



SLOVENSKI STANDARD

SIST EN 26189:1999

01-november-1999

Akustika - Pražna avdiometrija s čistimi toni za zvočno prevodnost za oceno ohranjenosti sluha (ISO 6189:1983)

Acoustics - Pure tone air conduction threshold audiometry for hearing conservation purposes (ISO 6189:1983)

Akustik - Reinton-Luftleitungs-Schwellenaudiometrie für die Gehörvorsorge (ISO 6189:1983)

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Acoustique - Audiométrie liminaire tonale en conduction aérienne pour les besoins de la préservation de l'ouïe (ISO 6189:1983)

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Ta slovenski standard je istoveten z: EN 26189:1991

ICS:

13.140	Vpliv hrupa na ljudi	Noise with respect to human beings
17.140.01	Akustična merjenja in blaženje hrupa na splošno	Acoustic measurements and noise abatement in general

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EUROPEAN STANDARD

EN 26189:1991

NORME EUROPEENNE

EUROPAISCHE NORM

October 1991

UDC 534.61.7:612.85:331.483

Descriptors : Acoustics, audiometry, audiometers, specifications, acoustic measurements, testing conditions, acoustic tests

English version

Acoustics - Pure tone air conduction threshold
audiometry for hearing conservation purposes
(Identical with ISO 6189:1983)

Acoustique - Audiométrie liminaire tonale en conduction aérienne pour les besoins de la préservation de l'ouïe (Identique à l'ISO 6189:1983)	Akustik - Reinton-Luftleitungs-Schwellenaudiometrie für die Gehörvorsorge (Identisch mit ISO 6189:1983)
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This European Standard was approved by CEN on 1991-10-07 and is identical to the ISO standard as referred to.

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Ref. No. EN 26189:1991 E



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 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

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Foreword

This European Standard has been taken over by CEN/TC 211 "Acoustics" from the work of the International Organization for Standardization (ISO).

This document has been submitted to the formal vote and has been approved.

National Standards identical to this European Standard shall be published at the latest by 92-04-09 and conflicting national standards shall be withdrawn at the latest 92-04-09.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

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Endorsement notice

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<https://standards.iteh.ai/catalog/standards/sist/f6e359f0-bfaa-4d4e-b790-1071-standard/sist-26189-1999>

The text of the International Standard ISO 6189:1983 has been approved by CEN as a European Standard without any modification.

International Standard



6189

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Acoustics — Pure tone air conduction threshold audiometry for hearing conservation purposes

Acoustique — Audiométrie liminaire tonale en conduction aérienne pour les besoins de la préservation de l'ouïe

First edition — 1983-12-01

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UDC 534.6/.7 : 612.85

Ref. No. ISO 6189-1983 (E)

Descriptors : acoustics, audiometry, definitions, audiometers, calibrating, testing conditions, acoustic measurement.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6189 was developed by Technical Committee ISO/TC 43, *Acoustics*, and was circulated to the member bodies in June 1982.

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It has been approved by the member bodies of the following countries :

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The member body of the following country expressed disapproval of the document on technical grounds :

France

Acoustics — Pure tone air conduction threshold audiometry for hearing conservation purposes

0 Introduction

This International Standard lays down requirements and procedures for conducting pure tone air conduction threshold audiometry when it is deemed by the responsible authority appropriate to monitor the hearing of subjects exposed to noise at work. Monitoring audiometry provides a safeguard against the effects of noise causing hearing loss and monitors the effectiveness of procedures such as organizational measures and the wearing of hearing protectors. Since hearing conservation concerns normal hearing as well as impaired hearing, requirements are presented for measuring hearing sensitivity down to levels below the standard reference zero for the calibration of pure tone audiometers. This International Standard does not present procedures for accomplishing either bone conduction pure tone audiometry or speech audiometry.

In obtaining a reliable measure of hearing sensitivity many factors are involved. It is essential that audiometers, when in service, be checked and the calibration maintained. This International Standard presents an outline of a calibration scheme. To avoid masking of the test tone of the audiometer by ambient noise in the audiometric test room, the levels of the ambient noise have to lie below certain values. This International Standard gives maximum permissible ambient sound pressure levels not to be exceeded when hearing threshold levels down to 0 dB (see ISO 389) have to be measured. It indicates the maximum ambient sound pressure levels which are permissible when other minimum hearing threshold levels have to be measured.

Recent exposure to noise may temporarily elevate hearing threshold levels. Procedures to minimize temporary threshold shift during audiometric testing are given.

Methods of conducting audiometric tests with manual and automatic recording fixed frequency audiometers are presented in this International Standard. For manual audiometry, a bracketing and an ascending method are specified. Also computer controlled or other automated equipment may be used for the audiometric procedure. It is essential that the preparation and the instruction of the test subject as well as the conduct of an audiometric test be carried out by a qualified person.

In this International Standard, rules are given to obtain the hearing threshold levels from an audiometric recording and to construct an audiogram. Provisional data is given for the difference existing between hearing threshold levels recorded by manual audiometers and those recorded by automatic recording audiometers.

