INTERNATIONAL STANDARD

ISO 13894-1

First edition
2000-03-15

High-pressure decorative laminates — Composite elements —

Part 1: Test methods

Stratifiés décoratifs haute pression — Éléments composites —

Partie 1: Méthodes d'essai

Reference number
ISO 13894-1:2000(E)

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Printed in Switzerland

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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 3.

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 part of ISO 13894 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13894-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

ISO 13894 consists of the following parts, under the general title *High-pressure decorative laminates — Composite elements*:

— *Part 1: Test methods*

— *Part 2: Specification of wood-based HPDL elements*

High-pressure decorative laminates — Composite elements —

Part 1:
Test methods

1 Scope

This part of ISO 13894 specifies the methods of test for determination of the properties of composite elements surfaced, and possibly edged, with high-pressure decorative laminate (HPDL) as defined in clause 3.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13894. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13894 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid part of ISO 13894.

ISO 1478:1999, *Tapping screw thread.*

ISO 4586-1:1997, *High-pressure decorative laminates — Sheets made from thermosetting resins — Part 1: Classification and specifications*.

ISO 4586-2:1997, *High-pressure decorative laminates — Sheets made from thermosetting resins — Part 2: Determination of properties*.

ISO 7170:1993, *Furniture — Storage units — Determination of strength and durability*.

3 Terms and definitions

For the purposes of this part of ISO 13894, the following terms and definitions apply.

3.1
composite element surfaced with high-pressure decorative laminate
a composite board produced by adhesively bonding high-pressure decorative laminate (HPDL) sheet material to one or both sides of a substrate

NOTE 1 The substrate may be a wood-based product (e.g. particle board), mineral board (e.g. calcium silicate), metal sheet, expanded honeycomb or a plastic material.

NOTE 2 Examples of adhesives are PVAc, urea formaldehyde and polychloroprene.

NOTE 3 Certain tests contained in this part of ISO 13894 are not applicable to all types of composite element.

3.2
high-pressure decorative laminate(s)
HPDL, HPL
See definition 3.1 in ISO 4586-1:1997.

4 Conditioning

Composite elements shall be pre-conditioned for a minimum period of 7 days at 20 °C ± 5 °C and (45 ± 20) % relative humidity before testing, or other conditions of temperature and humidity if agreed between supplier and purchaser.

5 Appearance

5.1 Principle

The HPDL elements are inspected for appearance under standardized conditions of lighting and viewing.

5.2 Procedure

Inspect the element from a distance of 1,5 m in accordance with test method 5.1 of ISO 4586-2:1997.

5.3 Expression of results

Report HPDL defects, as defined in 5.1 of ISO 4586-2:1997, plus fabrication defects such as surface ripple, bumps, cracks, indentations and adhesive smears.

5.4 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) any defects observed;

d) any deviations from the specified test method;

e) the date of the test.

6 Dimensions

6.1 Determination of length and width

6.1.1 Principle

The length and width of the element are measured using a steel tape or rule.

6.1.2 Apparatus

6.1.2.1 Steel tape or rule, of sufficient length to measure the greatest dimension of the element, and graduated to allow a reading accuracy of 0,5 mm. For cut-to-size elements requiring more precise dimensional tolerances, suitable high-precision measuring equipment shall be used.

6.1.3 Specimen

The specimen shall be the element as supplied by the manufacturer.

6.1.4 Procedure

Apply the steel tape or rule (6.1.2.1) to each edge of the element in turn, on a line approximately 25 mm from and parallel to the edge. Measure the length on each edge to the nearest 0,5 mm.

6.1.5 Expression of results

Express the length and width of the element, to the nearest 0,5 mm, as the length and width measurements showing the greatest deviation from the corresponding nominal values.

6.1.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the length and width values (see 6.1.5);

d) any deviations from the specified test method;

e) the date of the test.

6.2 Determination of edge straightness

6.2.1 Principle

A bow gauge is applied to the edge of the element and the deviation of the board edge from a straight line is measured.

6.2.2 Apparatus

6.2.2.1 Bow gauge, of suitable length (*l* in Figure 3), as specified in 7.2.1.

6.2.3 Specimen

The specimen shall be the element as supplied by the manufacturer.

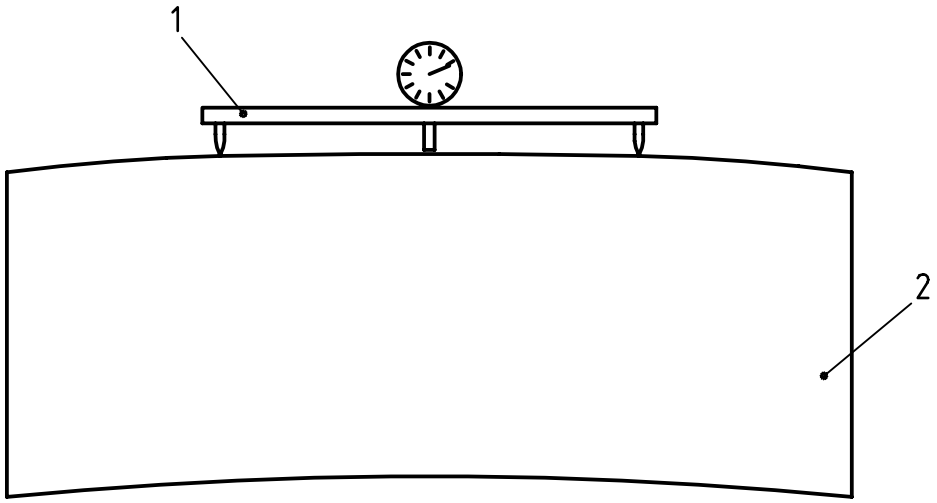
6.2.4 Procedure

Place the bow gauge (6.2.2.1) so that the three feet (two fixed and one movable) are lightly touching one edge of the element in the area of greatest deformation, and measure the straightness deviation (shown on the dial gauge) to the nearest 0,1 mm. Repeat this procedure for the other three edges.

For postformed elements, the feet of the bow gauge shall touch the extreme edge of the profile.

6.2.5 Expression of results

Record the maximum deviation for each of the four edges. Designate results “+” if the edge is convex, and “–” if the edge is concave.



Key

1 Bow gauge
2 Element

Figure 1 — Measuring edge straightness

6.2.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the test result for each of the four edges (see 6.2.5);

d) the distance *l* between the fixed feet of the bow gauge;

e) any deviations from the specified test method;

f) the date of the test.

6.3 Determination of edge squareness

6.3.1 Principle

A right-angled square is applied to the corner of the element and the deviation of the edge from the square is measured using a steel rule.

6.3.2 Apparatus

6.3.2.1 Right-angled square, with two arms at least 1 000 mm ± 1 mm long (see Figure 2).

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

6.3.3 Specimen

The specimen shall be the element as supplied by the manufacturer.

