INTERNATIONAL STANDARD

ISO 4586-2

Fifth edition
2004-10-15

High-pressure decorative laminates — Sheets made from thermosetting resins —

Part 2: Determination of properties

Stratifiés décoratifs haute pression — Plaques à base de résines thermodurcissables —

Partie 2: Détermination des caractéristiques

Reference number
ISO 4586-2:2004(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 4586-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This fifth edition cancels and replaces the fourth edition (ISO 4586-2:1997), of which it constitues a minor revision intended

a) to combine the 1997 edition with its amendments (Amendments 3 to 8) to give a single document;

b) to reintroduce a previously deleted method (determination of resistance to colour change in light from an enclosed carbon-arc lamp) (see 17.3).

ISO 4586 consists of the following parts, under the general title *High-pressure decorative laminates — Sheets made from thermosetting resins*:

— *Part 1: Classification and specifications*

— *Part 2: Determination of properties*

High-pressure decorative laminates — Sheets made from thermosetting resins —

Part 2: Determination of properties

1 Scope

This part of ISO 4586 specifies methods of test for determination of the properties of high-pressure decorative laminated sheets as defined in Clause 3. These methods are primarily intended for testing the sheets specified in ISO 4586-1.

The precision of the test methods specified in Clauses 4, 7 and 11 of this part of ISO 4586 is not known because inter-laboratory data are not available. When inter-laboratory 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 referenced documents are indispensable for the application 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 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-B02, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

ISO 4211-3, *Furniture — Tests for surface finishes — Part 3: Assessment of resistance to dry heat*

ISO 4586-1:2004, *High-pressure decorative laminates — Sheets made from thermosetting resins — Part 1: Classification and specification*

ISO 4892:1981, *Plastics — Methods of exposure to laboratory light sources*[1)]

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

ISO 4892-2:1994, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources*

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*

CIE Publication No. 85:1989, *Solar spectral irradiance*

1) Withdrawn, but still used in certain Asian countries.

3 Terms and definitions

For the purposes of this document, the definition of high-pressure decorative laminate(s) given in 3.1 of ISO 4586-1:2004 applies.

The abbreviation “HPDL” for high-pressure decorative laminate(s) is used in ISO 4586. It should be noted that the abbreviation “HPL” is frequently used instead of “HPDL”, and the term “HPL” in the European standard EN 438 is equivalent to “HPDL” in ISO 4586.

4 Thickness

4.1 Principle

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

4.2 Apparatus

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

4.3 Test specimen

The specimen shall be the sheet under test, as received.

4.4 Procedure

Check the gauge for accuracy and then determine the thickness of the sheet to the nearest 0,02 mm. It is recommended that the thickness be measured at a minimum of four points and at a distance of at least 20 mm from the edge of the sheet.

4.5 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) all values measured;

d) the location of the points at which measurements were made;

e) any deviation from the specified test method;

f) the date of the test.

5 Appearance

5.1 Surface defects

5.1.1 Principle

Sheets are inspected for surface appearance under standardized conditions of lighting and viewing.

5.1.2 Apparatus

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

5.1.2.2 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.

5.1.3 Test specimen

The specimen shall be the sheet under test, as received.

5.1.4 Procedure

Place the sheet, decorative face uppermost, on the inspection table. Wipe it free of any loose contamination, if necessary, with a soft cloth. Inspect it from the distance required by ISO 4586-1:2004 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. No magnifying glass shall be used in viewing the sheet.

5.1.5 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the viewing distance and any defects observed;

d) any deviation from the specified test method;

e) the date of the test.

5.2 Flatness

5.2.1 Apparatus

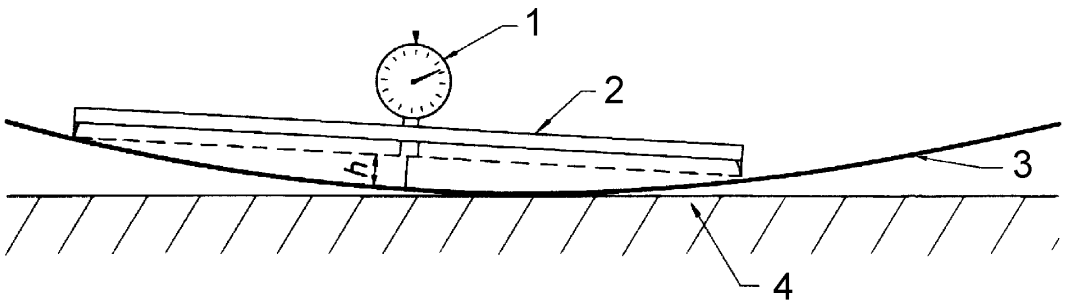
5.2.1.1 Straightedge, of 1 000 mm length, with optional **dial gauge** (see Figure 1).

5.2.2 Test specimen

The specimen shall be the sheet under test, as received, stored in the conditions recommended by the manufacturer.

5.2.3 Procedure

Place the sheet under test, concave side up, on a flat surface. Measure the departure between the straightedge and the concave surface of the laminate at the point of maximum curvature.



Key

1 dial gauge
2 straightedge
3 laminate
4 flat surface
h distance between the straightedge and the surface of the laminate

Figure 1 — Example of equipment for measuring flatness (see 5.2.1)

5.2.4 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the maximum deviation, in millimetres;

d) any deviation from the specified test method;

e) the date of the test.

6 Resistance to surface wear

6.1 Principle

The test measures the ability of the decorative surface of the sheet 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.

6.2 Materials

6.2.1 Calibration plates of rolled zinc sheet (Taber S-34 or equivalent), having a thickness of 0,8 mm ± 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.

6.2.2 Abrasive paper strips (Taber S-42 or equivalent), of width 12,7 mm ± 0,1 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).

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

6.3 Apparatus

6.3.1 Test machine, as specified in ISO 9352.

NOTE 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 product available commercially. This information is given for the convenience of users of this part of ISO 4586 and does not constitute an endorsement by ISO of this product.

6.3.2 Conditioning chamber, with a standard atmosphere of 23 °C ± 2 °C, relative humidity of (50 ± 5) %.

6.4 Test specimens

Each specimen shall be a piece of the sheet 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 side about 120 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.

6.5 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 at right angles to each other 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 6.3.2) before testing. After preconditioning, seal the paper strips in suitable polyethylene bags (maximum 10 strips per bag) until required for immediate use.

6.6 Procedure

6.6.1 Preparation of abrasive wheels

Bond a strip of preconditioned unused abrasive paper (6.2.2) to each of the rubber-covered wheels, using either the adhesive backing, if present, or the double-sided adhesive tape (6.2.3), in such a way that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper.

6.6.2 Calibration of abrasive paper

Prepare two abrasive wheels with preconditioned unused strips of abrasive paper from the batch to be used for testing (see 6.6.1).

Clamp a zinc plate (6.2.1) 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 130 mg ± 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.

6.6.3 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 its surface 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 the point at which the first clearly recognizable wear-through of the print, pattern, plain colour coating or solid paper appears and the sub-layer becomes exposed in three quadrants, with areas of at least 0,6 mm^2 wear-though in each of the three quadrants. 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.[2) 3)]

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.

6.7 Expression of results

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

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

where

IP is the initial wear point, expressed as a number of revolutions;

FP is the final wear point, expressed as a number of revolutions.

Average the value of the initial wear point (IP) of three specimens tested.

Average the value of the wear resistance of three specimens tested, rounded to the nearest 50 revolutions.

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2) A full-colour photographic visual aid, known as the IP poster, is available to assist correct interpretation, and increase repeatability and reproducibility in the determination of the initial wear point (IP). The poster is available from SIS Förlag AB, SE-11880 Stockholm, Sweden; Tel. +46 8 555 523 10, Fax. +46 8 555 523 11 (order reference 21990 IP1 poster).

3) Also available is a dirt size estimation chart. The use of this chart is recommended to determine precisely the size, in square millimetres, of the wear-through area. It is available from TAPPI, Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348-5113, USA; Tel. +1 770 446 1400, Fax. +1 770 446 6947 (order reference TAPPI — Dirt size estimation chart).

These are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 4586 and does not constitute an endorsement by ISO of these products.

6.8 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the average initial wear point (IP) of the sample under test, in revolutions;

d) the average surface wear resistance of the sample under test, in revolutions;

e) any deviation from the specified procedure;

f) the date of the test.

7 Resistance to immersion in boiling water

7.1 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 the occurrence of any blistering or delamination.

The test is generally in accordance with ISO 62:1999, Method 2, except for a longer period of immersion in the boiling water and the requirement for thickness measurements.

7.2 Apparatus

7.2.1 Balance, accurate to 1 mg.

7.2.2 Oven, capable of being maintained at 50 °C ± 2 °C.

7.2.3 Vessel, containing boiling distilled water.

7.2.4 Vessel, containing distilled water at 23 °C ± 2 °C.

7.2.5 Desiccator.

7.2.6 Micrometer thickness gauge, as described in 4.2.1.

If curvature of the specimen prevents accurate thickness measurement, then a suitable ball-ended micrometer thickness gauge shall be used.

7.2.7 Suitable heating apparatus (for example an electric hotplate).

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

7.3 Test specimens

Three specimens shall be taken from the same sheet. Each specimen shall be 50 mm ± 1 mm square, shall have the same thickness as the sheet, and shall be cut in such a way that no appreciable heat is generated and the edges are free from cracks. Cut edges shall be smooth.

7.4 Procedure

Dry the three specimens for 24 h ± 1 h in the oven (7.2.2), maintained at 50 °C ± 2 °C, and allow to cool in the desiccator (7.2.5) to 23 °C ± 2 °C. Weigh each specimen to the nearest 1 mg (mass m_1).

Measure the thickness of each specimen as specified in Clause 4, but at the centres of its four edges (d_1, d_2, d_3, d_4) and with the external edge of the micrometer anvil 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 (7.2.3). Take care to prevent the specimens from making contact over any substantial area with one another or with the vessel.

After 2 h $\pm$ 5 min, remove the specimens from the boiling water and allow to cool for 15 min $\pm$ 5 min in the vessel of distilled water maintained at 23 °C $\pm$ 2 °C (7.2.4). 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 (d_5, d_6, d_7, d_8).

Examine each specimen visually for change in appearance.

7.5 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 formulae

$$\frac{d_5 - d_1}{d_1} \times 100$$

$$\frac{d_6 - d_2}{d_2} \times 100,$$

etc.,

where

d_1, d_2, d_3 and d_4 are the thicknesses measured before immersion;

d_5, d_6, d_7 and d_8 are the thicknesses measured after immersion.

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

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

7.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the average percentage increase in mass of the three specimens;

d) the average percentage increase in thickness of the three specimens;

e) the effect on the surface of the specimens, 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

f) any deviation from the specified test method;

g) the date of the test.

8 Resistance to dry heat

8.1 Principle

A specimen taken from the sheet 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 laminated sheets for use in kitchens where contact with moderately hot cooking utensils is to be expected.

8.2 Materials

8.2.1 Glycerol tristearate, or any other material of similar specific heat which will produce the same result. To minimize health and safety risks, metal blocks can be used if it can be shown that similar results will be obtained. The aluminium alloy block specified in ISO 4211-3 has been found to be suitable.

The same glycerol tristearate or other material may normally be used for at least twenty tests, but if it has been heated to a temperature above 200 °C, or in case of dispute, fresh material shall be used.

8.2.2 Fine-faced wood chipboard, 230 mm ± 5 mm square, 18 mm to 20 mm nominal thickness with a tolerance of ± 0,3 mm, density 625 kg/m^3 to 700 kg/m^3 and moisture content (9 ± 2) %.

8.2.3 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

8.3 Apparatus

8.3.1 Cast cylindrical aluminium or aluminium alloy vessel, without a lid, the bottom of which has been machined flat. It shall have an external diameter of 100 mm ± 1,5 mm and an overall height of 70 mm ± 1,5 mm. The wall thickness shall be 2,5 mm ± 0,5 mm and the base thickness $2{,}5^{+0{,}5}_{0}$ mm.

8.3.2 Heat source, for heating the vessel (8.3.1) uniformly.

8.3.3 Suitable inorganic heat-insulating board, of thickness about 2,5 mm and 150 mm square.

8.3.4 Thermometer, range −5 °C to +250 °C.

8.3.5 Fixed frame, to hold the specimen flat.

8.3.6 Stirrer.

8.4 Test specimen

The specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (8.2.2), using the specified adhesive (8.2.3). One specimen 230 mm ± 5 mm square shall be used. The bonded specimen shall be preconditioned for at least 7 days at 23 °C ± 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.

8.5 Procedure

Fill the vessel (8.3.1) with sufficient glycerol tristearate (8.2.1) so that at 180 °C the level is about 15 mm from the top. Fix the thermometer (8.3.4) centrally in the vessel with its bulb about 6 mm from the bottom. Raise the temperature of the glycerol tristearate to approximately 185 °C, stirring from time to time. Transfer the vessel to the heat-insulating board (8.3.3) and allow the temperature to fall to 180 °C ± 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.

8.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the effect on the surface of the specimen, 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

d) any deviation from the specified test method;

e) the date of the test.

9 Resistance to wet heat

9.1 Principle

A specimen taken from the laminate under test (bonded to wood chipboard, if necessary, to simulate service conditions) is subjected to wet heat by contact for a specified period with a vessel containing hot water placed in a pool of boiling water which has been poured onto the surface of the specimen. Resistance to the test conditions is assessed by visual examination.

9.2 Materials

9.2.1 Distilled or de-ionized water.

9.2.2 Sheet of fine-faced wood particleboard, (230 ± 5) mm square, with a nominal thickness of 18 mm to 20 mm ($\pm$ 0,3 mm), a density of (680 ± 20) kg/m^3 and moisture content of (10 ± 3) %.

9.2.3 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

9.2.4 Supply of clean, soft, white cloth.

9.3 Apparatus

9.3.1 Cylindrical aluminium or aluminium-alloy vessel, without a lid, the bottom of which has been machined flat. It shall have an external diameter of $(100 \pm 1{,}5)$ mm and an overall height of $(70 \pm 1{,}5)$ mm. The wall thickness shall be $(2{,}5 \pm 0{,}5)$ mm and the base thickness $2{,}5^{+0{,}5}_{0}$ mm.

