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British Standard Methods for

Determination of constructional details of textile floor coverings with yarn pile

Méthodes de détermination du mode de construction des revêtements de sol textiles velours

Angaben zur Herstellung von textilen Bodenbelägen mit Florgarn

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Foreword

This British Standard has been published under the direction of the Textiles and Clothing Standards Policy Committee. It is the third revision of BS 4223 which was first published in 1967 and revised in 1976 and 1983. BS 4223 : 1983 is withdrawn.

In this revision four methods (see clauses 7, 8, 9 and 11) have been aligned with a single International Standard, ISO 8543, two other methods (see clauses 6 and 10) have been aligned with ISO 1763 and the recently revised ISO 1766.

Of the three methods described in the 1983 edition of this British Standard as 'estimations' only one has been retained in this revision (see appendix A).

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Contents

Method

1 Scope

This British Standard describes methods for the determination of the constructional details of textile floor coverings of woven, tufted or raschel constructions with a pile of cut or looped yarn including details of any integral foam backing.

NOTE 1. Appendix A describes a method for the estimation of pile length using simple metal gauges.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the definitions given in BS 5557 apply together with the following.

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

2.2 tuft. A length of yarn, for example, J-shaped, U-shaped or W-shaped, or a length of yarn in the form of a knot, the leg or legs of which form the pile of a textile floor covering.

2.3 tuft length. The distance between the extremities of a tuft, straightened in a groove.

NOTE. The tuft length is measured on the simplest tuft unit representing the basic construction.

2.4 loop length. The length of yarn forming one complete loop, including the portion held in the substrate.

2.5 total pile mass per unit area. The mass of the pile yarn in a unit area, including the yarn forming the base of the tufts or held in the substrate, but excluding any backing compound adhering to the pile yarn, determined in equilibrium with the standard temperate atmosphere for conditioning and testing specified in **3.1**.

2.6 pile above substrate. That part of the pile which is above the substrate.

NOTE. Pile above substrate is also known as the surface pile.

2.7 pile thickness. The difference in the thickness of the textile floor covering before and after the pile above substrate has been shorn away, measured under a pressure of 2.0 kPa.

2.8 surface pile density. The ratio of mass to volume of the pile above the substrate measured under a pressure of 2.0 kPa.

2.9 pile length. The length of one leg of a tuft or loop from the point where it emerges from the substrate to its extremity.

2.10 substrate. A construction, integral with the use-surface and composed of one or more layers, which serves as a support for the use-surface and possibly stabilizes the dimensions and/or acts as a cushion.

2.11 primary backing. Woven, knitted or nonwoven textile material or non-textile material in sheet form which acts as a carrier for the use-surface and is often additionally used as an anchor for other parts of the substrate.

2.12 backing fabric. A fabric which forms an additional stabilizing layer in the substrate of a textile floor covering and which often forms the final coating or layer.

NOTE. The backing fabric is also known as the secondary backing.

2.13 foam backing. Mechanically or chemically foamed polymer compound, applied to the back of a textile floor covering.

2.14 constant mass. No change in mass greater than 1 % when determined at hourly intervals over a period of 3 h.

3 General

3.1 Atmosphere for conditioning and testing

Specimens shall be conditioned and tested in the standard temperate atmosphere for testing textiles specified in BS 1051, i.e. an atmosphere having a temperature of 20 ± 2 °C and a relative humidity of 65 ± 2 %.

NOTE. There are no preconditioning requirements.

3.2 Sampling

Sampling shall be in accordance with BS 4664. The minimum sample size shall be 1 m^2.

3.3 Preparation of test specimens

Prepare test specimens using one or more of the following methods, as specified by the individual test method:

(a) for all determinations of mass, lay the specimens out flat, singly and with the use-surface uppermost and condition in accordance with **3.1** until the specimens reach constant mass (see **2.10**);

(b) for all determinations of thickness, lightly brush the use-surface against, and 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 and condition in accordance with **3.1** for at least 24 h;

(c) for all determinations not requiring mass or thickness, condition selected tufts and other pile yarn, lengths of yarn and test specimens in accordance with **3.1** for at least 2 h.

3.4 Test report

Each test report for a particular test shall include the following:

(a) a statement that the test was performed in accordance with this standard;

(b) an indication of which method was used where alternatives exist;

(c) a statement of the identity (source and type) of the sample from which the test specimens were taken.

4 Determination of tuft length of pile

4.1 Principle

Single tufts are straightened in V-shaped grooves in a transparent rigid block, with the aid of a straight glass rod, and then measured.

NOTE. For the definition of tuft length see 2.3.

4.2 Apparatus

4.2.1 *Tuft length block,* a transparent, rigid block measuring approximately 100 mm x 75 mm x 10 mm, into the upper surface of which three straight V-shaped grooves have been cut lengthways (see figure 1). The angle between the plane sides of the grooves is 60 ° and the widths of the grooves at the surface are:

(a) 4 mm to 5 mm, suitable for coarse tufts;

(b) 3 mm to 3.5 mm, suitable for ordinary tufts; and

(c) 1.5 mm to 2.0 mm, suitable for fine tufts.