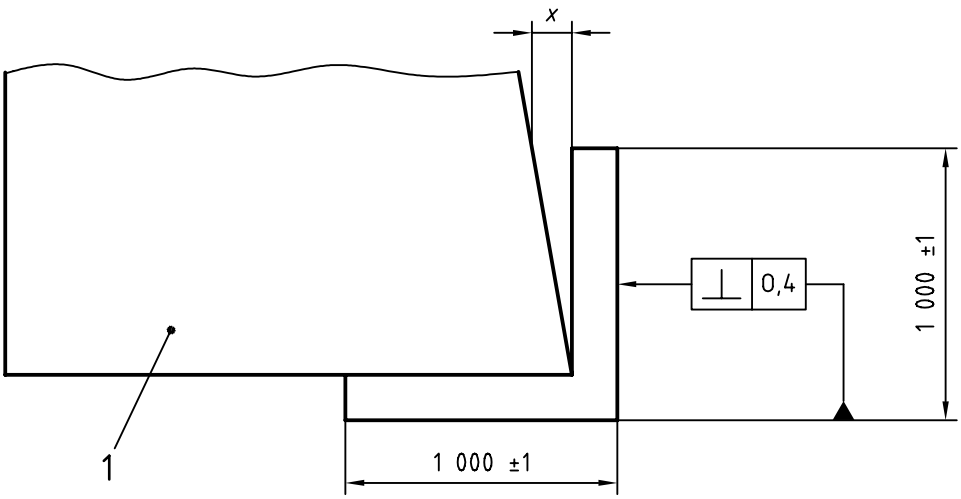
6.3.4 Procedure

Apply the right-angled square (6.3.2.1) to one corner of the element and measure the deviation of the edge of the board from the arm of the square at a distance of 1 m from the corner. Record the results to the nearest 0,5 mm. Repeat the procedure with the square applied to the diagonally opposite corner of the element.

6.3.5 Expression of results

Record the maximum deviation from square for the two diagonally opposite corners (x in Figure 2).

Dimensions in millimetres



Key

1 Element

Figure 2 — Measuring edge squareness

6.3.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the test result for each corner (see 6.3.5);

d) any deviations from the specified test method;

e) the date of the test.

6.4 Determination of thickness

6.4.1 Principle

The thickness of the element is measured using a thickness gauge.

6.4.2 Apparatus

6.4.2.1 Suitable thickness gauge, e.g. micrometer gauge, dial gauge or vernier sliding calliper, graduated to allow a reading accuracy of 0,1 mm.

6.4.3 Specimen

The specimen shall be the element as supplied by the manufacturer.

6.4.4 Procedure

Measure the thickness to the nearest 0,1 mm at the centre of each of the four edges, at a position 25 mm from the edge.

6.4.5 Expression of results

Calculate the thickness of the element as the arithmetic mean of the four thickness measurements, expressing it to the nearest 0,1 mm. Record the maximum and minimum values also.

6.4.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the mean thickness value, and maximum and minimum values (see 6.4.5);

d) any deviations from the specified test method;

e) the date of the test.

7 Flatness

7.1 Principle

The bow (deviation from flatness) of the element is measured using a bow gauge placed at the position of the greatest deformation.

7.2 Apparatus

7.2.1 Bow gauge, of suitable length (*l* in Figure 3), graduated to permit a reading accuracy of 0,1 mm.

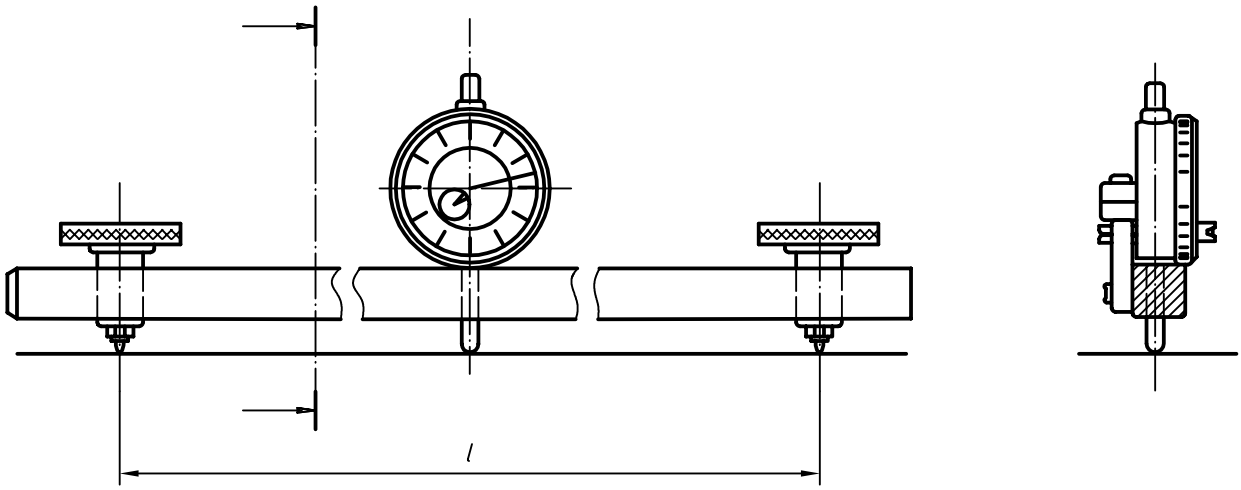


Figure 3 — Bow gauge

7.3 Specimen

The specimen shall be the element as supplied by the manufacturer.

7.4 Procedure

Position the element either horizontally or vertically as defined in the relevant specification.

When measured horizontally, the element shall be placed concave side up without restraint on a flat horizontal surface. When measured vertically, the element shall be held in a vertical position with the short or long edge resting on a horizontal base, and the bow shall be measured on the concave side.

Place the bow gauge (7.2.1) so that the three feet (two fixed and one movable) are lightly touching the surface of the element in the area of the greatest deformation, and measure the deviation from flatness (shown on the dial gauge) to the nearest 0,1 mm.

7.5 Expression of results

Record the maximum deviation from flatness measured using the bow gauge.

7.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the maximum deviation from flatness (see 7.5);

d) the distance *l* between the fixed feet of the bow gauge;

e) any deviations from the specified test method;

f) the date of the test.

8 Glue-line quality

8.1 Principle

The laminate is separated from the substrate using a chisel, followed by visual assessment of the separated components.

NOTE This test is only an assessment of the glue-line; it does not measure the integrity of the composite element.

