

INTERNATIONAL STANDARD

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Textiles — Determination of fabric propensity to surface fuzzing and to pilling —

Part 1: Pilling box method

Textiles — Détermination de la propension des étoffes à l'ébouriffage en surface et au boulochage —

Partie 1: Méthode de la boîte de boulochage

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Foreword

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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.

Attention is drawn to the possibility that some of the elements of this part of ISO 12945 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12945-1 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 24, *Conditioning atmospheres and physical tests for textile fabrics*.

ISO 12945 consists of the following parts, under the general title *Textiles — Determination of fabric propensity to surface fuzzing and to pilling*:

- Part 1: *Pilling box method*
- Part 2: *Modified Martindale method*
- Part 3: *Determination using a random tumble method*

Annex A of this part of ISO 12945 is for information only.

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Introduction

Pills are formed when fibres on a fabric surface "tease out" and become entangled during wear. Such surface deterioration is generally undesirable, but the degree of consumer tolerance for a given level of pilling will depend on the garment type and fabric end use.

Generally the level of pilling which develops is determined by the rates of the following parallel processes:

- a) fibre entanglement leading to pill formation;
- b) development of more surface fibre;
- c) fibre and pill wear-off.

The rates of these processes depend on the fibre, yarn and fabric properties. Examples of extreme situations are found in fabrics containing strong fibres versus fabric containing weak fibres. A consequence of the strong fibre is a rate of pill formation that exceeds the rate of wear-off. This results in an increase of pilling with an increase of wear. With a weak fibre the rate of pill formation competes with the rate of wear-off. This would result in a fluctuation of pilling with an increase of wear. There are other constructions in which the surface fibre wear-off occurs before pill formation. Each of these examples demonstrates the complexity of evaluating the surface change on different types of fabric.

The ideal laboratory test would accelerate the wear processes a), b) and c) by exactly the same factor and would be universally applicable to all fibre, yarn and fabric types. No such test has been developed. However, a test procedure has been established in which fabrics can be ranked in the same order of fuzzing and pilling propensity as is likely to occur in end-use wear.

Particular attention is drawn to annex A which gives advice on the maintenance of the apparatus. It is recommended that annex A be studied prior to carrying out the procedure.

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Textiles — Determination of fabric propensity to surface fuzzing and to pilling —

Part 1: Pilling box method

1 Scope

This part of ISO 12945 describes a method for the determination of the resistance to pilling and surface change of textile fabrics.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 12945. 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 12945 are encouraged to investigate the possibility of applying the most recent edition of the normative document 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 139, *Textiles — Standard atmospheres for conditioning and testing.*

3 Terms and definitions

For the purposes of this part of ISO 12945, the following terms and definitions apply.

3.1

fuzzing

roughing up of the surface fibres and/or teasing out of the fibres from the fabric producing a visible surface change

NOTE This change can occur during washing, dry cleaning and/or wearing.

3.2

pills

entangling of fibres into balls (pills) that stand proud of the fabric and are of such density that light will not penetrate and will cast a shadow

NOTE This change can occur during washing, dry cleaning and/or wearing.

3.3

pilling

generation of pills over the surface of the fabric

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4 Principle

Specimens are mounted on polyurethane tubes and tumbled randomly in a cork-lined box at a constant rotational speed. Fuzzing and pilling is assessed visually after a defined period of tumbling. Any special treatment of the laboratory sample, i.e. washing, cleaning, has to be agreed upon and shall be stated in the test report.

5 Apparatus

5.1 **Pill testing box**, cubic, with internal dimensions, before lining, of 235 mm. All internal surfaces of the box shall be lined with cork jointing material of 3,2 mm thickness. The box shall be rotated at (60 ± 2) r/min about a horizontal axis passing through the centres of two opposite faces. One side of the box shall be removable for access.

NOTE Advice on the calibration and comparison of pill testing boxes is given in annex A.

Cork linings shall be inspected at regular intervals and shall be replaced when obviously damaged or soiled in such a way as to alter their frictional properties (see A.4).

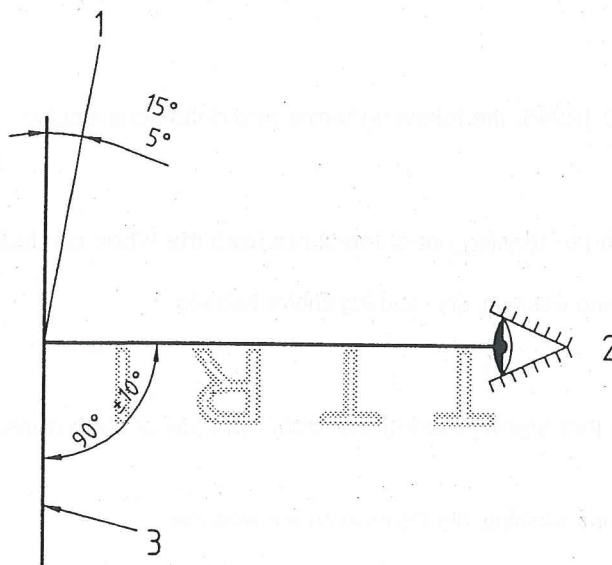
5.2 **Polyurethane specimen tubes**, (four are required), each measuring (140 ± 1) mm in length by $(31,5 \pm 1)$ mm outside diameter by $(3,2 \pm 0,5)$ mm wall thickness, mass $(52,25 \pm 1)$ g.

