BRITISH STANDARD

Continental quilts –

Part 2: Determination of thermal resistance for quilts filled with feather and/or down

ICS 97.160

Publishing and copyright information

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iii, a blank page, pages 1 to 9 and a back cover.

Foreword

Publishing information

This part of BS 5332 was published by BSI and came into effect on 6 March 2006. It was prepared by Technical Committee TCI/66, *Apparel and interior textiles*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5332 supersedes BS 5335-2:1991, which is withdrawn.

Relationship with other publications

This standard comprises two parts :

- Part 1: *Specification for quilts containing fillings other than feather and/or down*;
- Part 2: *Determination of thermal resistance for quilts filled with feather and/or down.*

Information about this document

This is a full revision of BS 5335-2. Originally BS 5335-2 comprised a specification for quilts filled with feather and/or down but it was superseded by BS EN 13186:2004. However, neither BS EN 13186 nor any other published European Standard for quilts deals with the question of thermal resistance. Therefore, pending the European committee beginning work in this area and in order to enable manufacturers to continue to test for thermal resistance, BS 5335-2 has been revised to give a suitable test method.

The testing of quilts with natural fillings might be subject to greater variation than manufactured filling when measuring thermal resistance. Manufacturing practice and material have changed since the last time data was established. The committee is seeking to establish and verify the current tog testing data in order to take these changes into account.

General advice and information for manufacturers and retailers is given in Annex A.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed either as a set of instructions or in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Attention is drawn to the Textile Products (Indications of Fibre Content) Regulations 1986 and subsequent amendments [1].

1 Scope

This part of BS 5335 describes a method for determining the thermal resistance of continental quilts containing feather and/or down, supplied for domestic use and manufactured in accordance with BS EN 13186.

NOTE The provisions of this standard do not apply to items of bedding that are supplied for use in children's products such as cots, moses baskets and sleeping bags.

2 Normative references

The following referenced documents are indispensable for the application 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.

BS 874-1, *Methods for determining thermal insulating properties – Part 1: Introduction, definitions and principles of measurement*

BS EN 13186, *Feather and down – Specification for feather and down filled bedding articles*

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

3 Terms and definitions

For the purposes of this standard, the definitions given in BS EN 13186 and the following apply.

3.1 tog
unit of thermal resistance, equal to one-tenth of a square metre Kelvin per watt
[1 tog = 0.1 $m^2 \cdot K/W$]

3.2 thermal resistance of a quilt
ten times the temperature difference between the two faces of a quilt, in Kelvins (K), when the heat flow rate across the unit area is equal to 1 W/m^2

NOTE The thermal resistance of a quilt is also known as its tog value.

4 Determination of thermal resistance

4.1 Principle

The thermal resistance of quilts is determined using a specially designed single specimen apparatus permitting conductance/transmittance measurements to be carried out. The quilt to be measured is laid upon a horizontal surface maintained at skin temperature whilst the air layer above the quilt is maintained at a constant relative humidity and temperature. The thermal resistance of the quilt plus the thermal resistance of the air layer is calculated, and the thermal resistance of the air layer is subtracted from this to give the thermal resistance of the quilt itself. Two different types of apparatus may be used.

4.2 Apparatus

4.2.1 General

The apparatus shall be built and operated in accordance with the principles of BS 874-1, and shall be so designed that it meets the following criteria.

a) The apparatus shall be horizontal, with the heat flowing upwards, designed so that measurements are made between the upper hot face of the apparatus and the ambient air above the quilt.

b) The surface of the upper hot face of the apparatus shall be flat, isothermal, metal and shall have a matt black finish. The central measuring area shall be a rectangle of minimum size 1.0 m × 0.6 m. The guard area or effective guard area around the central measuring area shall be not less than 0.15 m wide.

c) Sets of at least five temperature sensors, each set uniformly distributed over the central measuring area, shall be used to measure the upper hot face and lower hot face temperatures.

d) A set of at least five shielded temperature sensors, uniformly distributed over the central measuring area, shall be used to measure the temperature of the air layer above the quilt. The set shall be movable in a vertical direction so that it can be placed at a height of 75 mm to 100 mm vertically above the top surface of the quilt (see **4.5.5**).

e) Both the upper hot face temperature and the temperature of the air layer above the quilt shall be capable of being controlled to ±0.1 °C.

NOTE 1 *The high degree of control needed for the air temperature may be achieved by surrounding the upper part of the apparatus with a suitable temperature controlled hood giving sufficient air exchange with the room to ensure conformity to the humidity requirement above the quilt [see item f)]. Alternatively, computer-controlled environments may be employed.*

f) The apparatus shall be located in a conditioned room maintained at the standard atmosphere as described in BS EN ISO 139. The apparatus shall be screened from any sources of heat external to the apparatus, such as radiators, lamps, solar radiation and personnel, and from draughts.

NOTE 2 *Care should be taken with the positioning of any air-conditioning equipment.*

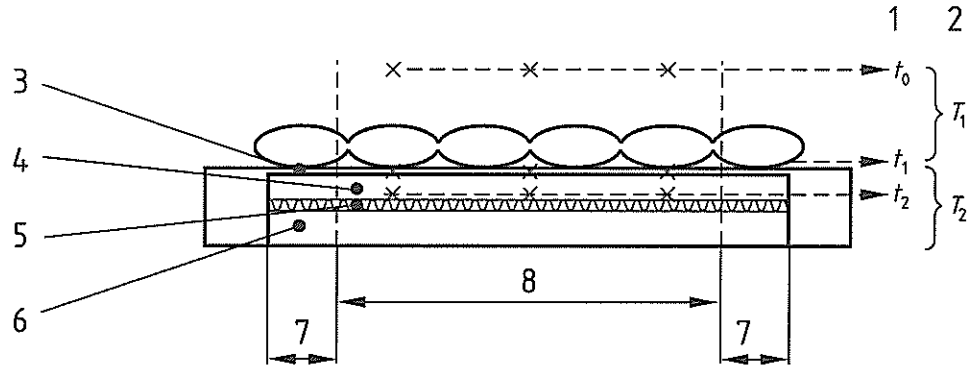
g) All surfaces visible to the upper surface of the quilt shall be of high thermal emittance.

NOTE 3 *Most building materials and building finishes in current use have a high thermal emittance.*

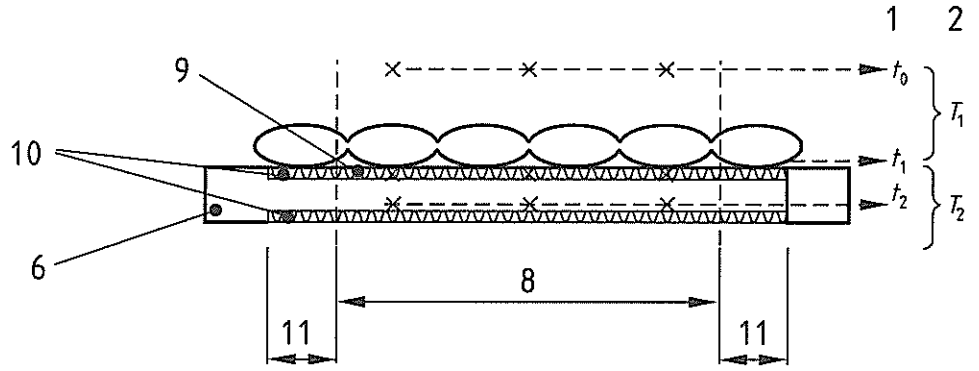
One of the following two possible types of apparatus shall be used:

- either a comparator apparatus as shown in Figure 1a) and used in accordance with the principle given in **4.2.2**; or
- a guarded hot-plate apparatus as shown in Figure 1b) and used in accordance with the principle given in **4.2.3**.

Figure 1 **Apparatus for the determination of thermal resistance of quilts**



a) Comparator apparatus



b) Guarded hot plate apparatus

Key

1	Temperature
2	Temperature difference
3	Metal hot face
4	Calibrated board
5	Heater
6	Insulation
7	Effective guard area
8	Central measuring area
9	Central heater
10	Guard heaters
11	Guard area
t_0	Temperature of the air layer above the quilt
t_1	Upper hot face temperature
t_2	Lower hot face temperature
T_1	Difference between the upper hot face temperature and the temperature of the air layer above the quilt
T_2	Difference between the lower hot face temperature and the upper hot face temperature
X	Temperature sensor

4.2.2 Comparator apparatus

If comparator apparatus is used, the thermal resistance of the quilt plus the air layer R_t shall be determined from the ratio of the temperature differences T_1 and T_2 and the thermal resistance of the calibrated board from the equation:

$$R_t = (T_1/T_2) \times R_c$$

where R_c is the thermal resistance of the calibrated board.

