BRITISH STANDARD

BS 5803-3: 1985

Incorporating Amendment No. 1

Thermal insulation for use in pitched roof spaces in dwellings —

Part 3: Specification for cellulose fibre thermal insulation for application by blowing

UDC 699.86:692.42:677.46

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Elements and Components (of Diverse Materials) for Buildings Standards Committee (ECB/-) to Technical Committee ECB/38 upon which the following bodies were represented:

Chartered Institution of Building Services

Consumer Standards Advisory Committee of BSI

Department of the Environment (Building Research Establishment, Fire Research Station)

Department of the Environment (Housing and Construction Industries)

Department of the Environment (Property Services Agency)

Eurisol (UK) (Association of Manufacturers of Mineral Fibre Insulation)

Greater London Council

Independent Waste Paper Processors' Association

Institution of Building Control Officers

National Association of Loft Insulation Contractors

National Council of Building Materials Producers

Royal Institute of British Architects

Thermal Insulation Manufacturers' Association

This British Standard, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee, was published under the authority of the Board of BSI and comes into effect on 28 February 1985

The following BSI references relate to the work on this standard:
Committee reference ECB/38
Draft for comment 83/10119 DC

ISBN 0 580 14244 2

Amendments issued since publication

Amd. No.	Date of issue	Comments
5829	June 1989	Indicated by a sideline in the margin

Contents

Foreword

This Part of BS 5803, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee. This Part covers the requirements for cellulose fibre thermal insulation for application by blowing.

Material used for thermal insulation in pitched roof spaces in dwellings should not sustain vermin or encourage the growth of fungus either when dry or wetted with clean water. It should also be free from objectionable odour when in normal use and when wetted with clean water. As these properties are of a subjective nature it is not possible to derive methods of test for them. They are not therefore included in the requirements for the materials contained in this Part but in considering the applicability of the materials in this Part they have been taken fully into account.

BS 5803 comprises the following Parts:

— *Part 1: Specification for man-made mineral fibre thermal insulation mats*;

— *Part 2: Specification for man-made mineral fibre thermal insulation in pelleted or granular form for application by blowing*;

— *Part 3: Specification for cellulose fibre thermal insulation for application by blowing*;

— *Part 4: Methods for determining flammability and resistance to smouldering*;

— *Part 5: Specification for installation of man-made mineral fibre and cellulose fibre insulation*.

Certification. It is strongly recommended that in view of the nature of this specification, manufacturers and purchasers make use of the certification facilities described on the inside back cover of this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 5803 specifies requirements for cellulose fibre thermal insulation for installation by blowing in pitched roof spaces in dwellings.

This Part does not apply to other forms of thermal insulation, and does not deal with methods of installation of insulating materials or with the general principles of insulation of pitched roofs.

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

2 Definitions

For the purposes of this Part of BS 5803, the definitions given in BS 874-1 and BS 3533 apply together with the following.

2.1
usage

the mass of blown fibre per unit area installed at a given thickness (in kg/m^2)

2.2
bag usage rate

the number of bags of stated mass per 100 m^2 of insulation installed at a given thickness

2.3
coverage

the reciprocal of usage (in m^2/kg) (see Appendix A)

2.4
bag coverage rate

the coverage multiplied by the stated mass of a bag of insulation (in m^2 per bag)

2.5
***R* value**

thermal resistance (in $m^2 \cdot K/W$) assessed at the appropriate thickness (see Appendix F)

3 Composition and form

The insulating material shall be composed of cellulose (wood-based) fibres treated with fire retardant and biocidal additives.

The material shall not contain extraneous foreign materials such as metal or glass.

4 General properties

4.1 The material shall not contain water soluble substances likely to accelerate the corrosion of metallic surfaces with which it comes into contact. It shall be deemed to be free from corrosive constituents if, when tested in accordance with Appendix B, no perforation of any of the metal coupons is evident.

4.2 The materials shall not exhibit more than 5 % settlement when tested in accordance with Appendix C.

4.3 The percentage settlement shall not exceed the value declared in item g) of clause **7** when tested in accordance with Appendix D.

NOTE This test is intended to simulate the effect of traffic vibration, heavy footsteps, door slamming, etc. over a period of many years.

4.4 The material shall have no deleterious effect on PVC or similarly covered electrical wiring. When tested in accordance with Appendix E, the material shall be deemed to be satisfactory if all four of the cable test pieces show no cracks in their sheathing. Any discoloration of the insulation or discoloration of the cable sheathing, or both, shall be noted as indicative of plasticizer migration, but does not in itself constitute failure.