5.3 **Mounting jig**, used to mount specimens on the tubes.

5.4 **Self-adhesive polyvinyl chloride (PVC) tape**, 19 mm wide.

5.5 **Sewing machine**.

5.6 **Viewing cabinet**, illuminated by a white fluorescent tube or bulb (the colour temperature of the light source is not critical) to give uniform illumination over the width of the specimen(s) and masked in such a way that the observer does not look directly into the light. Position the illuminant at an angle between 5° and 15° to the plane of the specimen (see Figure 1). The distance between the eye and the specimen shall be between 30 cm and 50 cm for normal corrected vision.



- Key
- 1 Light source
 - 2 Observer
 - 3 Specimen

Figure 1 — Illumination of specimens

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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 $(20 \pm 2)^\circ\text{C}$ and a relative humidity of $(65 \pm 2)\%$.

7 Preparation of test specimens

7.1 Pretreatment

Unless otherwise agreed, launder or dry clean the sample using a method agreed between the interested parties.

NOTE 1 The procedures described in ISO 6330 or ISO 3175-1 and ISO 3175-2 may be suitable.

NOTE 2 It is recommended to launder or dry clean test specimens in order to protect the friction surfaces of the pilling box and specimen tubes from lubricants or finishes which may cause inconsistent results.

If laundering or dry cleaning is carried out, assess the specimens before and after the pretreatment using the grading scheme described in clause 9.

7.2 Cutting out

From the sample, cut four test specimens, each $125\text{ mm} \times 125\text{ mm}$. On each test specimen mark the back of the fabric and the length direction. Where a fabric has no discernible face, test both sides. An additional cut specimen of $125\text{ mm} \times 125\text{ mm}$ is required for assessment.

NOTE Test specimens should be randomly placed with none of the test specimens having common warp or weft threads.

7.3 Number of test specimens

Take two specimens and fold each with its face, if discernible, inward and with the machine direction running in the direction of the fold. Sew 12 mm from the cut edges to form a tube, using a stitch density such that a balanced seam is produced. Prepare the other two specimens similarly with the cross direction running in the direction of the fold.

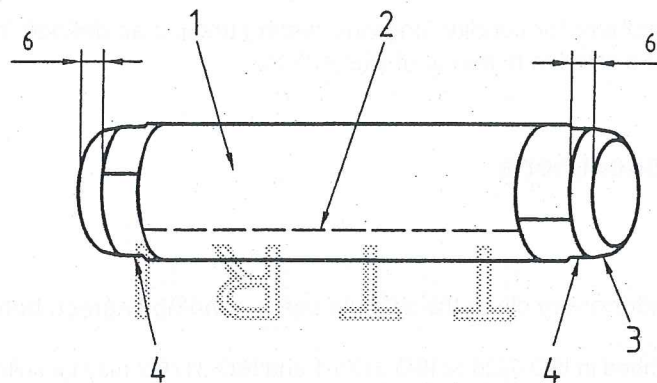
7.4 Mounting of test specimens

Turn each specimen inside out, so that the fabric face forms the outside of a tube, and cut 6 mm off each end of the fabric tube to remove any sewing distortion. Using the mounting jig (5.3), mount one prepared specimen on each polyurethane specimen tube (5.2) so that the specimen ends are an equal distance in from the ends of the polyurethane specimen tube (see Figure 2). Ensure that the seamed portion lies as flat as possible. Apply self-adhesive PVC tape (5.4) around each of the cut ends of each specimen, so that the tape fixes the specimen on to the tube and leaves 6 mm of the polyurethane specimen tube exposed. The length of tape on each end of the specimen shall not exceed a length of approximately 1.5 times the circumference of the tube.

7.5 Conditioning

Condition the specimens in the atmosphere specified in clause 6 for at least 16 h. Carry out the test in the same atmosphere.

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**Key**

- 1 Test specimen
- 2 Seam
- 3 Polyurethane tube
- 4 Adhesive tape

Figure 2 — Mounting of specimen on to polyurethane tube

8 Procedure

Ensure that the inside of the pill testing box (5.1) is clean and free from lint.

Place the four mounted specimens from the sample in the same pill testing box. Close and firmly secure the lid. Tumble the tubes in the box for the agreed number of revolutions.

