



BSI Standards Publication

Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain

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National foreword

This British Standard is the UK implementation of EN ISO 7933:2023. It is identical to ISO 7933:2023. It supersedes BS EN ISO 7933:2004, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/9/-/1, Ergonomics of the physical environment.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 17524 0

ICS 13.180

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2023.

Amendments/corrigenda issued since publication

| Date | Text affected |
|------|---------------|
|------|---------------|

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EUROPÄISCHE NORM

August 2023

ICS 13.180

Supersedes EN ISO 7933:2004

English Version

Ergonomics of the thermal environment - Analytical determination and interpretation of heat stress using calculation of the predicted heat strain (ISO 7933:2023)

Ergonomie des ambiances thermiques - Détermination analytique et interprétation de la contrainte thermique fondées sur le calcul de l'astreinte thermique prévisible (ISO 7933:2023)

Ergonomie der thermischen Umgebung - Analytische Bestimmung und Interpretation der Wärmebelastung durch Berechnung der vorhergesagten Wärmebeanspruchung (ISO 7933:2023)

This European Standard was approved by CEN on 13 June 2023.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN ISO 7933:2023) has been prepared by Technical Committee ISO/TC 159 "Ergonomics" in collaboration with Technical Committee CEN/TC 122 "Ergonomics" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2024, and conflicting national standards shall be withdrawn at the latest by February 2024.

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

This document supersedes EN ISO 7933:2004.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 7933:2023 has been approved by CEN as EN ISO 7933:2023 without any modification.

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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 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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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 159, *Ergonomics*, Subcommittee SC 5, *Ergonomics of the physical environment*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 122, *Ergonomics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 7933:2004), which has been technically revised.

The main changes are as follows:

- The maximum sweat rate S_{Wmax} described in [B.4](#) has been corrected, i.e. it is no longer adjusted for metabolic rate.
- As the model has not been extensively validated for conditions with unsteady environmental parameters, metabolic rate and/or clothing, a caution has been added for cases where these parameters vary substantially with time.

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.

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Introduction

ISO 15265 describes the assessment strategy for the prevention of discomfort or health effects in any thermal working condition, while ISO 8025¹⁾ recommends specific practices concerning hot working environments. For these hot environments, these standards propose relying on the wet bulb globe temperature (WBGT) heat stress index described in ISO 7243 as a screening method for establishing the presence or absence of heat stress, and on the more elaborate method presented in this document, to make a more accurate estimation of stress, to determine the allowable durations of work in these conditions and to optimize the methods of protection. This method, based on an analysis of the heat exchange between a person and the environment, is intended to be used directly when it is desirable to carry out a detailed analysis of working conditions in heat.

This document makes it possible to predict the evolution of a few physiological parameters (skin and rectal temperatures, as well as sweat rate) over time for a person working in a hot environment. This prediction is made according to the climatic parameters, the energy expenditure of the person and his or her clothing. This prediction is made for an average person and should be used to assess the risk of heat stress for a group of people; it cannot predict a particular person's responses.

This document is based on the latest scientific information. Future improvements concerning the calculation of the different terms of the heat balance equation or its interpretation will be taken into account when they become available.

Occupational health specialists are responsible for evaluating the risk encountered by a given individual, taking into consideration their specific characteristics that can differ from those of a standard person. ISO 9886 describes how physiological parameters are used to monitor the physiological behaviour of a particular person and ISO 12894 describes how medical supervision is organized.

1) Under preparation. Stage at the time of publication: ISO/DIS 8025:2023.

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Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain

1 Scope

This document describes a model [the predicted heat strain (PHS) model] for the analytical determination and interpretation of the thermal stress (in terms of water loss and rectal temperature) experienced by an average person in a hot environment and determines the maximum allowable exposure times within which the physiological strain is acceptable for 95 % of the exposed population (the maximum tolerable rectal temperature and the maximum tolerable water loss are not exceeded by 95 % of the exposed people).

The various terms used in this prediction model and, in particular, in the heat balance, show the influence of the different physical parameters of the environment on the thermal stress experienced by the average person. In this way, this document makes it possible to determine which parameter or group of parameters can be changed, and to what extent, in order to reduce the risk of excessive physiological strain.

In its present form, this method of assessment is not applicable to cases where special protective clothing (e.g. fully reflective clothing, active cooling and ventilation, impermeable coveralls) is worn.

This document does not predict the physiological response of an individual person, but only considers average persons in good health and fit for the work they perform. It is therefore intended to be used by, among others, ergonomists and industrial hygienists, as the outcomes can require expert interpretations. Recommendations about how and when to use this model are given in ISO 8025.

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 13731, *Ergonomics of the thermal environment — Vocabulary and symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13731 apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Symbols

For the purposes of this document, the symbols and units listed in [Table 1](#) apply.