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Method for the
Determination of thickness,
compression and recovery characteristics
of textile floor coverings

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Gr 5
British Standards Institution

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Foreword

BS 4098 was first published in 1967 under the title 'Method for the determination of thickness, compression and recovery of carpets'. In addition to incorporating certain necessary technical changes, in this revision the title has been modified slightly, metric units have replaced imperial units, and the term 'textile floor covering' has been used in place of the more restrictive 'carpet'. The first edition has been withdrawn as of the publication date of this revision.

The thickness of a textile floor covering depends upon the pressure applied to it. The ability of a textile floor covering to be compressed and to recover after compression is an important factor in its performance.

A background paper on this subject was published in *Textile Institute and Industry*, 11, no. 1 (April) 1973.

A pressure of 2 kPa* has been adopted for measuring the initial thickness of textile floor coverings since under the conditions of test this pressure has been found to be just sufficient to flatten any protruding fibres without appreciably compressing textile floor coverings of low density. The highest pressure used in this method is 200 kPa, which appreciably compresses most textile floor coverings.

The method of measuring thickness used in this standard is based on that prescribed in BS 4051 'Method for determination of thickness of textile floor coverings'.

* 1 kPa = 1 kN/m² = 10.2 gf/cm² = 0.145 lbf/in².

British Standard Method for the Determination of thickness, compression and recovery characteristics of textile floor coverings

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1. Scope

This British Standard specifies a method for measuring the thickness, compression and recovery characteristics of all types of textile floor coverings apart from pile carpets with varying thickness and/or density of pile, unless these areas can be measured separately.

2. References

The titles of the British Standards referred to in this standard are listed on the inside back cover.

3. Definitions

For the purposes of this British Standard the following definitions apply:

3.1 initial thickness. The thickness of a textile floor covering measured under a pressure of 2 kPa.

3.2 compression. The change in thickness of the textile floor covering when the pressure is increased from 2 kPa to 200 kPa.

3.3 work of compression. The work done on the textile floor covering when the pressure is increased from 2 kPa to 200 kPa, i.e. the area under the load-compression curve.

NOTE. Compression takes no account of the shape of the load-compression curve. Work of compression will distinguish between textile floor coverings which, although they have the same value of compression, have differently shaped load-compression curves.

3.4 percentage thickness recovery. The thickness to which the textile floor covering recovers when the pressure is diminished from 200 kPa to 2 kPa, expressed as a percentage of the initial thickness.

3.5 percentage compression recovery. The change in thickness when the pressure is diminished from 200 kPa to 2 kPa, expressed as a percentage of the compression.

3.6 percentage work recovery. The work done by the textile floor covering when the pressure is diminished from 200 kPa to 2 kPa, expressed as a percentage of the work of compression from 2 kPa to 200 kPa pressure, i.e. (the area under the load-recovery curve divided by the area under the load-compression curve) $\times 100$.

NOTE. Percentage thickness recovery is based upon the total thickness of the textile floor covering. Percentage compression recovery would normally be expected to rank textile floor coverings in the same order as the percentage work recovery. Percentage work recovery is mainly influenced by the work done by movement of the pile in carpets and is thus more sensitive to change in the pile than percentage thickness recovery and has a much lower value.

4. Principle

The thickness of a textile floor covering specimen is measured as the distance between the reference plate on which the textile floor covering rests and a parallel circular presser-foot exerting a known pressure to an area between 300 mm² and 1000 mm² inclusive within a larger area of textile floor covering. By applying a series of increasing, and subsequently of decreasing, loads to the specimen, the thickness at various pressures and the load-compression and load-recovery curves are determined.

5. Apparatus

5.1 The instrument used for measuring the thickness shall have a circular plane presser-foot of area between 300 mm² and 1000 mm². It shall be capable of exerting pressures normal to the surface of the textile floor covering from 2 kPa to 200 kPa with intermediate values of 5 kPa, 10 kPa, 20 kPa, 50 kPa, 100 kPa and 150 kPa, with an accuracy of 0.2 kPa. The instrument shall have a means of measuring thickness with an accuracy of 0.1 mm over a range of 25 mm. The movement of the presser-foot shall be normal to the plane of the textile floor covering. The reference plate on which the specimen rests shall be plane, at least 125 mm \times 125 mm in size, and parallel to the presser-foot to within one part in 500. The reference plate and the presser-foot shall be flat to an accuracy of 0.0125 mm.

