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**Ergonomics of the physical  
environment — Subjective judgement  
scales for assessing physical  
environments**

*Ergonomie de l'environnement physique — Échelles de jugements  
subjectifs pour l'évaluation des environnements physiques*

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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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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](http://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*.

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](http://www.iso.org/members.html).

This second edition cancels and replaces the first edition (ISO 10551:1995), which has been technically revised. The main changes compared to the previous edition are as follows:

- the title has been changed;
- the Scope has been reworded;
- new references have been added to [Clause 2](#);
- new entries have been added to [Clause 3](#);
- in [5.2.1](#), a unipolar scale has been added;
- [Annex B](#) has been changed;
- [Annexes C](#) to [G](#) have been added.

## Introduction

By using this document, you can construct subjective scales that can be used to ask people how they feel about their physical environment. That is whether they find it too hot, whether there is any noise and if it is annoying, if the light is too bright, is it “smelly” and so on. By constructing the scales and using them correctly, you can see, in a cost-effective way, how people find the environment. The information can be applied to report on the environmental quality and to work out how to improve the environment.

People are exposed to a range of physical environments which can affect their health and safety, comfort and performance. An important method for assessing physical environments, particularly when considering psychological constructs such as comfort or satisfaction, is to use subjective scales. The type of scale used and how it is administered is important in influencing the subjective responses of people. There are principles for constructing scales and procedures for administering them that reduce bias and ensure validity and reliability of response. There are also generic types of scale that can be used across environmental stimuli, for example, scales on which people rate sensation or comfort or acceptability or preference and so on.

This document provides a description of principles of scale construction and procedures for use. It also provides examples of commonly used scales across environmental components. This document does not standardize any particular scale but it provides the principles upon which appropriate scales can be constructed. It is needed to provide consistency in the production of valid and reliable scales. It is particularly useful to people who wish to conduct an environmental survey, for example to assess post occupant satisfaction of new or existing buildings or other spaces, environments where dissatisfaction occurs and a diagnosis of the problems is required and for people who are investigating the relationship between conditions in the physical environment and human perception. A consistent approach to subjective scale construction and use also allows a meaningful comparison of data obtained from investigations internationally.

This document forms part of a group of international standards on the assessment of comfort, stress and strain in physical environments.

This series is concerned, in particular, with:

- 1) establishing specifications on methods for measuring and estimating the characteristic physical parameters of environments;
- 2) establishing methods for assessing stress in environments.

This document proposes a set of specifications on direct expert assessment of comfort/discomfort expressed by persons subjected to various degrees of stress during periods spent in physical environments. The data provided by this assessment can be used on its own or to supplement physical and physiological methods of assessing 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, can complement data provided by predictive approaches described elsewhere in this group. The information provided in this document can be used to construct valid subjective scales for use in determining how people feel in their physical environment. This document does not give guidance on questionnaire design and application although the scales may be used in the construction of questionnaires.

If persons exposed to 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 may usefully be established between these persons and the organization responsible, through the persons conducting the ergonomic investigation.

The environments which lend themselves to the application of subjective judgement scales relate to conditions which differ to a moderate degree from comfortable conditions. Under extreme conditions, physical and physiological assessment methods of the environmental load are preferred, provided that their results can be used as criteria for a decision. In particular, tolerance limits for load cannot be confidently based on subjective judgements and need to be decided in view of accepted health risk

criteria. The decision of whether a person is exposed to an extreme environment is not left to the person exposed as their judgement can be impaired by the conditions.

The opinions held by persons about their environment 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 document 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 physical environment — Subjective judgement scales for assessing physical environments

## 1 Scope

This document presents principles and examples of practical application for the construction of appropriate subjective scales for use in the assessment and evaluation of the physical environment. It does not standardize particular scales.

It considers scales of perception, comfort, preference, acceptability, expression form and tolerance, and environmental components such as thermal, visual, air quality, acoustic and vibration.

It does not consider other scales such as:

- scales related to the effects of the environment on the ability to read displays or signs, on manual performance or on psychological conditions such as mood, etc.;
- scales related to pain or scales related to stimuli that can lead to injury.

This document does not present principles of surveys (see Note) or questionnaire design. However, the scales that are developed using this document can be incorporated into surveys or questionnaires.

NOTE Environmental surveys are described in ISO 28802. ISO 28802 includes scales that are complementary to, and based upon, the principles of scale construction that are described in this document.

