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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Decorative high-pressure laminates (HPL) — Sheets based on thermosetting resins —

Part 2 : Determination of properties

Stratifiés décoratifs haute pression (HPL) — Plaques à base de résines thermodurcissables —

Partie 2 : Détermination des caractéristiques

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4586-2 was prepared by Technical Committee ISO/TC 61, *Plastics*.

This second edition cancels and replaces the first edition (ISO 4586-2 : 1981), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Decorative high-pressure laminates (HPL) — Sheets based on thermosetting resins —

Part 2 : Determination of properties

1 Scope and field of application

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

2 References

ISO 48, *Vulcanized rubbers — Determination of hardness (Hardness between* 30 *and* 85 IRHD*)*.

ISO 62, *Plastics — Determination of water absorption.*

ISO 4586-1, *Decorative high-pressure laminates (HPL) — Sheets based on thermosetting resins — Part 1 : Specification.*

ISO 4892, *Plastics — Methods of exposure to laboratory light sources.*

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

3 Definition

For the purpose of this part of ISO 4586, the following definition applies:

decorative high-pressure laminated sheet: A sheet consisting of layers of fibrous sheet material (for example paper) impregnated with thermosetting resins and bonded together by means of heat and a pressure of not less than 5 MPa*, a layer or layers on one or both sides having decorative colours or designs.

Decorative high-pressure laminated sheet as defined in this part of ISO 4586 is made from core layers impregnated with phenolic resins and a surface layer or layers impregnated with aminoplastic resins (mainly melamine resins).

4 Thickness

4.1 Principle

Measurement of the thickness using a micrometer or a dial gauge indicator.

4.2 Apparatus

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 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 should 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.

* 1 MPa = 1 MN/m^2

5 Appearance

5.1 Surface defects

5.1.1 Principle

Inspection of sheets 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 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 test 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 for defects such as smudges, smears, finger-prints, scratches, foreign particles, damage or any other form of blemish evident within the decorative surface.

The inspector shall have 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 Warping

5.2.1 Apparatus

Straightedge, of 1 000 mm length, with **micrometer** (see figure 1).

5.2.2 Test specimen

The test 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 various positions.

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 warp, 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 sublayer. Abrasion is achieved by rotating a specimen in contact with a pair of loaded cylindrical wheels covered with abrasive paper. The wheels are positioned so that their cylindrical faces are equidistant from the specimen's axis of rotation but not tangential to it. As they are turned by the rotating specimen, they abrade an annular track on the specimen's surface. The number of revolutions of the specimen required to cause a defined degree of abrasion is used as a measure of resistance to surface wear.

6.2 Materials

6.2.1 Calibration plates of rolled zinc sheet, having a thickness of 0,8 ± 0,1 mm and a Brinell hardness of 48 ± 2 when tested in accordance with ISO 6506, except that the ball diameter shall be 5 mm and the load 360 N.

6.2.2 Abrasive paper strips, of width 12,7 mm and length about 160 mm, having the following composition:

a) paper of grammage 70 to 100 g/m^2;

b) powdered aluminium oxide 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, only required if the abrasive paper has no adhesive backing.

6.3 Apparatus

6.3.1 Testing machine consisting of the following items (see figure 2).

6.3.1.1 Specimen holder, in the form of a disc (7) which rotates in a horizontal plane at a frequency of 58 to 62 r/min and to which the test specimen (6) can be clamped flat (4/5).

6.3.1.2 Abrasive wheels (3) : two cylindrical rubber-covered wheels of width 12,7 mm and diameter 50 mm which rotate freely about a common axis. The curved surface of the wheels, to a depth of 6 mm, shall be of rubber (2) of hardness 50 to 55 IRHD when tested according to ISO 48. The inside faces of the wheels shall be 50 to 55 mm apart, and their common axis shall be 20 mm from the vertical axis of the specimen holder. The wheels shall be positioned symmetrically in a plane containing the axis of the specimen holder.

