
**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.

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 8996 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 8996:1990), which has been technically revised.

Ergonomics of the thermal environment — Determination of metabolic rate

1 Scope

The metabolic rate, as a conversion of chemical into mechanical and thermal energy, measures the energetic cost of muscular load and gives a numerical index of 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.

This International Standard specifies different methods for the determination of metabolic rate in the context of ergonomics of the climatic working environment. It can also be used for other applications — for example, the assessment of working practices, the energetic cost of specific jobs or sport activities, the total cost of an activity, etc.

The estimations, tables and other data included in this International Standard concern an “average” individual:

- a man 30 years old weighing 70 kg and 1,75 m tall (body surface area 1,8 m²);
- a woman 30 years old weighing 60 kg and 1,70 m tall (body surface area 1,6 m²).

Users should make appropriate corrections when they are dealing with special populations including children, aged persons, people with physical disabilities, etc.

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 9886, *Ergonomics — Evaluation of thermal strain by physiological measurements*

ISO 15265, *Ergonomics of the thermal environment — Risk assessment strategy for the prevention of stress or discomfort in thermal working conditions*

3 Principle and accuracy

The mechanical efficiency of muscular work — called the “useful work”, W — is low. In most types of industrial work, it is so small (a few percent) that it is assumed to be nil. This means that the total energy consumption while working is assumed equal to the heat production. For the purposes of this International Standard, the metabolic rate is assumed to be equal to the rate of heat production.

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

These approaches are structured following the philosophy exposed in ISO 15265 regarding the assessment of exposure. Four levels are considered here: