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Furniture — Tests for surface finishes —

Part 5: Assessment of resistance to abrasion

Ameublement — Essais des finitions de surface —

Partie 5: Évaluation de la résistance à l'abrasion

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 136, *Furniture*.

A list of all parts in the ISO 4211 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document can be used in conjunction with other relevant documents containing methods for the assessment of the abrasion resistance of surfaces.

Furniture — Tests for surface finishes —

Part 5: Assessment of resistance to abrasion

1 Scope

This document specifies a method for the assessment of the abrasion resistance of surfaces with foils, laminates, melamine faced boards, pigmented and transparent lacquers.

The test is intended to be carried out on an unused part of the finished furniture, but can 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.

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.

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

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

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
test surface
part of the test panel

3.2
test panel
panel including the test surface

Note 1 to entry: It 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 wheels covered by the abrasion paper strips

3.4
colour rendering index
R_a
unitless number that specifies how well the colour of an object appears under illumination by a light source compared to a reference light source

4 Principle

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

5 Apparatus and materials

5.1 Cleaning cloth. White soft absorbent cloth.

5.2 Calibration plates, which shall be Taber S-34[1)] or equivalent, having a thickness of (0,8 ± 0,1) mm and a Brinell hardness of (48 ± 2) when tested in accordance with ISO 6506-1, except that the ball diameter shall be 5 mm and the load 360 N.

5.3 Abrasion paper strips, which shall be Taber S-42[2)] or equivalent, of width (12,7 ± 0,1) mm and length about 160 mm, according to the following specifications:

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

b) open coated 180 grit powdered aluminium oxide (Al_2O_3) having a particle size such that it will pass through a sieve of aperture 100 µm and remain on a sieve having an aperture of 63 µm;

c) adhesive backing.

5.4 Test apparatus, which shall be as specified in ISO 9352 with following deviations[3)]:

a) the hardness of wheels' rubber layer shall be between 60 Shore A and 70 Shore A, when measured in the middle of the contact surface; make 4 measurements and calculate the average value;

The laboratories should measure the hardness at least once every 12 months. Checking of rubber wheels geometry shall be performed. If any deformation is observed the rubber wheel should be rejected.

b) weight of loading: every wheel shall apply a force (5,4 ± 0,2) N on the sample;

c) vacuum system: the suction nozzle should be as close to the surface as possible without rubbing it. The vacuum system shall remove practically all the dust;

d) the distance between the middle axis of the sample holder and the wheels should be calibrated according to Annex A;

e) the table rotary speed shall be (60 ± 2) r/min.

5.5 Balance, with an accuracy of 1 mg.

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

1) Taber S-34 is the trade name of a product supplied by Taber Acquisition Corp. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product named. Equivalent products may be used if they can be shown to lead to the same results.

2) Taber S-42 is the trade name of a product supplied by Taber Acquisition Corp. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product named. Equivalent products may be used if they can be shown to lead to the same results.

3) A suitable machine is available from Taber Acquisition Corp., Taber industries. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this machine.

5.7 Diffuse light source, providing evenly diffused light giving an illumination on the test surface of (1 200 ± 400) lx. This may either be diffused daylight or be diffused artificial daylight.

The daylight should be unaffected by surrounding trees, buildings, etc. When artificial light is used, it is recommended that it should have a correlated colour temperature of (6 500 + 50) K and a colour rendering index (R_a) greater than 92, by using a colour matching booth in accordance with ISO 3668.

6 Preparation and conditioning

6.1 Conditioning

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

NOTE The final curing of some coatings, such as waterborne coatings, can require a longer conditioning time.

The conditioning time shall be stated in the test report.

Condition the abrasion paper strips at least for one week in the conditioning atmosphere of (23 ± 2) °C and (50 ± 5) % RH, before testing, see 5.6.

6.2 Test surface

Three test surfaces shall be prepared.

The test surface shall be taken at least 5 mm from the edge of the test panel.

Each test surface shall be a piece of test panel, shaped to fit the type of clamping device used. It shall usually be a square of 100 mm × 100 mm, and including an appropriated hole drilled in the centre to place the test surface in the axis of the apparatus.

The test surface shall be carefully wiped with a cleaning cloth (5.1) before the test.

The test surface shall be substantially flat, and free from defect such as scratch, colour fading and surface folding.

6.3 Preparation of test surfaces and abrasive paper

Using a suitable marker pen, mark the surface of each test surface with two lines at right angles, diagonals, so that the surface area is divided into four quadrants, according to Figure 1.

