.3 Test specimens

Two test specimens shall be prepared in accordance with EN ISO 4892-3 and shall be of the size required by the test apparatus used, and of sufficient size to be representative of the finished sheet.

One specimen shall be exposed, and the other (the control specimen) shall be kept in dark conditions.

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28.4 Procedure

Mount the test specimen in a rack with the surface to be tested facing the lamps. Fill all available spaces with other specimens, or blind panels if necessary, to ensure uniform exposure conditions.

Set the programme for the specified test conditions, and operate the apparatus continuously through the required number of cycles. Interruptions to service the apparatus and to inspect the specimens shall be kept to a minimum.

The specimens are cycled through periods of exposure to UV radiation followed by periods of no radiation, during which temperature changes occur. The cycle consists of 4h of dry UV exposure at a black-standard temperature of (60 ± 3) °C followed by 4 h of condensation exposure, without radiation, at a black-standard temperature of (50 ± 3) °C.

The test shall be run for the specified duration. Replace two of the 8 UV-lamps with new ones and rotate the other lamps as recommended by the apparatus manufacturer to obtain uniform exposure of all specimens under test.

The use of a radiometer to monitor irradiance and radiant exposure is optional.

28.5 Evaluation and expression of results

28.5.1 General

The examination shall be carried out in the viewing enclosure (see 29.2.3) as follows.

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.

28.5.2 Contrast

Examine the contrast between the exposed and unexposed test specimens and record it in terms of a grade on the grey scale as defined in ISO 105-A02.

28.5.3 Appearance

Examine the surface of the test specimen with the naked eye, corrected if necessary, at a distance of approximately 50 cm, assessing the appearance in comparison with the control specimen in accordance with the following rating scale:

Rating 5: No visible change.

Rating 4: Change of gloss only.

Rating 3: Hairline surface cracks and/or erosion of surface.

Rating 2: Surface cracks.

Rating 1: Blistering and/or delamination.

28.6 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) description of test specimens;

d) type of apparatus used;

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e) description of test cycle;

f) exposure time expressed in hours;

g) resistance to UV-light expressed as a grey scale grade according to ISO 105-A02;

h) any change in surface appearance expressed in accordance with 28.5.3;

i) any deviation from the specified test method;

j) date of the test.

29 Resistance to artificial weathering (Exterior grade laminates)

29.1 Principle

A test specimen taken from the laminate under test is exposed to the combined influence of artificial daylight, simulated by the filtered light of one or more xenon arc lamp(s), and rain. The effect on the colour of the specimen is assessed by judging the contrast between the exposed specimen and an unexposed control specimen. Any change of appearance of the test specimen is assessed using a rating scale. This test method also verifies lightfastness under outdoor conditions.

29.2 Apparatus

29.2.1 A test device, as specified in EN ISO 4892-1 and EN ISO 4892-2, equipped with:

— one or more xenon arc lamp(s) filtered to provide a spectral energy distribution which closely approximates to that of solar irradiance as described in CIE 85:1989, Table 4 and EN ISO 4892-2:2013, 4.1.1 Method A;

— stainless steel specimen holders, in the form of an open frame, which provide the test specimens with a solid backing;

— black-standard thermometer according to EN ISO 4892-1;

— spray system capable of intermittently sprinkling de-ionised water (conductivity < 5 µS/cm);

— photoelectronic sensor according to ISO 9370 to measure the irradiance and the radiant exposure at the specimen surface in the wavelength range 300 nm to 400 nm, or 340 nm.

29.2.2 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

29.2.3 Viewing enclosure, having a matt interior colour corresponding approximately to Munsell N5. It shall be equipped with an artificial light source, located at the top, simulating average north sky daylight. The viewing enclosure shall be placed in a position where the surrounding lighting conditions will not affect the visual assessment of the specimen.

The light source [7]consist of a 70 W halogen lamp with a luminous flow of 1200 lm, colour temperature of 2800 K and colour rendering index of 100, mounted in a white reflector having an aperture of approximately 140 mm diameter and producing an illumination of 800 lx to 1000 lx at the test surface.

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[7] OSRAM code 64547 A ECO is an example of a suitable product available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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29.3 Test specimens

Two test specimens shall be prepared in accordance with EN ISO 4892-1. They shall be representative of the laminate under test, cut to the size required by the specimen holder used, and appropriate for the assessment after exposure.

One specimen shall be exposed, and the other (control specimen) shall be kept in dark conditions in the conditioning chamber (see 29.2.2).

29.4 Procedure

Carry out the test in accordance with EN ISO 4892-2 with the following operating conditions:

— irradiance at the test specimen surface in the wavelength range 300 nm to 400 nm: (60 ± 3) W/m²; or at wavelength 340 nm:(0,5 ± 0,03) W/m²;

— continuous exposure of radiation from the source;

— black-standard temperature: (65 ± 3) °C;

— relative humidity:(65 ± 10) %;

— spray cycle: duration of spraying (18 ± 0,5) min interval between spraying (102 ± 0,5) min.

Discontinue the test after the specified radiant exposure.

NOTE 1 650 MJ/m² radiant exposure at 300 nm to 400 nm equates to 5,4 MJ/m² at 340 nm, and corresponds to approximately 3000 h exposure (see note 2) at unchanged level of irradiance. 325 MJ/m² radiant exposure at 300 to 400 nm equates to 2,7 MJ/m² at 340 nm, and corresponds to approximately 1500 h exposure (see note 2) at unchanged level of irradiance.

NOTE 2 Intermediate examinations after shorter exposure times are permitted.

Remove the test specimen from the apparatus and leave it for (24 ± 2) h in dark conditions in the conditioning chamber (see 29.2.2) to prevent extraneous darkening and/or photochromism (see Note 3).

NOTE 3 Extraneous darkening and/or photochromism are due to the shock effect of accelerated exposure, and are not characteristics of natural exposure. Keeping the specimens in dark conditions for 24 h allows recovery from these effects.

29.5 Examination and expression of results

29.5.1 General

The examination shall be carried out in the viewing enclosure (see 29.2.3) as follows.

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.

29.5.2 Contrast

Examine the surface of the test specimen with the naked eye, corrected if necessary, at a distance of approximately 50 cm for any change in colour; assessing the contrast between the test specimen and the control specimen in terms of a grade on the grey scale as defined in ISO 105-A02.

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29.5.3 Appearance

Examine the surface of the test specimen with the naked eye, corrected if necessary, at a distance of approximately 50 cm, assessing the appearance in comparison with the control specimen in accordance with the following rating scale:

Rating 5: No visible change.

Rating 4: Change of gloss only.

Rating 3: Hairline surface cracks and/or erosion of surface.

Rating 2: Surface cracks.

Rating 1: Blistering and/or delamination.

29.6 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) details of the apparatus used;

d) irradiance at the specimen surface;

e) contrast between exposed and unexposed specimens (expressed as a grey scale grade according to ISO 105-A02);

f) any change in surface appearance expressed in accordance with 29.5.3;

g) any deviation from the specified test method;

h) date of the test.

