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Textiles — Determination of the abrasion resistance of fabrics by the Martindale method —

Part 2: Determination of specimen breakdown

Textiles — Détermination de la résistance à l'abrasion des étoffes par la méthode Martindale —

Partie 2: Détermination de la détérioration de l'éprouvette

Reference number
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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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 38, *Textiles*, Subcommittee SC 24, *Conditioning atmospheres and physical tests for textile fabrics*.

This second edition cancels and replaces the first edition (ISO 12947-2:1998), which has been technically revised.

It also incorporates the Technical Corrigendum ISO 12947-2:1998/Cor 1:2002.

A list of all parts in the ISO 12947 series can be found on the ISO website.

Textiles — Determination of the abrasion resistance of fabrics by the Martindale method —

Part 2:
Determination of specimen breakdown

1 Scope

This document specifies the procedure for the determination of specimen breakdown (end-point of test) by inspection at fixed intervals and is applicable to all textile fabrics including nonwovens apart from fabrics where the specifier indicates the end performance as having a low abrasion wear life.

This document is not applicable to coated fabrics (including laminated fabrics). If the abrasion behaviour of the coated surface of a coated fabric is to be determined, use the methods described in the various parts of ISO 5470.

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

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 12947-1:1998, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 1: Martindale abrasion testing apparatus*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12947-1, ISO 3572, ISO 8388, ISO 9092, ISO 23733 and the following apply.

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

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

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

3.1
thread
textile yarn, either single or resulting from twisting together two or more single or folded yarns

3.2
woven fabric
fabric produced by interlacing (by weaving on a loom or a weaving machine) a set of warp threads and a set of weft threads normally at right angles to each other

[SOURCE: ISO 3572:1976, 2.1]

3.3
knitted fabric
fabric in which at least one system of *threads* (3.1) is formed into knitted loops and the knitted loops are intermeshed into stitches

[SOURCE: ISO 8388:1998, 3.0.1]

3.4
cut pile fabric
fabric for which a surface effect is formed by tufts or cut loops of *threads* (3.1) that stand up from the ground fabric

Note 1 to entry: Corduroy fabric (cord fabric) is an example of cut pile fabric.

3.5
uncut pile fabric
fabric for which a surface effect is formed by uncut loops of *threads* (3.1) that stand up from the ground fabric

3.6
raised fabric
fabric for which a surface effect is formed by mechanically raising fibres from *threads* (3.1) of the ground fabric

3.7
flocked fabric
fabric for which a surface effect is formed by fixing fibre snippets (flock) onto the surface of a textile substrate

3.8
chenille yarn
novelty yarn with pile protruding radially from the axis, where the pile fibres are held between a core yarn system

[SOURCE: ISO 23733:2007, 3.1]

3.9
nonwoven fabric
structures of textile materials, such as fibres, continuous filaments, or chopped yarns of any nature or origin, that have been formed into webs by any means, and bonded together by any means, excluding the interlacing of yarns as in *woven fabric* (3.2), *knitted fabric* (3.3), laces, braided fabric or tufted fabric

[SOURCE: ISO 9092:2011, 2.1, modified.]

3.10
specimen breakdown
breakdown point which is reached when criteria based on thread breakage or *worn off area* (3.11) are met

3.11
worn off area
area which has been denuded of pile or flock such that the ground fabric is exposed

3.11.1
fully worn off area
worn off area (3.11) extending to more than three quarters of the exposed surface area

3.11.2
partially worn off area
worn off area (3.11) in which there is some visual loss of pile or flock in discrete locations

Note 1 to entry: A partially worn off area is such that when viewed through the template (5.2), no pile is visible and the ground fabric is exposed.

4 Principle

A circular specimen, mounted in a specimen holder and subjected to a defined load, is rubbed against an abrasive medium (standard fabric) in a translational movement tracing a Lissajous figure, the specimen holder being additionally freely rotatable around its own axis perpendicular to the plane of the specimen. The evaluation of the abrasion resistance of the textile fabric is determined from the inspection interval to breakdown of the specimens.