4.2.2 *Glass rod,* approximately 100 mm in length and 5.5 mm in diameter.

4.2.3 *Rule,* graduated in millimetres.

4.3 Conditioning

The test specimens shall be conditioned and tested in accordance with 3.1.

4.4 Test specimens

Remove not less than 20 tufts from different places down the length and across the width of the sample, bearing in mind the needs of further tests and taking only tufts representing the simplest basic unit. If the textile floor covering has pile of two or more different heights, take not less than 20 tufts of each height.

NOTE. For back-coated tufted textile floor coverings this can be done by inserting the point of a steel probe under the base of the tuft from the back of the textile floor coverings and withdrawing the tuft. Reject any tufts that are damaged by this operation.

4.5 Preparation of test specimens

Prepare the selected tufts in accordance with 3.3(c).

4.6 Test procedure

4.6.1 Choose the appropriate groove of the tuft length block, according to the thickness of the yarn forming the tuft.

NOTE. Ordinarily, yarn in the range 800 tex to 440 tex may be measured in the intermediate groove; when the tuft is straightened out in the groove the glass rod should compress it and still touch both lane sides of the groove. Hard twist yarns should be inserted in the narrowest groove.

4.6.2 Place a straightened out tuft in the appropriate groove of the tuft length block. Place the glass rod over the tuft and, using the scale, measure the length of the

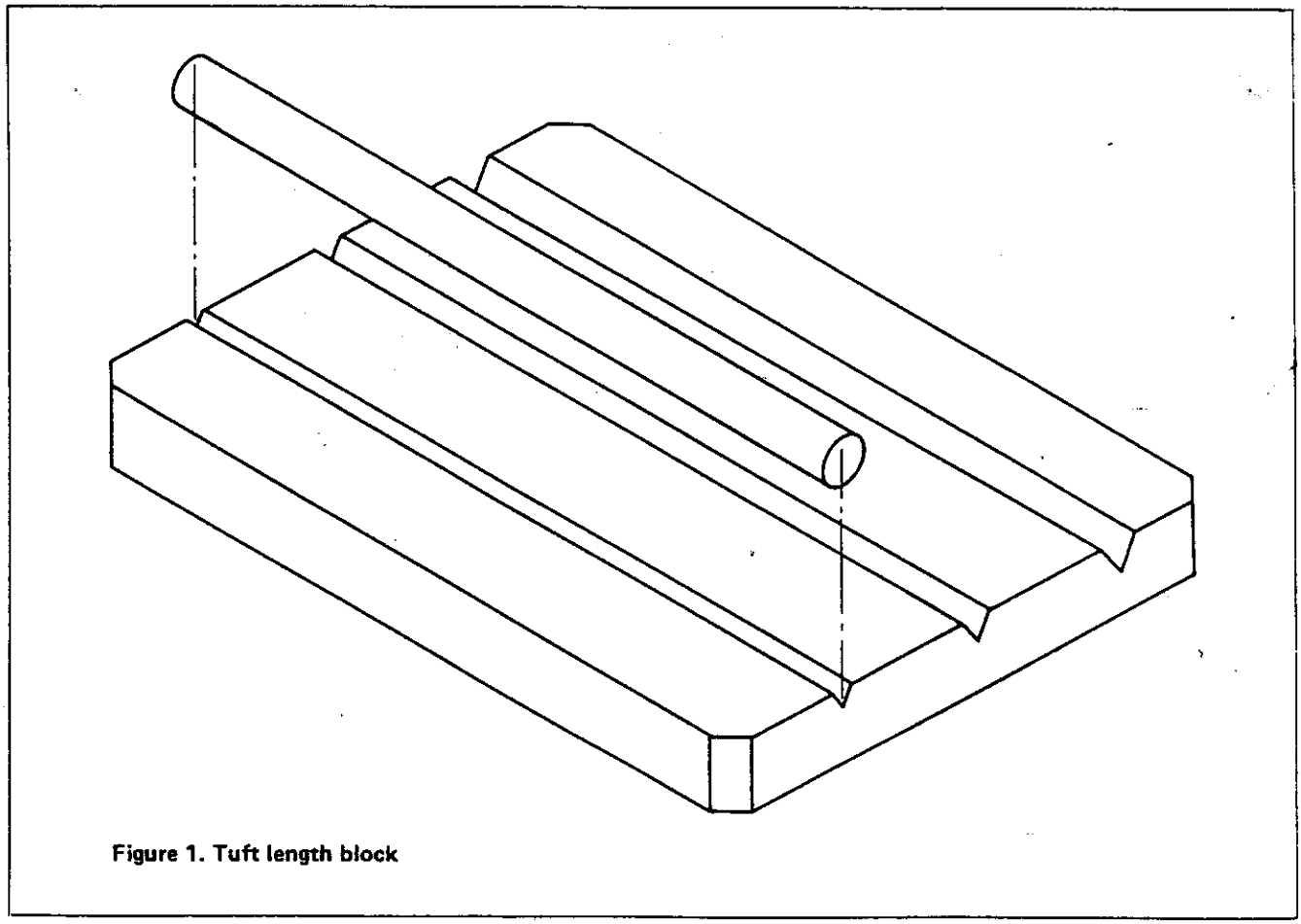

Figure 1. Tuft length block

tuft to the nearest 0.5 mm using a lens if necessary. Repeat this sequence with the other tufts.