30 Determination of the microscratch resistance

30.1 Principle

This test measures the micro-scratch resistance and can be used for all types of HPL.

The sample is fixed on a horizontal table. A circular scrub material fixed on a holder impacts on the sample with a defined load. Table and holder are moved perpendicular to each other, in a translational movement, with defined frequencies, tracing a Lissajou figure. The holder is additionally freely rotatable around its own axis perpendicular to the horizontal plane.

The sample is exposed to the scrub material for a predetermined number of rubs. The changes of the surface are determined by gloss measurement or visual assessment.

30.2 Terms and definitions

For the purposes of this test the following terms and definitions apply.

30.2.1

rub

one revolution of the two outer drives of the Martindale tester

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30.2.2

cycle

completion of all the translational movements tracing a Lissajous figure comprising 16 rubs

Note 1 to entry: This comprises of 16 revolutions of the two outer drives and 15 revolutions of the inner drive of the Martindale tester.

30.2.3

Lissajous figure

figure created by movement which ranges changes from a circle gradually narrowing ellipses, until it becomes a straight line, from which progressively widening ellipses develop, in a diagonally opposite direction before the pattern is repeated

30.3 Apparatus and materials

30.3.1 Martindale tester

The Martindale tester shall be as described in EN ISO 12947-1 with the following exceptions:

— the "Abrading table" is the table for the sample;

— the "clamping ring and mechanism" is not necessary;

— the "specimen holder" is the holder for the scrub material;

— the "loading pieces" are not necessary.

30.3.2 Holder for scrub material

The holder for scrub material shall be as described in EN ISO 12945-2, with the following exceptions:

— Version 1: consists of a guide plate with a inner diameter of (90 ± 0,5) mm and a spindle with an overall weight of 413 g ± 2 g (nominally called 4 N);

— Version 2: the assembly according to version 1, however the small ring weight is replaced by the large ring weight. The total mass of this assembly is 612 g ± 2 g. (nominally called 6 N).

30.3.3 Diffuse light source

Light source providing evenly diffused light giving an illumination on the test surface of (1200 ± 400) lx. This may either be diffuse daylight or be diffuse artificial daylight.

The daylight may be unaffected by surrounding trees, etc. When artificial daylight is used it is recommended that it should have a correlated colour temperature of (6500 ± 50) K and a Ra greater than 92, by using a colour matching booth in accordance with EN ISO 3668.

30.3.4 Reflectometer

For gloss measurement with 3 angle measurement geometry as described in EN ISO 2813.

30.3.5 Positioning device

For gloss measurement on the same position before and after the test with 4 measurement points.

An example of a positioning device is shown in Figure 23.

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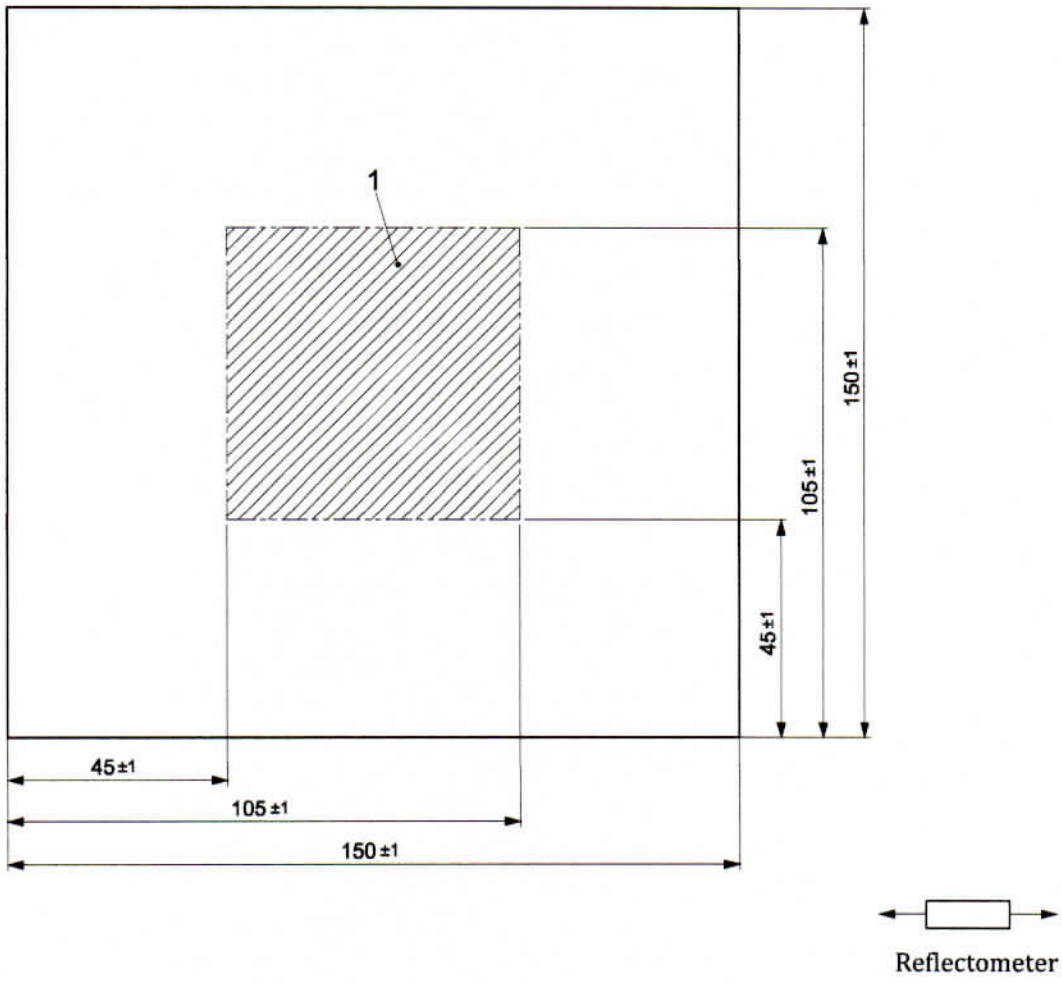
Dimensions in millimetres



Key

1 measurement area

Figure 23 — Scheme of positioning device for the reflectometer on the shaded measurement area

30.3.6 Scrub materials, consisting of a nylon web imbedded with alumina abrasive [8]. Two types of scrub materials (very fine and medium fine) are to use. The scrub materials shall be cut or stamped on a diameter of (89 ± 1) mm.

30.3.7 Double-sided tape to attach the scrub material on the guide plate of the holder and the sample on the table.

30.3.8 Soft cotton cloth

[8] Scotch Brite fleece 7447+ (very fine) and 7440 (medium fine) are examples of a suitable products available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of these products.

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30.3.9 Reference black high gloss HPL with antiscratch surface [9] by corundum in the top

To check every new lot of scrub materials (30.3.6).

30.4 Assembly and maintenance of the Martindale tester

The assembly of the tester shall be carried out in accordance with the instructions of the apparatus manufacturer. For the described test the outer position C shall be used for both axes to create the larger Lissajous figure as explained in EN ISO 12947-1 or the manufacture guidebook.

