
**Acoustics — Reference zero for the
calibration of audiometric equipment —**

Part 5:

Reference equivalent threshold sound
pressure levels for pure tones in the frequency
range 8 kHz to 16 kHz

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*Acoustique — Zéro normal de référence pour l'étalonnage d'équipements
audiométriques —*

ISO/TR 389-5:1998
*Partie 5: Niveaux de référence équivalents de pression acoustique liminaire
pour les sons purs dans le domaine de fréquences de 8 kHz à 16 kHz*
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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 main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard (“state of the art”, for example).

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Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 389-5, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 43, *Acoustics*.

This document is being issued in the Technical Report (type 2) series of publications (according to subclause G.3.2.2 of part 1 of the ISO/IEC Directives, 1995) as a “prospective standard for provisional application” with regard to the calibration of audiometric equipment in the frequency range 8 kHz to 16 kHz because there is an urgent need for guidance on the values of reference equivalent sound pressure levels to be used.

This Technical Report contains information on the reference equivalent threshold sound pressure levels (RETSPLs) related to the earphones for

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which threshold data are currently available in the frequency range 8 kHz to 16 kHz. It is hoped that by publishing this report, this information will become more readily available to manufacturers and users of high-frequency audiometric equipment. In addition, it is hoped that this will also encourage other workers to produce more threshold data which will enable this report to become an International Standard in due course.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this Technical Report (type 2) will be carried out not later than three years after its publication with the options of: extension for another three years; conversion into an International Standard; or withdrawal.

ISO 389 consists of the following parts, under the general title *Acoustics — Reference zero for the calibration of audiometric equipment*:

- *Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones*
- *Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones*
- *Part 3: Reference equivalent threshold force levels for pure tones and bone vibrators*
- *Part 4: Reference levels for narrow-band masking noise*
- *Part 5: Reference equivalent threshold sound pressure levels for pure tones in the frequency range 8 kHz to 16 kHz (Technical Report)*
- *Part 6: Reference equivalent threshold sound pressure levels for acoustic test signals of short duration*
- *Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions*

Part 1 will be a revision of ISO 389:1991; part 6 is under development.

Annex A of this part of ISO 389 is for information only.

A bibliography is given at the end of this Technical Report.

Introduction

An International Standard for extended high-frequency audiometers has been published, IEC 60645-4. Adaptors to be used with the IEC 60318-1 ear simulator to provide an interim acoustic coupler for the calibration of audiometric earphones in the extended high-frequency range are being standardized in IEC/TC 29 (IEC 60318-2). The reference equivalent threshold sound pressure levels for specific earphones described in this Technical Report enable calibration of those audiometers which are equipped with these earphones, in order to promote agreement and uniformity in the expression of hearing threshold level measurements worldwide.

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Acoustics — Reference zero for the calibration of audiometric equipment —

Part 5:

Reference equivalent threshold sound pressure levels for pure tones in the frequency range 8 kHz to 16 kHz

1 Scope

This part of ISO 389 specifies reference equivalent threshold sound pressure levels (RETSPs) of pure tones in the frequency range from 8 kHz to 16 kHz, applicable to the calibration of air conduction audiometers for specific earphones.

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NOTE Some notes and references on the derivation and the test conditions used to determine the recommended reference levels are given in annex A and the Bibliography. (standards.iteh.ai)

2 Normative references

[ISO/TR 389-5:1998](#)

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 389. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 389 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 389-1:—¹⁾, *Acoustics — Reference zero for the calibration of audiometric equipment — Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones.*

ISO 389-2:1994, *Acoustics — Reference zero for the calibration of audiometric equipment — Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones.*

IEC 60318-1:1998¹⁾, *Electroacoustics — Simulators of human head and ear — Part 1: Ear simulator for the calibration of supra-aural earphones.*

IEC 60318-2:1998¹⁾, *Electroacoustics — Simulators of human head and ear — Part 2: An interim acoustic coupler for the calibration of audiometric earphones in the extended high-frequency range.*

IEC 60645-1, *Audiometers — Part 1: Pure-tone audiometers.*

IEC 60711, *Occluded ear simulator for the measurement of earphones coupled to the ear by ear inserts.*

1) To be published.

3 Terms and definitions

For the purposes of this part of ISO 389, the terms and definitions given in ISO 389-1 and IEC 60318-2 apply.

