INTERNATIONAL STANDARD

ISO 4586-2

Fourth edition
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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 4586-2:1997(E)

Contents

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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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

This fourth edition cancels and replaces the third edition (ISO 4586-2:1995), in which method 13 (resistance to cracking) has been revised.

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 the 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, 9 and 10 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 standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4586. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4586 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 105-B02:1994, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test.*

ISO 4211-3:1993, *Furniture — Tests for surface finishes — Part 3: Assessment of resistance to dry heat.*

ISO 4586-1:1995, *High-pressure decorative laminates — Sheets made from thermosetting resins — Part 1: Classification and specifications.*

ISO 6506:1981, *Metallic materials — Hardness test — Brinell test.*

ISO 9352:1995, *Plastics — Determination of resistance to wear by abrasive wheels.*

3 Definition

For the purposes of this part of ISO 4586, the definition of high-pressure decorative laminate(s) contained in subclause 3.1 of ISO 4586-1:1995 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 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;

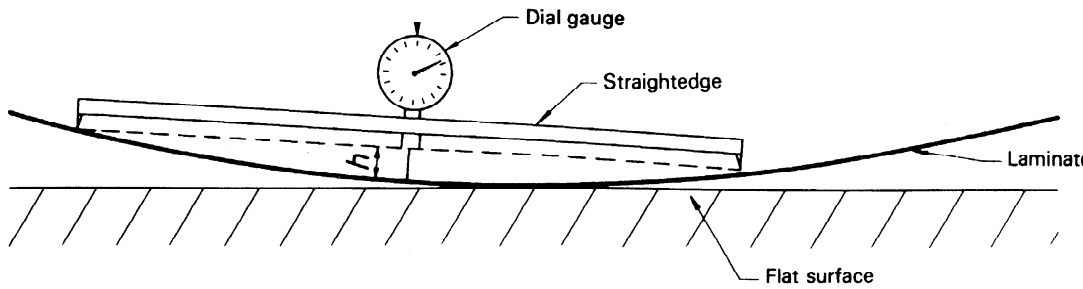
d) any deviation from the specified test method;

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).



h = Distance between the straightedge and the surface of the laminate

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

5.2.2 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.

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, having a thickness of 0,8 mm ± 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 g/m^2 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, required only if the abrasive paper has no adhesive backing.

6.3 Apparatus

6.3.1 Test machine, as specified in ISO 9352.

NOTE 1 A suitable machine is available from Taber Acquisition Corp., Taber Industries, 455 Bryant St, P.O. Box 164, North Tonawanda, NY 14120, USA. (This test machine is an example of a suitable machine 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 the machine.)

6.3.2 Conditioning chamber, with a standard atmosphere of 23 °C ± 2 °C, relative humidity (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 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. Precondition the 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 (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 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, operate the suction device, 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 an additional 500 revolutions, then wipe it clean and reweigh it to the nearest 1 mg. Its loss in mass shall be 130 mg $\pm$ 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 sufficient abrasive wheels for the test, using 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 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 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

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

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

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

The wear resistance of the sample under test shall be the average of the wear values obtained on the three 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 initial wear point (IP) for the sample under test, in revolutions;

d) the 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 62:1980, *Plastics — Determination of water absorption*, 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.

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 ± 5 min, remove the specimens from the boiling water and allow to cool for 15 min ± 5 min in the vessel of distilled water maintained at 23 °C ± 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 Dimensional stability at elevated temperature

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 maintained at 70 °C ± 2 °C.

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

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

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

9.2.5 Desiccator, of suitable size.

9.3 Test specimens

Each specimen shall be 250 mm long, 50 mm wide and of the thickness of the sheet under test. The edges shall be smooth and free from cracks. Measuring marks shall be made on the decorative

face of the specimens approximately 200 mm apart and 25 mm from each end.

Twelve 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 dry-heat test and three for the high-humidity test.

NOTE 3 If the machine direction is not known, carry out flexural strength tests at various angles. The highest value will usually be given by the specimen cut parallel to the machine direction.

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

9.4 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 or the desiccator (9.2.5).