4.2.3 Guarded hot plate apparatus

If guarded hot plate apparatus is used, the thermal resistance of the quilt plus the air layer R_t shall be determined from the energy dissipated in the central heater, the area of the central heater and the temperature difference T_1, using the following equation. The temperature difference T_2 shall be maintained at zero.

$$R_t = \frac{A \times T_1}{W}$$

where

A is the area of the central heater (central measuring area), in square metres (m^2);

T_1 is the temperature difference between the upper hot face temperature and the temperature of the air layer above the quilt;

W is the energy dissipated in the central heater, in watts (W).

4.3 Verification of apparatus

4.3.1 General

The apparatus shall be verified at three points over the expected thermal resistance range (i.e. 5 togs to 15 togs) using reference materials as specified in **4.3.2**. The value of the thermal resistance of each reference material, when determined in accordance with **4.3.3**, shall be within 5% of the corresponding stated value.

Verification shall be carried out, initially, on commissioning of the apparatus and thereafter at intervals not exceeding 12 months. Additionally, when repair, modification or maintenance of the equipment has taken place, which could affect the accuracy, or when there is reasonable cause to believe that the apparatus' results no longer accord (i.e. within 5%) with the values of the reference materials, the apparatus shall be verified before it is further used.

4.3.2 Reference materials

To verify the apparatus, reference materials of which the thermal resistances are accurately known shall be used. The three reference materials shall have thermal resistances of approximately 5 tog, 10 tog and 15 tog, and thicknesses of approximately 25 mm, 50 mm and 75 mm respectively.

4.3.3 Verification procedure

4.3.3.1 Principle

The thermal resistance of each reference material and of the air layer is determined for each reference material.

4.3.3.2 Procedure

Condition the reference material following the procedure given in **4.4.**

Lay the reference material on the test apparatus, and place a temperature sensor in good contact with the upper surface of the reference material vertically below each of the air temperature sensors. Follow the procedure for the determination of thermal resistance given in **4.5.5** to **4.5.8**, substituting the reference material for the quilt, but do not make any deduction for the thermal resistance of the air layer.

Calculate the thermal resistance of the reference material R_f (in togs) and the thermal resistance of the air layer R_a (in togs) from the equations:

$$R_a = \frac{R_f(t_3 - t_0)}{(t_1 - t_0)}$$

$$R_f = R_t - R_a$$

where:

R_t is the total thermal resistance of the reference material and the air layer, in togs;

t_0 is the temperature of the air layer above the reference material, in degrees Celsius (°C);

t_1 is the temperature of the reference material lower surface, in degrees Celsius (°C);

t_3 is the temperature of the reference material upper surface, in degrees Celsius (°C).

NOTE The value of $(t_3 - t_0)$ is very small and extreme care is required in its measurement.

4.3.4 Record of verification

For each test of each reference material, record the difference between the mean determination of the thermal resistance and the stated thermal resistance of the reference material as a percentage of the stated value.

4.4 Conditioning

4.4.1 Lay the reference material or quilt flat, or suspend the quilt from one side, such that there is a minimum of 25 cm free air access to all surfaces of the quilt. If a channelled quilt is suspended for conditioning, the channels shall be horizontal.

4.4.2 Condition the reference material or quilt in an atmosphere maintained at a relative humidity of (65 ± 2)% r.h., measured to an accuracy of ±2% r.h., and a temperature of (20 ± 2) °C, for the following minimum periods:

- reference material: 24 h;
- quilt: 5 days.

4.5 Test procedure

4.5.1 Prepare the quilt in the following manner.

a) Remove the quilt from its packaging and shake vigorously from both sides and both ends.

b) If a channelled quilt is loose filled, shake the quilt from each end until the filling occupies the middle of each channel.

c) Lay the quilt flat, or suspend it from one side, such that there is a minimum of 25 cm free air access to all surfaces of the quilt. If a channelled quilt is suspended for conditioning, the channels shall be horizontal.

d) Carefully spread the filling evenly throughout the quilt, checking its distribution by lightly running a hand over the casing.