The specimens are mounted in specimen holders with foam backing. Specimens with a mass per unit area ≥500 g/m^2 are mounted in specimen holders without foam. Pile fabrics which are tested without foam backing are subjected to a specified preparatory treatment (see 7.5.2).

Two abrasion load parameters are specified. The total effective mass of the abrasion load (i.e. the mass of the specimen holder assembly and the appropriate loading piece) are as follows:

a) (795 ± 7) g for fabrics intended for workwear, upholstery, bed linen and fabrics for technical use (i.e. a nominal pressure of 12 kPa);

b) (595 ± 7) g for fabrics intended for apparel and household textiles, excluding upholstery and bed linen (i.e. a nominal pressure of 9 kPa).

Abrasion testing is continued up to breakdown (see Clause 8) of the test specimen.

The inspection interval is determined by the specimen breakdown. The number of rubs is recorded at which specimen breakdown is not yet observed (this number of rubs is the upper limit of the time elapsed before specimen breakdown and, at the same time, the lower limit of the abrasion interval at which specimen breakdown occurs).

5 Apparatus and materials

5.1 Test apparatus and auxiliary materials, as specified in ISO 12947-1.

5.2 Template.

A mask made of a rigid transparent material with a hole of diameter (2,5 ± 0,1) mm through which the test specimen can be viewed (to get an approximate viewing area of 4,9 mm^2).

5.3 Magnifying device.

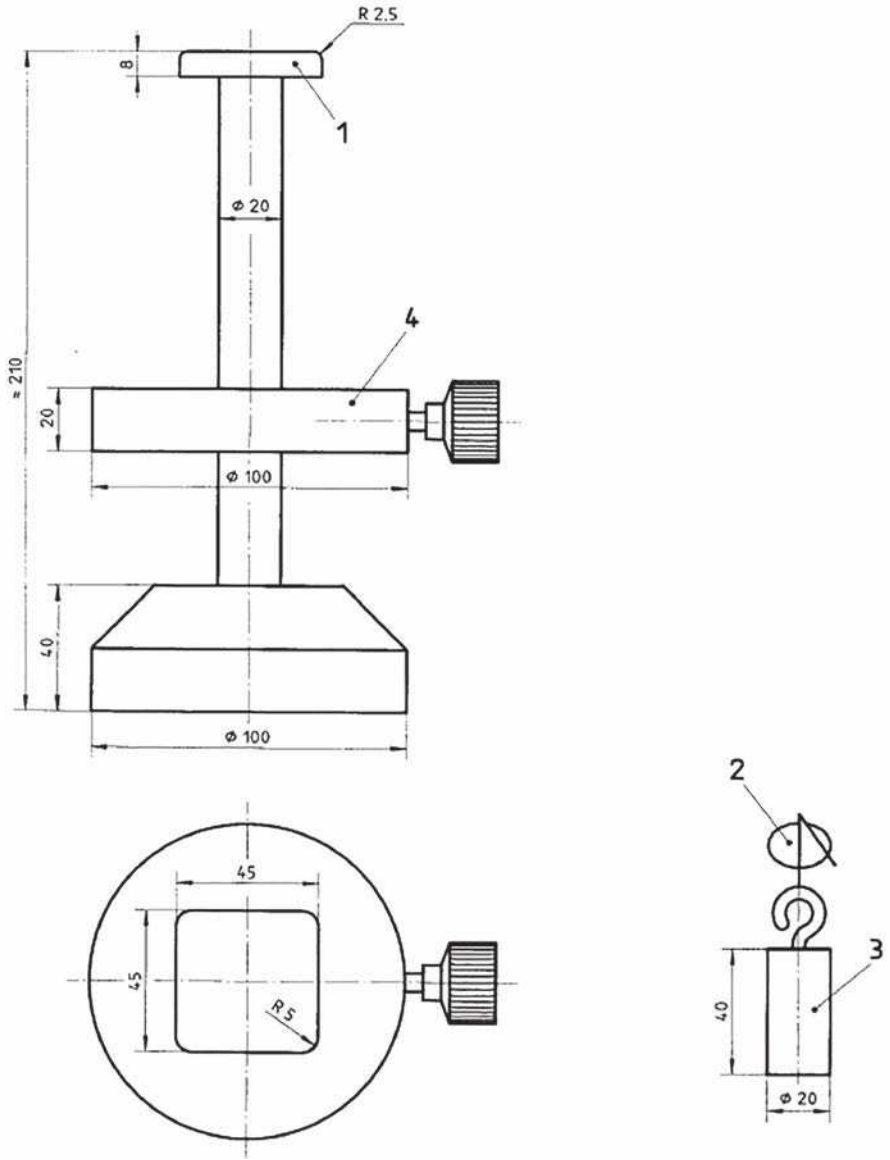
A magnifying device (in most of the cases, a magnification factor of 8 or 10 has been found suitable) shall be used in order to recognize completely broken threads, including threads forming loops.

