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

Part 3: Determination of mass loss

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

Partie 3: Détermination de la perte de masse

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International Organization for Standardization
 Case postale 56 • CH-1211 Genève 20 • Switzerland
 Internet iso@iso.ch

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12947-3 was prepared by Technical Committee ISO/TC 38, *Textiles*.

ISO 12947 consists of the following parts under the general title *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method*:

- *Part 1: Martindale abrasion testing apparatus*
- *Part 2: Determination of specimen breakdown*
- *Part 3: Determination of mass loss*
- *Part 4: Assessment of appearance change*

Annex A forms an integral part of this part of ISO 12947.

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

Part 3: Determination of mass loss

1 Scope

This part of ISO 12947 is applicable to the determination of the mass loss of specimens covering all textile fabrics including nonwovens apart from fabrics where the specifier indicates the end performance as having a low abrasion wear life.

NOTE Further introductory comments are given in ISO 12947-1.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 12947. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 12947 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour.*

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing.*

ISO 2859-1:—¹⁾, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

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

ISO 12947-2:1998, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 2: Determination of specimen breakdown.*

3 Definitions

For the purposes of this part of ISO 12947 the definitions given in ISO 12947-1 and ISO 12947-2 apply.

4 Principle

A circular specimen is 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

¹⁾ To be published. (Revision of ISO 2859:1989)

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 mass loss of the test specimens.

The specimens are mounted in the specimen holders with foam backing. Specimens with a mass per unit area greater than 500 g·m⁻² are mounted in the specimen holders without foam. Pile fabrics and cord fabrics which are tested without foam backing are subjected to a specified preparatory treatment (see 7.5.2).

Two abrasion 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:

- a) (795 ± 7) g for workwear, upholstery, bed linen and fabrics for technical use (nominal pressure of 12 kPa);
- b) (595 ± 7) g for apparel and household textiles, excluding upholstery and bed linen (nominal pressure of 9 kPa).

The mass loss of the test specimen is determined for each of the established numbers of rubs according to the number of rubs at which specimen breakdown occurs (see table 1).

Table 1 — Test intervals for mass loss testing

Test series	Number of rubs at which specimen breakdown occurs	Determination of mass loss at following numbers of rubs
a	≤ 1 000	100, 250, 500, 750, 1 000, (1 250)
b	> 1 000 ≤ 5 000	500, 750, 1 000, 2 500, 5 000, (7 500)
c	> 5 000 ≤ 10 000	1 000, 2 500, 5 000, 7 500, 10 000, (15 000)
d	> 10 000 ≤ 25 000	5 000, 7 500, 10 000, 15 000, 25 000, (40 000)
e	> 25 000 ≤ 50 000	10 000, 15 000, 25 000, 40 000, 50 000, (75 000)
f	> 50 000 ≤ 100 000	10 000, 25 000, 50 000, 75 000, 100 000, (125 000)
g	> 100 000	25 000, 50 000, 75 000, 100 000, (125 000)

NOTE Values in brackets should be agreed upon between the interested parties.

5 Apparatus and materials

In addition to the test apparatus and auxiliary materials specified in ISO 12947-1, a balance, having an accuracy of 1 mg, is required.

6 Conditioning and testing atmosphere

The standard temperate atmosphere for conditioning and testing textiles as defined in ISO 139 shall be used, i.e. a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %.

7 Sampling and preparation of test specimens

7.1 General

Perform sampling in accordance with statistical rules (see ISO 2859-1).

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. Check the representative nature of sampling from the start or end of a textile fabric.

Take the laboratory sample from across the full fabric width.

7.3 Sampling of the test specimens from the laboratory sample

Before sampling the test specimens from the laboratory samples, condition the laboratory samples, free from tension, for at least 18 h on a smooth horizontal surface with free access of air exposed to the standard atmosphere specified in clause 6.

