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Requirements for sleeping bags —

Part 1: Thermal and dimensional requirements

Exigences pour les sacs de couchage —

Partie 1: Exigences thermiques et dimensionnelles

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 23537 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 136, *Sports, playground and other recreational facilities and equipment* in collaboration with ISO Technical Committee TC 83, *Sports and other recreational facilities and equipment*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 23537 consists of the following parts, under the general title, *Requirements for sleeping bags*:

— *Part 1: Thermal and dimensional requirements*

— *Part 2: Fabric and material properties*

Introduction

This is the first edition of this part of ISO 23537. It is based on continued development of the European Standard, EN 13537.

This International Standard consists of two parts which allows for separate validation of thermal properties and product and material performance. This separation of parts also allows for continued development of new product combinations as it encourages manufacturers to consider new combinations of materials which for example might not be suitable to test by traditional textile physical tests, but which can still have thermal properties evaluated.

This part of ISO 23537 considers important aspects to the thermal performance of the sleeping bag.

During the development of this part of ISO 23537, consideration was given to the need to continue to reduce inter laboratory variability of the thermal testing and a number of test parameters have been tightened as a consequence.

Consideration has also been given to the definition of extreme climate zone which is now referred to as temperatures <–20 °C.

Requirements for sleeping bags —

Part 1:
Thermal and dimensional requirements

1 Scope

This part of ISO 23537 specifies the requirements and test methods as well as provisions for labelling of adult sized sleeping bags for use in sports and leisure time activities.

This part of ISO 23537 does not apply to sleeping bags intended for specific purpose such as military use and extreme climate zone expedition. It does not apply to sleeping bags for children or babies.

NOTE 1 No prediction model exists for the determination of the limiting temperatures based on the thermal resistance of the sleeping bag for children and babies. Moreover, such a model for testing cannot be developed because the necessary controlled sleep trials with children or babies in climatic chambers are, out of ethical reasons, not permitted.

NOTE 2 The limit temperature for extreme climate conditions is seen to be −20 °C.

This part of ISO 23537 describes the method for the assessment of the performance in steady-state conditions of a sleeping bag with regard to the protection against cold.

NOTE 3 Sleeping bags without homogeneous fillings designed to provide local extra insulation in certain parts pose issues with the calibration and/or test procedure. Ongoing work continues to provide suitable means of establishing temperature ratings.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 1096, *Plywood — Classification*

ISO 3758, *Textiles — Care labelling code using symbols*

ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

ISO 15831:2004, *Clothing — Physiological effects — Measurement of thermal insulation by means of a thermal manikin*

EN 13088, *Manufactured articles filled with feather and down — Method for the determination of a filled product's total mass and of the mass of the filling*

3 Terms and definitions

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

3.1
comfort temperature
T_{comf}
lower limit of the comfort range, down to which a sleeping bag user with a relaxed posture, such as lying on their back, is globally in thermal equilibrium and just not feeling cold

Note 1 to entry: For more information, see C.7.3.

3.2
limit temperature
T_{lim}
lower limit at which a sleeping bag user with a curled up body posture is globally in thermal equilibrium and just not feeling cold

Note 1 to entry: For more information, see C.7.2.

3.3
extreme temperature
T_{ext}
very low temperature where the risk of health damage by hypothermia is possible

Note 1 to entry: For more information, see C.7.1.

Note 2 to entry: This is a point of danger which can lead to death.

3.4
maximum temperature
T_{max}
upper limit of comfort range, up to which a partially uncovered sleeping bag user just does not perspire too much

Note 1 to entry: For more information, see C.7.4.

3.5
thermal manikin
dummy with human shape and heated body surface which allows the determination of thermal transfer through the sleeping bag under steady-state conditions

Note 1 to entry: i.e. constant heat flux and temperature gradient between body surface and ambient air.

3.6
thermal resistance
thermal insulation
R_c
property of the sleeping bag which is related to the dry heat loss of the sleeping bag user, effected by the difference of temperature between the skin and the ambient air, as measured with a thermal manikin

Note 1 to entry: The dry heat loss of the sleeping bag user is a combination of conductive, convective and radiative heat transfer.

Note 2 to entry: This thermal resistance represents the insulative property of a sleeping bag, which includes the effects of the shell fabrics and filling materials, air volume in the cavity inside the sleeping bag, boundary air layer on the outer face of the sleeping bag, mattress underneath the sleeping bag and garments worn by the sleeping bag user. It is considered to be the total thermal insulation (see ISO 15831).

