BS EN 15186:2012

BSI Standards Publication

Furniture — Assessment of the surface resistance to scratching

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National foreword

This British Standard is the UK implementation of EN 15186:2012. It supersedes DD CEN/TS 15186:2005, which is withdrawn and partially supersedes BS 3962-6:1980.

The UK participation in its preparation was entrusted to Technical Committee FW/0/1, Common Test Methods for Furniture.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Furniture - Assessment of the surface resistance to scratching

Ameublement - Evaluation de la résistance de la surface à la rayure

Möbel - Bewertung der Kratzfestigkeit von Oberflächen

This European Standard was approved by CEN on 8 March 2012.

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Contents

Page

Figures

Tables

Foreword

This document (EN 15186:2012) has been prepared by Technical Committee CEN/TC 207 “Furniture”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TS 15186:2005.

Regarding the significant technical changes that have been made in this new edition of EN 15186, see the informative Annex B.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies a method for the assessment of the surface resistance to penetrating scratches. It relates to the rigid surfaces of all finished products, regardless of their material.

It does not apply to finishes on leather and fabrics.

Method A is suitable for all types of surface coatings and coverings except for melamine faced boards (according to EN 14322) and HPL (according to EN 438-1). It simulates measurable penetrating and/or deforming scratches.

Method B is suitable for all types of surfaces. It simulates first visible scratches that may only be a change in the gloss.

The test is intended to be carried out on a part of finished furniture. It can however be carried out on test panels of the same material, finished in an identical manner to the finished product, and of a size sufficient to meet the requirements of the test.

It is essential that the test be carried out on unused surfaces.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 1518-1, *Paint and varnishes — Determination of scratch resistance – Part 1: constant loading method (ISO 1518-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
test surface
part of the test panel

3.2
test panel
panel including the test surface

Note 1 to entry: The panel may be cut from a finished item of furniture or it may be a separate panel produced in the same manner as the finished item of furniture.

3.3
test area
part of the test surface under the equipment, where the measurement is carried out

3.4
scratching tip

3.4.1
method A
needle with a point of defined geometry

Note 1 to entry: See 4.2.3.

3.4.2
method B
needle with a point of defined geometry

Note 1 to entry: See 5.2.1.6.

3.5
scratching trace

3.5.1
method A
visible and measurable mark on the tested surface which is produced under the specified load of the scratching tip; the shapes of the traces can be different depending on the substrate and coating type as shown in Table 2

3.5.2
method B
first visible scratches which may only be a change in the gloss

3.6
scratching resistance

3.6.1
method A
minimum load, in N, applied to the scratching tip, which produces a measurable width trace (W) of ≥ 0,30 mm

3.6.2
method B
minimum load, in N, applied to the scratching tip, which produces a continuous visible mark

3.7
preliminary assessments of the scratching resistance (method A)
minimum load causing the specified trace on one test surface

3.8
intermediate assessment of scratching resistance (method A)
mean value of preliminary assessments of one test surface

3.9
final value of scratching resistance (method A)
mean value of intermediate assessments of three test surfaces

Note 1 to entry: See Figure A.2 in the informative Annex A.

4 Linear method (method A)

4.1 Principle

Surface scratching resistance is defined as the minimum load in N (Newtons) applied to the tip with specified geometry, which produces a specified scratch width (see 4.4.2).

The width of the scratching trace is the result of the assessment of the series of scratches produced by the tip.

4.2 Apparatus and materials

4.2.1 Test apparatus

4.2.1.1 Equipment for linear, without hand movement of the scratching tip or the test surface, according to the principle of EN ISO 1518-1.

4.2.2 Equipment parameters

Technical parameters of the apparatus shall be as specified in Table 1.

Table 1 — Technical parameters

Parameter	Description/values
Tip/test surface movement	Linear
Load range (N)	1,0 - 20,0
Increment of load (N)	1,0 ± 0,1
Speed of the tip's/test surface movement (mm/s)	20 ± 10
Travel length of the tip or test surface (mm)	Minimum 22

4.2.3 Scratching tip

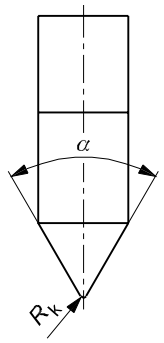
Scratching tip made of diamond, with a radius (R) of (0,30 ± 0,01) mm.

