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Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria

Ergonomie des ambiances thermiques — Détermination analytique et interprétation du confort thermique par le calcul des indices PMV et PPD et par des critères de confort thermique local

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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 document 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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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 fourth edition cancels and replaces the third edition (ISO 7730:2005), which has been technically revised.

The main changes are as follows:

- ~~deletion of~~ sections of the text (long-term evaluations, adaptation and diversity) ~~have been moved to the technical guideline TR23663~~;
- ~~mistakes in~~ **correction of** the calculation program ~~has been corrected~~;
- ~~deletion of~~ tables for predicting predicted mean vote (PMV) ~~have been deleted, as most people today will use a calculation program~~;

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.

Field Code Changed

Introduction

This document, covering the evaluation of moderate thermal environments, is one of a number of ISO documents (alongside ISO 7243, ISO 7933 and ISO 11079, all dealing with extreme environmental conditions) specifying methods for the measurement and evaluation of the moderate and extreme thermal environments to which human beings are exposed.

A human being's thermal sensation is mainly related to the thermal balance of his or her body as a whole. This balance is influenced by physical activity and clothing, as well as the environmental parameters air temperature, mean radiant temperature, air velocity and air humidity. When these factors have been estimated or measured, the index for thermal comfort predicted mean vote (PMV) can be calculated. See [Clause 4](#)~~Clause 4.~~

The predicted percentage dissatisfied (PPD) index provides information on thermal discomfort or thermal dissatisfaction expressed as the percentage of people likely to feel too warm or too cool in a given environment. The PPD can be obtained from the PMV. See [Clause 5](#)~~Clause 5.~~

Thermal discomfort can also be caused by unwanted local cooling or heating of the body. The most common local discomfort factors are radiant temperature asymmetry (cold or warm surfaces), draught (defined as a local cooling of the body caused by air movement), vertical air temperature difference and cold or warm floors. [Clause 6](#)~~Clause 6~~ specifies how to predict the percentage dissatisfied owing to local discomfort parameters.

Dissatisfaction can be caused by hot or cold discomfort for the body as a whole. Comfort limits can, in this case, be expressed by the PMV and PPD indices. But thermal dissatisfaction can also be caused by local thermal discomfort parameters. [Clause 7](#)~~Clause 7~~ deals with acceptable thermal environments for comfort.

[Clauses 6](#)~~Clauses 6~~ and [7](#)~~7~~ are based mainly on steady-state conditions. Means of evaluating non-steady-state conditions, such as transients (temperature steps), cycling temperatures or temperature ramps, are presented in [Clause 8](#)~~Clause 8.~~ Thermal environments in buildings or workplaces change over time and it is not always possible to keep conditions within recommended limits.

This document is intended to be used together with the technical guideline [ISO/TR 23663](#). ~~It is also intended to be used along with ISO 28803 when considering persons with special requirements, such as those with physical disabilities. Ethnic, national or geographical differences are also important, especially when considering non-conditioned spaces. Guidance is given in Clause 8 and 10 in the guideline ISO/TR 23663. Guidance for design, control and evaluation of moderate indoor thermal environment/TR 23663~~

Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria

1 Scope

This document defines a standardised method to evaluate the general thermal comfort of people in a space and the degree of discomfort (thermal dissatisfaction) of people exposed to moderate thermal environments. It defines the analytical determination and interpretation of thermal comfort using calculation of predicted mean vote (PMV) and predicted percentage of dissatisfied (PPD) and local thermal comfort criteria, giving the environmental conditions considered acceptable for general thermal comfort as well as those representing local discomfort.

It is applicable to healthy men and women exposed to indoor environments where thermal comfort is desirable, but where moderate deviations from thermal comfort occur, in the design of new environments or the assessment of existing ones.

Although developed specifically for the work environment, this document is applicable to other kinds of environment as well. It is intended to be used along with ISO 28803 when considering persons with special requirements, such as those with physical disabilities. Ethnic, national or geographical differences are also important, especially when considering non-conditioned spaces. Guidance is given in Clause 8 and 10 in the guideline ISO TR 23663.

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 8996, *Ergonomics of the thermal environment — Determination of metabolic rate*

ISO 9920, *Ergonomics of the thermal environment — Estimation of thermal insulation and water vapour resistance of a clothing ensemble*

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 and the following 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/>