9.3.2 Heat source, for heating the vessel (9.3.1) uniformly.

9.4 Test specimen

Prepare one specimen by uniformly bonding a piece (230 ± 5) mm square of the laminate under test to the particleboard (9.2.2), using the specified adhesive (9.2.3) evenly spread at 80 g/m^2 to 120 g/m^2. Condition the bonded specimen for at least 72 h at (23 ± 2) °C and (50 ± 5) % relative humidity before 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 particleboard.

9.5 Procedure

Fill the vessel (9.3.1) to 12 mm from the rim with distilled or de-ionized water, and heat it until the water boils vigorously.

As water boils and evaporates, dissolved minerals are left behind and will adhere to the vessel walls, forming scale which is an effective insulator. Any such scale shall be removed periodically or the accuracy of the test may be compromised. The use of distilled or de-ionized water will minimize this problem.

Using tongs, or other suitable means, carefully remove the vessel from the hotplate, pour approximately 10 ml of boiling water onto the horizontal surface of the test specimen and immediately place the vessel containing the remainder of the boiling water on the surface in the pool of water.

Allow the vessel to remain in place for 20 min.

At the end of this period, remove the vessel and wipe the surface of the specimen dry, using a clean, soft cloth (9.2.4) to remove any residual contaminants. Allow the specimen to cool for a period of 45 min.

Examine the specimen surface for 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.

9.6 Expression of results

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

Rating 5: No visible change

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

Rating 3: Moderate change in gloss and/or colour

Rating 2: Marked change in gloss and/or colour

Rating 1: Surface damage and/or blistering

9.7 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) the effect on the specimen, expressed in accordance with 9.6;

d) any deviation from the method specified;

e) the date of the test.

10 Resistance to steam

10.1 Principle

A specimen from the sheet 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 steam. 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.

10.2 Materials

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

10.2.2 Specimen holder and **heat screen** (see Figure 2).

10.2.3 Non-fibrous filter paper.

10.2.4 Hand lens, with ×6 magnification.

10.2.5 Electric hotplate, or other suitable heat source.

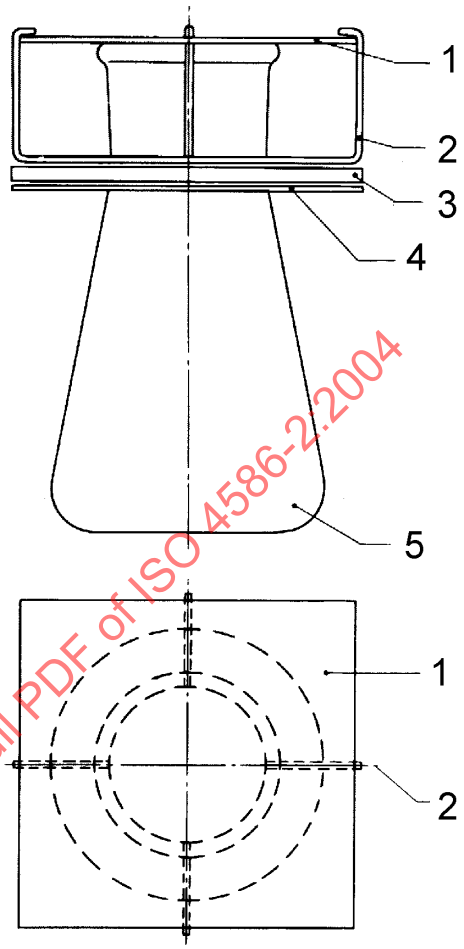
10.3 Test specimen

One specimen, measuring 100 mm × 100 mm × the thickness of the sheet under test, is required.

10.4 Procedure

Place approximately 200 ml of water in the flask (10.2.1) and bring it to the boil on the electric hotplate (10.2.5). Place the heat screen (see 10.2.2) in position around the neck of the flask and place the specimen, decorative face down, centrally over the mouth of the flask and fix it in position by the wire specimen holder (see Figure 2).

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



Key

1 specimen
2 wire specimen holder
3 heat screen
4 aluminium ring
5 Erlenmeyer flask, wide-necked, 250 ml

Figure 2 — Apparatus for resistance to steam (see 10.2)

After the decorative face has been exposed for 1 h to the steam from the boiling water, remove the specimen and use the non-fibrous filter paper (10.2.3) 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, and under ×6 magnification using the hand lens (10.2.4) for any change in appearance.

10.5 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the effect on the surface of the specimen, 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

d) any deviation from the specified procedure;

e) the date of the test.

11 Dimensional stability

11.1 Method A — At elevated temperature

11.1.1 Principle

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

11.1.2 Apparatus

11.1.2.1 Circulating-air oven, capable of being maintained at (70 ± 2) °C.

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

11.1.2.3 Standard-atmosphere conditioning chamber, with a standard atmosphere of (23 ± 5) °C and relative humidity (50 ± 5) %.

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

11.1.2.5 Fixture, to maintain specimens from thin laminates in a flat position while measurements are taken. A suitable fixture is shown in Figure 3.

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

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

11.1.2.8 Desiccator, of suitable size.

11.1.3 Test specimens

Cut four specimens (120 ± 1) mm square from the sheet under test. The edges shall be smooth and free from cracks.

Use two specimens for the dry-heat test and two 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.

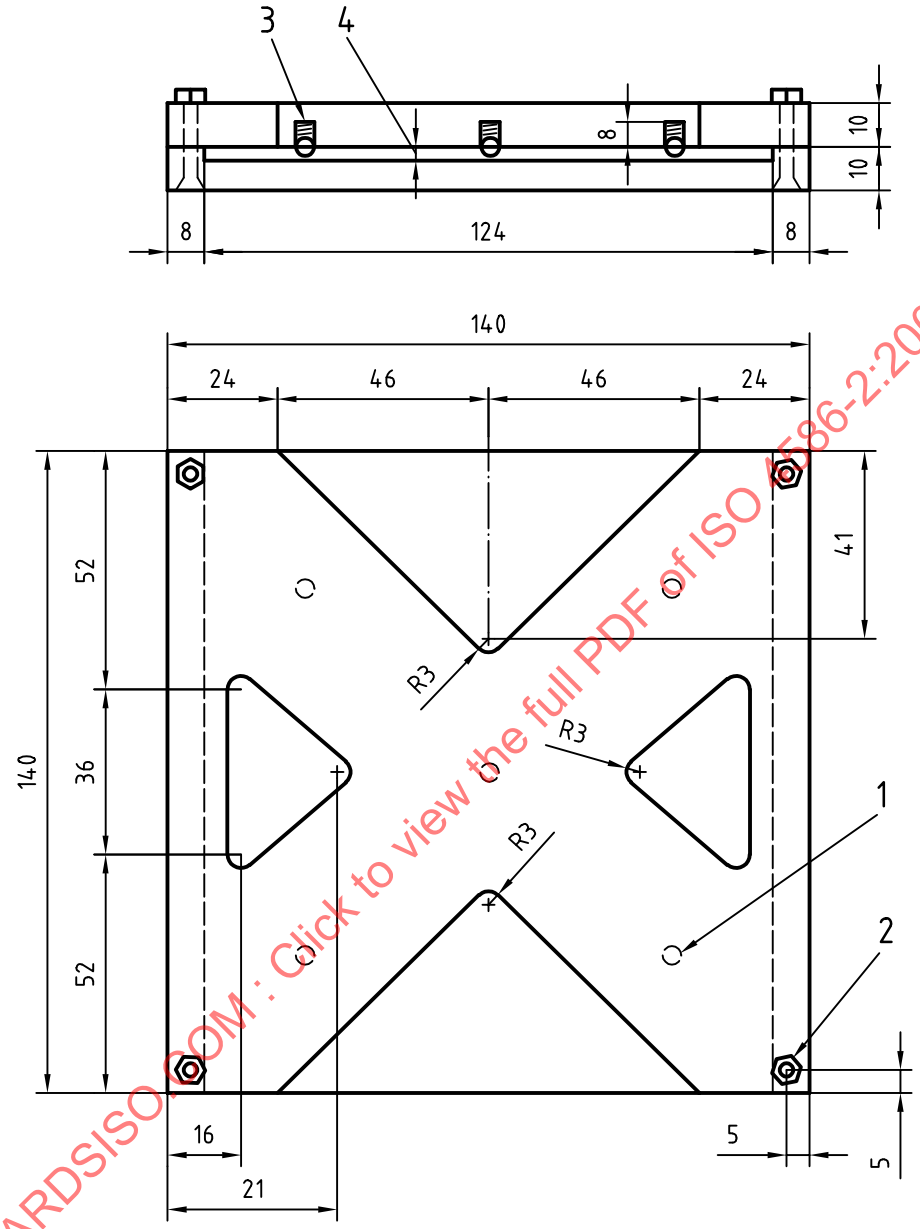
11.1.4 Procedure

11.1.4.1 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 (11.1.2.8).

The specimen shall be kept flat when making length measurements. For thin laminates, a suitable fixture such as that shown in Figure 3 shall be used.

Dimensions in millimetres



Key

1 3 mm steel ball and spring

2 (3×22) mm bolt and nut

3 suitable spring to maintain specimen in flat position

4 3-mm-wide slot

Figure 3 — Fixture to maintain the test specimen in position (see 11.1.2.5 and 11.2.2.5)

With each specimen, use the steel rule (11.1.2.7) to locate the point midway between two adjacent corners and 10 mm in from the corresponding edge. Mark this point, using a centre-punch (11.1.2.6) for instance. Repeat this for the other three sides of each specimen.

As an alternative to marking the measurement points by punching, they may be scribed or marked on the surface of the specimen in some other suitable way.

11.1.4.2 Dry-heat test

Taking two specimens, 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. Any suitable means (see11.1.2.4) may be used to measure the distances between the marks. If a centre-punch has been used to mark the measurement points, measure the distances using a caliper gauge with its points positioned in opposite locating indentations.

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

Place both specimens in the oven (11.1.2.1) maintained at $(70 \pm 2)\,^{\circ}\mathrm{C}$. At the end of 24 h, remove the specimens and allow them to cool to ambient temperature in the desiccator (11.1.2.8) for 1 h, then remeasure the distances between the marks.

11.1.4.3 High-humidity test

Taking the remaining two specimens, measure the distances between opposite marks in both the machine direction and transverse direction. Place both specimens in the high-humidity conditioning chamber (11.1.2.2) at $(40 \pm 2)\,^{\circ}\mathrm{C}$ and a 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 remeasure the distances between the marks.

11.1.5 Expression of results

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

Calculate the mean percentage change in machine-direction length 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 larger of the two average changes shall be taken as the cumulative dimensional change. The absolute figure shall be reported.

An example of results (using measurements in the transverse direction) is shown in Table 1.

The movements in the two tests are in opposite directions, therefore the cumulative dimensional change in the transverse direction is equal to 0,40 % + 0,65 % = 1,05 %.

Table 1 — An example of dimensional stability at elevated temperature

Dry-heat test			
	Specimen 1	**Specimen 2**	**Mean**
Initial distance (mm)	100,28	99,89	
Final distance (mm)	99,83	99,52	
Change (mm)	− 0,45	− 0,37	
Change (%)	− 0,45	− 0,37	− 0,41
		− 0,41 rounded to the nearest 0,05 = − 0,40 %	
High-humidity test			
	Specimen 1	**Specimen 2**	**Mean**
Initial distance (mm)	100,11	99,74	
Final distance (mm)	100,63	100,49	
Change (mm)	+ 0,52	+ 0,75	
Change (%)	+ 0,52	+ 0,75	+ 0,64
		+ 0,64 rounded to the nearest 0,05 = + 0,65 %	

11.1.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) the cumulative dimensional change for the machine direction;

d) the cumulative dimensional change for the transverse direction;

e) any deviation from the method specified;

f) the date of the test.

11.2 Method B — At ambient temperature

11.2.1 Principle

The test measures the lateral dimensional changes of specimens from the laminate under test over an extreme range of relative humidities at ambient temperature.

11.2.2 Apparatus

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

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

NOTE The low-humidity chamber may be set up to operate either mechanically or chemically to control the temperature at (23 ± 2) °C and to maintain (15 ± 5) % relative humidity. One way of maintaining the relative humidity at this level is by using a saturated solution of lithium chloride ($LiCl \cdot H_2O$) placed in a tray within the chamber.

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

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

11.2.2.5 Fixture, to maintain specimens from thin laminates in a flat position while measurements are taken. A suitable fixture is shown in Figure 3.

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

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

11.2.3 Test specimens

Cut two specimens (120 ± 1) mm square from the sheet under test. The edges shall be smooth and free from cracks.

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

11.2.4 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 specimen shall be kept flat when making length measurements. For thin laminates, a suitable fixture such as that shown in Figure 3 shall be used.

With each specimen, use the steel rule (11.2.2.7) to locate the point midway between two adjacent corners and 10 mm in from the corresponding edge. Mark this point, using a centre-punch (11.2.2.6) for instance. Repeat this for the other three sides of each specimen.

As an alternative to marking the measurement points by punching, they may be scribed or marked on the surface of the specimen in some other suitable way.

Place both specimens in the high-humidity chamber (11.2.2.1), positioned so that air can circulate freely around them.

After (96 ± 4) h, remove both 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. Any suitable means (see 11.2.2.4) may be used to measure the distances between the marks. If a centre-punch has been used to mark the measurement points, measure the distances using a caliper gauge with its points positioned in opposite locating indentations. Record these measurements as the initial measurements.

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

Place both specimens in the low-humidity chamber (11.2.2.2), positioned so that air can circulate freely around them.

After (96 ± 4) h, remove both specimens from the chamber and immediately remeasure the distances between the marks. Record these measurements as the final measurements.

11.2.5 Expression of results

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

Calculate the gross dimensional change in each direction, which is the difference between the average initial and average final measurements expressed as a percentage of the corresponding average initial measured length, to the nearest 0,05 %.

An example of results (using measurements in the transverse direction) is given below:

Average of two initial measurements $=$ 104,02 mm

Average of two final measurements $=$ 103,05 mm

Gross dimensional change $=$ 0,97 mm

Percentage gross dimensional change, to the nearest 0,05 % $=$ 0,95 %

11.2.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) the percentage gross dimensional change in the machine direction;

d) the percentage gross dimensional change in the transverse direction;

e) any deviation from the method specified;

f) the date of the test.

12 Resistance to impact by small-diameter ball

12.1 Principle

A specimen from the sheet 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 minimum spring force needed to cause visible damage is used as a measure of resistance to impact.

12.2 Materials

12.2.1 High-quality fine-faced wood chipboard, 18 mm to 20 mm nominal thickness with a tolerance of $\pm$ 0,3 mm, density 625 kg/m^3 to 700 kg/m^3 and moisture content (9 ± 2) %.

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 therefore very important in achieving good reproducibility with this test. In cases of dispute, the same test shall be carried out on chipboards from three different suppliers.

12.2.2 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

12.2.3 Solution of dye in alcohol, graphite or **talcum**, to contrast with the colour of the sheet under test (optional).

12.3 Apparatus

12.3.1 Impact tester (see Figure 4), 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 (housing).

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

The compression spring is 100 mm long when released and has a constant of 1 962 N/m $\pm$ 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.

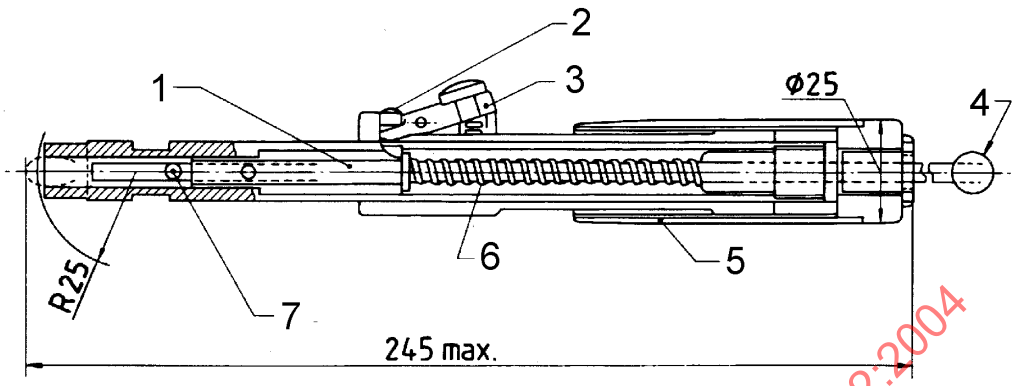
12.3.2 Force-producing arrangement (for example a scale-pan and weights), capable of being suspended from the impact bolt to exert a compressive force on the spring.

12.3.3 Support fixture (see Figure 5), 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.

12.3.4 Steel plate, having dimensions of approximately 300 mm $\times$ 300 mm $\times$ 50 mm.

12.3.5 Hand lens, with approximately $\times$6 magnification (optional).

Dimensions in millimetres

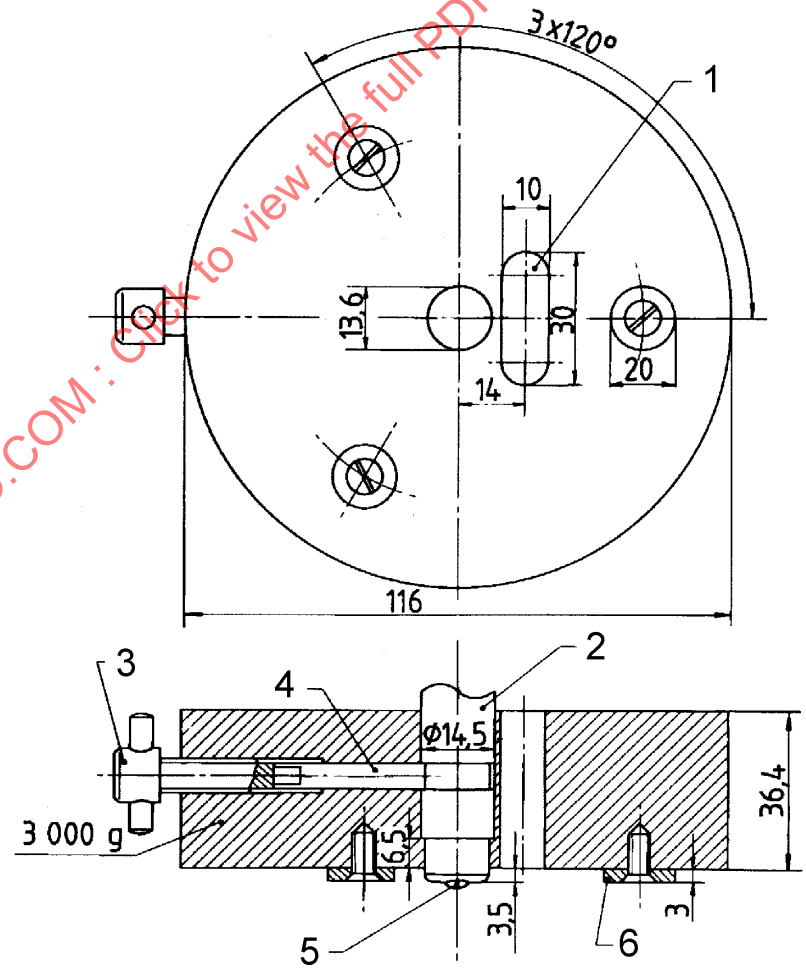


Key

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

Figure 4 — Impact tester (shown with spring compressed) (see 12.3.1)

Dimensions in millimetres



Key

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

Figure 5 — Support fixture for impact tester (see 12.3.3)

12.4 Test specimens

Specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (12.2.1), using the specified adhesive (12.2.2). About ten specimens, each 230 mm ± 5 mm square, shall be prepared. The bonded specimens shall be preconditioned for at least 7 days at 23 °C ± 2 °C and (50 ± 5) % relative humidity before being used for the test.

12.5 Calibration of the impact tester

Suspend the tester (12.3.1) with the impact bolt pointing upwards so that its longitudinal axis is free to hang vertically under gravity.

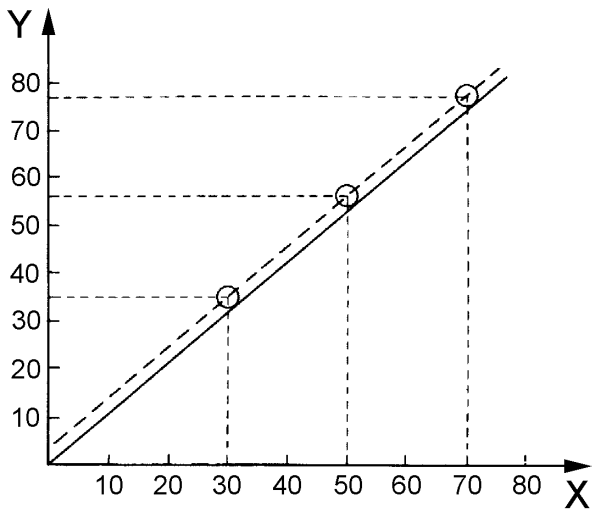
Set the force-setting barrel, which serves to vary the impact force, to zero on the scale. Compress the spring by a force F_e (calibration force) using a suitable arrangement (for example weights in a scale-pan) (12.3.2) suspended from the knob used to draw back the impact bolt, ensuring that the bolt is clear of the retainer of the release unit.

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

Repeat this calibration procedure for various values of F_x in the range required, and draw a graph relating values of the scale reading F_x to values of the calibration force F_e (see Figure 6 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 (N)

Figure 6 — Example of calibration graph relating actual force to scale value (see 12.5)

12.6 Procedure

The test shall be carried out in the laboratory atmosphere, and in cases of dispute it shall be carried out at 23 °C ± 2 °C.

Place the steel plate (12.3.4) 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 (12.3.3), load the tester, place the assembly on the specimen and release the impact bolt. Start preliminary tests 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 at least five additional 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 tests.

To make the damage more easily visible, the surface of the specimen may be rubbed after the test with a solution of dye in alcohol or with graphite or talcum (depending on the colour of the decorative surface). A magnifier (12.3.5) with ×6 magnification may also be used.

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

12.7 Expression of results

Enter the results of the series of tests on to an evaluation diagram (see Figure 7 for an example) in which they are subdivided into “Specimen not damaged” and “Specimen damaged”, for each value of spring force used. This results in a transition range in which some specimens are damaged and some undamaged. The impact strength of the material is the maximum value of the spring force, in newtons, for which no damage occurs in a series of five tests.

12.8 Test report

The test report shall include the following information:

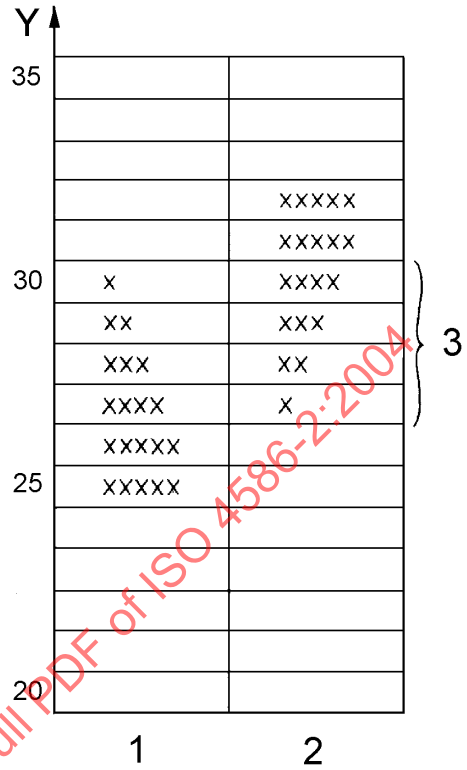
a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the impact strength, in newtons;

d) any deviation from the specified procedure;

e) the date of the test.



Key

Y	spring force (N)
1	specimen not damaged
2	specimen damaged
3	transition range

NOTE In the example, the impact strength of the material is 26 N.

Figure 7 — Example of evaluation diagram for assessing the effect of impact blows with an impact tester (see 12.7)

13 Resistance to impact by large-diameter ball

13.1 Principle

A specimen from the sheet 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.

13.2 Materials

13.2.1 High-quality fine-faced wood chipboard, 18 mm to 20 mm nominal thickness with a tolerance of $\pm$ 0,3 mm, density 625 kg/m^3 to 700 kg/m^3 and moisture content (9 ± 2) %.

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 therefore very important in achieving good reproducibility with this test. In cases of dispute, the same test shall be carried out on chipboards from three different suppliers.