The checking of the Lissajous figure shall be done according to 30.5.

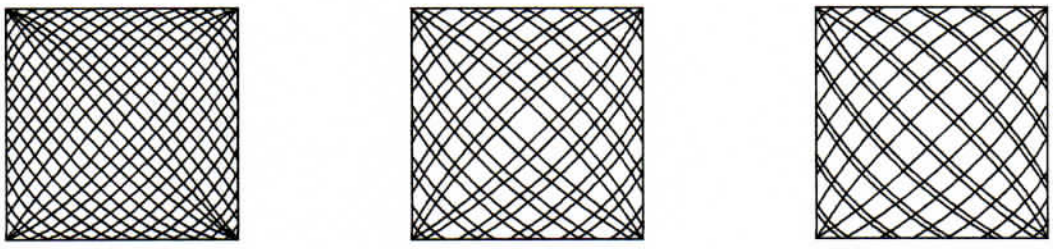
30.5 Method for checking the Lissajous figure

Obtain the Lissajous figure for each work station by means of the following method:

Remove materials from the abrading tables. Cover each abrading table surface with a plain paper measuring (100 ± 5) mm in diameter of minimum mass per unit area 100 g × m^{-2} and secure paper to abrading table ensuring the surface is perfectly flat.

Insert a steel sleeve of the same diameter as the specimen guide spindle counterbored to accept the introduction of a refill from a typical ballpoint pen through each of the specimen holder spindle bearings in turn in the specimen holder guide plate, so that the ball tip is resting on the surface of the paper. Set the machine for 16 rubs to produce one complete Lissajous figure.

Draw two parallel lines which just touch the outermost curves on two opposing sides of the Lissajous figure. Draw two more parallel lines for the other two sides making sure the lines intersect at right angles. Measure each side to an accuracy of ± 0,2 mm using suitable means. Check that 31 curves are drawn. It is important to check the symmetry of the Lissajous figures. If the curves run into one another or the spacing is uneven (see Figure 24) consult the machinery supplier.



a) acceptable b) unacceptable c) unacceptable

Figure 24 — Examples of acceptable and unacceptable Lissajous figures

30.6 Preparation and conditioning

30.6.1 Preparation

Six samples with the dimensions of 150 mm × 150 mm shall be prepared. The surface of the samples shall be substantially flat.

[9] James Heal Article "Black reference HPL (JH701-501)" is an example of a suitable product available commercially at James Heal (UK). This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product.

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30.6.2 Test surface

Conditioning of test surface shall begin at least 48 hours before testing and shall be carried out in air at a temperature of (23 ± 2) °C and relative humidity of (50 ± 5) %.

30.7 Test procedure

30.7.1 General

Two different procedures (A / B) are described. All the necessary parameters (scrub material, load, speed factor, number of cycles) are shown in Table 9.

Table 9 — Test procedures for determination of resistance to micro scratches

Test parameter	Procedure A	Procedure B
Scrub material	Very fine	Medium fine
Holder for scrub material	Version 2 (Sample holder plus large weight)	Version 1 (Sample holder plus small weight)
Speed	48 rev/min	48 rev/min
Number of rubs	80 rubs (= 5 Lissajous movements)	160 rubs (= 10 Lissajous movements)
Assessment	gloss change	Visual according to Annex B

NOTE Experience has shown that for a proper evaluation of the surfaces, Method A allows better differentiations for gloss surfaces and Method B for matt or deep structured surfaces.

30.7.2 Testing

30.7.2.1 Procedure A

Immediately after conditioning, the test shall be carried out in a test temperature of (23 ± 2) °C at 3 samples.

Before the test, 4 gloss measurements on each sample using the reflectometer (30.3.4) with a geometry of 60° and the positioning device (30.3.5) shall be carried out. If there is a decor or preferential structure direction on the sample the measurement shall be done parallel to this direction. Calculate the mean value for each sample.

If the mean value is higher than 70 (high gloss surface) or lower than 10 (low gloss surface) additional four measurements shall be carried out as follow (in Table 10):

Table 10 — Choice of geometry at reflectometer

Gloss surface	Value at 60°	Angle measurement geometry
High	>70 gloss units	If measurements exceeds 70, change setup to 20°
Medium	10-70 gloss units	Set up to 60°
Low	<10 gloss units	If measurements is less than 10, change setup to 85°

Fix the sample on the table of the Martindale tester using the adhesive tape (30.3.7). The very fine scrub material shall be fixed with the adhesive tape on the guide plate of holder.

Select 80 rubs on the counter of the Martindale device and start the test.

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After finishing remove the sample from the table and clean it with the cotton cloth (30.3.8). Remove also the used scrub material.

Measure the gloss again with the chosen geometry according to the above described procedure.

Calculate for each sample the gloss change $\Delta R'$ according to the following formula:

$$\Delta R' = \frac{(R_I - R_F)}{R_I} \times 100\,\%$$

With: R_I = mean value at initial state

R_F = mean value after finishing the test

In the case of negative sign of measured value use absolute values for calculation.

Calculate the mean value of the gloss change of the 3 sample and round it on the next integral number.

This procedure is also valid for checking of every new batch of very fine scrub materials (30.3.6). In this case 3 samples shall be taken from reference high gloss HPL (30.3.9) The batch of very fine scrub materials can be used for testing if the mean value of gloss change, determined with 20° reflectometer geometry, is in the range between 5 % and 20 %.

30.7.2.2 Procedure B

Immediately after conditioning, the test shall be carried out in a test atmosphere of (23 ± 2) °C at 3 samples.

Fix the sample on the table of the Martindale tester using the adhesive tape (30.3.6). The medium fine scrub material shall be fixed on the guide plate of holder with the adhesive tape.

Select 160 rubs on the counter of the Martindale device and start the test.

After finishing remove the sample from the table and clean it with the cotton cloth (30.3.8). Remove also the used scrub material.

Carefully examine the test surface with light coming from all directions for scratches using the scheme according to 30.8. For this purpose illuminate the surface separately using the diffuse light source (30.3.3) and examine from different angles, including angle combinations such that the light is reflected from the test surface and towards the observer's eye. Viewing distance shall be 0,25 m to 0,5 m.

The visual assessment shall be done by observers experienced in visual assessments of surfaces. In a case of doubt three observers shall assess.

If more than one observer has assessed the surface calculate the mean value of the assessments of the observers for every sample. Calculate a mean value from the values of the 3 samples and round it on the next integral number.

This procedure is also valid for checking of every new batch of medium fine scrub materials (30.3.6). In this case 3 samples shall be taken from reference high gloss HPL (30.3.9) The batch of medium fine scrub materials can be used for testing if the mean value of scratch pictures is 2 or 3.

30.8 Classification of the image after scratching according to procedure B

For the visual assessment of the surface after scratching according to procedure B (30.7.2.2) the classification given in Table 11 shall be used.

