

AS/NZS 2924.2:2024
ISO 4586-2:2018



Australian/New Zealand Standard™

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

Part 2: Determination of properties (ISO 4586-2:2018, IDT)



AS/NZS 2924.2:2024

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- Australian Forest Products Association
- Australian Timber Importers Federation
- Building Research Association of New Zealand (BRANZ)
- Department of Agriculture, Fisheries and Forestry (QLD)
- Engineered Wood Products Association of Australasia
- Forest and Wood Products Australia
- Frame & Truss Manufacturers Association Australia
- Glued Laminated Timber Association of Australia
- New Zealand Plywood Manufacturers Association
- New Zealand Timber Industry Federation
- Timber Design Society, New Zealand
- Timber Development Association (NSW)
- Timber Queensland
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Australian/New Zealand Standard™

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Part 2: Determination of properties (ISO 4586-2:2018, IDT)

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TM-011, Engineered Timber Products, to supersede AS/NZS 2924.2:1998, *High pressure decorative laminates — Sheets made from thermosetting resins, Part 2: Determination of properties*.

The objective of this document is to specify the methods of test for determination of the properties of high-pressure decorative laminates (HPL, HPDL) as defined in Clause 3. These methods are primarily intended for testing the sheets specified from AS/NZS 2924.3:2024 to AS/NZS 2924.8:2024.

The precision of the test methods specified in Clauses 5, 6, 7, 8, 9, 10, 13, 14, 16, 19, 20, 21, 22, 24, 25, 26, 39, and 40 is not known because interlaboratory data are not available. When interlaboratory data are obtained, precision statements will be added to the test methods at the following revision. As all the other test methods have an end point determination based on subjective judgement, it is not meaningful to make a statement of precision in these cases.

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The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This seventh edition cancels and replaces the sixth edition (ISO 4586-2:2015) which has been technically revised.

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

- correction of errors due to typographical, formatting, and omission issues.

A list of all parts in the ISO 4586 series can be found on the ISO website.

Introduction

In an effort to harmonize ISO 4586 with other high-pressure decorative laminate standards, multiple methods may be published that demonstrate similar properties. In these instances, the same test method title is given and is annotated as either “Method A” or “Method B”. This is the case in the following tests: Edge squareness — 8/9, Dry heat — 17/18 Dimensional stability at elevated temperatures — 19/20, Dimensional stability at ambient temperature — 21/22, Staining — 30/31, Lightfastness — 32/33, Formability — 38/39, and Blistering — 40/41. In these instances, either method may be utilized in testing. Compliance to both methods is not required. While these tests are similar they are by no means identical and results of one method do not necessarily correspond to the results of the accompanying test. In these situations, it is intended that the documentation in specific parts of ISO 4586 for performance requirements be consulted. Each specific method has performance requirements particular to that method for individual grades of high-pressure decorative laminate.

This document has been harmonized with EN 438-2 whenever possible.

Australian/New Zealand Standard

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

Part 2: Determination of properties (ISO 4586-2:2018, IDT)

1 Scope

This document specifies the methods of test for determination of the properties of high-pressure decorative laminates (HPL, HPDL) as defined in [Clause 3](#). These methods are primarily intended for testing the sheets specified from ISO 4586-3 to ISO 4586-8.

The precision of the test methods specified in [Clauses 5, 6, 7, 8, 9, 10, 13, 14, 16, 19, 20, 21, 22, 24, 25, 26, 39, and 40](#) is not known because interlaboratory data are not available. When interlaboratory data are obtained, precision statements will be added to the test methods at the following revision. As all the other test methods have an end point determination based on subjective judgement, it is not meaningful to make a statement of precision in these cases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 62, *Plastics — Determination of water absorption*

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

ISO 178, *Plastics — Determination of flexural properties*

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

ISO 1770, *Solid-stem general purpose thermometers*

ISO 3668, *Paints and varnishes — Visual comparison of colour of paints*

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

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

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

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

ISO 9352, *Plastics — Determination of resistance to wear by abrasive wheels*

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

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

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

EN 312, *Particleboards — Specifications*

EN 316, *Wood fibreboards — Definition, classification and symbols*

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

CIE publication no. 85: 1989, *Solar spectral irradiance*

3 Terms and definitions

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

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

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

3.1 high-pressure decorative laminate HPL HPDL

sheet consisting of layers of cellulosic fibrous material (normally paper) impregnated with thermosetting resins and bonded together by the *high-pressure process* (3.2)

Note 1 to entry: This is a general definition of high-pressure decorative laminate(s). More specific product definitions can be found from ISO 4586-3 to ISO 4586-8.3.2.