4 Reference equivalent threshold sound pressure levels (RETSPLs)

The reference equivalent threshold sound pressure levels depend on the model of earphone and on the combination of the coupler or ear simulator and adapter used to calibrate it. The recommended standard values of three different earphones [an insert earphone (ER-2), an open-type supra-aural earphone (HV/1A), and a closed-type circumaural earphone (HDA 200)] are given in Table 1.

Table 1 — Recommended reference equivalent threshold sound pressure levels of three different audiometric earphones for a specified coupler or ear simulator and a specified adapter

Frequency, Hz	RETSPL (ref. 20 µPa), dB		
	Model of earphone with ear simulator and adapter used		
	Etymotic Research ER-2 Ear simulator: IEC 60711; Adapter: ISO 389-2:1994, Fig. 2b)	KOSS HV/1A Ear simulator: IEC 60318-1; Adapter: IEC 60318-2:1998, Fig. 2	SENNHEISER HDA 200 Ear simulator: IEC/CDV 60318-1, Adapter: IEC 60318-2:1998, Fig. 1
8 000	18,5	15,5	17,5
9 000	14	19,5	18,5
10 000	20	24	22
11 200	28,5	23	23
12 500	36	25	28
14 000	41,5	34,5	36
16 000	55	52	56

NOTE 1 Values are rounded to the nearest half decibel.

NOTE 2 Values for the SENNHEISER earphone are based on the results of four laboratories, whereas those for the KOSS earphone and the Etymotic Research earphone are based on the results of one laboratory only (see annex A). They are derived from determinations of the threshold of hearing of otologically normal persons under conditions as close as possible to those described in reference [2].

NOTE 3 The characteristics of the SENNHEISER HDA 200 earphone in the extended high-frequency range depend on temperature, especially at 12,5 kHz. It is therefore recommended to calibrate audiometers equipped with these earphones as closely as possible within the temperature range 21°C to 25°C. Corresponding information on other types of earphones is not available.

The force of application of each headphone, together with the tolerances, are given in Table 2.

For specification of the conditions for measuring the headband force, see IEC 60645-1.

Table 2 — Force of application and tolerances for the models of headphone

Force of application, N	
KOSS HV/1A Plus	SENNHEISER HDA 200
3,5 ± 0,5	10,0 ± 1,0

Annex A (informative)

Notes on the derivation of the reference equivalent threshold sound pressure levels for audiometric earphones in the frequency range from 8 kHz to 16 kHz

The reference equivalent threshold sound pressure levels for audiometric earphones in the frequency range from 8 kHz to 16 kHz specified in this part of ISO 389 are obtained from the results of four independent experimental investigations communicated to ISO/TC 43. See references [3] to [6]. Brief particulars of the tests are given in Table A.1.

Table A.1 — Investigations of equivalent threshold sound pressure levels for audiometric earphones in the frequency range from 8 kHz to 16 kHz

Investigation	Reference [3]	Reference [4]	Reference [5]	Reference [6]
Types of test earphone(s)	SENNHEISER HDA 200	SENNHEISER HDA 200 KOSS HV/1A	SENNHEISER HDA 200 Etymotic Research ER-2	SENNHEISER HDA 200
Number of test subjects	24	28	31	38
Number of ears tested	24	28	62 (HDA 200), 31 (ER-2)	38
Males / females	15 / 9	18 / 10	17 / 14	15 / 23
Age range of test subjects, years	18 to 23	18 to 24	18 to 25	18 to 25
Frequencies tested, kHz	8 9 10 11,2 12,5 14 16	8 9 10 11,2 12,5 14 16	8 9 10 11,2 12,5 14 16	8 9 10 11,2 12,5 14 16
Type of ear simulator used	IEC 60318-1	IEC 60318-1	IEC 60318-1 for HDA 200 IEC 60711 for ER-2	IEC 60318-1
Type of adapter used for test earphone	IEC 60318-2:1998, Fig. 1	IEC 60318-2:1998, Fig. 1, for HDA 200 and IEC 60318-2:1998, Fig. 2, for HV/1A	IEC 60318-2:1998, Fig. 1, for HDA 200 and ISO 389-2:1994, Fig. 2b, for ER-2	IEC 60318-2:1998, Fig. 1
Statistical quantity used	median	median	median	median

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