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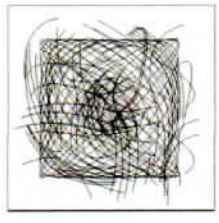
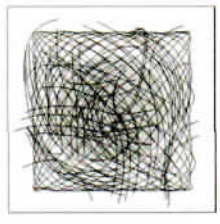
Table 11 — Classification for visual assessment according to procedure B

Class	scratch picture	explanation
5		No visible scratches or only few scratches
4		Many well visible scratches
3		A great number of well visible raw and fine scratches, Lissajou Figure partly visible
2		Mix of Lissajous-Figure and great number of scratches.
1		Mix of Lissajous-Figure and great number of scratches. Mat abrasion like area in the middle

30.9 Test report

The test report shall include the following information:

a) reference to this European Standard;

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b) description of the HPL which the samples were taken from (if possible);

c) the test temperature or temperatures;

d) conditioning time;

e) the number of observers at procedure B;

f) the single values of the three samples and the values for the results of the test according to procedure A and/or B with 30.8;

g) any deviations from this working draft;

h) date of the test.

31 Formability (Method A)

31.1 Principle

A test specimen is subjected to radiant heat on its decorative face until the reverse side reaches a predetermined temperature. It is then formed in a jig to a specified radius and angle, and cooled before examining for signs of failure on the bend line.

The test is carried out with specimens cut in the longitudinal and transverse directions of the laminate, with the decorative face on the outside of the bend.

This method is an alternative test method to the test method of Clause 32.

31.2 Apparatus

31.2.1 Radiant heater, consisting of two electrically heated sheathed elements of 1500 W total rating, mounted parallel and in a horizontal plane in a metal lined trough approximately 110 mm wide and 125 mm deep (Inside dimensions), the height of the heating elements above the bottom of the trough being such that, when a specimen is laid across the trough, the specimen is at a distance of (76 ± 1,0) mm above the heating elements. A windscreen enclosure to surround three sides and the top is advisable.

31.2.2 Variable-output transformer, with a voltage indicator, to control the voltage applied to the heater.

31.2.3 Temperature indicators, (thermal crayons or waxes), with melting points covering the required range of temperatures. Other types of temperature indicator with equal or better precision may also be used (e.g. infra-red thermometers, colour-change indicators).

31.2.4 Stopwatch, or other suitable timer.

31.2.5 Forming apparatus, (see Figure 25), with forming blocks machined from straight-grained wood.

The male forming block shall have a suitable means for attaching it securely to the moving arm of the forming apparatus.

31.2.6 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

31.2.7 Calibration strips, of plain-colour white laminate conforming to the specification for HGP given in EN 438-2, measuring approximately 200 mm × 50 mm and with the major axis in the machine direction of the fibrous sheet material from which the laminate was made.

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31.3 Test specimens

The specimens shall have dimensions of approximately 200 mm × 50 mm, shall be of the thickness of the sheet under test, and shall be sanded smooth at the long edges to remove any hairline cracks.

Four specimens shall be tested, two with their major axes in the machine direction of the fibrous sheet material from which the laminate was made, and two at right angles to this direction.

The specimens shall be conditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing

31.4 Procedure

31.4.1 Calibration of test apparatus

Turn on the heater (see 31.2.1) 30 min prior to conducting the test, with the variable transformer (see 31.2.2) at full line voltage.

Use a temperature indicator (see 31.2.3) with a melting point of 163 °C to make several marks about 100 mm long near the centre of the non-decorative surface of several calibration strips (see 31.2.7).

NOTE Metal laminates, according to EN 438-8, are processed and tested at a lower temperature than typical postformable laminates.

Place a calibration strip on the heating trough so that the heat is applied to the decorative face.

Adjust the input voltage by means of the variable transformer so that the time taken to reach 163 °C is 1 s per 0,025 mm of calibration strip thickness, accurate to within ± 2 s.

After three or more consecutive calibration strips reach 163 °C within the prescribed time ± 2 s, begin the test and maintain and record the voltage setting.

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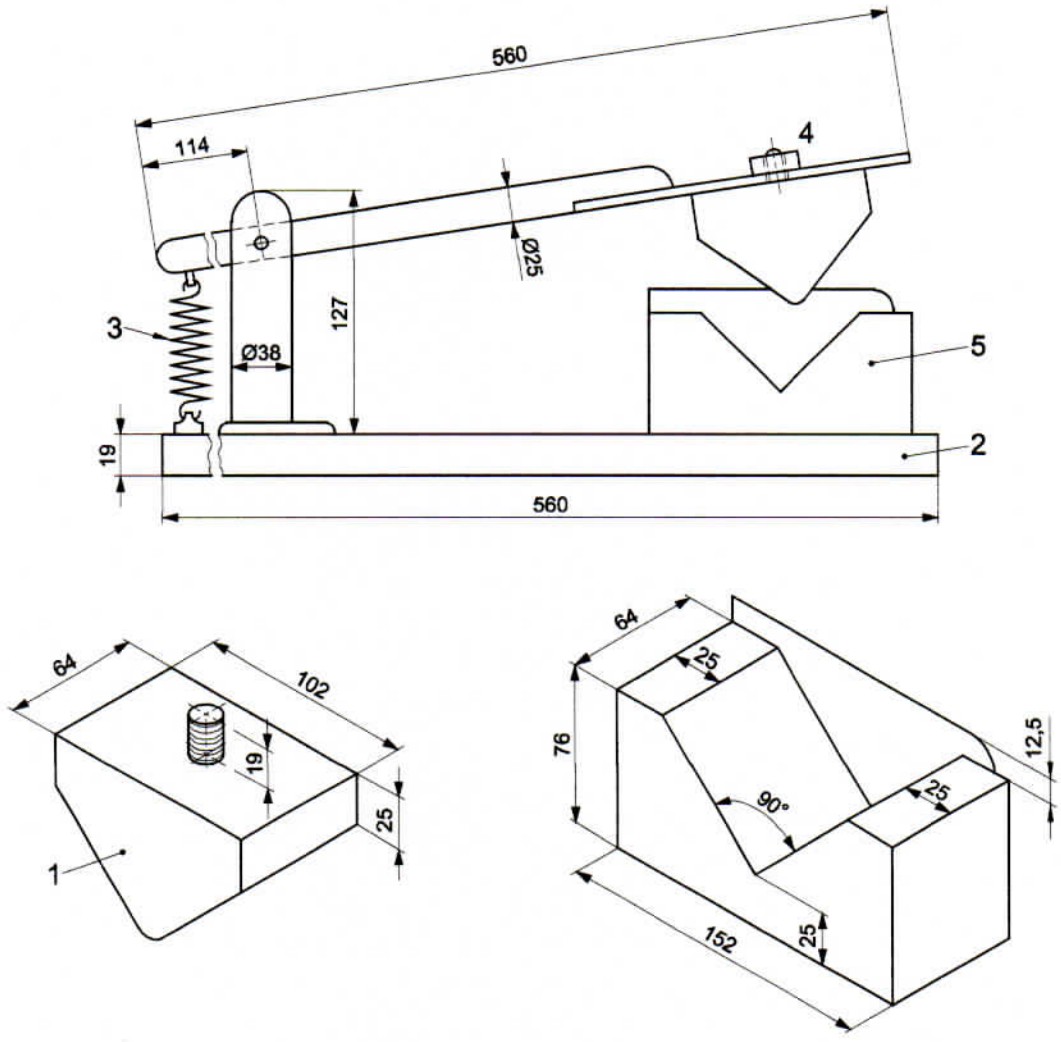
Dimensions in millimetres



Key

1 90° male forming block with the radius required for the type of laminate being tested.