8.2 Apparatus

8.2.1 Wood chisel, with a rigid steel blade approximately 30 mm wide (see Figure 4).

8.2.2 G-clamp, suitable for clamping the specimen to the bench.

8.2.3 Protective gloves.

Dimensions in millimetres

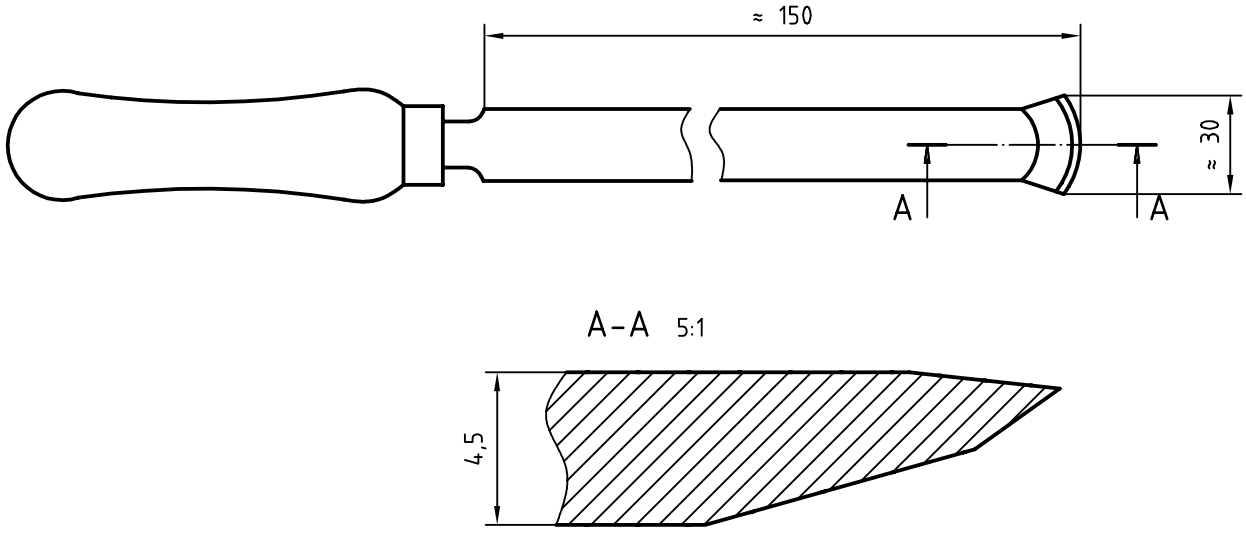


Figure 4 — Suggested tool for glue-line quality test

8.3 Specimens

Each specimen shall be approximately 300 mm × 100 mm, cut from the element after it has been stored in normal workshop conditions for at least 7 days after pressing. Two specimens shall be tested.

8.4 Procedure

WARNING — Suitable protective gloves must be worn when carrying out this test.

Clamp the specimen firmly to the bench using a G-clamp (8.2.2) or other suitable arrangement.

Starting from one of the narrow sides, insert the blade of the chisel (8.2.1) into the glue-line, by hammering if necessary, and carefully separate the laminate from the substrate, trying as far as possible to remove the laminate in one piece. Continue until all the laminate has been removed, either in one piece or several pieces, or until it becomes obvious that the laminate cannot be removed.

Examine the separated components to determine the effectiveness of the adhesive bond.

Repeat the procedure using the second specimen.

8.5 Expression of results

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

Rating 5: Extremely difficult to completely remove laminate from substrate;

Rating 3: Laminate completely removed from the substrate with some difficulty;

Rating 1: Laminate completely removed from the substrate easily.

8.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the lowest rating achieved (see 8.5);

d) any deviations from the specified test method;

e) the date of the test.

NOTE Additional observations may be specified for particular combinations of adhesives and substrates.

9 Surface bond strength

9.1 Principle

A tensile force is applied to a specified circular area of the surface, perpendicular to the surface, until the bond between laminate and substrate is ruptured.

9.2 Apparatus

9.2.1 Milling tool, capable of producing a circular groove of the dimensions specified in 9.3.

9.2.2 Mushroom-shaped steel pad (see Figure 5).

9.2.3 Centering frame (see Figure 6).

9.2.4 Tensile-testing machine, capable of applying a force of 2 500 N.

9.2.5 Universal-joint device, to fix the specimen in the test machine so that the tensile force is applied perpendicular to the surface (see Figure 7).

Dimensions in millimetres

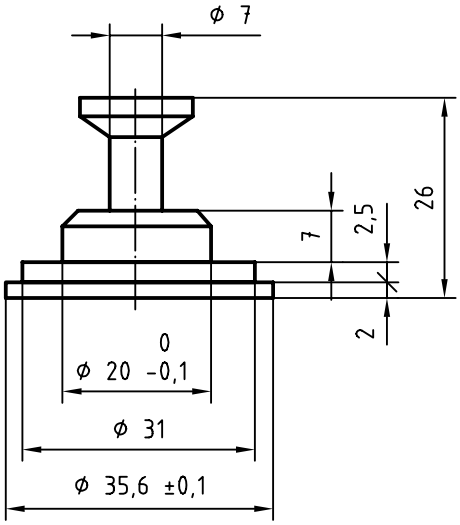
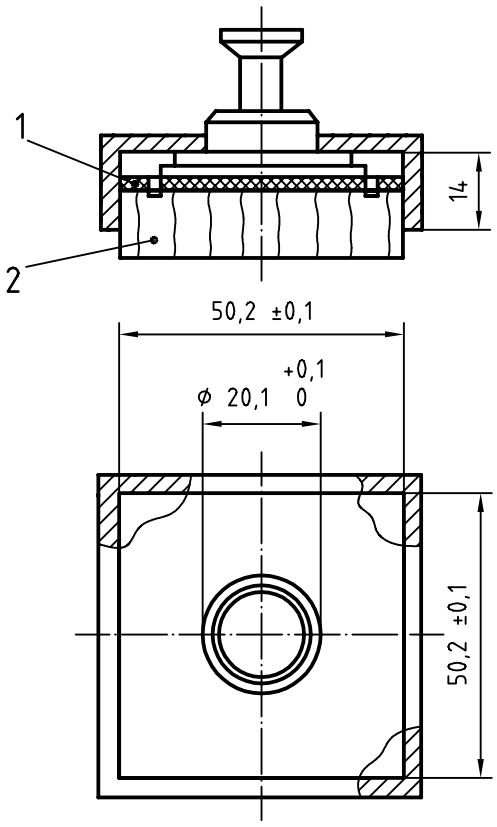


Figure 5 — Mushroom-shaped steel pad

Dimensions in millimetres



Key

1 HPDL

2 Substrate

Figure 6 — Centering frame

Dimensions in millimetres

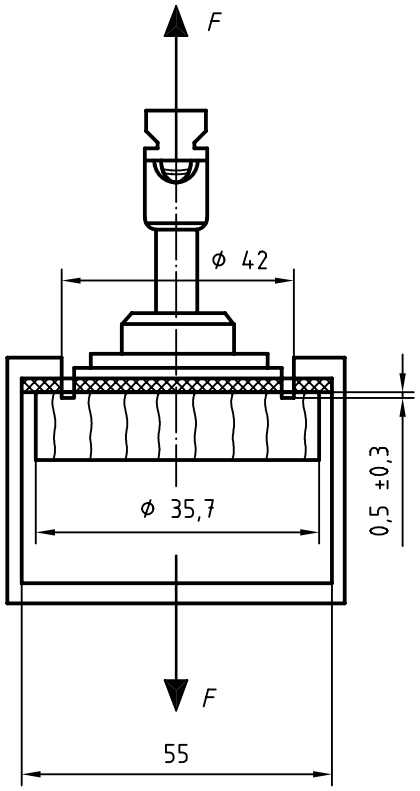


Figure 7 — Gimbal-mounted tensile-testing device

9.2.6 Hot-melt adhesive, with a melting point of less than 150 °C.

9.2.7 Medium-grade abrasive paper.

9.2.8 Oven, capable of being controlled to ± 2 °C within the range 150 °C to 170 °C.

9.3 Specimens

Each specimen shall be square with a side of length 50 mm ± 1 mm, cut from the element after it has been stored at 20 °C ± 5 °C and (45 ± 20) % relative humidity for at least 7 days after pressing. A circular groove having an inside diameter of 35,7 mm (enclosing an area of 1 000 mm^2) shall be milled in the centre of the specimen using the milling tool (9.2.1).

The depth of the groove shall exceed the thickness of the decorative laminate by 0,5 mm ± 0,3 mm.

Three specimens shall be tested.

9.4 Procedure

Using a suitable medium-grade abrasive paper (9.2.7), lightly sand the decorative laminate.