4.5 When the material is tested at the settled density in accordance with BS 5803-4:

a) in the flammability test, the combustion zone shall not extend to within 25 mm of any part of the timber surround in any of the five specimens tested; and

b) in the smouldering resistance test, the combustion zone shall not extend to more than 150 mm from the centre line of the ignition cylinder on more than one of the first five specimens tested.

If one of the specimens gives a combustion zone extending more than 150 mm from the centre line of the cylinder, a further set of five specimens shall be tested and they shall all comply with this requirement.

5 Thermal insulation properties

5.1 The manufacturer shall declare the installed and settled thickness needed to achieve *R* values of 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 $m^2 \cdot K/W$ after settlement, calculated in accordance with **F.4.2** and **F.4.1** respectively.

NOTE The installed thickness required to yield *R* values other than those declared by the manufacturer may be determined by interpolation or extrapolation.

5.2 The actual value of *R*, when calculated in accordance with **F.4.3**, shall be not less than 90 % of the manufacturer's declared (or interpolated) value.

6 Preparation of samples

Samples for verification of compliance with the requirements of clause **4** shall be prepared by blowing through a commercially available blowing machine to the average installed density marked on the packaging [see item h) of clause **7**].

7 Marking

Each bag (or package) shall be legibly and indelibly marked with the following.

a) The number and date of this British Standard, i.e. BS 5803-3:1985[1)].

b) The manufacturer's name, mark or symbol.

c) Type of material.

d) Action to be taken in the event that the material becomes accidentally soaked.

e) Bag mass.

f) A table, giving *R* values and corresponding thickness information as specified in **5.1**, together with coverage information based on the definitions and values given in **2.2**, **2.4** and items e) and h) of this clause, as follows.

R value	Thickness required		Average bag usage rate	Maximum bag coverage rate (not to be exceeded)
	As installed	After maximum settlement		
$m^2 \cdot K/W$	mm	mm	bags/100 m^2	m^2/bag
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

g) Maximum percentage settlement.

h) Average density as installed and after maximum settlement.

i) Thermal conductivity (λ) as settled density and a mean temperature of 10 °C.

j) Health and safety requirements regarding inhaling or ingesting dust.

[1)] Marking BS 5803-3:1985 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of such a claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendix A Method for the measurement of the installed thickness, coverage and density of cellulose fibre insulation

A.1 Principle

The installed thickness, coverage and density of cellulose fibre insulation supplied in bags and blown through a commercial unit, set to give its normal delivery rate, into a simulated loft area are determined.

A.2 Apparatus

A.2.1 *Simulated loft area*, 2 450 mm × 2 400 mm × 100 mm deep, constructed in accordance with Figure 1.

A.2.2 *Measuring device*, constructed in accordance with Figure 2.

A.3 Procedure

With the blowing nozzle of the commercial unit held horizontally and approximately 1 m above the simulated loft area, blow the fibre along the spaces between pairs of joists in turn to an approximate depth of 100 mm. Carefully remove any material resting on the tops of the joists.

Position the measuring device at each of 30 locations pre-marked on the joists at the spacing shown in Figure 1. Align the positioning marks on the device with the inner edges of the joists so that the rule is central in a joist space at the designated location.

Take readings by pushing the rule gently downwards until its end contacts the surface of the insulation with the rule vertical.

Remove the insulation from between the joists and weigh it to the nearest 0.1 kg.

Take a second set of readings, at the same locations, by pushing the rule gently downwards until its end contacts the floor of the simulated loft area with the rule vertical.

A.4 Calculations

A.4.1 *Installed thickness*

Calculate the installed thickness a as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the 30 locations.

A.4.2 *Coverage*

Determine the net ceiling area of the simulated loft by subtracting the area covered by the joists from the total area. Calculate the coverage C (in m^2/kg) using the following equation:

$$C = \frac{n}{m}$$

where

n is the net ceiling area (in m^2);

m is the mass of insulation (in kg).

A.4.3 *Installed density*

Calculate the installed density i (in kg/m^3) using the following equation:

$$i = \frac{1\,000m}{an}$$

where

a is the installed thickness (in mm);

n is the net ceiling area (in m^2);

m is the mass of insulation (in kg).