## 2 Normative references

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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 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 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

## 4 Subjective judgement scales for physical environments: Principles of scale construction and use

There are a number of subjective judgement scales for physical environments. They differ in whether emphasis is placed on some aspect of judgement:

- perceptual or affective (evaluative and preferential);
- global (encompassing the whole environment or organism) or localized;
- present or past;

— instantaneous or extended over a period of time.

They also differ as to the object of judgement: environment or person, the whole or its component parts, permanent or temporary situation.

This document retains judgements that people make about their own state as a whole. It distinguishes between perception, present affective assessment (comfort/discomfort) and future preference.

NOTE 1 This document also suggests supplementing the perceptual, evaluative and preferential judgement scales by a statement of acceptability and a scale of tolerance of environments

In most instances, the exposure to an environment lasts for several hours. Therefore, it is useful to gather the person's opinions throughout, by repeating the expression of the judgements at regular intervals, using exactly the same scales.

By repeatedly applying the same scales, the evolution with time of the comfort or strain experienced can be assessed and an integrated judgement obtained over the whole time of exposure by appropriate computation of the data (e.g. overall mean, overall change, variation, etc.).

Basic difficulties are encountered in any area which involves the use of language. In this regard, bias and variability in the data can result from inconsistencies and inappropriateness of accompanying instructions. Therefore, it becomes crucial to standardized preparatory instructions which explain the study, as well as the wording of the judgement scales. The terminology used to denote the degrees on the judgement scales is of special importance. This document specifies the principles used to develop subjective scales. The actual descriptors used can be influenced by the language structure and shall be established with subject experts from National Standards Body.

NOTE 2 International usage and acceptance of the scales in this document will result in the fixing of suitable wording of the degrees on the scales in various languages.

Other judgement scales are in use concerning the state of various parts of the body (e.g. head, torso, hands, feet), the total environment or various components of it, other aspects of the experience of the person or evaluations conducted over a certain period of time, including periods during which-conditions have not been measured. Other scales, e.g. a bipolar affective evaluation scale, have been structured differently on the model of perception; such a scale is useful for taking into account pleasure and is more sensitive than the unipolar discomfort scale in the region near to comfort.

This document is limited to the five scales described in [Clauses 4](#) and [5](#). The gathering of subjective judgement should first be concerned with localized sensations (parts of the body) and in constant conditions, given the current interest and application of these data. The second concern should be for data gathered under transient conditions, which are extremely important but are not yet sufficiently well known.

## 5 Perceptual, evaluation and preferential judgement scales

### 5.1 Instructions for using the judgement scales

It is important to distinguish between more objective ratings, such as sensations, and affective or evaluative ratings, such as comfort and pleasure. In everyday language, however, these dimensions are often confounded and distinctions are not made. In addition, the richness of the semantics for describing environments and responses to them depends on individuals, their experiences, their language and their culture, when investigating physical environments. Therefore, it is sometimes useful to first investigate the psychological dimension (or constructs) which individuals and groups use to describe their world<sup>[7]</sup>.

Two commonly used approaches are semantic differential techniques and personal construct theory methods. The methods invoke factor analysis or multidimensional scaling techniques to build a psychological model of the way in which physical environments are perceived and "modelled" (represented in psychological space) by the person. Similar stimuli on a particular dimension (or all combinations of dimensions) are placed close together in the multidimensional model of psychological space.



The form and method of administering the scales are important. For example, a continuous form of the scale would be to draw a line through all points on the scale where subjective terms are placed. This would allow a person exposed to the environment to choose values between ratings (e.g. between cool and cold, a rating of -1,6 on a thermal sensation scale.). In an analysis of the results, this would enable parametric statistics to be used. However, it is possible that the investigator does not consider that data are “strong enough” for this and is prepared to use only ordinal data (ranks) and non-parametric statistics. These, and other, points are of importance and, for further information, the reader is referred to a text on the design and analysis of surveys and on the use of subjective assessment methods (see [6]).

The psychological interaction when the scale is administered can also influence the results. Usually, the subjects are given the scale and asked to tick the place which represent “how they feel now”, for example. It is important to avoid ambiguity, which can lead to a person providing his or her own interpretation, for example, of what the environment is generally like or how other people perceive it. Other issues include range effects. The range provided, (e.g. hot to cold) influences the subject’s judgement as do leading questions: (e.g. “you are uncomfortable, aren’t you?”). The following important issues should be considered when constructing questionnaires:

- question specificity;
- language;
- clarity;
- leading questions;
- prestige;
- bias;
- embarrassing questions;
- hypothetical questions; and
- impersonal questions.