5.4 Mounting device for stretch fabrics.

A device, as described in Figure 1, designed to prevent the circular adhesion area loosening when preparing test specimen of fabric; fabric suspected to be deformed during the abrasion stage due to its stretchability.

The square table mount shall measure (45,0 ± 0,1) mm × (45,0 ± 0,1) mm.

Dimensions in millimetres



Key

1 table mount
2 clamp
3 mass (weight) piece
4 lowering console

Figure 1 — Mounting device for stretch fabrics

6 Conditioning and testing atmosphere

The preferred standard atmosphere for conditioning and testing shall be the standard atmosphere as defined in ISO 139.

The use of alternative standard atmospheres as specified in ISO 139 may be used but their use shall be stated on the test report.

NOTE Only test results obtained from tests performed in an equal testing atmosphere can be compared.

7 Sampling and preparation of test specimens

7.1 General

The sample shall be representative for the structure and patterns of the fabric.

Ensure throughout sampling and specimen preparation that handling imposes the minimum possible tensile stress so as to prevent incorrect extension of the textile fabric.

7.2 Selection of the laboratory sample

Select the laboratory sample from a test lot to be representative of properties of the textile fabric.

If possible, select the laboratory sample from across the full fabric width, containing at least two full pattern repeats.

The upper-side (also known as wear-side or face-side) of the fabric should be indicated.

7.3 Sampling of the test specimens from the laboratory sample

Either condition the whole sample or remove smaller samples sufficient to permit the required test specimens to be taken and condition the test samples in the standard atmosphere (according to Clause 6) for at least 18 h prior to test.

NOTE 1 The duration of 18 h has been found suitable for most of the fabrics to bring them in to equilibrium with the atmosphere.

If, in some cases (e.g. when the sample is received wetted), an additional time of conditioning is needed, this shall be reported.

Take at least three test specimens ensuring that the principles set out below have been followed.

In case of patterned fabric, take at least two specimens representing each different area of the design and/or texture in the fabric.

Test specimens should be taken so that they are at least 100 mm from the edge of the laboratory sample, or, if the laboratory sample is received full width, at least 150 mm from the selvedge.

The following principles shall be observed.

a) For all fabrics, except patterned fabrics or fabrics with a textured surface:

   1) for woven fabrics, take the test specimens so that they each contain different warp and weft threads;

   2) for knitted fabrics, take the test specimens so that they each contain different wales and courses.

b) For patterned fabrics or fabrics with textured surface, ensure that the test specimens contain the most characteristic parts of the pattern, with particular consideration for weak spots, e.g. floating threads. Where it is not possible to include examples of each different pattern or texture within

a set of at least three test specimens, then test such additional specimens as may be required to ensure that each pattern or textile is included in at least two separate test specimens. If more than four different patterns are present in the same fabric, select the test specimens at spots where patterns meet in order to have several — up to three, in equal parts — patterns represented in the specimen. In the case of a combination of various basic fabric types in the same sample, the test specimens shall contain all characteristic parts of the various fabric types with particular consideration for weak spots, e.g. floating threads.

NOTE 2 This may require the use of more than three test specimens and with this technique, up to nine patterns can be examined simultaneously.

7.4 Dimensions of specimens and auxiliary materials

7.4.1 Dimensions of the test specimens

The diameter of the test specimens shall be at least 38 mm. It is essential that the specimen can be placed without wrinkles in the specimen holder nut. Preparation of test specimens with excessive diameter should be avoided.

7.4.2 Dimensions of abradant

The dimensions of the abradant shall be at least 140 mm in diameter or length and width and such as it covers the felt on the abrading table and can be fixed in place with the clamping ring.

7.4.3 Dimensions of the abradant felt substrate

The dimensions of the woven wool felt underlay shall be at least 140 mm in diameter and such as the woven wool felt underlay covers the abrading table and can be fixed in place with the clamping ring.

7.4.4 Dimensions of the specimen holder foam backing

The diameter of the specimen holder foam backing shall be at least 38 mm. It is essential that the foam backing can be placed without wrinkles in the specimen holder nut. Preparation of foam backing with excessive diameter should be avoided.

7.5 Specimen preparation for specific fabrics

7.5.1 Stretch fabrics

If a fabric is suspected to lead to the test specimens to be deformed (e.g. bagged, folded) during the abrasion stage due to its stretchability, then apply the following instructions.

NOTE 1 Such “stretch” fabric can be fabric including elastomeric yarns, etc.

Cut or stamp out test specimens of dimensions 60 mm × 60 mm in square shapes, parallel with the stitches or threads.

Condition and place them on the square table mount of the mounting device for stretch fabrics (5.4) with the side to be abraded facing downwards.

Place a clip of 30 mm edge length on each of the four sides of the test specimen hanging over the table, secure and hang a mass on each clip without stretching the specimen. Place the four mass pieces on the bracket that can be lowered. Each mass with clamp shall be (100 ± 2,5) g, the total mass being (400 ± 10) g.

Lower and raise the bracket (and consequently, the mass, too) three times in quick succession so that the test specimen is subjected to loading by the four mass pieces, and then release the load.

Lower the bracket again with renewed loading of the test specimen. In this state, press a square film measuring about 50 mm × 50 mm, to which double-sided tape is attached, and which has a 30 mm diameter hole in the centre, on to the extended test specimen and affix it by means of the adhesive tape.

Raise the bracket again.

Remove the four mass pieces and clips from the specimen, remove the specimen from the mounting device and stamp the test specimen size of 38 mm for the abrasion test. Care should be taken that the hole of 30 mm diameter stamped in the foil is precisely centred so that the stamped-out specimen is held in the lightly extended state by a film ring 4 mm wide. To prevent the circular adhesion area loosening, mount the test specimen in the specimen holder immediately after stamping.

NOTE 2 Polyvinylchloride clear films of about 0,2 mm thickness have proved successful. Before stamping to the square shape measuring about 50 mm × 50 mm, attach double-sided tape (e.g. carpet fitting tape) to one side of the film and remove the outer protective film only on attachment to the test specimen. Stamp a central hole of 30 mm diameter in the square film. The test specimen upper surface thus lies with the film ring against the specimen holder plunger.

7.5.2 Pile fabrics exceeding 500 g/m²

Pile fabrics which have a mass per unit area >500 g/m² are tested without foam backing. Carry out the following preparatory treatment of specimens in order to check if pile can be removed from the reverse side of the fabric.

Mount one or more pieces of the laboratory sample. Each of which has dimensions at least 140 mm in diameter or length and width with the fabric reverse facing upwards on the abrading table over the abradant felt substrate.

