

# TECHNICAL REPORT

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## **Evaluation of cold environments — Determination of required clothing insulation (IREQ)**

*Évaluation des ambiances froides — Détermination de l'isolement requis  
des vêtements*



Reference number  
ISO/TR 11079:1993(E)

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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.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 11079, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Sub-Committee SC 5, *Ergonomics of the physical environments*.

A series of International Standards related to the assessment of thermal environments are being produced within the framework of ISO/TC 159/SC5. For cold environments there are few methods available, insufficient experimental support and limited practical experience. More experimental work is needed to validate and further elaborate the methods contained in this Technical Report before there is a basis for the development of an International Standard.

This document is being issued in the type 2 Technical Report series of publications (according to subclause G.4.2.2 of part 1 of the ISO/IEC Directives, 1992) as a "prospective standard for provisional application" in the field of assessment of thermal environments because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than two years after its publication with the options of: extension for another two years; conversion into an International Standard; or withdrawal.

Annexes A and B form an integral part of this Technical Report. Annexes C, D, E, F and G are for information only.

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## Introduction

Wind-chill is commonly encountered in cold climates, but low temperatures first of all endanger body heat balance. By proper adjustment of clothing, man can often control and regulate body heat loss to balance a change in the ambient climate. The method presented here is therefore based on the evaluation of the clothing insulation required to maintain in equilibrium the thermal balance of the body. The heat balance equation used takes into account the most recent scientific findings concerning heat exchanges at the surface of the skin as well as the clothing.

# Evaluation of cold environments — Determination of required clothing insulation (IREQ)

## 1 Scope

This Technical Report proposes methods and strategies to assess the thermal stress associated with exposure to cold environments. They apply to continuous, intermittent and occasional exposure and in both indoor and outdoor work. Specific effects associated with certain meteorological phenomena (e.g. precipitation) are not covered and should be assessed by other methods.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7726:1985, *Thermal environments — Instruments and methods for measuring physical quantities*.

ISO 7730:1984, *Moderate thermal environments — Determination of the PMV and PPD indices and specification of the conditions for thermal comfort*.

ISO 8996:1990, *Ergonomics — Determination of metabolic heat production*.

ISO 9920:—<sup>1)</sup>, *Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble*.

## 3 Symbols and abbreviations

|           |   |
|-----------|---|
| $A_{du}$  | body surface area, in square metres ( $m^2$ )   |
| $A_r$     | body surface area partaking in radiation heat exchange, in square metres ( $m^2$ )                        |
| $C$       | convective heat exchange, in watts per square metre ( $W/m^2$ )   |
| $c_e$     | latent heat of evaporation, in joules per kilogram  |
| $c_p$     | specific heat of dry air at constant pressure, in joules per kilogram of dry air                          |
| $C_{res}$ | respiratory convective heat exchange, in watts per square metre ( $W/m^2$ )                               |
| DLE       | duration limited exposure, in hours (h)   |
| $E$       | evaporative heat exchange by sweating, in watts per square metre ( $W/m^2$ )                              |
| $E_{res}$ | respiratory evaporative heat exchange, in watts per square metre ( $W/m^2$ )                              |
| $f_{cl}$  | ratio of surface area of the clothed body to the surface area of the nude body, dimensionless             |
| $h_c$     | convective heat transfer coefficient, in watts per square metre degree Celsius ( $W/m^2 \cdot ^\circ C$ ) |
| $h_r$     | radiation heat transfer coefficient, in watts per square metre degree Celsius ( $W/m^2 \cdot ^\circ C$ )  |

1) To be published.