INTERNATIONAL STANDARD

ISO 4586-2

Seventh edition
2018-07

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

Part 2: Determination of properties

Stratifiés décoratifs haute pression (HPL, HPDL) — Plaques à base de résines thermodurcissables (communément appelées stratifiés) —

Partie 2: Détermination des caractéristiques

Reference number
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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.

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

Part 2: Determination of properties

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 (≥ 1,35 g/cm^3), 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:

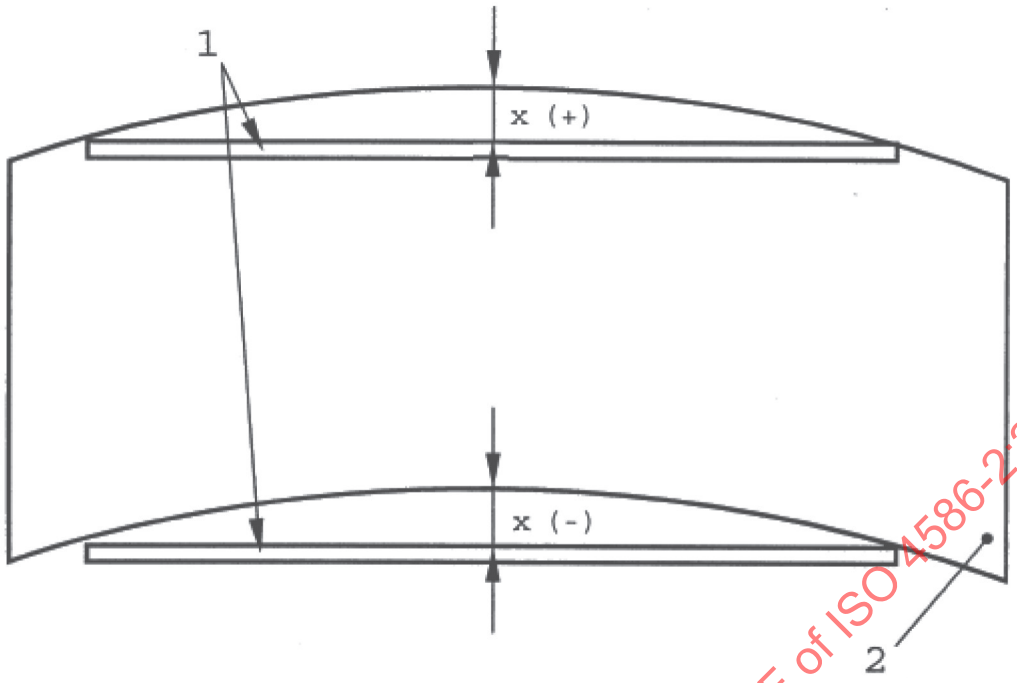
a) a reference to this document, i.e. ISO 4586-2;

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.

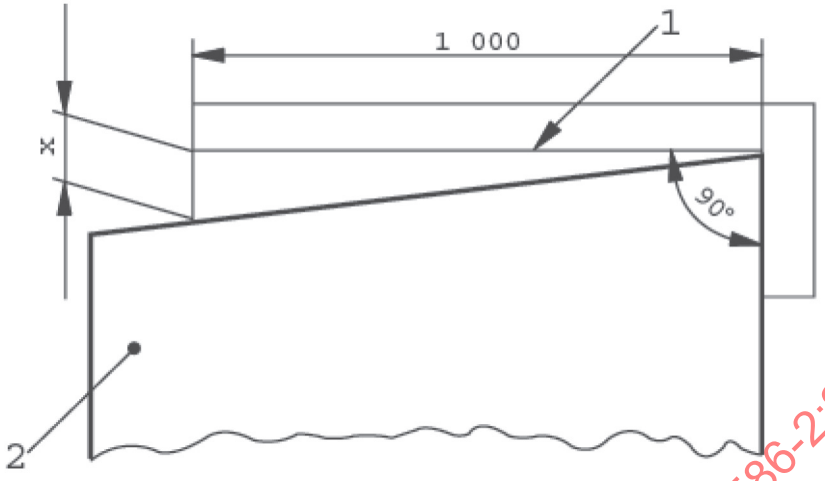
8.3 Test specimen

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.

Dimensions in millimetres



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 $|L1 - L2|$ = Squareness.

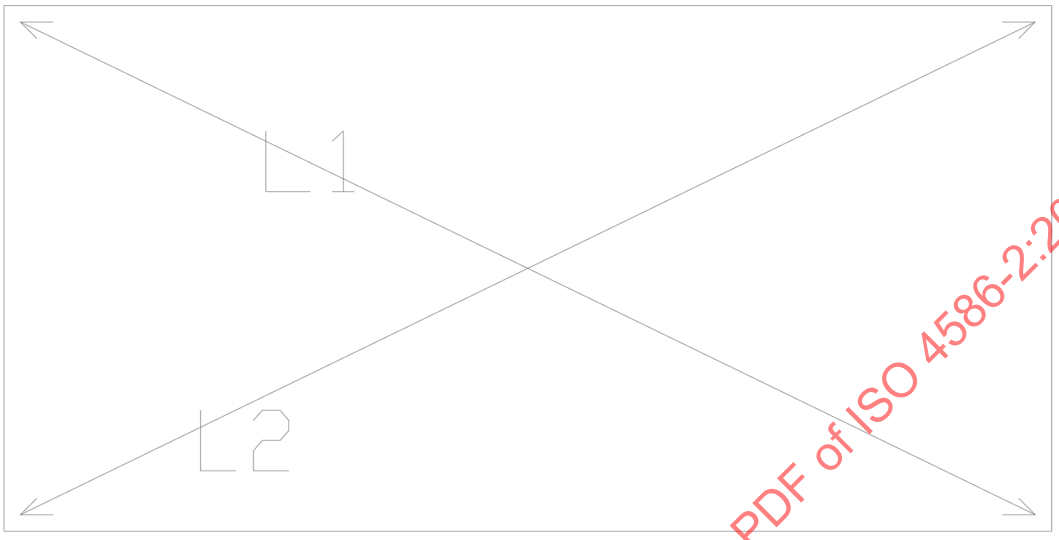


Figure 3 — Squareness

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

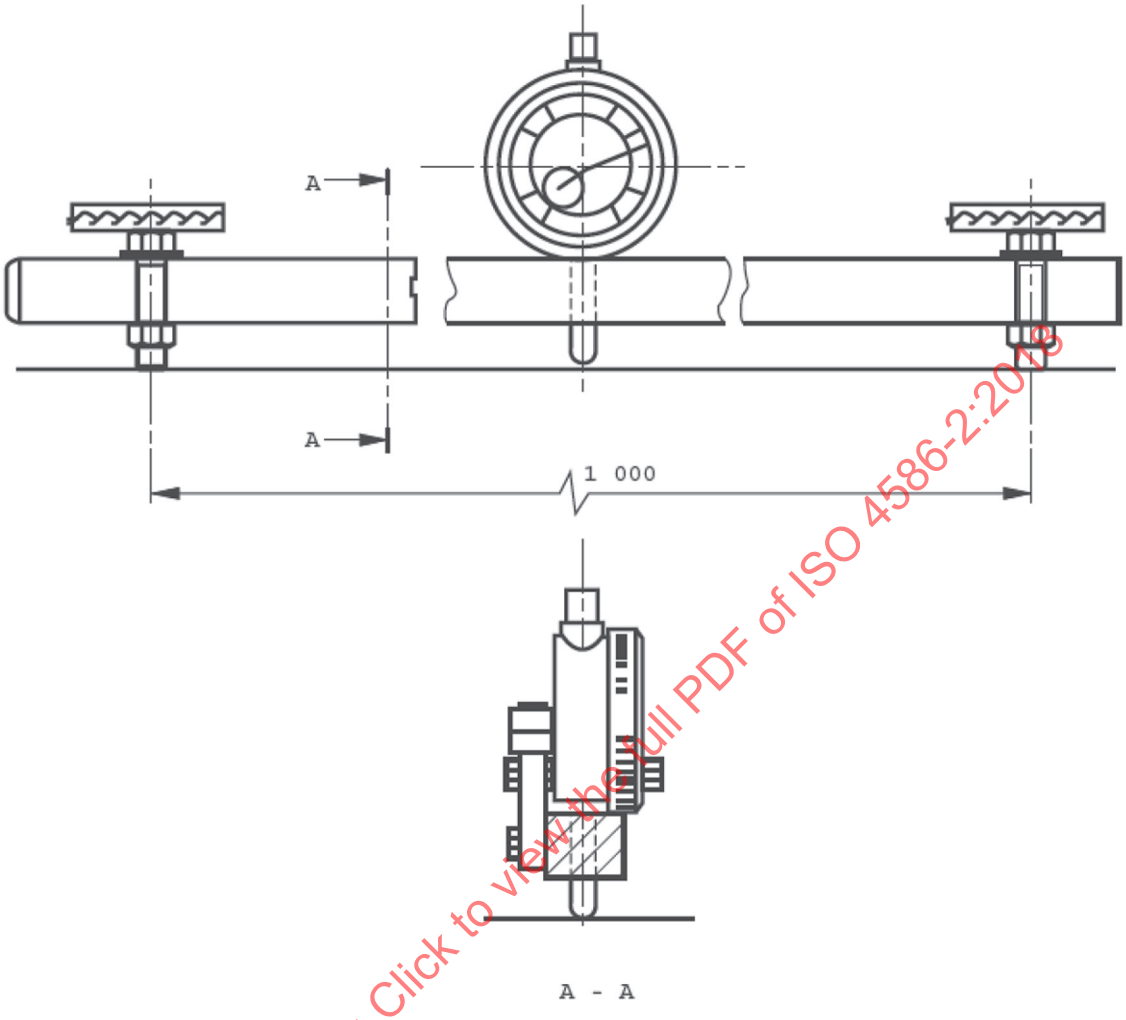


Figure 4 — Bow gauge for measuring flatness

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 ± 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 µm and remain on a sieve having an aperture of 63 µm;

c) adhesive backing (optional).

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

11.3 Apparatus

11.3.1 Test machine[1)], as specified in ISO 9352.

11.3.2 Conditioning chamber, in accordance with ISO 291, with a standard atmosphere of (23 ± 2) °C, relative humidity (50 ± 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 the 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 mm^2 wear-through in two quadrants and an area of 0,60 mm^2 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-poster[2)] 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 chart[3)] is used to precisely determine the size in mm^2 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 ± 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/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 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

12.3.1 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.

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.

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 ISO of this machine.

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 mm^2 wear-through in two quadrants and an area of 0,60 mm^2 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-poster[5)] 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 chart[6)] is used to precisely determine the size in mm^2 of the wear-through area.

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

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.

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

13.2.3 Vessel, containing boiling distilled water.

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

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) mm^2, 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 ± 0,1) mm and an outside diameter of (42,0 ± 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.

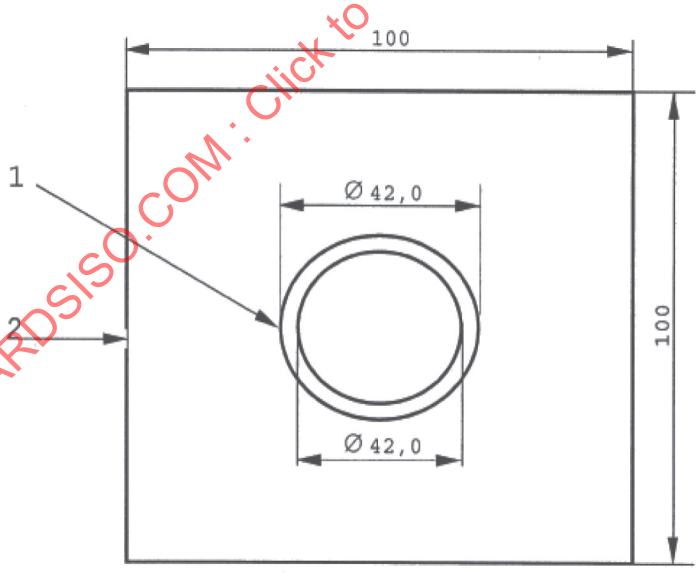
Re-measure the thickness in the same position as measurement t_1, and record it as value t_2.

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 ($t_2 - t_1$).

Dimensions in millimetres



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.

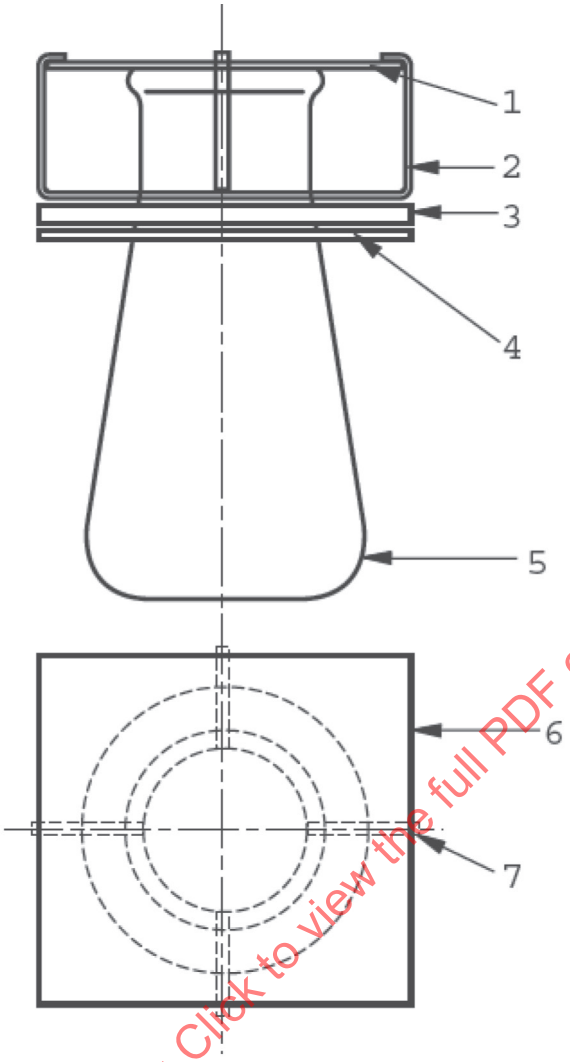
15.4 Procedure

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) mm^2 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 *Ra*, 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) mm^2, 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) %. As an alternative, particle board with a nominal density of 720 kg/m^3 (45 lbs/ft^3) 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.

