
**Textile floor coverings — Methods for
determination of mass**

Revêtements de sol textiles — Méthodes de détermination de la masse





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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 219, *Floor coverings*.

This third edition cancels and replaces the second edition (ISO 8543:1998), which has been technically revised.

The main changes compared to the previous edition are as follows:

- clarification of method in the case of artificial turf products.

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.

Textile floor coverings — Methods for determination of mass

1 Scope

This document specifies methods for the determination of the total mass per unit area, total pile mass per unit area, and mass of pile per unit area above the substrate, and for the calculation of measured surface pile density and measured pile fibre volume ratio of textile floor coverings.

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

ISO 1763, *Textile floor coverings — Determination of number of tufts and/or loops per unit length and per unit area*

ISO 1765, *Machine-made textile floor coverings — Determination of thickness*

ISO 1766, *Textile floor coverings — Determination of thickness of pile above the substrate*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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/>

3.1

constant mass

mass attained when successive weighings at hourly intervals over a period of 3 h do not vary by more than 1 %

3.2

total pile mass per unit area

mass of the pile yarn in a unit area, including that forming the base of the tufts or held in the substrate but excluding any backing compound adhering to the pile yarn, determined under specified conditions

Note 1 to entry: For the purpose of this document, the determination is carried out in equilibrium with the standard atmosphere for conditioning and testing described in [Clause 4](#).

3.3

measured surface pile density

ratio of mass to volume of the pile above the substrate measured under a pressure of 2,0 kPa

Note 1 to entry: 1 kPa = 10³ N/m².

3.4

measured pile fibre volume ratio

proportion of the volume of the pile actually occupied by fibre

4 Atmosphere for conditioning and testing

The specimens shall be conditioned and the test conducted in one of the standard atmospheres for conditioning and testing textiles specified in ISO 139.

5 Number of specimens

The number of specimens for each determination in accordance with [Clauses 6, 8](#) and [9](#) shall be sufficient to give 95 % confidence limits of ± 6 %. Four specimens shall be tested initially and if the coefficient of variation (CV) calculated from these tests is >4 %, then further specimens shall be tested as follows:

if $4 \% < CV < 5,5 \%$, test a further two specimens (total six);

if $5,5 \% < CV < 7 \%$, test a further four specimens (total eight);

if $CV > 7 \%$, test a further eight specimens (total twelve).

NOTE Confidence limits = $\pm \frac{t \cdot CV}{\sqrt{n}}$

where

t is the appropriate value for Student's t-test;

n is the number of specimens tested.

6 Determination of total mass per unit area

6.1 General

The method is applicable to textile floor coverings including those with varying pile height or density. It can be used prior to, and in conjunction with, the methods specified in [Clauses 8](#) and [9](#), with which it is compatible.

6.2 Principle

The mass of a measured area of textile floor coverings is determined in its entirety.

6.3 Apparatus

6.3.1 Sharp pointed knife or a punching machine.

6.3.2 Ruler, graduated in millimetres.

6.3.3 Balance, with a reading resolution to 0,01 g and a precision to 0,1 g.

6.4 Specimens

Select the specimens according to the standard procedure specified in ISO 1957. Cut out or punch out, using the sharp knife or punch knife, at least four rectangular specimens, each at least 200 mm \times 200 mm and 15 tuft rows, with the sides parallel with, and at right angles to, the machine production direction.

For artificial grass it is very important to try to cut in the middle of two tuft rows to decrease the variability

NOTE More than four specimens can be required in order to achieve the desired confidence limits (see [Clause 5](#)).

6.5 Preparation of specimens

Lay the specimens out flat, singly and with the use-surface uppermost in the atmosphere for conditioning and testing described in [Clause 4](#), until they reach constant mass as defined in [3.1](#).

6.6 Procedure

Determine the mass, m , in grams, of each specimen to a reading resolution of 0,01 g and a precision of 0,1 g. Afterwards measure the length and width of each specimen on the back, to the nearest millimetre, each in four places.

6.7 Expression of results

For each specimen, calculate the average length and width, in millimetres, and multiply these to obtain the area, A , in square millimetres. For each specimen, calculate the total mass per unit area, in grams per square metre, using the formula

$$10^6 \times \frac{m}{A}$$

where

m is the mass in g;

A is the surface of the specimen in mm².

Calculate the coefficient of variation (CV) and, if necessary, test further specimens according to [Clause 5](#). Calculate the mean and CV of all the results.