3.2 high-pressure process

simultaneous application of heat (temperature ≥ 120 °C) and high specific pressure (≥ 5 MPa), to provide flowing and subsequent curing of the thermosetting resins to obtain a homogeneous non-porous material with increased density ($\geq 1,35$ g/cm³), and with the required surface finish

3.3 rub

<microscratch resistance> one revolution of the two outer drives of the Martindale tester

3.4 cycle

<microscratch resistance> completion of all the translational movements tracing a *Lissajous figure* (3.5) comprising 16 *rubs* (3.3)

3.5 Lissajous figure

<microscratch resistance> 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

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

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 Overhead white fluorescent lights, of colour temperature approximately 5 000 K and giving an intensity of 800 lx to 1 000 lx over the whole area of the largest sheets to be inspected. 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 ISO 4586 for defects such as smudges, smears, fingerprints, scratches, foreign particles, damage, or any other form of blemish evident within the decorative surface.

The inspector shall use normal vision, corrected if necessary.

4.5 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- 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

5.2.1 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) a reference to this document, i.e. ISO 4586-2;
- 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

6.2.1 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 [6.2.1](#)) 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) a reference to this document, i.e. ISO 4586-2;
- 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 1 000 mm length.

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.

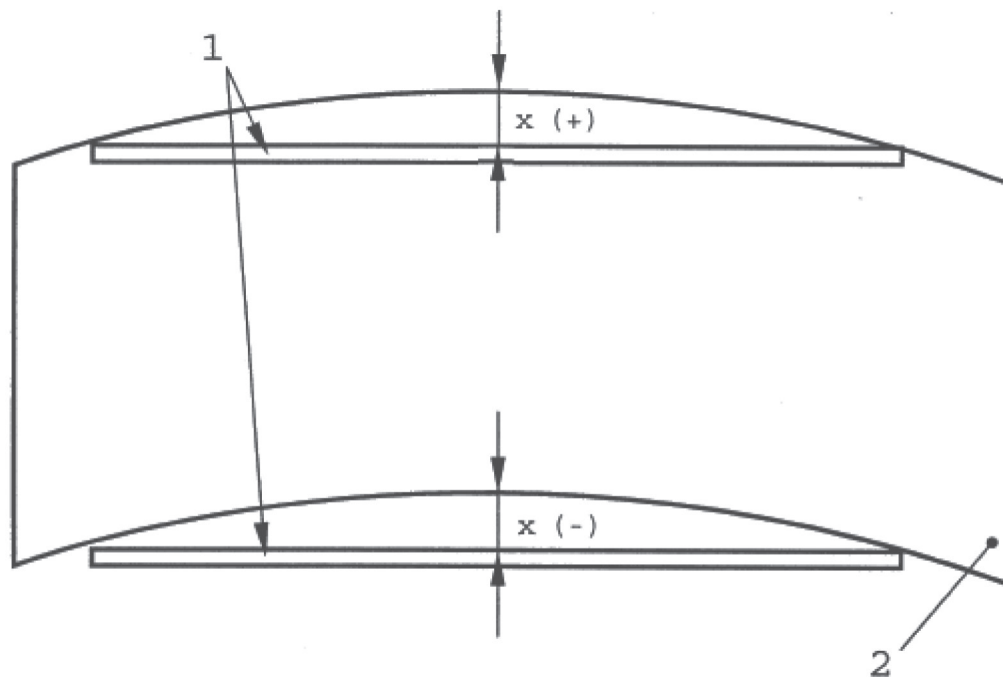
7.5 Expression of results

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) a reference to this document, i.e. ISO 4586-2;
- 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.



Key

- 1 metal straightedge
- 2 laminate

Figure 1 — Edge straightness measurement

8 Determination of edge squareness (Method A)

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 1 000 mm long (see [Figure 2](#)).