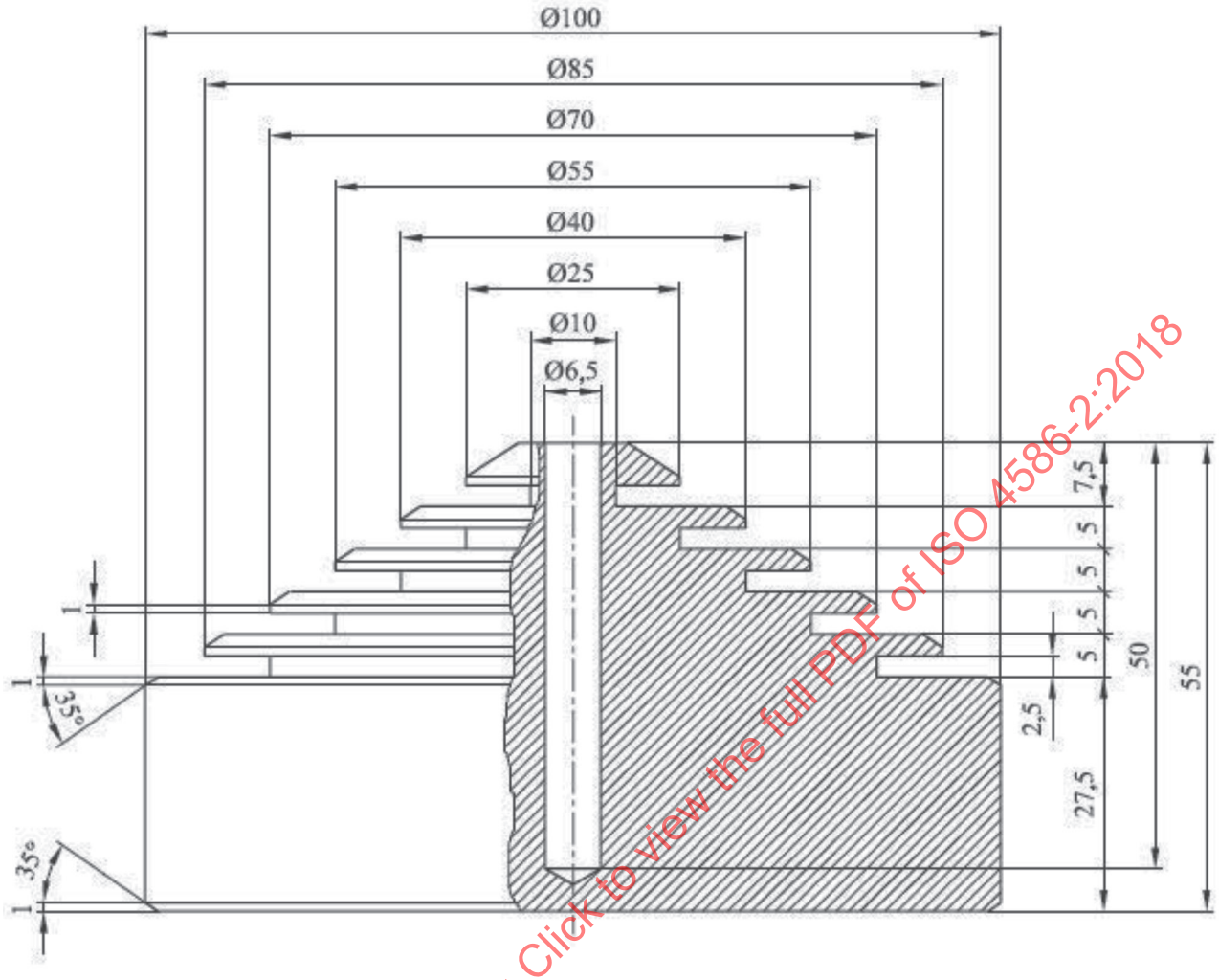
17.2.7 Heat-insulating foam, consisting of a melamine foam, with the following characteristics: density between 8,5 kg/m^3 and 11,5 kg/m^3; heat conductivity, less than 0,035 W/mK. The foam shall withstand at a temperature higher than 200 °C.

17.2.8 Diffuse light source, providing evenly diffused light, giving an illumination on the test surface of (1 200 ± 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 *Ra* greater than 92, by using a colour matching booth in accordance with ISO 3668.

17.2.9 Fixed frame, to hold the specimen flat.

Dimensions in millimetres



Dimensions: ± 0,2 mm of the nominal dimension
Angles: ± 2 of the nominal angle

Figure 7 — Aluminium block used as heat source

17.3 Test specimen

The specimen shall be prepared by uniformly bonding a piece of the laminate under test to the wood chipboard (see 17.2.3), using the specified adhesive (see 17.2.4) evenly spread at 80 g/m^2 to 120 g/m^2. One specimen (230 ± 5) mm^2 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.

17.4 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 (17.2.9).

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 (17.2.6) before the test.

Using the oven (17.2.5), raise the temperature of the heat source to a temperature higher than the specified test temperature, and transfer it to the heat insulating foam (17.2.7) or on a sufficient large board of wood particleboard (17.2.3).

Place the thermometer (17.2.1) or other means of measuring temperature in the centre bore of the heat source (17.2.2). 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 (17.2.6) and examine the tested area.

17.5 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 (17.2.8) 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.

17.6 Expression of results

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

— Rating 5: No change — Test area indistinguishable from adjacent surrounding area.

— Rating 4: Slight 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.

— Rating 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.

— Rating 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.

— Rating 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.

17.7 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.

18 Resistance to dry heat (Method B)

18.1 Principle

A specimen taken from the laminate under test, bonded to wood chipboard to simulate service conditions, is subjected to dry heat by contact with a vessel of defined heat capacity, initially at 180 °C but cooling during the 20 min of contact. Resistance to the test conditions is assessed by visual examination.

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.

18.2 Materials

18.2.1 Heating fluid, dimethyl polysiloxane oil, (100 cSt viscosity) or any other material of similar specific heat which will produce the same result.

18.2.2 Fine-faced wood particleboard, in accordance with EN 312 (for interior fitments), (230 ± 5) m^2, 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) %. As an alternative, particle board with a nominal density of 720 kg/m^3 (45 lbs/ft^3) and nominal thickness of 19 mm (3/4 inch) and sanded with 100 grit sandpaper may be used.

18.2.3 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.

18.3 Apparatus

18.3.1 Cast cylindrical aluminium or aluminium alloy vessel, (see Figure 8).

18.3.2 Heat source, for heating the vessel (see 18.3.1) uniformly.

18.3.3 Suitable inorganic heat-insulating board, of thickness about 2,5 mm and approximately 150 mm^2.

18.3.4 Thermometer, range –5 °C to +250 °C with an accuracy of 1 °C.

18.3.5 Fixed frame, to hold the specimen flat.

18.3.6 Stirrer.

18.4 Test specimen

The specimen shall be prepared by uniformly bonding a piece of the laminate under test to the wood chipboard (see 18.2.2), using the specified adhesive (see 18.2.3) evenly spread at 80 g/m^2 to 120 g/m^2. One specimen (230 ± 5) mm^2 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.

18.5 Procedure

Fill the vessel (see 18.3.1) with sufficient heating fluid (see 18.2.1) so that at 180 °C the level is about 15 mm from the top. Fix the thermometer (see 18.3.4) centrally in the vessel with its bulb about 6 mm from the bottom. Raise the temperature of the heating fluid to approximately 185 °C, stirring from time to time. Transfer the vessel to the heat-insulating board (see 18.3.3) and allow the temperature to fall to (180 ± 1) °C, stirring continuously.

Immediately place the vessel on the surface of the specimen and allow to stand for 20 min without further stirring.

At the end of this period, remove the vessel and allow the specimen to cool for a period of 45 min. Examine the specimen for surface disturbance, for example blistering, crazing, discolouration or loss in gloss, visible to the naked eye, corrected if necessary, allowing the light to fall on the specimen at various angles of incidence.

18.6 Expression of results

The result of the examination for surface disturbance 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: Surface damage and/or blistering.

Dimensions in millimetres

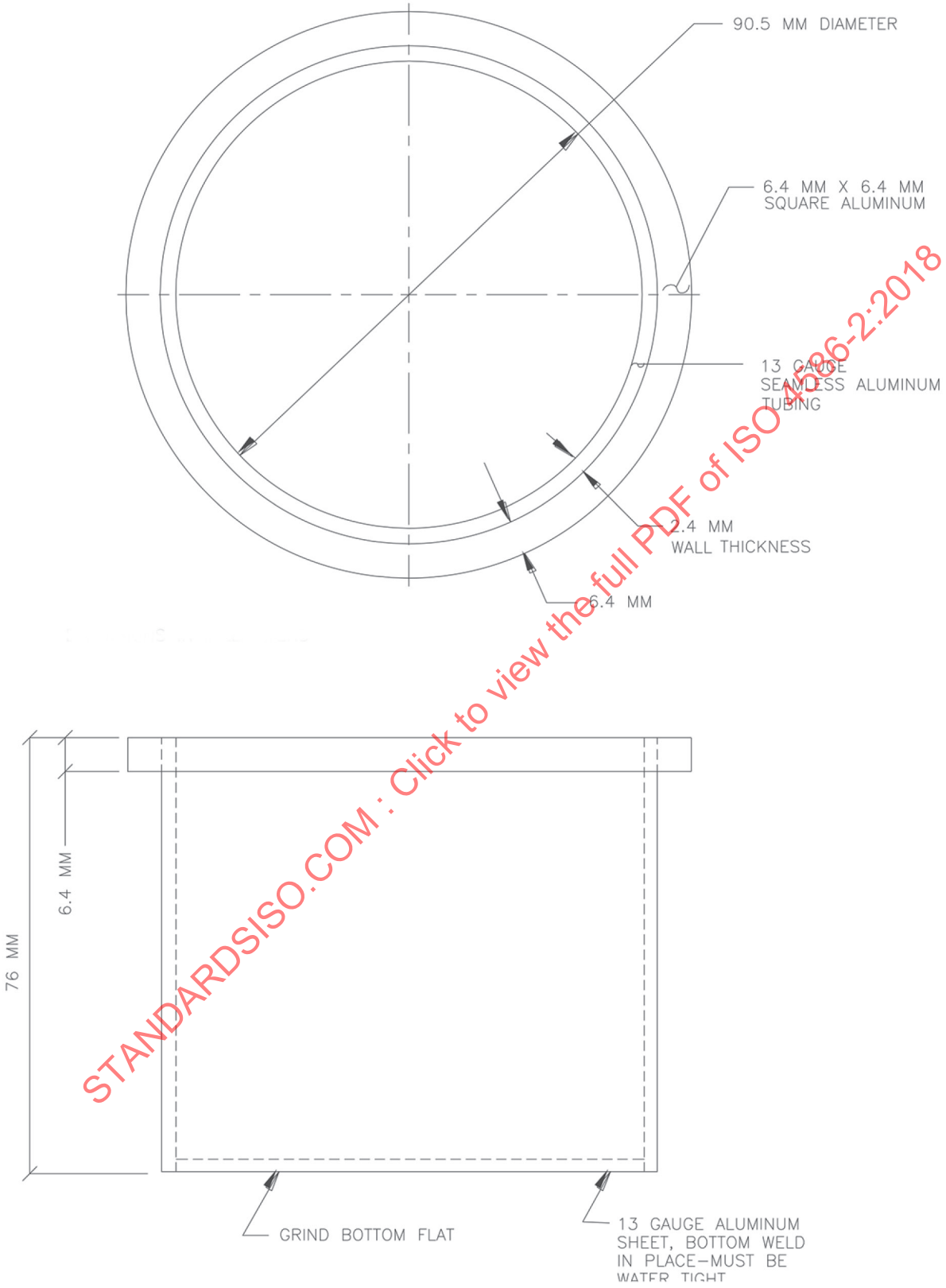


Figure 8 — Aluminium heating vessel

18.7 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.

19 Dimensional stability at elevated temperature (Method A)

19.1 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. This is a companion method to Clause 21 and an alternative method to Clause 20.

19.2 Apparatus

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

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

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

19.2.4 Means for measuring lengths, of 200 mm to the nearest 0,02 mm.

19.2.5 Desiccator, of suitable size.

19.3 Test specimens

Each specimen shall be (250 ± 2) mm long, (50 ± 1) mm wide and of the thickness of the laminate under test. The edges shall be smooth and free from cracks. Measuring marks shall be made on the decorative face of the specimens approximately 200 mm apart and 25 mm from each end.

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.

19.4 Procedure

19.4.1 All measurements of length shall be made to the nearest 0,02 mm. Measurements shall be made within 5 min after removal of the specimens from the conditioning atmosphere or the desiccator (see 19.2.5).

19.4.2 Dry-heat test

Taking two specimens in each direction, measure the distance between the marks on each specimen with the specimens laid flat, and then place them in the oven (see 19.2.1) 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 19.2.5) for 1 h, and then re-measure the distance between the marks.

19.4.3 High-humidity test

Taking the remaining two specimens in each direction, measure the distance between the marks and then place them in the conditioning chamber (see 19.2.2) at (40 ± 2) °C and relative humidity within the range 90 % to 95 %. After (96 ± 4) h, remove each specimen, wipe it free of surface water with a cloth, and immediately re-measure the distance between the marks.

19.5 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. This change is the sum of the mean absolute percentage changes in each of the dry-heat and high-humidity tests. The absolute figure shall be reported.

19.6 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) 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.

20 Dimensional stability at elevated temperature (Method B)

20.1 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. This is a companion method to Clause 22 and an alternative method to Clause 19.

20.2 Apparatus

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

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

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

20.2.4 Caliper gauge or other suitable means for measuring length, with a measurement range of at least 150 mm, graduated to provide accuracy of 0,01 mm. Centering points are recommended but not required.

20.2.5 Fixture, to maintain specimens from thin laminates in a flat position while measurements are taken. A suitable fixture is shown in Figure 9.

20.2.6 Center-punch and hammer (optional), suitable for making a small locating indentation in the surface of the test specimen.