2 pipe flange Base 19x305x560

3 spring

4 rod Ø25 Slot

5 90° female forming block

Figure 25 — Forming apparatus (Method A)

31.4.2 Test procedure

Place the male forming block with radius as recommended by the laminate manufacturer, or as required by the specification, into the forming apparatus (see 31.2.5).

Use a temperature indicator with a melting point as recommended by the laminate manufacturer to make several marks about 100 mm long on the surface that will be the inside of the bend, and near the centre of each specimen.

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Place a specimen on the heating trough so that the heat is applied to the side opposite the side marked with the temperature indicator.

Remove the specimen when the temperature indicator is completely melted in the area to be formed, place the specimen within 5 s in the bending jig and carry out the forming test.

The closing time of the male forming block after the initial contact with the specimen shall be 0,5 s to 1 s. Allow the specimen to cool in the closed bending jig.

Remove and inspect the specimen with the naked eye, corrected if necessary, after allowing it to cool for not less than 60 s. A material has failed if one or more of the four test specimens does not form to the prescribed forming radius, or shows cracking, blistering, crazing or discolouration. Edge cracks within 2 mm of the edge of the specimen shall be ignored.

Carry out the test to assess the formability in both the longitudinal and transverse directions of the sheet (testing two specimens in each case), with the decorative face on the outside of the bend.

If required, e.g. for a particular application, the test may be carried out with the decorative face on the inside of the bend.

31.5 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) forming radius;

d) direction of the major axis of the specimen;

e) nature of any failure, for example cracks and their extent, blisters, delamination, discolouration;

f) any deviation from the specified test method;

g) date of the test.

32 Formability (Method B)

32.1 Principle

A specimen from the laminate under test is subjected to infrared radiation until the heated face reaches a predetermined temperature. It is then formed on a jig made of wood (for example premachined chipboard) to a specified radius, allowed to cool and examined for signs of failure. The test is repeated with specimens cut in each direction of the sheet, with the decorative face on the outside of the bend. The formability is assessed in terms of the success or failure of the forming process at the specified radius.

This method is an alternative test method to Clause 31. It is possible that different laminates, even from the same manufacturer, may require different forming conditions. The conditions shall be specified by the laminate manufacturer, and the requirements shall be considered to be satisfied if the forming operation is successful under these conditions.

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32.2 Apparatus

32.2.1 Radiant heater element[10], fitted with a reflector[11], the distance and orientation relative to the test specimen being adjustable (see Figure 26a).

This heater unit is mounted on a hinged support allowing it to be quickly moved away to the rear.

32.2.2 Forming jig, of wood, chipboard, or other material having a similar thermal conductivity, the front of which is rounded to a specified radius. The jig is easily replaceable, and it is possible to use a series of forming jigs machined to specified radii (for example 8 mm, 9 mm, 10 mm, etc.) (see Figure 26).

32.2.3 Clamping device, for the test sample (see Figure 26a).

32.2.4 L-shaped forming bar, with a handle (see Figures 26 and 26a).

32.2.5 Temperature indicators, (thermal crayons or waxes), with melting points covering the required range of temperature. Other types of temperature indicator with equal or better precision may also be used (e.g. infra-red thermometers, colour-change indicators).

32.2.6 Stopwatch, or other suitable timer.

32.2.7 Conditioning chamber, in accordance with EN ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

32.3 Test specimens

The specimens shall measure approximately 180 mm × 90 mm and be of the thickness of the sheet under test. They shall be sanded smooth at the edges to remove any hairline cracks.

At least four specimens shall be prepared, two with their major axes in the machine direction of the fibrous sheet material from which the laminate was made, and two at right angles to this direction.

The specimens shall be conditioned for 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing.

[10] For example, Elstein Type FSR 650 W - 220 V (245 x 60 mm).

[11] For example, Elstein Type REO 250 mm. These are examples of suitable products available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of these products.

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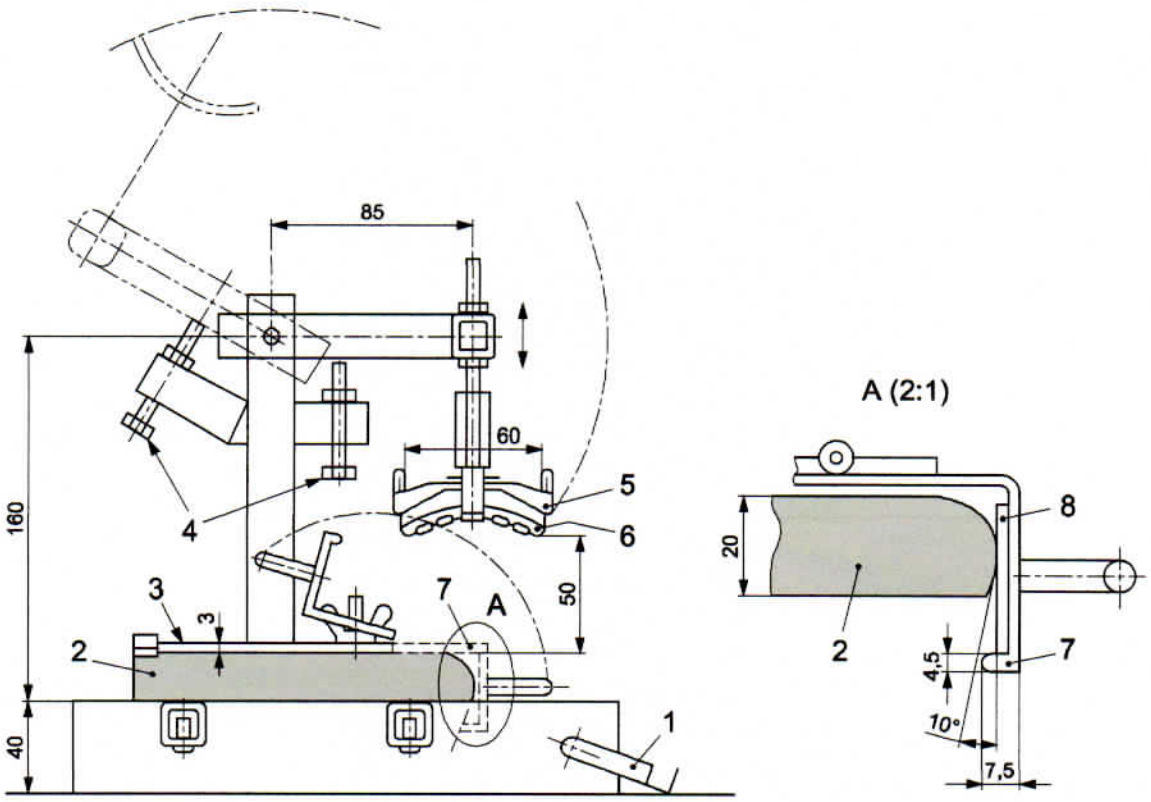
Dimensions in millimetres



Key

1 slotted support bar (for blister test only)
2 forming jig with specified radius
3 clamping device
4 adjustable stops
5 reflector
6 heater element
7 L-shaped forming bar
8 shoulder

Figure 26 — Forming apparatus (Method B)

32.4 Procedure

32.4.1 Use the forming jig corresponding to the specified radius.

Turn on the heater element at least 20 min prior to starting the test.

