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## Carpets — Determination of tuft withdrawal force

*Revêtements de sol textiles — Détermination de la force  
d'arrachement de touffes*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4919 was prepared by Technical Committee ISO/TC 219, *Floor coverings*.

This second edition cancels and replaces the first edition (ISO 4919:1978), which has been technically revised.

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# Carpets — Determination of tuft withdrawal force

## 1 Scope

This International Standard specifies a method for determination of tuft withdrawal force and is applicable to all carpets with a cut or loop pile yarn structure.

## 2 Normative references

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

ISO 1957, *Machine-made textile floor coverings – Selection and cutting of specimens for physical tests*

ISO 2424, *Textile floor coverings – Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2424 and the following apply.

### 3.1 tuft

length of yarn, for example I, J, U or W shaped, or length of yarn in the form of a knot, of which the leg or legs form the pile of a carpet

### 3.2 loop

continuous length of yarn or fibres between two successive lowest points of bindings of the pile in the substrate

NOTE In certain places in this International Standard, for example in the title, the term “tuft” when used in a general sense implies “and/or loop”.

## 4 Principle

Gripping of one end of a tuft, or hooking a loop, and recording the force registered at the point where slippage occurs in the bonds holding the tufts in the carpet structure during the removal process.

## 5 Apparatus

**5.1 Tensile testing apparatus**, with suitable ranges and an accuracy of  $\pm 5\%$  (normally a range equivalent to 10, 20, 50 or 100 N would be required).

Constant Rate of Extension (CRE) and Constant Rate of Loading (CRL) machines may be used (CRE machines being the most common); in any case the average test time for the achievement of the maximum withdrawal force of the tufts and loops should be between 5 s and 10 s. This may be achieved in machines which would give very short test times, for example those using load cells, by inserting a spring between the loading mechanism and the specimen.

The apparatus shall have a means of clamping a specimen of carpet to a base plate so that it is flat in a plane perpendicular to direction of pull upon the tuft or loop. The flat, horizontal part of the clamp which is brought into contact with the specimen during testing shall be at least 60 mm  $\times$  60 mm, shall have a circular cut-out of at least 12 mm radius around the tuft or loop to be withdrawn and shall

restrain the specimen outside of this cut-out area (see Figure 1). The cut-out may have a throat to allow easier positioning of the specimen with the tuft grip or hook attached (see Figure 1).

For cut pile carpets, a suitable means of selecting and gripping one end of a tuft shall be provided (for example locking surgical forceps) and for loop pile carpets, a suitable hook (for example a knitting-machine needle) is required. These tuft grips are attached to the upper jaw of the tensile apparatus.

The load-sensing mechanism of the machine shall be calibrated with the tuft grip or hook in position.

## 6 Atmosphere for conditioning and testing

The conditioning and testing atmosphere shall be the standard atmosphere for testing textiles defined in ISO 139, i.e. an atmosphere of relative humidity  $(65 \pm 4) \%$  and a temperature of  $(20 \pm 2) ^\circ\text{C}$ .

## 7 Test samples and specimens

Take samples from at least five places across the width of the carpet selected to be representative of the material under test in accordance with ISO 1957. Condition the samples for not less than 24 h in the standard atmosphere for testing textiles, as defined in Clause 6. Cut the specimens (one from each sample) to a size which is convenient for clamping on the testing machine and which will allow for at least 10 tufts to be withdrawn from each. No tufts shall be withdrawn from within 25 mm of the edge of a specimen or of any previously withdrawn tuft.

## 8 Procedure

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8.1 Conduct the test in the standard atmosphere for testing textiles, as defined in Clause 6.

8.2 For cut pile carpets, select one end of one tuft and attach the tuft grip. The selection of the tuft is easier if the specimen is bent backwards slightly to open out the tuft structure. Clamp the specimen firmly as described in Clause 5, and attach the tuft grip to the upper jaw. Set the machine in motion and completely withdraw the tuft along a path that is essentially perpendicular to that of the carpet specimen. Verify that only one tuft was withdrawn and register the maximum force recorded. If additional fibres from another tuft were gripped or if only part of the tuft was removed, ignore the result.

In certain carpet constructions the selection of one tuft is impracticable, for example fine gauge carpets with more than one end per dent, or needle and fine gauge velour products. In such cases grip the minimum number of tufts that can be selected, and inspect the withdrawn unit carefully to ensure that the required number of tufts has been isolated.

If tufts have been selected from more than one dent, or if examination of the carpet shows that not the entire tuft has been removed; the results for such tufts should be disregarded.

8.3 For loop pile carpets, select a suitable loop and engage the hook under the top of it. Attach the hook to the upper jaw. Set the machine in motion to move the hook along a path that is essentially perpendicular to that of the carpet specimen, and stop it as soon as slippage occurs in the bonds holding one of the loop sides. Verify that only one loop was withdrawn and register the maximum force recorded.

8.4 Where both cut and loop pile are present or where the specimen is composed of yarns of different linear densities, different fibres or different types, these shall be tested separately, and care should be taken to ensure that where possible the tufts or loops tested are surrounded by those of the same type. In some cases there may be no apparent physical differences in the yarns but real and statistically significant differences can be observed in the test results, justifying separation of the results into discrete populations. In the case of patterned goods, for example crossover tufted carpets, the tufts may be identified by the position in which they appear in the pattern and/or the colour of the tufts. Only completely cut tufts or completely uncut loops should be tested.