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

20.2.8 Desiccator, of suitable size.

Dimensions in millimetres

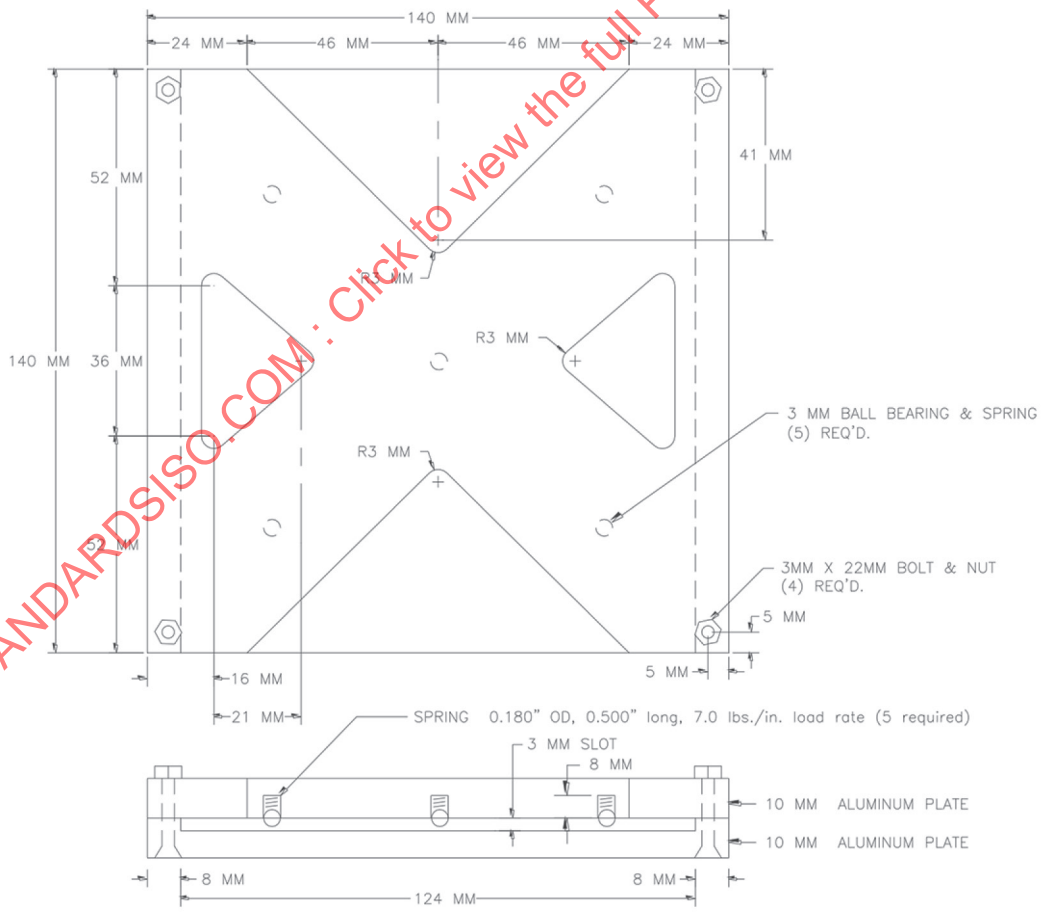


Figure 9 — Dimensional stability fixture

20.3 Test specimens

Cut six specimens (120 ± 1) mm^2 from the sheet under test. The edges shall be smooth and free from cracks. Use three specimens for the dry-heat test and three for the high-humidity test.

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.

20.4 Procedure

20.4.1 General

All measurements of length shall be made to the nearest 0,02 mm. Measurements shall be made within 5 min after removal of the specimens from the conditioning atmosphere or the desiccator (see 20.2.8). The specimens shall be kept flat when making measurements. For thin laminates, a suitable fixture such as that shown in Figure 9 shall be used.

With each specimen, use the steel rule (20.2.7) to locate the point midway between the two adjacent corners and 10 mm in from the corresponding edge. Mark this point using the centre punch (20.2.6). Repeat this step for the other three sides for that specimen and repeat for the additional five specimens such that all six specimens are marked in this fashion.

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.

20.4.2 Dry-heat test

Taking three specimens, measure the distance between the marks on each specimen with the specimens laid flat. Record the three machine direction and the three transverse-direction measurements.

Place the three specimens in the oven (20.2.1) maintained at (70 ± 2) °C for a period of 24 h (± 15 min).

At the end of 24 h, remove them and allow them to cool to ambient temperature in the desiccator (see 20.2.8) for 1 h, and then re-measure the distance between the marks.

20.4.3 High-humidity test

Take the remaining three specimens, measure the distance between the marks on each specimen with the specimens laid flat. Record the three machine direction and the three transverse-direction measurements.

Place the three specimens in the high-humidity conditioning chamber (20.2.2) maintained at (40 ± 2) °C and 90 % to 95 % relative humidity for a period of 96 h (± 15 min).

At the end of the period, remove each specimen, wipe it free of surface water with a cloth and then immediately re-measure the distances between the marks.

20.5 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 machine-direction length (see Table 1) and transverse-direction length for each of the two sets of specimens (i.e. the dry-heat and high-humidity sets to the nearest 0,05 %.

Calculate the cumulative dimensional change for each direction of the sheet. This change is the sum of the mean absolute percentage changes in each of the dry-heat and high-humidity tests if the changes are in opposite directions. If the changes are in the same direction, the largest of the three average changes shall be taken as the cumulative dimensional change. The absolute figure shall be reported.

Table 1 — Example of calculations in the machine direction

Dry Heat				
Specimen	1	2	3	Mean
Initial distance (mm)	100,28	99,89	99,95	
Final distance (mm)	99,83	99,52	99,55	
Change (mm)	−0,45	−0,37	−0,40	
Change (%)	−0,45	−0,37	−0,40	−0,41
−0,41 % rounded to the nearest 0,05 %				−0,40 %

High humidity test	1	2	3	Mean
Initial distance (mm)	100,11	99,74	99,21	
Final distance (mm)	100,63	100,49	99,92	
Change (mm)	+ 0,52	+ 0,75	+ 0,71	
Change (%)	+ 0,52	+ 0,75	+ 0,72	0,66
0,66 % rounded to the nearest 0,05 %				0,65 %
0,40 % + 0,65 % = 1,05 %				

The movements in the three sets are in the opposite directions; therefore the cumulative dimensional change in the machine direction is equal to the sum of the two means.

20.6 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) cumulative dimensional change for the machine direction (average of three specimens at each condition);

d) cumulative dimensional change for the cross-machine direction(average of three specimens at each condition);

e) any deviation from the specified test method;

f) date of the test.

21 Dimensional stability at ambient temperature (Method A)

21.1 Principle

The test measures the lateral dimensional changes of specimens from the sheet under test due to changes in humidity at ambient temperature. This is a companion method to Clause 19 and an alternative method to Clause 22.

21.2 Apparatus

20.2.1 Conditioning chambers, maintaining the following three atmospheres:

— (23 ± 1) °C, relative humidity (32 ± 3) %

— (23 ± 2) °C, relative humidity (90 ± 3) %

— (23 ± 2) °C, relative humidity (50 ± 5) %

20.2.2 Means for measuring lengths, of 200 mm to the nearest 0,02 mm.

21.3 Test specimens

Each specimen shall be (250 ± 2) mm long, (50 ± 1) mm wide and of the thickness of the laminate under test. The edges shall be smooth and free from cracks. Measuring marks shall be made on the decorative face of the specimens approximately 200 mm apart and 25 mm from each end.

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 low humidity 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.

21.4 Procedure

Measure the distance between the marks on all eight specimens to the nearest 0,02 mm with the specimens laid flat.

Keep four specimens, two cut in the lengthwise and two in the crosswise direction, for 7 d at (23 ± 1) °C and (32 ± 3) % relative humidity.

Keep the remaining four specimens for 7 d at (23 ± 2) °C and (90 ± 3) % relative humidity.

Re-measure the distance between the marks as before within 5 min after removal from the conditioning atmosphere.

21.5 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. This change is the sum of the mean absolute percentage changes in each of the low-humidity and high-humidity tests. The absolute figure shall be reported.

21.6 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) 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.

22 Dimensional stability at ambient temperature (Method B)

22.1 Principle

The test measures the dimensional changes of specimens from the sheet under test due to changes in humidity at ambient temperature. This is a companion method to Clause 20 and an alternative method to Clause 21.

22.2 Apparatus

22.2.1 High-humidity conditioning chamber, with an atmosphere of temperature (23 ± 2) °C and a relative humidity within the range (90 ± 3) %.

22.2.2 Low-humidity conditioning chamber, with an atmosphere of temperature (23 ± 2) °C and a relative humidity within the range (15 ± 5) %.

22.2.3 Standard-atmosphere conditioning chamber, with an atmosphere of temperature (23 ± 2) °C and a relative humidity within the range (50 ± 5) %.

22.2.4 Caliper gauge or other suitable means for measuring length, with a measurement range of at least 150 mm, graduated to provide accuracy of 0,01 mm. Centering points are recommended but not required.

22.2.5 Fixture, to maintain specimens from thin laminates in a flat position while measurements are taken. A suitable fixture is shown in Figure 7.

22.2.6 Center-punch and hammer (optional), suitable for making a small locating indentation in the surface of the test specimen.

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

22.3 Test specimens

Cut three specimens (120 ± 1) mm^2 from the sheet under test. The edges shall be smooth and free from cracks. Use three specimens for the dry-heat test and three 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.

22.4 Procedure

All measurements of length shall be made to the nearest 0,02 mm. Measurements shall be made within 5 min after removal of the specimens from the conditioning atmosphere. The specimens shall be kept flat when making measurements. For thin laminates, a suitable fixture such as that shown in Figure 9 shall be used.

With each specimen, use the steel rule (22.2.7) to locate the point midway between the two adjacent corners and 10 mm in from the corresponding edge. Mark this point using the centre punch (22.2.6). Repeat this step for the other three sides for that specimen and repeat for the additional five specimens such that all six specimens are marked in this fashion.

Place all three specimens in the high-humidity conditioning chamber (22.2.1), positioned so that air can circulate freely around them.

After (96 ± 4) h, remove the specimens from the chamber and immediately measure the distances between opposite marks (across the centres of the specimens) to the nearest 0,02 mm in both

the machine direction and the transverse direction. If a centre–punch has been used to mark the measurement points, measure the distance using a caliper gauge with its points positioned in opposing indentations. Record these measurements as the initial measurements.

Place all three specimens in the low-humidity conditioning chamber (22.2.2), positioned so that air can circulate freely around them.

After (96 ± 4) h, remove the specimens from the chamber and immediately measure the distances between opposite marks (across the centres of the specimens) to the nearest 0,02 mm in both the machine direction and the transverse direction. If a centre–punch has been used to mark the measurement points, measure the distance using a caliper gauge with its points positioned in opposing indentations. Record these measurements as the final measurements.

22.5 Expression of results

For each direction, calculate the average initial length and the average final length.

Calculate the gross dimensional change in each direction. This is the difference between the average initial measurement and the average final measurement. The dimensional movement at room temperature is calculated as the gross dimensional change divided by the average initial measurement multiplied by 100 and expressed as a percentage. An example of the calculations is included in Table 2.

Table 2 — Example of calculations in the machine direction

Specimen	1	2	3	Mean
Initial distance (mm)	104,01	104,23	104,15	104,13
Final distance (mm)	103,09	102,99	103,01	103,03
Gross dimensional change				1,1
Percentage of dimensional movement — [(1,10/104,13) × 100]				1,06 %

22.6 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) 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.

23 Resistance to climatic shock (exterior grade laminates)

23.1 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.

23.2 Apparatus

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

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

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

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

23.3 Test specimens

Eight specimens of the size specified in ISO 178 shall be cut in the cross-machine 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.

23.4 Procedure

On day one of the five day test cycle shown in Table 3, place four specimens in the hot-wet conditioning chamber (see 23.2.3) for 8 h, then follow the procedure described in Table 3.

Continue the transfer of the four 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 23.2.2) 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 acclimatize slowly.

Throughout the above four week conditioning period, the remaining 4 control specimens shall be kept in the standard atmosphere (see 23.2.2).

Table 3 — 5-day test cycle

	Climate conditions			
	Duration h	**Temperature** °C	**Relative humidity** %	**Condition**
First day	8	+80	90	Hot-wet (see 23.2.3)
	16	+80		Hot-dry (see 23.2.4)
Second day	8	+80	90	Hot-wet (see 23.2.3)
	16	−20		Cold-dry (see 23.2.1)
Third day	8	+80	90	Hot-wet (see 23.2.3)
	16	+80		Hot-dry (see 23.2.4)
Fourth day	8	−20		Cold-dry (see 23.2.1)
	16	+80		Hot-dry (see 23.2.4)
Fifth day	8	+80	90	Hot-wet (see 23.2.3)
	16[a]	−20		Cold-dry (see 23.2.1)

[a] Longer durations in cold-dry conditions are permitted to accommodate non-working day.

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 Clause 23.5.

b) After visual examination is complete, the four cycled specimens plus the four control specimens shall be tested for flexural strength and modulus of elasticity in flexure in accordance with ISO 178.

23.5 Expression of results

Examine the surface of the test specimens with the naked eye, corrected if necessary, at a distance of approximately 50 cm, assessing the appearance in comparison with the control specimens. The appearance shall be expressed as the lowest rating of the four cycled specimens assessed 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.

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.

23.6 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) 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.

24 Resistance to impact by small diameter ball

24.1 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.

24.2 Materials

24.2.1 Fine-faced wood particleboard, in accordance with EN 312 (for interior fitments), (230 ± 5) mm^2, 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) %. As an alternative, particle board with a nominal density of 720 kg/m^3 (45 lbs/ft^3) and nominal thickness of 19 mm (3/4 inch) and sanded with 100 grit sandpaper may be used.

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 important in achieving good reproducibility with this test.

24.2.2 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.

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

24.3 Apparatus

24.3.1 Impact tester, consisting of an impact bolt with a 5 mm steel 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 10).