Apply a maximum of 0,3 g of adhesive (9.2.6) spread evenly across the face of the steel pad (9.2.2) which has previously been heated to a temperature between 150 °C and 170 °C in the oven (9.2.8), and position the pad exactly in the centre of the specimen using the centering frame (9.2.3). Whilst the specimen is in the centering frame, press the hot steel pad onto the laminate surface of the specimen until the adhesive has cooled and hardened.

Place the specimen in the test machine (9.2.4), using the universal-joint device (9.2.5) to ensure that the force is applied perpendicular to the surface. Apply a tensile force so that fracture occurs within 30 s to 90 s.

Record the force at fracture F_1 to the nearest newton.

If a glue-line failure occurs between the laminate face and the steel pad, then the result is acceptable only if the force at rupture exceeds the specification limit for the product being tested. Otherwise, the test shall be repeated using a fresh specimen.

Repeat the test using the other two specimens, and record the results as F_2 and F_3.

9.5 Expression of results

Calculate the surface bond strength for each specimen using the following equation:

$$\text{Bond strength} = \frac{F}{1000}\ \text{MPa}$$

Calculate the surface bond strength of the element as the arithmetic mean of the three bond strengths, expressing it to the nearest 0,1 MPa.

9.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the surface bond strength (see 9.5);

d) any glue-line failures between steel pad and laminate;

e) any deviations from the specified test method;

f) the date of the test.

10 Perpendicular tensile strength

10.1 Principle

A specimen is subjected to a uniformly distributed tensile force perpendicular to the surface until rupture occurs.

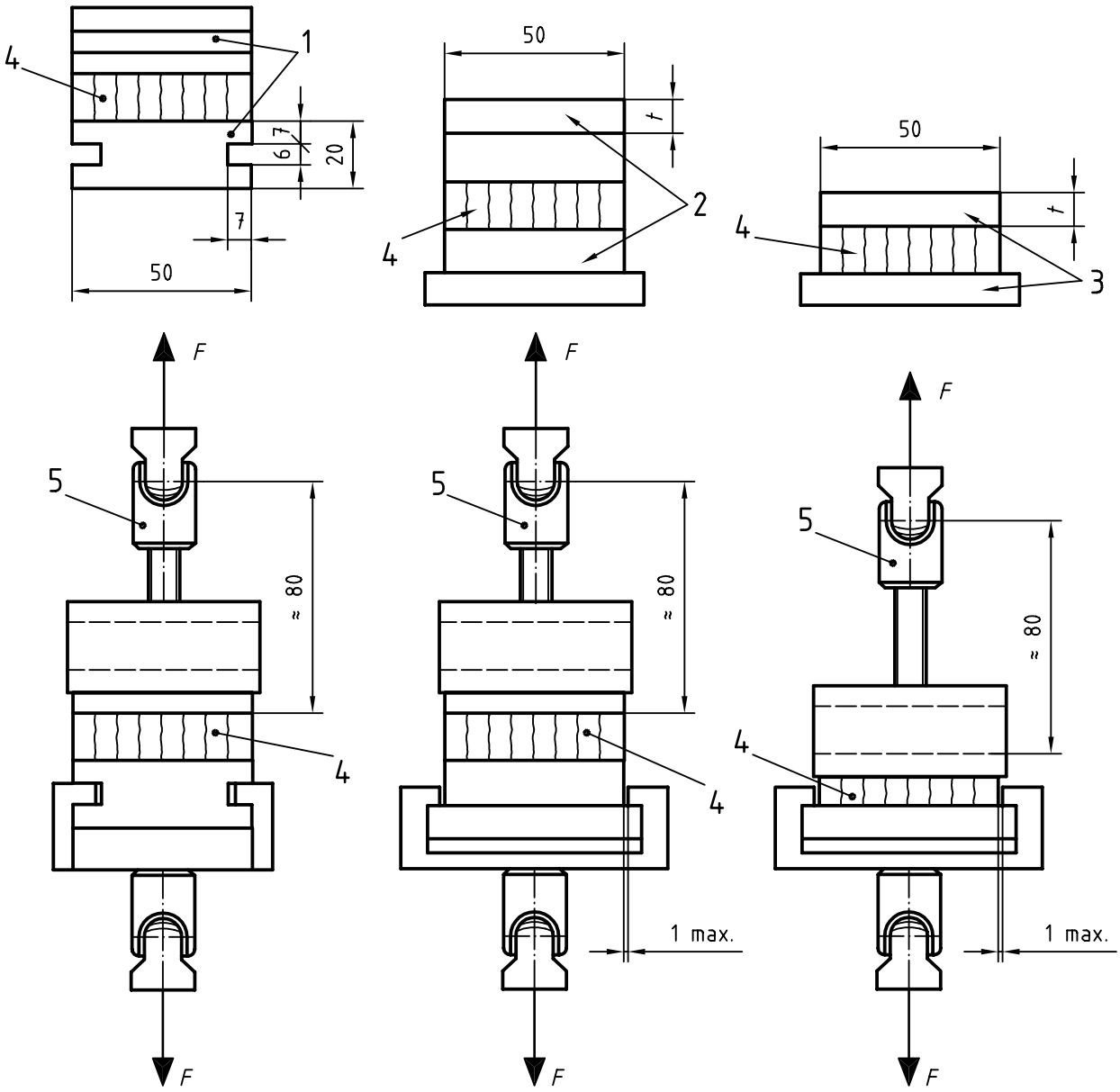
10.2 Apparatus

10.2.1 Vernier sliding-calliper gauge, graduated to allow a reading accuracy of 0,1 mm.

10.2.2 Tensile-testing machine, capable of applying a tensile force perpendicular to the surface of the test specimen by means of grips (see Figure 8) and measuring this force to an accuracy of 1 %. The grips shall be self-aligning by means of a ball-and-socket joint on each side of the test specimen.

10.2.3 Test blocks (metal, hardwood, or hardwood plywood), compatible with the fixation device to which the specimens are glued (see Figure 8).

Dimensions in millimetres



Key

1 Metal test block
2 Test block (metal, hardwood, or hardwood plywood)
3 Hardwood plywood test block (not suitable for thin boards)
4 Specimen
5 Self-aligning ball-and-socket joint

Thickness t = 10 mm minimum for metal blocks
Thickness t = 15 mm minimum for hardwood and hardwood plywood blocks

Figure 8 — Examples of apparatus for determining tensile strength perpendicular to the plane of the board

10.3 Specimens

The specimens shall be square with a side of length 50 mm ± 1 mm. The corner angles shall be 90° and the edges shall be straight and clean. Three specimens shall be tested.

10.4 Procedure

Measure the length and width of each specimen using the sliding-calliper gauge (10.2.1).

Glue each specimen to test blocks using a suitable adhesive. Any excess glue pressed out from the glue-line shall be removed.

NOTE 1 Hot-melt, epoxy and polyurethane adhesives have been found to be suitable for metal blocks and wood blocks.

NOTE 2 The surfaces of the specimens may be lightly abraded with a suitable abrasive paper to improve adhesion.

Allow the adhesive to cure for a minimum of 72 h in normal ambient conditions before carrying out the test.

Place the test assembly in the grips and apply a tensile force at a constant rate of crosshead movement until rupture occurs. The rate of loading shall be such that rupture occurs within 30 s to 90 s.