4 Requirements and test methods

4.1 Water vapour permeability index

When tested in accordance with ISO 11092, the material specific water-vapour permeability index (i_{mt}) of the sleeping bag shall be ≥0,45. Where front and back area of the sleeping bag are of different material combinations, both parts shall be tested.

NOTE The water-vapour permeability index is dimensionless, and has values between 0 and 1. A value of 0 implies that the material is water-vapour impermeable, that is, it has infinite water-vapour resistance, and a material with a value of 1 has both the thermal resistance and water-vapour resistance of an air layer of the same thickness.

4.2 Inside dimensions

4.2.1 Inside length

To enable labelling of the sleeping bag, the inside length of the sleeping bag shall be measured within ±3 cm. The measurement is made by turning the sleeping bag inside out and measuring the length from the position of the seam where the heel of the foot is placed to the top of the sleeping bag (excluding any vertical components of the hood), without applying any force to extend the sleeping bag length.

4.2.2 Maximum inside width

To enable labelling of the sleeping bag, the maximum inside width shall be measured within ±2 cm. The measurement is made by turning the sleeping bag inside out and measuring the circumference at the widest point without stretching the fabric. If the maximum inside width of the sleeping bag is not in the chest area, then the position of the widest point of the sleeping bag shall be indicated on the label. The circumference is halved to provide the width of the sleeping bag. If the sleeping bag has elastic seams, a force of (10 ± 1) N may be used to extend these seams prior to measurement, for instance by using a spring balance.

4.2.3 Inside foot width

To enable labelling of the sleeping bag, the foot width shall be measured within ±2 cm. The measurement is made by turning the sleeping bag inside out and measuring the circumference at a distance (30 ± 1) cm towards the hood from the position where the heel of the foot is placed. The circumference is halved to provide the width of the sleeping bag. If the sleeping bag has elastic seams, a force of (10 ± 1) N may be used to extend these seams prior to measurement, for instance by using a spring balance.

4.3 Total mass

The total mass of sleeping bags filled with feather and/or down shall be determined in accordance with EN 13088.

For sleeping bags filled with materials other than feather and down, samples shall be conditioned according to ISO 139 at 20 °C air temperature and 65 % relative air humidity and the mass of the sleeping bag (without stuff sack) shall be determined. The deviation of the total mass from the declared nominal value shall be ≤7 %.

4.4 Thermal properties

4.4.1 Principle

The thermal resistance of the sleeping bag is measured with a thermal manikin which meets the requirements and test procedure of ISO 15831 and which is inserted into the sleeping bag and placed in a controlled atmosphere.

A physiological model is then applied which uses this thermal resistance to determine ambient temperatures corresponding to a range of utility of the sleeping bag.

4.4.2 Thermal manikin

A thermal manikin according to ISO 15831 with the body height of (1,70 ± 0,15) m shall be used.

During the test, the manikin shall be dressed with the following garments:

— two-piece suit (upper part with long sleeves, trousers) with a material specific thermal resistance tested (R_{ct}) in accordance with ISO 11092 of

R_{ct} = (0,040 m²·K/W to 0,060 m²·K/W) (1)

— knee-length socks with a material specific thermal resistance tested in accordance with ISO 11092 of

R_{ct} = (0,040 m²·K/W to 0,060 m²·K/W) (2)

The thermal manikin's skin temperature shall be in accordance with ISO 15831:2004, Clause 7.

4.4.3 Climatic room

The test shall be performed in a climatic room with an air speed, a heat flux and a relative humidity in accordance with ISO 15831:2004, Clause 7.

The ambient temperature shall be (10 ± 5) °C. During the test, the fluctuation of the ambient temperature shall be in accordance with ISO 15831:2004, 5.2.1.

NOTE Very insulative sleeping bags might not allow the heat flux to be ≥20 W/m². In these cases, an ambient temperature of the lowest value within this range is seen as appropriate.

4.4.4 Thermal resistance

4.4.4.1 Thermal resistance posture 1 $R_c(1)$

The thermal resistance posture 1 $R_c(1)$ is measured with the thermal manikin completely inserted into the sleeping bag and lying on its back. The bag's zippers, if any, are closed. The bag's hood, if present, covers the manikin's head, and the cords of the hood are tightened as much as possible without using any additional aids (e.g. clothes pins, etc.) not supplied with the sleeping bag.