6.8 Test report

The test report shall include the following information:

- a statement that the procedure was conducted in accordance with ISO 8543:2020, Clause 6;
- the identity (source and type) of the sample from which the specimens were taken, and whether it was of varying pile height or density;
- the standard atmosphere used for conditioning and testing;
- the number of specimens tested;
- the total mass per unit area of each specimen, in g/m²;
- the mean total mass per unit area, in g/m², and the overall coefficient of variation.

7 Determination of total pile mass per unit area

7.1 General

The method is applicable to textile floor coverings with uniform or varying pile height or density, but is not appropriate for those where backing compound has been applied to the tufts. It can be used in conjunction with the method specified in [Clause 6](#), with which it is compatible.

NOTE In case of artificial turf, the compound can easily be removed.

7.2 Principle

A known area of the textile floor coverings is weighed and dissected completely. The pile yarn is separated from the other components and is weighed separately.

NOTE For the definition of total pile mass per unit area, see [3.2](#).

7.3 Apparatus

7.3.1 Sharp pointed knife or punching machine.

7.3.2 Ruler, graduated in millimetres.

7.3.3 Balance, with a reading resolution to 0,01 g and a precision to 0,1 g.

7.3.4 Dissecting needles and forceps.

7.4 Specimens

Select the specimens according to the standard procedure specified in ISO 1957. Cut out or punch out, using the sharp pointed knife or punching machine, at least four rectangular specimens, each at least 200 mm × 200 mm and 15 tuft rows, with the sides parallel with, and at right angles to, the machine production direction. Trim them so that each side of each specimen is formed by a complete row of pile or line of stitches.

Measure the length and width at four places on the back of each specimen, to the nearest millimetre.

NOTE 1 More than four specimens can be required in order to achieve the desired degree of accuracy (see [Clause 5](#)).

NOTE 2 For artificial turf, see [7.5.2](#).

7.5 Procedure

7.5.1 Textile floor covering

With the needle and forceps, carefully remove all the yarn forming tufts and collect it together for each specimen.

When analysing multi-frame Wilton carpets, treat buried pile yarn from dead frames as pile yarn, irrespective of whether it forms tufts in the specimen under examination or not.

In some multi-frame Wilton carpets, the buried pile yarn may be of a different composition from the working pile. If this is so in the specimen under test, determine the mass of the buried pile separately from that of the working pile.

Afterwards condition the tufts and buried pile (if present) in the atmosphere for conditioning and testing specified in [Clause 4](#), until they reach constant mass as defined in [3.1](#).

Determine the mass m , in grams, of the conditioned yarn forming tufts and of the buried pile (if present), to a reading resolution of 0,01 g and a precision of 0,1 g.

7.5.2 Artificial turf

For artificial turf, select 20 tufts and remove the latex or coating.

Treat buried pile yarn (if present) from dead frames as pile yarn.

Condition the tufts in the atmosphere for conditioning and testing specified in [Clause 4](#), until they reach constant mass as defined in [3.1](#).

Determine the mass m , in grams, of the conditioned yarn forming tufts and of the buried pile (if present) to the nearest 0,01 g.

7.6 Expression of results

7.6.1 For textile floor coverings

Calculate the area A , of each specimen, in square millimetres. Then calculate the total pile per unit area, in grams per square metre, for each specimen, using the formula

$$10^6 \times \frac{m}{A}$$

where

m is the mass in g;

A is the surface of the specimen in mm².

Calculate the coefficient of variation (CV) and, if necessary, test further specimens according to [Clause 5](#). Calculate the mean and CV of all the results.

7.6.2 For artificial turf

Calculate the total pile mass using the formula

$$m/20 \times N$$

where

m is the mass in g up to a reading resolution of 0,001 g and a precision of 0,01 g;

N is the number of tufts and/or loops per m² (determined in accordance with ISO 1763).

Calculate the coefficient of variation (CV) and, if necessary, test further specimens according to [Clause 5](#). Calculate the mean and CV of all the results.

7.7 Test report

The test report shall include the following information:

- a statement that the test procedure was conducted in accordance with ISO 8543:2020, Clause 7;
- the identity (source and type) of the sample from which the specimens were taken, and whether it was of varying pile height or density;
- the standard atmosphere used for conditioning and testing;

- d) the number of specimens tested;
- e) the total pile mass per unit area, in g/m², for each specimen;
- f) the mean total pile mass in g/m² and the overall coefficient of variation;
- g) if, in a multi-frame Wilton carpet, the buried pile is of a different composition from the working pile, state this fact and report the buried pile mass separately from that of the working pile.

