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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

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 draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 207.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European foreword

This document (prEN 15186:2022) has been prepared by Technical Committee CEN/TC 207 “Furniture”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15186:2012.

Compared with EN 15186:2012, the following modifications have been made:

- a) subclauses of Clause 4, Linear method (method A), revised;
- b) subclauses of Clause 5, Circular method (method B), revised;
- c) Annex B deleted; the significant changes in the revised edition are now given in the European foreword;
- d) Bibliography updated.

1 Scope

This document 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 traces (e.g. scratches, marks) that can also 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 are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 1518-1, *Paints 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

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 scratch on the tested surface which is produced under the specified load of the scratching tip; the shapes of the traces edges can be different depending on the substrate and coating type as shown in Table 2

3.5.2**method B**

first visible traces on the tested surface (e.g. scratches, marks) which may also 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 trace of the width (W) of $\geq 0,30$ mm

3.6.2**method B**

minimum load, in N, applied to the scratching tip, which produces a continuous visible trace in at least six of eight slots of the template

3.7**preliminary assessments of the scratching resistance (method A)**

minimum load causing the specified width of scratch on test surface

3.8**intermediate assessment of scratching resistance (method A)**

mean value of preliminary assessments of test surface

3.9**final result 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 (Newton) 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 to 20,0
Increment of load (N)	$1,0 \pm 0,1$
Speed of the tip's/test surface movement (mm/s)	20 ± 10
Travel length of the tip or test surface (mm)	Minimum 20

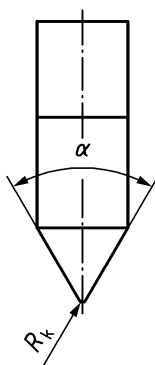
4.2.3 Scratching tip

Scratching tip made of diamond, with a radius (R) of $(0,30 \pm 0,01)$ 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.

**Key**

α tip's angle $\alpha = (60,0 \pm 1,0)^\circ$

R_k radius of tip's rounded part $R_k = (0,30 \pm 0,01)$ 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 $\pm 0,05$ mm accuracy.

4.2.5 Suitable illumination

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

4.2.6 Conditioning chamber

A chamber with a standard atmosphere of $(23 \pm 2)^\circ\text{C}$ and relative humidity of $(50 \pm 5)\%$.

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 $(23 \pm 2)^\circ\text{C}$ and relative humidity of $(50 \pm 5)\%$.

The conditioning time shall be stated in the test report.

NOTE Some finishing systems do not fully cure after one week of conditioning.

4.3.2 Test surface

Three test surfaces shall be prepared.

The test surface shall be taken 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 substantially flat. If the original thickness of the test panel is reduced, the bottom side shall be parallel to the test surface.

4.3.3 Checking of the tip's geometry

The tip's geometry shall be inspected (see Figure 2). If any flatness, holes or other kind of damages are found, the scratching tip shall be rejected and replaced by a new one.



Figure 2 — Correct shape of the scratching tip

4.4 Test Procedure

4.4.1 General

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 $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \% \text{ R.H.}$

4.4.2 Scratching of test area

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

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.

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 $\geq 0,30 \text{ mm}$, 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.

For each test surface, repeat the series of scratching test and record the results of width measurements rounded to 0,05 mm (see the protocol example in Table A.1). The measurement shall be taken in the middle part of scratching trace.

For the customer's request, determine the minimum tip's load (using optical equipment see 4.2.4) producing clearly visible cracking of the tested coating (crack within the scratching trace or crack propagating in the coating outside the scratching trace). Water solution of methylene blue or another colouring agent can be used.

4.4.3 Determination of scratching resistance

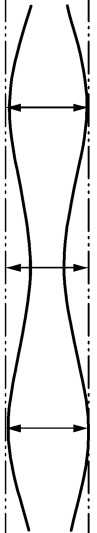
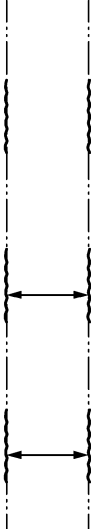
The determination of scratching resistance shall be established by one observer experienced in this type of assessment, by measuring, after 24 h, all the scratching trace widths using the optical measurement equipment (see 4.2.4).