The coupling between the spherical part of the tool and the truncated cone section shall allow the width of the trace produced by the tool on the test area to be higher than 0,30 mm, without disturbing this truncated cone section.

An example of this tool is shown in Figure 1.

The tip shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction.

The tip shall be checked before use (see 4.3.3).



Key

α tip's angle α = (60,0 ± 1,0) °
R_k radius of tip's rounded part R_k = (0,30 ± 0,01) mm

Figure 1 — Scratching tip of the cone type

4.2.4 Optical measurement equipment

Any suitable equipment (e.g. a microscope) for measuring the trace's width with ± 0,05 mm accuracy and for assessment of the scratching tip's geometry with ± 0,01 mm accuracy.

4.2.5 Suitable illumination

Suitable illumination for measurement of the trace's width with ± 0,05 mm accuracy.

4.2.6 Conditioning chamber

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

4.2.7 Cleaning cloth

White, soft, absorbent cloth.

4.3 Preparation and conditioning

4.3.1 Conditioning

Conditioning of the test surface shall begin at least one week before testing, and shall be carried out in air with a temperature of (23 ± 2) °C and relative humidity of (50 ± 5) %.

The conditioning time shall be stated in the test report.

NOTE Some finishing systems may not have achieved full cure after one week of conditioning.

4.3.2 Test surface

Three test surfaces shall be prepared.

The test surface taken shall be at least 20 mm from the edge.

Each test surface shall be a piece of the test panel, shaped to fit the type of clamping device used.

The test surface shall be carefully wiped with a cleaning cloth (see 4.2.7) before the test without scratching the surface.

The test surface shall be largely flat.

4.3.3 Checking of the tip's geometry

The scratching tip shall be inspected visually before each test (see Figure 2).

The scratching tip shall be checked using the optical measurement equipment to obtain an accuracy of ± 0,01 mm and ± 1 º, at least every series of 1 000 tests.

In both cases, if any flatness, holes, mass losses or other kind of damages are found, the scratching tip shall be rejected and replaced by a new one.

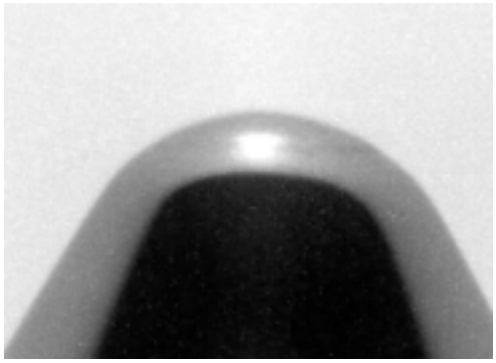


Figure 2 — Shape of the tip before use

4.4 Test Procedure

4.4.1 General

Check the geometry of the scratching tip according to 4.3.3.

Place the test apparatus (see 4.2.1) in a horizontal position to the test surface, with the tip perpendicular to the test surface.

Carry out the test in a conditioned atmosphere of (23 ± 2) °C and (50 ± 5) % R.H.

4.4.2 Scratching of test area

For each test surface, repeat the scratch test and record the results of width measurements rounded to 0,05 mm (see the protocol example in Table A.1).

The scratches shall be carried out across the grain direction, if applicable.

Start the test with the first test surface with a load of 1,0 N and continue with increments of 1,0 N, until 20,0 N, or until the scratch width is ≥ 0,30 mm, whichever is reached first.

NOTE The determination of the width of the scratches on the second and third test surface can normally begin 3,0 N below the load found for the first test surface.

The distance between two adjacent scratching traces shall be at least 5 mm, and at least 20 mm between the scratching trace and the edge of the test surface.

4.4.3 Determination of scratching resistance

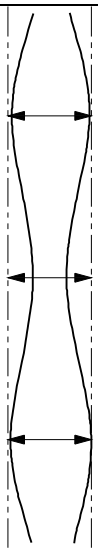
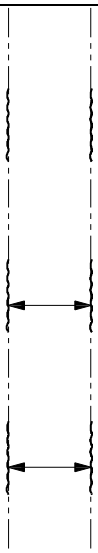
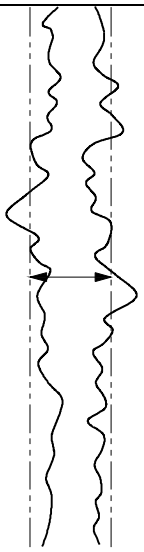
The determination of scratching resistance shall be established by one observer experienced in this type of assessment, by measuring, after 24 h, all the scratching trace widths using the optical measurement equipment (see 4.2.4).