32.4.2 Calibration of test apparatus

Clamp a specimen on the forming jig (see 32.2.2).

Using a 163 °C temperature indicator (see 32.2.5), make a mark on the upper face in the area to be formed.

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Lower the heater element (see 32.2.1) over the specimen and start the timer (see 32.2.6) immediately. The time to reach 163 °C shall be (30 ± 5) s.

Move the heater element quickly to the rear.

If the time to reach 163 °C is not (30 ± 5) s, adjust the height of the heater element relative to the specimen until the setting is found where the indicator melts in this time.

32.4.3 Test procedure

Clamp the specimen on the forming jig.

Make a mark on the upper face in the area to be formed, using a temperature indicator (see 32.2.5) in the temperature range recommended by the laminate manufacturer.

NOTE Metal laminates, according to EN 438-8, are processed and tested at a lower temperature than typical post formable laminates.

Lower the heater element over the test sample, and start the timer immediately.

Observe the temperature indicator mark for signs of melting. When the mark melts completely, stop the timer, and note the heating time required for the specimen to reach the forming temperature.

Move the heater element quickly to the rear.

Using the handle, immediately but smoothly lower the forming bar (see 32.2.4). The forming time shall not exceed 1 s.

Keep the bar lowered for 1 min to allow the formed specimen to cool in the forming apparatus.

Raise the bar and release and remove the formed specimen.

Carry out the test to assess the formability in both the longitudinal and transverse directions of the sheet (testing two specimens in each case), with the decorative face on the outside of the bend.

If required, e.g. for a particular application, the test may be carried out with the decorative face on the inside of the bend.

If the dimensions of the equipment permit, several specimens can be formed side by side simultaneously.

Inspect the formed specimens with the naked eye, corrected if necessary.

A material has failed if one or more of the four test specimens does not form to the prescribed forming radius, or shows cracking, blistering, crazing or discolouration. Edge cracks within 2 mm of the edge of the specimen shall be ignored.

32.5 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) forming radius;

d) direction of the major axis of the specimen;

e) nature of any failure, for example cracks and their extent, blisters, delamination, discolouration;

f) any deviation from the specified test method;

g) date of the test.

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33 Resistance to blistering (Method A)

33.1 Principle

This test measures the ability of post forming-type high-pressure decorative laminate to resist blistering during the forming process. This is a companion test to that described in Clause 31.

This method is an alternative test method to Clause 34.

33.2 Apparatus

The same as in 31.2 plus an additional timer.

33.3 Test specimens

The specimens shall measure approximately 200 mm × 50 mm, and shall be of the thickness of the sheet under test.

Three specimens shall be tested.

The specimens shall be conditioned for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing.

33.4 Procedure

33.4.1 Calibration of test apparatus

Calibrate the apparatus as specified in 31.4.1.

33.4.2 Test procedure

Use a temperature indicator (see 31.2.3) with a melting point as recommended by the laminate manufacturer to make several marks about 100 mm long on the non-decorative surface and near the centre of the specimen.

NOTE Metal laminates, according to EN 438-8, are processed and tested at a lower temperature than typical post formable laminates.

Place the specimen on the heating trough (see 31.2.1) so that the heat is applied to the decorative side, and start both timers immediately.

Observe the temperature indicator marks on the specimen for signs of melting. When the marks have melted completely, stop the first timer and record the time in seconds (t_1). Allow the second timer to run until blistering occurs, then stop it immediately and record the time in seconds (t_2). Blistering is detected visually and/or audibly.

33.5 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) melting point of the temperature indicator used;

d) average time to reach this temperature (first timer), t_1;

e) average time to blistering (second timer), t_2;

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f) average time from the melting point of the temperature indicator to blistering, $t_2 - t_1$;

g) any deviation from the specified test method;

h) date of the test.

34 Resistance to blistering (Method B)

34.1 Principle

This test measures the ability of post forming-type high-pressure decorative laminate to resist blistering. This is a companion test to that described in Clause 32.

This method is an alternative test method to Method 33.

34.2 Apparatus

The same as in 32.2 plus an additional timer.

34.3 Test specimens

Specimens shall be approximately 180 mm × 90 mm and of the thickness of the sheet under test.

Three specimens shall be tested.

The specimens shall be conditioned for 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing.

34.4 Procedure

34.4.1 General

Any forming jig radius can be used.

34.4.2 Calibration of test apparatus

Calibrate the apparatus as specified in 32.4.2.

34.4.3 Test procedure

Clamp a specimen on the forming jig (see 32.2.2), decorative face up. Raise the slotted support bar (see Figure 26a) to support the free end of the specimen and prevent it from warping during the test.

Make a mark on the upper face in the bending area using a temperature indicator (see 32.2.5) corresponding to the forming temperature recommended by the laminate manufacturer.

NOTE Metal laminates, according to EN 438-8, are processed and tested at a lower temperature than typical post formable laminates.

Lower the heater element (see 32.2.1) over the specimen and start the two timers immediately.

Observe the temperature indicator mark for signs of melting. When the mark melts completely, stop the first timer and record the time in seconds (t_1). Allow the second timer to run until blistering occurs, then stop it immediately and record the time in seconds (t_2). Blistering is detected visually and/or audibly.

Move the heater element to the rear.

34.5 Test report

The test report shall include the following information:

a) reference to this European Standard;

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b) name, type and nominal thickness of the product;

c) melting point of the temperature indicator used;

d) average time to reach this temperature (first timer), t_1;

e) average time to blistering (second timer), t_2;

f) average time from the melting point of the temperature indicator to blistering, $t_2 - t_1$;

g) any deviation from the specified test method;

h) date of the test.

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Annex A
(informative)

Surface finish and colour influence on surface evaluations

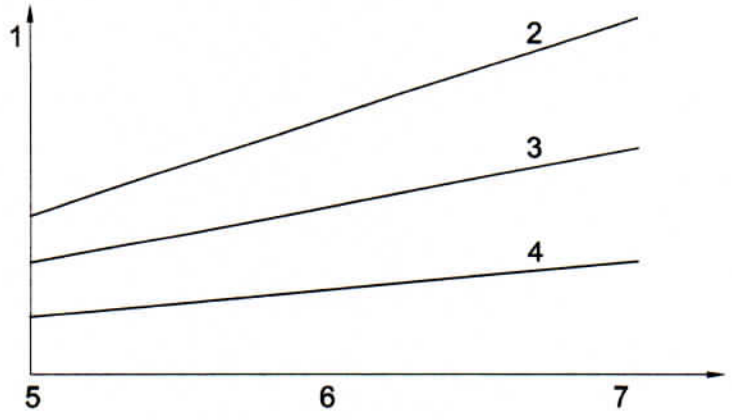
The degree to which decorative laminates show surface damages e.g. scuff, scratch and impact marks, stains, is influenced by surface finish and colour.