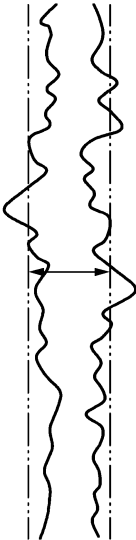
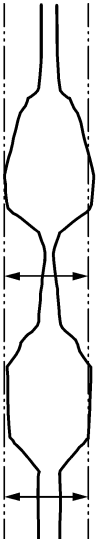
In case of a dispute, three experienced observers shall carry out the determination.

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 scratching traces (depending on the substrate and coating) are shown in Table 2.

Table 2 — Examples of scratching traces edges

Scratching traces edges	Width measurement
	For scratching trace with a similar appearance as shown, the maximum value of the width shall be chosen.
	For scratching trace with a similar appearance as shown, the average width shall be chosen.

Scratching traces edges	Width measurement
	For scratching trace with a similar appearance as shown, the average width shall be chosen.
	For scratching 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.

In case of one observer calculate the final result of scratching resistance as the mean value of the preliminary assessments of 3 test surfaces, rounded to the nearest 1,0 N (see Figure A.2). The intermediate assessment shall be omitted.

In case of three observers 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 result 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

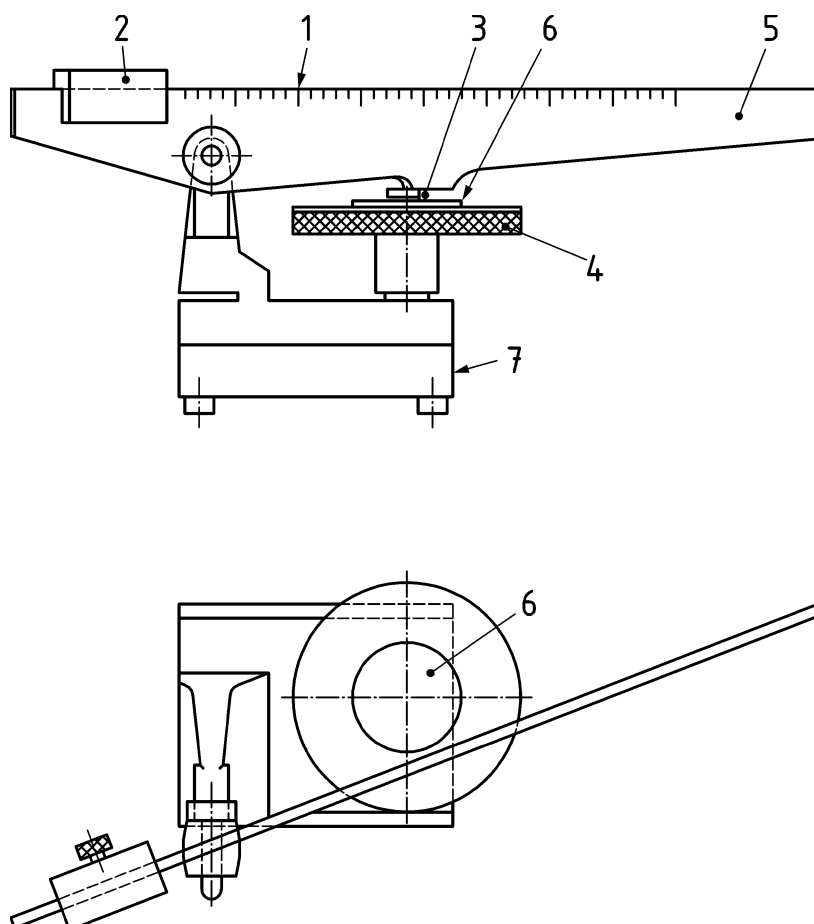
Decreasing loads are applied in specified steps to a diamond scratching tip of defined geometry.

