
**Rubber- or plastics-coated
fabrics — Determination of abrasion
resistance —**

**Part 2:
Martindale abrader**

*Supports textiles revêtus de caoutchouc ou de plastique —
Détermination de la résistance à l'usure —*

Partie 2: Appareil d'essai d'abrasion Martindale

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 5470-2:2003), which has been technically revised. The main changes compared with the previous edition are as follows:

- the Normative references have been updated;
- the Terms and definitions have been added;
- in [5.2.1](#), the definition of wool abradant fabrics has been replaced by a reference to ISO 12947-1;
- [5.5](#) has been revised in accordance with ISO 12947-2;
- in [8.1.1](#), specimen clamping has been described more precisely;
- [8.1.2](#) has been revised;
- the period of use for abradant has been supplemented in [8.1.5](#);
- the Bibliography has been updated.

A list of all parts in the ISO 5470 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.

Rubber- or plastics-coated fabrics — Determination of abrasion resistance —

Part 2: Martindale abrader

WARNING — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This document specifies two separate methods for determining the resistance of a material to wet and dry abrasion.

It is applicable to the coated surface or surfaces of coated fabrics.

It does not apply to determining the abrasion behaviour of an uncoated surface of a coated fabric, for which the methods for uncoated textiles described in the ISO 12947 series apply.

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 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

ISO 2286-1, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 1: Methods for determination of length, width and net mass*

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

No terms and definitions are listed in this document.

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 <http://www.electropedia.org/>

4 Principle

This document details two different methods. In method 1, test specimens are clamped in a specimen holder and abraded using pieces of a selected abrasant under constant pressure. A variant of this method consists of carrying out the method with a wet abrasant. Method 2 reverses the position of the abrasant and the specimen. In both cases, the relative movement between the abrasant and the specimens creates a harmonic motion in right angles to each other by a cyclic planar motion in

form of a Lissajous figure which produces rubbing in all directions. The test is stopped either after a predetermined number of cycles in which case the damage to each specimen is assessed or when the specimen has reached a predetermined degree of abrasion in which case the number of cycles is noted.

5 Apparatus and material

5.1 Abrasion machine, with one or more test stations, each fitted with the items of equipment specified in [5.1.1](#) to [5.1.6](#).

5.1.1 Circular specimen holder, with a clamping ring which grips the specimen around its edge, leaving an exposed raised flat circular portion of area $(645 \pm 5) \text{ mm}^2$.

5.1.2 Horizontal abrasant table, of sufficient size to incorporate a square central test area of side 88 mm. Typically, abrasant tables are circular and have a diameter of at least 125 mm.

5.1.3 Means of holding the exposed flat portion of the specimen holder ([5.1.1](#)) in contact with the abrasant table ([5.1.2](#)), while allowing the specimen holder to rotate freely in the plane of the abrasant table.

5.1.4 Means of producing relative movement between the specimen holder ([5.1.1](#)) and the abrasant table ([5.1.2](#)), which forms a Lissajous figure occupying an area of $(60 \pm 1) \text{ mm} \times (60 \pm 1) \text{ mm}$ (see [Figure 1](#)). Each Lissajous figure requires 16 elliptical motions (revolutions) of the specimen holder, and the speed of operation of the tester shall be $(48 \pm 4) \text{ revs/min}$.

The parallelism of the abrasant table ([5.1.2](#)) and the specimen holder ([5.1.1](#)) shall be maintained to within $\pm 0,05 \text{ mm}$ throughout each Lissajous figure. A dial gauge fitted in place of the specimen holder can be used to verify the parallelism of the abrasant table.

The circumferential parallelism of the holder ([5.1.1](#)) in contact with the abrasant table shall be better than $\pm 0,05 \text{ mm}$. This can be verified by attempting to insert slip gauges of thickness less than 0,05 mm under the edges of the flat face of the specimen holder.

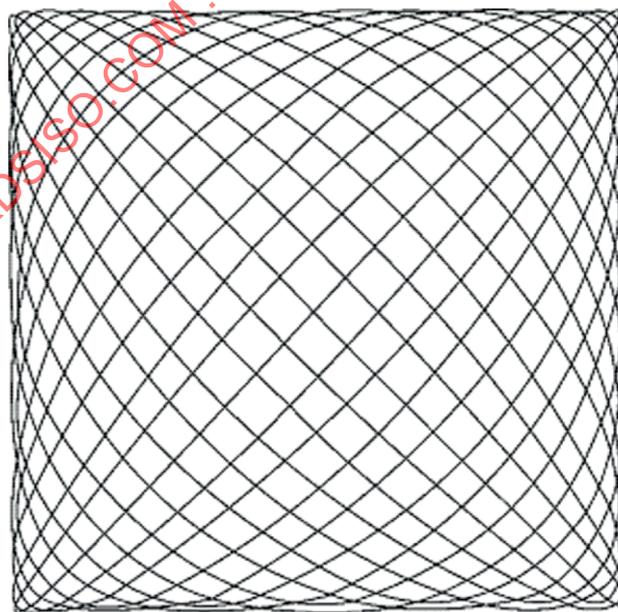


Figure 1 — Lissajous figure

5.1.5 Means of maintaining a constant pressure of $(12 \pm 0,2)$ kPa between the specimen holder (5.1.1) and the abrasant table (5.1.2). This will be the case if the mass of the specimen holder and its associated fittings is (795 ± 5) g.