13.2.2 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

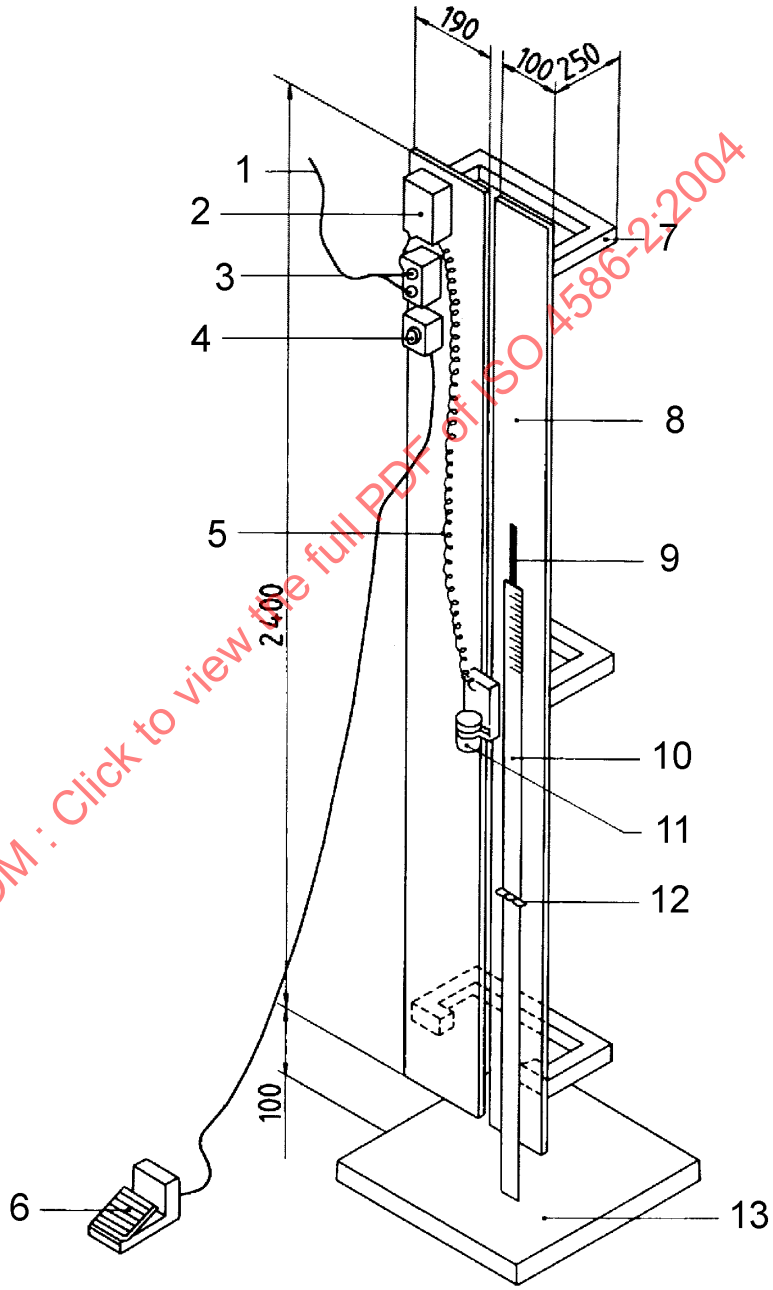
13.3 Apparatus

13.3.1 Free-fall test apparatus, of the type shown in Figure 8, or an equivalent which will produce the same results.

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

13.3.3 Specimen clamping frame, conforming to Figure 9.

Dimensions in millimetres

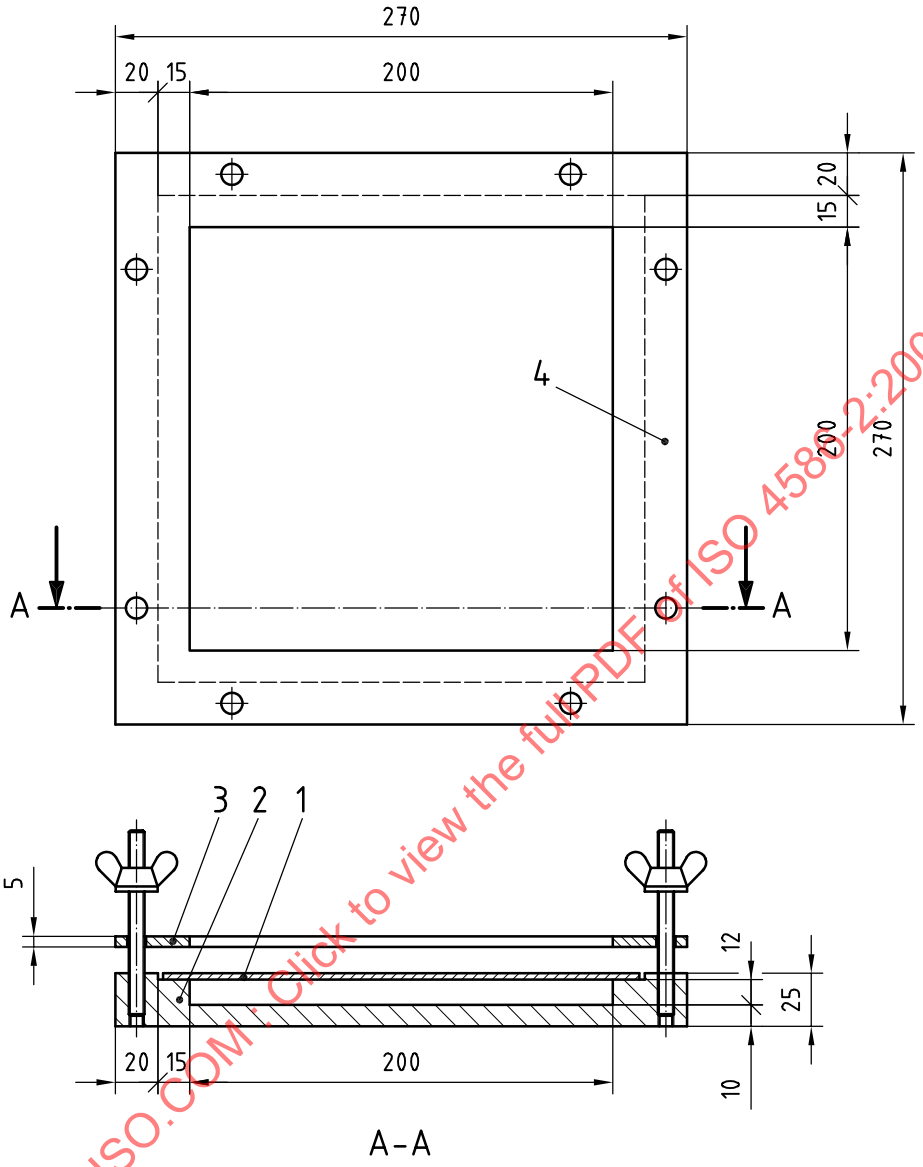


Key

1	electric power supply
2	transformer and rectifier
3	junction box with two-pin socket
4	junction box with indicator light
5	coiled wire lead
6	foot treadle switch
7	angle iron brackets (attached firmly to wall or column, plumb and perpendicular to base plate)
8	mounting board for test apparatus (medium- or high-density chipboard)
9	6-mm-wide slot
10	slidable machinist's steel scale
11	electromagnet on sliding mount
12	wing nut
13	450 mm × 450 mm × 20 mm steel base plate, levelled and set firmly to floor, and projecting out far enough in front of the stand for the whole of the clamping frame holding the test specimen (see Figure 9) to be placed on it

Figure 8 — Resistance to impact by large-diameter ball (see 13.3.1)

Dimensions in millimetres



Key

1 specimen
2 metal frame
3 upper metal frame, thickness 5 mm
4 lower metal frame

Figure 9 — Clamping frame (see 13.3.3)

13.4 Test specimens

Specimens shall be 230 mm $\pm$ 5 mm square. For laminates of thickness less than 2,0 mm, specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (13.2.1) using the specified adhesive (13.2.2). The bonded specimens shall be preconditioned for at least 7 days at 23 °C $\pm$ 2 °C and (50 ± 5) % relative humidity before being used for the test.

For laminates of thickness $\geqslant$ 2,0 mm and $<$ 5,0 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 $\geqslant$ 5,0 mm shall be tested clamped in the frame without the chipboard support.

13.5 Procedure

The test shall be carried out in the laboratory atmosphere, and in cases of dispute it shall be carried out at 23 °C ± 2 °C.

Clamp the specimen in the clamping frame (13.3.3) and place the assembly on the solid base of the free-fall test apparatus (13.3.1). 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 (13.3.2) on the energized electromagnet. Operate the release mechanism so that the ball falls on the specimen, catching the ball on the first rebound so that multiple impacts do not occur.

Examine the impact spot. If cracking is evident, or the carbon imprint is greater than the diameter specified in ISO 4586-1, 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, which is defined as the maximum height for which no visible surface cracking, or imprint greater than the specified diameter, occurs in five successive strikes.

13.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the impact resistance, expressed in centimetres;

d) the indentation diameter, expressed in millimetres;

e) any deviation from the specified test method;

f) the date of the test.

14 Resistance to cracking under stress (thin laminates ⩽ 2 mm)

14.1 Principle

A specimen, with a drilled hole, taken from the sheet under test is rigidly clamped in a steel fixture. Additional stress is imposed by heating the clamped specimen at 50 °C for 6 h, and the resistance to cracking assessed by visual examination.

14.2 Apparatus

14.2.1 Clamping device, as shown in Figure 10.

14.2.2 Drilling jig, to facilitate drilling of accurate holes which are free from chipping or cracking. A suitable jig is shown in Figure 11.

14.2.3 Conditioning chamber, with a standard atmosphere of 23 °C ± 2 °C and relative humidity of (50 ± 5) %.

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

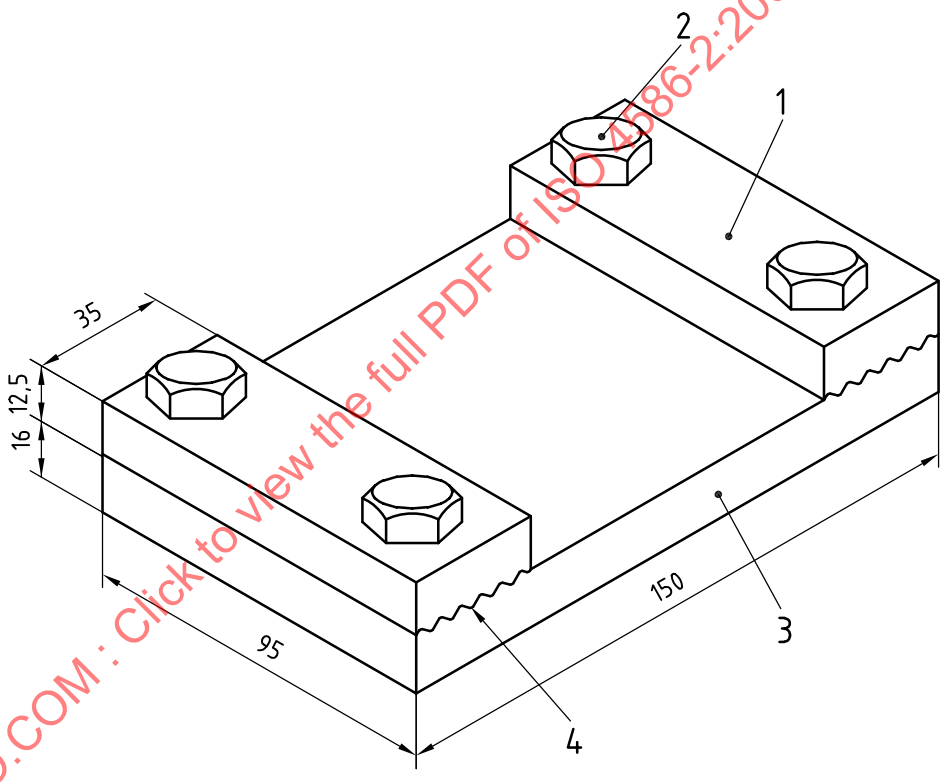
14.2.5 Hand lens, with approximately ×6 magnification.

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

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

14.2.8 Micrometer thickness gauge, as described in 4.2.1.

Dimensions in millimetres



Key

1	clamping block
2	nut
3	base plate
4	serrated surfaces

Figure 10 — Clamping device (mild steel)

14.3 Test specimens

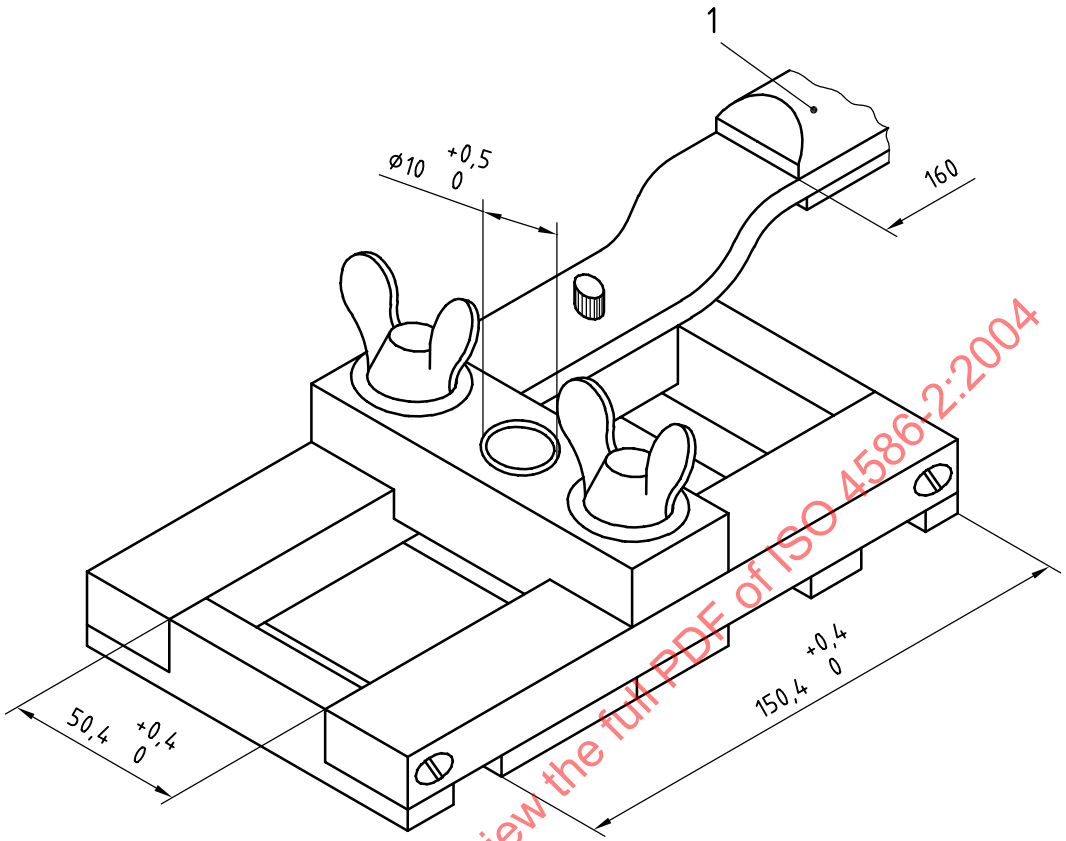
Four specimens shall be prepared, of which three shall be tested and the fourth used as a drill backing piece.

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

The specimens shall have a 10 mm ± 0,5 mm diameter hole drilled in their centres using a drilling jig (14.2.2), 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 14.4).

Dimensions in millimetres



Key

1 handle

Figure 11 — Drilling jig (mild steel)

14.4 Procedure

Measure the thickness of the laminate under test in accordance with Clause 4.

Precondition the specimens for 48 h in a standard atmosphere of 23 °C ± 2 °C and (50 ± 5) % relative humidity.

Preheat the clamping device (14.2.1) in the oven (14.2.4) for 2 h at 50 °C ± 2 °C.

Take one specimen from the conditioning chamber (14.2.3), place it immediately in the pre-heated 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 °C ± 2 °C.

After 6 h ± 15 min, 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.

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.

14.5 Expression of results

Express the result of the examination in accordance with the following rating scale (see also Figure 12):

Rating 5: No evidence of cracking

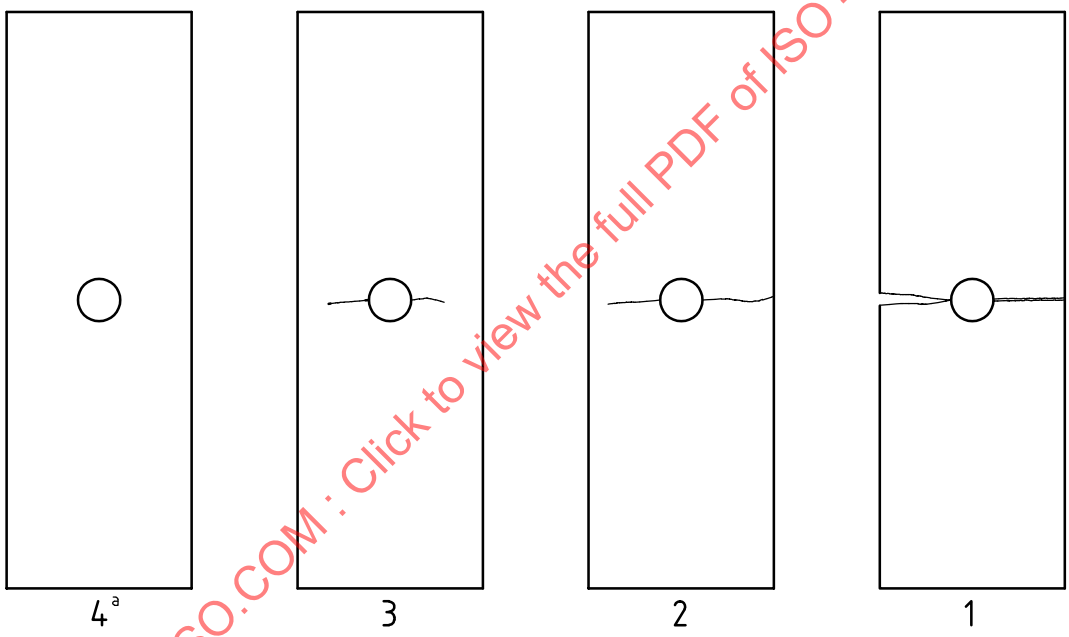
Rating 4: Hairline cracks only visible under ×6 magnification

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

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

Rating 1: Specimen broken into two pieces

The resistance to cracking under stress is expressed as the arithmetic mean of the three individual ratings, rounded to the nearest integer.