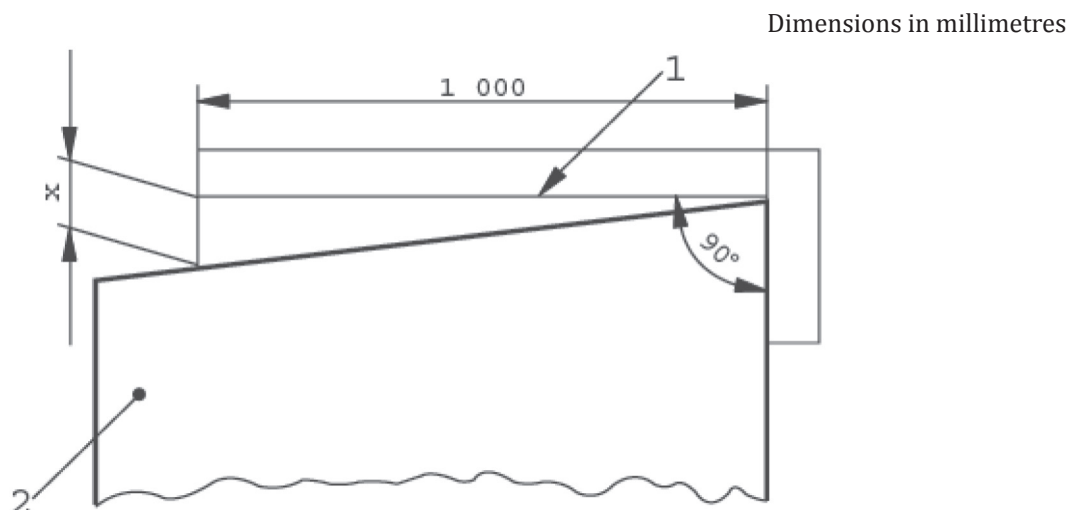
8.2.2 Steel rule, graduated in 0,5 mm divisions.

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 m 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.



Key

- 1 right-angled square
- 2 laminate

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) a reference to this document, i.e. ISO 4586-2;
- 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 edge squareness (Method B)

9.1 Principle

To determine the squareness of a laminate by measuring the length of diagonal dimensions.

9.2 Apparatus

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

9.3 Test specimen

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

9.4 Procedure

Measure the distance from one corner to the opposite corner and record as $L1$. Measure the opposite diagonal and record as $L2$ (see [Figure 3](#)).

EXAMPLE $|L1 - L2| = \text{Squareness}$.

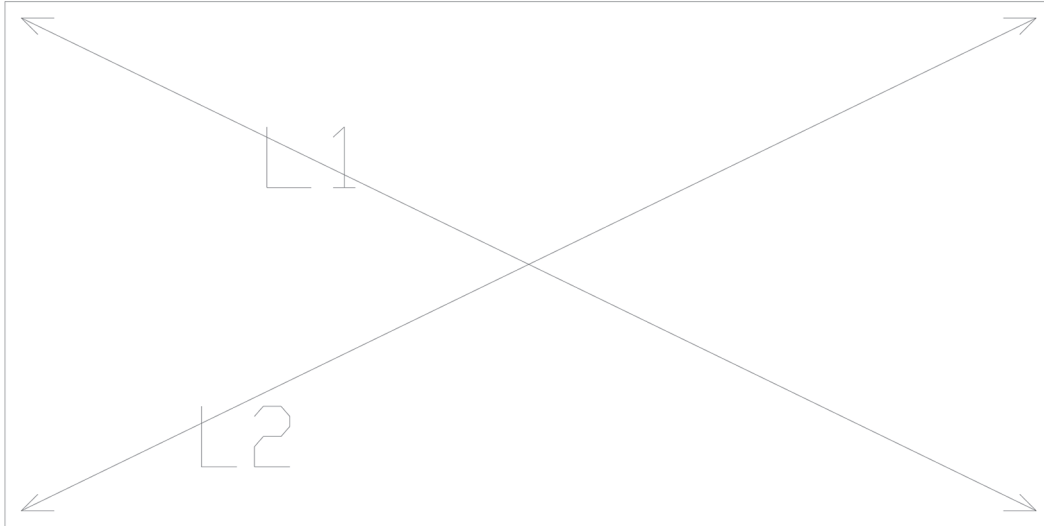


Figure 3 — Squareness

9.5 Expression of results

Squareness is determined as the absolute value of the difference of $L1$ from $L2$.

9.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- 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.