8 Determination of mass of pile per unit area above the substrate

8.1 General

This method is applicable to textile floor coverings with a pile of cut and/or looped yarn, and may be used for textile floor coverings with varying pile height or density. It may be used in conjunction with the methods specified in [Clauses 6](#) and [9](#), and in ISO 1766, on the same specimens.

Difficulties have been experienced when using this method for bonded-pile textile floor coverings, textile floor coverings with needled-pile and flocked-pile textile floor coverings, because of the problems of determining a suitable end point when shearing these products. The results obtained from such products should therefore be treated with caution.

8.2 Principle

The masses of specimens of textile floor coverings of known dimensions are determined before and after the pile has been shorn.

8.3 Apparatus

8.3.1 Sharp pointed knife or punching machine.

8.3.2 Balance, with a reading resolution to 0,01 g and a precision to 0,1 g.

8.3.3 Ruler, graduated in mm.

8.3.4 Band knife machine or hand-held clippers, capable of shearing the pile close to the substrate.

The particulars of the shearing machine and details of its operation should be agreed between the interested parties.

The results from the two types of apparatus may not be identical.

8.3.5 Press and cutter, or other apparatus, either circular or square, of known areas, not less than 25 000 mm².

8.4 Specimens

Select specimens according to the standard procedure specified in ISO 1957. Cut out or punch out, using the sharp pointed knife or punching machine, at least four specimens, each at least 200 mm × 200 mm and 15 tuft rows, with the sides parallel with, and at right angles to, the direction of manufacture.

NOTE More than four specimens can be required in order to achieve the desired degree of accuracy (see [Clause 5](#)).

8.5 Preparation of specimens

Lay the specimens out flat, singly and with the use-surface uppermost in the atmosphere for conditioning and testing described in [Clause 4](#), until they reach constant mass as defined in [3.1](#).

8.6 Procedure

Determine the mass of each specimen, m_1 , in grams, to a reading resolution of 0,01 g and a precision of 0,1 g.

Then measure the length and width, in millimetres, each in four places, on the back of each specimen, to the nearest 1 mm.

Shear the pile from the specimen. When using a hand knife machine, keep on repeating the process with the roller being set progressively lower until it is as low as possible without damaging the substrate. At each setting, insert the specimen into the machine several times, each time in a different direction. After each process, brush the pile upright.

When using clippers, use forward strokes in all directions. Shear as close as possible to the substrate by running the points of the comb and cutter along the substrate without digging in. Avoid plucking any tufts or damaging the substrate. It is not necessary to shear the edges of the specimen, provided that the area of 25 000 mm² in the centre is closely shorn.

Brush, blow or suction clean the specimen during and/or after shearing. Continue shearing until no further significant amount of pile yarn dust appears on the shearing blades or falls away when the specimen is shaken, pile down, over a smooth surface of contrasting colour.

After shearing, unless the total area of the specimen is completely shorn without damage to the substrate and can be used to determine the mass per unit area of the substrate, cut a completely shorn piece of not less than 25 000 mm² from the centre of the specimen, using the press and cutter. In either case, the substrate yarns in this area shall be undamaged, and no tufts shall have been plucked from it.

Condition each area cut out of the shorn carpet specimens by laying them flat, singly, in the atmosphere for conditioning and testing described in [Clause 4](#), until they reach constant mass as defined in [3.1](#).

Determine the final conditioned mass of the shorn area of each specimen, m_2 , to the nearest 0,01 g.

8.7 Expression of results

From the measurements made in [6.6](#), calculate for each specimen the average length and width, in millimetres, and the area (A_1), in square millimetres. Calculate the total mass per unit area (m_1/A_1) of carpet for each specimen separately, in grams per square millimetre. Note the area (A_2), in square millimetres, of each specimen of shorn carpet as described in [8.6](#) and calculate the mass per unit area (m_2/A_2) for each, in grams per square millimetre.

NOTE In cases where it was possible to determine the mass of the whole of the shorn original specimen, then $A_2 = A_1$. In cases where the cutter was used, A_2 equals the known area of the cutter.

For each specimen, calculate the mass of shorn pile per unit area, Q_A , in grams per square metre, to the nearest gram per square metre, using the formula

$$10^6 \times \left(\frac{m_1}{A_1} - \frac{m_2}{A_2} \right)$$

Calculate the coefficient of variation (CV) and, if necessary, test further specimens according to [Clause 5](#). Calculate the mean and CV of all the results.

