INTERNATIONAL STANDARD

ISO 20852

First edition
2020-01

Textiles — Determination of the total heat transfer through textiles in simulated environments

Textiles — Détermination du transfert de chaleur total à travers les textiles dans des simulations d'environnements

Reference number
ISO 20852:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Symbols and units **2**
5 Principle **3**
6 Apparatus **3**
7 Materials **3**
7.1 Water 3
7.2 Liquid barrier 3
8 Test specimens **3**
9 Test procedure **3**
9.1 Test conditions 3
9.2 Procedure 4
9.2.1 Determination of R_{ct0} 4
9.2.2 Measurement of total thermal resistance R_{ct} for a test specimen 4
9.2.3 Measurement of intrinsic thermal resistance of the test specimen, R_{cf} 4
9.2.4 Measurement of the evaporative resistance including the air layer on the surface of the liquid barrier without a test specimen, $R_{et0}{}^{A}$ 4
9.2.5 Measurement of the apparent total evaporative resistance $R_{et}{}^{A}$ 5
9.2.6 Measurement the intrinsic evaporative resistance provided by the test specimen alone $R_{ef}{}^{A}$ 5
9.2.7 Determination of the total heat transfer Q_t 6
10 Test report **6**

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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document specifies the testing method for the determination of the amount of the heat transferred through clothing fabrics by the combined dry and evaporative heat emission under the simulated and specified conditions.

The amount of heat emission through clothing from our body is very important for comfort in hot environment or during vigorous activities. It is why we consider the comfort of our body as a thermal balancing among ambient climate, energy metabolism and the performance of clothing through removing the excessive heat from our body. The total heat transfer from the body occurs during both the dry heat transmission such as radiation, convection, conduction and the evaporative heat transmission by sweating at the same time. The amount of total heat transfer depends on both gradients of temperature and humidity, for example, the evaporative heat emission has more weight in hot environment with moderate humidity because the dry heat transfer is decreased by the reduction of the temperature difference between body and ambient climate.

Therefore, this document specifies the testing method for the determination of the amount of the heat transferred through clothing fabrics by the combined dry and evaporative heat emission simultaneously under the simulated and specified standard conditions using sweating guarded hot plate. It is for evaluating the performance of clothing fabrics for cooling down the excessive heat from our body.

Textiles — Determination of the total heat transfer through textiles in simulated environments

1 Scope

This document specifies the test method for determining the amount of heat transferred through clothing fabrics by the combined dry and evaporative heat emission under simulated and specified conditions. This test method can be used for fabrics, films, coatings, foams and leathers including multilayer assemblies used in hot environment or in activities.

The application of this measurement technique is restricted to a maximum amount of total heat transfer which depend on the dimensions and construction of the apparatus used (e.g. about 1 200 W/m^2 for the maximum specifications of the equipment according to ISO 11092).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 11092:2014, *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 following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
dry heat emission
heat transferred by the temperature difference between the two faces of a material divided by the resultant heat flux per unit area in the direction of the gradient in dry state

Note 1 to entry: It is a quantity which determines the dry heat flux across a given area in response to a steady applied temperature gradient.

3.2
evaporative heat emission
heat transferred by the 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, when evaluated non-isothermally

Note 1 to entry: It is a quantity which determines the "latent" evaporative heat flux across a given area in response to a steady applied water-vapour pressure gradient. The evaporative heat flux may consist of condensation as well as diffusive and convective components.

3.3
total heat transfer
amount of heat transferred by the combined dry and evaporative heat exchanges under the specified conditions

Note 1 to entry: It is expressed in watts per square metre.

4 Symbols and units

R_{ct} total thermal resistance of the test specimen and the air layer, K·m²/W

R_{ct0} thermal resistance including the air layer on the surface of the plate without a test specimen

This is the apparatus constant, K·m²/W.

R_{cf} intrinsic thermal resistance of the test specimen only

In the calculation of this value, the assumption is made that the boundary layers of the bare plate and the boundary layers of the test specimen are equal, K·m²/W.

R_{et}^{A} apparent total evaporative resistance of the test specimen, liquid barrier, and surface air layer when evaluated non-isothermally, kPa·m²/W

The term apparent A is used as a modifier for total evaporative resistance to reflect the fact that condensation may occur within the specimen, kPa·m²/W.

R_{et0}^{A} evaporative resistance including the air layer on the surface of the liquid barrier without a test specimen (that is, bare plate) when evaluated non-isothermally.

This is the apparatus constant, kPa·m²/W.

R_{ef}^{A} intrinsic evaporative resistance of the test specimen only when evaluated non-isothermally, kPa·m²/W

In the calculation of this value, the assumption is made that the boundary layers of the bare plate and the boundary layers of the fabric are equal.

A area of the measuring unit, m²

T_a temperature in the air flowing over the specimen, °C

T_m temperature of the measuring unit, °C

T_s temperature of the thermal guard, °C

P_a water-vapour partial pressure, kPa, in the test enclosure at temperature T_a

P_m saturation water-vapour partial pressure, kPa, at the surface of the measuring unit at temperature T_m

$R.H.$ relative humidity, %

H heating power supplied to the measuring unit, W

Q_t total heat transfer through textiles, W/m²

R_{ct0_t25} 0,065 K·m²/W, the standardized bare plate thermal resistance at the air temperature 25 °C in test enclosure

$R_{et0\_t25}^{A}$ 0,003 5 kPa·m²/W, the standardized bare plate evaporative resistance at the air temperature 25 °C in test enclosure

5 Principle

This test evaluates two forms of heat transfer which are dry heat and evaporative heat emission. The total heat transfer results from combining both by calculation. Dry heat emission represents the heat loss resulting from the external environment due to the temperature gradient 10 °C and it is drawn from the standardized total thermal resistance of the test specimen and air layer. Evaporative heat emission represents the heat loss resulting from the external environment due to the vapour pressure gradient 3,57 kPa and it is drawn from the standardized total evaporative resistance of the test specimen and air layer

6 Apparatus

6.1 Sweating guarded hot plate test machine, as described in ISO 11092.

7 Materials

7.1 Water

For the evaporative resistance measurements, water for analytical laboratory use over grade 3, according to ISO 3696, shall be used to wet the test plate surface.

7.2 Liquid barrier

A smooth, water-vapour permeable but liquid-water impermeable cellophane membrane of thickness 10 µm to 50 µm shall be fitted over the porous plate.

8 Test specimens

Three test specimens are used. Use test specimens large enough to cover the surface of the hot plate test section and the guard section completely. Remove any undesirable wrinkles from the test specimens. Possible techniques for removing wrinkles include smoothing, free-hanging, pressing, steaming, ironing, and so forth. Allow the test specimens to come into equilibrium with the atmosphere 25 °C, 65 % R.H. of the testing chamber after conditioning them at the same environment for at least 12 h.

9 Test procedure

9.1 Test conditions

Maintain the temperature of the test plate, guard section and bottom plate at (35 ± 0,5) °C without fluctuating more than ± 0,1 °C during a test.

Air temperature should be (25 ± 0,5) °C and it should maintain the air flowing over the test plate at the same condition without fluctuating more than ± 0,1 °C during a test.

Maintain the relative humidity of the air flowing over the plate at (65 ± 4) % R.H. during the test.

Set the air velocity 1 m/s. Maintain the same air velocity for all calibrations and tests, and without fluctuating more than ± 0,1 m/s over the duration of the test measurement.