9.4.1 Dry-heat test

Taking three specimens in each direction, measure the distance between the marks on each specimen with the specimens laid flat and then place them in the oven (9.2.1) maintained at 70 °C ± 2 °C. At the end of 24 h, remove them and allow them to cool to ambient temperature in the desiccator (9.2.5) for 1 h, and then remeasure the distance between the marks.

9.4.2 High-humidity test

Taking the remaining three specimens in each direction, measure the distance between the marks and then place them in the conditioning chamber (9.2.2) at 40 °C ± 2 °C and relative humidity within the range 90 % to 95 %. After 96 h ± 4 h, remove each specimen, wipe it free of surface water with a cloth, and remeasure the distance between the marks.

9.5 Expression of results

For each specimen, calculate the change as a percentage of the initial distance between marks.

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

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

EXAMPLE (using specimens in one direction only)

Dry-heat test

Specimen	1	2	3	Mean to nearest 0,05 %
Initial length (mm)	200,90	199,86	200,64	
Final length (mm)	200,12	199,04	199,84	
Change in length (mm)	− 0,78	− 0,82	− 0,80	
Change (%)	− 0,39	− 0,41	− 0,40	− 0,40

High-humidity test

Specimen	4	5	6	Mean
Initial length (mm)	201,40	200,22	199,98	
Final length (mm)	202,00	200,86	200,54	
Change in length (mm)	+ 0,60	+ 0,64	+ 0,56	
Change (%)	+ 0,30	+ 0,32	+ 0,28	+ 0,30

The movements in the two tests are in opposite directions; therefore, the cumulative 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 cumulative dimensional change for the machine direction;

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

e) any deviation from the specified test method;

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 in humidity at 20 °C.

10.2 Apparatus

10.2.1 Conditioning chambers, maintaining the following three atmospheres:

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

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

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

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

10.3 Test specimens

Four specimens measuring approximately 250 mm × 50 mm shall be cut from the sheet under test in both the machine and cross-machine 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 subclause 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 4 days in a standard atmosphere of 23 °C ± 2 °C and (50 ± 5) % relative humidity.

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

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

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

Remeasure the distance between the marks as before within 5 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 cumulative dimensional change for each direction of the sheet. This change is the sum of the mean absolute percentage changes in each of the low- 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 cumulative dimensional change for the machine direction;

d) the cumulative 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 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) %.

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.

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

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 2), 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 ± 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 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.

11.3.3 Support fixture (see figure 3), 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.

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

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

11.4 Test specimens

Specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (11.2.1), using the specified adhesive (11.2.2). 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.

11.5 Calibration of the impact tester

Suspend the tester (11.3.1) 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) (11.3.2) suspended from the knob used to draw back the impact bolt, ensuring that the bolt is clear of the retainer of the release unit.

Dimensions in millimetres

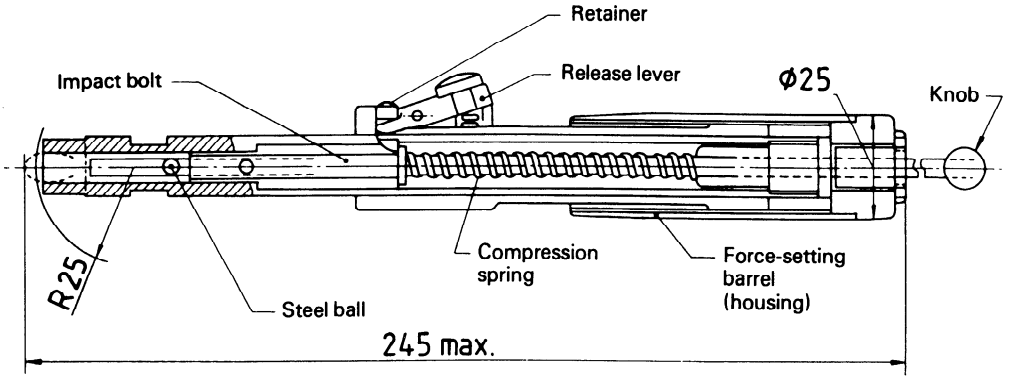


Figure 2 — Impact tester (shown with spring compressed) (see 11.3.1)