8.8 Test report

The test report shall include the following information:

- a) a statement that the test procedure was conducted in accordance with ISO 8543:2020, Clause 8;
- b) the identity (source and type) of the sample from which the specimens were taken, and whether it was of varying pile height or density;
- c) the standard atmosphere used for conditioning and testing;
- d) the number of specimens tested;
- e) the mass of pile per unit area above the substrate, in g/m^2 , for each specimen;
- f) the mean mass of pile per unit area above the substrate, in g/m^2 , and the overall coefficient of variation;
- g) whether the sample was of varying pile height or density;
- h) the type of shearing apparatus used.

9 Calculation of measured surface pile density and measured pile fibre volume ratio

9.1 General

This method is applicable to textile floor coverings capable of being shorn from the backing, but is not applicable to textile floor coverings of varying pile thickness or density unless the areas can be measured separately. It is used in conjunction with the methods specified in [Clause 8](#) and ISO 1766.

Difficulties have been experienced when using this method for bonded-pile textile floor coverings, textile floor coverings with needled-pile and flocked-pile textile floor coverings, because of the problems of determining a suitable end point when shearing these products. The results obtained from such products should therefore be treated with caution.

9.2 Principle

Pile thickness and mass are determined before and after the pile has been shorn. The measured surface pile density and the measured pile fibre volume ratio are calculated from the values obtained.

NOTE For the definitions of measured surface pile density and measured pile fibre volume ratio, see [3.3](#) and [3.4](#).

9.3 Apparatus

9.3.1 Sharp pointed knife or punching machine, balance, rule, hand-knife machine or hand-held clippers, and press and cutter, as specified in [8.3](#).

9.3.2 Carpet thickness tester and straightedge as described in ISO 1765.

9.4 Specimens

Select four (or more) specimens as described in [6.4](#).

9.5 Preparation of specimens

Lightly brush the use-surface, first against, then with, the direction of pile lean, using a straightedge, e.g. a ruler. Lay the specimens out flat, singly and with the use-surface uppermost in the atmosphere for conditioning and testing as specified in [Clause 4](#), for a period of at least 24 h, and until they reach constant mass as defined in [3.1](#).

9.6 Procedure

Measure the thickness of each specimen as described in ISO 1765.

Then determine the mass of the pile per unit area before and after shearing, as described in [Clause 8](#), shearing the pile from the specimen as described in [8.6](#).

Measure the thickness of each shorn specimen as described in ISO 1765.

9.7 Expression of results

Calculate the mean pile thickness d for all specimens, in millimetres, as described in ISO 1766, to the nearest 0,1 mm.

Calculate the mean mass of shorn pile per unit area above the substrate as described in [8.7](#), in grams per square metre, to the nearest gram per square metre.

Calculate Q_S , the measured surface pile density, in grams per cubic centimetre, under a pressure of 2,0 kPa, using the formula

$$10^{-3} \times \frac{Q_A}{d}$$

$$= 10^3 \times \frac{\frac{m_1}{A_1} - \frac{m_2}{A_2}}{d}$$

where

m_1, m_2, A_1, A_2 , and Q_A are defined in [8.6](#) and [8.7](#);

d is the pile thickness determined in accordance with ISO 1766.

Calculate the measured pile fibre volume ratio using the formula:

$$\frac{Q_S}{Q_F}$$

where

Q_S is the measured surface pile density;

Q_F is the pile fibre density in g/cm³.

NOTE Pile fibre volume ratio can be estimated by expressing, as a percentage, the measured surface pile density (see [3.3](#)) divided by the pile fibre density.

If the pile consists of two or more fibre types, the average pile fibre density $\overline{Q_F}$ can be calculated as follows

$$\overline{Q_F} = \frac{100}{(C_1/Q_{F1}) + (C_2/Q_{F2}) + \dots + (C_n/Q_{Fn})}$$

where

C_1 is the percentage, by mass, of the fibre of density Q_{F1} ;

C_2 is the percentage, by mass, of the fibre of density Q_{F2} ;

C_n is the percentage, by mass, of the fibre of density Q_{Fn} .

9.8 Test report

The test report shall include the following information:

- a) a statement that the test procedure and calculation were conducted in accordance with ISO 8543:2020, Clause 9;
- b) the identity (source and type) of the sample from which the specimens were taken;
- c) the standard atmosphere used for conditioning and testing;
- d) the pile thickness, in mm, for each specimen;
- e) the mean pile thickness, in mm, to the nearest 0,1 mm;
- f) the mass of pile per unit area above the substrate, in g/m^2 , for each specimen;
- g) the mean mass of pile per unit area above the substrate, in g/m^2 ;
- h) the measured surface pile density under a pressure of 2,0 kPa, in g/cm^3 ;
- i) the measured pile fibre volume ratio;
- j) the type of shearing apparatus used.