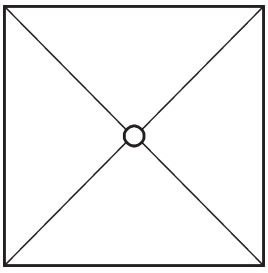


Figure 1 — Test surface area divided into four quadrants

7 Test procedure

7.1 Preparation of abrasive wheels

Bond a strip of conditioned unused abrasive paper to each of the rubber covered wheels. Ensure that the cylindrical surface is completely covered, but without any overlapping of the abrasive paper.

7.2 Calibration of abrasive paper

Carry out this calibration three times for each box.

Prepare two abrasive wheels, in the correct hardness range (5.4), with conditioned unused strips of abrasive paper.

Clamp a zinc plate in the specimen holder, start the vacuum device, set the revolution-counter to zero, lower the wheels, ensuring that the arms are horizontal and the load on the zinc plate is (5,4 ± 0,2) N, and abrade the zinc plate for 500 revolutions. Wipe the zinc plate clean and weigh to the nearest 1 mg. Replace the abrasive paper on the wheels with preconditioned unused strips from the same batch, clamp the same zinc plate in the specimen holder, lower the abrasive wheels and operate the suction device. Abrade the zinc plate for an additional 500 revolutions, then wipe it clean and reweigh it to the nearest 1 mg.

Any box containing abrasive paper which causes a loss in mass of the zinc plate which is outside (110 ± 20) mg, for any pair of calibrate strips, shall not be used for testing.

Calculate a correction factor by use of Formula (1):

$$CF = \frac{(avg)}{(110)} \tag{1}$$

where

CF is the correction factor;

avg is the mean value if three calibrations, in mg;

110 is the limit for the mass loss value of the zinc plate, in mg.

Report this factor in the test report.

7.3 Abrasion of test area

Perform the test immediately after removal of the test surface and calibrated abrasive paper from the conditioning atmosphere.

Prepare two wheels, in the correct hardness range, with preconditioned unused abrasive paper from the same box previously approved by calibration. Fit the wheels to the machine and set the revolution counter to zero.

Clamp the test surface in the holder, ensuring that it is placed horizontally. Lower the abrasive wheels on to the specimen, ensuring that the arms are horizontal and the load on the samples is (5,4 ± 0,2) N. Start the vacuum device for removing practically all the dust, and begin abrading the test area.

NOTE If the arms are not horizontal, then there are two possibilities: to modify appropriately the apparatus or to reduce appropriately the thickness of the test surface before the conditioning, see Clause 6.

Before each assessment, in order to correctly assess the Initial Wear Point (IP), see 7.4, ensure the surface is free of dust. If needed, wipe with the cleaning cloth.

At the beginning of the test, the visual assessment shall be carried out, depending on the expected IP (see 7.4), as follows:

— under 200 revolutions, every 10 cycles;

— over 200 revolutions, every 25 cycles;

— over 500 revolutions, every 50 cycles;

— when close to IP, the assessment shall be carried out every 10 cycles.

Replace the abrasive paper after every 200 revolutions.

Continue the test in this way until the IP is reached. Record the number of revolutions.

7.4 Determination of initial wear point (IP)

7.4.1 General

The determination of IP shall be established by one observer experienced in this type of assessment. In case of a dispute, three observers shall carry out the visual assessment.

The determination of IP shall be carried out under the light described above, see 5.7.

To assess the IP, see 7.4.2 to 7.4.4.

7.4.2 Foil, uncoated and coated laminate and melamine faced boards

The first clearly recognisable wear-through of the print, pattern or plain colour appears and the sublayer becomes exposed in four quadrants.

Compare the examined test surface with the examples for IP points, see Table B.1.

The sub-layer for printed patterns is the background on which the pattern is printed; for plain colours it is the first sub-layer of different colour.

7.4.3 Pigmented lacquers

The first clearly recognisable wear-through of the substrate, or layer with other colour, appears in all the four quadrants.

7.4.4 Transparent lacquers on wood or lignocellulosic-substrates

The first clearly recognisable wear-through of the lacquers becomes exposed in four quadrants, see examples in Table B.2.

The following procedure shall be used:

— draw a circle on the abrasion trace by using a marker pen giving a contrast with the sample colour (not waterproof ink);

— if the ink penetrates into the wood grain along the grain direction in any part of abrasion trace, the IP point is nearly reached;

— the IP shall be assessed by using any agent suitable for marking when the wood or wood veneer substrate is exposed, such as a water solution of a volume fraction of 0,1% methyl blue. The liquid shall be spread over the surface and removed with a dry paper in order to colour the abraded surface and distinguish it from the not completely abraded surface.