Take the test specimens at least 100 mm from the edge distributed across the entire laboratory sample. Take a sufficient number of test specimens to be in accordance with statistical rules (see 7.1).

For woven fabrics, take the specimens so that they each contain different warp and weft threads.

For patterned fabrics or fabrics with textured surface, take care to ensure that the test specimens contain all characteristic parts of the pattern ensuring that the parts of the pattern likely to be sensitive to abrasion are contained in the test specimens.

7.4 Dimensions of specimens and auxiliary materials

7.4.1 Dimensions of the test specimens

The diameter of the test specimens shall be 38^{+5}_0 mm.

7.4.2 Dimensions of abradant

The dimensions of the abradant shall be at least 140 mm in diameter or length and width.

7.4.3 Dimensions of the abradant felt substrate

The diameter of the woven wool abradant felt underlay shall be 140^{+5}_0 mm.

7.4.4 Dimensions of the specimen holder underlay foam backing

The diameter of the specimen holder underlay foam backing shall be 38^{+5}_0 mm.

7.5 Specimen preparation for specific fabrics

7.5.1 Stretch fabrics

See annex A, clause A.1.

7.5.2 Cord fabrics and pile fabrics

See annex A, clause A.2.

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.

Determine the mass of each conditioned test specimen to the nearest 1 mg by weighing.

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

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

7.6.2 Mounting of the specimen

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

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 of less than $500 \text{ g}\cdot\text{m}^{-2}$ place the foam backing on the test specimen.

NOTE 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.

7.6.3 Mounting of the abradant

Move the specimen holder guide plate to ensure free access to the abrading tables.

Place the felt on the abrading tables and place the abradant over the felt.

Fit the abradant so that the two thread systems of the woven fabric lie parallel to the edge of the machine frame.

Compress the felt and abradant on the abrading table with a pressing weight having a mass of $(2,5 \pm 0,5) \text{ kg}$ and a diameter of $(120 \pm 10) \text{ mm}$.

Fit the clamping ring and secure the felt and abradant firmly.

Remove the pressing weight.

7.7 Useful life of auxiliary materials

Renew the abradant for every test. For abrasion tests with more than 50 000 rubs, change the abradant every 50 000 rubs.

Inspect the felt for soiling and wear after every abrasion test. If soiling or detectable wear occur replace the felt. Both sides of the felt may be used.

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 and place the loading piece prescribed for the abrasion test on each specimen holder spindle.

8 Abrasion test procedure

Preselect the number of rubs according to the relevant test series listed in table 1 for the abrasion test previously determined by ISO 12947-2. Where necessary complete the preparatory treatment of the specimens in accordance with 7.5.2 and the preparation in accordance with clause 7. Start the abrasion tester.

Abrade the required number of specimens of known mass to each of the selected test intervals in the chosen test series e.g. for test series a in table 1 abrade separate sets of specimens to 100, 250, 500 etc. rubs.

Remove the load from the specimens and carefully remove the specimen holders from the testing machine. Check the specimens for abnormal surface change (e.g. neps or pilling, creases, tuft loss in pile textiles). In the event of such abnormalities reject the test specimens. If all specimens exhibit such changes do not continue the test. If only

individual specimens are abnormal, repeat the test until the required number of specimens has been tested. The abnormalities observed and the number of abnormal test specimens shall be recorded in the test report.

To determine the mass loss of the test specimens carefully remove the test specimens from the specimen holder, hold by forceps and remove the abraded material (fibre debris) from both sides with a soft brush, without touching the test specimens with the fingers. Determine the mass of each test specimen to the nearest 1 mg after conditioning in the standard atmosphere.

9 Results

For each test specimen determine the mass loss to the nearest 1 mg from the difference between the mass of the test specimen before testing and the mass of the specimen after testing.

From the mass loss of the test specimens tested for the same number of rubs, calculate the mean, confidence limits of the mean and standard deviation and record to the nearest 1 mg and record the relative confidence limits and variation coefficient to the nearest 0,1 %.