4.6.3 Note the shape of the tufts, i.e. whether they are J-shaped, U-shaped or W-shaped.

4.7 Calculation and expression of results

Calculate the mean tuft length L (in mm) to the nearest 0.25 mm. If the textile floor covering contains tufts of different lengths, calculate the mean for each type and the number of each type tested.

4.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the number of tufts measured;

(c) the mean tuft length L, in millimetres to the nearest 0.25 mm;

(d) if the sample has tufts of different length;

(1) the mean length of each type;

(2) the number of each type tested;

(e) the shape of the tufts, i.e. whether they are J-shaped, U-shaped or W-shaped.

5 Determination of loop length of pile (excluding bulked or stretch yarns)

5.1 Principle

A length of yarn containing several loops is extracted from the textile floor covering and measured when straightened, but not stretched.

NOTE. For the definition of loop length see **2.4**.

5.2 Apparatus

Any apparatus by use of which a length of yarn can be measured to 1 mm, straightened but not stretched, is suitable.

NOTE. Usually this may be done by hand using two pairs of forceps to hold the yarn against a scale.

Alternatively the length may be measured under a tension of 0.75 N, as for example in a yarn crimp tester.

5.3 Conditioning

The test specimens shall be conditioned and tested in accordance with **3.1**.

5.4 Test specimens

5.4.1 From the different positions in the length and width of the textile floor covering sample remove not less than five lengths of pile yarn, each containing 20 successive loops, cutting the yarn at the top of one loop and again at the top of the twentieth loop further on. For tufted textile floor coverings pull from the back; for woven textile floor coverings use dissection. Reject any lengths where damage has occurred.

5.4.2 If the textile floor covering contains loops of different length, select at least five lengths of each type. If 20 successive loops of the same length cannot be obtained, use the largest number possible. If the loop length varies continuously, select 10 sets of 20 successive loops at random.

5.5 Preparation of test specimens

Prepare the lengths of yarn in accordance with **3.3**(c).

5.6 Procedure

5.6.1 If measuring using forceps, grip each end of the yarn specimen with forceps and straighten but do not stretch the yarn against a rule graduated to 1 mm with one end against a datum or zero mark. Record the length as read from the position of the other end of the yarn to the nearest 1 mm. Repeat on at least five specimens.

5.6.2 If measuring using a yarn crimp tester insert each end of the yarn specimen in the grips of the crimp tester up to datum marks. Adjust the tension control to 0.75 N and move the ends apart until this tension is realized. Record the distance between the datum marks, to the nearest 1 mm. Repeat on at least five specimens.

5.7 Calculation and expression of results

Calculate the mean measured length to the nearest 1 mm and calculate the mean loop length L by dividing this by 20 (or by the actual number of loops if 20 were not obtained).

If the textile floor covering contains loops of different lengths calculate L for each type separately.

5.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the manner in which the test was carried out, i.e. whether by hand, or under a tension of 0.75 N;

(c) the number of yarn specimens measured;

(d) the number of loops in each yarn specimen;

(e) the mean loop length L to the nearest 0.1 mm;

(f) if the sample has loops of different length either:

(1) the mean loop length for each type and the number of each type tested; or

(2) a statement that the loop length is continuously variable, together with the mean loop length.

6 Determination of number of tufts (and/or loops) per unit length in directions parallel with and at right angles to direction of manufacture

NOTE. This method is essentially in agreement with that given in ISO 1763.

6.1 Principle

The number of complete tufts (and/or loops) and spaces, in directions parallel with and at right angles to the direction of manufacture, is counted over a distance of at least 100 mm. At least 40 complete tufts (and/or loops) and spaces are counted.

6.2 Apparatus

6.2.1 *Rule,* graduated in millimetres.

6.3 Test specimens

Select from the sample four different areas such that each area is at least 41 tufts (and/or loops) square, and is not less than 100 mm x 100 mm.

6.4 Preparation of test specimens

Prepare the test specimens in accordance with **3.3**(c).

6.5 Procedure

Take one test specimen and count 40 tufts (and/or loops) and spaces, in the direction parallel with the direction of manufacture. Where two or more pile yarns lie side by side but are not twisted together, count them as one tuft. Using the rule measure the distance occupied by them, in mm. If the distance is less than 100 mm, continue to count until the number of complete tufts (and/or loops) and spaces extends over at least 100 mm. If the textile floor covering is not of uniform construction, note the type of construction.

Repeat the measurement in the direction at right angles to the direction of manufacture, then repeat the procedure on the other three specimens.