**8.5** Repeat the procedure for a minimum of 20 tufts or loops, spread evenly through the available samples taking into account the restriction of at least 25 mm between a previously withdrawn tuft or edge of the specimens. If the pile yarn breaks without pulling out the tuft or loop, register the maximum force recorded and mark the result “broken”. Include this result in the number of valid tests but use it separately in calculations.

NOTE The coefficient of variation of tuft withdrawal force is usually fairly large and may be of the order of 20 % to 30 %. Assuming these values, if 20 tests are carried out, the 95 % confidence limits of the mean are about  $\pm$  (9 to 13) % of the mean value.

Greater accuracy may be obtained by testing more tufts; for example, if 50 tufts are tested, the 95 % confidence limits would be  $\pm$  (6 to 9) % of the mean value.

## 9 Expression of results

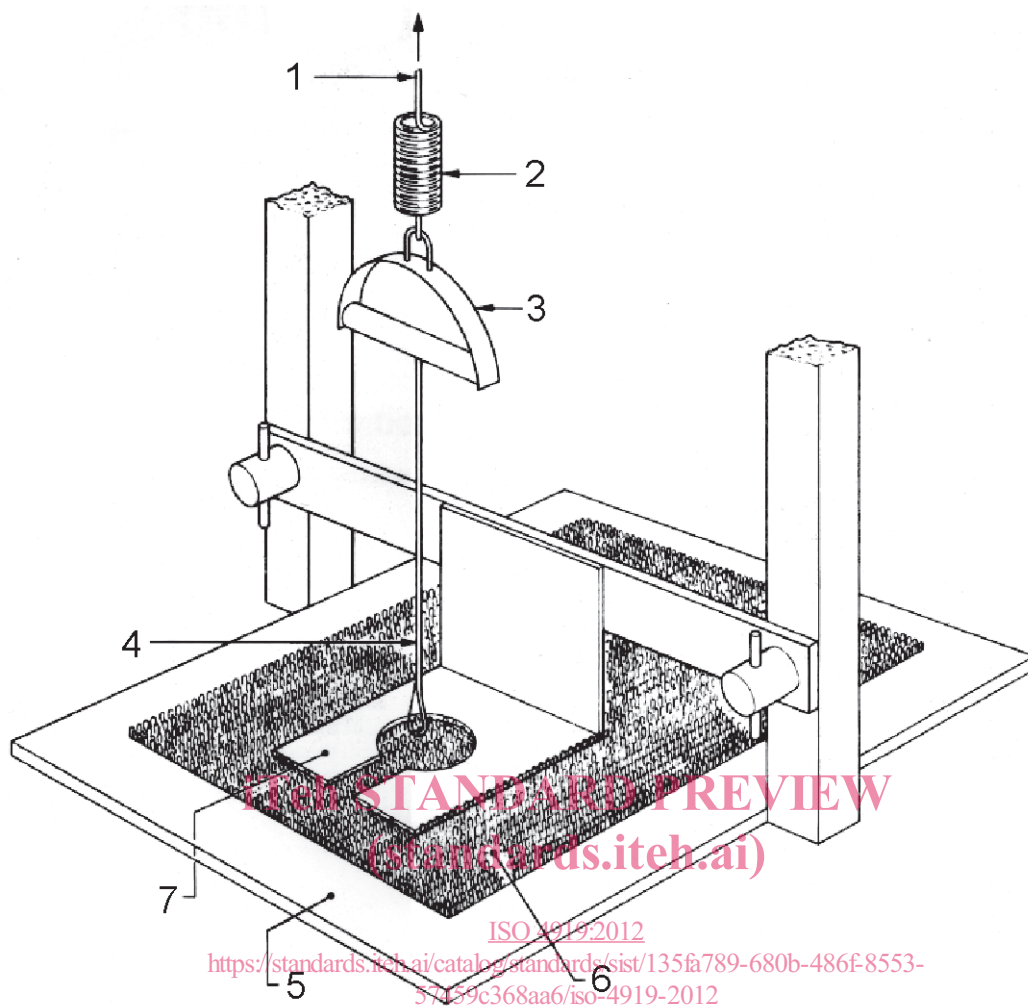
Calculate the mean tuft withdrawal force, in newtons, and the coefficient of variation for all of the results, excluding any marked “broken”. Calculate the mean force for the broken tufts separately.

If different types of pile or different yarns are tested separately and there is a marked difference between results from different areas, this should be reported.

## 10 Test report

The test report shall include the following information:

- a) that the tests were performed in accordance with this International Standard;
- b) the date the tests were performed;
- c) the type of tensile machine used (CRE/CRL);
- d) the number of tufts or loops tested;
- e) the mean tuft withdrawal force and the coefficient of variation and, if applicable, the mean breaking force of the broken tufts, and the different areas and different types (see 8.4);
- f) if applicable, a statement that a multiple number of tufts was withdrawn, and a careful description of the unit.



**Key**

- |   |                       |   |  |
|---|-----------------------|---|--|
| 1 | loading mechanism     | 5 | base plate                                   |
| 2 | spring (if necessary) | 6 | carpet specimen                              |
| 3 | upper jaw             | 7 | specimen clamp, dimensions as defined in 5.1 |
| 4 | tuft grip or hook     |   |  |

**Figure 1 — One possible form of flat horizontal mounting**



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