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

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 $(5 \pm 1) \text{ min}^{-1}$.

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

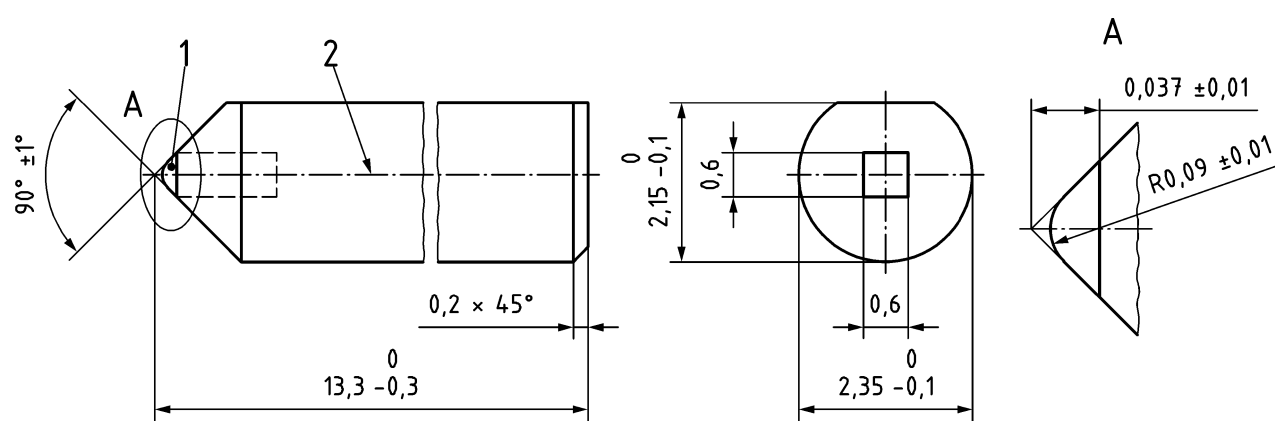
The height of this axis shall be adjustable so that the arm is exactly horizontal when the scratching tip rests on the test surface.

5.2.1.5 Means of applying a known load in the range 0,1 N to 10 N with an accuracy of $\pm 0,1$ N to the scratching tip.

5.2.1.6 Hemispherical diamond scratching tip with a tip radius of $(0,090 \pm 0,003)$ mm and an included angle of $(90 \pm 1)^\circ$ (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
- A detail

Figure 4 — Diamond scratching tip

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

5.2.1.7 Checking of the tip's geometry

The tip's geometry shall be inspected (see Figure 4). If any flatness, holes or other kind of damages are found, the scratching tip shall be rejected and replaced by a new one.

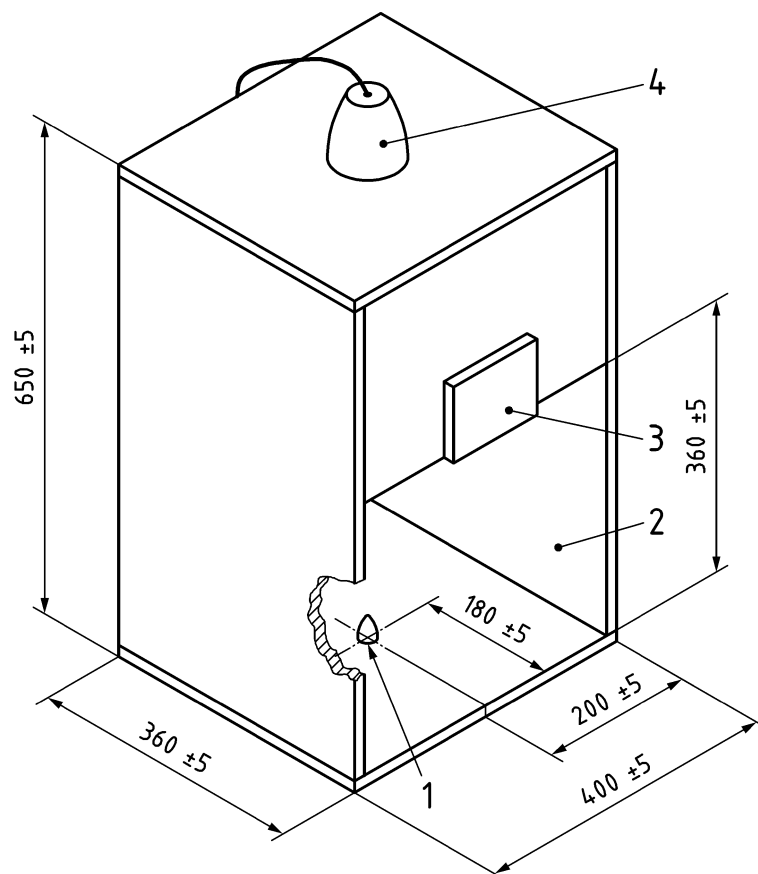
5.2.1.8 Clamping disc to keep the test surface flat.