Compare the examined test surface with the examples for IP points and deviations described in Annex B.

8 Assessment of results

The abrasion resistance of the test surface shall be expressed as the number of revolutions at which IP is reached.

The test result shall be the mean value of the 3 test surfaces rounded to the nearest 10 cycles.

9 Test report

The test report shall include at least the following information:

a) a reference to this document, i.e. ISO 4211-5:2021;

b) the name, type and if the test surface has been cut in order to get the horizontality of the arms;

c) conditioning time;

d) the mean abrasion resistance for the sample under test, in revolutions;

e) the correction factor;

f) any deviations from this document;

g) the name and address of the test facility;

h) the date of the test.

Annex A
(informative)

Calibration and maintenance of Taber abrasion equipment

A.1 General

Calibration and maintenance of the equipment shall be carried out, in order to ensure correct and comparable test results.

The procedures contained in this annex have been developed for the Taber equipment. The principles may, however, be applied to similar equipment.

Three parts have been identified as potential sources of error. Each is addressed separately in this annex; however, each is dependent upon the other. The first source of error is bearing wear, the second is shaft wear and the third is alignment of the arms.

Improper alignment of the abrasive wheels can lead to each wheel abrading a different path from the wheel across the sample as well as the wheels on other machines. The path surface area can differ by as much as 20 % and the area abraded by both wheels on a sample could be less than 50 % of the total abraded area for that sample.

The procedures outlined below do not necessarily address all potential sources of variance.

A.2 Apparatus

A.2.1 Calibration block, of preferably steel measuring (77,90 ± 0,02) mm × (77,90 ± 0,02) mm × (25,00 ± 0,02) mm with a hole drilled and threaded with UNF ¼ inch in the centre (38,95 ± 0,02) mm of the (77,90 ± 0,02) mm × (77,90 ± 0,02) mm face such that the block can be threaded onto the holder disc of the abrader. All edges shall be made with a radius of 1 mm.

A.2.2 Feeler gauges, gauges of various thickness.

A.2.3 Shim washers, washers of various thickness ranging from 0,05 mm and up. The inside diameter shall be 8 mm and the outside diameter shall be 13 mm.

A.3 Procedure

A.3.1 Bearing wear

Examine each arm of the abrader visually and by hand for any bearing wear. Specific areas to examine are the pivot areas of the abrader arm and the shaft on which the wheel revolve. This includes, but is not limited to, any sideways, twisting, or other motion outside the specific rotation of the arm or the shaft. Any movement noted, other than the pivoting of the arm or shaft, requires that further examination be made to determine the cause of the excess movement.

Specific repairs shall be completed before attempting subsequent portions of the procedure.

A.3.2 Shaft wear

In certain instances, the shaft for the abrader wheel may slide end to end. This movement shall be eliminated by placing shim washers of appropriate thickness between the bearing face and the shaft keeper ring on the end of the shaft opposite the abrader wheel mounting. This can be measured using the feeler gauges to measure the gap prior to disassembly and the appropriate thickness of shim washers placed on the shaft.

A.3.3 Alignment

Remove the rubber wheels from their respective shaft mounting and set aside. Remove the rubber mat on the sample table (if used).

Attach the calibration block to the table by the threaded mount (see Figure A.1).

Gently lower the arms with the exposed shaft ends onto the block. Rotate the block to square the block with the shaft face of each arm. The face of each shaft shall squarely meet the adjacent face of the calibration block without force and without any gap. If the arm does not seat squarely onto the block or leaves a gap between the face and block, then that arm shall be aligned.

If the alignment does not allow the wheel shaft to rest against the shaft hub and face, the arm shall be moved away from the block by loosening the two set screws on the top of the machine toward the back that holds the shaft on which the arm pivots and moving the entire arm assembly away from the block enough so that the shaft face and hub rest squarely against the calibration block. Retighten the set screws and recheck.

If the alignment leaves a gap between the shaft hub/face and the calibration block, the arm shall be moved toward the block by loosening the two set screws on the top of the machine toward the back that holds the shaft on which the arm pivots and moving the entire arm assembly towards the block enough so that the shaft face and hub rest squarely against the calibration block. Retighten the set screws and recheck.

A.3.4 Alignment — Dual head abrader

In the case of a dual head abrader, the alignment is more complex due to the common mount utilized by the shaft holding the interior arms for each side of the abrader. In the case of a dual head abrader, the following order of alignment adjustments is made.