Superior surface resistance performance can be achieved by selecting particular combinations of surface finish, colour and pattern.

The abrasion resistance is defined by the thickness of the surface layer(s). The wear ratings are therefore nearly independent from the shape of the surface structure at low to moderate depths. Nevertheless extreme deep structured finishes may lead to a lower initial wear point, IP-value, due to the higher pressure on the top of the surface structure during the determination of the surface wear.

In general terms, surface marks are less easily observable on textured surfaces than on plane surface finishes; light colours are better than dark colours; and prints are usually better than plain colours.

Figure A.1 gives an indication of the effect of surface finish and colour on the surface resistance performance of laminates. The choice of surface finish, colour and print can be made to suit the particular application.



Key

1 surface resistance
2 deep textures
3 shallow textures
4 smooth finishes
5 dark colours
6 medium colours
7 light colours

Figure A.1 — Effects of surface finish and colour on surface resistance

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Annex B
(informative)

Calibration and maintenance of abrasion equipment

B.1 General

This annex outlines procedures for calibration and maintenance of equipment utilized for abrasion resistance testing. The information contained is developed for specific equipment. Other manufacturers of similar equipment may have other requirements. The procedures outlined below do not necessarily address all potential sources of variance. The schedule for use of described procedures has not been established. Good laboratory practice and experience will indicate required intervals in each laboratory. Improper alignment of the abrasive wheels can lead to each wheel abrading a different path from its complementary wheel across the sample as well as the wheels on other machines. Path surface area can differ by as much as 20 % and the area abraded by both wheels on a sample could be less than 50 % of the total abraded area for that sample, hence the source of potential error.

Three parts have been identified as potential sources of error. Each is addressed separately; however each is dependent upon the other. The first is bearing wear (looseness), the second is shaft wear and the third is alignment of the arms. They are addressed without any order of priority below.

B.2 Apparatus

B.2.1 Calibration block of preferably steel measuring 77,9 × 77,9 × 25 mm with a hole drilled and threaded with UNF ¼ inch in the centre (38,95 ± 0,02) mm of the 77,9 × 77,9 mm face such that the block can be threaded onto the holder disc of the abrader. All edges shall be made with a radius of 1 mm.

B.2.2 Feeler gages of various thickness.

B.2.3 Shim washers of various thickness ranging from 0,05 mm and up. The inside diameter shall be 8 mm and the outside diameter shall be 13 mm.

B.3 Procedure

B.3.1 Bearing Wear

a) Examine each arm of the abrader visually and by hand for any bearing wear. Specific areas to examine are the pivot areas of the abrader arm and the shaft on which the wheel revolves. This includes but is not limited to any sideways, twisting, or other motion outside the specific rotation of the arm or the shaft. Any movement noted other than the pivoting of the arm or shaft requires that further examination be made to determine the cause of the excess movement.

b) Specific repairs shall be completed before attempting subsequent portions of the procedure.

B.3.2 Shaft Wear

In certain instances, the shaft for the abrader wheel may slide end to end. This movement shall be eliminated by placing shim washers of appropriate thickness between the bearing face and the shaft keeper ring on the end of the shaft opposite the abrader wheel mounting. This can be measured using the feeler gauges to measure the gap prior to disassembly and the appropriate thickness of shim washers placed on the shaft.

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B.3.3 Alignment

Remove the rubber wheels from their respective shaft mounting and set aside. Remove the rubber mat on the sample table (if used).

Attach the calibration block to the table by the threaded mount.

Gently lower the arms with the exposed shaft ends onto the block. Rotate the block to square the block with the shaft face of each arm. The face of each shaft shall squarely meet the adjacent face of the calibration block without force and without any gap. If the arm does not seat squarely onto the block or leaves a gap between the face and block then that arm shall be aligned.

If the alignment does not allow the wheel shaft to rest against the shaft hub and face, the arm shall be moved away from the block by loosening the two set screws on the top of the machine toward the back that holds the shaft on which the arm pivots and moving the entire arm assembly away from the block enough so that the shaft face and hub rest squarely against the calibration block. Retighten the set screws and recheck.

If the alignment leaves a gap between the shaft hub/face and the calibration block, the arm shall be moved toward the block by loosening the two set screws on the top of the machine toward the back that holds the shaft on which the arm pivots and moving the entire arm assembly towards the block enough so that the shaft face and hub rest squarely against the calibration block. Retighten the set screws and recheck.

In the case of a dual head abrader, the alignment is more complex due to the common mount utilized by the shaft holding the interior arms for each side of the abrader. In the case of a dual head abrader, the following order of alignment adjustments is made.

Remove rubber wheels and tablemats from both heads and attach the calibration block to the left head.

Check Arm 1 for correct alignment. If adjustment is required loosen SS1 and SS2 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws and recheck.

Check Arm 2 for correct alignment. If adjustment is required loosen SS3, SS4 and SS5 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws SS3 and SS4 and recheck.

Remove the calibration block from the left head and attach to the right head.

Check Arm 3 for correct alignment. SS5 is loose. Seat the shaft beneath SS5 fully to the left and check the Arm 3 alignment. If the shaft face/hub is too tight to the calibration block, shims shall be removed from Arm 3 assembly at the point the shaft seats into the arm at point X. Part the assembly by moving the Arm 3 and shaft under SS5 fully to the right and remove the shims as needed to squarely place the shaft face/hub against the calibration block. Retighten the set screw SS5 and recheck. If the shaft face/hub is loose against the calibration block, shims shall be added to the arm 3 at the point the shaft seats into the arm at point X. Measure the gap between the block and the shaft face/hub with the feeler gauge to determine the thickness of shim washers to add. Part the assembly by moving the Arm 3 and shaft under SS5 fully to the right and add the shims as needed to squarely place the shaft face/hub against the calibration block. Retighten the set screw SS5 and recheck.

Check Arm 4 for correct alignment. If adjustment is required loosen SS6 and SS7 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws and recheck.