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

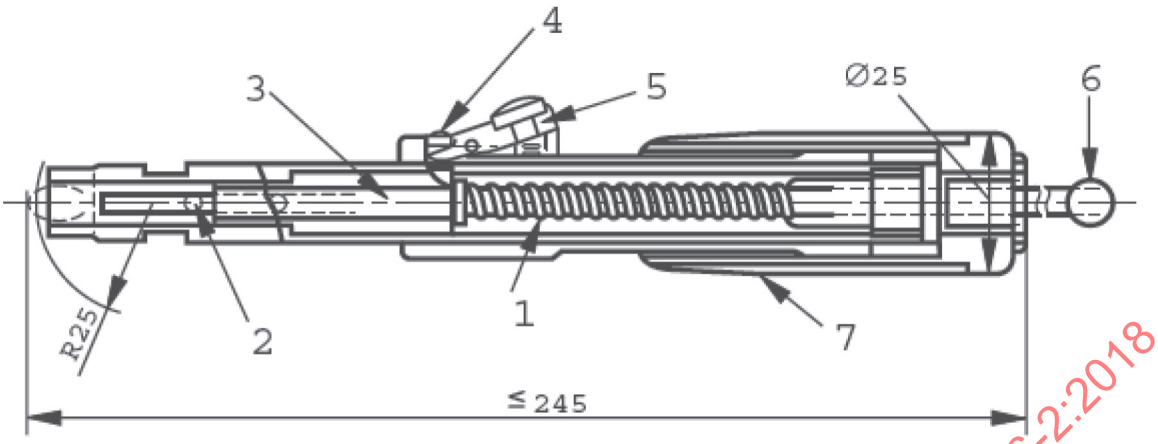
The compression spring is 100 mm long when released and has a constant of (1 962 ± 50) N/m. It is compressed by drawing back the impact bolt and is held in the loaded position by a retainer which engages in the bolt. It is released to deliver the impact blow by a release unit which withdraws the retainer.

24.3.2 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.

24.3.3 Support fixture, (see Figure 11) 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).

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

Dimensions in millimetres



Key

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

Figure 10 — Impact tester (shown with spring compressed) (see 24.3.1)

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

24.4 Test specimens

Specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (see 24.2.1), using the specified adhesive (see 24.2.2) evenly spread at 80 g/m^2 to 120 g/m^2. Sufficient specimens, each (230 ± 5) mm^2, 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.

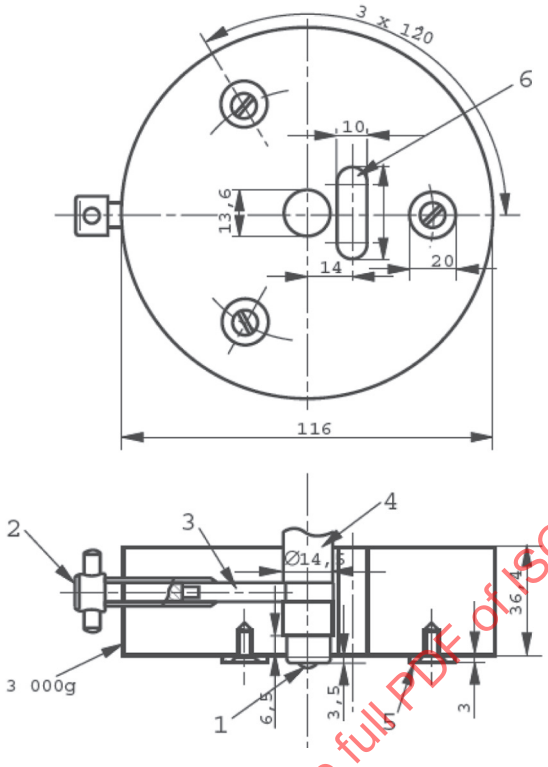
24.5 Calibration of the impact tester

Suspend the tester (see 24.3.1) 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 24.3.2) 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.

Dimensions in millimetres



Key

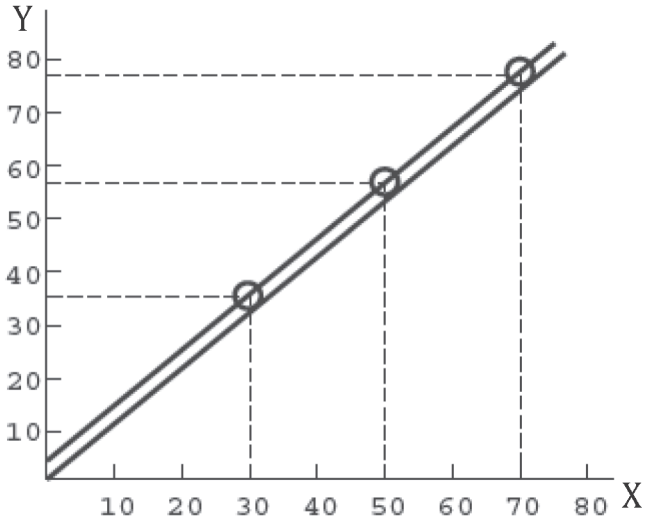
1 steel ball
2 clamp screw
3 pressure bolt
4 shaft of impact tester
5 foot
6 observation slot

Figure 11 — Support fixture for impact tester (see 24.3.3)

Repeat this calibration procedure for various values of *F*x in the range required, and draw a graph relating values of the scale reading *F*x to values of the calibration force Fe (see Figure 12 for an example).

The graph will be an approximately straight line which will not pass through the origin, because a constant but undetermined force is exerted during the calibration procedure by the mass of the impact bolt and any suspension arrangement (for example, a scale-pan). Draw a second line passing through the origin and parallel to the first line. This second line is the calibration graph of the instrument and shall be used to correct every indicated force *F*x employed in testing.

Prepare a new calibration graph after every 500 tests.



Key

X calibration force *F*e (N)

Y scale reading on instrument *F*x (N)

Figure 12 — Example of calibration graph relating actual force to scale value (see 23.5)

24.6 Procedure

The test shall be carried out in the laboratory atmosphere.

Place the steel plate (see 24.3.4) 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 24.3.3), 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.

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 24.2.3) 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.

24.7 Expression of results

The impact resistance of the laminate under test is the maximum value of the spring force, in newtons, 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.

24.8 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) impact resistance, in newtons;

d) any deviation from the specified test method;

e) date of the test.

25 Resistance to impact by large diameter ball

25.1 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 surface cracking or producing an imprint greater than a specified maximum diameter.

25.2 Materials

25.2.1 Fine-faced wood particleboard, in accordance with EN 312 (for interior fitments), (230 ± 5) mm^2, 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) %. As an alternative, particle board with a nominal density of 720 kg/m^3 (45 lbs/ft^3) and nominal thickness of 19 mm (3/4 inch) and sanded with 100 grit sandpaper may be used.

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 important in achieving good reproducibility with this test.

25.2.2 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.

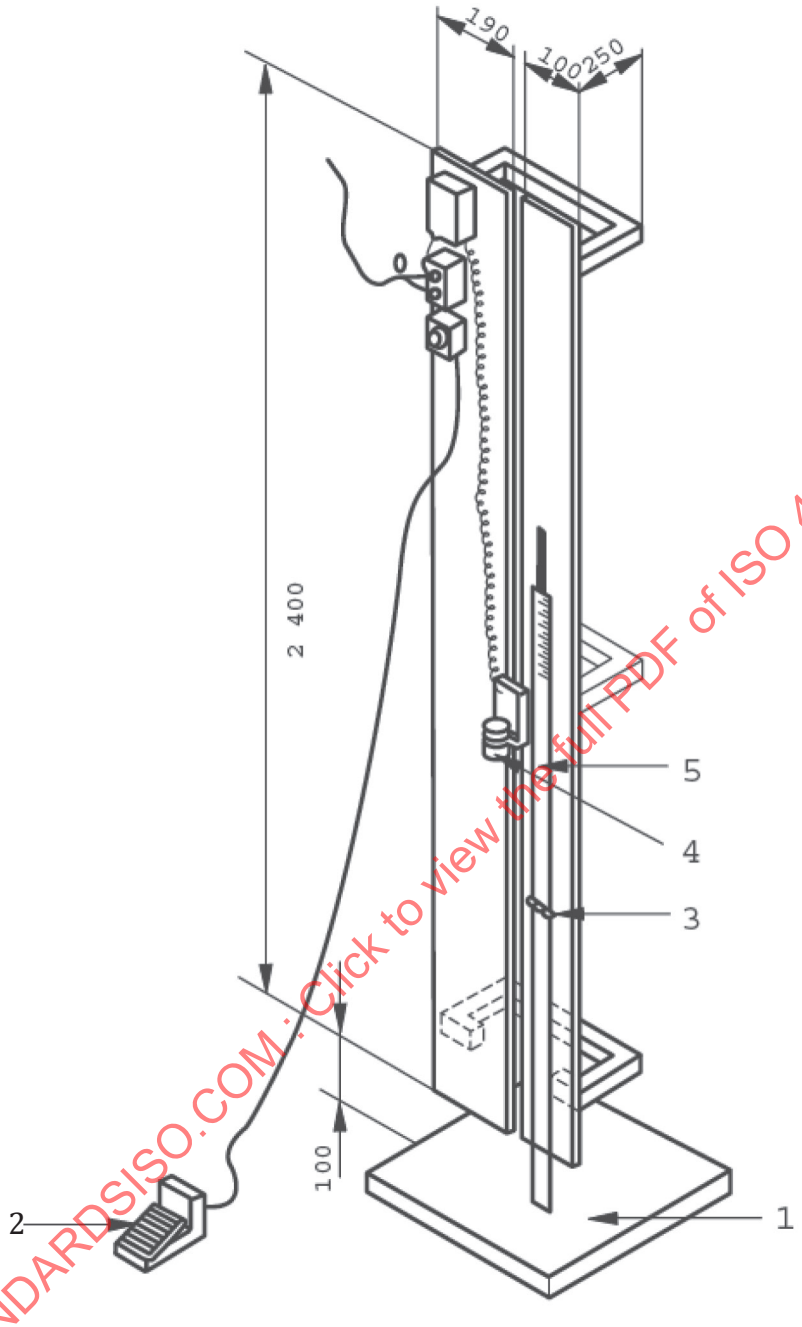
25.3 Apparatus

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

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

25.3.3 Specimen clamping frame, conforming to Figure 14.

Dimensions in millimetres

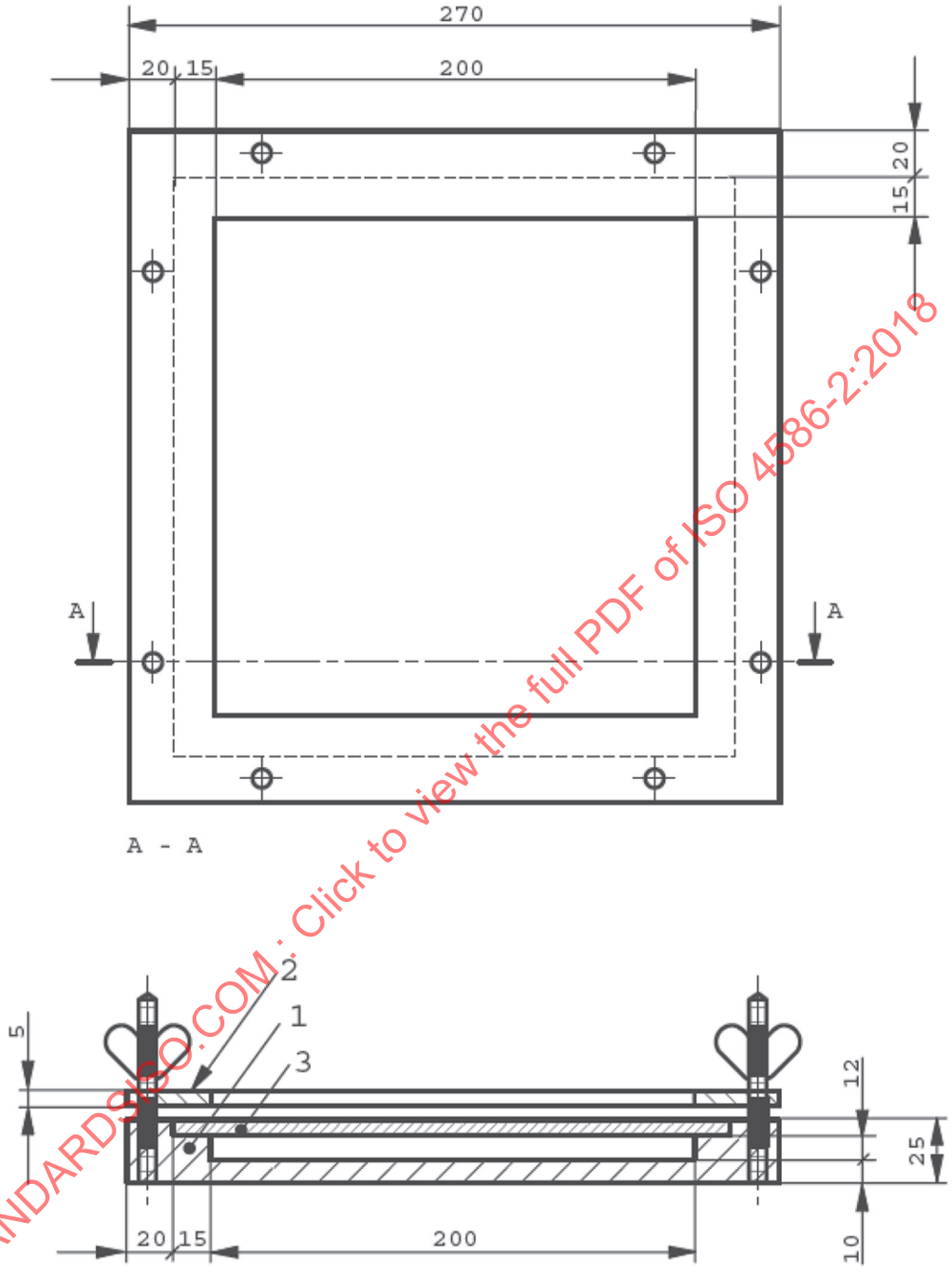


Key

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 (see 25.3.1)

Dimensions in millimetres



Key

1 lower metallic frame
2 upper metallic frame
3 test specimen

Figure 14 — Specimen clamping frame (see 25.3.3)

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

25.4 Test specimens

Specimens shall be (230 ± 5) mm^2. 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 25.2.1) using the specified adhesive (see 25.2.2) evenly spread at 80 g/m^2 to 120 g/m^2. 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).

25.5 Procedure

The test shall be carried out in the laboratory atmosphere.

Clamp the specimen in the clamping frame (see 25.3.3) and place the assembly on the solid base of the free-fall test apparatus (see 25.3.1). 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 25.3.2) 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 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 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.

25.6 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.

25.7 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) impact resistance, expressed in centimetres;

d) indentation diameter, expressed in millimetres;

e) any deviation from the specified test method;

f) date of the test.