Record, to an accuracy of 1 %, the maximum load sustained. Reject the results from any specimen that exhibits partial or total glue-line failure or failure in the test block. In such cases, the test shall be repeated using a new specimen.

10.5 Expression of results

Calculate the perpendicular tensile strength of each specimen using the following equation:

$$f_{\mathrm{t}} = \frac{F_{\max}}{a \times b}$$

where

f_{t} is the perpendicular tensile strength, expressed in megapascals;

$F_{\max}$ is the load at rupture, expressed in newtons;

a and b are the length and width of the specimen, expressed in millimetres.

Calculate the perpendicular tensile strength as the arithmetic mean of the three tests results, expressing it to the nearest 0,1 MPa.

10.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the perpendicular tensile strength (see 10.5);

d) the nature of the failure (e.g. substrate or glue-line);

e) any deviations from the specified test method;

f) the date of the test.

11 Resistance to elevated temperature (short-term exposure)

11.1 Principle

A specimen is subjected to a specified elevated temperature for a prescribed length of time, followed by visual inspection for defects.

11.2 Apparatus

11.2.1 Forced-air oven, capable of being controlled to ±2 °C within the range 80 °C to 100 °C.

11.3 Specimens

Each specimen shall be approximately 300 mm × 100 mm, cut from the element, and may include postformed or flat-bonded HPDL edges. Two specimens shall be tested.

11.4 Procedure

Place both specimens in a central position in the heated oven (11.2) controlled to ±2 °C at the specified temperature. Place only two specimens in the oven at any one time.

After 1 h, remove the specimens from the oven and inspect immediately, and again after 1 h at room temperature, with normal vision (corrected if necessary), for changes such as formation of cracks, ripples, blisters, glue-line failures or colour changes.

11.5 Expression of results

Record as defects any distortion, blistering, cracking, glue-line failure or marked change in appearance.

11.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) any defects recorded (see 11.5);

d) any deviations from the specified test method;

e) the date of the test.

12 Resistance to elevated temperature (long-term exposure)

12.1 Principle

A specimen is subjected to a specified elevated temperature for a prescribed length of time, followed by visual inspection for defects.

12.2 Apparatus

12.2.1 Forced-air oven, capable of being controlled at a temperature of 70 °C ± 2 °C measured at the location of the test specimens.

12.3 Specimens

Each specimen shall be approximately 300 mm × 100 mm, cut from the element, and shall include any postformed or flat-bonded HPDL edges. Two specimens shall be tested.

12.4 Procedure

Place both specimens in a central position in the heated oven (12.2.1). After 16 h, remove the specimens from the oven and allow them to cool in normal ambient conditions for 1 h.

At the end of the cooling period, inspect the specimens with normal vision (corrected if necessary) for changes such as formation of cracks, ripples, blisters, glue-line failures or colour changes.

12.5 Expression of results

Record as defects any distortion, blistering, cracking, glue-line failure or marked change in appearance.

12.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) any defects recorded (see 12.5);

d) any deviations from the specified test method;

e) the date of the test.

13 Resistance to water vapour

13.1 Principle

The edge and surface of a specimen cut from the HPDL element are exposed to water vapour for a prescribed length of time, followed by visual inspection for defects.

13.2 Apparatus (see Figure 9)

13.2.1 Stainless-steel cover, approximately 300 mm × 300 mm × 300 mm with a (50 ± 1) mm × (10 ± 0,5) mm slot cut in the top centre.

13.2.2 Metal pot, of 1 litre capacity.

13.2.3 Thermostatically controlled hot-plate.

13.2.4 Two strips of 3 mm thick insulating sheet (for example HPDL), approximately 300 mm × 100 mm.

13.3 Specimen

The specimen shall be approximately 200 mm long by 100 mm wide, cut from the element so that the edge to be tested is along one long side of the specimen. One specimen shall be tested.

13.4 Procedure

Pour approximately 750 ml of water into the metal pot (13.2.2), place the pot on the hot-plate (13.2.3) and bring the water to the boil. Set the thermostatic control to provide just enough heat to keep the water boiling during the 30 min test period.

Place the stainless-steel cover (13.2.1) centrally over the hot-plate and pot, and position the two strips of insulating sheet (13.2.4) adjacent to the ends of the 50 mm slot as shown in Figure 9.

Place the specimen on the insulating strips so that the edge and surface to be tested are positioned over the slot and in contact with the escaping water vapour. For horizontal elements such as worktops, the water vapour shall flow around the backing liner and the area where the HPDL surface meets the backing. For vertical elements such as doors, the water vapour shall flow around the edge.

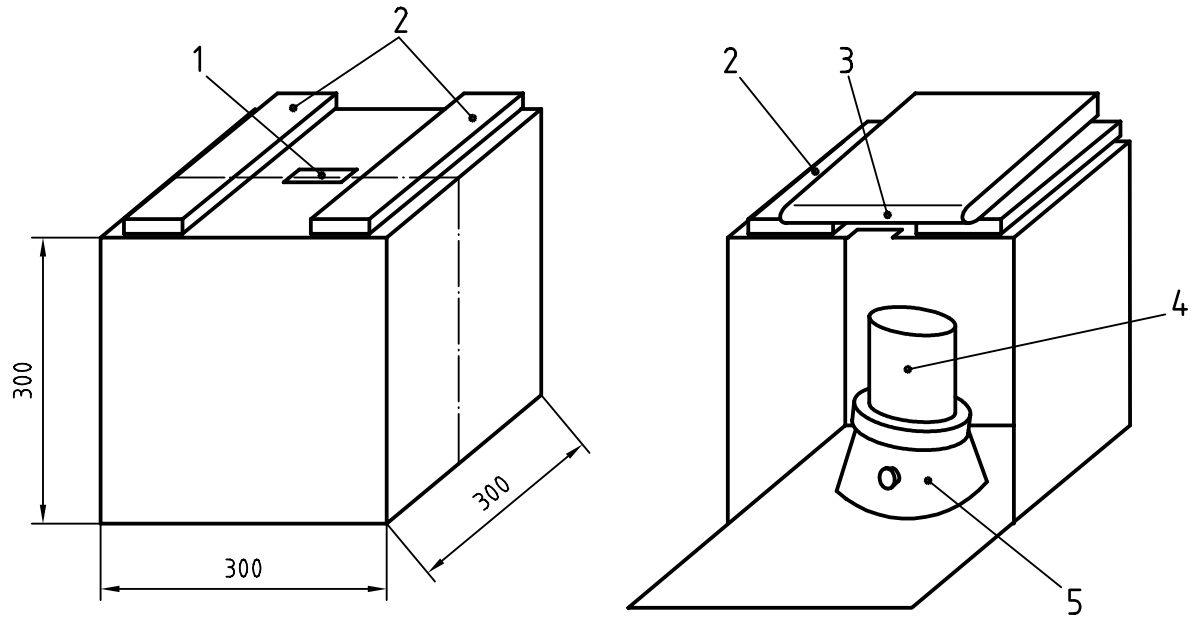
After 30 min exposure to the water vapour, remove the specimen, dry the surface, and allow to cool for 1 h.

At the end of the cooling period, inspect the specimen with normal vision (corrected if necessary) for any swelling in the joints or surface areas, opening of joints or delamination.

13.5 Expression of results

Record as defects any swelling, opening of joints or delamination.

Dimensions in millimetres



Key

1 Slot to allow steam to escape
2 Insulating strips (13.2.4)
3 Element edge under test
4 Pot (13.2.2)
5 Hot-plate (13.2.3)

Figure 9 — Apparatus for resistance to water vapour

13.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) any defects recorded (see 13.5);

d) any deviations from the specified test method;

e) the date of the test.

14 Substrate protection against water vapour

14.1 Principle

The increase in thickness of the specimen resulting from exposure of a surface (which has been cut by vandalism, for example) to water vapour for a prescribed length of time is measured.

14.2 Apparatus

14.2.1 Milling tool, as specified in 9.2.1, capable of producing a circular groove having an inside diameter of 35,7 mm and an outside diameter of 42,0 mm.

14.2.2 Thickness gauge, as specified in 6.4.2.1.

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

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

14.3 Specimens

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

14.4 Procedure

Using the milling tool (14.2.1), cut a circular groove in the centre of a specimen, as shown in Figure 10, to a depth which is just sufficient to expose the first sub-layer (i.e. the layer immediately beneath the decorative surface).

Using the thickness gauge (14.2.2), measure the thickness at the centre of the specimen to the nearest 0,1 mm and record it as value t_1.

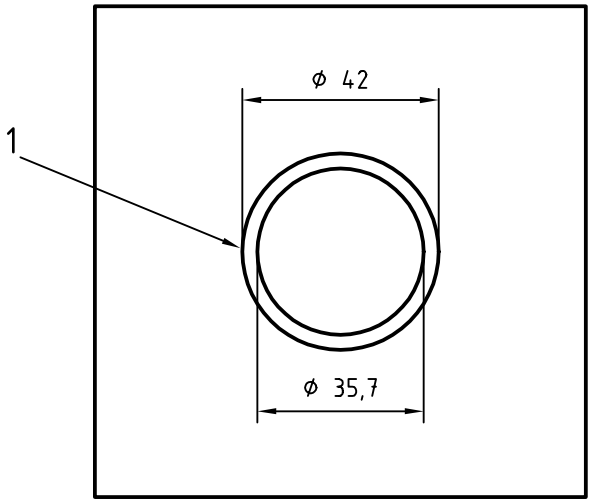
Place approximately 200 ml of water in the flask (14.2.3) and bring it to the boil on the hot-plate (14.2.4). Place the specimen, with the cut decorative surface face down, centrally over the mouth of the flask.

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

Re-measure the thickness at the centre of the specimen and record it as value t_2.

Repeat the procedure using the second specimen.

Dimensions in millimetres



Key

1 Circular groove

Figure 10 — Specimen for substrate protection test

14.5 Expression of results

Express the substrate protection against water vapour as the difference between the final thickness and the initial thickness ($t_2 - t_1$).

14.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the higher of the two values of $t_2 - t_1$ (see 14.5);

d) any deviations from the specified test method;

e) the date of the test.

15 Resistance to axial withdrawal of wood screws (screw-holding)

15.1 Principle

The force required to withdraw a defined screw from the face and edge of the element is measured.

As it is not good practice to screw directly through the HPDL face, carry out the test perpendicular to the board surface on the substrate only.

NOTE The edge test is not applicable to elements less than 15 mm thick.

15.2 Apparatus

15.2.1 Test machine, capable of applying an increasing axial force to the underside of the screw head through a suitable stirrup, whilst adequately restraining the specimen, and measuring the maximum load to an accuracy of 1 %.

15.2.2 Metal jig, for testing the resistance to withdrawal of screws from the faces of elements less than 15 mm thick. The use of a metal jig with a central hole (see Figure 11) which restrains the test piece is recommended.

15.2.3 Steel screws, nominal size 4,2 mm × 38 mm, with a No. ST 4,2 thread as defined in ISO 1478, and a thread pitch of 1,4 mm (see Figure 12).

15.2.4 Drilling equipment, capable of drilling 2,7 mm ± 0,1 mm pilot holes perpendicular to the surface of the specimen being drilled.

15.2.5 Boring tool, of diameter 6 mm to 8 mm.

15.2.6 Suitable screwdriver.

15.3 Specimens

Each specimen shall be square with a side of length of 75 mm ± 1 mm. Three specimens shall be tested.

15.4 Procedure

Prepare each specimen by drilling pilot holes, perpendicular to the surfaces being drilled, at the midpoints of one face and two adjacent edges. The holes shall have a diameter of 2,7 mm ± 0,1 mm and a depth of 19 mm ± 1 mm.

Using the boring tool (15.2.5), carefully remove the total thickness of HPDL from the surface of the substrate on the side where the screw will be inserted.

Insert screws (15.2.3) into the pre-drilled pilot holes in such a way that 15 mm ± 0,5 mm of complete thread is embedded in the specimen (see Figure 12).

When testing the resistance to withdrawal from faces of specimens less than 15 mm thick, remove the HPDL from both sides of the specimen and insert the screw in such a way that a length of incomplete thread (y in Figure 12) protrudes on the opposite side of the specimen.

Mount the specimen in the test machine so that the surface under test is not supported at any point closer than 15 mm to the periphery of the embedded part of the screw, and is held perpendicular to the direction of the force applied to the screws (see Figure 13). When testing the screw withdrawal from the faces of specimens < 15 mm thick, use the metal jig (see Figure 11) in such a way that the screw is inserted into the centre hole of the metal jig, and the specimen is well restrained by the jig.

Apply an increasing axial force to the underside of the head of each screw in turn, through a stirrup incorporating a parallel-sided slot of suitable width to fit easily into the shank of the screw. Apply the force at a constant rate of movement of 10 mm/min ± 1 mm/min until the maximum force is achieved.

Record the maximum force, to the nearest 10 N, sustained by the specimen during each of the withdrawal tests on the face and both edges.

15.5 Expression of results

For elements 15 mm thick or more, calculate the face and edge screw-holding values as the arithmetic means of the three face test results and the six edge test results, respectively, expressing the means to the nearest 10 N. For elements less than 15 mm thick, calculate the arithmetic mean of the face test results by dividing the force in newtons by the thickness of the substrate in millimetres, expressing the mean to the nearest 1 N/mm.

15.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the face and edge screw-holding values (see 15.5);

d) any deviations from the specified test method;

e) the date of the test.