Key

1 to 4 ratings on rating scale (see 14.5)

[a] Hairline cracks only visible under ×6 magnification.

Figure 12 — Classification of types of failure

14.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the thickness of the sheet under test;

d) the resistance to cracking under stress;

e) any deviation from the specified procedure;

f) the date of the test.

15 Resistance to scratching

15.1 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 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.

15.2 Materials

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

15.2.2 Supply of cotton fabric.

15.3 Apparatus

15.3.1 Scratch test apparatus (see Figure 13), consisting of the following parts:

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

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

15.3.1.3 Arm (B), 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.

15.3.1.4 Means of applying a known load, with an accuracy of $\pm$ 0,01 N to the scratching point with weights (C + D).

15.3.1.5 Hemispherical diamond scratching point (E), with a point radius of $(0{,}090 \pm 0{,}003)$ mm and an included angle of $(90 \pm 1)^\circ$ (see also Figure 14)[4]. The diamond shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction.

15.3.1.6 Clamping disc (F), to keep the test specimen flat.

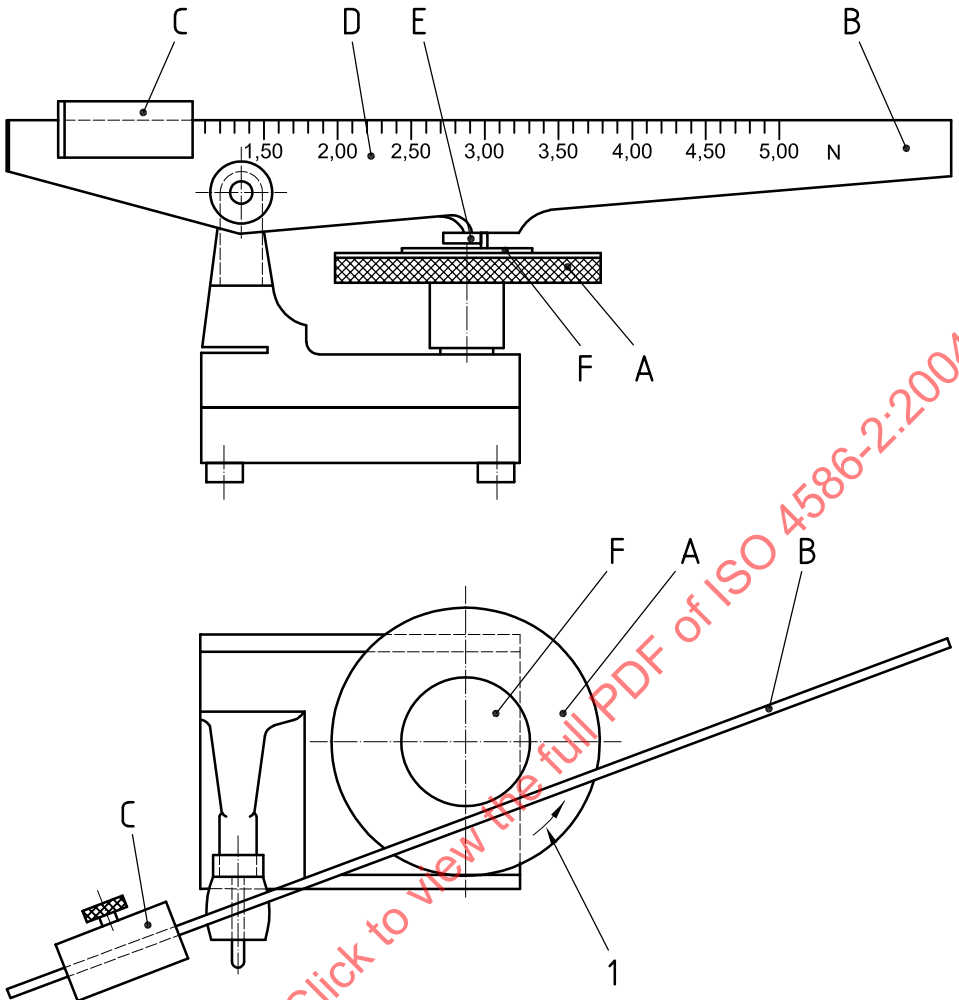
15.3.2 Viewing enclosure, having a matt black interior and a light source (defined below) located at the top. Its dimensions shall be such that the test specimen is located vertically below the light source and at distance of (600 ± 5) mm. An aperture in the front shall allow inspection of the test specimen at various angles from a distance of (400 ± 10) mm. A diagram of a suitable enclosure is shown in Figure 15.

The light source shall consist 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.

15.3.3 Conditioning chamber, with a standard atmosphere of (23 ± 2) °C and relative humidity of (50 ± 5) %.

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

4) Diamond points conforming to these dimensions and profile are available from Cie Weinz, Industrie Edelstein Fabrik, Postfach 2740, D-55743 Idar-Oberstein, Germany. The same product is available through Erichsen GmbH & Co. KG, D-58675 Hemer-Sundwig/Westfalien, Germany. This is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 4586 and does not constitute an endorsement by ISO of this product.

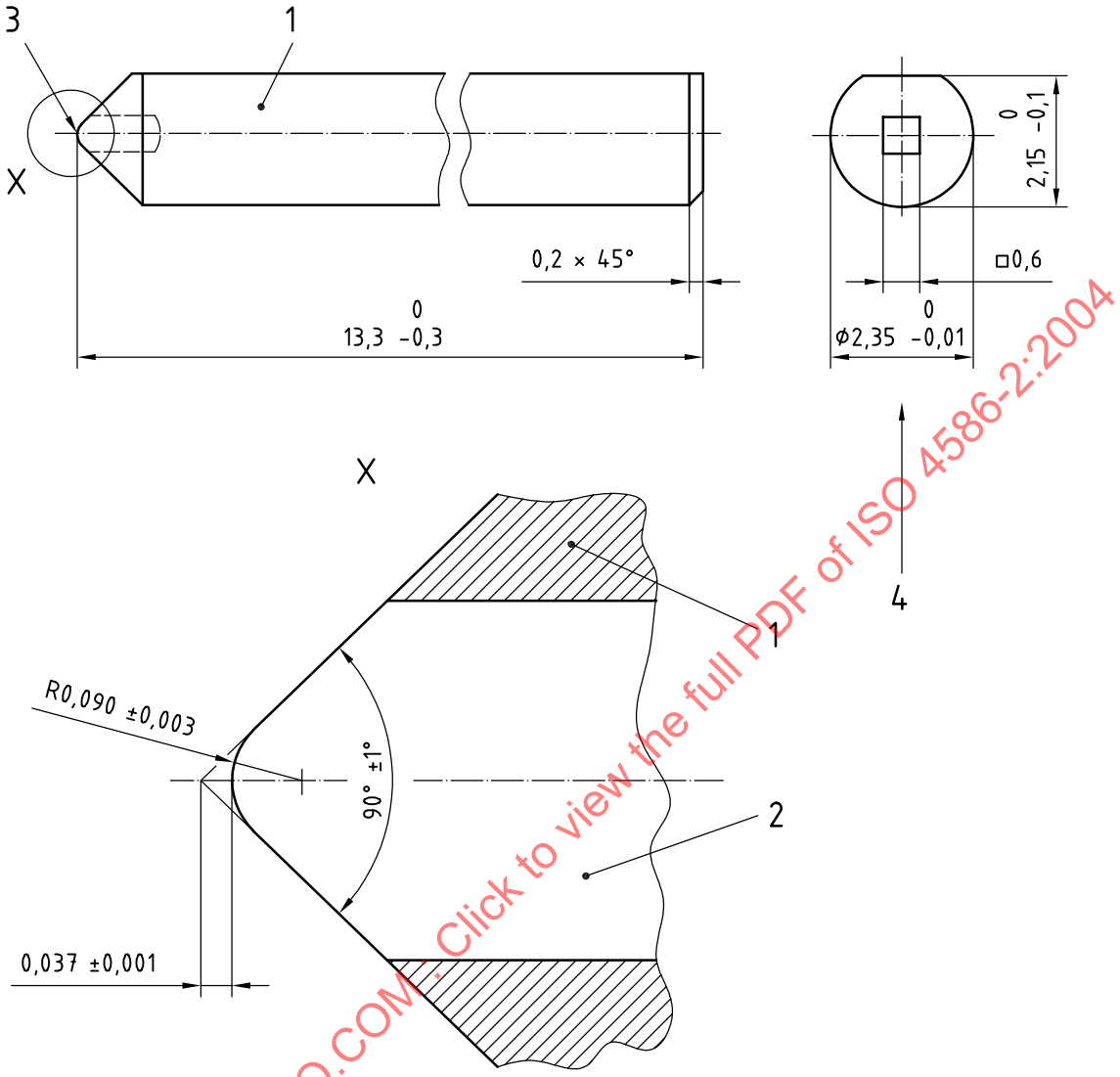


Key

1 direction of rotation

Figure 13 — Type of apparatus for measuring resistance to scratching (see 15.3.1)

Dimensions in millimetres



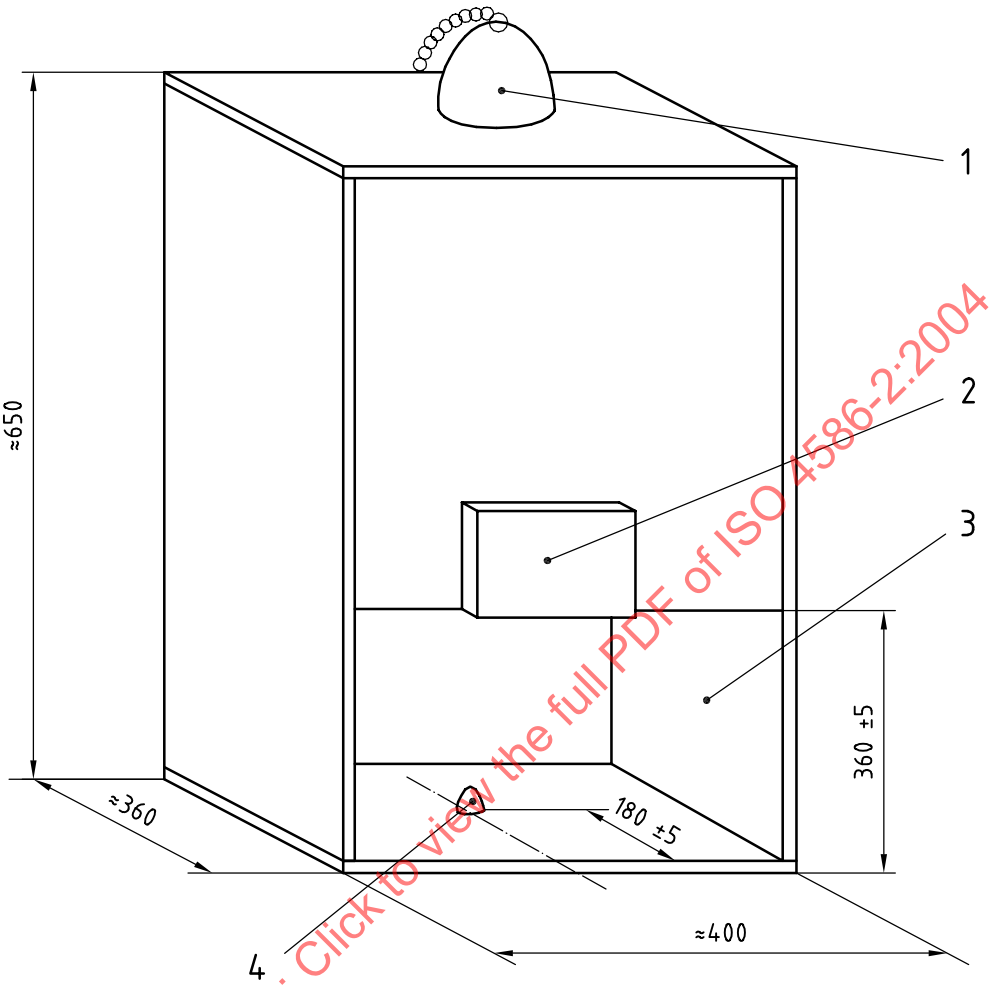
Key

1 diamond holder
2 diamond
3 diamond point
4 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 given for information only.

Figure 14 — Diamond scratching point (see 15.3.1.5)

Dimensions in millimetres



Key

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

Figure 15 — Example of suitable viewing enclosure (see 15.3.2)

15.4 Calibration of apparatus

Place the diamond point on the table of the electronic balance (15.3.4) and, with the arm (B) in a horizontal position, verify that the position marks for the sliding weight (C) correspond to the load values shown in Table 2. If not, move weight C as necessary to achieve the correct loads, and mark the correct positions on the arm (B).

Table 2 — Load values

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

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

15.5 Test specimen

The test specimen shall be a square of side (100 ± 1) mm cut from the sheet under test. If required by the type of apparatus used, a hole of suitable size shall be drilled in the centre of the specimen. One specimen shall be tested.

Wipe the specimen surface using cotton fabric (15.2.2) 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 15.3.3.

15.6 Procedure

Make sure that the stand of the test apparatus is standing horizontally.

Adjust the height of the arm (B) so that it is horizontal when the diamond point rests on the test specimen.

Start the test by making two scratches (each with one revolution of the turntable) 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 (15.2.1) so that it is engrained in the scratches.

Carefully wipe the surface with clean cotton fabric (15.2.2) to remove any excess contrast medium which is not engrained in a scratch.

NOTE This procedure is necessary to ensure that only true scratches are considered, and superficial hairline polish marks are ignored.

