INTERNATIONAL STANDARD

ISO 389-5

First edition
2006-11-15

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

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

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

Reference number
ISO 389-5:2006(E)

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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 389-5 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

This first edition of ISO 389-5 cancels and replaces ISO/TR 389-5:1998, which has been technically revised.

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*

— *Part 6: Reference hearing threshold levels for test signals of short duration*

— *Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions*

— *Part 8: Reference equivalent threshold sound pressure levels for pure tones and circumaural earphones*

A part 9, dealing with the preferred test conditions for the determination of reference hearing threshold levels is under development.

Introduction

An International Standard for extended high frequency audiometers has already been published as IEC 60645-4. Adaptors to be used with the IEC 60318-1 ear simulator to provide an interim acoustic coupler for the calibration of circumaural audiometric earphones in the extended high frequency range presently are standardized in IEC 60318-2 (to be included in a revised IEC 60318-1). The reference equivalent threshold sound pressure levels for specific circumaural and insert earphones described in this International Standard 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.

Annexes A and B of this part of ISO 389 are for information only. A Bibliography is given at the end of this International Standard.

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 (RETSPLs) of pure tones in the frequency range from 8 kHz to 16 kHz applicable to the calibration of air conduction audiometers for specific earphones.

NOTE Some notes and references on the derivation and the test conditions used to determine the reference levels are given in Annex A and the Bibliography.

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 389-1, *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[1)], *Electroacoustics — Simulators for human head and ear — Part 1: Ear simulator for the calibration of supra-aural and circumaural earphones*

IEC 60318-2:1998[2)], *Electroacoustics — Simulators for human head and ear — Part 2: An interim acoustic coupler for the calibration of audiometric earphones in the extended high-frequency range*

IEC 60711[3)], *Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts*

3 Terms and definitions

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

1) Under revision.

2) To be withdrawn; its contents will be included in a revised IEC 60318-1.

3) To become IEC 60318-4.

4 Specifications

The reference equivalent threshold sound pressure levels, RETSPLs, depend on the model of earphone and on the combination of the ear simulator and adapter used to calibrate it. Specified values for two different earphones [an insert earphone (ETYMOTIC RESEARCH ER-2 together with eartips type ER1-14A) and a closed-type circumaural earphone (SENNHEISER HDA 200)] are given in Table 1.

Table 1 — Reference equivalent threshold sound pressure levels

Frequency Hz	**RETSPL re. 20 µPa**[a] dB	
	Etymotic Research ER-2[b,c] Ear simulator: IEC 60711[e] Adapter: ISO 389-2:1994, Figure 2b)	SENNHEISER HDA 200[b,d] Ear simulator: IEC 60318-1[c] Adapter: IEC 60318-2:1998, Figure 1
8 000	19	17,5
9 000	16	19
10 000	20	22
11 200	30,5	23
12 500	37	27,5
14 000	43,5	35
16 000	53	56

NOTE RETSPL values for the KOSS HV/1A earphone, which is no longer in production, are given in Annex B for information.

[a] Each of the values is the arithmetic mean of the median values derived from several laboratories rounded to the nearest half decibel.

[b] Model of earphone with ear simulator and adapter used.

[c] Values for the Etymotic Research earphone are based on the results of two laboratories (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 [3].

The characteristics of SENNHEISER HDA 200 earphone in the extended high-frequency range depend on temperature, especially at 12,5 kHz; see Reference [5]. It is therefore recommended to calibrate audiometers equipped with these earphones as closely as possible within the temperature range 21 °C to 25 °C.

[d] Values for the SENNHEISER earphone are based on the results of four laboratories. Temperature-dependence information is not available.

[e] IEC 60711 is at present defined in the frequency range up to and including 10 kHz but is according to this document used up to 16 kHz. A revision with a frequency range up to 16 kHz is planned and will become IEC 60318-4.

The headband force of the circumaural earphone SENNHEISER HDA 200 shall be within 10,0 $\pm$ 1,0 N. The headband force shall be measured when the two earphones are separated by 145 mm and the height of the earphone is adjusted to provide a distance of 130 mm measured between the centre (top) of the headband and a line between the centres of the earphones.

The eartip of the insert earphone ETYMOTIC RESEARCH ER-2 shall be inserted deeply into the ear canal of a test subject so that the outer end of the ear tip is flush with the bottom of the concha.

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 five independent experimental investigations given in References [4] to [8]. 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

Parameter	Investigation				
	Reference [4]	Reference [5]	Reference [6]	Reference [7]	Reference [8]
Types of test earphone(s)	SENNHEISER HDA 200	SENNHEISER HDA 200	SENNHEISER HDA 200 Etymotic Research ER-2	SENNHEISER HDA 200	Etymotic Research ER-2
Number of test subjects	24	28	31	38	24
Number of ears tested	24	28	62 (HDA 200), 31(ER-2)	38	24
Males/ females	15/9	18/10	17/14	15/23	13/11
Age range of test subjects, years	18 to 23	18 to 24	18 to 25	18 to 25	18 to 25
Frequencies tested, kHz	8 to 9 10 to 11,2 12,5 to 14 16	8 to 9 10 to 11,2 12,5 to 14 16	8 to 9 10 to 11,2 12,5 to 14 16	8 to 9 10 to 11,2 12,5 to 14 16	8 to 9 10 to 11,2 12,5 to 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	IEC 60711
Type of adapter used for test earphone	IEC 60318-2:1998, Figure 1	IEC 60318-2:1998, Figure 1	IEC 60318-2:1998, Figure 1, for HDA 200 and ISO 389-2:1994, Figure 2b), for ER-2	IEC 60318-2:1998, Figure 1	ISO 389-2:1994, Figure2b)
Statistical quantity used	median	median	median	median	median

Annex B
(informative)

RETSPL values for Koss HV/1A

RETSPL values for the KOSS HV/1A earphone were specified in the earlier version of this International Standard. Though this earphone is no longer in production, some users can, for a period, still need the RETSPL values. They are, therefore, given in this annex for information together with the specifications and the description of positioning of an adapter making the IEC 60318-1 ear simulator complying with the KOSS earphone specifications.