Appendix B Method of test for corrosivity

B.1 Principle

This test is intended to provide a basis for the acceptance or rejection of the level of corrosivity displayed by a fibrous insulation where water may cause chemical constituents to migrate to thin copper or zinc-coated elements adjacent to the insulation.

NOTE 1 This is an accelerated test and analytical laboratory hygiene is required at all stages.

NOTE 2 Material passing this test is deemed acceptable when installed adjacent to the thick-sectioned steel components (e.g. nails) which may be present in a loft. Thin-sectional steel components devoid of zinc coating or other protection are at risk in any humid loft environment irrespective of the nature of any insulation present.

B.2 Reagents and materials

B.2.1 *Four metal test coupons*, two of copper foil of 99.9 % purity and two of zinc foil of 99.9 % purity, each 50 mm × 50 mm × 0.075 mm thick, judged free of tears, distortions, scratches, perforations, corrosion or other flaws when viewed under and over a 40 W coiled coil incandescent light bulb.

B.2.2 *Trichloroethylene*, of analytical reagent quality.

NOTE Attention is drawn to the possible health risks when using this material.

B.2.3 *Sulphuric acid*, (*C*) H_2SO_4 = 0.5 mol/L to 1 mol/L.

B.2.4 *Saturated ammonium acetate solution*

B.3 Apparatus

B.3.1 *Humidity chamber* maintained at 40 ± 2 °C and 90 % to 95 % r.h.

B.3.2 *Four cylindrical glass crystallizing dishes*, well washed, nominally 90 mm in diameter and 50 mm deep.