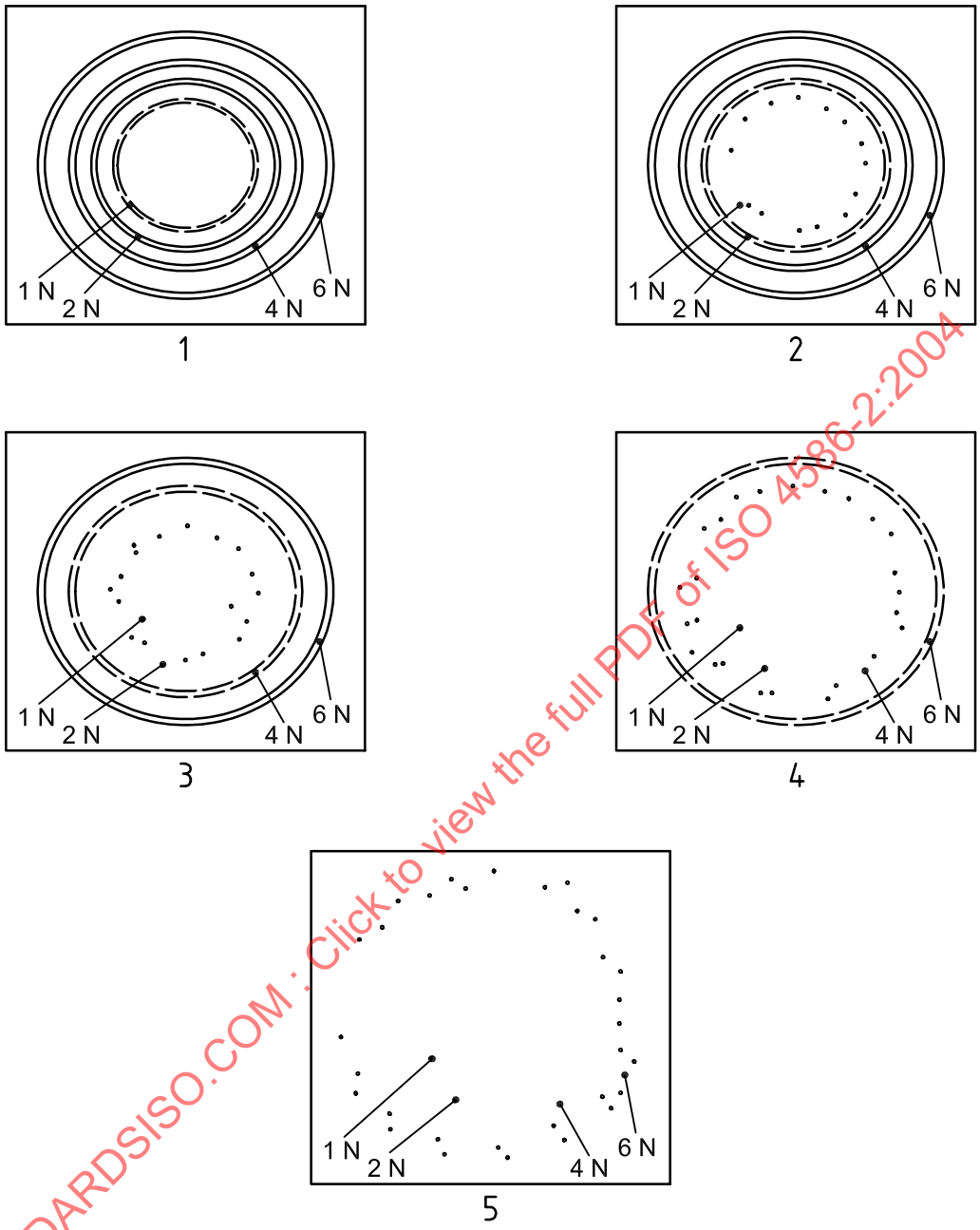
Place the specimen against the centre support in the viewing enclosure (15.3.2) at an angle such that the specimen can be viewed at right angles to the plane of the surface.

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 16 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.



Key

1 to 5 ratings on rating scale (see Table 3)

Figure 16 — Examples of scratch resistance test results

15.7 Expression of results

Express the scratch resistance of the laminate under test in accordance with the rating scale in Table 3 (see also Figure 16).

Table 3 — 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

15.8 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) the scratch resistance, expressed in accordance with the rating scale in Table 3;

d) any deviation from the specified test method;

e) the date of the test.

16 Resistance to staining

16.1 Method A

16.1.1 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 product under test meets specification requirements when tested with each of the six staining agents marked with an asterisk, 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.

16.1.2 Staining agents

Staining agent	Test conditions	Contact time
Group 1 *Acetone Trichlorethane Other organic solvents Toothpaste Hand cream Urine Alcoholic beverages Natural fruit and vegetable juices Lemonade and fruit drinks Meats and sausages Animal and vegetable fats and oils Water Yeast suspension in water Salt (NaCl) solutions Mustard Lyes, soap solutions Cleaning solution 23 % dodecylbenzene sulfonate 10 % alkyl aryl polyglycol ether 67 % water Phenol and chloramine T disinfectants Stain or paint remover based on organic solvents Citric acid (10 % solution)	16.1.5.1 Procedure A Apply staining agent at ambient temperature	16 h to 24 h
Group 2 *Coffee (120 g of coffee per litre of water) Black tea (9 g of tea per litre of water) Milk (all types)	16.1.5.1 Procedure A Apply staining agent at approximately 80 °C	
Cola beverages Wine vinegar Alkaline-based cleaning agents diluted to 10 % concentration with water Hydrogen peroxide (3 % solution) Ammonia (10 % solution of commercial concentrate) Nail varnish Nail varnish remover Lipstick Water colours Laundry marking inks Ball point inks	16.1.5.1 Procedure A Apply staining agent at ambient temperature	16 h
Group 3[a] *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-hydroxymercurifluorescein, disodium salt) *Shoe polish Hair colouring and bleaching agents Tincture of iodine (or 10 % povidone iodine) Boric acid Lacquers and adhesives (except fast-curing materials) Amidosulfonic acid descaling agents (< 10 % solution)	16.1.5.1 Procedure A Apply staining agent at ambient temperature	10 min
Group 4 *Citric acid (10 % solution) Acetic acid (5 % solution)	16.1.5.2 Procedure B	20 min

[a] Acids and alkalis, in concentrations stronger than those shown in group 3, which can be contained in commercial cleaning agents, can cause surface damage or marking, even with very short contact times. Any spillage of such materials shall be washed off immediately.

16.1.3 Apparatus and materials

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

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

16.1.3.3 Flat-bottomed aluminium vessel, in accordance with 8.3.1.

16.1.3.4 Hotplate, or other suitable heat source.

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

16.1.3.6 Wetting agent, for example domestic detergent.

16.1.3.7 Solvents, such as ethanol, acetone, methyl ethyl ketone, etc. (see 16.1.5).

16.1.3.8 Soft clean cloth.

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

16.1.4 Test specimens

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

In cases of dispute, specimens shall be bonded to chipboard (see 8.4), particularly for procedure B.

16.1.5 Procedures

16.1.5.1 Procedure A

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 16.1.2. Cover the staining agent on one of the two specimens with a glass cover (16.1.3.1).

After the specified contact time has elapsed, if necessary remove the staining agent with a suitable solvent (for example butyl acetate to remove nail varnish), then wash with water containing a suitable wetting agent (16.1.3.6), and finally with ethanol (16.1.3.7) or other solvents as required to clean the surface. A suitable brush (16.1.3.9) may be used to remove staining agent from textured surfaces.

One hour after washing, place the specimen on the inspection surface (16.1.3.5) and view it from various angles at a distance of 400 mm.

16.1.5.2 Procedure B

The specimen shall be prepared in accordance with 8.4.

Apply a small quantity (for example 2 or 3 drops) of the staining agent to the specimen. The staining agent shall be at ambient temperature.

Fill the vessel (16.1.3.3) with water (to within 15 mm of the top) and heat it until the water boils vigorously. Discontinue heating and immediately place the vessel containing the boiling water on the surface of the specimen directly over the pool of staining agent.

After the specified contact time, remove the vessel and wash the specimen with water containing a suitable wetting agent (16.1.3.6) and then with ethanol (16.1.3.7) or other solvents as required to clean the surface. A suitable brush (16.1.3.9) may be used to remove staining agent from textured surfaces.

One hour after washing, place the specimen on the inspection surface (16.1.3.5) and view it from various angles at a distance of 400 mm.

16.1.6 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 six 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

16.1.7 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) an assessment of stain resistance for each staining agent applied, expressed in accordance with the rating scale given in 16.1.6;

d) any deviation from the specified procedure;

e) the date of the test.

16.2 Method B

16.2.1 Principle

Test specimens are left in contact with a series of staining agents that are likely to be encountered in everyday household use. At the end of the prescribed contact period, the specimens are subjected to a specified cleaning programme and examined for any residual surface marks.

This test method may also be used with staining agents other than those specified, to cover specific requirements agreed between supplier and purchaser.

16.2.2 Materials

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

16.2.2.2 Commercially available bleach, containing $(5 \pm 0{,}5)$ % of sodium hypochlorite.

16.2.2.3 Baking soda.

16.2.2.4 Supply of clean, soft, white cloth.

16.2.2.5 Supply of cotton balls.

16.2.2.6 Acetone.

16.2.2.7 Distilled water.

16.2.2.8 Staining agents, as listed in Table Table 4.

Table 4 — Staining agents and their application

Agent number	Description	Preparation notes	Application
1	Distilled water	—	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 tea bag 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	—	Apply a spot approximately 6 mm in diameter; do not cover
13	HB pencil	—	
14	Wax crayon	—	
15	Black paste shoe polish	—	

NOTE Staining agents shall be kept in closed containers to avoid any change in concentration. Perishable food items shall be kept refrigerated.

16.2.3 Apparatus

16.2.3.1 Glass covers, approximately 25 mm in diameter (for example watch-glasses), one for each test requiring a cover.

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

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

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

16.2.3.5 Weight, of one kilogram mass.

16.2.4 Test specimen

The test specimen shall have a surface area sufficient to permit all 15 test reagents to be placed on the surface in two lines with the individual stains about 50 mm apart. A 100 mm × 400 mm specimen is adequate.

16.2.5 Procedure

16.2.5.1 Staining procedure

Clean the surface of the test specimen using the cleaner (16.2.2.1) and water on a clean cloth (16.2.2.4). Rinse the specimen thoroughly and dry using another clean, soft cloth. Allow to dry completely at room temperature.

Position the test specimen on a flat, level, horizontal surface and fix it down (e.g. with tape or weights) to keep it in a horizontal plane.

Place a small quantity of each staining agent (to give a spot approximately 6 mm in diameter) on the surface of the test specimen. The staining agents shall be at room temperature.

If indicated in Table 4, cover each staining agent with a glass cover (16.2.3.1), concave side down, and move the glass cover gently while in contact with the surface of the test specimen until the entire circular rim of the glass cover is wetted by the staining agent and the staining agent covers an area both under and outside the glass cover.

Mark the test specimen suitably so that each staining agent is identified.

Leave the test specimen undisturbed for a period of 16 h to 24 h, then remove the glass covers and subject the test specimen to the cleaning procedures prescribed in16.2.5.2.

16.2.5.2 Cleaning procedures and ratings

Stage 1: Flush the surface of the specimen with water and wipe gently with the sponge (16.2.3.3) moistened with water. Blot the specimen dry with a clean, soft cloth (16.2.2.4) and examine the surface in accordance with the inspection procedure described in 16.2.5.3. If a staining agent is completely removed by stage 1 cleaning (i.e. no visible marks remain), then give that agent a rating of 0. If any stains remain, proceed to stage 2.

Stage 2: Wet the surface of the specimen with the non-abrasive cleaner (16.2.2.1). Moisten the sponge (16.2.3.3) with water and place it on the surface, then place the 1 kg weight (16.2.3.5) centrally on top of the sponge. Push the weighted sponge back and forth (without any additional downward pressure) over the area to be cleaned, for 25 cycles (see NOTE). Rinse the specimen with water and wipe dry using a clean, soft cloth (16.2.2.4), then examine the surface in accordance with the inspection procedure (see 16.2.5.3). If a staining agent is completely removed by stage 2 cleaning (i.e. no visible marks remain), then give that agent a rating of 1. If any stains remain, proceed to stage 3.

NOTE In stages 2 and 3, one cycle is a movement forward across the area to be cleaned and back again to the starting position.

Stage 3: Wet the surface of the specimen with the non-abrasive cleaner (16.2.2.1) and add baking soda to achieve a pasty consistency. Using the stiff-bristle brush (16.2.3.4), scrub any areas where traces of the staining agents are still visible, for 25 cycles (see NOTE). Rinse the specimen with water and wipe dry using a clean, soft cloth (16.2.2.4), then examine the surface in accordance with the inspection procedure (see 16.2.5.3). If a staining agent is completely removed by stage 3 cleaning (i.e. no visible marks remain), then give that agent a rating of 2. If any stains remain, proceed to stage 4.

Stage 4: Using a cotton ball (16.2.2.5) saturated with acetone (16.2.2.6), rub the stain gently for two minutes. Rinse the specimen with water and wipe dry using a clean, soft cloth (16.2.2.4), then examine the surface in accordance with the inspection procedure (see 16.2.5.3). If a staining agent is completely removed by stage 4 cleaning (i.e. no visible marks remain), then that agent shall be given a rating of 3. If any stains remain, proceed to stage 5.

Stage 5: Place a cotton ball (16.2.2.5) saturated with hypochlorite bleach (16.2.2.2) on the stain, and allow it to remain in contact for a period of two minutes. Rinse the specimen with water and wipe dry using a clean, soft cloth (16.2.2.4), then examine the surface in accordance with the inspection procedure (see 16.2.5.3). If a

staining agent is completely removed by stage 5 cleaning (i.e. no visible marks remain) then give that agent a rating of 4.

Give any staining agent that remains visible after stage 5 a rating of 5.

16.2.5.3 Inspection procedure

After each stage of cleaning, place the specimen on a horizontal surface under the inspection lights (16.2.3.2) and view it at an eye-to-specimen distance of 750 mm to 900 mm, and at an angle of 45° to 75° to the horizontal plane. Rotate the specimen on the horizontal surface and view it from all directions. Direct sunlight or other light sources which might accentuate or minimize the visual effect shall be avoided.