Table B.1 — Recommended reference equivalent threshold sound pressure levels

Frequency Hz	**RETSPL re.** 20 µPa dB
8 000	15,5
9 000	19,5
10 000	24
11 200	23
12 500	25
14 000	34,5
16 000	52

Dimensions in millimetres unless otherwise indicated

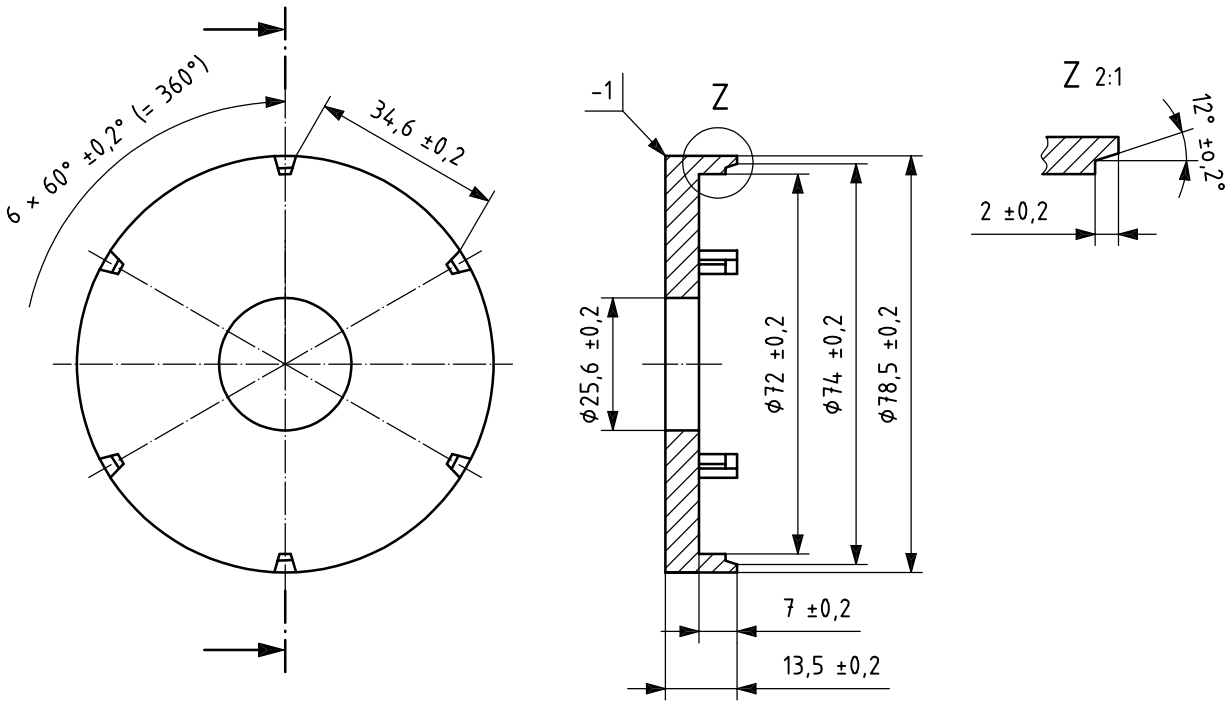
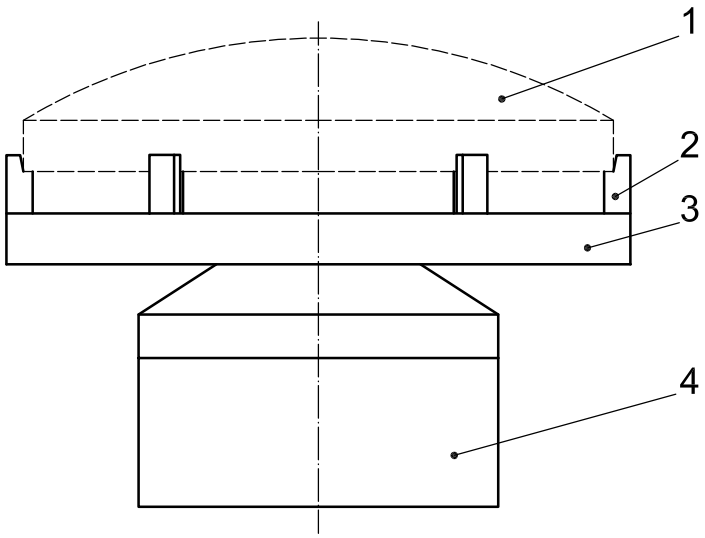


Figure B.1 — Adapter for use with IEC 60318-1 ear simulator



Key

1 example of a KOSS HV/1A earphone
2 distance clamp
3 adapter
4 IEC 60318-1 ear simulator

Figure B.2 — Position of the adapter on the IEC 60318-1 ear simulator

Bibliography

[1] ISO 389-8, *Acoustics — Reference zero for the calibration of audiometric equipment — Part 8: Reference equivalent threshold sound pressure levels for pure tones and circumaural earphones*

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4) Under preparation as ISO 389-9.

ICS 13.140

Price based on 6 pages