10 Determination of flatness

10.1 Principle

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

10.2 Apparatus

10.2.1 Bow gauge, of length 1 000 mm graduated to permit a reading accuracy of 0,1 mm (see [Figure 4](#)).

Dimensions in millimetres

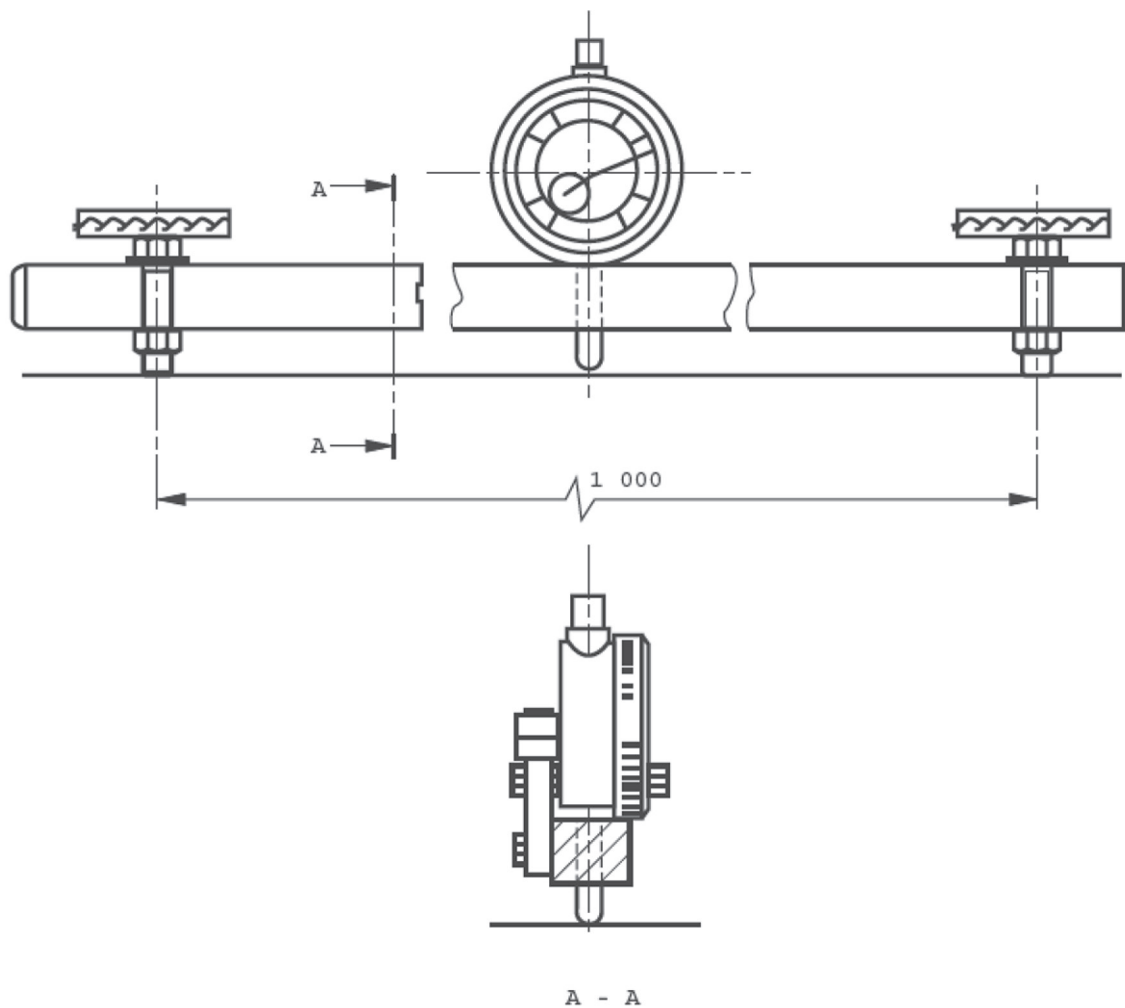


Figure 4 — Bow gauge for measuring flatness

10.3 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.

10.4 Procedure

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

Place the bow gauge (see [10.2.1](#)) 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.

10.5 Expression of results

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

10.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- 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.

11 Resistance to surface wear

11.1 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.

11.2 Materials

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

11.2.2 Abrasive paper strips

- a) paper of grammage 70 g/m^2 to 100 g/m^2 ;
- 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 $100 \text{ }\mu\text{m}$ and remain on a sieve having an aperture of $63 \text{ }\mu\text{m}$;
- c) adhesive backing (optional).

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

11.3 Apparatus

Test machine ¹⁾, as specified in ISO 9352.

