SLOVENSKI STANDARD
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Nadomešča:
SIST EN ISO 8996:2005

Ergonomija toplotnega okolja - Ugotavljanje presnovne toplote (ISO 8996:2021)

Ergonomics of the thermal environment - Determination of metabolic rate (ISO 8996:2021)

Ergonomie der thermischen Umgebung - Bestimmung des körpereigenen Energieumsatzes (ISO 8996:2021)

Ergonomie de l'environnement thermique - Détermination du métabolisme énergétique (ISO 8996:2021)

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Ergonomics of the thermal environment - Determination of metabolic rate (ISO 8996:2021)

Ergonomie de l'environnement thermique - Détermination du métabolisme énergétique (ISO 8996:2021)

Ergonomie der thermischen Umgebung - Bestimmung des körpereigenen Energieumsatzes (ISO 8996:2021)

This European Standard was approved by CEN on 3 December 2021.

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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 8996:2021) 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of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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 8996:2004.

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Endorsement notice

The text of ISO 8996:2021 has been approved by CEN as EN ISO 8996:2021 without any modification.

INTERNATIONAL STANDARD

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Ergonomics of the thermal environment — Determination of metabolic rate

Ergonomie de l'environnement thermique — Détermination du métabolisme énergétique

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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 8996:2004), which has been technically revised.

The main changes to the previous edition are as follows:

— The metabolic rate associated with a given task and estimated using the methods described in this document is expressed in watts.

— At level 1, Screening, the method classifying metabolic rate according to occupation has been removed, and revised procedures are provided for the evaluation of metabolic rate for given activities (level 2, Observation) and when using heart rate (level 3, Analysis).

— The accuracy of the methods for estimating the metabolic rate has been reevaluated in light of the recent literature and consequently the integral method is no longer recommended at level 4, Expertise.

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.

Introduction

The metabolic rate, as a conversion of chemical into mechanical and thermal energy, measures the energetic cost of muscular load and gives a quantitative estimate of the activity. Metabolic rate is an important determinant of the comfort or the strain resulting from exposure to a thermal environment. In particular, in hot climates, the high levels of metabolic heat production associated with muscular work aggravate heat stress, as large amounts of heat need to be dissipated, mostly by sweat evaporation. On the contrary, in cold environments, high levels of metabolic heat production help to compensate for excessive heat losses through the skin and therefore reduce the cold strain.

The estimations, tables and other data included in this document concern the general working population. Corrections can be needed when dealing with special populations, including children, aged persons or people with physical disabilities. Personal characteristics, such as body mass, may be used if the body is moved due to walking or climbing (Annex B). Gender, age and body mass are considered in Annex C for the evaluation of the metabolic rate from heart rate.

Ergonomics of the thermal environment — Determination of metabolic rate

1 Scope

This document specifies different methods for the determination of metabolic rate in the context of ergonomics of the thermal working environment. It can also be used for other applications, e.g. the assessment of working practices, the energetic cost of specific jobs or sport activities and the total energy cost of an activity. The methods are classified in four levels of increasing accuracy: level 1, Screening, with a table giving examples of activities with low, moderate and high metabolic rates; level 2, Observation, where the metabolic rate is estimated by a time and motion study; level 3, Analysis, where the metabolic rate is estimated from heart rate recordings or accelerometers measurements; and level 4, Expertise, where more sophisticated techniques are described. The procedure to put into practice these methods is presented and the uncertainties are discussed.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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 The units

The metabolic rate associated with a given task and estimated using the methods described in this document shall be expressed in watts.

If the task does not involve displacements, the metabolic rate will not vary as a function of the size and the weight of the subject. If it involves displacements, then the weight of the person shall be taken into account (see Annex B).

As the heat associated to this metabolic rate and produced inside the body leaves it essentially through the skin, thermophysiologists usually express the metabolic rate per unit of body surface area in $W \cdot m^{-2}$ and the estimations of thermal comfort and thermal constraints described in ISO 7243, ISO 7730, ISO 7933 and ISO 11079 are done using metabolic rates in $W \cdot m^{-2}$.

5 The four levels of methods for estimating the metabolic rate

The mechanical efficiency of muscular work – called the 'useful work' – is low. In most types of industrial work, it is so small (a few per cent) that it is assumed to be nil. This means that the energy spent while working is assumed to be completely transformed into heat. For the purposes of this document, the metabolic rate is assumed to be equal to the rate of heat production.

Table 1 lists the different approaches presented in this document for determining the metabolic rate.