This International Standard presents measures of the reliability of audiometric measurements and contains a bibliography.

1 Scope

This International Standard specifies procedures and requirements for air conduction pure tone threshold audiometry without masking that are applicable to individuals whose hearing sensitivity might be adversely affected by occupational noise exposure and presents techniques for automatic recording and manual audiometry.

2 Field of application

The procedures and requirements presented in this International Standard are restricted to air conduction pure tone threshold audiometry by earphones; other audiometric techniques, such as bone conduction pure tone threshold audiometry, masking and speech audiometry, are not specified. Techniques for computer controlled audiometry are not specified, but shall elicit results equivalent to manual audiometry. The specifications in this International Standard are not intended for clinical purposes nor are they applicable without modification in other circumstances, such as at schools or at health service institutes.

3 References

- ISO 389, *Acoustics — Standard reference zero for the calibration of pure-tone audiometers.*¹⁾
- ISO 4869, *Acoustics — Measurement of sound attenuation of hearing protectors — Subjective method.*
- IEC Publication 303, *IEC provisional reference couple for the calibration of earphones used in audiometry.*
- IEC Publication 318, *An IEC artificial ear, of the wideband type, for the calibration of earphones used in audiometry.*
- IEC Publication 645, *Audiometers.*

1) See also ISO 389/Add. 1.

ISO 6189-1983 (E)

4 Definitions

For the purpose of this International Standard the following definitions apply :

4.1 pure tone audiometer : An electroacoustic instrument, equipped with earphones, which provides pure tones of specified discrete frequencies at known sound pressure levels.

4.2 manual audiometer : A pure tone audiometer in which the signal presentations, frequency and hearing level selection and recording of the responses of the subject are performed manually.

4.3 automatic recording audiometer : A pure tone audiometer in which hearing level variations are under subject's control and are recorded automatically.

4.4 computer controlled audiometer : A pure tone audiometer in which the test procedure is controlled by computer. For the purpose of this International Standard a computer is considered as any electronic device that has a program controlling the test procedure.

4.5 air conduction : The transmission of sound through the external and middle ear to the internal ear.

4.6 audiometric recording : A display of the responses of a subject to the signals emitted by an audiometer.

4.7 hearing level : The hearing level of a pure tone at a specified frequency, for a specific type of earphone and for a specified manner of applications, is the sound pressure level of this signal set up by the earphone in a specified coupler or artificial ear minus the appropriate reference equivalent threshold sound pressure level.

4.8 hearing threshold level : The hearing threshold level of a given ear at a specified frequency is the threshold level at that frequency, derived by a specified method from an audiometric recording, expressed as hearing level.

4.9 audiogram of a subject : Presentation, in graphical or tabular form, of the hearing threshold levels of the subject's ears, determined under specified conditions and by a specified method, as a function of frequency.

5 Audiometers

5.1 General requirements

Audiometers shall be initially constructed and calibrated according to the requirements of ISO 389 and IEC Publication 645, concerning type 4 monitoring air conduction pure tone manual and automatic recording audiometers, and shall be maintained and calibrated regularly according to 5.3. Computer controlled audiometers shall be constructed so that they meet the requirements concerning monitoring air conduction pure tone manual audiometers and are operating according to the specifications given in 8.1 and 8.3 and give results equivalent to 8.2 and 8.4.

5.2 Specific requirements

5.2.1 Frequencies and sound pressure levels of test tones

Audiometers shall be provided with test tones of at least the following frequencies : 500, 1 000, 2 000, 3 000, 4 000 and 6 000 Hz, and preferably also with 8 000 Hz. The hearing levels shall preferably cover at least the range from -10 dB to +70 dB but should cover at least the range from 0 dB to 70 dB.

5.2.2 Order of presentation of test tones

Automatic recording audiometers shall be so adjusted that the test tones are presented in one of the following sequences : 500, 1 000, 2 000, 3 000, 4 000, 6 000, (8 000) Hz or 1 000, 2 000, 3 000, 4 000, 6 000, (8 000), 500 Hz. The test tone frequency 8 000 Hz is recommended. The sequence of the test tones shall be the same to both ears.

The test tones of automatic recording audiometers shall be pulsed, according to the specification given in IEC Publication 645.

For manual and computer controlled audiometers, the test tones shall be presented in the sequence : 1 000, 2 000, 3 000, 4 000, 6 000, (8 000), 500, 1 000 Hz to one ear followed by the same sequence to the other ear. The test tone frequency 8 000 Hz is recommended.

NOTE — In special cases the test frequency 500 Hz may be omitted. If so, appropriate adjustments should be made to the requirements in 5.2.1 and 6.1.1.

5.2.3 Attenuation rate of automatic recording audiometers

For automatic recording audiometers the preferred attenuation rate shall be 5 dB/s. If another rate is used, it shall be 2,5 dB/s.