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

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

11.4 Test specimens

Each specimen shall be a piece of the laminate under test, shaped to fit the type of clamping device used. It will usually be a disc of diameter about 130 mm, or a square of about 100 mm with its corners rounded to give a diagonal of about 130 mm, and it will usually have a hole of diameter 6 mm in its centre. Three specimens shall be prepared.

11.5 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 [11.3.2](#)) before testing. After preconditioning seal the paper strips in suitable polythene bags (maximum 10 strips per bag) until required for immediate use.

11.6 Procedure

11.6.1 Preparation of abrasive wheels

Bond a strip of preconditioned unused abrasive paper (see [11.2.2](#)) to each of the rubber covered wheels, using either the adhesive backing, if present, or the double-sided adhesive tape (see [11.2.3](#)). Ensure that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper.

11.6.2 Calibration of abrasive paper

Prepare two abrasive wheels with preconditioned unused strips of abrasive paper from the batch to be used for testing (see [11.6.1](#)).

Clamp a zinc plate (see [11.2.1](#)) 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.

11.6.3 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.

Examine the specimen for wear after each 25 revolutions and examine the abrasive paper for clogging with abraded particles. Replace the abrasive paper if it becomes clogged, or after 500 revolutions, whichever happens first.

Continue the test in this way until the initial wear point (IP) is reached. Record the number of revolutions and resume the test until the final wear point (FP) is reached. Record the number of revolutions again.

The initial wear point (IP) is that point at which the first clearly recognizable wear-through of the print, pattern or plain colour appears and the sub-layer becomes exposed in three quadrants. The initial wear point is reached when there are areas of at least 0,60 mm² wear-through in two quadrants and an area of 0,60 mm² wear-through becomes visible in a third quadrant.

The sub-layer for printed patterns is the background on which the pattern is printed; for plain colours it is the first sub-layer of different colour.

The final wear point (FP) occurs in the case of a patterned laminate when about 95 % of the pattern is removed in the abraded area, and in the case of a plain-colour laminate when an underlayer of a different colour is exposed over about 95 % of the abraded area.

NOTE 1 IP-poster²⁾ is a full-colour photographic visual aid with text in multiple languages, to assist correct interpretation, and increase repeatability and reproducibility in the determination of the initial wear point (IP).

NOTE 2 The dirt size estimation chart³⁾ is used to precisely determine the size in mm² of the wear-through area.

11.7 Expression of results

Calculate the wear resistance, expressed as a number of revolutions, for each specimen using the following formula:

$$\text{Wear resistance} = \frac{IP + FP}{2}$$

The initial wear point (IP) for the sample under test shall be the average of the IP values obtained on the three specimens.

The resistance to surface wear of the laminate under test shall be the average of the wear resistance values obtained on the three specimens, rounded to the nearest 50 revolutions.

11.8 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- b) name, type and nominal thickness of the product;
- c) initial wear point (IP) for the sample under test, in revolutions;
- d) resistance to surface wear of the sample under test, in revolutions;
- e) any deviation from the specified test method;
- f) date of the test.

2) The IP-poster is available from SIS Förlag AB, Box 6455, SE-113 82 STOCKHOLM, Sweden; Tel. 00 46 8 610 30 60, Fax 00 46 8 30 18 50 (order reference 21824 IP-poster). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

3) The dirt size estimation chart is available from TAPPI, Technology Park/Atlanta, P.O. Box 105 113, Atlanta, GA 30348-5113, USA; Tel. 00 1 770 446 1400, Fax. 00 1 770 446 6947 (order reference TAPPI - Dirt size estimation chart). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

12 Resistance to abrasion (Flooring grade laminates)

12.1 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 number of revolutions of the specimen required to cause a defined degree of abrasion is used as measures of resistance to abrasion. This test is applicable only to flooring grade laminates.

12.2 Materials

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

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

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

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

12.3 Apparatus

Test machine ⁴⁾, as specified in ISO 9352.

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

12.4 Test specimens

Each specimen shall be a piece of the laminate under test, shaped to fit the type of clamping device used. It will usually be a disc of diameter about 130 mm, or a square of about 100 mm with its corners rounded to give a diagonal of about 130 mm, and it will usually have a hole of diameter 6 mm in its centre. Three specimens shall be prepared.

12.5 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.

