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Textiles — Determination of drying rate in dynamic state by the modified sweating-guarded hotplate

Textiles — Détermination de la vitesse de séchage en régime dynamique à l'aide de la plaque chaude gardée transpirante modifiée

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13029 was prepared by Technical Committee ISO/TC 38, *Textiles*.

Introduction

The purpose of this International Standard is for testing textile fabrics that have moisture-management properties.

International Standards do not provide a detailed definition of Moisture Management Textiles. Here, moisture management generally refers to a feature in which absorbed sweat is transported within the fabric and along the fabric surface and is dried from the fabric surface.

The drying that takes place in textiles, which are designed to dry the absorbed sweat in a timely manner using the capillary-tube phenomenon, progresses in a condition that is different from the drying that is generally practiced after washing. This is because textiles intended for moisture-management properties show the feature of drying the absorbed sweat at the same time as the sweat vapour is continuously allowed in from the human body. Also, the drying of the textile progresses by evaporating only in the direction that is opposite to the side where the sweat heated by the human body temperature contacts the skin. To distinguish between these two types of drying, the condition in which textiles are dried after washing is specified as “steady state” while “dynamic state” drying is the term used for the drying feature of the textile material with moisture-management properties.

To evaluate the drying condition of textiles under a dynamic state, the sweating-guarded hotplate (SGHP) equipment specified in ISO 11092 has been modified and used. Distilled water is used to avoid the estimation errors that can occur when applying artificial sweat to the SGHP.

This International Standard does not evaluate the physiological feature of textile materials. However, it can provide information that can be used for comparison among textile materials by estimating their drying features in limited environmental conditions.

Textiles — Determination of drying rate in dynamic state by the modified sweating-guarded hotplate

1 Scope

This International Standard specifies a method for measuring the drying rate of fabric products for sports, leisure use or underwear, that have contact with the skin in their normal use, and other similar fabric products.

The method is not applicable to textiles that cannot be permeated by water vapour or for those textiles which are more than 5 mm thick.

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.

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

3 Terms and definitions

For the purposes of this document, the definitions given in ISO 11092 and the following apply.

3.1
moisture management
feature designed into some textile fabrics to control or enhance the speed of absorption and evaporation of sweat from the wearer's skin

NOTE 1 Moisture-management features may include differences in spreading rates along the surfaces of the fabric intended to be in contact with the skin and with the air.

NOTE 2 See AATCC method 195 for measurements of dynamic properties other than drying.

3.2
drying rate
time, in seconds, for a test specimen, saturated with 5 ml of distilled water, to reach its initial water vapour steady state under isothermal test conditions

3.3
dynamic state
drying condition relative to the continuous application of a specified degree of heat and moisture

3.4
water vapour resistance
R_{et}
water-vapour pressure difference between the two faces of a material divided by the resultant evaporative heat flux per unit area in the direction of the gradient

NOTE 1 The evaporative heat flux may consist of both diffusive and convective components.

NOTE 2 Water-vapour resistance R_{et}, expressed in square metres pascal per watt, is a quantity specific to textile materials or composites which determines the "latent' evaporative heat flux across a given area in response to a steady applied water-vapour pressure gradient.

NOTE 3 Water-vapour resistance R_{et} is measured according to ISO 11092.