Remove rubber wheels and table mats from both heads and attach the calibration block to the left head.

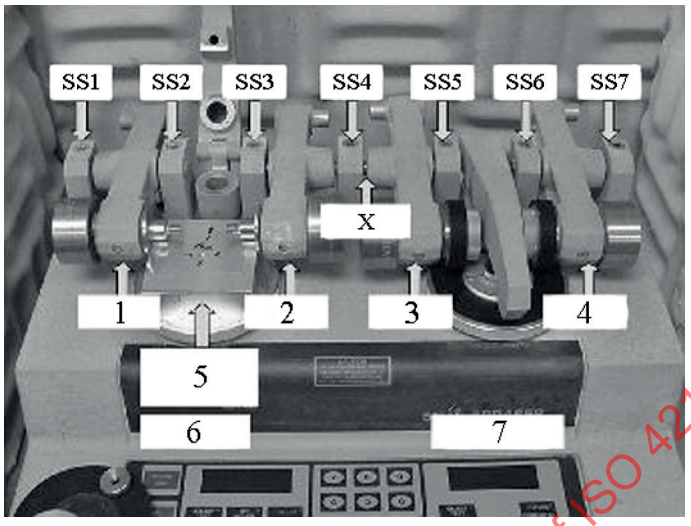
Check Arm 1 for correct alignment (see Figure A.2). If adjustment is required, loosen SS1 and SS2 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws and recheck.

Check Arm 2 for correct alignment. If adjustment is required, loosen SS3, SS4 and SS5 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws SS3 and SS4 and recheck.

Remove the calibration block from the left head and attach it to the right head.

Check Arm 3 for correct alignment. SS5 is loose. Seat the shaft beneath SS5 fully to the left and check the Arm 3 alignment. If the shaft face/hub is too tight to the calibration block, shims shall be removed from Arm 3 assembly at the point the shaft seats into the arm at Point X. Part the assembly by moving the Arm 3 and shaft under SS5 fully to the right and remove the shims as needed to squarely place the shaft face/hub against the calibration block. Retighten the set screw SS5 and recheck. If the shaft face/hub is loose against the calibration block, shims shall be added to the arm 3 at the point the shafts seats into the arm at point X. Measure the gap between the block and the shaft face/hub with the feeler gauge to determine the thickness of shim washers to add. Part the assembly by moving the Arm 3 and shaft under SS5 fully to the right and add the shims as needed to squarely place the shaft face/hub against the calibration block. Retighten the set screw SS5 and recheck.

Check Arm 4 for correct alignment. If adjustment is required, loosen SS6 and SS7 and move the arm assembly in or out to squarely align the shaft face/hub to the calibration block. Retighten the set screws and recheck for correct alignment.



Key

1 arm 1
2 arm 2
3 arm 3
4 arm 4
5 calibration block
6 left head
7 right head

Figure A.1 — Dual head abrader with calibration block and identification points

Dimensions in millimetres

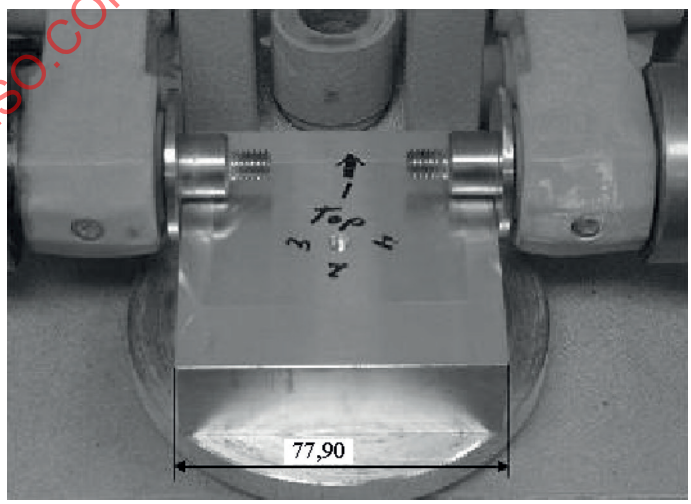


Figure A.2 — Calibration block with arms correctly aligned

Annex B
(informative)

Examples of abrasion traces

Table B.1 — Examples of abrasion traces

Description	Example of abrasion traces on printings
IP is not reached (no abrasion until the print in all 4 quadrants)	
IP is correct (beginning abrasion until the print in all 4 quadrants)	
IP is passed (too many revolutions after abrasion until the substrate)