4) A suitable machine is available from Taber Acquisition Corp., Taber Industries, 455 Bryant St, P.O. Box 164, North Tonawanda, NY 14120, USA. This is an example of a suitable machine available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by AS/NZS 2924.2:2024.

Precondition the specimens and the abrasive strips for at least 72 h in the conditioning atmosphere (see [12.3.2](#)) before testing. After preconditioning seal the paper strips in suitable polythene bags (maximum 10 strips per bag) until required for immediate use.

12.6 Procedure

12.6.1 Preparation of abrasive wheels

Bond a strip of preconditioned unused abrasive paper (see [12.2.2](#)) to each of the rubber covered wheels, using either the adhesive backing, if present, or the double-sided adhesive tape (see [12.2.3](#)). Ensure that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper.

12.6.2 Calibration of abrasive paper

Prepare two abrasive wheels with preconditioned unused strips of abrasive paper from the batch to be used for testing (see [12.6.1](#)).

Clamp a zinc plate (see [12.2.1](#)) 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.

12.6.3 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. Examine the specimen for abrasion after each 100 revolutions and renew the abrasive papers after every 200 revolutions.

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

The initial wear point (IP) is that point at which the first clearly recognizable wear-through of the print, pattern or plain colour appears and the sub-layer becomes exposed in three quadrants. The initial wear point is reached when there are areas of at least 0,60 mm² wear-through in two quadrants and an area of 0,60 mm² wear-through becomes visible in a third quadrant. The sub-layer for printed patterns is the background on which the pattern is printed; for plain colours it is the first sub-layer of different colour.

NOTE 1 IP-poster⁵⁾ is a full-colour photographic visual aid with text in multiple languages, to assist correct interpretation, and increase repeatability and reproducibility in the determination of the initial wear point (IP).

NOTE 2 The dirt size estimation chart⁶⁾ is used to precisely determine the size in mm² of the wear-through area.

5) The IP-poster is available from SIS Förlag AB, Box 6455, SE-113 82 STOCKHOLM, Sweden; Tel. 00 46 8 610 30 60, Fax 00 46 8 30 18 50 (order reference 21824 IP-poster). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

6) The dirt size estimation chart is available from TAPPI, Technology Park/Atlanta, P.O. Box 105 113, Atlanta, GA 30348-5113, USA; Tel. 00 1 770 446 1400, Fax. 00 1 770 446 6947 (order reference TAPPI - Dirt size estimation chart). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

Record the number of revolutions as the IP-value. Repeat the test immediately using the two remaining test specimens.

12.7 Expression of results

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.

12.8 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- b) name, type and nominal thickness of the product;
- c) resistance to abrasion for the sample under test, in revolutions;
- d) any deviation from the specified test method;
- e) date of the test.

13 Resistance to immersion in boiling water

13.1 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 ISO 62, except for a longer period of immersion in the boiling water and the requirement for thickness measurements.

13.2 Apparatus

13.2.1 Balance, accurate to 1 mg.

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

13.2.3 Vessel, containing boiling distilled water.

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

13.2.5 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.

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

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

ISO of this product.

13.3 Test specimens

Three specimens shall be taken from the same laminate, cut from positions greater than 50 mm from the edge of the sheet. Each specimen shall be (50 ± 1) mm², 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.

13.4 Procedure

Place the three specimens for at least 72 h in the conditioning chamber (see [13.2.2](#)).

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.

13.5 Expression of results

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 formula:

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

$$\frac{t_6 - t_2}{t_2} \times 100, \text{ etc.}$$

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 12 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 accordance with the following rating scales:

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.
- Rating 1: Blistering and/or delamination.

Edge rating scale:

- Rating 5: No visible change.
- Rating 4: Slight hairline edge cracks visible to the naked eye.
- Rating 3: Moderate edge cracks.
- Rating 2: Severe edge cracks.
- Rating 1: Core layer delamination.

13.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- b) name, type and nominal thickness of the product;
- c) average percentage increase in mass;
- d) average percentage increase in thickness;
- e) result of the examination for change in appearance;
- f) any deviation from the specified test method;
- g) date of the test.

14 Substrate protection against water vapour

14.1 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.

14.2 Apparatus

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

14.2.2 Thickness gauge, as specified in [5.2](#).

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

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

14.3 Test specimens

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

14.4 Procedure

Using the milling tool (see [14.2.1](#)) cut a circular groove in the centre of the specimen as shown in [Figure 5](#), 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 [14.2.2](#)) 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 [14.2.3](#)) and bring it to the boil on the hot-plate (see [14.2.4](#)). Place the specimen, with the cut decorative surface face down, centrally over the mouth of the flask.