B.3.3 *Rubber or PVC gloves*

B.3.4 *Stainless steel spatula*

B.3.5 *Tweezers*

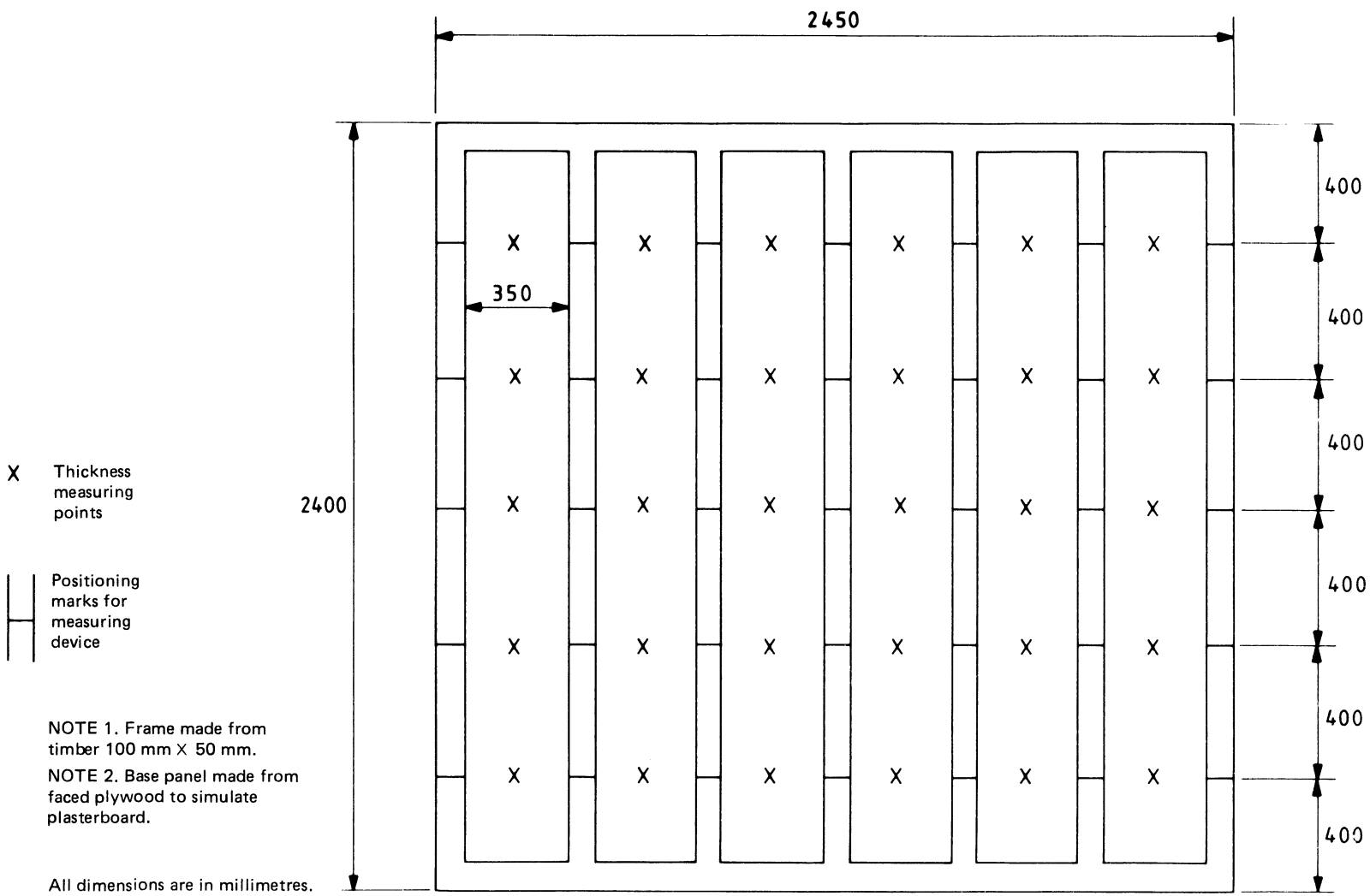
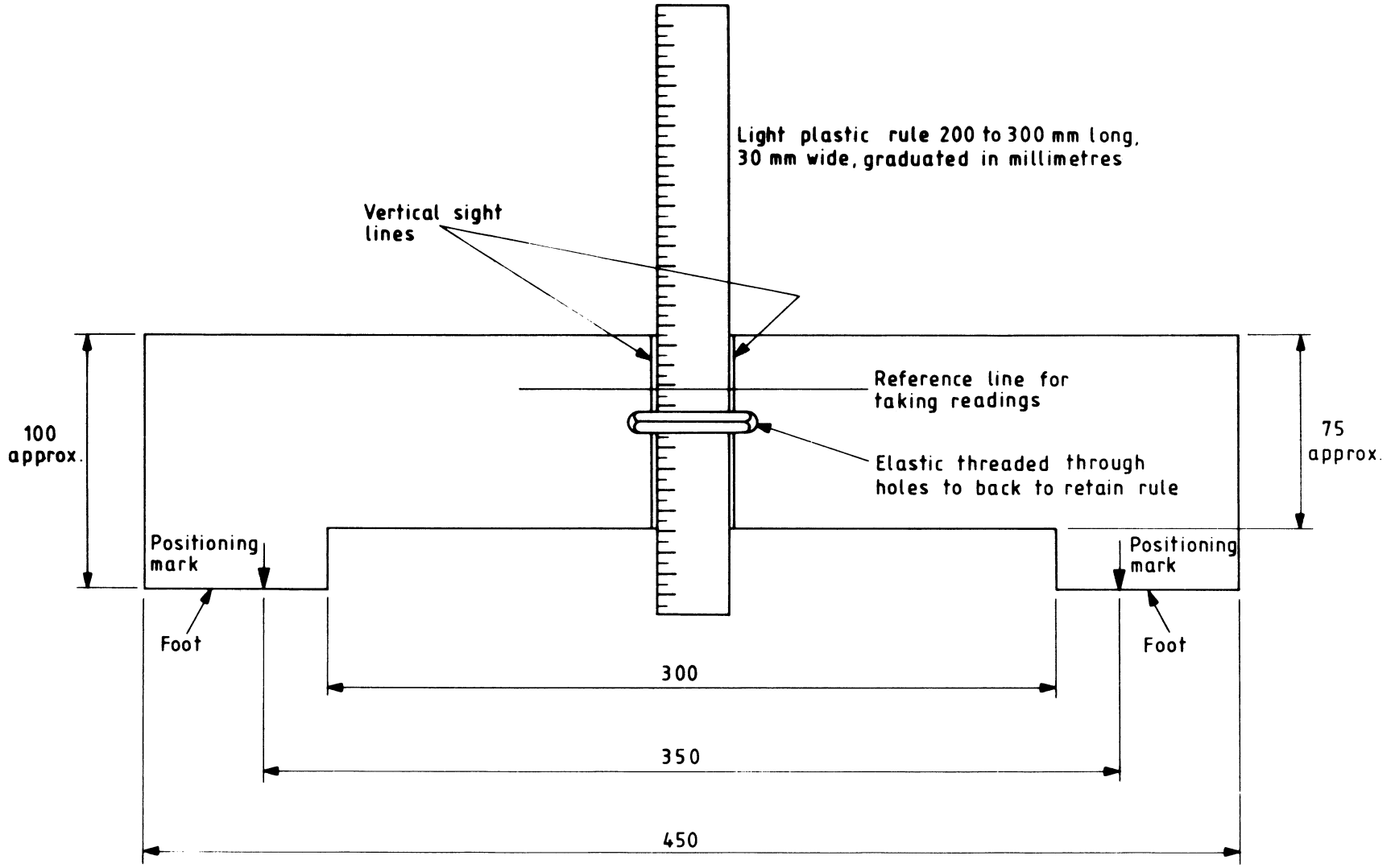


