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**Acoustics — Audiometric test methods —**

**Part 3:  
Speech audiometry**

*Acoustique — Méthodes d'essais audiométriques —*

*Partie 3: Audiométrie vocale*

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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.

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.

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 8253-3 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

This second edition cancels and replaces the first edition (ISO 8253-3:1996), which has been technically revised.

ISO 8253 consists of the following parts, under the general title *Acoustics — Audiometric test methods*:

- *Part 1: Pure-tone air and bone conduction threshold audiometry*
- *Part 2: Sound field audiometry with pure-tone and narrow-band test signals*
- *Part 3: Speech audiometry*

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## Introduction

Speech audiometry is used for the assessment of hearing in connection with diagnostic evaluation and audiological rehabilitation.

The results of speech audiometry depend on the speech material and test method used. This part of ISO 8253 sets conditions for speech materials in order to assure minimum requirements of precision and comparability between different tests using different speech materials including materials in different languages. It also specifies procedures to be used when testing speech recognition.

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# Acoustics — Audiometric test methods —

## Part 3: Speech audiometry

### 1 Scope

This part of ISO 8253 specifies basic methods for speech recognition tests for audiological applications.

In order to ensure minimum requirements of precision and comparability between different test procedures including speech recognition tests in different languages, this part of ISO 8253 specifies requirements for the composition, validation and evaluation of speech test materials, and the realization of speech recognition tests. This part of ISO 8253 does not specify the contents of the speech material because of the variety of languages.

Furthermore, this part of ISO 8253 also specifies the determination of reference values and fulfilment requirements for the realization and manner of presentation.

This part of ISO 8253 specifies procedures and requirements for speech audiometry with the recorded test material being presented by air conduction through an earphone, or from a loudspeaker for sound field audiometry. Methods for using noise either for masking the non-test ear or as a competing sound are described.

Some test subjects, for example children, can require amended test procedures not specified in this part of ISO 8253.

Specialized tests such as those used for evaluating directional hearing and dichotic hearing are outside the scope of this part of ISO 8253.

### 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 266, *Acoustics — Preferred frequencies*

ISO 8253-1, *Acoustics — Audiometric test methods — Part 1: Pure-tone air and bone conduction audiometry*

ISO 8253-2, *Acoustics — Audiometric test methods — Part 2: Sound field audiometry with pure-tone and narrow-band test signals*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

IEC 60645-1, *Electroacoustics — Audiological equipment — Part 1: Pure-tone audiometers*

IEC 60645-2:1993, *Audiometers — Part 2: Equipment for speech audiometry*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8253-1 and ISO 8253-2 and the following apply.

**3.1**

**speech signal**

acoustic signal which carries information in a given language

NOTE A speech signal may be a voice signal or an acoustic signal simulating a voice signal.

**3.2**

**test item**

particular monosyllabic or polysyllabic word or logatom, or sentence, or time-limited segment of connected speech, used in accordance with defined rules of presentation and scoring in a speech audiometric procedure

NOTE Scoring may be based on a complete test item or parts thereof being correctly recognized.

**3.3**

**speech material**

entire set of test items which is used for speech recognition tests

NOTE Usually the speech material is subdivided into several test lists.

**3.4**

**open-set test material**

set of test items in which the number of alternative responses to each test item is unlimited

**3.5**

**closed-set test material**

set of test items in which the number of alternative responses to each test item is limited

**3.6**

**phoneme**

smallest recognizable unit of speech in a given natural language

**3.7**

**phoneme class**

subdivision of phonemes that show characteristic similarities in vocal production mode as well as in acoustical signal properties

**3.8**

**syllable**

segment of speech which consists of a vowel with or without one or more accompanying consonants immediately preceding or following

**3.9**

**spondee**

two-syllable word with equal stress on each syllable

**3.10**

**logatom**

syllabic unit that has no verbal meaning to the listener

NOTE A logatom is sometimes called a “nonsense syllable”.

**3.11**

**test list**

number of selected test items, presented and scored as a single unit

**3.12**

**set of test items**

selected number of test items from a test list

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**3.13****phonemically balanced test list**

test list which contains approximately the same proportions of the various phonemes as are present in typical speech communication within a given language

**3.14****perceptually balanced test list**

test list which yield equivalent speech recognition score with minimized variance at a specified speech level under equivalent conditions (specified manner of presentation and specified group of listeners)

NOTE Usually the specified group of listeners consists of otologically normal persons with an age from 18 years to 25 years inclusive. For special tests, different groups (e.g. otologically normal children within a specified age range) may be used as well.

