

SLOVENSKI STANDARD

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Ergonomics - Evaluation of thermal strain by physiological measurements (ISO 9886:2004)

Ergonomie - Ermittlung der thermischen Beanspruchung durch physiologische Messungen (ISO 9886:2004)

Ergonomie - Evaluation de l'astreinte thermique par mesures physiologiques (ISO 9886:2004)

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ICS:

13.180

Ergonomija

Ergonomics

SIST EN ISO 9886:2004

en

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 9886

February 2004

ICS 13.180

Supersedes EN ISO 9886:2001

English version

**Ergonomics - Evaluation of thermal strain by physiological
measurements (ISO 9886:2004)**

Ergonomie - Evaluation de l'astreinte thermique par
mesures physiologiques (ISO 9886:2004)

Ergonomie - Ermittlung der thermischen Beanspruchung
durch physiologische Messungen (ISO 9886:2004)

This European Standard was approved by CEN on 19 February 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN ISO 9886:2004) 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 August 2004, and conflicting national standards shall be withdrawn at the latest by August 2004.

This document supersedes EN ISO 9886:2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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The text of ISO 9886:2004 has been approved by CEN as EN ISO 9886:2004 without any modifications.

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INTERNATIONAL STANDARD

ISO
9886

Second edition
2004-02-15

Ergonomics — Evaluation of thermal strain by physiological measurements

*Ergonomie — Évaluation de l'astreinte thermique par mesures
physiologiques*

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Reference number
ISO 9886:2004(E)

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ISO 9886:2004(E)

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 9886 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 9886:1992), which has been technically revised.

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Introduction

This document is part of a series of standards concerned with the assessment of thermal stress and strain.

This series of International Standards aims in particular at

- a) establishing specifications for the methods of measuring physical parameters characterising thermal environments;
- b) establishing methods for assessing thermal stress in cold, moderate and hot environments.

The analysis methods described by these latter standards allow the prediction of the average physiological response of subjects exposed to a thermal environment. Some of these methods are not applicable under exceptional climatic circumstances, when the characteristics of the exposed subjects differ greatly from the average or when special means of protection are used.

In these cases, or for the sake of research, it may be useful or even necessary to measure directly the physiological strain experienced by the subject.

This International Standard gives a series of specifications concerning the methods of measurement and interpretation of the physiological parameters considered as reflecting the response of the human organism placed in a hot or cold environment.

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Ergonomics — Evaluation of thermal strain by physiological measurements

1 Scope

This International Standard describes methods for measuring and interpreting the following physiological parameters:

- body core temperature;
- skin temperatures;
- heart rate;
- body-mass loss.

The choice of variables to be measured and techniques to be used is at the discretion of those responsible for the health of the employees. These persons will have to take into account not only the nature of the thermal conditions, but also the degree of acceptance of these techniques by the employees concerned.

It should be emphasised that direct measurements on the individual can only be carried out on two conditions.

- a) If the person has been fully informed about the discomfort and the potential risks associated with the measurement technique and gives free consent to such measurements.
- b) If the measurements present no risk for the person which is unacceptable in view of general or specific codes of ethics.

In order to simplify this choice, Annex A presents a comparison of the different methods concerning their field of application, their technical complexity, the discomfort and the risks that they might involve.

This standard defines the conditions which are to be met in order to ensure the accuracy of the data gathered from the different methods. The measurement methods are described in Annex B. Limit values are proposed in Annex C (informative).

This standard is not concerned with experimental conditions for which investigators may develop alternative methods intended to improve knowledge in this area. It is however recommended, when conducting such studies in the laboratory, to use the methods described below as references, so that results may be compared.

Before using the evaluations methods described in this International Standard, the user is required to follow the ethics and legal rules in force in his country or institution. Accordingly, ethical committees will be consulted and rules concerning free written consent, freedom of participation, confidentiality, etc. will be strictly followed.

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 7933, *Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain*

3 Symbols and abbreviated terms

A_{Du}	body surface area calculated from the Du Bois formula (m ²)
HR	heart rate (beats·min ⁻¹)
HR_0	average heart rate (beats·min ⁻¹) of the subject at rest while sitting under neutral conditions
HR_r	heart rate (beats·min ⁻¹) during a break in work after heart rate components due to static exertion and dynamic muscular work have disappeared
HR_L	limit of heart rate (beats·min ⁻¹)
ΔHR_M	increase in heart rate (beats·min ⁻¹) linked with work metabolism
ΔHR_S	increase in heart rate (beats·min ⁻¹) linked with static exertion
ΔHR_T	increase in heart rate (beats·min ⁻¹) connected with the thermal strain experienced by the subject
ΔHR_N	increase in heart rate (beats·min ⁻¹) due to psychological factors
ΔHR_ε	residual component in heart rate (beats·min ⁻¹) connected with rhythm of breathing, circadian rhythm, etc.
I_{cl}	thermal clothing insulation (clo)
k_i	weighting coefficient for a point measurement
Δm	body mass variation
M	average metabolic rate (W/m ²)
Δm_{clo}	mass variation due to variation of clothing or to sweat accumulation in the clothing
Δm_g	gross body-mass loss
Δm_o	mass loss due to the mass difference between carbon dioxide and oxygen
Δm_{res}	mass loss due to evaporation in the respiratory tract
Δm_{sol}	mass variation of the body due to intake (food) and excretions (stools) of solids
Δm_{sw}	mass loss due to sweat loss during the time interval
Δm_{wat}	mass variation of the body due to intake and excretion (urine) of water
p_a	partial water vapour pressure in the air (kPa)
R	respiratory quotient (dimensionless)
Δt	time interval (min)
t_{ab}	intra-abdominal temperature (°C)
t_{ac}	auditory canal temperature (°C)

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