Dimensions in millimetres

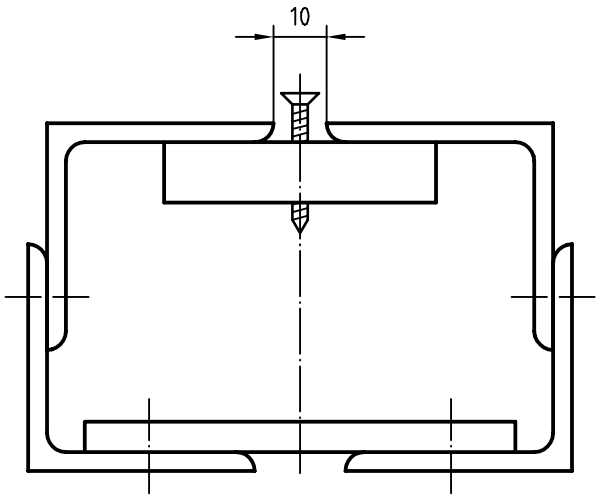


Figure 11 — Principle of screw-holding test on specimens < 15 mm thick

Dimensions in millimetres

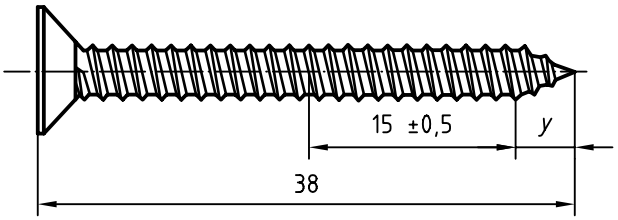
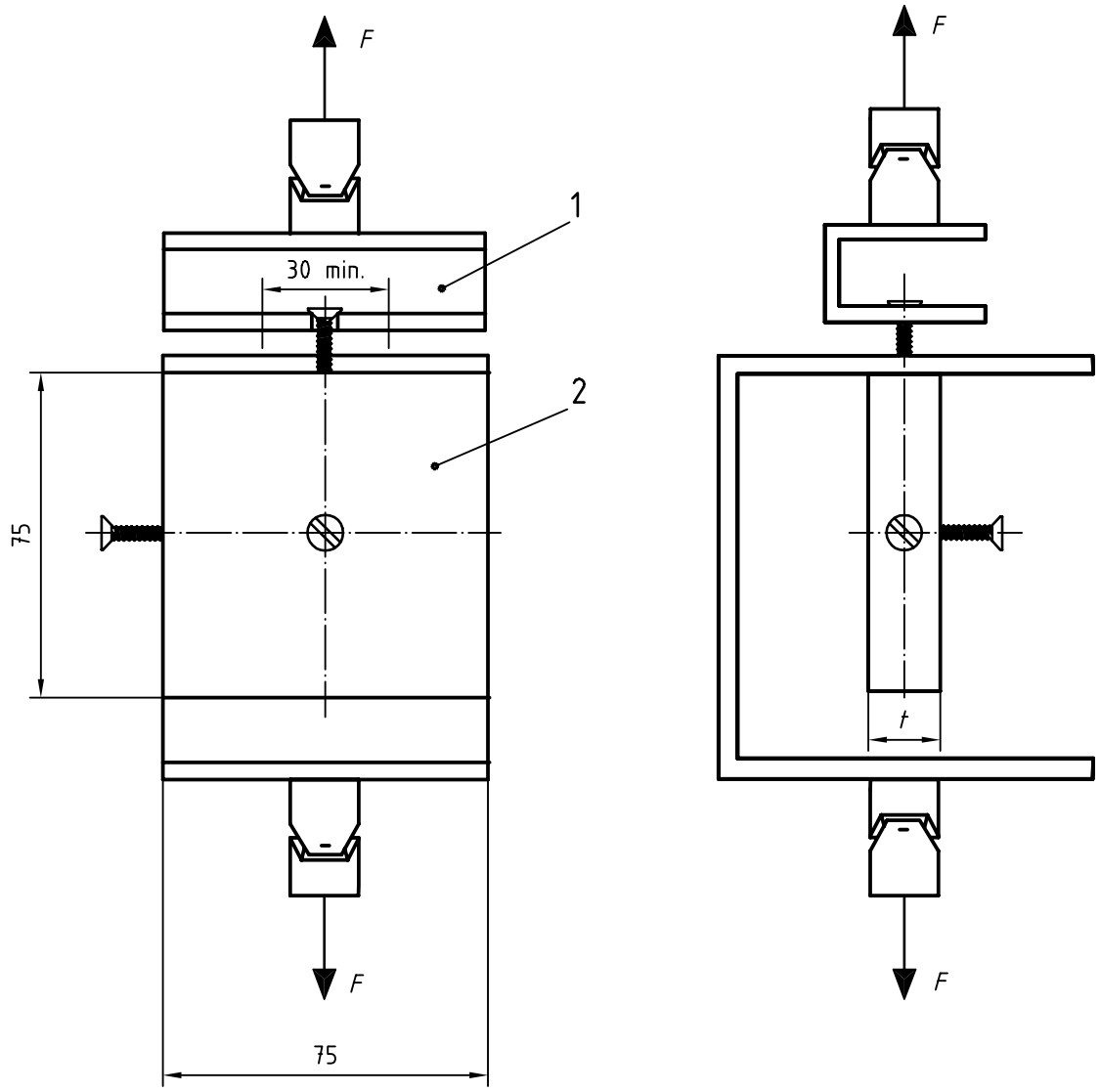


Figure 12 — Parallel-shank screw, nominal size 4,2 mm × 38 mm, thread No. ST4,2 as defined in ISO 1478, thread pitch 1,4 mm

Dimensions in millimetres



Key

1 Stirrup
2 Specimen

Figure 13 — Example of arrangement for screw-holding test

16 Determination of continuous-load capability of shelving

16.1 Principle

The shelf under test is placed on supports appropriate to the final application, and the deflection of the shelf is measured under specified conditions of loading.

16.2 Procedure

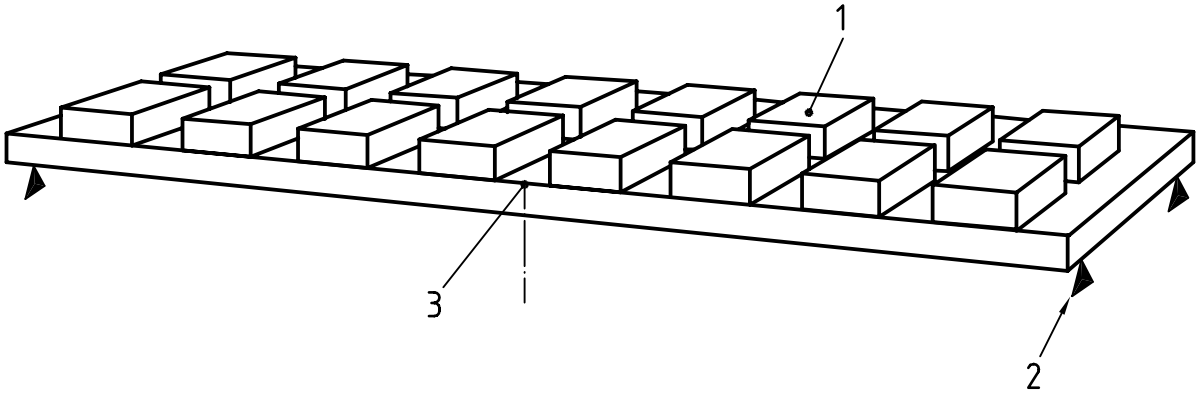
Determine the continuous-loading capability in accordance with the deflection test for shelves in ISO 7170.

One specimen shall be tested.

The specimen shall form a shelf on its supports. Place weights of 1 000 g ± 10 g distributed uniformly on the shelf to apply the load specified in the requirement documents (see Figure 14 and the note).

Measure the deflection of the shelf from a straight line drawn between the supports at the centre of the front edge immediately before application of the load, then again 5 min after applying the load, and after 14 days and 28 days (see Figure 14).

NOTE Recommended test loads in ISO 7170:1993 are 0,5 kg/dm^2, 1,5 kg/dm^2, 2 kg/dm^2 and 2,5 kg/dm^2.



Key

1 Load
2 Shelf support
3 Measurement point

Figure 14 — Deflection test for shelves

16.3 Expressions of results

Record the four deflection values, in millimetres, to an accuracy of ±0,1 mm, and also as a percentage of the distance between the supports.