26 Resistance to impact by large diameter ball (Flooring grade laminates)

26.1 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.

26.2 Materials

26.2.1 Dry process fibreboard (MDF), in accordance with EN 316, (230 ± 5) mm^2, with a nominal thickness of (6,0 ± 0,3) mm, and a density of (850 ± 50) kg/m^3.

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

26.2.2 PVAc adhesive.

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

26.3 Apparatus

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

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

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

26.4 Test specimens

Specimens shall be (180 ± 5) mm^2, prepared by uniformly bonding a piece of the laminate under test to the fibreboard (see 26.2.1) using the specified adhesive (see 26.2.2) evenly spread at 80 g/m^2 to 120 g/m^2 or per the adhesive manufacturer's instructions.

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).

26.5 Procedure

The test shall be carried out in the laboratory atmosphere.

Place the test specimen on a sub-layer of polyethylene foam (see 26.2.3), and place the specimen plus the sub-layer on the solid base of the free-fall test apparatus (see 26.3.1). 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 26.3.2) 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.

26.6 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.

26.7 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) impact resistance, expressed in centimetres;

d) indentation diameter, expressed in millimetres;

e) any deviation from the specified test method;

f) date of the test.

27 Resistance to cracking under stress (Laminates ≤ 2 mm thick)

27.1 Principle

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

27.2 Apparatus

27.2.1 Clamping device, as shown in Figure 15.

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

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

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

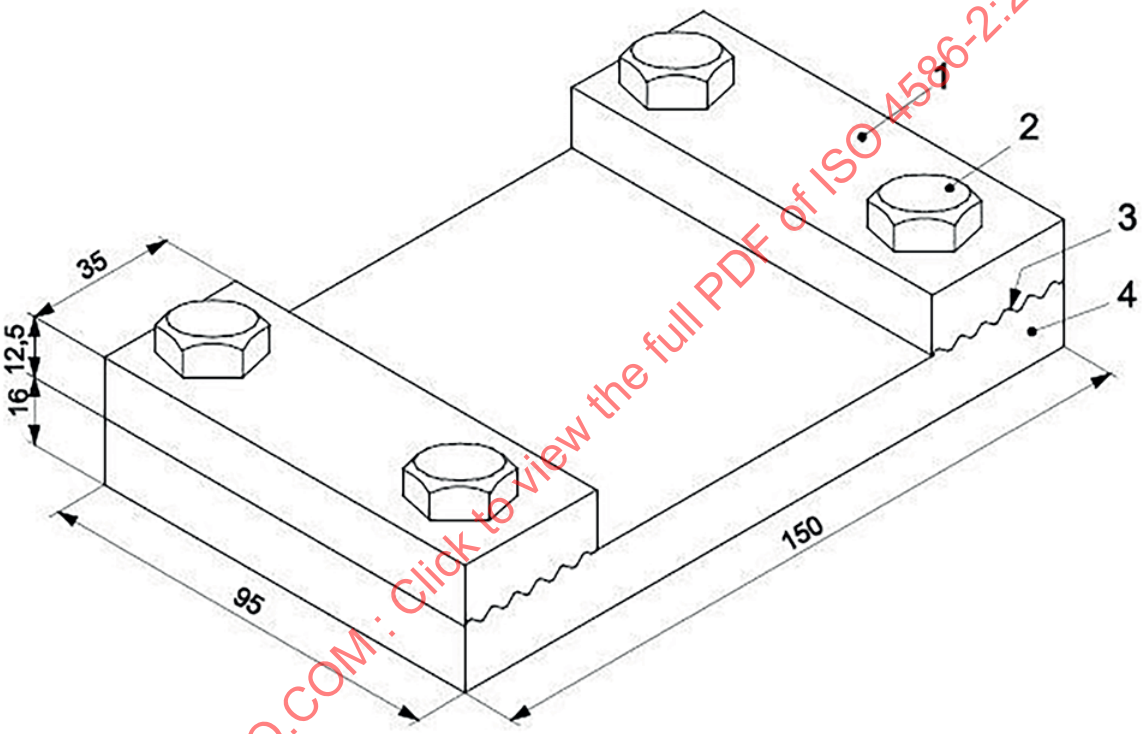
27.2.5 Hand lens, with approximately 6× magnification.

27.2.6 Lighting, of intensity 800 lx to 1 000 lx.

27.2.7 Drilling machine, operating at less than 400 r/min.

27.2.8 Micrometer thickness gauge, as described in 5.2.1.

Dimensions in millimetres



Key

1 clamping block
2 nut
3 serrated surfaces
4 base plate

Figure 15 — Clamping device

Dimensions in millimetres

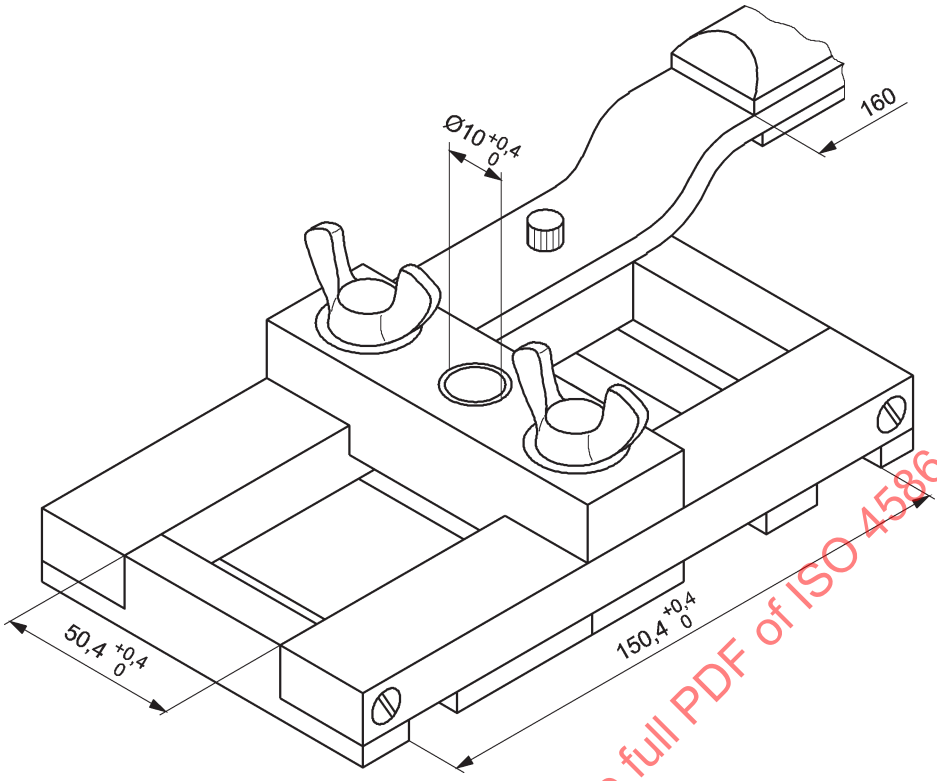


Figure 16 — Drilling fixture

27.3 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-machine direction of the sheet.

The specimens shall have a (10 ± 0,5) mm diameter hole drilled in their centres using a drilling fixture (see 27.2.2), 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 r/min. 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 27.4).

27.4 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 27.2.1) in the oven (see 27.2.4) for 2 h at (50 ± 2) °C.

Take the specimen under test from the conditioning chamber (see 27.2.3), 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 6× magnification for signs of cracking around the hole. The light intensity during the examination shall be 800 lx to 1 000 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.

27.5 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 Figure 17).

— Rating 5: No evidence of cracking.

— Rating 4: Hairline cracks only visible under 6X 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.

27.6 Test report

The test report shall include the following information:

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

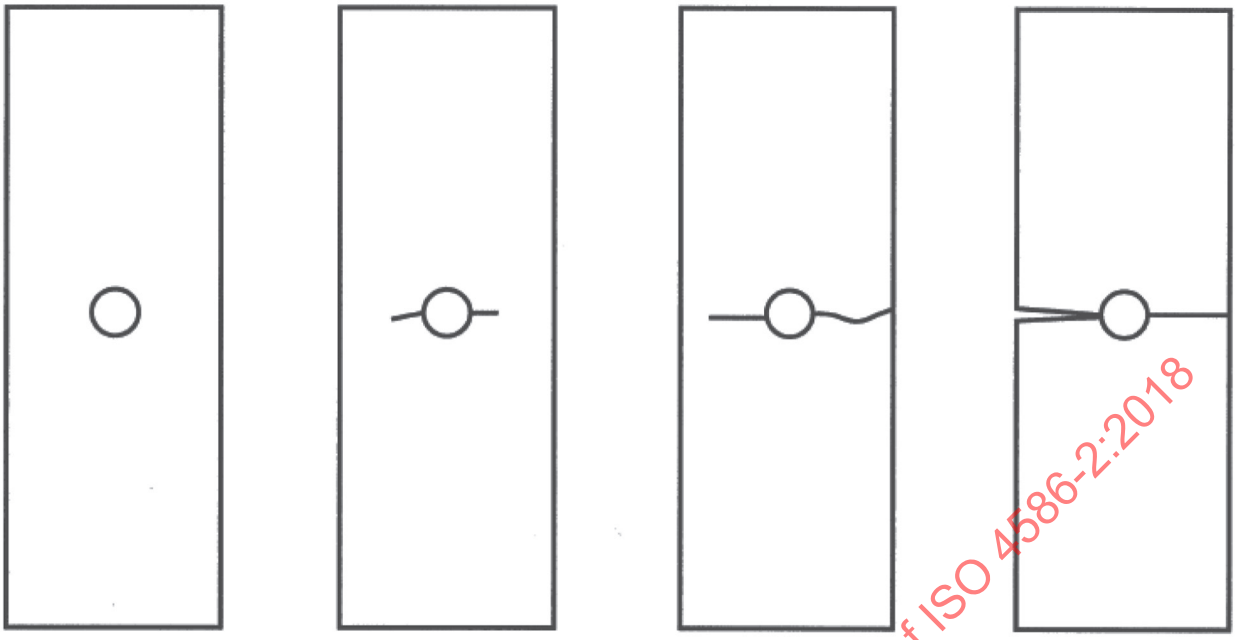
b) name, type and nominal thickness of the product;

c) 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.



a) Rating 4 **b) Rating 3** **c) Rating 2** **d) Rating 1**

NOTE Hairline cracks only visible under 6× magnification.

Figure 17 — Rating scale

28 Resistance to crazing (Compact laminates)

28.1 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.

28.2 Apparatus

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

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

28.2.3 Lighting, of intensity 800 to 1 000 lx.

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

28.3 Test specimens

The specimens shall be (250 ± 2) mm^2 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.

28.4 Procedure

Place the specimens in the holder (see 28.2.1) and then place the holder in the oven (see 28.2.2), 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 800 lx to 1 000 lx.

28.5 Expression of results

The results of the examination shall be expressed in accordance with the following rating scale:

— 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.

The resistance to crazing is the lower of the two results obtained from the test.

28.6 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) 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.

29 Resistance to scratching

29.1 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.

29.2 Materials

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

29.2.2 Supply of cotton fabric.

29.3 Apparatus

29.3.1 Scratch testing apparatus, (see Figure 18), consisting of the following parts.

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

29.3.1.2 Motor driven turntable, able to rotate about a vertical axis without play. The rotational frequency shall be (5 ± 1) r/min.

29.3.1.3 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.

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

29.3.1.5 Hemispherical diamond scratching point, with a point radius of (0,090 ± 0,003) mm and an included angle of (90 ± 1)° (see Figure 19)[7]. The diamond shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction.

29.3.1.6 Clamping disc, to keep the test specimen flat.

29.3.2 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 20.

The light source consists of a 100 W frosted bulb, mounted in a white reflector having an aperture of approximately 140 mm diameter and producing an illumination of 800 lx to 1 000 lx at the specimen surface.

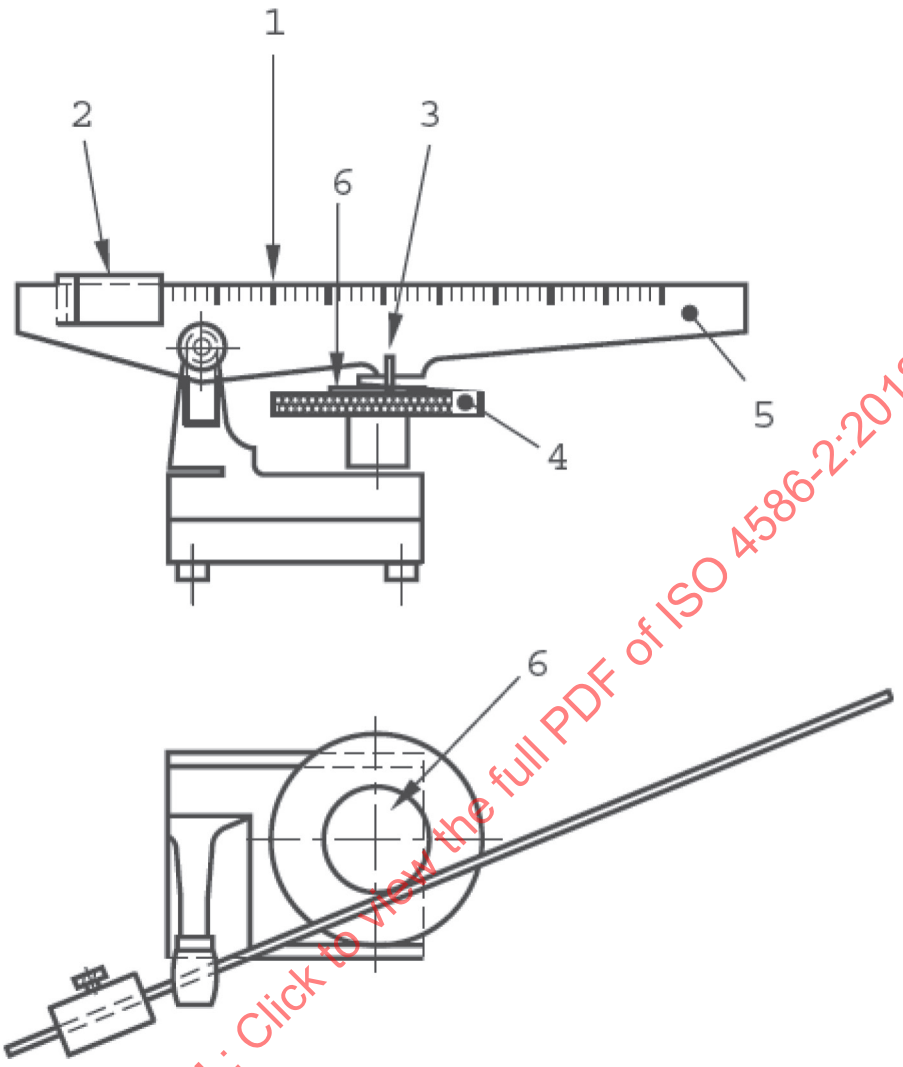
29.3.3 Conditioning chamber, in accordance with ISO 291, with a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) %.