¹ These are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by CEN of these products.

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.

Dimensions in millimetres



Key

- 1 test panel position
- 2 inside wall mat black
- 3 forehead rest (foam-rubber pad)
- 4 lamp-holder

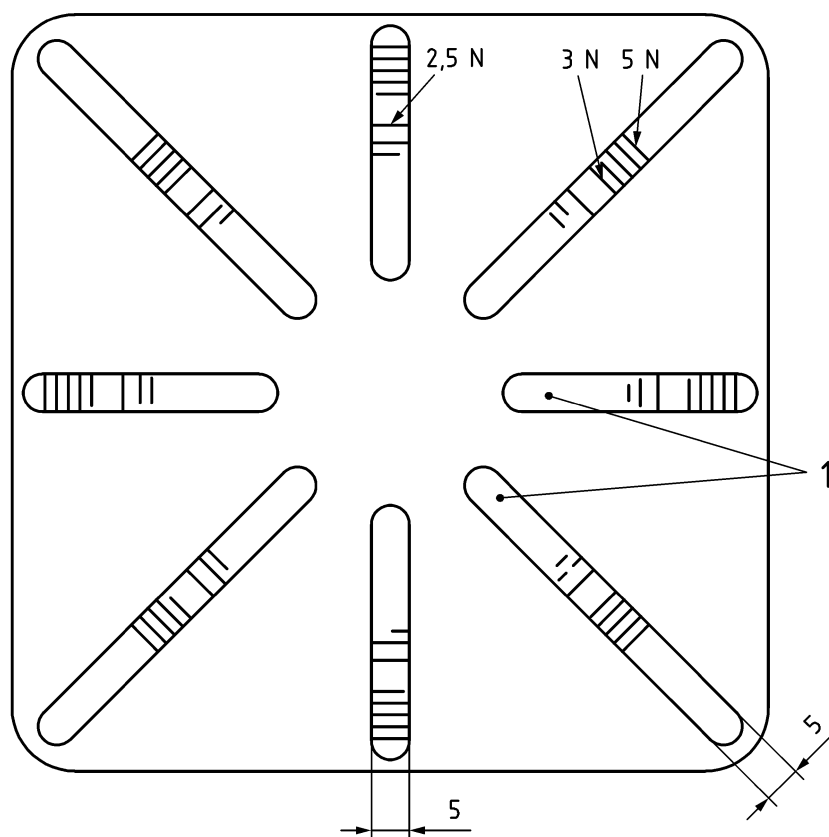
Figure 5 — Example of suitable viewing cabinet

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: OSRAM® code 64547 A ECO or equivalent ².

² OSRAM® code 64547 A ECO is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by CEN of this product.

5.2.3 Template

With dimensions 100 mm × 100 mm and maximum thickness of 1,5 mm, made from an opaque material such as plastic, metal or paperboard and with a mat surface (see Figure 6).



