
**Ergonomics of human-system
interaction —**

**Part 126:
Guidance on the presentation of
auditory information**

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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).

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).

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 4, *Ergonomics of human-system interaction*.

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

Interactive systems have used auditory information as primary sources and, more commonly, to enhance interactions in primarily visual systems since about the time the digital computer was invented. Even before that, one can consider telephone conversations to be a type of interactive system where information is presented aurally. The way participants in a telephone conversation present information to one another is largely based on learned and subconscious conventions. In the digital realm, sound has been used in increasingly symbolic ways, straying out of necessity from the realistic representations of objects and actions in the physical world.

Unlike visual displays, the information conveyed through sound is typically sparse, and it seems more difficult to intuitively understand what makes a sound scheme usable, whether in its design or its presentation. Since the main communication medium of modern interactive software is the visual display, it is not surprising that a need was first identified for guidelines relating to presentation of visual information. However, designers developing for both visual and auditory information would benefit from guidelines rooted in scientific discovery, that lead to clear and usable communication of information, while not inhibiting the creative process.

This document focuses on guidelines for presentation of information in the auditory modality.

The success of this document will depend on its positive impact on usability of future systems presenting auditory information using these guidelines. However, this document is not necessarily designed to be used by the direct beneficiaries of this desired usability increase. Instead, it serves the following types of users:

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- a) the user interface designer, who will apply these guidelines during the development process;
 - b) the buyer, who will reference this document during the product procurement process, and whose end users will gain from the potential benefits provided by the guidelines;
 - c) those responsible for ensuring products meet the recommendations in this document;
 - d) designers of auditory interface development tools to be used by auditory interface designers;
 - e) writers of software industry standard guides to be used by auditory interface designers.

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Ergonomics of human-system interaction —

Part 126:

Guidance on the presentation of auditory information

1 Scope

This document provides guidance for the auditory presentation of information controlled by software, irrespective of the device. It includes specific properties such as the syntactic or semantic aspects of information, e.g. coding techniques, and gives provisions for the organization of information taking account of human perception and memory capabilities.

This document does not address the hardware issues of the transmission and the production of auditory information.

NOTE 1 Volume is dependent on hardware and thus cannot always be absolutely controlled by software. Environmental conditions can also affect the ability for sounds to be perceived, which can be beyond the ability of the software to take into account.

This document does not apply to auditory alarms, warnings or other safety-related uses of auditory information.

NOTE 2 Safety-related uses of auditory presentation of information are covered in various domain specific standards, such as ISO 7731:2003 which deals with auditory danger signals for public and work areas, and IEC 60601-1-8:2006 which provides very specific requirements for auditory alarms for medical devices.

While this document applies to the presentation of all non-safety-related information, it does not include application domain specific guidance (e.g., audio instructions for consumer products).

This document can be utilized throughout the design process (e.g. as specification and guidance for designers during design or as a basis for heuristic evaluation). Its provisions for the presentation of information depend on the auditory design approach, the task, the user, the environment and the single or multiple technologies that can be used for presenting the information. Consequently, this document cannot be applied without knowledge of the context of use. It is not intended to be used as a prescriptive set of rules to be applied in its entirety but rather assumes that the designer has proper information available concerning task and user requirements and understands the use of available technology.

This document does not address visual or tactile/haptic presentation of information or modality shifting for the presentation of auditory information in other modalities.

NOTE 3 ISO 9241-112 provides high-level ergonomic guidance that applies to all modalities.

2 Normative references

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 9241-171, *Ergonomics of human-system interaction — Part 171: Guidance on software accessibility*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>

3.1

pitch

perception of the highness or lowness of a sound's *frequency* (3.2)

3.2

frequency

number of complete oscillations per unit time of a periodic waveform

3.3

fundamental frequency

lowest *frequency* (3.2) component of a periodic waveform

3.4

overtone

higher *tone* (3.18) produced simultaneously with a *fundamental frequency* (3.3) and that, with the fundamental frequency, comprise a complex tone

3.5

harmonic

overtone (3.4) that is an integer multiple of the *fundamental frequency* (3.3)

3.6

harmonicity

degree to which a sound's *overtones* (3.4) are composed of integer multiples of its *fundamental frequency* (3.3)

Note 1 to entry: A sound with high harmonicity is called "harmonic" while a sound with low harmonicity is called "inharmonic".