For sleeping bags that have hood draw cords with which the hood aperture can be closed to <120 mm diameter or <375 mm perimeter, a cold-protective mask[1)] shall be used on the manikin's face. For sleeping bags with hood draw cords with which the hood aperture cannot be closed to <120 mm diameter or <375 mm perimeter, a cold-protective mask shall not be used on the manikin's face. For sleeping bags that do not have a hood or do not have hood draw cords, a cold-protective mask shall not be used.

The thermal resistance posture 1 $R_c(1)$ is determined using either the serial or the parallel calculation method according to ISO 15831. A combination of these two calculation methods is also possible. With a given thermal manikin, the decision as to which calculation model is appropriate shall be based on the results of the calibration procedure including the correlation for the individual thermal manikin, as described in 4.4.9.

1) Mask, Extreme Cold Weather, U.S. G.I., is the trade name of a product supplied by Colemans. This Information is given for the convenience of users of this documents and does not constitute an endorsement by ISO of the products named. Equivalent products may be used if they can be shown to lead to the same results.

4.4.4.2 Thermal resistance posture 2 $R_c(2)$

The thermal resistance posture 2 $R_c(2)$ is measured with the thermal manikin only partly inserted into the sleeping bag, and lying on its back. The upper part of the sleeping bag is pulled up only to the thermal manikin's arm pits; and the arms of the thermal manikin lie outside the bag's upper part. The zippers of the sleeping bag, if any, are completely opened. The bag's hood, if present, is placed below the thermal manikin's head without tightening the cords. No cold-protective mask is on the thermal manikin's face.

The thermal resistance posture 2 $R_c(2)$ is determined using the parallel calculation method according to ISO 15831.

4.4.5 Artificial ground

The test shall be operated with the thermal manikin placed into the sleeping bag in accordance with 4.4.4.1 or 4.4.4.2, lying on a foam mattress with a material specific thermal resistance R_{ct} = (0,85 ± 0,06) m^2·K/W when tested in accordance with ISO 11092 and placed on an artificial ground. This ground shall consist of a wooden board according to ISO 1096, large enough that no part of the manikin or the sleeping bag protrudes over the board, with a thickness of (20 ± 2) mm.

The artificial ground is held at least 100 mm above the floor by some kind of support which allows air circulation underneath the artificial ground.

4.4.6 Test samples and pre-treatment

Before testing, the sleeping bag shall be dry tumbled in a dryer with a capacity of ≥250 l without any additional load for 15 min at a temperature of <30 °C. After this dry tumbling and immediately prior to the test, it shall be conditioned for ≥12 h in the ambient conditions of the test.

4.4.7 Test procedure

The test shall be performed according to the requirements in 4.4.2, 4.4.3, and 4.4.5.

For each specific thermal manikin, the position of the arms and legs in relation to the torso of the manikin, the wooden board and the artificial ground shall be defined as part of the calibration procedure and remain the same in all the tests performed according to this part of ISO 23537.

Calculate the value of the thermal resistance posture 1 $R_c(1)$ and/or the thermal resistance posture 2 $R_c(2)$ by applying the correlation gained from the calibration procedure as given in 4.4.9.

Three separate tests shall be completed; each commencing from the insertion of the manikin into the sleeping bag. The arithmetic mean value of the thermal resistance of the sleeping bag shall then be calculated.

If the tests cannot be completed using three separate sleeping bags, then use of a single bag is permissible however it shall undergo the pre-treatment in accordance with 4.4.6 in between individual tests, and the test report shall show a single bag was used.

4.4.8 Calculation of temperatures of the range of utility

The sleeping bag's comfort, limit and extreme temperatures (T_{comf}, T_{lim}, T_{ext}) shall be determined on the basis of the thermal resistance posture 1 $R_c(1)$, according to the physiological model described in Annex C. The sleeping bag's maximum temperature T_{max} may be determined optionally on the basis of the thermal resistance posture 2 $R_c(2)$, according to the physiological model also described in Annex C.

The temperatures of the sleeping bag's range of utility may also be obtained with acceptable accuracy using Table 1 and Table 2. If the thermal resistances posture 1 $R_c(1)$ and the thermal resistances posture 2 $R_c(2)$ measured for the sleeping bag are in between the values in Table 1 or Table 2, a linear interpolation shall be performed on the basis of the nearest upper and lower values of the thermal