16.2.6 Expression of results

16.2.6.1 Cleanability

Add up the ratings given to the 15 staining agents, and report the cleanability of the test specimen as the sum of the ratings of the 15 agents.

A typical example, showing a specimen with a cleanability of 16, is shown in Table 5.

Table 5 — A typical 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 shoe polish	4
		Total: 16

16.2.6.2 Stain resistance

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

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

Rating 3: The staining agents 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 agents 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.

Record any staining agents that produce a moderate or severe effect.

16.3 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) the cleanability of the specimen, expressed in accordance with 16.2.6.1;

d) the stain resistance of the specimen, expressed in accordance with 16.2.6.2, plus a note of any staining agents that produced a moderate or severe effect;

e) any deviation from the test method specified;

f) the date of the test.

17 Lightfastness

17.1 Method A

17.1.1 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 lamps. 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.

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

17.1.2 Apparatus

17.1.2.1 Test device, as specified in ISO 4892-1 and ISO 4892-2, equipped with:

— one or more xenon-arc lamps, 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 4892-2:1994, Subclause 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;

— a black-standard thermometer as specified in ISO 4892-1;

— a photoelectronic sensor (radiometer) of one of the types specified in ISO 9370 to measure the irradiance and the radiant exposure at the specimen surface in the wavelength range 300 nm to 400 nm, or at 340 nm.

17.1.2.2 Conditioning chamber, maintained at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) %.

17.1.2.3 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 $(6\,500 \pm 200)$ K and at least 800 lux at 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.

17.1.3 Test specimen

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

17.1.4 Procedure

The test specimen and a set of blue wool references 5, 6 and 7 (as specified in 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 under 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: $(0{,}5 \pm 0{,}03)$ 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 blue wool reference 6 is equal to grade 4 on the grey scale, as defined in ISO 105-A02 (see NOTE 1).

Measure and record the radiant exposure (over 300 nm to 400 nm, or at 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 (17.1.2.2) to prevent extraneous darkening and/or photochromism (see NOTE 2).

NOTE 1 Although the use of blue wool references is no longer the preferred method of measuring radiant exposure (see ISO 4892-2:1994), 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.

17.1.5 Assessment of specimen and expression of results

Place the test specimen in the viewing enclosure (17.1.2.3).

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 in accordance with 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 on the grey scale.

17.1.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) details of the apparatus used;

d) the irradiance at the test specimen surface;

e) the radiant exposure;

f) the exposure time;

g) the lightfastness of the specimen;

h) any deviation from the method specified;

i) the date of the test.

17.2 Method B

17.2.1 Principle

The test assesses the effect on the colour of a test specimen of exposure to a filtered xenon-arc light source having a frequency range approximating to sunlight through window glass.

It is not intended to show the resistance to continuous exposure to outdoor weathering conditions.

17.2.2 Materials

17.2.2.1 White petroleum jelly.

17.2.3 Apparatus

17.2.3.1 Suitable xenon-arc test apparatus, as specified in ISO 4892-1 and ISO 4892-2, capable of providing radiant energy closely approximating to sunlight, with a spectral bandpass of 280 nm to 800 nm and with appropriate filtering to simulate daylight through window glass. The apparatus shall incorporate a system for mounting specimen holders at an equal radial distance from the centre of the light source and revolving them around the light source so as to provide equal radiant exposure.

17.2.3.2 Specimen holders, suitable for the test apparatus, and incorporating a mask to cover half of the exposed face of the test specimen.

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

17.2.3.4 Conditioning chamber, maintained at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) %.

17.2.4 Standardization of apparatus

Calibration, maintenance and filter changes shall be strictly in accordance with the equipment manufacturer's recommendations.

The calibration wavelength for the xenon unit shall be 420 nm.

17.2.5 Test specimen

The test specimen shall be of the size specified for the test apparatus being used. The length of the specimen shall be in the machine direction of the laminate.

Condition the specimen for at least 48 h prior to the test at a temperature of (23 ± 2) °C and relative humidity (50 ± 5) %.

17.2.6 Procedure

Mount the test specimen in a specimen holder (17.2.3.2) so that approximately one-half of the specimen is exposed to the light source, the other half being covered by the mask. Fill all the specimen holders, utilizing blanks if necessary, and keep them filled during the whole of the test, in order to maintain correct air-flow conditions through the test chamber.

Carry out the test under the operating conditions specified in Table 6.

NOTE 1 The setting of the wet-bulb temperature in relation to the dry-bulb temperature is designed to maintain a relative humidity of (50 ± 5) %.

NOTE 2 All test parameters should be maintained as close as possible to the required settings.

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.

At the conclusion of the specified exposure period, remove the test specimen from its holder and allow it to condition at room temperature for a period of 24 h.

After this conditioning period, examine the specimen within 4 h by placing the specimen on a horizontal surface under the inspection lights (17.2.3.3) and viewing it at an eye-to-specimen distance of 750 mm to 900 mm, and at an angle of 45° to 75° from the horizontal plane. Rotate the specimen on the horizontal surface and view it from all directions. Direct sunlight or other light sources which might accentuate or minimize the visual effect 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 (17.2.2.1) and re-examine it. If the difference persists, report the difference as a colour change; if it disappears, report it as a change in surface finish.

Table 6 — 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 %
Power adjustment	Automatic	To maintain steady irradiance levels, allowing for ageing of xenon burners and solarization of filters

17.2.7 Expression of results

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

Rating 5: No change in colour or surface finish

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

Rating 3: A moderate change in colour or surface finish that is just visible at all viewing angles and directions

Rating 2: A marked change in colour or surface finish that is very evident at all viewing angles and directions

Rating 1: Surface blistering and/or cracking

17.2.8 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

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

c) details of the apparatus used;

d) the lightfastness of the specimen, expressed in accordance with 17.2.7;

e) any deviation from the method specified;

f) the date of the test.

17.3 Method C (Resistance to colour change in light from an enclosed carbon-arc lamp)

17.3.1 Principle

Part of a test specimen taken from the sheet under test is exposed, together with standard blue wool specimens, to the light of an enclosed carbon-arc lamp. The light dosage is determined by the effect on the wool specimens, and the effect on the test specimen is assessed at a specified light dosage by the contrast between the exposed and unexposed portions of the specimen.

The test is fully described in ISO 4892:1981.

17.3.2 Apparatus

As specified in ISO 4892:1981, without control of humidity.

17.3.3 Test specimen

As specified in ISO 4892:1981.

17.3.4 Procedure

Carry out the test using the single-exposure method described in ISO 4892:1981, and discontinue the exposure when blue wool standard No. 5 shows a contrast between exposed and unexposed portions equal to grade 4 on the grey scale.

17.3.5 Evaluation and expression of results

Examine the contrast between the exposed and unexposed portions of the test specimen and record it in terms of grades on the grey scale.

Express the result in relation to the resistance to colour change of blue wool standard No. 5 as one of the following:

Specimen contrast (grey scale grade No.)	Resistance to colour change (blue wool standard No.)
> 4	> 5
4	5
< 4	< 5

17.3.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the resistance of the specimen to colour change, expressed as greater than, equal to, or less than of blue wool standard No. 5;

d) any deviation from the specified procedure;

e) the date of the test.

18 Resistance to cigarette burns

18.1 Method A

18.1.1 Principle

Specimens from the sheet under test are bonded to wood chipboard to simulate service conditions and subjected to the heat from burning cigarettes placed on their surfaces. The test result is expressed in terms of any resultant damage.

18.1.2 Materials

18.1.2.1 Fine-faced wood chipboard, 18 mm to 20 mm nominal thickness with a tolerance of $\pm$ 0,3 mm, density 625 kg/m^3 to 700 kg/m^3 and moisture content (9 ± 2) %.

18.1.2.2 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

18.1.2.3 Pale-tobacco cigarettes without filters, from each of three well known brands, each with a mass of 1,0 g to 1,1 g for a length of 70 mm and with the tobacco evenly distributed over its length. They shall be kept in the standard atmosphere (see 18.1.4) for at least 24 h before being used for the test.

18.1.2.4 Ethanol, 95 % by volume.

18.1.2.5 Soft cloth.

18.1.3 Test specimen

The specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (18.1.2.1), using the specified adhesive (18.1.2.2). The bonded specimen shall be kept in the standard atmosphere (see 18.1.4) for at least 7 days before being used for the test. One specimen 230 mm $\pm$ 5 mm square shall be prepared.

18.1.4 Apparatus

18.1.4.1 Conditioning chamber, with a standard atmosphere of 23 °C $\pm$ 2 °C and relative humidity of (50 ± 5) %.

18.1.5 Procedure

Ignite one cigarette from one of the brands and let it burn to consume a length of approximately 10 mm.

Place the burning cigarette in full-length contact with the horizontal surface of the specimen in a draught-free area so that the glued seam of the cigarette is not in contact with the specimen. Allow the cigarette to continue

burning until an additional 20 mm length is consumed. If the cigarette goes out before this occurs, repeat the test.

Follow the same procedure with the two cigarettes from the other two brands.

Remove any superficial combustion residues with a soft cloth moistened with alcohol. Examine the surface with the naked eye, corrected if necessary, for any changes such as discolouration, cracks or blisters.

18.1.6 Expression of results

Express the result for each area of cigarette contact in accordance with the following rating scale:

Rating 5: No visible change

Rating 4: Slight change of gloss only visible at certain viewing angles and/or slight brown stain

Rating 3: Moderate change of gloss and/or moderate brown stain

Rating 2: Severe brown mark, but no destruction of the surface

Rating 1: Blistering and/or cracks

18.1.7 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the brands of cigarette used;

d) the cigarette burn resistance of the specimen, expressed as the arithmetic mean of the three individual ratings, rounded to the nearest integer;

e) any deviation from the specified procedure;

f) the date of the test.

18.2 Method B (simulated test using electric heater)

18.2.1 Principle

Specimens taken from the sheet under test, and bonded to wood chipboard to simulate service conditions, are exposed to local radiant heat from an electric heater. The resistance of the material is assessed in terms of the duration of exposure needed to cause visible damage.

18.2.2 Materials

18.2.2.1 Fine-faced wood chipboard, 18 mm to 20 mm nominal thickness with a tolerance of $\pm$ 0,3 mm, density 625 kg/m^3 to 700 kg/m^3 and moisture content (9 ± 2) %.

18.2.2.2 Urea-formaldehyde adhesive, containing approximately 15 % filler, or an equivalent adhesive.

18.2.3 Apparatus

18.2.3.1 Heating-element support (see Figure 17), consisting of electrically non-conducting laminated sheet.

18.2.3.2 Heating element (see Figure 17), of iron-aluminium alloy, having the following characteristics:

— cross-section of flat wire: 1,6 mm × 0,25 mm;

— wire length: 480 mm;

— electrical resistance: 1,8 Ω ± 0,1 Ω.

This heating element shall be in the form of a spiral (outside diameter approximately 15 mm, external ring not included).

18.2.3.3 Adjustable mounting, for the heating element (see Figure 17), consisting of an externally threaded brass sleeve located vertically by two knurled brass nuts.

18.2.3.4 Calibration block (see Figure 18), of electrically insulating laminate, on which are mounted:

a) A disc support, made from homogeneous heat-insulating diatomaceous-earth sheet material of bulk density 512 kg/m^3 to 576 kg/m^3, and of thermal conductivity 0,10 W/(m·K) to 0,12 W/(m·K) in the temperature range 0 °C to 300 °C.

b) A stainless-steel disc, to the bottom of which is silver-soldered an iron-constantan thermocouple. The surface of the disc shall be highly polished and flat, and shall be in the same plane as the surface of the disc support. The disc shall be clamped firmly on its support.

18.2.3.5 Glass-windowed cover (see Figure 19), with the following nominal dimensions:

length	240 mm
width	110 mm
height	80 mm

18.2.3.6 Stopwatch.

18.2.3.7 Power source, producing a constant current for the heating element.

This source may be

a) either a series of well charged accumulators with elements in good condition, able to provide the heating element with a power greater than 20 W,

b) or an electrical unit powered from the mains supply.

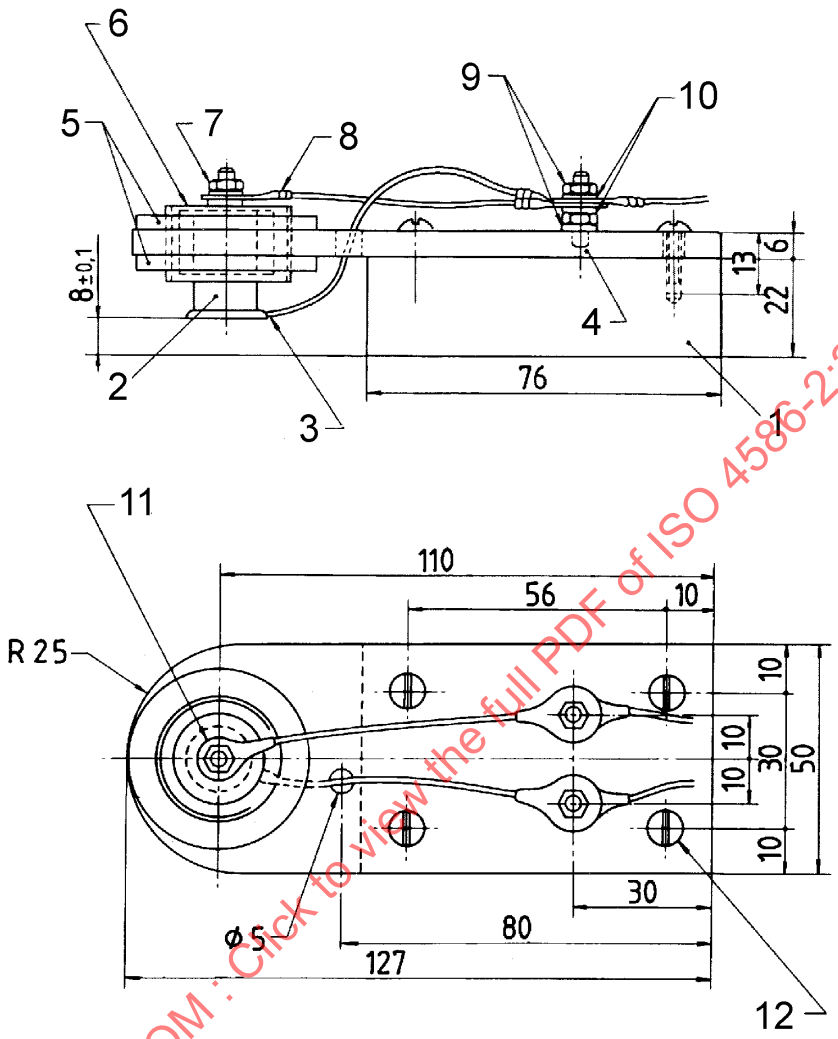
18.2.3.8 Control circuit, to adjust and maintain the power consumption of the heating element with an accuracy of ± 0,1 %. Measurements are made by means of a voltmeter and an ammeter. A circuit for use with a 115 V supply is shown in Figure 20.