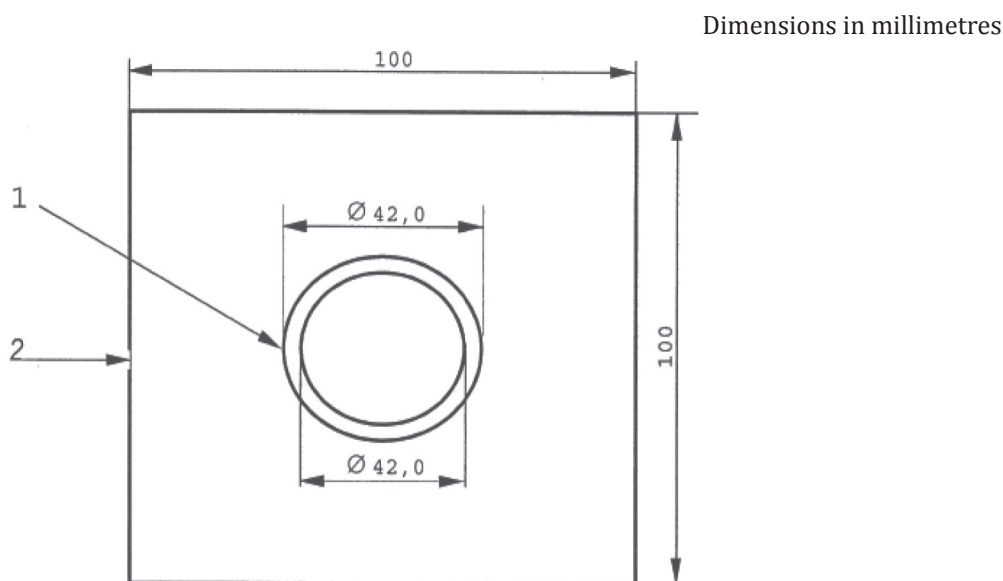
After 1 h, remove the specimen and remove excess water from the surfaces and edges using absorbent paper.

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.

14.5 Expression of results

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



Key

- 1 circular groove
- 2 test specimen

Figure 5 — Specimen for substrate protection test

14.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- 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.

15 Resistance to water vapour

15.1 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.

15.2 Apparatus

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

15.2.2 Specimen holder, and heat screen, (see [Figure 6](#)).

15.2.3 Filter paper, or tissue.

15.2.4 Electric hotplate, or other suitable heat source.

15.3 Test specimen

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

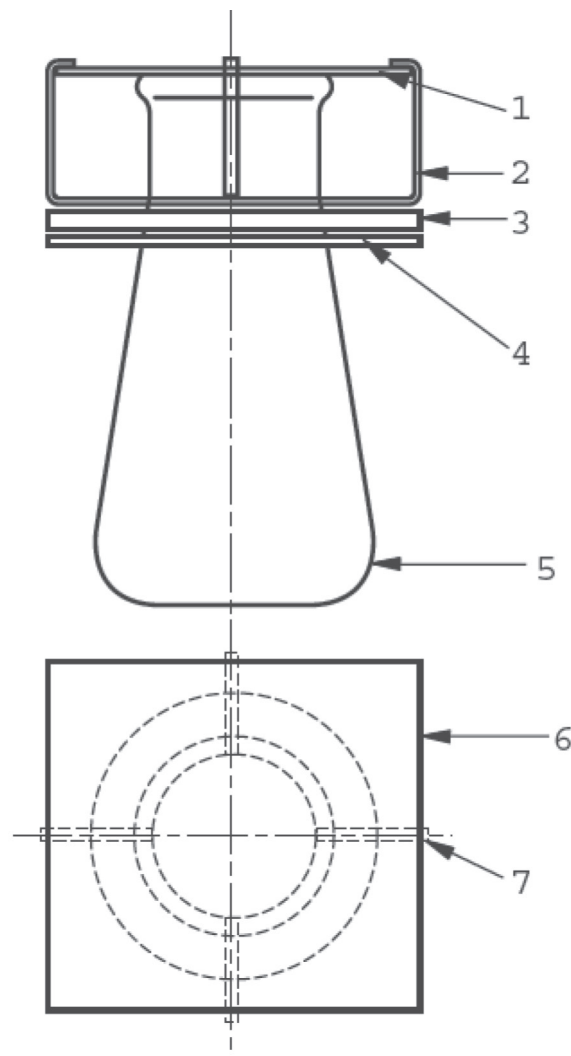
15.4 Procedure

Place approximately 200 ml of water in the flask (see [15.2.1](#)) and bring it to the boil on the electric hotplate (see [15.2.4](#)). Place the heat screen (see [15.2.2](#)) 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 [15.2.2](#) and [Figure 6](#)).