6.3.1.3 Holding and lifting device (8) for the abrasive wheels, so constructed that each wheel exerts a force of 5,4 ± 0,2 N on the test specimen.

6.3.1.4 Revolution counter.

6.3.1.5 Suction device, so fitted that two nozzles are over the abraded section of the specimen under test. One nozzle shall be situated between the wheels, the other diametrically opposite. The centres of the nozzles shall be 77 mm apart and 1 to 2 mm from the surface of the test specimen. When the nozzles are closed, there shall be a vacuum of 1,5 to 1,6 kPa.

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

6.4 Test specimens

Each test 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 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 test specimens and abrasive paper

Clean the surface of the test specimens with an organic solvent which is immiscible with water, for example 1,1,1-trichloroethane. Precondition the test specimens and the abrasive strips for at least 72 h in the conditioning atmosphere (see 6.3.2) before testing.

6.6 Procedure

6.6.1 Preparation of abrasive wheels

Bond a strip of preconditioned abrasive paper (see 6.2.2) to each of the rubber-covered wheels using either the adhesive backing, if present, or the double-sided adhesive tape (see 6.2.3), in such a way that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper [see figure 2, (1)].

6.6.2 Calibration of abrasive paper

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

Clamp a zinc plate (see 6.2.1) in the specimen holder (see 6.3.1.1), operate the suction device (see 6.3.1.5), 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 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 a further 500 revolutions, then wipe it clean and reweigh it to the nearest 1 mg. Its loss in mass shall be 130 ± 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 test specimen

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

Prepare sufficient abrasive wheels for the test using previously unused abrasive paper. Fit two 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, operate the suction device and allow the specimen to rotate. Examine the specimen for wear after each 25 revolutions and examine the abrasive paper for clogging with abraded particles. Replace the abrasive paper if it becomes clogged, or after 500 revolutions, whichever happens first.

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

The initial wear point (IP) is that point at which the first clearly recognizable wear-through of the print, pattern, plain colour coating or solid paper appears and the sub-layer becomes exposed in each of four 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.

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

The wear resistance, expressed in revolutions, for each specimen is given by the formula

$$\frac{IP + FP}{2}$$

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

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 wear resistance, in revolutions, of the sample under test;

d) any deviation from the specified test method;

e) 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 a test specimen and by noting the occurrence of any blistering or delamination.

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

7.2 Apparatus

7.2.1 Balance, accurate to 1 mg.

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

7.2.3 Vessel, containing boiling distilled water.

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

7.2.5 Desiccator.

7.2.6 Micrometer, thickness gauge.

7.2.7 Suitable heating apparatus (for example 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

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

7.4 Procedure

Dry the three test specimens for 24 ± 1 h in the oven (7.2.2), controlled at 50 ± 2 °C, allow to cool in the desiccator (7.2.5) to 23 ± 2 °C, and 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 ± 5 min, remove the specimens from the boiling water and allow to cool for 15 ± 5 min in the vessel of distilled water maintained at 23 ± 2 °C (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 test specimen to the nearest 0,01 mm at the same points as before (d_5, d_6, d_7, d_8).

Examine each test specimen visually for change in appearance.

7.5 Expression of results

The boiling water absorbed by each test 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 test specimen is given by the formulae

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

$$\frac{d_6 - d_2}{d_2} \times 100, \text{ etc.}$$

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 test 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:

Degree 5: No visible change.

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

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

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

Degree 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.

NOTE — 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 should be used.

8.2.2 Fine-faced wood chipboard, 230 ± 5 mm square, 18 to 20 mm nominal thickness with a tolerance of ±0,3 mm, density 650 to 700 kg/m^3 and moisture content (9 ± 2) %.

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

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 ± 1,5 mm and an overall height of 70 ± 1,5 mm. The wall thickness shall be 2,5 ± 0,5 mm and the base thickness 2,5 $^{+0,5}_{0}$ mm.

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

8.3.3 Suitable inorganic heat-insulating board, of thickness about 2,5 mm and 150 mm square. Asbestos cement shall not be used.