Note 2 to entry: The degree to which a sound's overtones depart from being integer multiples of its fundamental frequency is called "inharmonic".

3.7

pure tone

tone (3.18) composed of a single *frequency* (3.2) with no *harmonics* (3.5)

3.8

intensity

power per unit area of a sound wave in a direction perpendicular to that area

3.9

loudness

perception of a sound's *intensity* (3.8)

3.10

masking threshold

sound pressure level below which a signal is not audible when in the presence of another specified sound (i.e. a masking signal or masker)

Note 1 to entry: The masking threshold depends on the sound's *frequency* (3.2), the type of masker, and the kind of sound being masked.

3.11

timbre

quality given to a sound by its *overtones* (3.4)

3.12

**reverberation
resonance
echo**

prolongation of a sound through reflection off objects or structures in the sound environment

3.13

interaural

relating to sound reception and perception by each ear considered separately

3.14

monaural

relating to sound emanating from a single sound source or presented equally from all sound sources

3.15

rhythm

strong, regular, repeated pattern of sound

3.16

accent

increased stress or emphasis on a particular sound within a sequence, usually by increasing its *intensity* (3.8) or duration relative to other sounds in the sequence

3.17

earcon

auditory icon

brief, distinctive sound used to represent a specific object or event

3.18

tone

discrete musical sound

3.19

prosody

rhythmic and intonational aspect of language

3.20

lateral sound localization

ability of a user to approximate the location where a sound originated

3.21

accessibility

extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: ISO 9241-112:2017, 3.15]

4 Application

4.1 Accessibility

Auditory presentation of information shall be in accordance with ISO 9241-171, which gives specific requirements and recommendations for the presentation of information in the auditory modality and the presentation of the same information in different modalities.

NOTE ISO 9241-171:2008, 10.6, contains significant guidance on the controllability and accessibility of audio output.

4.2 Applying the recommendations in this document

It is recognized that different clauses in this document apply in different situations:

- [Clause 5](#) contains recommendations on appropriate usage of auditory presentation of information;
- [Clause 6](#) contains general recommendations on the auditory presentation of information;
- [Clause 7](#) contains recommendations on auditory dimensions;
- [Clause 8](#) contains recommendations on speech;
- [Clause 9](#) contains recommendations on earcons;
- [Clause 10](#) contains recommendations on auditory coding.

Each individual recommendation should be evaluated for its applicability and, if judged to be applicable, should be implemented, unless there is evidence that doing so would cause deviation from the design objectives, or would result in an overall degradation in usability. In judging whether applicable recommendations have been met, evaluators should evaluate the product or observe representative users of the product in the context of accomplishing the user's task.

5 Appropriate usage

5.1 Visual system unavailability

If the user's visual system is either unavailable or overburdened, then consider presenting information aurally unless there is reason to prefer tactile communication.

EXAMPLE 1 A blind user's visual system is unavailable, so the user opts for an auditory presentation.

EXAMPLE 2 In an application with a dense visual display of information, additional information is provided by the auditory channel to possibly increase the user's task performance efficiency.

5.2 Inadequate or excessive light

If the ability to perceive visually is limited by excessive light or darkness, including the need to maintain dark adaptation, consider presenting information aurally.

5.3 Inability to maintain visual attention

If the task prevents the user from maintaining focus on a visual display, then consider presenting information aurally.

EXAMPLE An auditory presentation used for a shop floor inventory application because workers using the application are moving around the shop floor and also using both hands much of the time.

5.4 Message brevity and simplicity

Auditory messages should be considered when:

- 1) messages can be short and simple;
- 2) other means of communication are not practical; and/or
- 3) aural presentation is more natural for the information to be presented than other modalities of communication.