In cases where the abrasion test is performed using several stages of numbers of rubs in accordance with table 1, from the mean mass losses appertaining to the respective numbers of rubs (where necessary indicating the confidence limit of the mean) produce a graph to show the mass loss over the number of rubs as an abrasion index of the textile fabric tested.

If required assess shade change in accordance with ISO 105-A02.

NOTE See ISO 5725 for literature for statistical evaluation or visual examination of textiles using ordinal characteristics.

10 Test report

The test report shall include the following information:

- a) reference to this part of ISO 12947, i.e. ISO 12947-3;
- b) specimen constitution, presentation and technical data for the test sample;
- c) details and test series (see table 1) of the method used;
- d) specimen preparatory treatment;
- e) test or assessment result together with further observations where applicable e.g.:
 - for each specified number of rubs the mean together with the absolute and relative confidence limits of the mean, standard deviation, variation coefficient and graph showing the mass loss over the number of rubs (abrasion index of the textile fabric) as the mass loss index of the test specimen, shall be given;
 - whether shade change has been assessed (see clause 9);
- f) departures from the procedure (e.g. special agreements on the conditions of testing or assessment);
- g) date of test.

Annex A (normative)

Specimen preparation for specific fabrics

A.1 Stretch fabrics

For elastane-containing fabrics prepare the test specimen as follows.

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 test bed, measuring 45 mm × 45 mm, 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. The mass of each weight with clamp shall be 100 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 (extended) three times by the four mass pieces and release the load. Lower the bracket again with renewed loading (extension) of the test specimen. In this state press a square foil 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 weights 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 foil circle 4 mm wide. To prevent the circular adhesion area loosening, mount the test specimen in the specimen holder immediately after stamping. See figure A.1.

NOTE Polyvinylchloride clear foils of 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 foil, and remove the outer protective foil only on attachment to the test specimen. Stamp a central hole of 30 mm diameter in the square foil. The test specimen upper surface thus lies with the foil ring against the specimen holder plunger.

A.2 Cord fabrics and pile fabrics

For cord fabrics and pile fabrics which are tested without backing, carry out the following preparatory treatment of specimens.

Mount an initial piece of the laboratory sample having dimensions at least 140 mm in diameter or length and width with the fabric back facing upwards on the abrading table over the abradant felt substrate and mount a piece of abradant having dimensions $38^{+0,5}_0$ mm diameter in the specimen holder with specimen holder foam backing.

For apparel, subject the back of the fabric to 1 000 rubs and for upholstery 4 000 rubs under an abrasion mass of 595 g or 795 g respectively.

On completion of the prescribed number of rubs take between four and six test specimens from the specimen piece subjected to this preparatory treatment and mount in the specimen holders in the usual way.

Use a new piece of abradant for each preparatory treatment.

