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## **Ergonomics of the thermal environment — Estimation of thermal insulation and water vapour resistance of a clothing ensemble**

*Ergonomie des ambiances thermiques — Détermination de l'isolement thermique et de la résistance à l'évaporation d'une tenue vestimentaire*



Reference number  
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## Contents

Page

Foreword.....	v
Introduction .....	vi
<b>1 Scope .....</b>	<b>1</b>
<b>2 Terms and definitions.....</b>	<b>1</b>
<b>3 Application of this International Standard .....</b>	<b>5</b>
<b>4 Estimation of thermal insulation of clothing ensemble based on tables and with values measured on a standing thermal manikin.....</b>	<b>7</b>
<b>4.1 General.....</b>	<b>7</b>
<b>4.2 Insulation values of complete ensembles.....</b>	<b>8</b>
<b>4.3 Ensemble thermal insulation values based on individual garments .....</b>	<b>8</b>
<b>4.4 Complete ensemble insulation corrected for small differences in composition .....</b>	<b>8</b>
<b>4.5 Calculation of thermal insulation for clothing ensembles .....</b>	<b>9</b>
<b>4.6 Calculation of thermal insulation for individual garments .....</b>	<b>9</b>
<b>5 Estimation of clothing area factor.....</b>	<b>10</b>
<b>6 Estimation of surface (or boundary) air layer insulation.....</b>	<b>10</b>
<b>7 Estimation of water vapour resistance.....</b>	<b>12</b>
<b>7.1 General.....</b>	<b>12</b>
<b>7.2 Estimation of vapour resistance of clothing ensembles based on tables with values measured on standing thermal manikin.....</b>	<b>12</b>
<b>7.3 Estimation of vapour resistance of clothing ensemble based on its relation with dry heat resistance .....</b>	<b>12</b>
<b>8 Influence of body movement and air movement on the thermal insulation and vapour resistance of a clothing ensemble .....</b>	<b>13</b>
<b>8.1 General.....</b>	<b>13</b>
<b>8.2 Correction of clothing insulation .....</b>	<b>13</b>
<b>8.3 Correction of clothing vapour resistance .....</b>	<b>18</b>
<b>8.4 Activities other than walking .....</b>	<b>20</b>
<b>8.5 Relative air velocity .....</b>	<b>20</b>
<b>9 Other factors influencing clothing insulation.....</b>	<b>22</b>
<b>9.1 General.....</b>	<b>22</b>
<b>9.2 Posture.....</b>	<b>22</b>
<b>9.3 Effect of seats .....</b>	<b>22</b>
<b>9.4 Effect of pressure .....</b>	<b>22</b>
<b>9.5 Wetting .....</b>	<b>22</b>
<b>9.6 Washing .....</b>	<b>22</b>
<b>Annex A (normative) Thermal insulation values for clothing ensembles .....</b>	<b>23</b>
<b>Annex B (normative) Thermal insulation values for individual garments.....</b>	<b>46</b>
<b>Annex C (normative) Vapour permeability index values for clothing ensembles .....</b>	<b>73</b>
<b>Annex D (informative) Measurement of thermal insulation and water vapour resistance of clothing ensembles on a thermal manikin .....</b>	<b>88</b>
<b>Annex E (informative) Measurement of thermal insulation and water vapour resistance of a clothing ensemble on human subjects .....</b>	<b>94</b>
<b>Annex F (informative) Different expressions for the thermal insulation of clothing.....</b>	<b>96</b>
<b>Annex G (informative) Estimation of the heat exchanges for reflective clothing.....</b>	<b>98</b>

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<b>Annex H (informative) Guidance on the determination of the covered body surface area.....</b>	<b>100</b>
<b>Bibliography .....</b>	<b>102</b>

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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 9920 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 5, *Ergonomics of the physical environment*.

This second edition cancels and replaces the first edition (ISO 9920:1995), which has been technically revised. It includes major changes to the sections on clothing vapour resistance as well as those dealing with the effects of air movement and body motion on clothing insulation and vapour resistance.

This corrected version of ISO 9920:2007 incorporates the following corrections.

- A value and a symbol missing from Equation (38) have been reinstated.
- In Equation (15), the multiplication symbol has been substituted for an (incorrect) asterisk.
- In Figure A.1, traditional Korean garments erroneously captioned “China” and “Sokchina” have been corrected to read *Chima* and *Sokchima*.
- In Equation (F.8), the subscript of the second representation of “ $I_{cl}$ ” has been changed to  $I_{cli}$ .
- In the description of symbol  $H$  given with Equation (F.1), the minus sign missing from the superscript attached to the unit  $W \cdot m^{-2}$  has been inserted.
- “Mean skin temperature”, given as the description for  $\bar{t}_{sk}$  with Equation (G.6), has been corrected to “mean outer clothing surface temperature”.
- In a number of instances, “weight” has been changed to the accepted ISO term, *mass*.
- Values in Table A.2, No. 134 for  $I_{cl}$  and  $I_T$  have been corrected.
- Introductory text similar to that present in the first edition has been reinstated in Annex A, and a new introductory text has been added to Annex C.
- Some minor editorial corrections and additions have been made.

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## Introduction

This International Standard is one of a series of International Standards intended for use in the study of thermal environments. It is a basic document for evaluation of the thermal characteristics of a clothing ensemble (thermal insulation and water vapour resistance). It is necessary to know these values when evaluating the thermal stress or degree of comfort provided by the physical environment according to standardized methods. The thermal characteristics determined in this International Standard are values for steady-state conditions. Properties like "buffering", adsorption of water and similar are not dealt with.

The emphasis in this International Standard is on the estimation of the thermal characteristics. The heat and vapour resistance may also be measured directly, and this is discussed in the annexes.

This International Standard does not deal with the local thermal insulation on different body parts, nor the discomfort due to a non-uniform distribution of the clothing on the body.

Man's thermal balance in neutral, cold and warm environments is influenced by the clothing worn. For evaluating the thermal stress on human beings in the cold (IREQ, see ISO/TR 11079, insulation index), neutral environments (PMV-PPD, see ISO 7730, indices) and the heat (predicted heat strain, see ISO 7933, index), it is necessary to know the thermal characteristics of the clothing ensemble, i.e. the thermal insulation and the water vapour resistance.