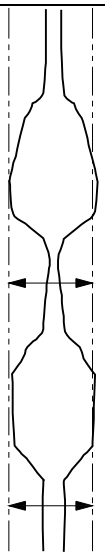
In case of a dispute, three experienced observers shall carry out the determination.

NOTE For easier assessment of the scratching trace width, the surfaces of the estimated test areas before the measurement can be marked with a soft pencil (or another suitable colouring agent) across the scratching traces.

The points of width measurement of the different types of traces (depending on the substrate and coating) are shown in Table 2.

Table 2 — Examples of scratch patterns

Scratch patterns	Width measurement
	For trace with a similar appearance as shown, the maximum value of the width shall be chosen.
	For trace with a similar appearance as shown, the average width shall be chosen.
	For trace with a similar appearance as shown, the average width shall be chosen.

	For trace with a similar appearance as shown, the maximum value of the width shall be chosen.

4.5 Assessment of results

Record the preliminary assessments of the scratching resistance.

Calculate the intermediate assessment for each test surface as the mean value of the preliminary assessments, rounded to the nearest 1,0 N.

Calculate the final value of scratching resistance as the mean value of the intermediate assessments of 3 test surfaces, rounded to the nearest 1,0 N (see Figure A.2).

5 Circular method (method B)

5.1 Principle

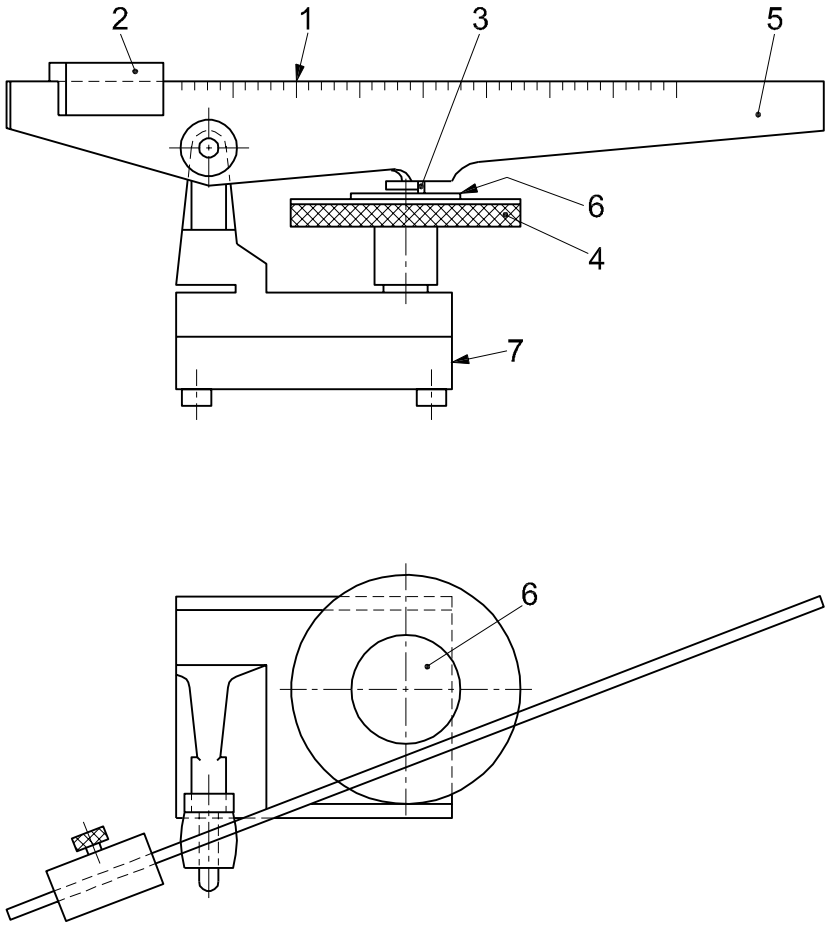
Decreasing loads are applied in specified steps to a diamond scratching tip of defined geometry.

Surface scratching resistance is expressed as an average value that defines the minimum applied load that produces a continuous surface scratch trace.

5.2 Apparatus and materials

5.2.1 Test apparatus

5.2.1.1 **Scratching apparatus** consisting of the following parts (see Figure 3):



Key

1 Scale
2 Movable weight
3 Hemispherical diamond scratching tip
4 Motor driven turntable
5 Arm
6 Clamping disc
7 Stand

Figure 3 — Example of a type of apparatus for the determination of resistance to scratching

5.2.1.2 **Stand** with a device to indicate the horizontal, e.g. a spirit level.