**3.15****carrier phrase**

sentence or phrase in which a test item is embedded such that the correct recognition of the test item is not dependent upon the context or meaning of the sentence or phrase

**3.16****reference recording of speech material****master recording**

well-defined recording that represents the speech material and that is used for validation and application of the speech material

**3.17****speech level**

equivalent continuous sound pressure level of the speech material as measured in an appropriate coupler, ear simulator or in a sound field, with frequency weighting C according to IEC 61672-1

NOTE For speech test lists based on single test items separated by silent intervals, the integration does not include these intervals. For test lists based on single test items with a carrier phrase, the integration includes the test items only. In a digital recording, the silent intervals can be removed by editing. Numerical correction may also be made by determination of the total duration of the test items and the total duration of the silent intervals.

**3.18****equivalent continuous sound pressure level**

$L_{p,eqT}$

ten times the logarithm to the base 10 of the ratio of the time average of the square of the sound pressure,  $p$ , during a stated time interval of duration,  $T$  (starting at  $t_1$  and ending at  $t_2$ ), to the square of a reference value,  $p_0$ , expressed in decibels

$$L_{p,eqT} = 10 \lg \left[ \frac{\frac{1}{T} \int_{t_1}^{t_2} p^2(t) dt}{p_0^2} \right] \text{ dB}$$

where the reference value,  $p_0$ , is 20  $\mu\text{Pa}$

NOTE Because of practical limitations of the measuring instruments,  $p^2$  is always understood to denote the square of a frequency-weighted and frequency-band-limited sound pressure. If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency bands are applied, this should be indicated by appropriate subscripts; e.g.  $L_{p,A,10s}$  denotes the A-weighted time-averaged sound pressure level over 10 s.

[ISO/TR 25417<sup>[3]</sup>, 2.3]

**3.19****speech detection threshold level**

for a given test subject, for specified speech material and a specified manner of signal presentation, the speech level at which it is detected (not necessarily understood) in 50 % of the trials

**3.20**

**speech recognition score**

for a given test subject, for specified speech material, a specified manner of signal presentation and at a specified speech level, the percentage of correctly recognized test items or scorable items if the scoring method is not based on whole test items

**3.21**

**maximum speech recognition score**

for a given test subject, for specified speech material and a specified manner of signal presentation, the maximum speech recognition score obtained regardless of speech level

**3.22**

**speech recognition threshold level**

for a given test subject, for specified speech material and a specified manner of signal presentation, the lowest speech level or speech-to-noise ratio at which the speech recognition score is equal to 50 %

NOTE Speech recognition threshold has been called “speech reception threshold”.

**3.23**

**reference speech recognition threshold level**

for specified speech material and a specified manner of signal presentation, the median value of the speech recognition threshold levels of a sufficiently large number of otologically normal persons, of both sexes, between 18 years and 25 years inclusive for whom the test material is appropriate

**3.24**

**optimum speech level**

for a given test subject, for specified speech material and a specified manner of signal presentation, the speech level or range of speech levels at which maximum speech recognition score is obtained

**3.25**

**half-optimum speech level**

for a given test subject, for specified speech material and a specified manner of signal presentation, the speech level at which half of the maximum speech recognition score is obtained

**3.26**

**speech recognition curve**

for a given test subject, for specified speech material and a specified manner of signal presentation, a curve that describes the speech recognition score as a function of speech level

**3.27**

**reference speech recognition curve**

for specified speech material and a specified manner of presentation, a curve that describes the median speech recognition score as a function of speech level for a sufficiently large number of otologically normal persons of both sexes, aged between 18 years and 25 years inclusive and for whom the test material is appropriate

**3.28**

**hearing level for speech**

for specified speech material and a specified manner of signal presentation, the speech level minus the appropriate reference speech recognition threshold level

**3.29**

**competing sound**

additional sound that is presented during speech recognition tests

**3.30**

**competing sound pressure level**

equivalent continuous sound pressure level of a competing sound as measured in an appropriate coupler, ear simulator or in a sound field, with frequency weighting C according to IEC 61672-1

**3.31****speech-to-noise level difference****speech-to-noise ratio****SNR**

difference between the speech level and the competing sound level

**3.32****effective masking level for speech**

level of a specified masking sound which is numerically equal to that hearing level for speech to which the speech recognition threshold level for a specified speech signal would be raised by the presence of that masking sound

**3.33****most comfortable level for speech**

for a given test subject and a specified manner of presentation, the speech level at which the loudness of the speech signal is judged by the test subject to be the most comfortable

**3.34****connected speech****running speech**

continuous speech with natural intonation, consisting of consecutive sentences with logical connections

**4 Requirements for recording of speech material****4.1 General requirements**

Each copy of the recording shall contain the following signals:

- a) the speech material;
- b) a signal for the calibration of the equipment for speech audiometry, of a duration not less than 60 s; the calibration signal shall be a weighted random noise, e.g. as specified in IEC 60645-2:1993, 13.1, a band of noise centred at 1 kHz and having a bandwidth of one-third octave, or a frequency-modulated tone at 1 kHz having a bandwidth of at least one-third octave — the modulating signal shall be either sinusoidal or triangular with a repetition rate in the range from 4 Hz to 20 Hz;
- c) signals for testing the frequency response of the equipment to be used for speech audiometry including the playback equipment and the recording — such signals shall have a duration of not less than 15 s and consist of one-third-octave bands of white noise centred at the preferred one-third-octave frequencies in accordance with ISO 266 in the frequency range 125 Hz to 8 000 Hz.

**NOTE** For speech material based on other time and/or frequency weightings than C-weighted equivalent sound pressure level, correction factors can be determined describing the difference related to C-weighted equivalent sound pressure level for speech level, calibration signal level and competing noise level.

**4.2 Reference recording**

A suitable speaker, either male or female, should have a normal and clear articulation without pronounced dialect. The speaker should be instructed to maintain clarity, natural pace, and vocal effort and avoid emphasis on key words.

A reference recording mainly consists of the elements specified in 4.1. The reference recording shall not be modified. All copies shall be made from the reference recording. Any changes of the reference recording (e.g. a new recording or changes of levels or frequency content) require a new validation (see Clause 5).

For speech audiometry intended to be performed in noise the reference recording shall also include the associated competing noise or noises, either on the same or on separate channels.

### 4.3 Recording environment

The room in which the speech is recorded shall be sufficiently quiet to provide a signal-to-noise ratio of at least 40 dB and shall have a reverberation time of less than 0,5 s at any frequency in the range from 125 Hz to 8 000 Hz.

### 4.4 Frequency response of recording equipment

The frequency response of the recording equipment including the microphone used shall be flat within 2 dB in the frequency range from 125 Hz to 8 000 Hz.

NOTE The quality of the recording and negligible loss of quality after repeated use make digital recordings superior.

### 4.5 Interval between successive test items

The intervals between the successive test items of the recording should be specified and constant within  $\pm 10\%$ .

For single test words, an interval of not less than 4 s is suggested.

### 4.6 Levels

#### 4.6.1 Speech material

The average reference speech recognition threshold level of the smallest set of test items to be used at a predetermined sound pressure level shall not deviate by more than  $\pm 1$  dB from the average of all test items within the list. The reference speech recognition threshold level of any single test item shall not deviate by more than  $\pm 3$  dB from the average reference speech recognition threshold level of all test items of the list. The average speech recognition threshold level of test lists shall not differ from the average reference speech recognition threshold level of all test items recorded by more than  $\pm 1$  dB, see Annex D.

#### 4.6.2 Calibration signal <https://standards.iteh.ai/catalog/standards/sist/780fa1a0-bb0e-41ce-aff9-e06da73b4be6/iso-8253-3-2012>

The level of the calibration signal shall not deviate by more than  $\pm 0,5$  dB from the average speech level of all test items of the specific speech material. The level of the calibration signal shall be measured using the same frequency weighting as when measuring the speech level.

### 4.7 Signal-to-noise ratio

The level of any inherent background noise on the recording shall be at least 40 dB below the level of the calibration signal in accordance with 4.6.2 as measured using the same frequency weighting as when measuring the speech level.

### 4.8 Phonemic balance across test lists

All test lists of a specific speech material shall be phonemically balanced.

In some cases, it may not be possible to achieve perfect phonemic balance. In such cases, the test lists shall be phonemically balanced based on phoneme classes, i.e. voiced and unvoiced plosives and fricatives, nasals, long and short vowels.

The distribution of phonemes of the speech material should approximate the phoneme distribution of the test language as closely as possible. Speech materials consisting of a large amount of items allow a closer approximation than smaller speech materials. In some cases, the possibility of achieving a close approximation to the phoneme distribution is limited, e.g. in screening tests or tests for children, because the speech material has to be limited to a relatively small number of test items.