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 [15.2.3](#)) 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.



Key

- 1 test specimen
- 2 wire specimen holder
- 3 heat-resistant screen
- 4 aluminium ring
- 5 Erlenmeyer flask, wide neck, 250 ml
- 6 test specimen
- 7 wire specimen holder

Figure 6 — Apparatus for resistance to water vapour

15.5 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.

15.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- 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.

16 Resistance to wet conditions (Exterior grade laminates)

16.1 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 long-term influence of exposure to moisture.

16.2 Apparatus

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

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

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

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

16.2.5 Balance, accurate to 1 mg.

16.3 Test specimens

The specimens shall be (150 ± 1) mm² and be of the thickness of the laminate under test. The cut edges shall be smooth and free from cracks.

Three specimens shall be used, cut from positions greater than 50 mm from the edge of the sheet.

16.4 Procedure

Place the three specimens for at least 72 h in the conditioning chamber (see [16.2.4](#)).

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

Place the specimens in the specimen holder (see [16.2.2](#)) and place the specimen holder in the water bath (see [16.2.1](#)) 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 [16.2.3](#)) 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.

16.5 Expression of results

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.

The result of the examination for change in appearance shall be the lowest rating of the three specimens assessed in accordance with the following rating scales:

Surface rating scale

- Rating 5: No visible change.
- Rating 4: Slight change of gloss/colour, only visible at certain viewing angles.
- Rating 3: Moderate change of gloss/colour.
- Rating 2: Marked change of gloss/colour.
- Rating 1: Blistering and/or delamination.

Edge rating scale

- Rating 5: No visible change.
- Rating 4: Slight hairline edge cracks visible to the naked eye.
- Rating 3: Moderate edge cracks.
- Rating 2: Severe edge cracks.
- Rating 1: Core layer delamination.

16.6 Test report

The test report shall contain the following information:

- a) a reference to this document, i.e. ISO 4586-2;
- b) name, type and nominal thickness of the product;
- c) average percentage increase in mass;
- d) result of the examination for change in appearance;

- e) any deviation from the specified test method;
- f) date of the test.

17 Resistance to dry heat (Method A)

17.1 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. This is an alternative method to [Clause 18](#).

17.2 Apparatus and materials

17.2.1 Thermometer, as specified in ISO 1770 capable of insertion to the bottom of the centre bore of the heat source ([17.2.2](#)) or other means of measuring the temperature of the heat source to an accuracy of ± 1 °C.

17.2.2 Heat source consisting of a block as shown in [Figure 7](#) manufactured from aluminium alloy according to ISO 209[3], Al Mg Si (alloy shall contain more than 94 % aluminium). The roughness of bottom surface shall be (2 ± 1) μm , expressed as R_a , according to ISO 4287[6] and ISO 4288[7].

NOTE Alloy 6060 and 64430 are suitable.

17.2.3 Fine-faced wood particleboard, in accordance with EN 312 (for interior fitments), (230 ± 5) mm², with a nominal thickness of 18 mm to 20 mm ($\pm 0,3$ mm), a density of (680 ± 20) kg/m³, and moisture content (10 ± 3) %. As an alternative, particle board with a nominal density of 720 kg/m³ (45 lbs/ft³) and nominal thickness of 19 mm (3/4 inch) and sanded with 100 grit sandpaper may be used.

17.2.4 Urea-formaldehyde adhesive, containing approximately 15 % filler, or a PVAc (white glue) utilized in accordance with the adhesive manufacturer's instructions or an equivalent adhesive.

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

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

17.2.7 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.

17.2.8 Diffuse light source, providing evenly diffused light, giving an illumination on the test surface of $(1\,200 \pm 400)$ 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 (5 000 to 6 500) K and a R_a greater than 92, by using a colour matching booth in accordance with ISO 3668.

17.2.9 Fixed frame, to hold the specimen flat.