Key

- 1 slots for visual assessment

Figure 6 — Template

5.2.4 Conditioning chamber

A chamber with a standard atmosphere of $(23 \pm 2) ^\circ\text{C}$ and relative humidity of $(50 \pm 5) \%$.

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 $(23 \pm 2) ^\circ\text{C}$ and relative humidity of $(50 \pm 5) \%$.

The conditioning time shall be stated in the test report.

NOTE Some finishing systems do not fully 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. The test surface shall be substantially flat. If the original thickness of the test panel is reduced, the bottom side shall be parallel to the test surface.

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 trace 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 trace 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 trace 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) % RH 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 trace. 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 scratch trace in at least 6 slots of the template (see also the example in Figure 7).

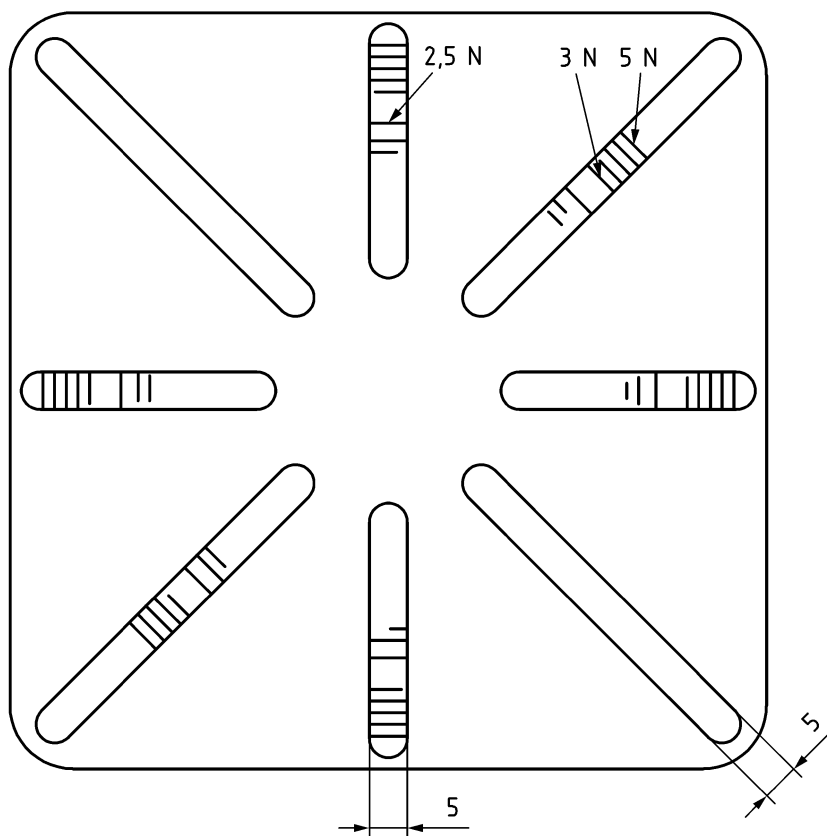


Figure 7 — Template

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 document;
- 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: preliminary (in case of one observer) or intermediate assessments (in case of three observers) and final result 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;
- 2) Method B: Results for individual test surfaces and the 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 document;

h) name and address of the test facility;

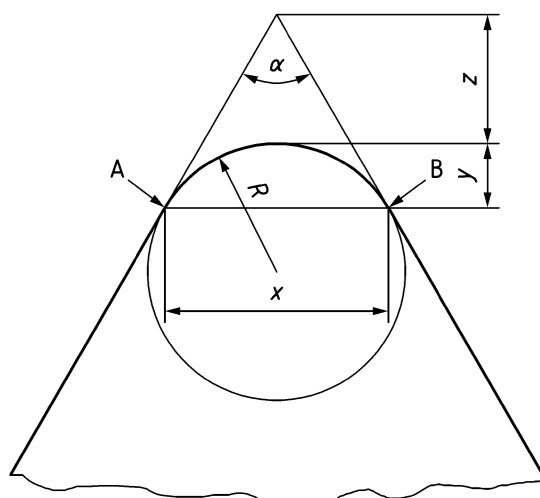
i) date of test.