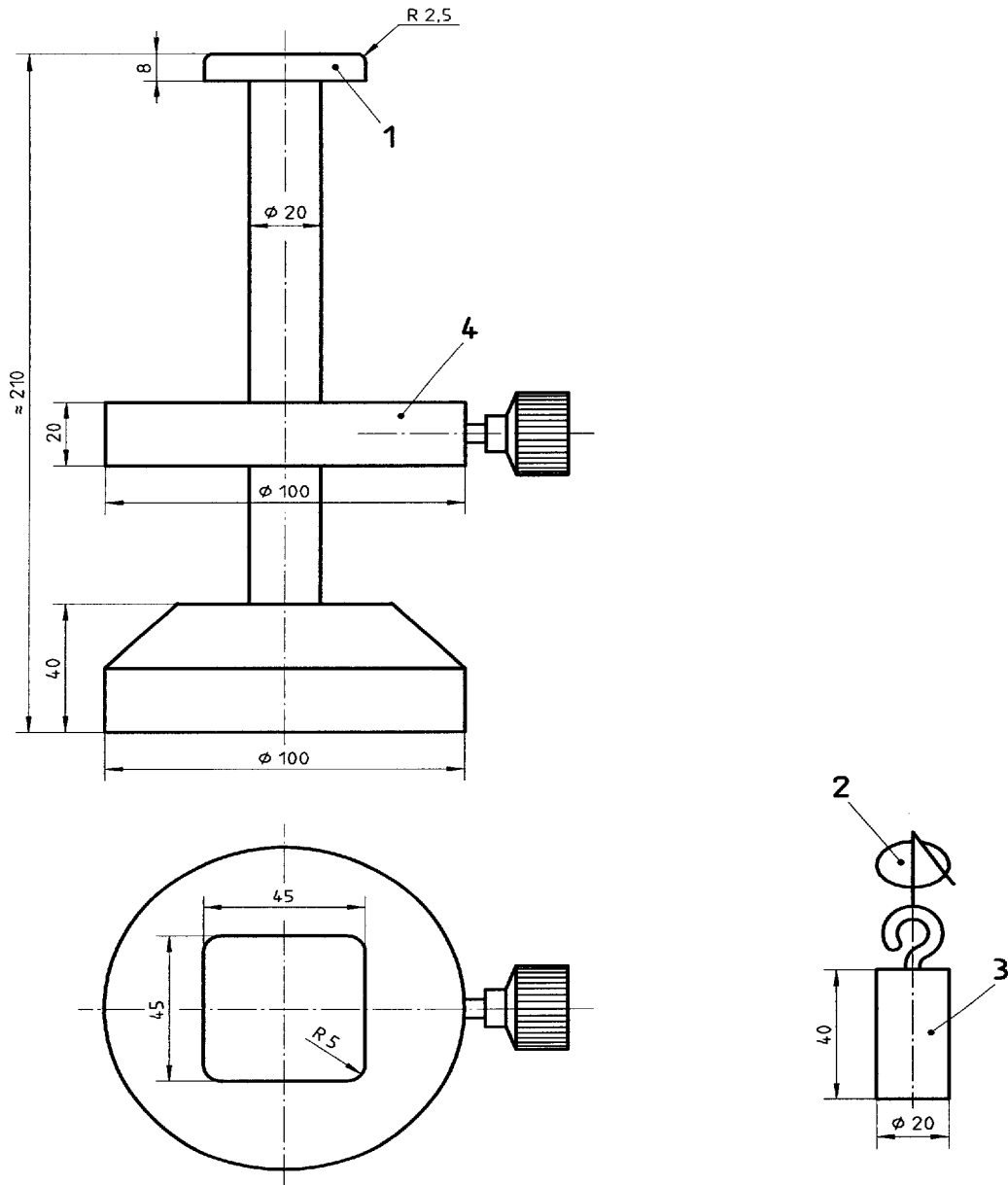
Depending on the construction and quality of the cord or pile fabric, either very little or a significant amount of pile loss could occur during the preparatory treatment and this could influence whether it would be worthwhile continuing with the test. In the event of proceeding with the normal abrasion test, record any notable change after the preparatory treatment in the test report.

The action to be taken in the event of a significant pile loss should be by agreement between the parties concerned and could be based, for example, on an adverse effect on the appearance of the face side of the fabric that is in

excess of agreed limits, or a limit on the loss in mass (in grams or as a percentage) of the area of the fabric subjected to the preparatory abrasion treatment.

The end point for a pile fabric is when the pile is fully worn off.

Dimensions in millimetres



- Key**
- 1 Table mount
 - 2 Clamp
 - 3 Weight
 - 4 Lowering console

Figure A.1 — Mounting device for easily stretched fabrics

Bibliography

- [1] ISO 5725:1986²⁾, *Precision of test methods — Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests.*

²⁾ This International Standard has been superseded by ISO 5725, parts 1 to 6. ISO 5725:1994 is the nearest in relevance to ISO 5725:1986.

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