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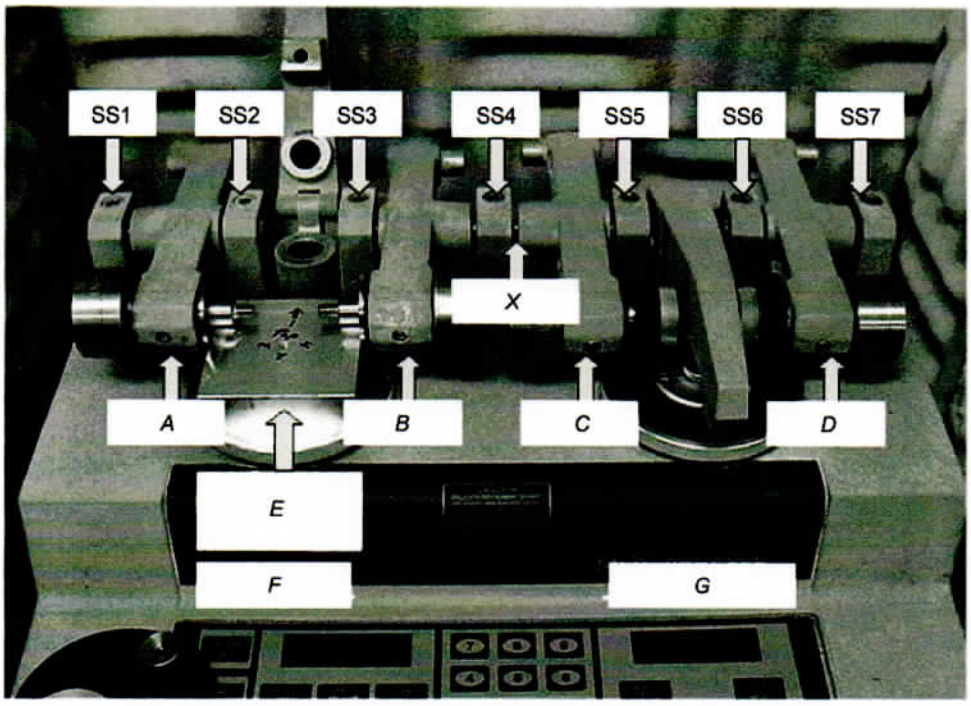

Key

A arm 1
B arm 2
C arm 3
D arm 4
E calibration block
F left head
G right head
X point X

Figure B.1 — Dual Head Abrader with Calibration Block and Identification Points

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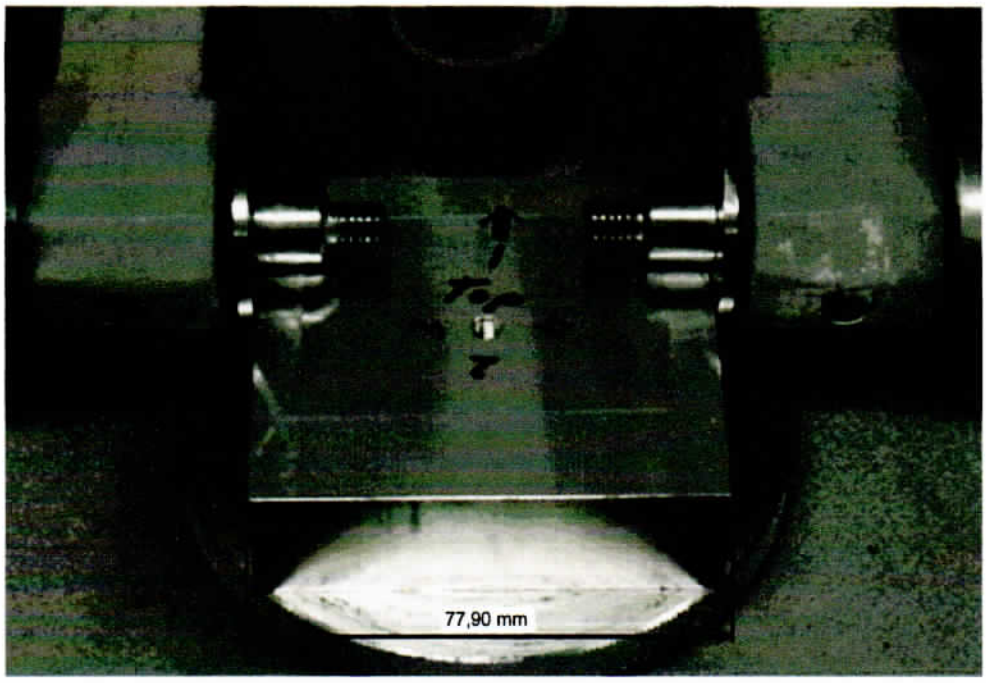

Figure B.2 — Calibration Block with Arms Correctly Aligned

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Annex C
(normative)

Measurement of shore A hardness

For shore A test measurements, the apparatus used shall be a shore type A durometer instrument with a 12,7 mm presser foot diameter, operating stand with a mechanically controlled rate of decent, and 1 kg mass centered on the axis of the indenter. The wheel to be tested shall be firmly located with its major axis horizontal and with the area in which the hardness is to be measured uppermost and positioned directly under the durometer indenter by means of a fixture or V-block (Figure C.1). The hardness measurements are to be taken vertically on the apex of the wheel with the indenter normal to the wheel tread surface and in the middle of the wheel tread. The presser foot shall be applied to the wheel tread at a controlled rate of decent, without shock until the full force of the 1 kg mass is applied to the wheel tread surface. The reading shall be taken 5 s after the presser foot is in firm contact with the wheel surface. Four points shall be measured at equally spaced intervals around the diameter of the wheel and the average of these measurements shall be calculated for wheel hardness.

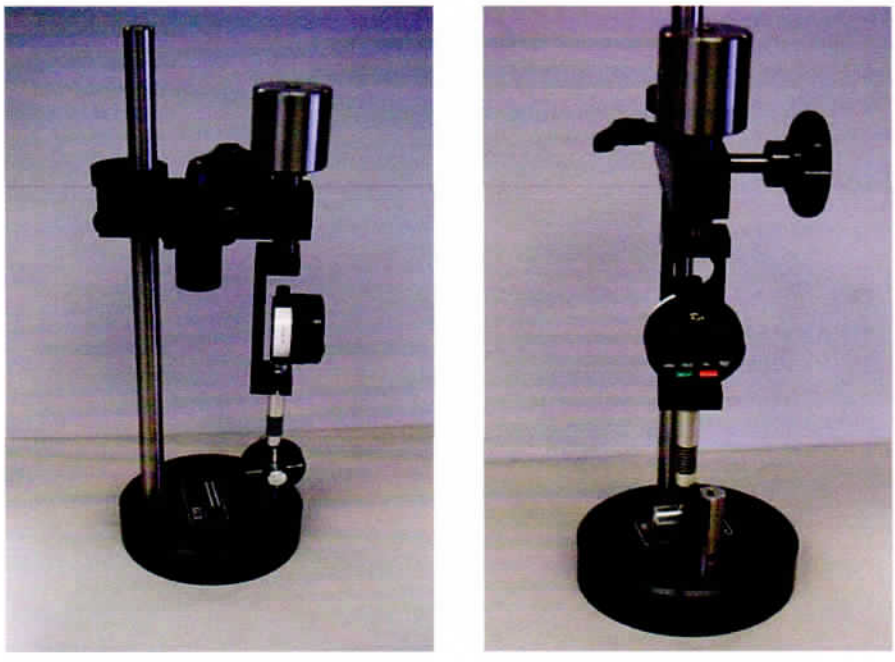

Figure C.1 — Example for a suitable measurement setup

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