NOTE No test/wear predictions are available covering all types of textile fabrics. It is therefore necessary for the parties concerned to agree on the number of revolutions for the particular fabric construction under test.

Remove the specimens from the box and remove the stitching from the seam.

9 Assessment of fuzzing and/or pilling

The viewing cabinet shall be situated in a darkened room.

Place the tested specimen and a piece of the original sample, with or without pretreatment (see 7.1), centrally on the lectern in the viewing cabinet (see Figure 1), with the length direction vertical. If necessary use a piece of self-adhesive PVC tape (5.4) to ensure correct placement. Mount the tested specimen on the left and the original sample on the right.

In order to prevent glare from the light source view each specimen from just outside the viewing cabinet (5.6), directly in front of the specimen, as in Figure 1.

Due to the subjective nature of the assessment, it is recommended that more than one observer assess the specimens.

Grade each specimen in accordance with the grading scheme given in Table 1. If the grading appears between two grades, report the "half" grading as, for example, 3-4.

The test result for each individual observer is the average of four specimen grades. The test result for the laboratory sample is the average of the observer grades.

Photographic assessment may be used to support the primary descriptive method of assessment, as agreed between interested parties.

A second assessment may be made by rotating the specimen to a position where the observed pilling is more severe. This assessment may be used to provide data for an "extreme" condition, e.g. where a surface is being viewed along the plane of the surface.

Report any other aspect which shows deterioration in surface appearance.

Table 1—Visual assessment

Grade	Description
5	No change.
4	Slight surface fuzzing and/or partially formed pills.
3	Moderate surface fuzzing and/or moderate pilling. Pills of varying size and density partially covering the specimen surface.
2	Distinct surface fuzzing and/or distinct pilling. Pills of varying size and density covering a large proportion of the specimen surface.
1	Dense surface fuzzing and/or severe pilling. Pills of varying size and density covering the whole of the specimen surface.

10 Results

Record the grading for each specimen and calculate the mean result for all assessments carried out as described in clause 9. If the mean result is not a whole number, round the result to the nearest half grade. The variation in the result based on the mean of four test specimens should be no more than half a grade. If this variation is more than half a grade, the grading of each specimen shall be reported.

11 Test report

The test report shall include the following information:

- reference to this part of ISO 12945, i.e. ISO 12945-1:2000;
- description of the laboratory sample;
- where applicable, details of pretreatment of the laboratory sample;
- number of test specimens and number of observers;
- number of revolutions;
- date of test;
- the final grade assessed and whether it relates to fuzzing or pilling or both;
- details of any deviation from the procedure.

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Annex A (informative)

Advice on the use of the pill testing box

A.1 Pill testing box

The rotational speed of (60 ± 2) r/min should be checked periodically.

New liners require running in for approximately 200 h with four blank tubes until the liner has stopped shedding cork dust. Generally, the frictional properties of the cork are not a major source of test result variation, but after prolonged use the surface of the cork may become polished or contaminated. Such changes can lead to less severe pill testing. In such cases, the cork liners should be replaced.

A.2 Specimen tubes

The press-moulded polyurethane tubes should be identical to each other when new. Experience of intensive use has shown that no significant wear of these tubes occurs under normal use conditions.

The most critical part of the tube is the convex outer surface at its end. New tubes should be checked on receipt in order to ensure that no moulding faults have occurred in the critical region. In-use damage is unlikely, but if it should occur it is essential that the tube be replaced.

A.3 Cleaning and maintenance

Before each test it is essential to ensure that all fluff and debris from the previous test have been removed from inside the box, e.g. by means of a vacuum cleaning device or by using a painter's small brush. Periodically, it may be necessary to clean the cork liners if they have become contaminated by finishes etc. from test fabrics. A suitable cleaning solvent is industrial methylated spirit. Use only a minimum amount of solvent to wipe the surface of the cork.

NOTE The use of industrial methylated spirit may be the subject of national legal regulations.

A.4 Calibration

It is recommended that each user of this test method retain two calibration fabrics relevant to the work of the laboratory and having different levels of pilling and fuzzing in the range grade 1-2 to grade 4.

These calibration fabrics should be used to test every newly installed box and every newly relined box and the tested fabric specimens should be retained for subsequent reassessment. At regular intervals, e.g. 6 months, the calibration fabrics should be retested and compared with the initially tested specimens. In this way any drift, either between boxes or within a box, can be detected. The fact that specimens may have a slightly flattened surface should be taken into account.

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Bibliography

- [1] ISO 3175-1:1998, *Textiles — Dry cleaning and finishing — Part 1: Method for assessing the cleanability of textiles and garments.*
- [2] ISO 3175-2:1998, *Textiles — Dry cleaning and finishing — Part 2: Procedures for tetrachloroethene.*
- [3] ISO 6330:—¹⁾, *Textiles — Domestic washing and drying procedures for textile testing.*

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