5.2.1.3 **Motor driven turntable** able to rotate freely around a vertical axis without looseness.

The rotational frequency shall be $(5 \pm 1)\ min^{-1}$.

5.2.1.4 **Arm** carrying the holder for the diamond, mounted on a ball bearing, with a horizontal axis.

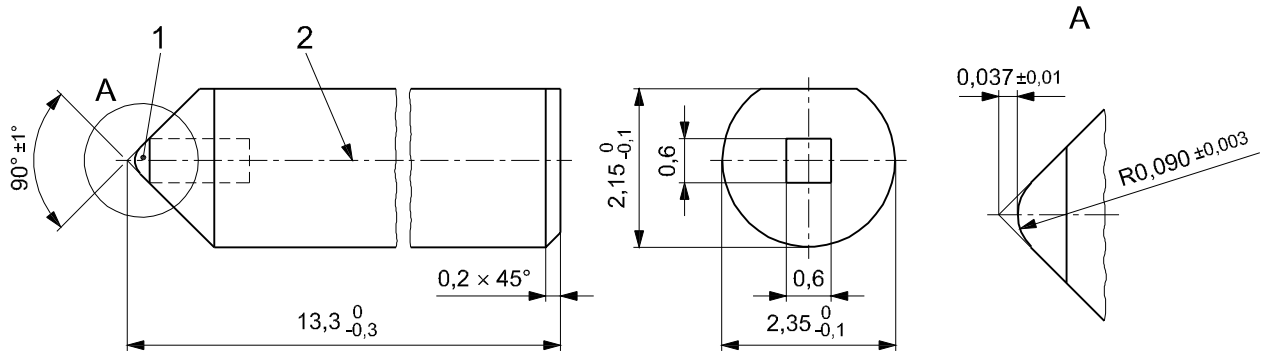
The height of this axis shall be adjustable so that the arm is exactly horizontal when the scratching tip rests on the test surface.

5.2.1.5 **Means of applying a known load in the range 0,1 – 10 N** with an accuracy of ± 0,1 N to the scratching tip.

5.2.1.6 Hemispherical diamond scratching tip with a tip radius of (0,090 ± 0,003) mm and an included angle of (90 ± 1)° (see Figure 4).

The diamond shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction.

Dimensions in millimetres



Key

1 Diamond tip
2 Optical axis of projector

Figure 4 — Diamond scratching tip

NOTE 1 The crystal axis of the diamond should be parallel to the longitudinal axis of the diamond holder. The dimensions of the diamond holder are approximate and are for information only.

NOTE 2 Diamond tips conforming with these dimensions and profile are available from: Erichsen GmbH & Co. KG, D-58675 Hemer-Sundwig/Westfalien, Germany; and through Cie Weinz, Industrie Edelstein Fabrik, Postfach 2740, D-55743 Idar-Oberstein, Germany[1)].

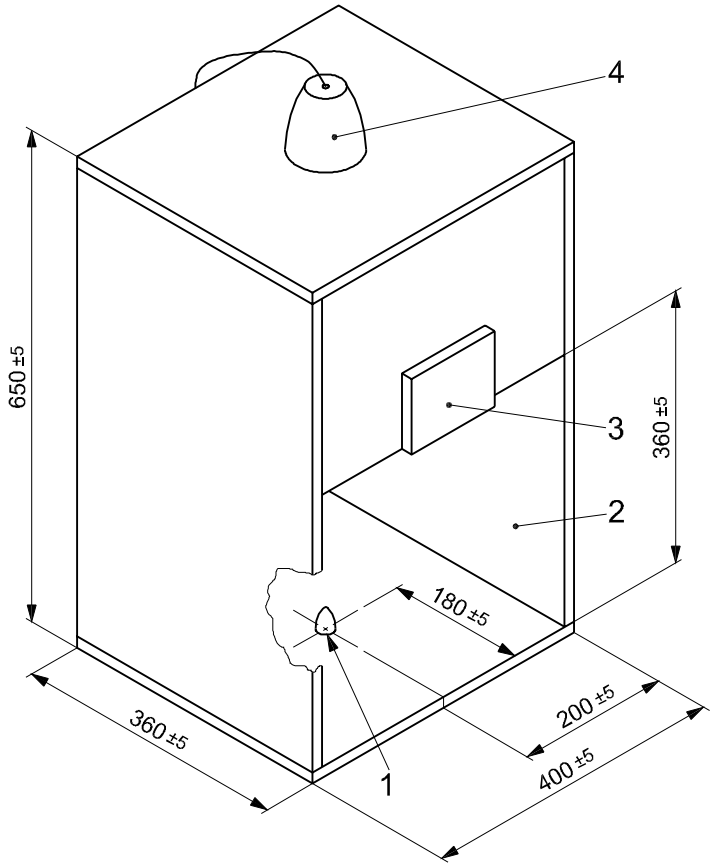
5.2.1.7 Clamping disc to keep the test surface flat.