Mount a piece of abradant having dimensions at least 38 mm in diameter (and such as the specimen can be placed without wrinkles in the specimen holder nut), in the specimen holder with specimen holder foam backing.

Use a new piece of abradant for each preparatory treatment.

Subject the reverse of the fabric to 1 000 rubs using an abrasion loading of 595 g for apparel fabrics and other fabrics as described in Clause 4 b). Subject the reverse of the fabric to 4 000 rubs using 795 g for all other fabrics as defined in Clause 4 a).

On completion of the prescribed number of rubs, examine the test specimens.

Depending on the construction and quality of the pile fabric, two situations may occur following the preparatory treatment.

a) No pile removal: take test specimens, as described in 7.3, from the specimen piece subjected to this preparatory treatment and perform the abrasion test in the usual way.

b) Visible pile removal: take decision by agreement between the concerned parties whether it would be worthwhile continuing with the abrasion test:

   1) either proceed with the normal abrasion test and then, record any notable change after the preparatory treatment in the test report, or

   2) do not proceed with the abrasion test and then report accordingly that the fabric was unsuitable for abrasion testing to this test method.

7.6 Preparation and mounting of the test specimens and cutting-out and mounting of the auxiliary materials

7.6.1 Preparation

Stamp or cut out the test specimens from the laboratory sample. Give particular attention to the clean status of the cut edges to prevent the occurrence of unwanted material loss in subsequent handling and to ensure that uncut threads are not snagged or pulled when removing the test specimen from the laboratory sample.

NOTE 1 A pair of fine tipped scissors can be used to carefully trim uncut threads.

Prepare the auxiliary materials in a similar fashion from the available pieces of woven abradant fabric, woven wool felt or foam.

NOTE 2 The auxiliary materials can, under some circumstances, be obtained already prepared to the required dimensions.

NOTE 3 To avoid the fraying of test specimens, the edges (maximum 2 mm) of the test specimens can be glued.

7.6.2 Mounting of the specimen

Place the specimen holder nut in the mounting device on the Martindale machine.

Place the test specimen in the specimen holder nut with wear side downward, carefully and centrally. For test specimens having a mass per unit area <500 g/m^2, place the foam backing on the test specimen.

Avoid fabric distortion when mounting the test specimen.

Place the specimen holder insert in the specimen holder nut, place the specimen holder body over the nut and screw down tightly using both hands to maintain a continuous downwards pressure on the assembly against the mounting device.

Verify by visual examination that the test specimen has been centrally located in the test specimen holder and that no cut edges of the test specimen are visible. If a cut edge is visible in the specimen holder, then remove the test specimen and remount it.

NOTE Annex A provides information about a potential “edge effect” of tested specimens.

7.6.3 Mounting of the abradant

Mount the abradant fabric so that its technical face is uppermost.

Move the specimen holder guide plate to ensure free access to the abrading tables. Place the felt centrally on the abrading tables and place the abradant over the felt with the right face uppermost.

Compress the felt and abradant on the abrading table with a pressing weight having a mass of (2,5 ± 0,5) kg and a diameter (120 ± 10) mm.

Ensure the woven wool felt and woven wool abradant are placed centrally on the abrading table and the central position maintained when the pressing weight is used.

Fit the clamping ring and secure the felt and abradant firmly. Remove the pressing weight.

Verify by visual examination that the abradant has been centrally located on the abrading table and that no cut edges of the abradant are visible within the area of the clamping ring. If a cut edge of the abradant is visible in the clamping ring, then remove the test specimen and remount it.

7.7 Useful life of auxiliary materials

Renew the abradant at the start of every test. For abrasion tests >50 000 rubs, change abradant after every 50 000 rubs.

Inspect the felt for soiling and wear. If soiling has occurred whereby a staining ≤3 (grey scale grade in accordance with ISO 105-A03) has occurred, then the felt shall be replaced. If the felt exhibits a change in mass and/or thickness such that it no longer meets the requirements of ISO 12947-1:1998, Table 2, then it shall be replaced.

