

INTERNATIONAL  
STANDARD

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**Evaluation of thermal strain by physiological  
measurements**

*Évaluation de l'astreinte thermique par mesures physiologiques*



Reference number  
ISO 9886:1992(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.

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.

International Standard ISO 9886 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Sub-Committee SC 5, *Ergonomics of the physical environments*.

Annexes A, B, C and D of this International Standard are for information only.

## Introduction

This International Standard 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 characterizing 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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## Evaluation of thermal strain by physiological measurements

### 1 Scope

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

- a) body core temperature;
- b) skin temperatures;
- c) heart rate;
- d) 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 emphasized that direct measurements on the individual may 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 International 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.

This International Standard is not concerned with experimental conditions for which investigators may

develop alternative methods intended to improve knowledge in this area. It is recommended, however, when conducting such studies in the laboratory, to use the methods described below as references, so that results can be compared.

### 2 Measurement of body core temperature,

$t_{cr}$

#### 2.1 General

The term "core" refers to all the tissues located at a sufficient depth not to be affected by a temperature gradient through surface tissue. Temperature differences are however possible within the core depending on local metabolisms, on the concentration of vascular networks and on local variations in blood flow. The core temperature is thus not a unique concept and measurable as such. This temperature may be approximated by the measurement of temperature at different points of the body:

- a) oesophagus: oesophageal temperature,  $t_{es}$ ;
- b) rectum: rectal temperature,  $t_{re}$ ;
- c) gastro-intestinal tract: intra-abdominal temperature,  $t_{ab}$ ;
- d) mouth: oral temperature,  $t_{or}$ ;
- e) tympanum: tympanic temperature,  $t_{ty}$ ;
- f) auditory canal: auditory canal temperature,  $t_{ac}$ ;
- g) urine temperature,  $t_{ur}$ .

The order of presentation of these different techniques has been adopted only for the clarity of the presentation.

Depending on the technique used, the temperature measured can reflect

- the mean temperature of the body mass; or