5.2.2 Viewing cabinet

Having a matt black interior and a light source (defined below) located at the top. Its dimensions shall be such that the test surface is located in an oblique way vertically below the light source and at a distance of (600 ± 20) mm. An aperture in the front shall allow inspection of the test surface at various angles from a distance of (400 ± 10) mm. A diagram of a suitable cabinet is shown in Figure 5.

1) This is an example of a suitable product available commercially. This information is given for the convenience of users of EN 15186 and does not constitute an endorsement by CEN of this product.

Dimensions in millimetres



Key

1 Test panel position
2 Inside wall mat black
3 Forehead rest (foam-rubber pad)
4 Lamp-holder

Figure 5 — Example of suitable viewing cabinet

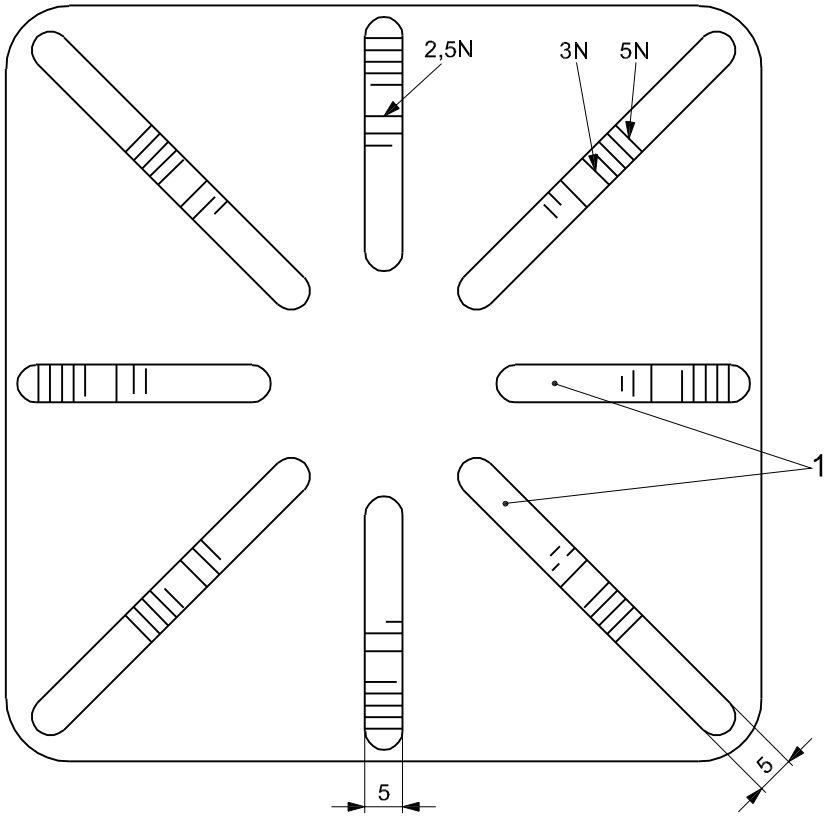
The light source consists of a 70 W halogen lamp with a luminous flow of 1 200 lm, a colour temperature of 2 800 K and a colour rendering index of 100, mounted in a white reflector having an aperture of approximately 140 mm diameter and producing an illumination of 800 lx to 1 000 lx at the test surface.

NOTE OSRAM® code 64547 A ECO.[2)].

5.2.3 Template

With dimensions 100 mm x 100 mm and maximum thickness of 2 mm, made from an opaque material such as plastic, sheet or paperboard and with a mat surface (see Figure 6).

2) This is an example of a suitable product available commercially. This information is given for the convenience of users of EN 15186 and does not constitute an endorsement by CEN of this product.



Key

1 Slots for visual assessment

Figure 6 — Template

5.2.4 Conditioning chamber

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

5.2.5 Cleaning cloth

White, soft, absorbent cloth.

5.3 Preparation and conditioning

5.3.1 Conditioning

Conditioning of the test surface shall begin at least one week before testing and shall be carried out in air with a temperature of (23 ± 2) °C and relative humidity of (50 ± 5) %.

The conditioning time shall be stated in the test report.

NOTE Some finishing systems may not have achieved full cure after one week of conditioning.

5.3.2 Test surface

Four test surfaces shall be prepared.

Each test surface shall be a square of (100 ± 5) mm side length. If the thickness of the original test panel is reduced, the bottom side shall be parallel to the test surface.

Check the flatness of the test surface using a spirit level just before the test, and just before the result if the thickness sample has been reduced.

The test surface shall be carefully wiped with a cleaning cloth before the test (see 5.2.5). It is important that, once cleaned, the surface is not touched by hand in the test area.

5.4 Test procedure

Ensure that the stand of the test apparatus and the test surface are horizontal. Adjust the height of the arm so that it is horizontal when the diamond scratching tip rests on the test surface.

Carry out the test in a conditioned atmosphere of (23 ± 2) °C and relative humidity of (50 ± 5) %.

a) Preliminary test for the determination of the relevant load range. For each load, one circle shall be carried out with a complete revolution. The distance between the circles shall be 1 mm to 2 mm. Start the test at a load of 5 N:

   1) If there is a continuous mark in the circle, the next load shall be reduced by increments of 0,5 N until the load at which a continuous and visible scratch is not recorded.

   2) If there is not a continuous mark in the circle, the next load shall be increased by increments of 1 N until the load at which a continuous and visible scratch is first recorded.

b) Main test with three test surfaces. Start the test at a load 1 N above the minimum load which has led to a continuous and visible scratch trace. The load shall be reduced until 2 N by increments of 0,5 N, below 2 N until 1 N by increments of 0,20 N, and below 1 N by increments of 0,1 N, until a continuous and visible scratch is not recorded. The distance between the circles shall be 1 mm to 2 mm.

5.5 Assessment of results

After the main test, the three test surfaces shall be stored in the atmosphere of (23 ± 2) °C and (50 ± 5) % R H for 24 h.

The test surface shall be carefully wiped with a cleaning cloth (see 5.2.5).

Place the test surface with the template (see Figure 6) against the centre support in the viewing cabinet (see Figure 5) and assess the test surface from a viewing distance of approximately 400 mm for scratch marks. These marks shall be visible in at least 6 slots of the template. The test surface can be moved for assessment under all incidence angles of the light. In cases of uncertainty the template can be moved on the sample.

The scratching resistance of the test surface shall be expressed as the minimum load which has led to a full visible marking in at least 6 slots of the template (see also the example in Figure 7).