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Other issues include whether knowledge of the results is given. For example, if responses are requested over time, is the subject informed of previous ratings that he or she made, and whether the ratings are given in the presence of others? In some circumstances, people can avoid extremes such as end points on scales or be influenced by the range presented.

Although subjective measurement techniques can be useful for measuring extreme environments, they should not be used as a primary measure in health and safety. In these conditions, the ability of a person to make a “rational” subjective judgement can be impaired. While a subject shall always be allowed to withdraw from an investigation, he or she does not have the overriding right to remain in it. It is the investigator’s judgement as to whether he or she should remain exposed (based on physiological responses, etc.) even if the subject is willing (enthusiastic) to do so.

The three judgement scales should be applied in the following order: perceptual scale, evaluative scale, scale of preference. The combination of possible replies provides all the required information.

The following introductory questions should be posed:

- before applying the perceptual scale: “How are you feeling (at this precise moment)?” (followed by the replies from the scale);
- after the response given on the perceptual scale, and immediately before applying the evaluative scale: “Do you find this... ?” (followed by the replies from the scale);
- after the response given on the evaluative scale, and immediately before the application of the preference scale: “Please state how you would prefer to be now” (followed by the replies from the scale).

A 7-degree scale should be applied in the case of environments judged to be close to neutrality; a 9-degree scale should be applied in the case of environments judged to be more intense.

Full scales are presented, even in cases of surroundings located only in a limited range of conditions. The wording of all the degrees of a scale provides a frame of reference useful to those asked to verbalize their instantaneous experience.

There is utility to the investigator to consider a large number of environmental impacts and a variety of scales. However, the desire for data shall be balanced with the willingness of the participants to provide accurate perceptions, and the management’s tolerance for the use of the time required. The survey is most acceptable if it is focused on legitimate environmental concerns specific to the environment in question. The scales used and the ergonomic aspect assessed shall get to the point and provide actionable data.

## 5.2 Scale of perception of the personal state

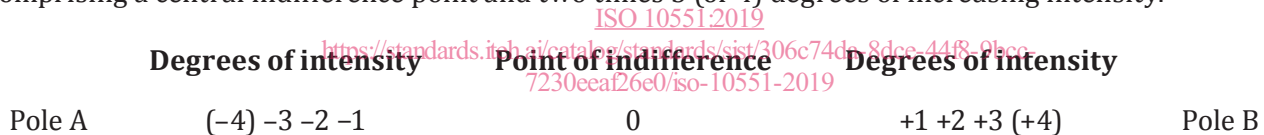
### 5.2.1 Structure of the scale

Scales can be unipolar or bipolar.

For a unipolar scale, a 4-degree one-pole scale, which can be extended to 5 degrees, with a point of origin indicating the absence of the effect, and 3 (or 4) degrees of increasing intensity of the effect.



For bipolar scales, a symmetrical 7-degree two-pole scale, which can be extended to 9 degrees, comprising a central indifference point and two times 3 (or 4) degrees of increasing intensity.



### 5.2.2 Wording of the degrees

Poles A and B are at either end of the scale. The central point of indifference corresponds to absence of sensation. The wording of the degrees depends on the vocabulary choices in each language. The selection of the terms should be carried out carefully and tested beforehand on a representative number of persons who are native speakers of the given language.

The following wordings should be taken as an example:

- for languages which have several (at least two) distinct terms to denote different degrees of intensity, these terms are used along the lines of the English wording;
- for languages which do not have two terms for denoting different degrees of intensity for each of the poles, a single term is used for each pole and its intensity modulated by the use of adverbs along the lines of the French wording.

NOTE [Tables A.1](#) and [C.1](#) give examples for each case.

## 5.3 Evaluative scale

### 5.3.1 Structure of the scale

A 4-degree one-pole scale, which can be extended to 5 degrees, with a point of origin indicating the absence of the effect, and 3 (or 4) degrees of increasing intensity of the effect.

Point of origin	Degrees of intensity	Unique pole
0	1 2 3 (4)	

### 5.3.2 Wording of the points

The unique pole devoted to the evaluation of the load denotes a negative effect: DISPLEASURE, DISSATISFACTION or DISCOMFORT. Its intensity can be modulated by adverbs. COMFORT, located at the point of origin, and ABSENCE OF DISCOMFORT, are also classed as positive evaluations (pleasure, satisfaction).