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 $(0,30 \pm 0,01)$ mm

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

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

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

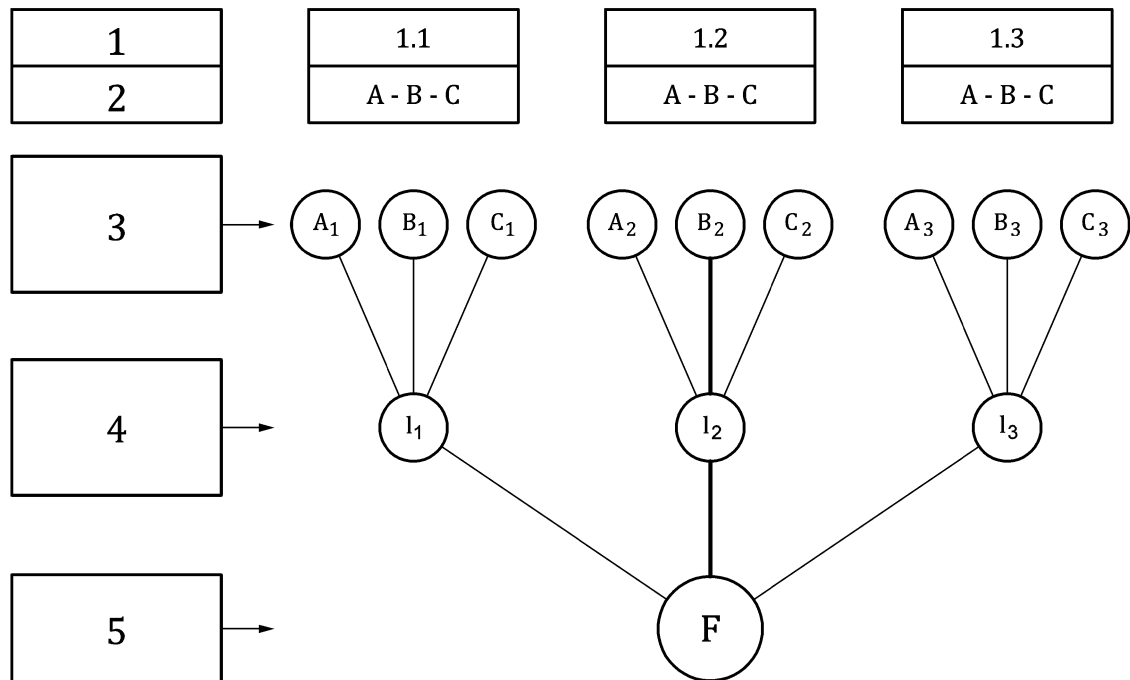
Figure A.1 — Nominal geometry of the tips used in the scratching test method evaluation

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 result (F) according to the example (1.1, 1.2, 1.3) as shown in Figure A.2:

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



((Symbol)) In case of one observer

((Symbol)) In case of three observers

Key

- 1 test surfaces
- 2 observers
- 3 preliminary (PRE) load assessments:
 - A_i PRE given by observer A for test surface 1.i
 - B_i PRE given by observer B for test surface 1.i
 - C_i PRE given by observer C for test surface 1.i
- 4 intermediate (INTER) assessments:
 - I_i INTER for test surface i
- 5 final result

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

A.3 Example of Protocol to record the results

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

Table A.1 — Protocol of scratching trace width measurement

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 assessment (PRE) [N]	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 assessment (INTER) [N]	I_1			I_2			I_3		
Final result [N]	F								
((Symbol)) In case of one observer ((Symbol)) In case of three observers									
^a $0,30 \text{ mm} \leq W$ if $R = (0,30 \pm 0,01) \text{ mm}$.									

Bibliography

- [1] EN 438-2, *High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 2: Determination of properties*
- [2] EN 14323, *Wood-based panels - Melamine faced boards for interior uses - Test methods*