4 Symbols and abbreviations

T_a Temperature of the air inside the test enclosure, °C

T_m Temperature of measuring unit, °C

T_s Temperature of thermal guard, °C

RH Relative humidity inside the test enclosure, %

H Heating power supplied to measuring unit, W

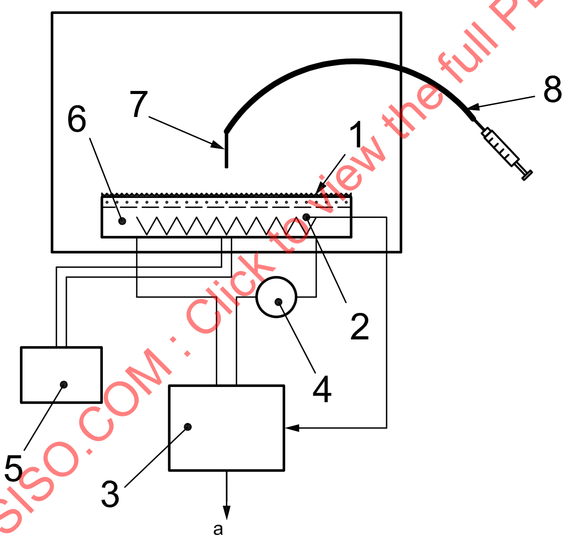
5 Apparatus

5.1 General

For the test device, the sweating-guarded hotplate, which is specified in ISO 11092, is used with a water input device.

5.2 Measuring unit with water input device

The measuring unit of the sweating-guarded hotplate is to be used as specified in ISO 11092. The water input device (Figure 1, item 7) is positioned directly above and centred on the specimen.



Key

1 Specimen
2 Temperature sensor
3 Temperature controller
4 Heating power measuring device
5 Water supply device
6 Metal block, including heating elements
7 Water input device
8 Syringe connecting with flexible tubing

Figure 1 — Measuring unit of sweating-guarded hotplate with water input device

5.3 Water input device

The device used to drop the water onto the test specimen is installed directly above the centre of the specimen. Tubing with an inside diameter of (3,5 ± 0,5) mm inside the chamber is connected to a syringe outside the chamber. In all cases, the water input device shall be fixed such that the water is delivered at a height of (50 ± 5) mm above the surface of the test specimen and that the water shall be inserted within (5 ± 1) s by using a syringe or its equivalent.

5.4 Test enclosure

The test enclosure of the sweating-guarded hotplate shall conform to the contents specified in ISO 11092.

6 Test procedure

6.1 Preparation of specimen

6.1.1 Cut a minimum of 3 test specimens of (300 × 300) mm from the test sample. The dimension of the test specimens shall be sufficient to completely cover the surface of the measuring unit and temperature guard.

6.1.2 Before testing, the specimen shall be conditioned for a minimum 12 h at 35 °C and 40 % RH in a conditioning test room in accordance with ISO 11092

6.2 Measurement of water-vapour resistance R_{et}

The R_{et} measurement of the test specimen by the sweating-guarded hotplate shall conform to the testing conditions and procedures of ISO 11092 regarding materials which are less than 5 mm thick.

6.2.1 Set the temperature of both the measuring unit and air to 35 °C with 40 % relative humidity. Hold the air speed at 1 m/s.

NOTE These isothermal conditions prevent water-vapour condensation within the test specimen.

6.2.2 Place the test specimen on the measuring unit, wait until the instrument and specimen have reached steady-state, and read the R_{et} value from the sweating-guarded hotplate.

6.3 Determination of drying time

6.3.1 Prepare the water input device with (5 ± 0,1) ml of water to allow the water to reach the required (20 ± 2) °C temperature.

6.3.2 After maintaining these conditions for 10 min, wet the test specimen with 5 ml of water through the water input device.

6.3.3 As the test specimen starts wetting, record the point of time where the R_{et} value in the steady-state starts to rapidly change (the point at which it deviates from the average value of the 5 min of steady-state immediately before adding the distilled water) as t_1.

6.3.4 By estimating the time taken until the R_{et} value reaches the average R_{et} value before t_1, measure the time elapsed and set it as t_2. Here, the value of R_{et} at t_2 that is 99 % of the average R_{et} value before t_1 is determined using the linear interpolation method.

6.4 Calculation of drying time

The drying time, t, is calculated by using the t_1 and t_2 values in the following equation:

$$t = t_2 - t_1 \quad (1)$$

where

t: drying time of the test specimen, s;

t_1: point at which drying starts right after water moisture, s;

t_2: point at which drying of water terminates, s.