29.3.4 Electronic balance, suitable for verifying the force applied to the diamond point.

29.4 Calibration of apparatus

Place the diamond point on the table of the electronic balance (see 29.3.4) and, with arm in a horizontal position, verify that the position marks for sliding weight correspond to the load values shown in Table 4. If not, move weight as necessary to achieve the correct loads, and mark the correct positions on arm.

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

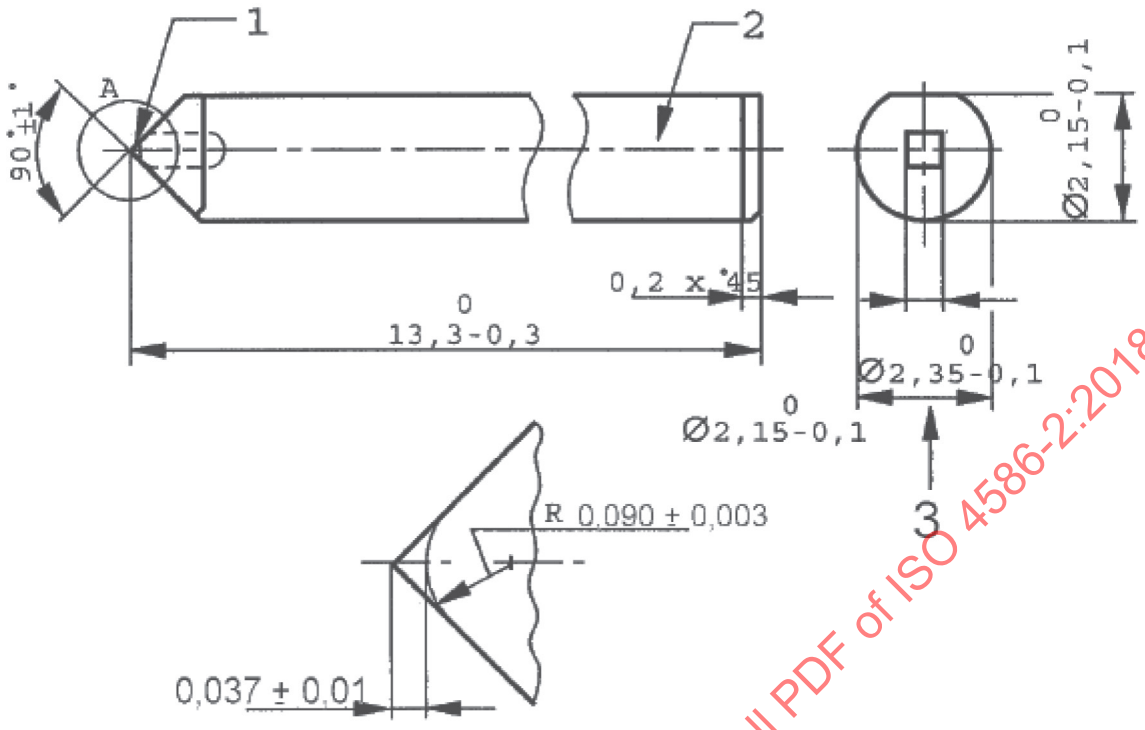


Key

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

Figure 18 — Type of apparatus for measuring resistance to scratching (see 29.3.1)

Dimensions in millimetres



Key

1 diamond point

2 diamond holder

3 optical axis of projector

NOTE The crystal axis of the diamond shall be parallel to the longitudinal axis of the diamond holder. The dimensions of the diamond holder are approximate and are for information only.

Figure 19 — Diamond scratching point (see 29.3.1.5)

Standardization of the apparatus shall be carried out at least once a year.

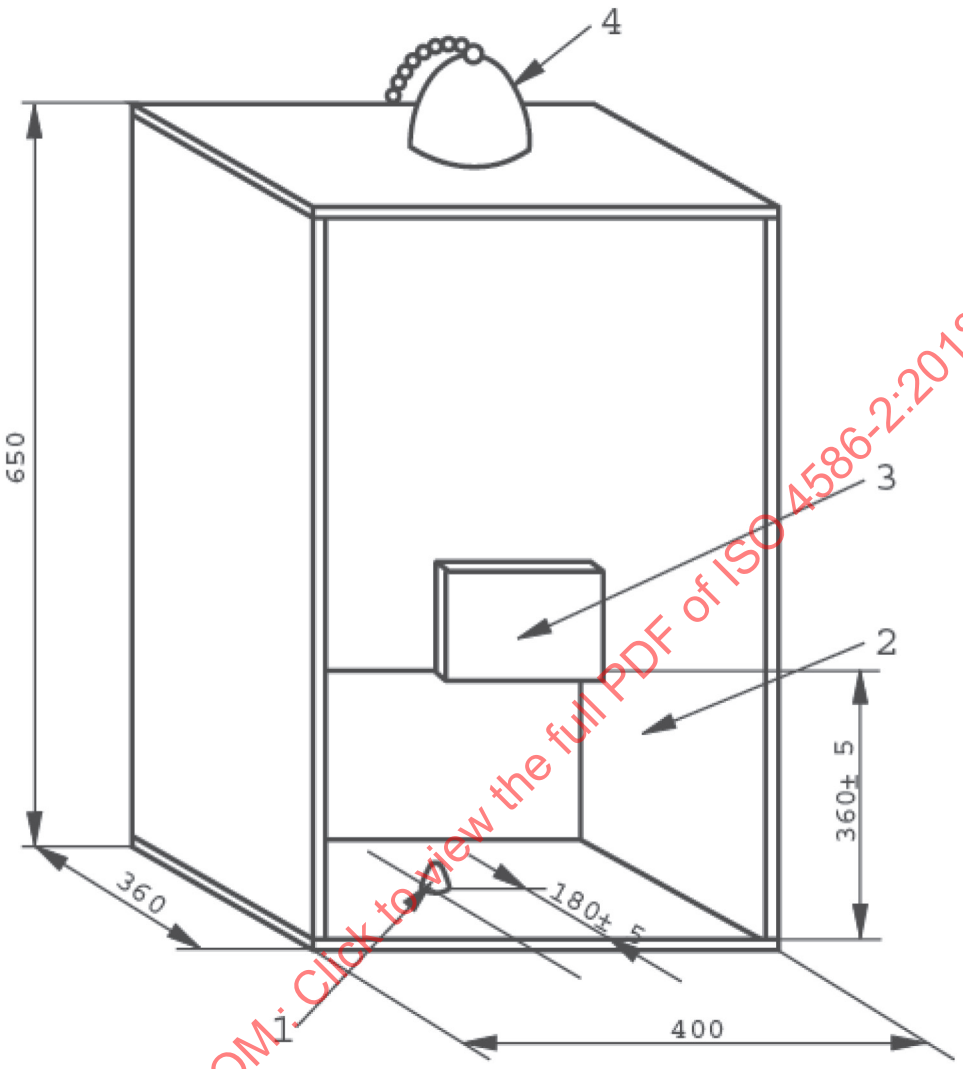
Table 4 — Load values

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

29.5 Test specimen

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

Dimensions in millimetres



Key

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

Figure 20 — Example of suitable viewing enclosure (see 29.3.2)

One specimen shall be tested.

Wipe the specimen surface using cotton fabric (see 29.2.2) 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 29.3.3.

29.6 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.

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 29.2.1) so that it is engrained in any scratches.

Carefully wipe the surface with clean cotton fabric (see 29.2.2) 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 29.3.2) 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 21 can be used as a guide.

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.

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 s, and the operator shall ensure that the double circle of scratch marks selected is truly > 90 % continuous.

29.7 Expression of results

The scratch resistance of the laminate under test shall be expressed in accordance with the rating scale shown in Table 5. See Figure 21 for further explanation.

Table 5 — Scratch resistance 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

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

d) any deviation from the specified test method;

e) date of the test.

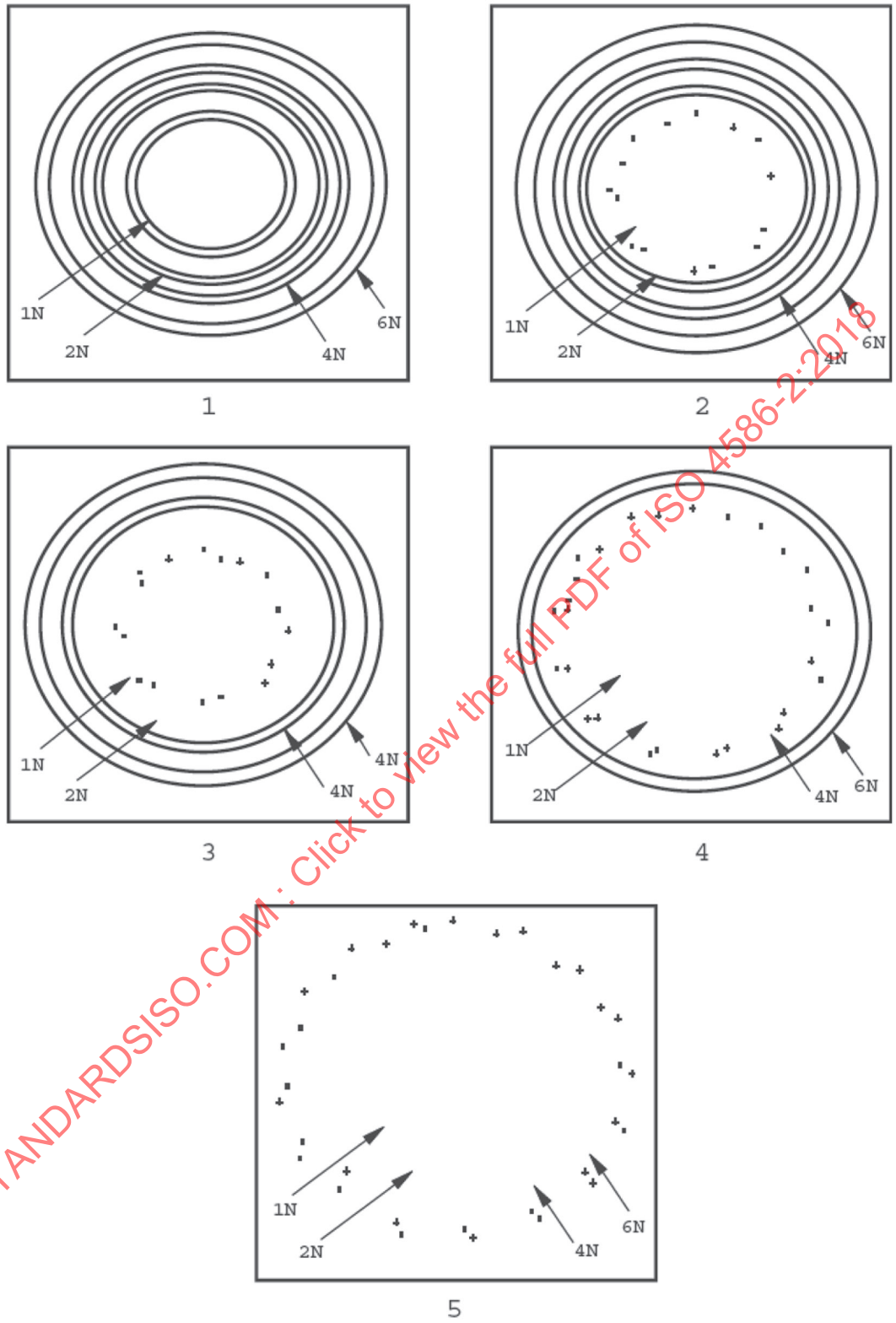


Figure 21 — Scratch Rating 1 to Rating 5

30 Resistance to staining (Method A)

30.1 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. This is an alternative method to Clause 31.

30.2 Staining agents

See Table 6.

Table 6 — Staining agents and test conditions

Staining agent — Group 1	Test conditions	Contact time
*Acetone. Other organic solvents. Toothpaste. Hand cream. 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 % dodecyl-benzene 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
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.		

Table 6 *(continued)*

Staining agent — Group 2	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) Wine vinegar.	Apply staining agent at approximately 80 °C	16 h
Alkaline-based cleaning agents (to 10 % concentration with water). Hydrogen peroxide (3 % solution). Ammonia (10 % solution of commercial concentration). Nail varnish. Nail varnish remover. Lipstick. Water colours. Laundry marking inks. Ball point inks.	Apply staining agent at ambient temperature	16 h
Staining agent — Group 3[a]	**Test conditions**	**Contact time**
*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-ydroxymercurifluoresein, disodium salt). *Shoe polish. 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
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.		

30.3 Materials

30.3.1 Wetting agent, for example domestic detergent.

30.3.2 Solvents, such as ethanol, acetone, methyl ethyl ketone, etc. (see 30.6).

30.3.3 Soft clean cloth.

30.4 Apparatus

30.4.1 Glass covers (for example watch glasses), to restrict evaporation.

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

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

30.4.4 Hotplate, or other suitable heat source.

30.4.5 Horizontal inspection surface, illuminated by overhead and low-angle daylight or white fluorescent light of intensity 800 to 1 000 lx.

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

30.5 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.

30.6 Procedure

The specimens shall be initially at ambient temperature.

Apply a small quantity (for example 2 or 3 drops) of staining agent to two specimens. The staining agent shall be at the temperature specified in 30.2. Cover the staining agent on one of the two specimens with a glass cover (see 30.4.1).

After the specified contact time has elapsed remove the glass cover. If necessary use a suitable solvent to remove the staining agent (for example butyl acetate to remove nail varnish), then wash with water containing a suitable wetting agent (see 30.3.1), and finally with ethanol or other solvents (see 30.3.2) as required to clean the surface. A suitable brush (see 30.4.6) may be used to remove staining agent from textured surfaces.