6.6 Calculation and expression of results

Calculate the number of tufts (and/or loops) and spaces per unit length in each direction from the following formulae:

$$S = 100\ \frac{N_s}{L_s}$$

$$G = 100\ \frac{N_g}{L_g}$$

where

N_s is the number of tufts (and/or loops) and spaces in the specimen counted parallel to the direction of manufacture;

N_g is the number of tufts (and/or loops) and spaces in the specimen counted perpendicular to the direction of manufacture;

L_s is the actual length of the counted tufts (and/or loops) and spaces, in mm, measured parallel to the direction of manufacture;

L_g is the actual length of the counted tufts (and/or loops) and spaces, in mm, measured perpendicular to the direction of manufacture.

If required calculate the number of tufts and/or loops per 10 000 mm^2 for each specimen by multiplying together the values of S and G.

6.7 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the values of S and G, and if required the number of loops and/or tufts per 10 000 mm^2 calculated in accordance with **6.6**, to one decimal place;

(c) the shape of the tufts, i.e. whether they are J-shaped, U-shaped or W-shaped;

(d) the pile yarn construction;

(e) if two or more pile yarns lie side by side, a statement to this effect;

(f) if the sample was not of uniform construction, a statement to this effect together with an indication of the type of construction.

7 Determination of total mass per unit area

NOTE. This method is applicable to textile floor coverings with varying pile height or density. It is substantially identical with ISO 8543 and can be used prior to, and in conjunction with, clauses **8** and **9**, with which it is compatible.

7.1 Principle

The mass of a measured area of textile floor covering is determined.

7.2 Apparatus

7.2.1 *Sharp pointed knife.*

7.2.2 *Rule,* graduated in millimetres.

7.2.3 *Balance,* capable of determining mass to 0.01 g.

7.3 Conditioning

The test specimens shall be conditioned and tested in accordance with **3.1**.

7.4 Test specimens

Cut out from the sample, using the sharp knife, at least four square test specimens each at least 200 mm x 200 mm with the sides parallel with and at right angles to the direction of manufacture.

NOTE. More than four specimens may be required in order to achieve the desired degree of accuracy (see **7.7**).

7.5 Preparation of test specimens

Prepare the test specimens in accordance with **3.3**(a).

.6 Procedure

.6.1 Determine the mass m (in g) of each test specimen o the nearest 0.01 g.

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

.7 Calculation and expression of results

For each test specimen, calculate the average length and vidth (in mm) and multiply these to obtain the area A in mm^2). Then calculate the total mass per unit area in g/m^2) from the following formula:

$$\text{Total mass per unit area} = \frac{10^6 m}{A}$$

Calcu the mean of the results for the four test pecir s and the coefficient of variation (V). Use V to determine the total number of test specimens required to give 95 % confidence limits of ± 6 % from the following formula:

$$n = \frac{(tV)^2}{(6)}$$

where

n is the number of test specimens required;

t is the appropriate value for Student's t,

.e. if $V \leqslant 4$ %,
then the four specimens tested are sufficient;
if $4\ \% < V \leqslant 5.5$ %,
test a further two specimens (total six);
if $5.5\ \% < V \leqslant 7$ %,
test a further four specimens (total eight);
if $V > 7$ %,
test a further eight specimens (total twelve).

Then ulate the mean and coefficient of variation of all the te ecimens tested, and the 95 % confidence limits, from the following formula:

$$\text{Confidence limits} = \pm \frac{(tV)}{(\sqrt{n})}$$

.8 Test report

The test report shall include the following:

(a) the information required by 3.4;

(b) the number of test specimens tested;

(c) the total mass per unit area for each test specimen (in g/m^2);

(d) the mean total mass per unit area (in g/m^2), the overall coefficient of variation and the 95 % confidence limits;

(e) if the sample is of varying pile height or density, a statement to this effect.

8 Determination of total pile mass per unit area

NOTE. This method is appropriate only for textile floor coverings without adhesive backings; it is also the only one suitable for figured Wilton textile floor coverings. It may be used for textile floor coverings with varying pile height or density. The method is substantially identical with that given in ISO 8543 and can be used in conjunction with clause 7, with which it is compatible.

8.1 Principle

A known area of the textile floor covering is dissected completely from a test specimen; the pile yarn is separated from the other components and weighed.

NOTE. For the definition of total pile mass per unit area see 2.5.

8.2 Apparatus

8.2.1 *Sharp pointed knife.*

8.2.2 *Balance,* capable of determining mass to 1 mg.

8.2.3 *Dissecting needles and forceps.*

8.2.4 *Rule,* graduated in millimetres.

8.3 Conditioning

The test specimens shall be conditioned and tested in accordance with 3.1.

8.4 Test specimens

Cut out from the sample, using the sharp knife, at least four squares each at least 150 mm x 150 mm, selected at random from the area available. Measure the length and width of each test specimen in four places on the back, to the nearest 1 mm.

NOTE. More than four specimens may be required in order to achieve the desired degree of accuracy (see 8.6).