If a dial gauge is used for the thickness measurement, it shall conform to the requirements of BS 907. The rigidity of the instrument frame should be such that no measurable deflection occurs under the loads to be used.

5.2 The circular guard ring shall have a mass of 1000 g, an external diameter not greater than 125 mm and an internal diameter of $d + 40$ mm (d being the diameter of the presser-foot in mm), such that a pressure of at least 1 kPa is exerted. A throat of 40 mm width may be cut from the guard ring. AmD3742

5.3 A straightedge, e.g. a ruler, for brushing the surface of the specimen.

6. Atmosphere for conditioning and testing

6.1 The atmosphere required for conditioning and testing is the standard atmosphere for testing textiles specified in BS 1051, i.e. an atmosphere of relative humidity $65 \pm 2\%$ and temperature $20 \pm 2^\circ\text{C}$.

~~(6.2 Pre-conditioning at a lower relative humidity before conditioning in the standard atmosphere for testing textiles is not required.)~~ AmD3742

AMD 3742

7.1 Textile floor coverings with yarn pile or flocked pile. Prepare sufficient specimens to allow at least five tests to be made. Test specimens shall be at least 75 mm x 75 mm, but they may be of any larger dimensions as required by other tests, or several measurements may be made on one larger sample provided that the centres of the areas in contact with the presser-foot are not less than 75 mm apart and the whole area of the specimen is supported in the same horizontal plane. Select these specimens well away from distorted parts of the sample. Test areas shall not contain the same warp and weft threads.

7.2 Textile floor coverings other than those covered by 7.1. Prepare sufficient specimens to allow ten tests to be made. Test specimens shall be at least 125 mm x 125 mm, but they may be of any larger dimensions as required by other tests, or several measurements may be made on one larger sample provided that the centres of the areas in contact with the presser-foot are not less than 75 mm apart and the whole area of the specimen is supported in the same horizontal plane. Select these specimens well away from distorted parts of the sample, and ensure that the area tested has not been previously compressed by a guard ring. Test areas shall not contain the same warp and weft threads.

Ensure that the apparatus is placed on a vibration-free surface, and check that the presser-foot shaft moves freely with negligible friction. With the presser-foot and base plate in contact, set the gauge to read zero or, alternatively, obtain the zero reading for the base plate. Place the specimen, use-surface uppermost, on the base plate so that no part of the presser-foot will be within 20 mm of the edge of the specimen or within 75 mm of any previous measurement. (When a textile floor covering of more than one thickness level or pile construction is being tested, no part of the presser-foot shall be within 20 mm of a change of construction.) Lower the presser-foot gently onto the specimen to apply a pressure of 2 kPa, and after 30 s note the gauge reading to the nearest 0.1 mm.

*Use the guard ring when testing textile floor coverings without pile.
NOTE. The guard ring may be used when testing other constructions.

Without raising the presser-foot, add extra mass carefully* to increase the pressure to 5 kPa and record the gauge reading after 30 s. Then immediately increase the pressure to 10 kPa and after 30 s record the gauge reading. Continue this procedure, raising the pressure in turn to 20 kPa, 50 kPa, 100 kPa, 150 kPa and 200 kPa, recording the gauge reading in each case when the pressure has been applied for 30 s.

*Take care to add extra mass gently so that the required pressure is not exceeded.

†Calculate the area under the curve as

$$(1.5t_2 + 4t_5 + 7.5t_{10} + 20t_{20} + 40t_{50} + 50t_{100} + 50t_{150} - 173t_{200}) J/m^2$$

where

t_2 is the thickness at 2 kPa (mm),

t_5 is the thickness at 5 kPa (mm) etc.,

using the appropriate values for the compression and recovery portions of the cycle.

Immediately after taking the gauge reading at the highest pressure, reduce the pressure to 150 kPa. After 30 s record the gauge reading and reduce the pressure to 100 kPa. Continue removing the mass at 30 s intervals, recording the gauge reading before the removal of each incremental mass, down to the original pressure of 2 kPa.

Do not at any time decrease the pressure during the loading sequence or increase it during the unloading sequence.

Repeat the procedure for each specimen.

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10. Calculation and expression of results

10.1 The thickness for each specimen shall be tabulated to the nearest 0.1 mm at each pressure. When a textile floor covering of more than one thickness level or pile construction has been tested, the results for each level shall be tabulated separately and each level treated separately in the calculations and graphs that ensue.