Both sides of the felt may be used. Prior to testing, each new batch of woven wool felt shall be checked in accordance with the laboratory's internal calibration procedures. The felt shall be renewed after maximum 500 000 rubs, on each side, on all heads of the Martindale machine simultaneously, regardless of the number of rubs performed with each head, even if the staining and thickness remain within the specified tolerances.

Where foam is used in abrasion testing, use a new piece for every abrasion test.

7.8 Preparation of the abrasion machine

After mounting the test specimens and auxiliary materials, place the specimen holder guide plate in position and correctly position the specimen holders and spindles at their respective work stations.

Place the additional loading piece prescribed for the abrasion test on each specimen holder spindle.

8 Abrasion test procedure: Determination of the physical end-point

Fabrics shall be abraded in stages and evaluated at intervals according to Table 2. Select the number of rubs for the first interval and start the abrasion apparatus. Continue the abrasion test without interruption until the selected number of rubs has been reached.

If required, assess colour change after 6 000 rubs in accordance with ISO 105-A02, unless it is required to be assessed at a different interval.

After each test interval, carefully remove the specimen holder with the mounted specimen from the testing machine. Gently remove loose fibres or debris from the surface of the test specimen and the abradant without damaging or disturbing the threads (e.g. by blowing or lightly brushing using a soft bristle brush). Examine the whole area for signs of breakdown (see Table 1). If no breakdown has yet been established, replace the holders in the machine and start the next test interval. Continue this test and assessment sequence without undue interim delay until a breakdown is observed. Inspect the specimen, where appropriate with the aid of the magnifying device (5.3) or the template (5.2).

If necessary, carefully use an inspection needle to check if threads or loops are completely broken, without pulling out or otherwise damaging threads.

Pills or other aggregation of fibres on the test specimen surface shall not be removed.

Assess any visual change in appearance, e.g. partially worn off area of pile, loss of pile tufts, loss of flock, partially broken thread (showing undamaged fibres or filament, e.g. elastane), breakdown of loops, loss of nap, glazing or significant change in colour. Where such visual changes in appearance are observed, record the nature of the change and the interval at which it occurred. This information shall be reported.

If it is difficult to inspect the fabric surface whilst the test specimen is still mounted in the specimen holder, carefully remove the test specimen from the specimen holder, taking care to avoid any fraying or unravelling. The test specimen may then be inspected by placing it over a backlit surface (e.g. light table) as breaks in yarn or thinning of the fabric may be identifiable using this technique. The use of this technique shall be reported. Test specimens removed from the specimen holder may be reused provided that they can be replaced in the test specimen holder without causing any degradation of the test specimen.

Table 1 — Specimen breakdown

<table>
<tr><th colspan="2" rowspan="2">Type of fabric</th><th colspan="3">Breakdown point (end-point)[a]</th></tr>
<tr><th>“Thread breakage” criteria:</th><th></th><th>“Worn off area” criteria:</th></tr>
<tr><td colspan="2">Woven fabric (without pile)</td><td>Two threads completely broken</td><td></td><td>N.A.</td></tr>
<tr><td colspan="2">Knitted fabric (without pile)</td><td>One thread completely broken</td><td></td><td>N.A.</td></tr>
<tr><td rowspan="4">Pile fabric</td><td>Cut pile woven fabric</td><td rowspan="4">One thread completely broken (knitted fabric)
Two threads completely broken (woven fabric)</td><td rowspan="4">or</td><td rowspan="4">Fully worn off area</td></tr>
<tr><td>Cut pile knitted fabric</td></tr>
<tr><td>Fabric made with chenille yarns</td></tr>
<tr><td>Uncut pile fabric</td></tr>
<tr><td colspan="2">Raised fabric</td><td>One thread completely broken (knitted fabric)
Two threads completely broken (woven fabric)</td><td></td><td>N.A.</td></tr>
<tr><td colspan="2">Flocked fabric</td><td>N.A.</td><td></td><td>Fully worn off area</td></tr>
<tr><td colspan="2">Nonwoven fabric</td><td colspan="3">Hole[b] in the fabric</td></tr>
<tr><td colspan="5">[a] Alternative test specimen breakdown point criteria could be used as agreed between the interested parties and should be reported.
[b] A hole is of a diameter at least equal to 2,5 mm, which means that the surface layer is worn away by forming a hole so that a layer with a different appearance or a backing fabric is visible when viewed through the template (5.2).
N.A. Not Applicable.</td></tr>
</table>

