

# INTERNATIONAL STANDARD

**ISO**  
**10551**

First edition  
1995-05-15

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## **Ergonomics of the thermal environment — Assessment of the influence of the thermal environment using subjective judgement scales**

*Ergonomie des ambiances thermiques — Évaluation de l'influence des  
ambiances thermiques à l'aide d'échelles de jugements subjectifs*



Number of reference  
ISO 10551:1995(E)

Contents

	Page
1 Scope.....	1
2 Normative references.....	1
3 Symbols .....	1
4 Subjective judgement scales for thermal environments: Principles of scale construction and conditions of use.....	2
5 Perceptual, evaluation and preferential judgement scales .....	3
6 Personal acceptability statement and tolerance scale .....	5
7 Instructions for repeat enquiries .....	6
8 Summary of the scales.....	6
9 Formats and methods of presentation of the scales .....	7
10 Data analysis and application of the results.....	7
<b>Annexes</b>	
A Examples of the wording of subjective judgement scales on thermal conditions .....	8
B Application of assessment procedure and judgement scales: Examples, including data analysis.....	11
C Bibliography.....	18

## 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 10551 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 5, *Ergonomics of the physical environment*.

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

## Introduction

The present International Standard forms part of a series of standards on the assessment of thermal stress and strain in the work environment.

This series is concerned in particular with:

- 1) establishing specifications on methods for measuring and estimating the characteristic physical parameters of climatic environments, thermal properties of clothing and metabolic heat production;
- 2) establishing methods for assessing thermal stress in hot, cold and temperate environments.

This International Standard proposes a set of specifications on direct expert assessment of thermal comfort/discomfort expressed by persons subjected to various degrees of thermal stress during periods spent in various climatic conditions at their workplace. The data provided by this assessment will most probably be used to supplement physical and physiological methods of assessing thermal loads. The methods belong to a psychological approach consisting in gathering, as appropriate, the on-site opinions of persons exposed to the conditions under consideration (diagnosis) and thus may complete data provided by predictive approaches described elsewhere in this series.

The ergonomist who is concerned with the thermal environment of workplaces is able to determine the value of various indices (WCI, PMV and PPD, WBGT) which will predict the average climatic conditions for thermal comfort or the average degree of thermal stress suffered by a worker in a number of general cases. In practice, specific cases often differ from general cases in ways such as spatial heterogeneities, local differences, temporal fluctuations, clothing arrangements, personal characteristics. Thus it becomes necessary to supplement the values proposed in an initial predictive approach by a direct determination of the subjective experience which persons at work have of the climatic environment and of their corresponding personal state, an experience which these persons can judge and express. The approach is diagnostic.

These data are not obtained by means of a questionnaire; it is left to the user to incorporate the scales into a list of more comprehensive or more specific questions (medical survey, list of work stresses), presented in a form (oral, written; individual, collective) adapted to the particular case and to the collective standards (national, professional) in force.

If persons exposed to thermal environments are to be asked about their corresponding experiences or information requested on their cultural attitude in order to obtain the most appropriate subjective judgement scales, favourable relationships should first be established between these persons and the organization responsible, through the persons conducting the ergonomic investigation.

The thermal environments which lend themselves to the application of subjective judgement scales relate to conditions which differ to a moderate degree from thermal neutrality. Under extreme conditions, physical and physiological assessment methods of the thermal load shall be preferred, provided that their results can be used as criteria for a decision. In particular, tolerance limits for thermal load cannot be confidently based on subjective judgements and have to be decided in view of accepted health risk criteria. More specific conditions for applying the judgement scales will be made clear in connection with each of them.

The subjective nature of the data obtained using judgement scales leads some experts to doubt their benefit and prefer "objective", physical or physiological data. The question of the validity of subjective data as regards thermal environments can be viewed in two distinct ways:

- a) The first approach corresponds to the following question:

To what extent is the information provided by these data the same as that provided by "objective" data?

The relation which may or may not exist between objective and subjective data will be examined with the aim of substituting collection of the former by that of the latter, which are more easily obtained. This International Standard is not concerned with this approach, however interesting it may be once the relation has been established.

- b) The second approach corresponds to the following question:

What is the intrinsic value of the data supplied by these scales?

The opinions held by persons about the thermal environments in which they work have a value in themselves. It is up to the ergonomist whether or not to take them into account. The reputation of these data for lack of reliability does not justify dismissing them out of hand. The aim of this International Standard is precisely to improve their reliability by specifying the appropriate tools to use in collecting them and the requirement for using them.

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# Ergonomics of the thermal environment — Assessment of the influence of the thermal environment using subjective judgement scales

## 1 Scope

This standard covers the construction and use of judgement scales (scales of thermal perception, thermal comfort, thermal preference, acceptability, expression form and tolerance scale) for use in providing reliable and comparative data on the subjective aspects of thermal comfort or thermal stress.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7243:1989,	<i>Hot environments — Estimation of the heat stress on working man, based on the WBGT-index (wet belt globe temperature).</i>
ISO 7726:1985,	<i>Thermal environments — Instruments and methods for measuring basic physical quantities.</i>
ISO 7730:1994,	<i>Moderate thermal environments — Determination of the PMV and PPD indices and specification of the conditions for thermal comfort.</i>
ISO 7933:1989,	<i>Hot environments — Analytical determination and interpretation of thermal stress, using calculation of required sweat rate.</i>
ISO 8996:1990,	<i>Ergonomics of the thermal environment — Estimation of metabolic heat production.</i>
ISO 9886:1992	<i>Evaluation of the thermal strain by physiological measurements.</i>
ISO 9920:1994	<i>Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble.</i>
ISO/TR 11079:1993	<i>Evaluation of cold environments — Determination of required clothing insulation (IREQ).</i>

## 3 Symbols

$I_{cl}$	thermal resistance (insulation) of the clothing, in square metres degrees Celsius per watt or in clo (1 clo = 0,155 m <sup>2</sup> · °C/W);
Met	heat produced by the metabolism, in watts per square metre;
PMV	predicted mean vote (see ISO 7730);