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 test specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (see 8.2.2) using the specified adhesive (see 8.2.3). One specimen 230 ± 5 mm square shall be used. The bonded specimen shall be preconditioned for at least 7 days at 23 ± 2 °C and (50 ± 5) % relative humidity before being used for the test.

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

8.5 Procedure

Fill the vessel (see 8.3.1) with glycerol tristearate (see 8.2.1). Fix the thermometer (see 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 (see 8.3.3) and allow the temperature to fall to 180 ± 1 °C, stirring continuously.

Immediately place the vessel of hot glycerol tristearate on the surface of the test 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:

Degree 5: No visible change.

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

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

Degree 2: Heavy change of gloss and/or colour.

Degree 1: Surface distortion and/or blistering.

d) any deviation from the specified test method;

e) the date of the test.

9 Dimensional stability at elevated temperatures

9.1 Principle

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

9.2 Apparatus

9.2.1 Oven, capable of being controlled at 70 ± 2 °C.

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

NOTE — This relative humidity occurs at a temperature of 40 °C in equilibrium above a saturated solution of sodium tartrate [$(CHOHCOONa)_2 \cdot 2H_2O$].

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

9.2.4 Bedplate and mounted dial gauge, or other apparatus capable of measuring to an accuracy of 0,02 mm.

9.2.5 Rigid jig, for holding the specimen straight during measurement. A typical jig is shown in figure 3.

9.2.6 Desiccator, of suitable size.

9.3 Test specimens

Each test specimen shall be 140 ± 0,8 mm long, 12,7 ± 0,4 mm wide and of the thickness of the sheet under test. The edges shall be free from cracks and shall be made smooth with fine abrasive paper or cloth. Machining and abrading operations shall be slow enough to avoid heating the material appreciably.

Twelve test specimens shall be tested, six of them with their major axes parallel to the machine direction of the fibrous sheet material (for example paper) from which the sheet has been made, and six with their major axes at right angles to the machine direction. Three specimens from each direction shall be used for the low humidity test and three for the high humidity test.

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

Before making the first measurements, all specimens shall be kept for 4 days in a standard atmosphere of 23 ± 2 °C and (50 ± 5) % relative humidity.

9.4 Procedure

Make all measurements of length to the nearest 0,02 mm with the test specimen vertical in the jig (see 9.2.5), the lower end in contact with the bedplate and the upper end in contact with the foot of the dial gauge (see 9.2.4). When any test specimen is measured for the second time, take care to ensure that it is located in the jig in the same relative position as when it was first measured. Make all measurements within 5 min after removal from the conditioning atmosphere.

9.4.1 Dry heat test

Measure the length of each of the six specimens and then place them in the oven (see 9.2.1) controlled at 70 ± 2 °C. At the end of 24 h, remove them and allow them to cool to ambient temperature in the desiccator (see 9.2.6) for 1 h. Again measure the length of each specimen.

9.4.2 High humidity test

Measure the length of each of the six specimens and then place them in the conditioning chamber (see 9.2.2) at 40 ± 2 °C and relative humidity within the range 90 % to 95 %. After 96 ± 4 h, remove each specimen, wipe it free of surface water with a cloth, and again measure its length.

9.5 Expression of results

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

Calculate the mean percentage change for each of the four sets of three test specimens, to the nearest 0,05 %.

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

Example (using test specimens in one direction only):

Dry heat test

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

High humidity test

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

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

9.6 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 combined dimensional change for the machine direction;

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

e) any deviation from the specified procedure;

f) the date of the test.

10 Dimensional stability at 20 °C

10.1 Principle

The test measures the lateral dimensional changes of specimens from the sheet under test due to changes of humidity at 20 °C.