4.5.2 Condition the quilt in the following manner.

a) Take care not to disturb the uniformity of the distribution of the filling following the preparation procedure.

b) Prepare the quilt in accordance with **4.4.1**.

c) Condition the quilt in the atmosphere given in **4.4.2** for a minimum period of 5 days.

4.5.3 Transfer the quilt to the test apparatus without disturbing the filling. Place the quilt on the central measuring area. Fluff up each half of the quilt by lifting each side and gently shaking three times that half of the quilt, shaking across the channels if the quilt is channelled.

NOTE This is to allow the filling to attain its maximum thickness without disturbing the uniformity of the distribution of the filling.

4.5.4 If necessary, re-position the quilt with gentle shakes so that all of the central measuring area is covered by the quilt and all points on the periphery of the central measuring area are not less than 30 cm from the nearest point on the edge of the quilt.

4.5.5 Adjust the apparatus so that the temperature sensors in the air layer above the quilt are placed at a height of 75 mm to 100 mm vertically above the top surface of the quilt, and the test conditions are:

a) upper hot face temperature (33.0 ± 0.5) °C;

b) temperature of air layer above the quilt (20.0 ± 0.5) °C;

c) airspeed above the quilt not greater than 0.3 m/s.

4.5.6 Make determinations of the total thermal resistance of the quilt and air layer at equally spaced time intervals of not less than 60 min. The quilt and air layer shall be deemed to have reached equilibrium when the range between the lowest and the highest of the three most recent determinations of thermal resistance does not exceed 1% of the mean of those three most recent determinations.

4.5.7 Control the temperatures of the upper hot face and of the air layer above the quilt to within ±0.1 °C.

4.5.8 Make at least three more determinations of thermal resistance of the quilt and air layer at equally spaced time intervals of not less than 30 min. If the value of any of these three determinations differs by more than 1% from the most recent mean calculated in accordance with **4.5.6**, then repeat the procedure given in **4.5.6**. The thermal resistance of the quilt shall be taken as the mean of these three determinations minus the thermal resistance of the air layer as determined in **4.3.3**.

4.6 Test report

Report, to the nearest one-tenth of a tog, the thermal resistance of the conditioned quilt.

NOTE The manufacturing specification for a quilt should include an allowance both for the experimental error resulting from the method of test for the determination of thermal resistance and for manufacturing tolerances. It should also be noted that, in some cases, packaging can reduce the tog value of a quilt and this should, therefore, be taken into account when claims for tog values are being made. The thermal resistance of a quilt should fall within the range –0.5 *tog to* +3.0 *tog of the value stated on the label.*

5 Labelling

Each product shall be labelled with a statement of conformity to:

a) BS EN 13186:2004;[1)]

b) BS 5335-2:2006.[1)]

Each product shall also be labelled with:

1) the manufacturer's name, trademark or other means of identification;

2) appropriate cleansing instructions.

The claimed thermal resistance of the quilt shall state one of the values given in the following list:

- 4.5 togs minimum;
- 6.0 togs minimum;
- 7.5 togs minimum;
- 9.0 togs minimum;
- 10.5 togs minimum;
- 12.0 togs minimum;
- 13.5 togs minimum;
- 15.0 togs minimum.

[1)] Marking BS EN 13186:2004 or BS 5335-2:2006 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 the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex A (informative) General advice and information for manufacturers and retailers

The following information may be stated on the packaging of a quilt, or in an explanatory leaflet enclosed within the packaging; a minimum character height of 2.5 mm (approximately 7 point in an average sans-serif typeface) should be used:

a) the thermal resistance of the quilt as given in Clause **5** together with either:

b) the statement: "British Standard warmth categories range from summer use to warm to extra warm in the following ratings: 4.5, 6, 7.5, 9, 10.5, 12, 13.5, 15 togs minimum respectively"; or

c) a reproduction of the following table.

Minimum rating	4.5 togs	6.0 togs	7.5 togs	9.0 togs	10.5 togs	12.0 togs	13.5 togs	15.0 togs
Warmth classification	←Summer use----------Warm----------Extra warm-----→							

Bibliography

Standards publications

BS 5335-1, *Continental quilts – Part 1: Specification for quilts containing fillings other than feather and/or down*

Other publications

[1] GREAT BRITAIN. Textile Products (Indications of Fibre Content) Regulations 1986 and subsequent amendments. SI 1986, No. 26. London: HMSO.

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