16.4 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the length, width and thickness of the shelf element, in millimetres;

d) the test load;

e) the deflection, in millimetres and as a percentage, before loading and after loading for each of the specified periods (see 16.3);

f) any deviations from the specified test method;

g) the date of the test.

17 Surface impact resistance (large-diameter ball)

17.1 Principle

A steel ball is dropped onto the surface of the element in order to determine the maximum drop height which does not cause cracking or significant indentation of the surface.

17.2 Procedure

Determine the surface impact resistance in accordance with test method 12 of ISO 4586-2:1997. Test sufficient specimens, cut from the element as supplied by the manufacturer, to obtain a final result.

17.3 Expression of results

Record the surface impact resistance of the element as the maximum drop height which does not result in cracking or an imprint of diameter greater than the specified value in a series of five consecutive strikes.

17.4 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the surface impact resistance (see 17.3);

d) any deviations from the specified test method;

e) the date of the test.

18 Surface impact resistance (small-diameter ball)

18.1 Principle

The surface of the element is subjected to the impact of a 5 mm diameter steel ball mounted at one end of a spring-loaded bolt in order to determine the maximum spring force which does not cause cracking of the surface.

18.2 Procedure

Determine the surface impact resistance in accordance with test method 11 of ISO 4586-2:1997.

18.3 Expression of results

Record the surface impact resistance as the maximum value of the spring force, in newtons, for which no damage occurs in a series of five consecutive strikes.

18.4 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the surface impact resistance (see 18.3);

d) any deviations from the specified test method;

e) the date of the test.

19 Water resistance (edge swell)

19.1 Principle

The increase in thickness of the edge of the element resulting from the edge under test being in contact with wet sponges for a defined period of time is measured.

19.2 Apparatus

19.2.1 Suitable-sized container, made of non-porous material, with a flat horizontal base.

19.2.2 Sponges, made from open-cell plastic-based flexible cellular material having a density of 20 kg/m^3 ± 5 kg/m^3. The sponges shall be 50 mm ± 0,5 mm high, with all edges mutually at right angles.

19.2.3 Two spacers, 50 mm ± 0,1 mm high and 10 mm to 20 mm thick, made of rigid material which is not sensitive to water. The length of the spacers shall be approximately 20 mm less than the internal width of the container.

19.2.4 Thickness gauge, as specified in 6.4.2.1.

19.2.5 Stopwatch, or other suitable timer.

19.2.6 Means of supporting the specimen in a vertical position throughout the duration of the test.

19.2.7 Suitable spirit level.

19.3 Specimen

The specimen shall be the element as supplied by the manufacturer, or a cut panel. In the case of a cut panel, cut edges other than the one under test shall be suitably sealed (e.g. with silicone compound).

19.4 Procedure

Make sure the container (19.2.1) is level using a spirit level (19.2.7).

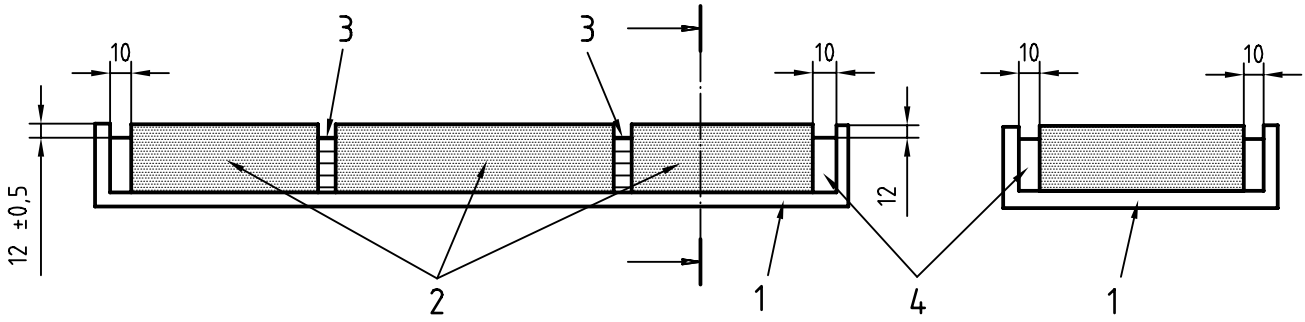
Stand the two spacers (19.2.3) on their long edges in the container so as to roughly divide the base area of the container into thirds.

Place sufficient sponges (19.2.2) in the container to completely cover the base except for a space of approximately 10 mm around the perimeter (see Figure 15).

Fill the container with de-ionized water and compress the sponges to saturate them with water. Leave the container for 2 h to 3 h to ensure that the sponges are totally saturated.

Adjust the water level so that it is 12 mm ± 0,5 mm below the top surfaces of the sponges (see Figure 15).

Dimensions in millimetres



Key

1 Container
2 Sponges
3 Spacers
4 Water

Figure 15 — Container for edge swell test

Mark four points (A, B, C and D) on one surface of the specimen. The points shall be positioned 2 mm ± 0,5 mm from the edge to be tested, with point A at one corner and points B, C and D at suitable equal intervals along the edge, or at those points considered to be most critical (see Figure 16).

Measure the thickness of the element at points A, B, C and D using the thickness gauge (19.2.4).

Position the specimen so that the edge to be tested is resting on the two spacers, and the specimen is held in a vertical position by a suitable support (see Figure 16).

After the period of time defined in the specification, remove the specimen and remove excess water from the surfaces and edges using absorbent paper.

Re-measure the thickness at points A, B, C and D, and examine the specimen with normal vision (corrected if necessary) for any signs of separation of the edging.

19.5 Expression of results

Calculate the percentage increase in thickness for points A, B, C and D as follows:

$$\text{Percentage increase in thickness} = \frac{(\text{Final thickness} - \text{Initial thickness})}{\text{Initial thickness}} \times 100\,\%$$

Record the edge resistance to water, expressed as percentage edge swell, as the highest value obtained from the measurements made at points A, B, C and D.

19.6 Test report

The test report shall include the following information:

a) a reference to this part of ISO 13894;

b) the name and type of product;

c) the highest percentage edge swell value (see 19.5), and the nature of any observed edge separation;

d) any deviations from the specified test method;

e) the date of the test.

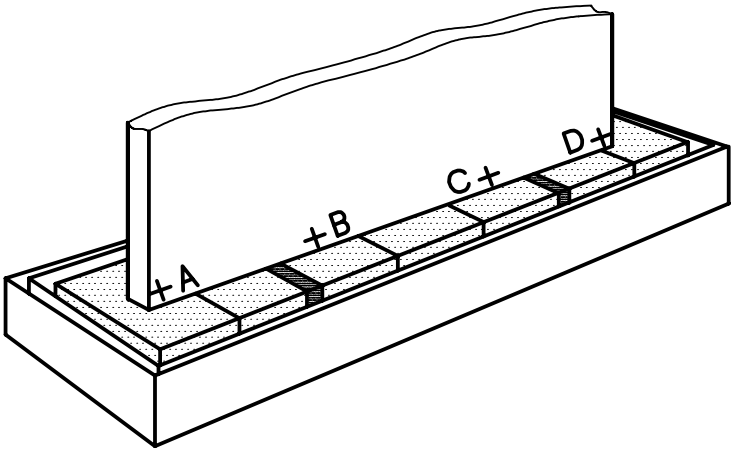


Figure 16 — Edge swell test

ICS 83.140.20

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