Figure 1 — Plan of simulated loft area for the determination of coverage and installed thickness



NOTE 1 Body of device made from 75 mm thickness timbers, planed.
NOTE 2 Feet smooth faced and in same plane, so as to sit on simulated loft area timbers or collection boxes without rocking.

Figure 2 — Measuring device

B.4 Procedure

Carry out the procedure as follows.

a) Wash each metal coupon successively in two glass dishes of the trichloroethylene to remove any grease or oil, and dry at room temperature. At this and all subsequent handling of the coupons, thin rubber or PVC gloves should be worn and tweezers used.

b) Take four 20 g samples of fibrous insulation and mix each with 150 mL of distilled or deionized water at room temperature in a clean glass beaker.

c) Transfer approximately half of one sample of the saturated fibrous insulation, using gloved hands and a clean stainless steel spatula, to one of the crystallizing dishes and tamp level such that a layer of 10 mm to 15 mm thickness is formed. Place one of the metal coupons horizontally on this layer by introducing one end at a slight angle to the saturated material, progressively pressing the remainder of the coupon gently down and shaking the dish slightly, in such a way that all air bubbles are expelled from the underside of the coupon. If necessary, gently tamp the saturated layer and coupon level again.

Transfer the remainder of the sample of saturated fibrous insulation as before, together with any free liquor, to cover the first layer and coupon evenly. Remove carefully any air (silvery bubbles) still visible through the glass and then gently tamp the compact level.

Repeat the above procedure so that composite test assemblies are produced for all four metal coupons.

d) Transfer the four composite test assemblies without delay to the preconditioned humidity chamber. The assemblies are not covered, but if the chamber is capable of dripping onto them, position a guard so as to prevent it.

e) Leave the test assemblies undisturbed in the humidity chamber for 336 ± 4 h (14 days), except for brief and occasional opening of the chamber for visual inspection or the introduction of other test assemblies. If, as a result of a visual inspection, it is found that a detectable drying of the surface of a composite test assembly has occurred, the minimum quantity of distilled or deionized water necessary to restore the original condition may be sprayed onto that surface, and a check made on the functioning of the chamber.

f) Upon completion of the test period, take the metal coupons from the assemblies and remove loose corrosion products by immersion for not longer than 30 s, as follows:

i) copper coupons in sulphuric acid at room temperature.

ii) zinc coupons in saturated ammonium acetate solution at room temperature.

Wash the coupons immediately under running water and dry without delay.

g) Immediately after cleaning, examine the metal coupons for perforation over the 40 W light bulb. Discount any notches or perforations within 3 mm of the edge of a coupon and note only those perforations within the remaining central zone.

Appendix C Determination of settlement at high humidity

C.1 Principle

The degree of settlement of cellulose fibre insulation supplied in bags and blown through a commercial unit, set to give its normal delivery rate is determined, after subjection to high humidity.

C.2 Apparatus

C.2.1 *Open-topped collection box*, constructed from 10 mm thick plywood and with internal measurements of 300 mm × 300 mm × 100 mm deep. The top edges of the box shall be smooth and in the same plane.

C.2.2 *Measuring device*, constructed as shown in Figure 2.

C.2.3 *Humidity chamber*, maintained at 25 ± 2 °C and 90 % to 95 % r.h.

C.3 Procedure

C.3.1 Make positioning marks on the top of the collection box such that the rule carried by the measuring device may be located over the centre of the box and at four more points 100 mm to each side of that central point along the principal axes of the box.

C.3.2 Weigh the box to 0.001 kg and place it on a level floor surface.

C.3.3 Position the measuring device at each of the five locations pre-marked on the top of the collection box, with the inside edges of its feet aligned with the inside faces of the box.

C.3.4 Take readings by pushing the rule gently downwards until its end contacts the floor of the collection box with the rule vertical.

