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Ergonomics of the thermal environment — Application of International Standards to people with special requirements

Ergonomie de l'environnement thermique — Application des Normes internationales aux personnes ayant des exigences particulières

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 14415 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 5, *Ergonomics of the physical environment*.

Introduction

This Technical Specification is a supplementary document to International Standards which specify methods for measuring and evaluating hot, cold or moderate thermal environments (see Clause 2). It provides the necessary considerations and underlying principles for the application of each of those International Standards to the assessment of thermal environments for the disabled, the aged and other persons with special requirements.

In working towards the ideal of “Full Participation and Equality” declared for the International Year for Disabled People, in 1981, a considerable number of disabled persons having various types of disabilities are now integrated into workplaces.

Ergonomics is not only applicable to workplaces but also to other human physical situations, such as those in the home, during transportation and at leisure, in which a wide variety of persons have special ergonomic requirements due to disability, age, pregnancy or sickness. Many such persons have additional thermal requirements which must be considered when measuring and evaluating the thermal environment. However, thermal effects differ widely between individuals with disabilities.

Ergonomics of the thermal environment — Application of International Standards to people with special requirements

1 Scope

This Technical Specification provides background information on the thermal responses and needs of groups of persons with special requirements so that International Standards concerned with the assessment of the thermal environment can be appropriately applied for their benefit. It is applicable to the use of the International Standards listed in Clause 2 and includes

— a description of the range and variety of responses and adaptations to thermal environments of people with special requirements, and the consequences for measuring and evaluating those environments,

— the application of the PMV/PPD index when considering persons with special requirements and thermal comfort in moderate environments,

— the application of International Standards for the assessment of hot and cold thermal environments when such environments are occupied by people with special requirements, and

— brief descriptions of thermal disabilities and their relevant thermal response characteristics with detailed information from available knowledge on several of the most important of these (see Annex A).

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 7243, *Hot environments — Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)*

ISO 7726, *Thermal environments — Instruments and methods for measuring physical quantities*

ISO 7730, *Moderate thermal environments — Determination of the PMV and PPD indices and specification of the conditions for thermal comfort*

ISO 8996, *Ergonomics — Determination of metabolic heat production*

ISO 7933, *Hot environments — Analytical determination and interpretation of thermal stress using calculation of required sweat rate*

ISO 9886, *Evaluation of thermal strain by physiological measurements*

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

ISO 10551, *Ergonomics of the thermal environment — Assessment of the influence of the thermal environment using subjective judgement scales*

ISO/TR 11079, *Evaluation of cold environments — Determination of required clothing insulation (IREQ)*

ISO 13732 (all parts), *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces*

ISO 12894, *Ergonomics of the thermal environments — Medical supervision of individuals exposed to extreme hot or cold environments*

ISO 13731, *Ergonomics of the thermal environment — Vocabulary and symbols*

3 Factors requiring special consideration when assessing the thermal environment

3.1 Sensory impairment and paralysis

Some physical disabilities and methods of treatment (e.g. drugs) will affect thermal sensation and requirements for thermal comfort. Additional issues include methods for collecting valid and reliable data on the comfort responses of people with special requirements (the pregnant, aged, babies, etc.).

3.2 Difference in body shape

The loss of or atrophy of a limb makes the application of the Dubois' surface area formula difficult and prone to error. Consequently, it will have some influence on the concept of mean skin temperature. Infants and babies will have somewhat different body proportions compared to average adults. This influences the projected surface area available for heat exchange, from different parts of the body, and hence the impact of thermal radiation, convection and evaporation.

3.3 Impairment of sweat secretion

It is not uncommon for more than 80 % of the sweat-secreting skin area to be impaired in quadriplegic persons (high-level spinal-cord-injured persons) and some other paralytic diseases. This will affect the interpretation of thermal environment indices for hot environments, especially rational ones in which a “normal” level of sweating is assumed and the concept of wettedness plays an important role.

3.4 Impairment of vasomotor control

Impairment of peripheral vasomotor control, which is often found in such groups as the aged, spinal-cord-injured persons or persons taking vasodilator drugs, affects adaptability to both cold and hot environments and often requires special consideration when accounting for thermal conditions.

3.5 Differences in metabolic rate

People with physical disabilities who use technical aids such as wheelchairs often have low metabolic rates due to their sedentary activity level. Conversely, others (such as those suffering athetosic cerebral palsy) will require greater energy to perform tasks and hence have a higher metabolic rate due to the greater effort involved. Aged persons are often less active and have a lower metabolic rate than average adults but there are large individual differences.

3.6 Influence of thermal stress on other physiological functions

Cerebral apoplexy and cardiovascular attacks are often evoked by thermal stress in (cold) winters and unusually hot summers. Sweat secretion can cause some cutaneous chronic diseases such as *epidermolysis bullosa hereditaria*. Cold environments may affect kidney functions and cause pollakisuri. Strain is greater after exhaustive work, night work, jet-lag, etc.