One hour after washing, place the specimen on the inspection surface (see 30.4.5) and view it from various angles at a distance of 400 mm.

30.7 Expression of results

The effect on the surface of the specimen shall be expressed in accordance with the following rating scale for each of the five mandatory staining agents.

— 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: Surface distortion and/or blistering.

30.8 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) 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.

31 Resistance to staining (Method B)

31.1 Principle

Test specimens are left in contact with a series of staining agents which are likely to be encountered in everyday household use. At the end of the specified contact period, the specimens are subjected to a specified cleaning program and examined for any residual surface marks. This is an alternative method to Clause 30.

31.2 Materials

31.2.1 Commercially available non-abrasive cleaner, containing approximately 4 % butyl cellosolve.

31.2.2 Commercially available bleach, containing (5,0 ± 0,5) % sodium hypochlorite.

31.2.3 Baking soda.

31.2.4 Acetone.

31.2.5 Distilled water.

31.2.6 Staining agents, as listed in Table 7.

Table 7 — Staining agents and test conditions

Agent number	Description	Preparation notes	Application
1	Distilled water	—	Reagents 1–11 Apply 2 drops (an approximately 6 mm diameter spot) and cover with a watch glass
2	Ethyl alcohol	A mixture of 50 % ethyl alcohol and 50 % distilled water	
3	Acetone	—	
4	Household ammonia	Non-sudsing type	
5	10 % Citric acid	A solution of 10 % citric acid in distilled water	
6	Vegetable oil	—	
7	Fresh coffee	One teaspoon instant coffee per 180 ml distilled water	
8	Fresh tea	Brew 1 teabag per 120 ml boiling distilled water for two minutes	
9	Tomato ketchup	—	
10	Yellow mustard	—	
11	Tincture of Iodine (or 10 % povidone iodine)	—	
12	Black permanent marker	—	Reagents 12–15 Apply a spot approximately 6 mm in diameter; do not cover
13	HB pencil	—	
14	Wax crayon	—	
15	Black paste shoe polish	—	
Staining agents shall be kept in closed containers to avoid any change in concentration. Perishable food items shall be kept refrigerated.			

31.3 Apparatus

31.3.1 Concave glass covers, approximately 25 mm in diameter (for example 1 inch watch glasses). One for each test reagent that requires a cover, to restrict evaporation.

31.3.2 Overhead white fluorescent lights, with bulb(s) positioned parallel to the line of sight and providing an intensity of 800 lx to 1 100 lx at the specimen surface.

31.3.3 Cellulose sponge, measuring approximately 75 mm × 100 mm × 50 mm.

31.3.4 Horizontal inspection surface, illuminated by overhead white fluorescent light of intensity 800 lx to 1 000 lx.

31.3.5 Hard polyamide (nylon) bristle brush (for example a nail brush).

31.3.6 Supply of clean, soft, white cloth.

31.3.7 Supply of cotton balls.

31.3.8 1 kg mass.

31.4 Test specimens

The test specimen shall have an area sufficient to permit placement of all 15 of the test reagents on its surface in two lines. Individual stains shall be placed approximately 50 mm apart. A 100 mm × 400 mm specimen is adequate. Keep the specimen flat during the test.

31.5 Procedure

Clean the surface of the test specimen using the cleaner (31.2.1) and water and a clean cloth (31.3.6). Rinse the specimen thoroughly and dry using another clean cloth (31.3.6). Allow the specimen to dry completely at room temperature.

Position the test specimen on a flat, horizontal surface and tape or weigh it down so there will be no deviation from the horizontal plane.

Place a 6 mm spot of each test reagent as defined in Table 7 on the surface of the test specimen so that each reagent is approximately 50 mm from the nearest adjacent reagent and the edge of the specimen. Reagents shall be applied at room temperature.

As each reagent is deposited, place a glass cover (31.3.1) concave side down over the reagent if required in Table 7 above. Move the glass cover gently while in contact with the test surface until the reagent is on contact with both the test specimen and the glass cover and the reagent is both under and outside the glass cover. The entire circular rim of the glass cover shall be wetted with the reagent. The test specimen shall be marked so that each reagent is identified.

Leave the test specimen and the reagents undisturbed for a period of 16 h to 24 h. Remove the glass covers and subject the test specimen to the following cleaning procedures.

After each cleaning step, place the specimen on a horizontal surface (31.3.4) and examine under standard lighting (31.3.2) for residual stain(s) by rotating the specimen on the horizontal surface and view it from all directions at a distance of approximately 750 mm to 900 mm and at an angle of 45° to 75° to the horizontal plane. Direct sunlight or other light sources which might accentuate or minimize the visual effect shall be avoided.

Flush the specimen surface with water and wipe gently with the sponge (31.3.3) moistened with water. Blot the specimen dry with a clean, soft, white cloth. If the reagent is removed by this step, then it is graded "0". If any stain remains, proceed with the next step.

Wet the specimen with the cleaner (31.2.1). Moisten the sponge (31.3.3) with water and place it on the specimen surface. Place the 1 kg mass (31.3.8) on top of the sponge. Push the weighted sponge back and forth without downward pressure for 25 cycles. Rinse the specimen with water and wipe dry with a clean, soft, white cloth. If the reagent is removed by this step it is graded "1". If any stain remains, proceed with the next step.

Wet the specimen with the cleaner (31.2.1) and add baking soda to achieve a paste consistency. Using the polyamide brush (31.3.5), scrub the remaining stain(s) where reagents can still be observed for 25 cycles. The specimen shall not be rubbed so as to permanently mar the surface finish. Rinse the specimen with water and wipe dry with a clean, soft, white cloth. If the reagent is removed by this step it is graded "2". If any stain remains, proceed with the next step.

Using a cotton ball (31.3.7) saturated with acetone, rub the remaining stain(s) gently for up to two minutes. Rinse the specimen with water and wipe dry with a clean, soft, white cloth. If the reagent is removed by this step it is graded "3". If any stain remains, proceed with the next step.

Place a cotton ball (31.3.7), saturated with hypochlorite bleach on the remaining stain(s) and allow to remain in contact for a period of 2 min. If the reagent is removed by this step it is graded "4". If any stain remains, proceed with the next step.

If any reagent(s) remain visible after cleaning, the specimen for that reagent shall be graded a "5".

31.6 Expression of results

Add the ratings assigned to each of the 15 staining reagents. The cleanability is reported as the sum of the ratings. See Table 8.

Table 8 — Example of cleanability

Agent number	Stain	Rating
1	Distilled water	0
2	Ethyl alcohol	0
3	Acetone	0
4	Household ammonia	0
5	10 % Citric acid	0
6	Vegetable oil	0
7	Fresh coffee	0
8	Fresh tea	0
9	Tomato ketchup	1
10	Yellow mustard	2
11	Tincture of iodine (or 10 % povidone iodine)	2
12	Black permanent marker	2
13	HB pencil	2
14	Wax crayon	3
15	Black paste show polish	4
Total		16

Assess the stain resistance after the required stages of cleaning and report as one of the following:

— Rating 5: The staining reagents have no effect. All marks from the reagents were removed with no impairment to the surface appearance other than a change in gloss due to cleaning.

— Rating 3: The staining reagents have a moderate effect. One or more slight stains evident, with no other impairment to surface appearance other than a change in gloss due to cleaning.

— Rating 1: The staining reagents have a severe effect. One or more heavy stains evident, and/or disturbance of the surface other than a change in gloss due to cleaning.

31.7 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) the cleanability of the specimen;

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

e) any deviation from the specified test method;

f) date of the test.

32 Lightfastness (xenon arc) (Method A)

32.1 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 and unexposed portions of the test specimen. The radiant exposure is determined both instrumentally, and by assessing the effect on blue wool references which are exposed simultaneously. This is an alternative method to Clause 33.

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

32.2 Apparatus

32.2.1 A test device, as specified in ISO 4892-1 and 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 publication no. 85:1989 Table 4 and 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 ISO 4892-1;

— photoelectronic sensor in accordance with 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.

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

32.2.3 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 (e.g. tungsten-halogen incandescent lamps) and generating a colour temperature of (6 500 ± 200) K and at least 800 lx on the surface of the specimen. The viewing enclosure shall be placed in a position where the surrounding lighting conditions will not affect the visual assessment of the specimen.

32.3 Test specimen

One test specimen shall be prepared in accordance with ISO 4892-1. It shall be representative of the laminate to be tested, cut to the size required for the specimen holder used, and appropriate for the method of assessment after exposure.

32.4 Procedure

The test specimen and a set of blue wool references 5, 6 and 7 (see ISO 105-B02) shall be exposed simultaneously. Blue wool references 5 and 7 are included to provide confirmation that wool reference 6 has degraded to the specified degree of contrast.

Using opaque stainless steel covers, shield approximately one half of both the test specimen and the set of blue wool references.

Carry out the test in accordance with 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/m^2; or at wavelength 340 nm: (0,5 ± 0,03) W/m^2;

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

— relative humidity:(50 ± 5) %.

Discontinue the exposure when the contrast between the exposed and unexposed portions of the blue wool reference 6 is equal to grade 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 32.2.2) to prevent extraneous darkening and/or photochromism.

NOTE 1 Although the use of blue wool references is no longer the preferred method of measuring radiant exposure (see ISO 4892), and blue wool standards are no longer commercially available in some countries, the method is still in common use and is therefore permitted. Once sufficient data have been collected, the end point of the test will be defined by the level of radiant exposure.

NOTE 2 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.

32.5 Assessment and expression of results

Place the test specimen in the viewing enclosure(see 32.2.3).

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 exposed and unexposed portions of the test specimen in terms of a grade on the grey scale according to ISO 105-A02.

The lightfastness of the test specimen is expressed in terms of the contrast being greater than, equal to or less than grade 4 of the grey scale.

32.6 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) 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.

33 Lightfastness (xenon arc) (Method B)

33.1 Principle

This test measures the ability of high-pressure decorative laminate to retain its colour when exposed to a light source having a frequency range approximating sunlight through window glass. This is an alternative method to Clause 32.

33.2 Apparatus

33.2.1 A test device, of xenon gas arc discharge type capable of providing radiant energy closely approximating sunlight through window glass with a spectral bandpass of 280 nm to 800 nm with appropriate filtering to simulate light energy through a window. The equipment shall conform to ISO 4892-2 and ASTM G155. The apparatus shall be capable of maintaining the following parameters with the range specified:

— black panel temperature ± 3 °C;

— dry bulb temperature ± 3 °C;

— wet bulb temperature ± 1 °C;

— conditioning water ± 3 °C;

— duration of cycle time ± 1 % of cycle time;

— automatic stepping of power to the light source to maintain steady irradiance levels and accommodate aging effect of xenon burners and solarisation of filters;

— calibration at 420 nm.

33.2.2 Overhead white fluorescent lights, positioned parallel to the line of sight and providing an intensity of 800 lx to 1 100 lx on the specimen surface.

33.2.3 White petroleum jelly.

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

33.3 Test specimen

The test specimen shall be representative of the laminate to be tested and cut to the size required for the specimen holder used. The long dimension of the specimen shall be cut in the machine direction.

33.4 Procedure

The test specimen shall be conditioned in a standard atmosphere of (23 ± 2) °C and relative humidity (50 ± 5) % for a minimum period of 4 h prior to testing.

Mount the specimen in the in a specimen holder so that approximately one-half of the specimen is exposed to the light source, the other half covered by the opaque mask. Fill all specimen holders prior to starting the test cycle, using blanks if necessary, in order to maintain correct air flow through the test chamber.

Adjust the equipment to maintain the following conditions for the duration of the test.

Table 9 — Operating conditions

Parameter	Setting	Tolerance
Total irradiance	285,1 kJ/m^2	± 2,0 kJ/m^2
Irradiance level	1,10 W/m^2	± 0,03 W/m^2
Black-panel temperature	70 °C	± 3 °C
Dry-bulb temperature	50 °C	± 3 °C
Wet-bulb temperature	39 °C	± 1 °C
Conditioning water temperature	20 °C	± 3 °C
Duration of exposure	72 h	+ 1 % (43 min)
Power adjustment	Automatic	To maintain steady irradiance levels, allowing for aging of xenon burners and solarisation of filters.
The black panel thermometer shall be mounted at the same distance from the light source as the test specimen. The black coating shall be maintained in good condition in order to achieve as accurately as possible the black body temperature of the panel. NOTE 1 The black panel temperature is the primary controlled temperature and the dry bulb temperature is under secondary control. NOTE 2 The wet bulb temperature is set in relation to the dry bulb temperature in order to maintain 50 % relative humidity.		

Expose the specimen to the light source as outlined in Table 9. At the conclusion of the exposure period, remove the specimen from the specimen holder and allow to condition at ambient room temperature in the dark for a period of (24 ± 4) h.

Examine the conditioned specimen by placing it, without preinspection, on a flat surface under defined inspection lighting and viewing the specimen at a distance of 750 mm to 900 mm and at an angle of 45° to 75° from the horizontal plane (table surface). The specimen shall be rotated in the horizontal plane and viewed from all directions. Direct sunlight and/or other angle light sources which can accentuate or minimize the effects, shall be avoided.

If a difference in appearance is evident between the exposed and unexposed areas of the test specimen, coat the surface of the specimen with a thin film of white petroleum jelly and re-examine the specimen. If the difference persists, report the difference as a change in colour and grade the specimen as follows. If the difference disappears, report the change as a change in surface finish.

33.5 Expression of results

Express the result of the examination in accordance with the following scale:

— Rating 5: No Effect — No change in colour or surface finish.

— Rating 4: Slight Effect — A slight change in colour or surface finish visible only at certain viewing angles and directions.

— Rating 3: Moderate Effect — A moderate change in colour or surface finish that is visible at all viewing angles and directions but does not notably alter the original condition of the specimen.

— Rating 2: Severe Effect — A change in colour or surface finish which markedly alters the original conditions of the specimen.

— Rating 1: Surface blistering and/or cracking.

33.6 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) 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.

34 Resistance to UV light (Exterior grade laminates)

34.1 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.

34.2 Apparatus

The apparatus shall be as specified in ISO 4892-3. The test chamber enclosing eight 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 ISO 4892-3.

34.3 Test specimens

Two test specimens shall be prepared in accordance with 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.

34.4 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. In accordance with exposure mode 1 of ISO 4892-3 the cycle consists of 4 h 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 eight 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.