C.3.5 With the blowing nozzle of the commercial unit held horizontally and approximately 1 m above the floor, blow the fibre into the box to a depth marginally above 100 mm and such that a sensibly smooth and level surface is obtained. Carefully remove any material resting on the top edges of the box.

C.3.6 Weigh the filled collection box to 0.001 kg.

C.3.7 Take readings with the measuring device positioned as in **C.3.3**, by pushing the rule gently downwards until its end contacts the surface of the insulation with the rule vertical.

C.3.8 Check that the density of the material is in accordance with **C.4**.

C.3.9 Transfer the filled box without delay to the pre-conditioned humidity chamber. Ensure that no jarring of the box occurs during the transfer or when closing the chamber door.

C.3.10 Leave the filled box in the chamber for a period of 72 h then remove it from the chamber and place it on a level surface without jarring.

C.3.11 Take readings as in **C.3.7**.

C.4 Density check

Determine the mass of insulation material used to fill the box (in kilograms) from the difference of the masses obtained in **C.3.2** and **C.3.6**. Determine the initial thickness of material blown into the box as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the five locations in **C.3.4** and **C.3.7**.

Calculate the density ρ of the insulation (in kg/m^3) used to fill the collection box using the following equation.

$$\rho = \frac{m}{0.00009a}$$

where

m is the mass of the insulation (in kg);

a is the initial thickness (in mm).

Confirm that the density lies within 15 % of the installed density before proceeding to **C.3.9**.

C.5 Calculation of percentage settlement

Determine the settlement of the material as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the five locations in **C.3.7** and **C.3.11**.

NOTE Because the degree of settlement permitted by **4.2** is relatively small in relation to the surface profile of blown fibre, it may prove necessary to make more than one attempt at filling the collection box or employ limited hand picking or screeding before a surface smooth enough for accurate and repeatable measurement according to **C.3.7** and **C.3.11** is obtained. In either event, the density has to be in accordance with **C.4**.

For similar reasons, the readings taken in accordance with **C.3.7** and **C.3.11** should be made by the same person, with the same degree of contact between the rule and fibrous surface achieved at both times.

Determine the initial thickness of material blown into the box as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the five locations in **C.3.4** and **C.3.7**.

Calculate the percentage settlement S of the material at high humidity using the following equation:

$$S = \frac{100t}{a}$$

where

t is the settlement (in mm);

a is the initial thickness (in mm).

Appendix D Determination of vibration settlement and settled density

D.1 Principle

The degree of settlement and settled density of cellulose fibre insulation supplied in bags and blown through a commercial unit, set to give its normal delivery rate is determined, after subjection to mechanical vibration.

D.2 Apparatus

D.2.1 *Open-topped collection box*, constructed from 10 mm thick plywood and with internal measurements of 600 mm × 300 mm × 100 mm deep. The top edges of the box shall be smooth and in the same plane.

D.2.2 *Measuring device*, constructed as shown in Figure 2.

D.2.3 *Vibration apparatus*, of high frequency and low amplitude, in accordance with **28.1** of BS 2972:1975.

D.3 Procedure

D.3.1 Make positioning marks on the top of the collection box such that the rule carried by the measuring device may be located over the principal axis of the box at six points 50, 150, 250, 350, 450 and 550 mm measured from one end.

D.3.2 Weigh the box to 0.001 kg and place it on a level floor surface.

D.3.3 Position the measuring device at each of the six locations pre-marked on the top of the collection box, with the inside edges of its feet aligned with the inside faces of the box.

D.3.4 Take readings by pushing the rule gently downwards until its end contacts the floor of the collection box with the rule vertical.

D.3.5 With the blowing nozzle of the commercial unit held horizontally and approximately 1 m above the floor, blow the fibre into the box to a depth marginally above 100 mm and such that a sensibly smooth and level surface is obtained. Carefully remove any material resting on the top edges of the box.

D.3.6 Weigh the filled collection box to 0.001 kg.

D.3.7 Take readings with the measuring device positioned as in **D.3.3** by pushing the rule gently downwards until its end contacts the surface of the insulation with the rule vertical.

D.3.8 Check that the density of the material is in accordance with **D.4**.

D.3.9 Transfer the filled box without delay to the vibration apparatus. Ensure that no jarring of the box occurs during the transfer or when clamping it into the apparatus.

D.3.10 Vibrate the filled box for 2 h then remove it from the apparatus and place it on a level surface without jarring.