If the number of rubs exceeds 50 000, interrupt the test every 50 000 rubs in order to renew the abradant. In this case, very carefully remove the specimen holders with mounted test specimens from the testing machine in order to avoid damage.

Continue the abrasion test until all specimens reach the specified end-point/breakdown. The test may be stopped at a pre-defined agreed maximum number of rubs or at 100 000 rubs if end-point has not been reached (alternative maximum number of rubs could be used as agreed between the interested parties and should be reported). Then the result shall be reported as “abrasion resistance ≥ *xxx* 000 rubs, without reaching the end-point” (“*xxx* 000” means the agreed maximum number of rubs).

Record the test result for each test specimen as the lower limit of the current interval when specimen breakdown is observed.

EXAMPLE When breakdown is observed after 25 000 rubs, record 20 000 rubs as the last inspection interval before breakdown was observed.

Table 2 — Test intervals for abrasion testing

Interval steps[a]	Evaluation intervals (rubs)
Every 1 000 rubs (up to 6 000 rubs)	1 000 - 2 000 - 3 000 - 4 000 - 5 000 - 6 000
Every 2 000 rubs (from 6 001 to 20 000 rubs)	8 000 - 10 000 - 12 000 - 14 000 - 16 000 - 18 000 - 20 000
Every 5 000 rubs (from 20 001 to 50 000 rubs)	25 000 - 30 000 - 35 000 - 40 000 - 45 000 - 50 000
Every 10 000 rubs (over 50 001 rubs)	60 000 - ... (+ every additional 10 000 rubs)

[a] Alternative interval steps could be used as agreed between the interested parties and should be reported. The interval steps given in this table widen with an increase of the abrasion resistance and as an agreement between the interested parties, reduced interval steps (but not less than 1 000 rubs) may be used to reach the end-point.

9 Results

The individual test results are expressed as the number of rubs of the inspection interval prior to the end-point of each test specimens being reached.

The quoted result shall be defined as the lowest individual test result of all the test specimens tested.

Due to the changes in end-point definitions, in interval steps, evaluation intervals and expression of the results (all of which have an impact on the uncertainty measurement), it is important that these be borne in mind when comparing test results from this edition of ISO 12947-2 against fabric specifications based on the previous edition (ISO 12947-2:1998).

10 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 12947-2;

b) the specimen constitution, presentation and technical data for the test sample;

c) the mass and nominal pressure used in the test (e.g. nominal pressure of 12 kPa and/or mass of 795 g);

d) if applicable, the specimen preparatory treatment;

e) use of a conditioning atmosphere according to ISO 139 other than the standard atmosphere specified in Clause 6;

f) if applicable, when foam was not used to back the test specimens;

g) the type of fabric and the corresponding type of end-point (threads completely broken, pile totally worn off, etc.);

h) the individual results of the test specimens;

i) the quoted result, i.e. the lowest individual result;

j) any significant changes in appearance and/or structure including, e.g. falling off of pile tufts or of flock, breakdown of loops, changes of structure, pattern, pilling, etc. and the interval at which these observations were made;

k) any unusual behaviour;

l) any deviation from the procedure;

m) if the test stopped at *xxx* 000 rubs, “abrasion resistance ≥ *xxx* 000 rubs”;

n) if required, the number of rubs at which the colour change was assessed and the resultant grade.