NOTE [Tables A.2, C.2, D.1](#), and [E.1](#) give examples for each case.

## 5.4 Preference scale

### 5.4.1 Structure of the scale

A symmetrical 7-degree bipolar scale comprises a central point of indecision and two times 3 degrees of increasing intensity.

	Degrees of intensity	Point of indecision	Degrees of intensity	
Pole A	-3 -2 -1	0	+1 +2 +3	Pole B

### 5.4.2 Wording of the degrees

Poles A and B are at either end of the scale. The central point of indecision corresponds to the ABSENCE OF CHANGE.

The degrees should be worded using for each pole, a comparative term which can be modulated in intensity by means of adverbs. It is possible to reduce the three degrees of each of the poles to a single degree worded by means of an unmodulated comparative term.

NOTE [Tables A.3, B.2](#), and [C.3](#) give examples for each case.

## 6 Personal acceptability statement and tolerance scale

### 6.1 General

In addition to the previous judgements, information should be obtained indicating how the workers personally feel toward their situation.

This assessment would be in terms of rejection or acceptance on a personal level, complemented in any case by a relative judgement of the degree of personal tolerance. Rejection or acceptance is expressed on a personal level, i.e. out of context, the judgement being based purely on personal preference. The expression of rejection on a personal level (unacceptability) is therefore not incompatible with actual acceptance, which takes into account other contextual motivations (instructions, job requirement, short duration of exposure, remuneration).

In contrast to the three preceding scales, the personal acceptability statement and the tolerance scale consist of judgements made about the surroundings.

### 6.2 Instructions for using the judgement expression forms

The acceptability statement form and tolerance scale should be applied after the perception and assessment scales described above, and should be in the following order: acceptability statement form, then tolerance scale.

The following introductory questions should be posed:

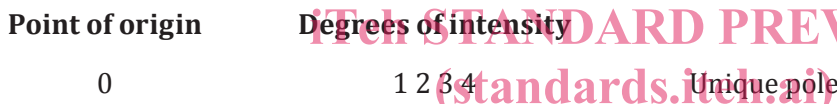
- before application of the acceptability statement form:
  - 1) in explicit terms: “How do you judge this environment on a personal level?”;
  - 2) with the initial statement: “Taking into account only your personal preference,” either:
    - a) “... would you rather accept this environment than reject it?”; or
    - b) “... would you rather reject this environment than accept it?”;
- before the application of the tolerance scale: “In your opinion, is the environment ...?”.

### 6.3 Description of the forms of judgement expression

#### 6.3.1 Structure of the forms of judgement expression

The form of the personal acceptability statement will be a binary structure of the type: PERSONAL ACCEPTANCE (GENERALLY ACCEPTABLE) — PERSONAL REJECTION (GENERALLY UNACCEPTABLE).

The personal tolerance scale has a unipolar 5-degree structure, the single pole expressing DIFFICULTY IN TOLERATING, with a point of origin indicating no difficulty in tolerating and with 4 degrees of increasing difficulty in tolerating, the 4th degree expressing intolerable.



#### 6.3.2 Wording of the degrees

The wording of the two categories on the personal acceptability statement form can consist of either:

- a) a clarification of the judgement of the person questioned;

A.1.1.1.1 Categories	A.1.1.1.2 Wording	A.1.1.1.3 Response
ACCEPTABLE	Environment acceptable rather than unacceptable	
UNACCEPTABLE	Environment unacceptable rather than acceptable	

- b) or the expression of agreement or disagreement of the person questioned with the initial statement.

Initial statement	Category ACCEPTABLE	Category UNACCEPTABLE
Either “personal acceptance”	Yes (agreement)	No (disagreement)
Or “personal rejection.”	No (disagreement)	Yes (agreement)

NOTE The degrees on the personal tolerance scale can be worded in terms of difficulty in tolerating (or bearing). An example is given in [Table A.5](#).

## 7 Instructions for repeat enquiries

Persons submitted to repeated application of the same judgement scales should be informed beforehand, in order to avoid undesired reactions and to present arguments justifying the application of the procedure. The following instructions can be issued:

“As you usually stay several hours at this workplace, you will be asked several times, at regular intervals, by means of the same scales, to judge the physical conditions; indicate your actual