D.3.11 Take readings as in **D.3.7**.

D.4 Density check

Determine the mass of insulation material used to fill the box (in kilograms) from the difference of the masses obtained in **D.3.2** and **D.3.6**. Determine the initial thickness of material blown into the box as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the six locations in **D.3.4** and **D.3.7**.

Calculate the density ρ of the insulation (in kg/m^3) used to fill the collection box using the following equation.

$$\rho = \frac{m}{0.00018a}$$

where

m is the mass of the insulation (in kg);

a is the initial thickness (in mm).

Confirm that the density lies within 15 % of the installed density as calculated in **A.4.3** before proceeding to **D.3.9**.

D.5 Calculations

D.5.1 *Percentage settlement*

Determine the settlement of the material as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the six locations in **D.3.7** and **D.3.11**.

NOTE Because the degree of settlement is relatively small in relation to the surface profile of blown fibre, it may prove necessary to make more than one attempt at filling the collection box or employ limited hand picking or screeding before a surface smooth enough for accurate and repeatable measurement according to **D.3.7** and **D.3.11** is obtained. In either event, the density has to be in accordance with **D.4**.

For similar reasons, the readings taken in accordance with **D.3.7** and **D.3.11** should be made by the same person, with the same degree of contact between the rule and fibrous surface achieved at both times.

Determine the initial thickness of material blown into the box as the arithmetic mean, to the nearest millimetre, of the difference between the pairs of readings taken at each of the six locations in **D.3.4** and **D.3.7**.

Calculate the percentage settlement S of the material after vibration using the following equation:

$$S = \frac{100t}{a}$$

where

t is the settlement (in mm);

a is the initial thickness (in mm).

D.5.2 ***Settled density***

Calculate the settled density f of the material (in kg/m^3) using the following equation:

$$f = i\frac{a}{b}$$

where

i is the installed density as calculated in **A.4.3** (in kg/m^3);

a is the initial thickness (in mm);

b is the settled thickness (in mm), i.e. $a - t$.

Appendix E Effect of thermal insulation on domestic PVC sheathed electrical cable

E.1 Principle

This test determines whether PVC sheathed electrical cable is adversely affected by contact with thermal insulation, e.g. embrittlement of the PVC sheathing due to migration or oxidation of the plasticizer.

E.2 Materials

E.2.1 *Five pieces of cable*, 200 mm long and cut from the same length. The cable shall be PVC sheathed, twin core, 1.5 mm^2 conductor cable complying with BS 6004 and exhibiting no signs of cracked sheathing.

To check the acceptability of the cable for test purposes, bend one of the five pieces through 180° around a 25 mm diameter cylindrical former at room temperature (20 ± 2 °C). Remove the cable from the former while retaining its "U" shape and inspect it for cracking of the sheathing. Retain the piece of cable as a reference sample.

E.3 Apparatus

E.3.1 *Four square frames*, open at both top and bottom, constructed from 10 mm thick plywood and with internal measurements of 300 mm × 300 mm × 100 mm deep.

E.3.2 *Eight pieces of paper-faced gypsum plasterboard*, not less than 320 mm × 320 mm in area.

E.3.3 *Cylindrical former*, 25 mm in diameter.

E.3.4 *Oven(s) or other enclosures*, maintained at 70 ± 2 °C and 40 ± 2 °C.

E.4 Number of specimens

Four specimens shall be tested, each sufficient to fill a frame of volume 0.009 m^3 at the settled density as calculated in **D.5.2**.

E.5 Procedure

E.5.1 Place a 200 mm length of cable across the centre of a piece of the plasterboard. Position a plywood frame on the plasterboard and sift one of the specimens of fibrous insulation evenly into the box so formed. Place a further piece of plasterboard on top of the box so as to press the insulation and cable into close contact.

E.5.2 Repeat **E.5.1** so that composite test assemblies are produced for four pieces of cable (i.e. not including the piece checked for cracking and retained as a reference).

E.5.3 Place two of the assemblies in the oven or enclosure controlled at 70 ± 2 °C for 24 h, and the other two in the oven or enclosure controlled at 40 ± 2 °C for 7 days.

NOTE It is permitted to use the same oven, if suitable, and carry out the conditioning of the assemblies at separate times.

E.5.4 Remove the test assemblies from their conditioning environments, invert and remove the upper piece of plasterboard from each so as to expose the pieces of cable.