Dimensions in millimetres

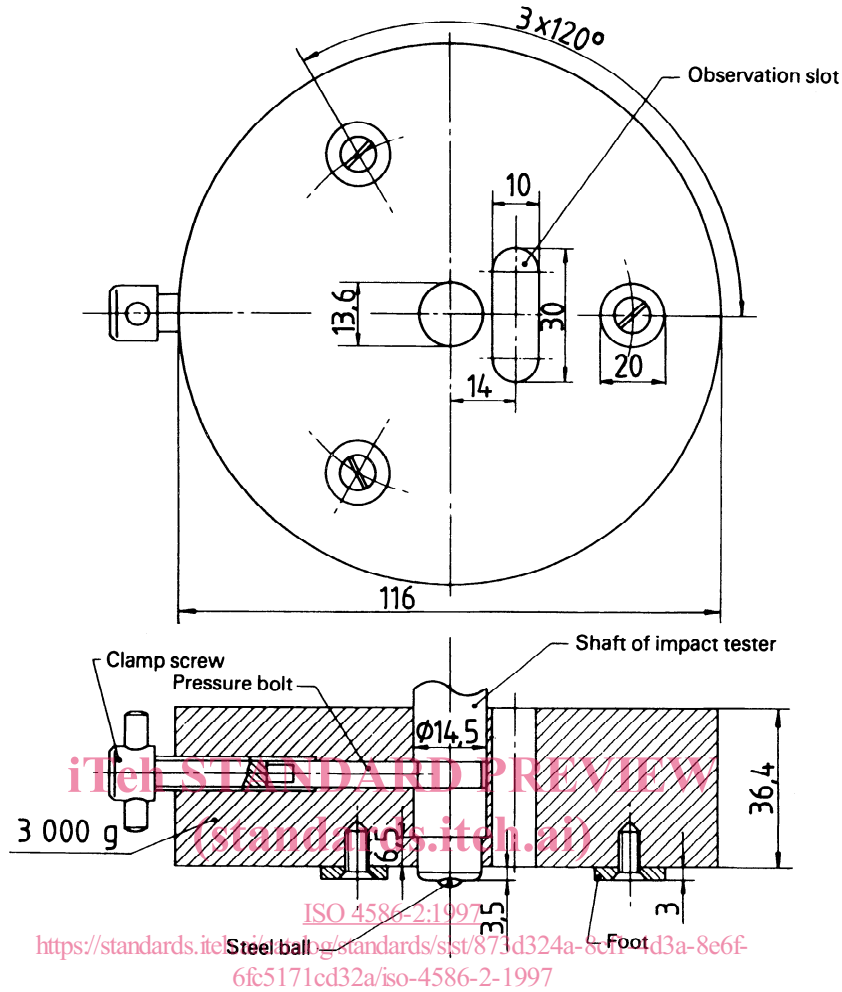


Figure 3 — Support fixture for impact tester (see 11.3.3)

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 4 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.

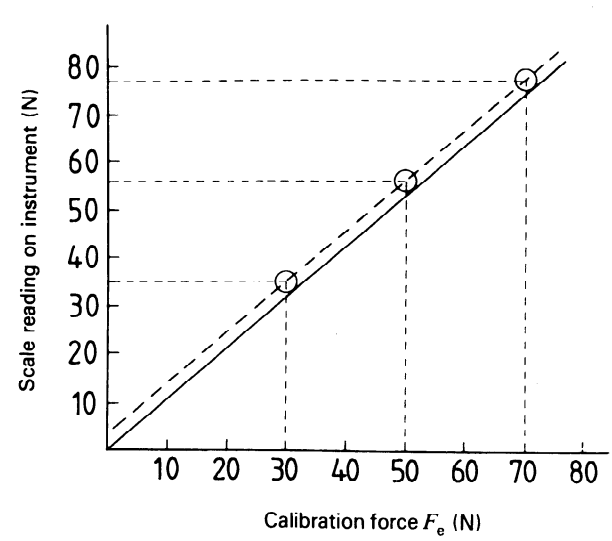


Figure 4 — Example of calibration graph relating actual force to scale value (see 11.5)