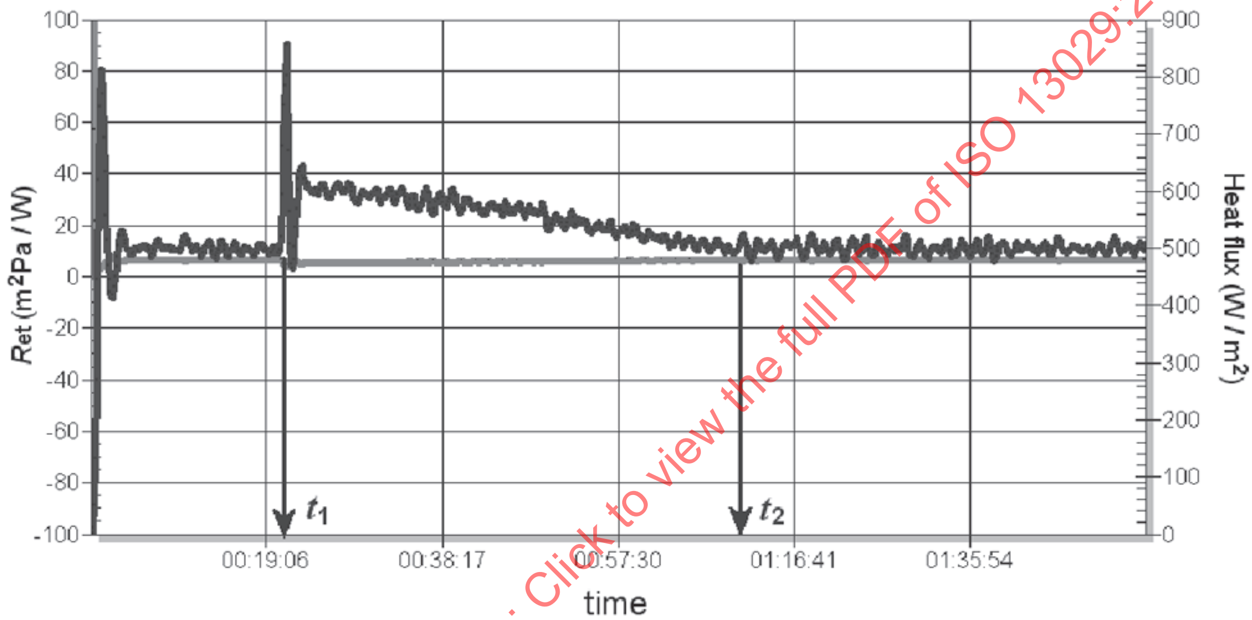


Figure 2 — Determination of drying time by measuring t_1 and t_2

6.5 Expression of drying rate

The calculated drying time is an estimated result based on using 5 ml of distilled water, and therefore it is expressed as a drying rate in seconds per 5 ml of water.

7 Test report

The test report shall include the following information:

a) number and date of this International Standard;

b) identification of the sample;

c) number of specimens;

d) conditional atmosphere used;

e) average and coefficient of variation for the drying rate;

f) any deviation from the specified procedure in this International Standard.

Annex A
(informative)

Example of test result

A.1 Comparison of drying rates

The purpose is to compare the drying rate for 4 kinds of samples which are single-layer knitted fabrics. The value is obtained by averaging three measured drying times for each specimen, and the variation coefficient within the scope of 5,5 to 7,7 % is shown. The drying rate of sample #1 is 2333,7 s/5 ml and the drying rate of sample #4 is 2959,3 s/5 ml in their average drying time, and thus a difference in drying performance can be quantified.

A.2 Drying rates of samples

In a comparison between 4 kinds of fabric samples, one person conducted the tests of “determination of drying rate” with the same measurement procedure and instrument at the same location over a short period of time. Table A.1 shows the repeatability of the test result.

Table A.1

	Fibre composition (%)	**Unit mass** (g/m^2)	**Determined drying time of specimen** (s)			**Average time** (s)	**Standard deviation**	**Coefficient of variation** (%)
			#1	#2	#3			
sample 1	Polyester 100 %	154	2232	2534	2235	2333,7	173,5	7,4
sample 2	Polyester 100 %	161	2636	2834	2991	2820,3	177,9	6,3
sample 3	Polyester 100 %	178	2893	2618	2489	2666,7	206,4	7,7
sample 4	Polyester 100 %	184	2977	2787	3114	2959,3	164,2	5,5