Annex A
(informative)

Topics for further investigations

A.1 Orientation of the abradant fabric

In relation to 7.6.3, ISO 12947-2:1998 required: "Fit the abradant so that the two thread systems of the woven fabric lie parallel to the edges of the machine frame", but there is no current evidence that the orientation of the fabric on the abrasion table could impact the abrasion resistance (due to the nature of the Lissajous curves).

Further investigations should be carried out to provide a conclusive answer to this question.

A.2 Alternative intervals steps

In relation to Table 2, footnote a, there is no current evidence that number of the rubs of the interval steps could impact the abrasion resistance.

Further investigations should be carried out to provide a conclusive answer to this question.

A.3 "Edge effect" of tested specimens

During a proficiency testing organized in France in 2003, based on 7.6.3, ISO 12947-2:1998, with the participation of 8 laboratories, the organizer of the proficiency tests analysed the tested specimens of a cut pile fabric (returned by participants in the proficiency testing) and identified that the appearance of the abraded surfaces of the tested specimens was not the same in all test specimens returned.

The organizer categorized the appearance of the returned test specimens based on the appearance of an "edge effect". The "edge effect" may be defined as a significant difference in the abraded area around the internal circumference of the test specimen holder in comparison to the abraded central area of the test specimen and is typically characterized by increased exposure or abrasion of the ground fabric around the periphery of the test specimen as compared to the central area of the test specimen.

The organizer of the proficiency testing stated that

— high "edge effect" means that the ground fabric of the pile fabric is visible mainly around the internal circumference of the test specimen holder nut,

— light "edge effect" means that the whole surface of the test specimen is evenly abraded, and

— intermediate state means test specimens whose appearance falls between high edge effect and light edge effect.

The organizer reported that the appearance of the "edge effect" is related to the distribution of the laboratory results produced in the proficiency testing. Test specimens which showed a high "edge effect" tended to produce a lower abrasion resistance result, whilst test specimens showing a light "edge effect" tended to produce a higher abrasion resistance result.

Further investigation by the organizer led to the conclusion that the "edge effect" is directly related to the pressure applied to the test specimen during the mounting of the test specimen in the specimen holder prior to abrasion testing.

Simulations of different pressures applied to the test specimen during the mounting of the test specimen led to the ability to reproduce the “edge effect”. “Light” pressure led to high “edge effect” whilst “high” pressure led to light “edge effect” (see Figure A.1 and Figure A.2).

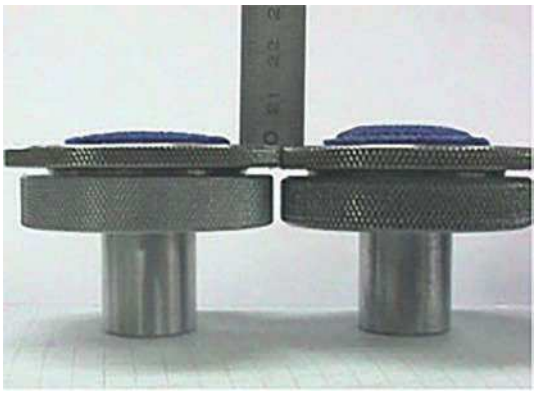


Figure A.1 — Comparative profiles of tested test specimens “with pressure” (left) and “without pressure” (right)

Figure A.2 — Comparative faces of tested test specimens “with pressure” (left) and “without pressure” (right)

Based on this evidence, and as the existing procedure for mounting of test specimens lacks guidance on the pressure to be used during mounting of the test specimens, this has been identified as a potential source of test uncertainty. The organizer therefore concluded that the application of a constant pressure (applied by means of an additional mass) during the preparation of the test specimen was required in order to improve the reproducibility (between laboratories) of the test method. An additional mass of approximately 5,5 kg was found to be suitable.

Further investigations should be carried out to provide a conclusive answer to this question. ISO/TC 38/SC 24 decided in 2015 to accept a preliminary work item to deal with a potential alternative test specimen preparation methodology using an additional mass.

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