18.2.3.9 Potentiometer, for measuring the temperature of the stainless-steel disc.

18.2.3.10 Cotton wick, saturated with liquid paraffin.

18.2.3.11 Conditioning chamber, with a standard atmosphere of 23 °C ± 2 °C and relative humidity of (50 ± 5) %.

Dimensions in millimetres



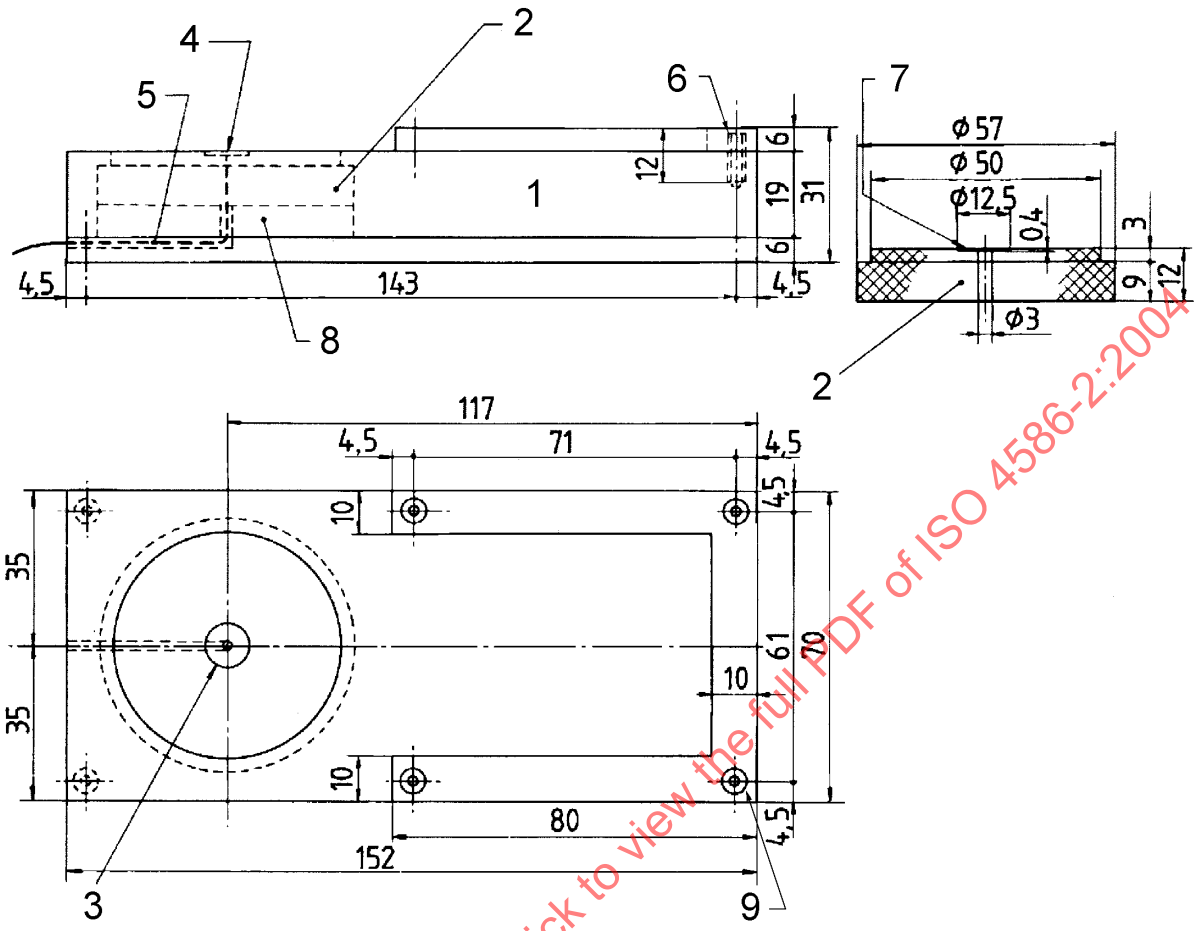
Key

1 heating-element support
2 heating element
3 silver-soldered connection
4 two screws F/90, Ø 4/18 mm
5 two knurled nuts, thickness 3 mm, fine threaded pitch 0,75 mm, Ø int. 27 mm, Ø ext. 39 mm
6 tube, Ø 20/27 mm, length 17 mm, externally threaded, fine threaded pitch 0,75 mm
7 nut HM4
8 earthing terminal
9 four nuts HM4
10 four washers M4
11 electrical resistance coil soldered to the threaded tube at three points on the circumference
12 four screws R 4/12

Materials: Electrically insulating laminate, screws and threaded tube.

Figure 17 — Electric heater for cigarette test (see 18.2.3.1, 18.2.3.2 and 18.2.3.3)

Dimensions in millimetres



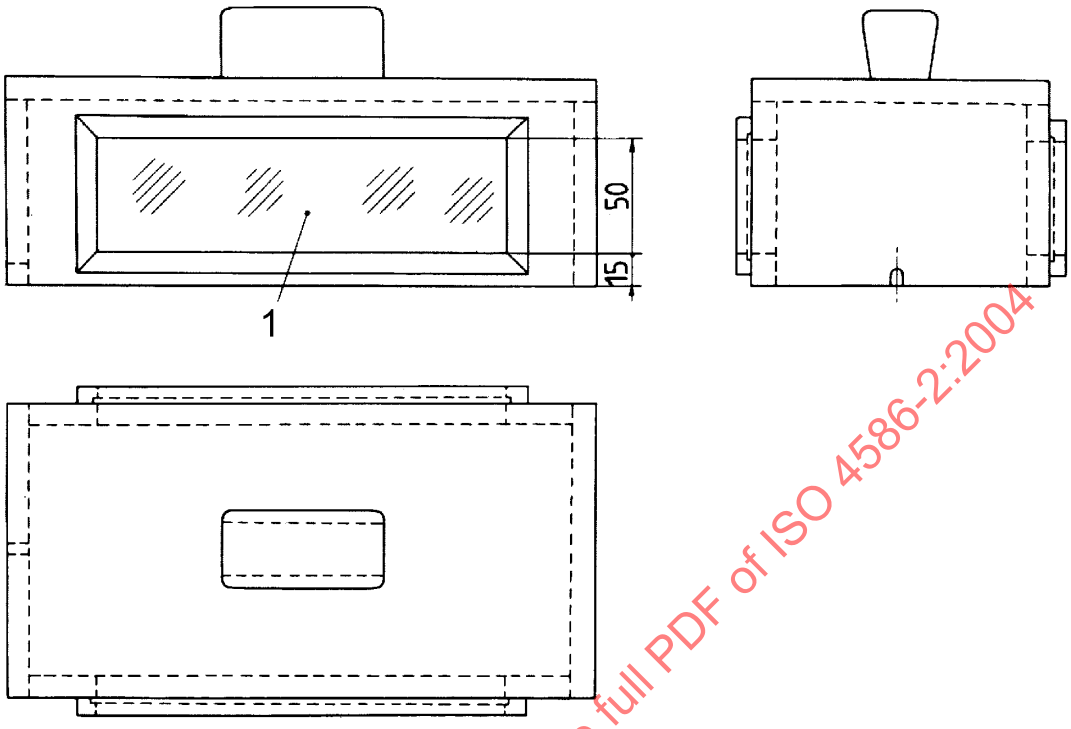
Key

1 calibration block
2 disc support (material: diatomaceous earth or similar insulating material)
3 stainless-steel disc, Ø 12,5 mm, thickness 0,4 mm, central hole Ø 1 mm
4 iron-constantan thermocouple silver-soldered in a hole (Ø 1 mm) in the stainless-steel disc
5 duct, Ø 3 mm
6 holes, Ø 3,5 mm
7 circular depression
8 electrically insulating laminate washer, Ø ext. 57 mm, Ø int. 3 mm, thickness 7 mm
9 eight screws F/90, Ø 3/10 mm

Materials: Electrically insulating laminate.

Figure 18 — Calibration block for cigarette test (see 18.2.3.4)

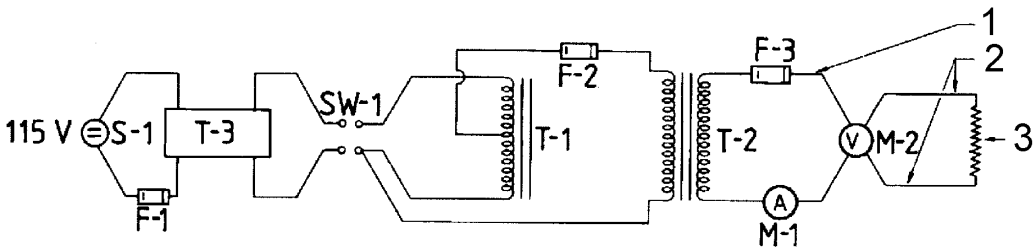
Dimensions in millimetres



Key

1 two glass-covered observation windows facing each other — size 180 mm × 50 mm (nominal)

Figure 19 — Apparatus cover for cigarette test (see 18.2.3.5)



Key

1 5 mm^2 wire
2 5 mm^2 heater cord
3 resistor heating element

List of items

Symbol	Function	Description
F-1	Line fuse	5 A
	Line fuse mounting	
F-2	Control fuse	1 A
	Control fuse mounting	Extractor post
F-3	Power fuse	10 A
	Power fuse mounting	Extractor post
M-1	Ammeter	0 A to 10 A alternating current
M-2	Voltmeter	0 V to 6 V alternating current (452/V)
S-1	Line connector	Male connector
SW-1	Line switch	DPST toggle switch
T-1	Autotransformer	Primary: 115 V; secondary: 0,130 V; 5 A
T-2	Power transformer	Primary: 115 V; secondary: 5,25 V; 22 A
T-3	Voltage stabilizer	100 V · A; 115 V output ± 1 %

Figure 20 — Wiring diagram of control circuit for cigarette test (see 18.2.3.8)

18.2.4 Test specimens

Each specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (18.2.2.1), using the specified adhesive (18.2.2.2). The bonded specimens shall be kept in the conditioning chamber (18.2.3.11) for at least 7 days before being used for the test. Three specimens measuring (230 ± 2) mm $\times$ (80 ± 1) mm shall be prepared.

18.2.5 Procedure

18.2.5.1 Calibration

The bottom of the heating element shall be flat.

Adjust the heating element so that the distance between its lower side and the disc is 8 mm $\pm$ 0,1 mm (without including the edging ring).

Stand the heating-element support (18.2.3.1) on its end and adjust the power input to approximately 20 W.

Allow to heat for 30 min.

Blacken the stainless-steel disc with the flame from the burning paraffin-saturated wick to produce a uniform coating of carbon. The insulating support shall be kept clean.

Place the heating-element support on the calibration block so that the heating element covers the disc.

Cover the assembly to exclude draughts.

Allow the heating element to warm the disc for 10 min in order to produce a final temperature of approximately 285 °C.

It is not necessary to record the intermediate temperatures. If the final temperature is not 285 °C, adjust the power input. Lift up the heating-element support without disconnecting the power supply and stand it in the vertical position.

Keep the calibration block under the cover until the disc cools to 40 °C $\pm$ 0,5 °C, then replace the heating-element support on the calibration block and cover immediately.

Start the stopwatch when the heating-element support and the calibration block touch. Measure and record the temperature at 1 min intervals, for a period of 10 min.

The calibration curve shall be within the following limits:

Time (min)	**Temperature** (°C)
0	40 $\pm$ 0,5
1	215 $\pm$ 3
2	251 $\pm$ 3
3	265 $\pm$ 3
4	274 $\pm$ 3
5	279 $\pm$ 3
6	282 $\pm$ 3
7	284 $\pm$ 3
8	285 $\pm$ 3
9	286 $\pm$ 3
10	287 $\pm$ 3

During the calibration, the current shall not fluctuate. If necessary, adjustment shall be made and further calibration carried out until the desired curve is obtained (each time allowing the calibration block to cool to 40 °C ± 0,5 °C).

When the calibration curve is obtained, proceed with the test.

18.2.5.2 Test

Position the heater on the specimen so that the resistance coil is at least 40 mm from the nearest edge, start the timer at the same time, and cover the assembly with the enclosure within 2 s.

Continue the test until the specimen fails or for 10 min. Failure is defined for this purpose as blistering, charring, permanent discolouration or crazing. If failure occurs in less than 10 min, record the time of failure.

The test shall be invalid if

a) the heating element is moved during the test or is not positioned 8 mm ± 0,1 mm above the surface of the specimen;

b) the power input to the heating element does not remain constant at the level of last calibration;

c) the cover is removed at any time during the test.

Repeat the test on additional specimens to obtain three valid results.

The calibration of the heating element shall be checked at least once per hour, and at any time that irregular results or an unsteady power input are observed.

18.2.6 Expression of results

Report the result as the average of the three times to failure, in seconds.

If one or two tests are discontinued without failure, their results shall be taken as 600 s for the purpose of calculating the average. If all three tests are discontinued without failure, the result shall be recorded as “no failure in 600 s”.

18.2.7 Test report

The test report shall include the following information:

a) a reference to this part of ISO 4586;

b) the name and type of product;

c) the average time to failure, or a statement that failure did not occur in 600 s;

d) the type of failure, for example blistering, crazing;

e) any deviation from the specified procedure;

f) the date of the test.