E.5.5 For each test assembly, inspect the paper face of the plasterboard where it was in contact with the cable. Inspect the cable and remove it, and inspect the fibrous material which was adjacent to the cable. The inspections are made to detect any visible signs of plasticizer migration, e.g. discoloration.

E.5.6 Allow the pieces of cable to cool for 1 h at room temperature (20 ± 2 °C) and then bend each in turn through 180° around the 25 mm diameter former. Remove the cable pieces from the former while retaining their "U" shape and inspect them for cracks in their sheathing.

Appendix F Determination of thermal properties

F.1 Principle

F.1.1 This appendix describes a method for the measurement of thermal conductivity and determination of the settled and installed thickness of material required for any given thermal resistance R. The method of determining, by test and calculation, an actual value of R for comparison with the manufacturer's declared (or interpolated) value is also given.

F.1.2 Thermal resistance R is the quotient of thickness and thermal conductivity.

The thermal conductivity of an insulation material is not a constant factor. It depends, among other things, on the hot and cold face temperatures in the test, and on the thickness and density of the test specimens. The given method of preparation of specimens ensures that thermal conductivity is measured at settled density rather than at installed density, so that the appropriate settled thickness may be calculated for a given R value; and so that the installed thickness, calculated to ensure that settled thickness, will have not less than the required R value.

F.2 Apparatus

F.2.1 *Guarded hot plate thermal conductivity apparatus,* complying with BS 874-2.1 with a hot face temperature of 20 ± 3 °C and a cold face temperature of 0 ± 3 °C.

F.2.2 *Two plywood frames*, 50 mm deep and with external dimensions equal to those of the plates in the thermal conductivity apparatus. One face of each frame is covered with a thin film of plastics to form a specimen holder.

F.3 Procedure

Pass a suitable quantity of the fibrous insulation material through a blowing machine.

Weigh one or two samples of the blown material (as required by the thermal conductivity apparatus being used) sufficient to fill the specimen holders at the settled density calculated in **D.5.2**.

Sift the material evenly into the frames, such that it stands proud and may be compressed to 50 mm thickness when placed in the thermal conductivity apparatus, so that the density is the settled density.

Determine the thermal conductivity (λ) of the specimen or the average thermal conductivity for the test specimens if there are two with the hot face temperature controlled at 20 ± 3 °C and the cold face temperature controlled at 0 ± 3 °C.

F.4 Calculations

F.4.1 *Required settled thickness*

Calculate the settled thickness b (in mm) of material for any given R value, using the following equation:

$$b = 1\,000\,R\,\lambda$$

where

R is the thermal resistance (in $m^2 \cdot K/W$);

λ is the thermal conductivity [in $W/(m \cdot K)$] as measured in **F.3**.

F.4.2 *Required installed thickness*

Calculate the installed thickness a (in mm) of material required for any R value after settlement, using the following equation:

$$a = \frac{b}{1 - 0.01S}$$

where

S is the percentage settlement as calculated in **D.5.1**;

b is the settled thickness (in mm) as calculated in **F.4.1**.

F.4.3 ***Actual*** R ***value***

Calculate the actual R value (in $m^2 \cdot K/W$) of sampled bags of material for comparison with the manufacturer's declared (or interpolated) value, by using the formula:

$$R = \frac{a(1 - 0.01S)}{1\,000\lambda}$$

where

a is the installed thickness (in mm) as calculated in **A.4.1**;

S is the percentage settlement as calculated in **D.5.1**;

λ is the thermal conductivity [in $W/(m \cdot K)$] as measured in **F.3**;

all for the same bulk sample of material.

NOTE The calculated R value is specific to the installed thickness of approximately 100 mm and may be compared under **5.2** with the value declared by the manufacturer for that installed thickness or, more probably, with a value interpolated for the installed thickness from the manufacturer's data tabulated in accordance with item f) of clause **7**.

Publications referred to

BS 874, *Methods for determining thermal insulating properties.*
BS 874-1, *Introduction, definitions and principles of measurement.*
BS 874-2.1, *Guarded hot-plate method.*
BS 2972, *Methods of test for inorganic thermal insulating materials.*
BS 3533, *Glossary of thermal insulation terms.*
BS 5803, *Thermal insulation for use in pitched roof spaces in dwellings.*
BS 5803-4, *Methods for determining flammability and resistance to smouldering.*
BS 6004, *Specification for PVC-insulated cables (non-armoured) for electric power and lighting.*

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