10.2 Apparatus

10.2.1 Conditioning chambers, maintaining the following three atmospheres:

20 ± 2 °C, relative humidity (32 ± 3) %

20 ± 2 °C, relative humidity (90 ± 3) %

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

10.2.2 Means for measuring lengths of 200 mm to the nearest 0,05 mm.

10.3 Test specimens

Four test specimens approximately 250 mm × 50 mm shall be cut from the sheet under test in both the machine and cross-directions of the fibrous sheet material (for example paper) from which the sheet was manufactured. If these directions are not known, they may be determined as specified in 9.3. Measuring marks shall be made on the decorative face of the specimens approximately 200 mm apart and 25 mm from each end.

10.4 Procedure

Precondition the specimens for 7 days in a standard atmosphere of 23 ± 2 °C and (50 ± 5) % relative humidity.

Measure the distance between the marks on all eight specimens to the nearest 0,05 mm with the specimens laid out flat.

Keep four specimens, two cut in the lengthwise and two in the crosswise direction, for 7 days at 20 ± 2 °C and (32 ± 3) % relative humidity.

Keep the remaining four specimens for 7 days at 20 ±2°C and (90 ± 3) % relative humidity.

Remeasure the distance between the marks as before within 1 min after removal from the conditioning atmosphere.

10.5 Expression of results

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

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

Calculate the combined dimensional change for each direction of the sheet. It is the sum of the mean absolute percentage changes in each of the low and high humidity tests. The absolute figure shall be reported.

10.6 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 combined dimensional change for the machine direction;

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

e) any deviation from the specified procedure;

f) the date of the test.

11 Resistance to impact by small-diameter ball

11.1 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.

11.2 Materials

11.2.1 High-quality fine-faced wood chipboard, 18 to 20 mm nominal thickness with a tolerance of ±0,3 mm, density 650 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 case of dispute, the same test shall be carried out on chipboards from three different suppliers.

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

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

11.3 Apparatus

11.3.1 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 to 90 N by means of a force-setting barrel (housing).

The 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 ± 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.

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

11.3.3 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 test specimen and to avoid recoil following the release of the impact bolt.

11.3.4 Steel plate, having dimensions approximately 300 mm × 300 mm × 50 mm.

11.3.5 Hand lens, with approximately 6 × magnification (optional).

11.4 Test specimens

Test specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (see 11.2.1) using the specified adhesive (see 11.2.2). About ten specimens, each 200 ± 5 mm square, shall be prepared. The bonded specimens shall be preconditioned for at least 7 days at 23 ± 2 °C and (50 ± 5) % relative humidity before being used for the test.

11.5 Calibration of the impact tester

Suspend the tester 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) 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 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 parallell 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.

11.6 Procedure

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

Place the steel plate on a convenient rigid horizontal surface and locate the test specimen on it with its decorative surface

uppermost. Fix the impact tester in its support fixture, load the tester, place the assembly on the test 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 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 test 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 test specimen shall sustain no damage after ten successive individual impact blows with the prescribed spring force.

11.7 Expression of results

Enter the results of the series of tests onto an evaluation diagram (see figure 7 for example) in which they are subdivided into "Test specimen not damaged" and "Test 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.

11.8 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.

12 Resistance to impact by large-diameter ball

12.1 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.

12.2 Materials

12.2.1 High-quality fine-faced wood chipboard, 18 to 20 mm nominal thickness with a tolerance of ± 0,3 mm, density 650 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 case 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 such as PVAc.

12.3 Apparatus

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

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

12.3.3 Specimen clamping frame, conforming to figure 9.

12.4 Test specimens

The test specimens shall be 230 ± 5 mm square. For laminates of thickness less than 2,0 mm, the specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (see 12.2.1) using the specified adhesive (see 12.2.2). The bonded specimens shall be pre-conditioned for at least 7 days at 23 ± 2 °C and (50 ± 5) % relative humidity before being used for the test.

For laminates of thickness ⩾ 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 ⩾ 5,0 mm shall be tested clamped in the frame without the chipboard support.

12.5 Procedure

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

Clamp the test specimen in the clamping frame and place the assembly on the solid base of the free-fall test apparatus. 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 test specimen.