The mean for each pressure shall be calculated and plotted on a graph as in figure 1 with lines joining the mean values. The individual values of thickness at each pressure shall also be plotted on the same graph so as to display the variation.

In figure 1,

t_2 is the initial thickness at 2 kPa pressure (point A),

t_{200} is the compressed thickness at 200 kPa pressure (point B),

t_r is the recovered thickness at 2 kPa pressure after loading to 200 kPa pressure (point C).

10.2 One or more of the following estimates of compression and recovery may then be calculated from the mean results:

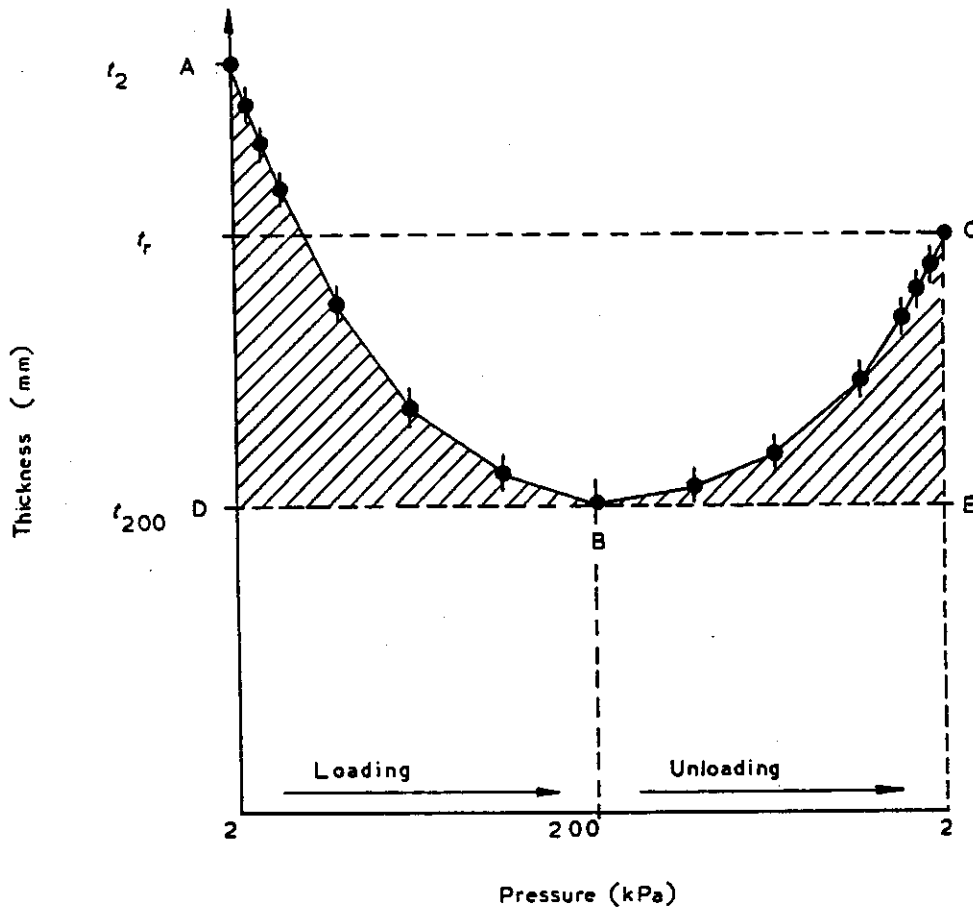
(a) the compression ($t_2 - t_{200}$) to the nearest 0.1 mm;

(b) the work of compression, in joules per square metre, estimated as the area under the loading curve†, e.g. area ABD in figure 1;

(c) the percentage thickness recovery, $100t_r/t_2$;

(d) the percentage compression recovery, $[(t_r - t_{200})/(t_2 - t_{200})] \times 100$;

(e) the percentage work recovery, as estimated by the ratio of the work of recovery to the work of compression†, e.g. $100 \times \text{area BCE}/\text{area ABD}$ in figure 1.



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Figure 1. Typical thickness-pressure curve for textile floor coverings

11. Report

11.1 The report shall state that the tests were performed in accordance with this standard and shall indicate which of any optional or alternative requirements have been met.

11.2 The mean thickness of the sample at 2 kPa, to the nearest 0.1 mm, and the number of specimens tested shall be reported. A graph of the individual observations with lines joining the mean values shall be given. If required, the calculated values of compression, work of compression, percentage thickness recovery, percentage compression recovery or percentage work recovery shall be stated.

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