34.5 Evaluation and expression of results

34.5.1 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.

34.5.2 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.

34.6 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) description of test specimens;

d) type of apparatus used;

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 34.5.2;

i) any deviation from the specified test method;

j) date of the test.

35 Resistance to artificial weathering (Exterior grade laminates)

35.1 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.

35.2 Apparatus

35.2.1 A test device, as specified in ISO 4892-1 and 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 publication no. 85:1989 Table 4 and 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 ISO 4892-1;

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

— photoelectronic sensor in accordance with 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.

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

35.2.3 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 (e.g. tungsten-halogen incandescent lamps) and generating a colour temperature of (6 500 ± 200) K and at least 800 lx on the surface of the specimen. The viewing enclosure shall be placed in a position where the surrounding lighting conditions will not affect the visual assessment of the specimen.

35.3 Test specimens

Two test specimens shall be prepared in accordance with 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 35.2.2).

35.4 Procedure

Carry out the test in accordance with 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/m^2; or at wavelength 340 nm:(0,5 ± 0,03) W/m^2;

— continuous exposure of radiation from the source;

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

— relative humidity: (65 ± 5) %;

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

Discontinue the test after the specified radiant exposure.

Remove the test specimen from the apparatus and leave it for (24 ± 2) h in dark conditions in the conditioning chamber (see 35.2.2) to prevent extraneous darkening and/or photochromism.

NOTE 1 650 MJ/m^2 radiant exposure at 300 nm to 400 nm equates to 5,4 MJ/m^2 at 340 nm, and corresponds to approximately 3 000 h exposure at unchanged level of irradiance. 325 MJ/m^2 radiant exposure at 300 nm to 400 nm equates to 2,7 MJ/m^2 at 340 nm, and corresponds to approximately 1 500 h exposure at unchanged level of irradiance.

NOTE 2 Two intermediate examinations after shorter exposure times are permitted.

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.

35.5 Examination and expression of results

35.5.1 General

The examination shall be carried out in the viewing enclosure (see 35.2.3) as follows.

35.5.2 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.

35.5.3 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.

35.6 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) 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 35.5.3;

g) any deviation from the specified test method;

h) date of the test.

36 Resistance to radiant heat

36.1 Principle

A specimen from the sheet under test is bonded to wood chipboard to simulate service conditions, and subjected to the heat from a radiant heat source placed in close proximity to the surface. The test result is expressed as time in seconds to failure.

36.2 Apparatus

36.2.1 Radiant heater, consisting of two electrically heated sheathed elements of 1 500 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 (see Figure 22). A windscreen enclosure to surround three sides and the top is advisable.

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

36.2.3 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. infrared thermometers, colour-change indicators).

36.2.4 Stopwatch, or other suitable timer.

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

36.2.6 Calibration strips, of plain-colour white laminate conforming to the specification for HGS given in ISO 4586-2, 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.

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

36.2.8 Fine-faced wood particleboard, in accordance with EN 312 (for interior fitments), (230 ± 5) mm^2 with a nominal thickness of 18 to 20 mm (± 0,3 mm), a density of (680 ± 20) kg/m^3, and moisture content (10 ± 3) %. As an alternative, particle board with a nominal density of 720 kg/m^3 (45 lbs/ft^3) and nominal thickness of 19 mm (3/4 inch) and sanded with 100 grit sandpaper may be used.

36.2.9 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.

36.3 Test specimen

The test specimens shall be 50 mm × 200 mm and shall be bonded to particleboard (37.2.8) utilizing a PVAc adhesive (37.2.9) following the adhesive manufacturer's instructions. The 200 mm dimensions shall be cut parallel with the machine direction of the laminate.

Dimensions in millimetres

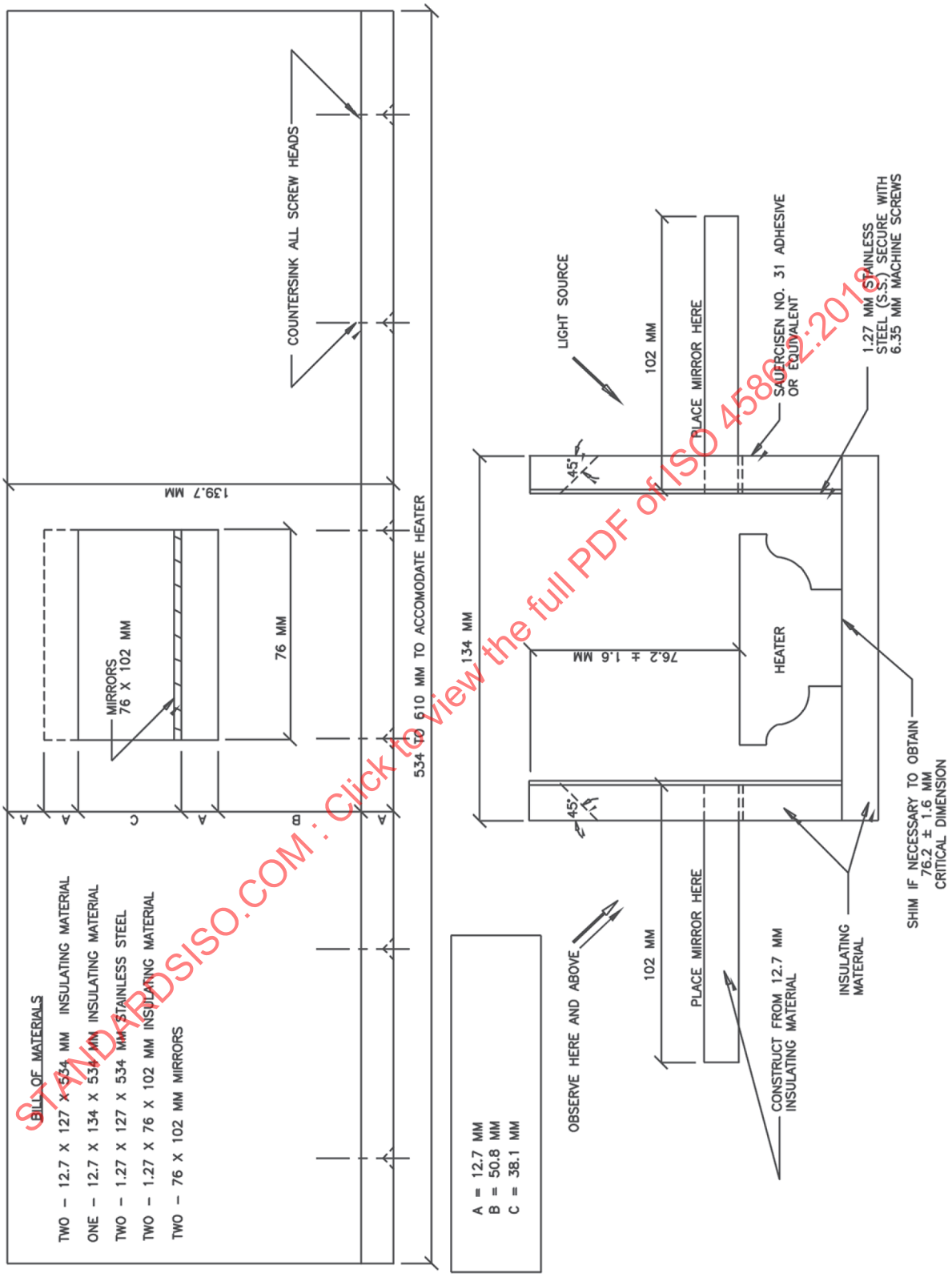


Figure 22 — Radiant heater and trough

Compact laminates shall be tested unbounded. The bonded specimen shall be preconditioned (36.2.7) for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before being used for the test. Three specimens shall be prepared from a laminate sheet for testing.

36.4 Procedure

Turn on the heater (see 36.2.1) 30 min prior to conducting the test, with the variable transformer (see 36.2.2) at full line voltage.

Use a temperature indicator (see 36.2.3) 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.

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.

Simultaneously start the timer and place the test specimen, decorative face down, on the centre of the heating apparatus.

Observe the decorative side of the specimen for damage including but not limited to permanent discoloration, blistering, charring, crazing, or deformation. Observation is best accomplished by observing the decorative surface via the mirror on the heating apparatus. Additional illumination may be required to observe initial damage.

Stop the timer when initial damage occurs and record the time. If damage has not occurred at 600 s, terminate the test and record the time as > 600 s.

Repeat the above steps for the two additional specimens.

36.5 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) average time to initial damage in seconds or > 600 s if no damage occurs within that time;

d) any deviation from the specified test method;

e) date of the test.

37 Formability (Method A)

37.1 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 an apparatus 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 39 and a companion method to Clause 40.

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.

37.2 Apparatus

37.2.1 Radiant heater element[8], fitted with a reflector, the distance and orientation relative to the test specimen being adjustable (see Figure 22).

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

37.2.2 Forming apparatus, of wood, chipboard, or other material having a similar thermal conductivity, the front of which is rounded to a specified radius. The apparatus radius is easily replaceable, and it is possible to use a series of forming radiuses machined to specified radii (for example 8 mm, 9 mm, 10 mm, etc.) (see Figures 23 and 24).

37.2.3 Clamping device, for the test sample (see Figure 23).

37.2.4 L-shaped forming bar, with a handle (see Figures 23 and 24).

37.2.5 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. infrared thermometers, colour-change indicators).

38.2.6 Stopwatch, or other suitable timer.

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

37.3 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.

37.4 Procedure

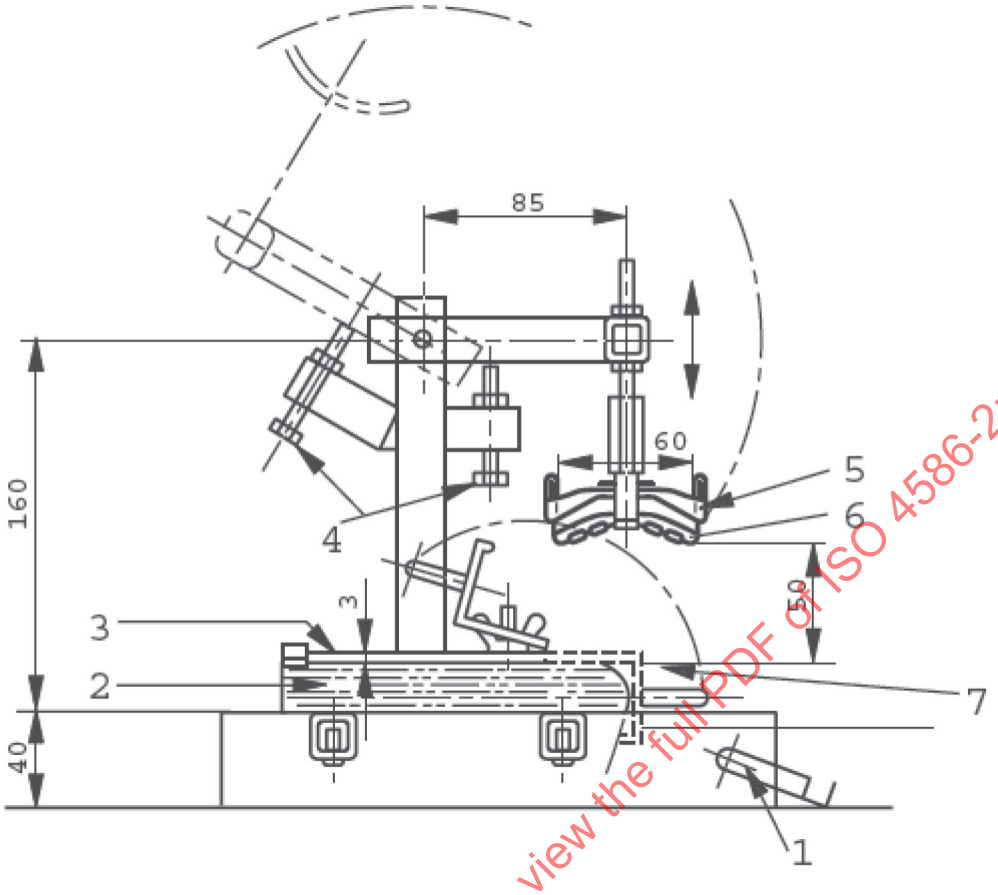
37.4.1 General

Use the forming apparatus corresponding to the specified radius.

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

8) Elstein Type FSR 650 W – 220 V (245 mm × 60 mm) and Elstein Type REO 250 mm are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

Dimensions in millimetres



Key

1 slotted support bar (for blister test only)
2 forming apparatus
3 clamping device
4 adjustable stops
5 reflector
6 heater element
7 L-shaped forming bar

Figure 23 — Forming apparatus (Method A)

37.4.2 Calibration of test apparatus

Clamp a specimen on the forming apparatus (see 37.2.2).

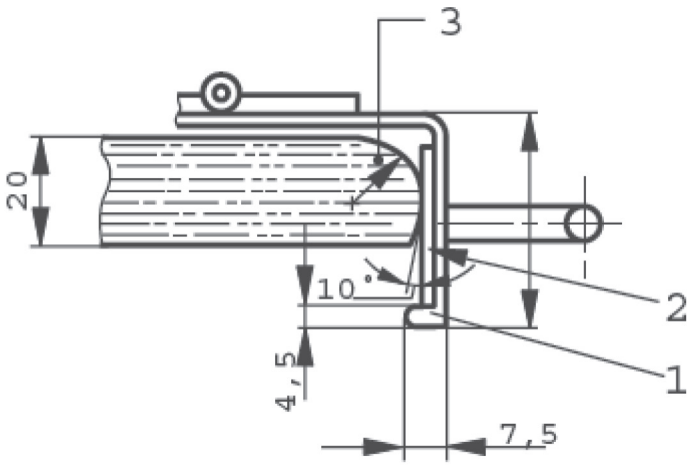
Using a 163 °C temperature indicator (see 37.2.5), make a mark on the upper face in the area to be formed.

Lower the heater element (see 37.2.1) over the specimen and start the timer (see 37.2.6) 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.

Dimensions in millimetres



Key

1 L-shaped forming bar
2 felt
3 forming apparatus with specified radius

Figure 24 — Forming apparatus (Method A)

37.4.3 Test procedure

Clamp the specimen on the forming apparatus.

Make a mark on the upper face in the area to be formed, using a temperature indicator (see 38.2.5) in the temperature range recommended by the laminate manufacturer.

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 37.2.4). 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.