5.1.6 Means of counting the number of abrasion cycles completed in terms of revolutions (16 revs per cycle).

5.2 Reference abrasant.

Unless otherwise stated by mutual agreement between the interested parties, this shall be either a wool abrasant fabric (5.2.1) or a silicon carbide cloth (5.2.2). Results from tests carried out with different abrasants are not considered to be comparable. When tests are carried out, by mutual agreement of all parties, using a non-standard abrasant, a description of this abrasant shall be included in the test report.

5.2.1 Wool abrasant fabric.

The properties of the wool abrasant fabric shall be as defined in ISO 12947-1:1998, Clause 6, Table 1.

The two faces of the wool abrasant fabric will not necessarily have the same abrasive characteristics, and when purchased from a supplier, it shall be noted which face the supplier recommends for use. This is normally the slightly smoother face of the fabric. Stocks of the fabric shall be controlled to ensure that only this face is used in testing.

5.2.2 Silicon carbide cloth.

The properties of silicon carbide cloth shall be as given in Table 1.

Table 1 — Properties of silicon carbide cloth

Abrasive	Fused silicon carbide free from extraneous material
Backing	Cotton cloth of minimum breaking strength 961 N/50 mm width in the warp direction and 392 N/50 mm in the weft direction
Grade	P 180

5.3 Flat weightpiece, of suitable dimensions to place over the entire surface of the abrasant table to ensure that the abrasant fabric is held flat while it is clamped in position. The weightpiece shall apply a pressure of $(2 \pm 0,2)$ kPa.

5.4 Cutting device, such as a die cutter, of sufficient size to produce specimens that will be held firmly in the specimen holders (5.1.1). The exact size of the device will depend on the design of the clamping system of the specimen holder.

5.5 Four pieces of wool felt, mass per unit area of (750 ± 50) g/m² and thickness of $(2,5 \pm 0,5)$ mm. Both sides of the felt may be used. The felts shall be inspected with respect to soiling and wear. The felts can be reused as long as the values of mass per unit area and/or thickness meet the requirements as well as there are no signs of staining or wear. The felts already used for wet testing shall be reused only for wet testing.

5.6 Polyurethane foam, of thickness (3 ± 1) mm, density (30 ± 2) kg·m³ and indentation hardness $(5,8 \pm 0,8)$ kPa.

5.7 Water-jet. A rubber tube with one end restricted and the other attached to a cold-water tap at mains pressure is suitable.

5.8 Magnifier, with a magnification of six times.

6 Test specimens

6.1 Method 1 — Test specimens clamped in holders

6.1.1 Using the cutting device (5.4), take at least four specimens, of sufficient size for them to be firmly held in the specimen holders (5.1.1), from non-adjacent areas within the usable width of the roll, as defined in ISO 2286-1. With double-coated fabrics, if both surfaces are to be tested, select another set of at least four specimens.

6.1.2 If the material under test has an irregular embossing pattern or irregular printing pattern (patches), take specimens from positions selected so that each part of the pattern is tested. This may mean that more than four specimens are required.

6.1.3 If the result of the test required by the relevant product specification is expressed in terms of mass loss, determine the mass of each specimen.

6.2 Method 2 — Test specimens on the table

6.2.1 Cut at least four specimens, each measuring 125 mm × 125 mm, from non-adjacent areas within the usable width of the roll (as defined in ISO 2286-1).

6.2.2 If the material under test has an irregular embossing pattern or irregular printing pattern (patches), take specimens from positions selected so that each part of the pattern is tested. This may mean that more than four specimens are required.

6.2.3 If the result of the test required by the relevant product specification is expressed in terms of mass loss, determine the mass of each specimen.

7 Conditioning of specimens and wetting of abradant

7.1 For dry tests, place the specimens in a conditioning atmosphere as specified in ISO 2231:1989 for at least 16 h prior to testing and carry out the test in this atmosphere. Specimens for wet tests need not be conditioned prior to test.

7.2 For wet tests, fully saturate the abradant cloth (5.2) and wool felt (5.5) (method 1) or the specimen mounted on the abradant table (method 2) by directing the water-jet (5.7) to and fro over their surfaces until complete saturation can be seen by a uniform darkening in colour.

8 Procedure

8.1 Method 1

8.1.1 Remove the clamping ring of a specimen holder (5.1.1). Insert the specimen centrally so that the surface to be abraded is facing outwards.

Complete the assembly by putting or screwing on the back plate tightly including all the necessary components of the specimen holder while pressing the face of the specimen firmly against a hard surface to prevent wrinkling.

Repeat for remaining specimens.

8.1.2 If testing materials with a mass per unit area of less than 500 g·m², place a similar-size piece of polyurethane foam (5.6) in each of the specimen holders as backing for the specimen.