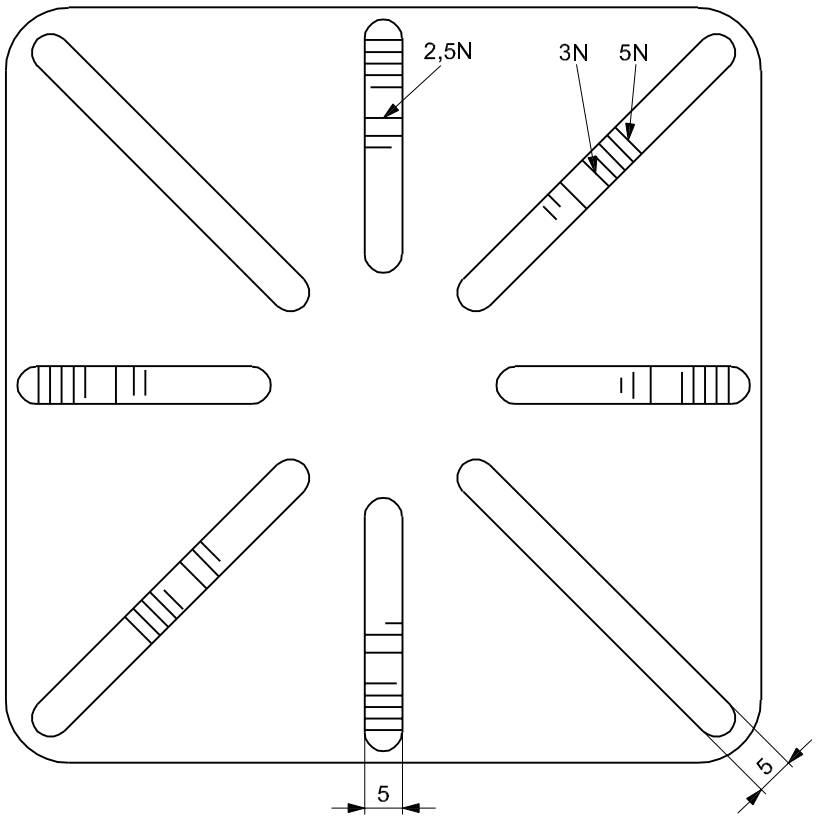


Figure 7 — Template

The result shall be the mean value of the three test surfaces rounded to the nearest 0,1 N.

The result in the example of Figure 6 is 2,5 N.

5.6 Expression of results

The rounded average of scratch resistance according to method B shall be expressed.

6 Test report

The test report shall include at least the following information:

a) reference to this European Standard;

b) panel tested, including relevant data (wherever possible the substrate, the finishing system and the finishing date shall be identified);

c) test method used:

   1) Method A;

   2) Method B;

d) test results:

   1) Method A: intermediate assessment and final assessment according to 4.5; but if the maximum load (20,0 N) is achieved without getting the specified trace width, the width for 20,0 N shall be reported;

2) Method B: average value;

3) Method B: information regarding type of damage, indicating if it is a change of gloss, a physical deformation of material or any other type of damage;

e) Method B: indicate if the thickness of the sample has been reduced according to 5.3.2;

f) conditioning time;

g) any deviations from this European Standard;

h) name and address of the test facility;

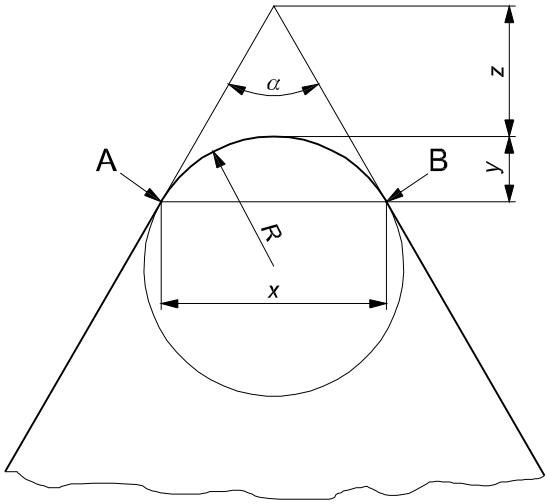
i) date of test.

Annex A
(informative)

Checking of the tip, calculation of final results and example of protocol to record the results

A.1 Checking of the tip

Figure A.1 provides information to help the tip's verification.



Key

A, B = contact points of the cone and the ball

R = (0,30 ± 0,01) mm

$$y = R \cdot \left[1 - \sin\left(\frac{\alpha}{2} \right) \right]$$ (maximal depth of the trace produced by round part of the tip)

$$x = 2 \cdot R \cdot \cos\left(\frac{\alpha}{2} \right)$$ (maximal width of the trace produced by round part of the tip)