8.5 Preparation of test specimens

Remove all the yarn forming tufts carefully from the test specimens with needle and forceps, and collect it together for each test specimen. In analysing multiframe Wilton textile floor coverings treat buried pile yarn from dead frames as pile yarn, irrespective of whether it forms tufts in the specimen under examination or not. Prepare the tufts and other pile yarn in accordance with 3.3(a).

8.6 Procedure

Determine the mass, m (in g) of the conditioned pile from each specimen to the nearest 1 mg. In some multiframe Wilton textile floor coverings the dead frame 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 dead frame yarn pile separately from the working pile.

8.7 Calculation and expression of results

Calculate the area A (in mm^2) of each specimen. Then calculate the total pile mass per unit area (in g/m^2) for each specimen from the following formula:

$$\text{Total pile mass per unit area} = \frac{10^6 m}{A}$$

Calculate the mean of the results for the four test specimens and the coefficient of variation, V. Use V to determine the total number of test specimens required to give 95 % confidence limits of ± 6 % from the following formula:

$$n = \frac{(tV)^2}{(6)}$$

where

n is the number of specimens required,

t is the appropriate value for Student's t,

i.e. if $V \leqslant 4$ %,
then the four specimens tested are sufficient;

if $4\ \% < V \leqslant 5.5\ \%$,
test a further two specimens (total six);

if $5.5\ \% < V \leqslant 7\ \%$,
test a further four specimens (total eight);

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

Then calculate the mean and coefficient of variation of all the test specimens tested, and the 95 % confidence limits, from the following formula:

$$\text{Confidence limits} = \pm \frac{(tV)}{(\sqrt{n})}$$

8.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the number of test specimens tested;

(c) the total pile mass per unit area for each specimen (in g/m^2);

(d) the mean total pile mass (in g/m^2), the overall coefficient of variation and the 95 % confidence limits;

(e) if, in a multiframe Wilton, the dead frame yarn pile is composed differently from the working pile:

(1) a statement to this effect;

(2) a statement of the dead frame yarn pile mass separate from the working pile mass;

(f) if the sample has a varying pile height or density, a statement to this effect.

9 Determination of mass of pile above substrate per unit area

NOTE. This method can be used for textile floor coverings with varying pile height or density. It is essentially in agreement with ISO 8543, and may be used in conjunction with clauses **7**, **10** and **11** on the same test specimens.

9.1 Principle

The mass of measured test specimens of a textile floor covering is determined before and after the pile above substrate has been shorn.

NOTE. For the definition of pile above substrate see **2.6**.

9.2 Apparatus

9.2.1 *Sharp pointed knife.*

9.2.2 *Press and cutter,* or other apparatus, either circular or square, of known area, not less than 25 000 mm^2.

9.2.3 *Rule,* graduated in millimetres.

9.2.4 *Balance,* capable of determining mass to 0.01 g.

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

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

9.3 Conditioning

The test specimens shall be conditioned and tested in accordance with **3.1**.

9.4 Test specimens

Cut out from the sample, using the sharp knife, at least four square test specimens each at least 200 mm x 200 mm, with the sides parallel with and at right angles to the direction of manufacture.

NOTE. More than four specimens may be required in order to achieve the desired degree of accuracy (see **9.7.2**).

9.5 Preparation of test specimens

Prepare the test specimens in accordance with **3.3**(a).

9.6 Procedure

9.6.1 Determine the mass of each test specimen m_1, to the nearest 0.01 g.

9.6.2 Measure the length and width of each test specimen in four places on the back, to the nearest 1 mm.

9.6.3 Shear the pile from each test specimen. When using a band 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 test 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 to the edges of the test specimen provided an area of 25 000 mm^2 in the centre is closely shorn.

Brush, blow or suction clean the test 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 test specimen is shaken, pile down, over a smooth surface of contrasting colour.

9.6.4 After shearing, unless the total area of the test specimen is completely shorn without damage to the substrate and can be used to estimate the mass per unit area of the substrate, cut a completely shorn piece of not less than 25 000 mm^2 from the centre of the test 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.

9.6.5 Condition each area cut out of the shorn test specimens in accordance with 3.3(a).

9.6.6 Determine the final conditioned mass of the shorn area of each test specimen m_2 to the nearest 0.01 g.

9.7 Calculation and expression of results

9.7.1 From the measurements made in 9.6.2, calculate for each specimen the average length and width, and the area A_1 (in mm^2). Calculate the total mass per unit area m_1/A_1 (in g/mm^2) of textile floor covering for each test specimen separately. Determine the area A_2 (in mm^2) of each shorn test specimen in accordance with 9.6.4, and calculate the mass per unit area m_2/A_2 (in g/mm^2) for each test specimen.

For each test specimen, calculate the mass of pile above substrate per unit area M, to the nearest 1 g/m^2, from the following formula:

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

where

m_1 is the mass of unshorn test specimen (in g);

m_2 is the mass of shorn test specimen (in g);

A_1 is the area of unshorn test specimen (in mm);

A_2 is the area of shorn test specimen (in mm).