5.3 Maintenance and calibration

It is essential that the audiometer, when in service, is calibrated in accordance with ISO 389 and complies with the calibration requirements of IEC Publication 645.

In order to ensure this the following scheme, consisting of a regularly performed check procedure supplemented by basic calibrations, is specified as a minimum requirement.

5.3.1 Check procedure

A listening check according to 5.3.1.1 shall be performed at the beginning of each day of testing. A subjective test according to 5.3.1.2 shall be performed at least once a week and preferably daily. An objective calibration check according to 5.3.1.3 shall be carried out once every three months.

5.3.1.1 Listening check

An experience tester with normal hearing shall listen carefully for distortions, attenuator and tone-switch transients and other unwanted sound from the audiometer at a minimum of three attenuator settings at all test frequencies. If any unwanted sounds from the audiometer are heard, the audiometer shall be withdrawn from service for inspection and repair.

5.3.1.2 Subjective calibration check

Take an audiogram of a person having known stable hearing, with hearing threshold levels not exceeding 25 dB at each test frequency, and compare the test results with the known audiogram. If the results indicate hearing threshold level differences exceeding 10 dB at any frequency the audiometer shall be withdrawn from service and subjected to an objective calibration check or basic calibration.

5.3.1.3 Objective calibration check

Measure the frequency of all test tones. Measure the sound pressure levels of the test tones at each frequency at each earphone.

NOTE — The audiometer may be set to 70 dB hearing level for this purpose and the appropriate correction made.

In addition, perform a listening check according to 5.3.1.1. The audiometer shall be withdrawn from service and subjected to a basic calibration, if any departures from the requirements of type 4 audiometers, given in IEC Publication 645 concerning frequency accuracy and sound pressure level accuracy, or if any unwanted sounds have been observed.

5.3.2 Basic calibration

A basic calibration shall be performed by a competent laboratory every 2 years, or when judged necessary as a result of the periodic checks given in 5.3.1.

The procedure shall be such that after its application the audiometer is calibrated in accordance with ISO 389 and meets the requirements of type 4 instruments given in IEC Publication 645 relating to :

- frequency accuracy;
- harmonic distortion;
- accuracy of sound pressure levels;
- on/off ratio and rise/fall time of tone switch for manual audiometers;
- pulsed tone for use with automatic recording audiometer (see also 5.2.3);
- earphones;
- general requirements.

When the instrument is returned after basic calibration it should be checked according to 5.3.1.1 and 5.3.1.2 before being put back into service.

6 Conditions for audiometric test rooms

6.1 Ambient noise

6.1.1 Maximum permissible ambient sound pressure levels

In order to avoid masking of the test tones the ambient sound pressure levels in the audiometric test room shall not exceed certain values as described in this clause.

The maximum permissible ambient sound pressure level, L_{max} , measured at the head position in the test room, but with the subject absent, is given by the formula :

$$L_{max} = k + A$$

where

k is as given in tables 1 to 3;

A is the average sound attenuation of the audiometric earphone (measured, for example, according to the procedure specified in ISO 4869.)

NOTE — When values of A are known for a particular pattern of audiometric earphone, these values should be used. Values of $k + A$ are, however, given in the third column of tables 1 to 3, for convenience, for the case of typical current supra aural earphones. The data are based on experimental values for two commercially available earphone types^{[7][8]}.

The ambient sound pressure level measurements should be made at a time when conditions are representative of those existing when audiometric tests are carried out.

The values provided in tables 1 to 3 assume that the lowest test frequency is 500 Hz.

If minimum hearing threshold levels other than 0 dB have to be measured, the maximum permissible ambient sound pressure levels, shall be calculated by adding to the values given in the tables 1, 2 and 3 the minimum hearing threshold levels to be measured. For example, if the minimum hearing threshold level to be measured is -10 dB, 10 dB is subtracted from the values presented in the tables 1, 2 and 3.

NOTES

1 Audiometry for hearing conservation purposes is not recommended when the ambient noise exceeds the values in table 1 by 10 dB or more, even when the minimum hearing threshold level to be measured is higher than 10 dB.

2 Psycho-acoustical check on ambient noise

If sound pressure level measurements cannot be carried out, a psycho-acoustical check on the ambient noise may be performed by conducting an audiometric test on at least two test subjects during the time in which the audiometry would normally be conducted and by comparing these audiograms with audiograms taken in the same manner and on the same subjects in an audiometric test room conforming to 6.1.1. Hearing threshold levels obtained in the audiometric test room under consideration which are higher by 5 dB or more indicate a requirement for reduction of the noise in the room. For this check, the hearing threshold levels of the test subjects at any frequency shall not be higher than the lowest hearing level to be measured during regular testing.

6.2 Other environmental requirements

The test subject and the audiometrician should be comfortably seated during audiometric testing and should not be disturbed nor distracted by events unrelated to the test procedure nor by people in the surroundings. If manual audiometry is employed the subject shall be clearly visible to the audiometrician but shall not be able to see the audiometer settings change nor the test tone switched on or interrupted.