$$z = R \cdot \left[\sin^{-1}\left(\frac{\alpha}{2} \right) - 1 \right]$$

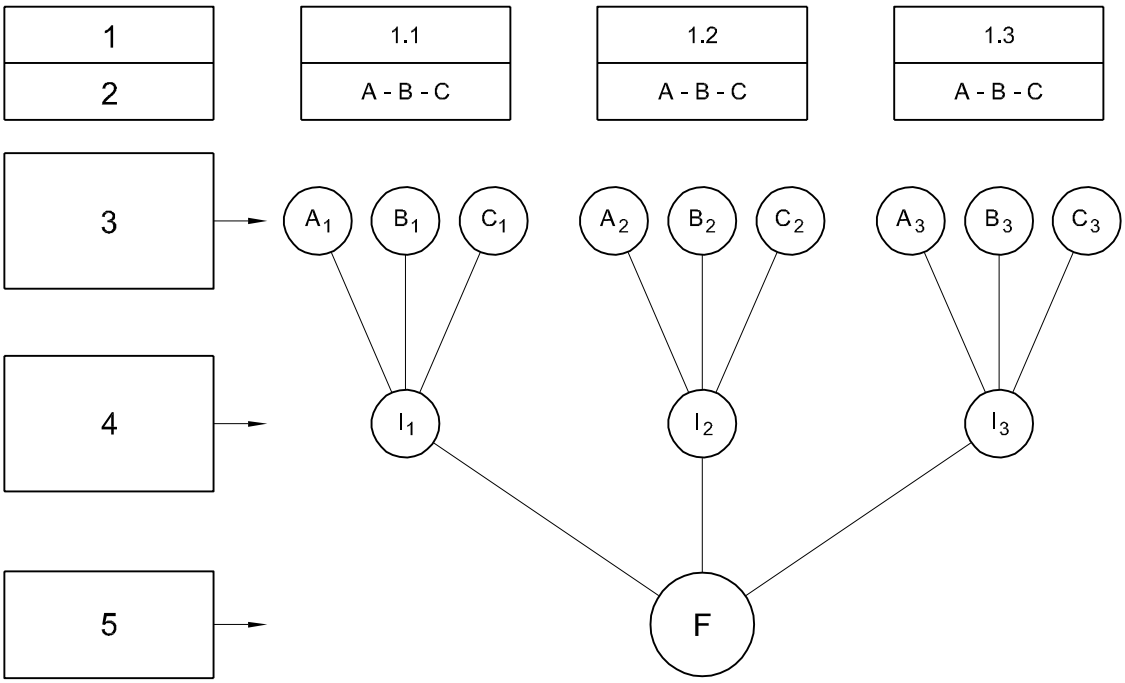
Figure A.1 — Nominal geometry of the tips used in the scratching test method evaluation

A.2 Calculation of Final Result

Figure A.2 provides information to help the calculation of the results, when 3 observers make the measurement.

Calculate the final results (F) according to the example (1.1, 1.2, 1.3) as shown in Figure A.2.

- Record the PRE assessment results as shown in Table A.1;
- Calculate the INTER- and FINAL assessments, rounded to the nearest 1,0 N.



Key

1 Test surfaces
2 Observers
3 Preliminary (PRE) load assessments:
  Ai PRE given by observe A for test surface 1.i
  Bi PRE given by observe B for test surface 1.i
  Ci PRE given by observe C for test surface 1.i
4 Intermediate (INTER) assessments:
  Ii INTER for test surface i
5 Final result

Figure A.2 — The way of expressing the final results of scratching resistance [N] for one type of material

A.3 Example of Protocol to record the results

Table A.1 — Protocol of scratching trace width measurement

Name of the tested material... Set No. 1... of test surface: 1.1, 1.2, 1.3

Tip's Load [N]	Test surface ...1.1			Test surface ...1.2			Test surface ...1.3		
	Observer			Observer			Observer		
	A	B	C	A	B	C	A	B	C
	Scratching trace width [mm]								
1,0									
2,0									
3,0									
4,0									
5,0									
6,0									
7,0									
…									
…									
20,0									
Load assessment, in N, on the base of trace's width (W)[a]									
Preliminary (PRE)	A ...1.1	B....1.1	C ...1.1	A ...1.2	B ...1.2	C ...1.2	A ...1.3	B ...1.3	C ...1.3
Surface scratching resistance assessment									
Intermediate value (INTER) [N]	I_1			I_2			I_3		
Final result [N]	F								

[a] 0,30 mm ≤ W if R = (0,30 ± 0,01) mm

Annex B
(informative)

Significant technical changes in revised edition of this standard

Significant technical differences between this document and CEN/TS 15186:2005 are as follows:

a) Two test methods are described:

   1) Linear Method A: suitable for all types of surface coatings and coverings except for melamine faced boards (according to EN 14322) and HPL (according to EN 438-1); it simulates measurable penetrating and/or deforming scratches;

   2) Circular Method B: suitable for all types of surface. It simulates first visible scratches which may only be a change of gloss;

b) former Linear Method B has been deleted as the same effects can be achieved with linear Method A;

c) suitable illumination for measurement of trace's width with ± 0,05 mm accuracy;

d) storing of test unit/test panel is deleted;

e) inspection of the scratching tip with the use of the optical measurement at least every 1 000 tests series;

f) number of observers.

Bibliography

[1] EN 438-1, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (Usually called Laminates) — Part 1: Introduction and general information*

[2] EN 14322, *Wood-based panels — Melamine faced boards for interior uses — Definition, requirements and classification*

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