9.7.2 Calculate the mean value of M from the values obtained for the four test specimens, and the coefficient of variation V. Use V to determine the total number of test specimens required to give 95 % confidence limits of ± 6 % from the following formula:

$$n = \frac{(tV)^2}{(6)}$$

where

n is the number of specimens required;

t is the appropriate value for Student's t,

i.e. if $V \leqslant 4$ %,
then the four specimens tested are sufficient;
if 4 % $< V \leqslant$ 5.5 %,
test a further two specimens (total six);
if 5 % $< V \leqslant$ 7 %,
test a further four specimens (total eight);
if $V >$ 7 %,
test a further eight specimens (total twelve).

Then calculate the mean and coefficient of variation of all the test specimens tested, and the 95 % confidence limits, from the following formula:

$$\text{Confidence limits} = \pm \frac{(tV)}{(\sqrt{n})}$$

9.8 Test report

The test report shall include the following:

(a) the information required by 3.4;

(b) the number of test specimens tested;

(c) the mass of pile above substrate per unit area for each test specimen (in g/m^2);

(d) the mean mass of pile above substrate per unit area (in g/m^2), the overall coefficient of variation, and the 95 % confidence limits;

(e) if the sample was of varying pile height or density, a statement to this effect;

(f) the type of shearing apparatus used.

10 Determination of thickness of pile above substrate

NOTE. This method is not applicable to textile floor coverings of varying pile thickness or density unless the areas can be measured separately. It is substantially identical with ISO 1766, and is used in conjunction with clause 9.

10.1 Principle

Pile thickness is determined by measuring the thickness of specimens under a pressure of 2.0 kPa before and after removal of the pile above substrate.

NOTE. For the definition of pile thickness see 2.7.

10.2 Apparatus

10.2.1 *Band knife machine or hand-held clippers,* in accordance with 9.2.4.

10.2.2 *Textile floor covering thickness tester,* capable of measuring thickness under a pressure of 2.0 kPa and in accordance with BS 4051.

10.2.3 *Straightedge,* e.g. a ruler, for brushing the surface of the specimen.

10.3 Conditioning

The test specimens shall be conditioned and tested in accordance with 3.1.

10.4 Test specimens

Cut out from the sample four square test specimens each at least 200 mm x 200 mm with the sides parallel with and at right angles to the direction of manufacture.

10.5 Preparation of test specimens

Prepare the test specimens in accordance with 3.3(b).

10.6 Procedure

NOTE. It is essential that test specimens are flat against the base plate of the textile floor covering thickness tester during measurement and the guard ring referred to in BS 4051 may be used for this purpose.

10.6.1 Measure the thickness of each test specimen at five approximately equally spaced places, under a pressure of 2.0 kPa in accordance with clause 9 of BS 4051 : 1987.

10.6.2 Shear the pile from the specimen in accordance with **9.6.3.**

10.6.3 Measure the thickness of each shorn specimen in accordance with **10.6.1.**

10.7 Calculation and expression of results

For each test specimen calculate the mean thickness of the unshorn specimen and the mean thickness of the shorn specimen. For each test specimen, calculate the thickness of pile from the difference between the mean thickness of the unshorn test specimen and the mean thickness of the shorn test specimen in millimetres to the nearest 0.1 mm.

Calculate the mean pile thickness for all test specimens in millimetres to the nearest 0.1 mm.

10.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the thicknesses of the unshorn specimen, the thicknesses of the shorn specimen, and the thickness of pile for each specimen, in millimetres to the nearest 0.1 mm;

(c) the mean thickness of each unshorn specimen, the mean thickness of each shorn specimen, and the mean pile thickness for all specimens, in millimetres to the nearest 0.1 mm;

(d) the type of shearing apparatus used;

(e) if the sample was of varying pile height or density, a statement to this effect.

11 Determination of surface pile density

NOTE. This method is not applicable to textile floor coverings of varying pile thickness or density unless the areas can be measured separately. It is substantially identical with ISO 8543, and is used in conjunction with clauses **9** and **10.**

11.1 Principle

Thickness and mass are determined before and after the pile above substrate has been shorn from the test specimen. The surface pile density is calculated from the values obtained.

NOTE. For the definition of surface pile density see **2.8.**

11.2 Apparatus

11.2.1 *Sharp pointed knife.*

11.2.2 *Press and cutter, rule, balance and band knife machine or hand-held clippers,* as described in **9.2.**

11.2.3 *Straightedge and textile floor covering thickness tester,* as described in **10.2.**

11.3 Conditioning

The test specimens shall be conditioned and tested in accordance with **3.1.**

11.4 Test specimens

Cut four test specimens in accordance with **9.4.**

11.5 Preparation of test specimens

Prepare the test specimens in accordance with **3.3**(a) and **3.3**(b).