If the testing material exhibits a mass of unit area ≤ 500 g·m² but also a pronounced rear-lamination, the polyurethane foam as backing may be omitted.

8.1.3 Check that the specimen in its holder is not baggy, creased or distorted in any way.

8.1.4 Place a piece of dry or wet felt (5.5) on the abrading table, depending on whether dry or wet test conditions are being used.

8.1.5 Place a corresponding dry or wet piece of the abrasant fabric (5.2) over each piece of table felt with the test face uppermost. For each new test, a new piece of abrasant has to be used. At a number of revolutions of more than 51 200, the piece of abrasant shall be replaced by a new one after each 50 000 cycles.

8.1.6 Place the weightpiece (5.3) on top of the abrasant fabric and clamp the abrasant in position so that it is free of wrinkles. When this has been achieved, remove the weightpiece.

8.1.7 Repeat the procedure given in 8.1.1 to 8.1.6 for any other test stations.

8.1.8 Fit each filled specimen holder into the abrasion machine so that the specimen is resting on the abrasant.

8.1.9 Apply a vertical downwards force, normally 12 kPa ± 0,2 kPa, to each specimen holder to provide the required pressure between the specimen and the abrasant.

8.1.10 Start the abrasion machine (5.1).

8.1.11 At the numbers of revolutions indicated in Table 2, remove the specimens from their holders and inspect the specimens by means of the magnifier (5.8) under bright indirect lighting for signs of damage. If possible, compare each specimen with a piece of the same material which has not been abraded and rate the observed alterations in accordance with Clause 9, Table 3.

If the damage is rated to be “complete” as indicated in Clause 9, Table 3, stop the test. If the predetermined number of revolutions is reached, note the rating of the damage and stop the test. If the damage has reached a predetermined limit, note the number of revolutions performed and stop the test. Otherwise, note the number of revolutions and the rating of the damage observed.

Table 2 — Recommended inspection and abrasant re-wetting stages

Number of revolutions	Inspect specimen	Re-wet abrasant or specimen
1 600	Yes	No
3 200	Yes	No
6 400	Yes	Yes
12 800	Yes	Yes
25 600	Yes	Yes
38 400	No	Yes
51 200	Yes	No

8.1.12 Return each specimen to the same holder/abrasant table and restart the machine.

8.1.13 Stop the machine at each inspection point and repeat the procedure given in 8.1.11.

8.1.14 If appropriate, re-wet the abradant fabric and wool felt or specimen at each wet test station at the points shown in [Table 2](#), as follows:

- with the fabric and felt still clamped over the abradant table, gradually pour up to 30 g of water onto the surface while lightly rubbing in the water with the finger tips;
- stop pouring the water when it stops being absorbed and excess water is seen to accumulate on the surface;
- place the weightpiece ([5.3](#)) on top of each abradant for (10 ± 2) s and then remove.

8.2 Method 2

8.2.1 Apply double-sided adhesive tape to the back of a specimen. Ensuring that no creases or wrinkles are introduced in the specimen, fix the specimen to the abradant table ([5.1.2](#)). Continue the same procedure for the remaining specimens.

8.2.2 Into each specimen holder, place a piece of abradant fabric ([5.2](#)) of sufficient size to allow it to be fixed firmly within the specimen clamps.

8.2.3 Back the abradant cloth with a similar-size piece of polyurethane foam ([5.6](#)).

8.2.4 Ensuring that the abradant and foam are not baggy, creased or distorted in any way, firmly clamp the assembly in place.

8.2.5 Follow the same procedure as detailed in [8.1.10](#) to [8.1.14](#) for assessing the damage to the specimen on the abradant table.

9 Assessment of damage — Methods 1 and 2

To assess the amount of damage suffered by each specimen, rate them using the scale given in [Table 3](#).

If the test requires an assessment of the loss in mass of the specimens after a predetermined number of cycles, before the test, condition the specimens and record the mass of each. After completing the required number of cycles, recondition the specimens for the same time as before the test and then re-weigh.

Table 3 — Specimen damage rating scale

0	None	No change.
1	Very slight	Modification of brightness. Printing, if any, shows no wear. No attack of top coat.
2	Slight	Change in brightness. Printing, if any, is partially or totally worn. Top coat not attacked, or only very superficially.
3	Moderate	Top coat attacked.
4	Severe	Top coat worn through and intermediate or foam layer attacked.
5	Complete	Base fabric appears.

10 Test report

The test report shall include the following information:

- a) a reference to this document including the year of publication (i.e. ISO 5470-2:2021) and the method used (i.e. method 1 or method 2, wet or dry);
- b) a description of the material under test;

- c) in the case of double-coated fabrics, the surface which was tested;
- d) details of the abradant employed;
- e) details of any changes in the characteristics of the coated fabric, as required by the product specification;
- f) details of any deviations from the method specified;
- g) the pressure applied;
- h) the rating of the damage observed, in accordance with [Table 3](#), and the corresponding number of revolutions for each individual test specimen;
- i) details of whether the test was stopped due to early complete wear, or because the specified number of revolutions or the specified abrasion damage was attained;
- j) any unusual features observed;
- k) the date of test.

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