11.6 Procedure

11.6.1 Measure the thickness of each test specimen in accordance with **10.6.1.**

11.6.2 Determine the mass of the pile above substrate per unit area of each test specimen in accordance with **9.6.**

11.6.3 Measure the thickness of each shorn specimen in accordance with **10.6.1.**

11.7 Calculation and expression of results

11.7.1 Calculate the mean pile thickness t (in mm) for each specimen in accordance with **10.7.**

11.7.2 Calculate the mean mass of pile above substrate per unit area for each test specimen in accordance with **9.7.**

11.7.3 Calculate the surface pile density ρ (in g/cm^3) for each test specimen under a pressure of 2.0 kPa, from the following formula:

$$\rho = \frac{10^{-3} M}{T}$$

$$= \frac{10^3}{T}\left(\frac{m_1}{A_1} - \frac{m_2}{A_2}\right)$$

where

m_1 is the mass of unshorn test specimen (in g);

m_2 is the mass of shorn test specimen (in g);

A_1 is the area of unshorn test specimen (in mm^2);

A_2 is the area of shorn test specimen (in mm^2);

T is the mean pile thickness of the test specimen (in mm)

11.7.4 Calculate the mean surface pile density for the four test specimens.

11.7.5 Calculate the coefficient of variation V and use V to determine the total number of test specimens required to give 95 % confidence limits of ± 6 % from the following formula:

$$n = \frac{(tV)^2}{(6)}$$

where

n is the number of specimens required;

t is the appropriate value for Student's t,

i.e. if $V \leqslant 4$ %,
then the four specimens tested are sufficient;
if $4\ \% < V \leqslant 5.5\ \%$,
test a further two specimens (total six);
if $5.5\ \% < V \leqslant 7\ \%$,
test a further four specimens (total eight);
$V > 7$ %,
test a further eight specimens (total twelve).

Then calculate the mean and coefficient of variation of all the test specimens tested, and the 95 % confidence limits, from the following formula:

$$\text{Confidence limits} = \pm \frac{(tV)}{(\sqrt{n})}$$

11.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the pile thickness of each test specimen;

(c) the mean pile thickness, to the nearest 0.1 mm;

(d) the mass of pile above substrate per unit area for each test specimen;

(e) the mean mass of pile above substrate per unit area;

(f) the surface pile density under a pressure of 2.0 kPa;

the type of shearing apparatus used;

(h) if the sample was of varying pile height or density, a statement to this effect.

12 Determination of thickness and density of foamed backing

12.1 Principle

The thickness and mass of a foamed backing are determined after the foam has been removed from the textile floor covering. The density of the foam is calculated from the values obtained.

12.2 Apparatus

12.2.1 *Electric carving knife.*

12.2.2 *Double-sided adhesive tape.*

12.2.3 *Press and circular cutter,* of known area not less than 645 mm^2.

12.2.4 *Balance,* capable of determining mass to 0.01 g.

12.2.5 *Textile floor covering thickness tester,* as described in **10.2.2.**

12.3 Conditioning

The test specimens shall be conditioned in accordance with **3.1.**

12.4 Test specimens

Cut four test specimens in accordance with **9.4.**

12.5 Preparation of test specimens

Adhere the pile surface of the textile floor covering to the surface of a bench using double-sided adhesive tape. Use the electric carving knife to remove the foam from the textile floor covering using the primary backing as a guide.

Cut sufficient circles from the foam using the press and cutter to give a pile approximately 25 mm in height.

12.6 Procedure

Measure the thickness of the pile of circles in accordance with **10.6.1.**

Determine the mass of the pile of circles.

12.7 Calculation and expression of results

12.7.1 For each test specimen calculate the foam density ρ (in g/cm^3) under a pressure of 2.0 kPa from the following formula:

$$\rho = \frac{M \times 10^3}{h \times a}$$

where

M is the mass of the pile of circles (in g);

h is the thickness of the pile of circles (in mm);

a is the area of the circle (in mm^2).

Calculate the mean foam density for the four test specimens.

12.7.2 For each test specimen calculate the foam thickness T (in mm) under a pressure of 2.0 kPa from the following formula:

$$T = \frac{h}{n}$$

where

h is the thickness of the pile of circles (in mm);;

n is the number of circles in the pile.

Calculate the mean foam thickness for the four test specimens.

12.8 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the foam density of each test specimen;

(c) the mean foam density;

(d) the foam thickness of each test specimen;

(e) the mean foam thickness.

13 Determination of filler content of foamed backing

13.1 Principle

The filler content of a foamed backing is determined after the foam has been removed from the textile floor covering. The organic content of the foam is burned away leaving the inorganic fillers.

13.2 Apparatus

13.2.1 *Muffle furnace,* controlled at 575 ± 25 °C.

13.2.2 *Balance,* accurate to 0.0001 g.

13.2.3 *Crucibles of silica, porcelain or platinum,* 45 mm to 75 mm diameter and at least the same depth, plus lids.

13.2.4 *Bunsen burner.*

13.2.5 *Pipe-clay triangle.*

13.2.6 *Tripod stand.*

13.2.7 *Desiccator.*

13.2.8 *Electric carving knife.*

13.2.9 *Double-sided adhesive tape.*

13.2.10 *Air circulating oven,* capable of being maintained at 100 ± 5 °C.

13.3 Preparation of test specimens

Adhere the pile surface of the textile floor covering to the surface of a bench using double-sided adhesive tape. Use the electric carving knife to remove the foam from the textile floor covering using the primary backing as a guide. Cut the foam into cubes of side 2 mm to 3 mm.

13.4 Conditioning

Place the foam cubes in a container in an air circulating oven at 100 ± 5 °C for 1 h. Afterwards, remove the container containing the foam cubes and place in the desiccator to cool.

13.5 Procedure

NOTE. This procedure should be carried out in duplicate.

13.5.1 Weigh a crucible and lid.

13.5.2 Place approximately 1 g of the foam cubes in the crucible, replace the lid and weigh.

13.5.3 Displace the lid of the crucible to allow fumes to escape and place the crucible, lid and contents on the pipe-clay triangle supported by the tripod stand.

13.5.4 Gently heat the crucible with a small bunsen burner flame.

Continue heating until the cubes are fully carbonized, taking care that ignition does not occur, as this may give rise to erratic results from indeterminate losses.

13.5.5 Transfer the crucible, lid and contents to a muffle furnace heated to 575 ± 25 °C for 2 h to 3 h. Allow incineration to proceed to completion.

13.5.6 Transfer the crucible, contents and lid to the desiccator and allow to cool.

13.5.7 Determine the mass of the crucible, lid and residue.

13.5.8 Repeat **13.5.1** to **13.5.7** using a different test specimen.

13.6 Calculation and expression of results

For each test specimen calculate the ash content a as a percentage by mass from the following formula:

$$a = \frac{m_3 - m_1}{m_2 - m_1} \times 100$$

where

m_1 is the mass of the crucible and lid;

m_2 is the mass of the crucible, lid and foam cubes;

m_3 is the mass of the crucible, lid and ash.

Calculate the filler content as parts per hundred dry rubber from the following formula:

$$\text{Filler content} = \frac{a}{100 - a} \times 100$$

Calculate the mean filler content from the values for each test specimen.

13.7 Test report

The test report shall include the following:

(a) the information required by **3.4**;

(b) the filler content for each specimen;

(c) the mean filler content.

Appendix

Appendix A. Estimation of pile length

NOTE. This method is essentially in agreement with ISO 2549 for hand-made textile floor coverings.

A.1 Principle

Pile length is determined by inserting flat metal gauges of known height into the pile and determining which gauge corresponds to the pile length.

NOTE. For the definition of pile length see 2.9.

A.2 Apparatus

A.2.1 *Pile length gauges,* comprising flat strips of metal of specified heights, in intervals of 1 mm. Examples of suitable types are given in figures 2 and 3.

A.2.2 *Straightedge,* e.g. a ruler, for brushing the surface of the specimen.

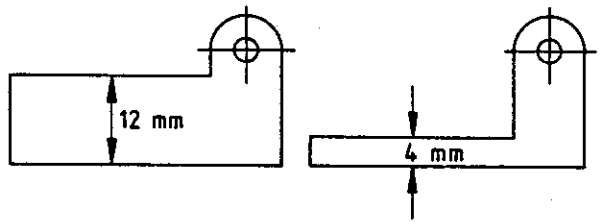

Figure 2. Pile length gauges of ISO 2549 type

A.3 Conditioning

The test specimens should be conditioned in accordance with 3.1.

A.4 Test specimens

Select and cut out a number of specimens sufficient to be representative of the finished textile floor covering as a whole, ensuring that the area of each is sufficient to estimate the pile length.

A.5 Preparation of test specimen

Prepare the test specimens in accordance with 3.3(c).

A.6 Procedure

A.6.1 Insert a gauge into the pile between the tufts or loops ensuring that firm contact is made with the substrate. Support the pile in a vertical position beside the gauge, by stroking with the straightedge if necessary. By successively using different gauges select the gauge which corresponds to the pile length. Check that this is the nearest gauge by inserting in the same position gauges a unit higher and lower than that selected. Estimate the pile length to the nearest 1 mm.

A.6.2 If the textile floor covering contains as a design feature pile of different levels, determine the lengths of each section separately.

A.6.3 Repeat the measurements at varying positions in the specimen so that at least 10 measurements are made at each pile level.

A.7 Calculation and expression of results

Determine the mean pile length for each pile level, to the nearest 1 mm.

A.8 Test report

The test report should include the following:

(a) the information required by 3.4;

(b) the pile length for each measurement made;

(c) the mean pile length for each pile level.

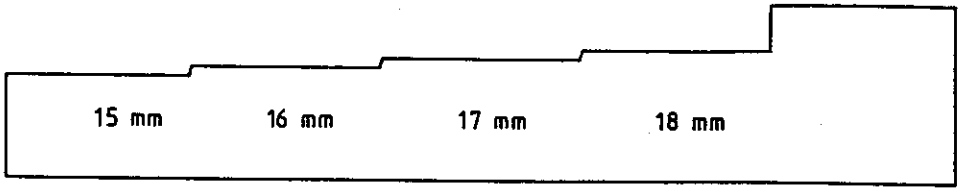

Figure 3. Pile length gauge of IWS* type

*International Wool Secretariat.