Acoustics — Reference zero for the calibration of audiometric equipment —

Part 1:
Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones

Acoustique — Zéro de référence pour l’étalonnage d’équipements audiométriques —
Partie 1: Niveaux de référence équivalents de pression acoustique liminaire pour les écouteurs à sons purs supra-auraux
Foreword

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— 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

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Introduction

Each part of ISO 389 specifies a specific reference zero for the calibration of audiometric equipment. The present part 1 is applicable to audiometric equipment for the transmission of pure tones by air conduction and supra-aural earphones. ISO 389-2 is applicable to audiometric equipment for the transmission of pure tones by air conduction and insert earphones. ISO 389-3 is applicable to pure-tone bone-conduction audiometers, ISO 389-4 specifies reference levels for narrow-band masking noise, and ISO 389-7 specifies reference levels for presentation in free and diffuse sound fields.

The first edition of ISO 389 specified a standard reference zero for the scale of hearing threshold level applicable to pure-tone air conduction audiometers in terms of the response of certain models of earphone measured on an artificial ear or coupler of stated type. Five of these earphone-coupler combinations corresponded with those used at that time in standardizing laboratories in France, Germany, the United Kingdom, the USA and the USSR. In a second set of values, the corresponding reference equivalent threshold sound pressure levels (RETSPL) for eleven audiometric earphones were given, referred to a single type of coupler, the National Bureau of Standards, Washington, USA type 9A coupler, which was later specified in IEC 303:1970 (now IEC 60303).

Most of the earphone-coupler combinations mentioned in the first edition of ISO 389 are now no longer in use. The ISO member bodies of the countries primarily concerned with those types of standard earphones and artificial ears agreed to eliminate obsolete data. This was done in the second edition of ISO 389. It contained only RETSPL values for two earphone models still widely in use for audiometric purposes, namely Telephonics type TDH 39 with cushion type MX 41/AR (or model 51) and Beyer type DT 48, both in conjunction with an acoustic coupler complying with IEC 303:1970.

The two remaining sets of data differ mainly as a consequence of differences between the acoustical properties of the coupler and those of the average human ear.

For the same reason, the RETSPL for an earphone of a model not covered by ISO 389 could not be inferred from the data given in that International Standard. Until then it had been necessary to obtain the appropriate values by subjective comparison with one of the specified models of earphone.

In principle, RETSPL values would be rendered independent of earphone model if they were referred to an artificial ear having acoustical properties exactly simulating those of the average human ear. A device designed with this aim in view was standardized in 1970 in IEC 318:1970 (now IEC 60318).
Addendum 1 to ISO 389:1985 was therefore prepared, based on an assessment of technical data provided by laboratories listed in annex A on RETSPL values relative to the IEC artificial ear, covering a variety of earphone models.

These data were analysed to produce a set of RETSPL values which, within an acceptable tolerance, provide a standard audiometric reference zero for earphones of any model within a broadly defined class. A note on the derivation of the standard values and the origin of the data input is given in annex A for information.

Use of the standard reference zero specified in Addendum 1 obviated the need for subjective calibration of supra-aural audiometric earphones which meet the broad requirements specified, and thus promoted agreement and uniformity in the expression of hearing threshold levels throughout the world, without inhibiting the development of improved models of supra-aural earphone.

The data of Addendum 1 were incorporated in ISO 389:1991.

In both ISO 389 and ISO 389/Add. 1, the RETSPL values were specified for pure tones in octave steps from 125 Hz to 8 000 Hz and for the intermediate audiometric frequencies 1 500 Hz, 3 000 Hz and 6 000 Hz. However, in addition, 750 Hz is sometimes used as an intermediate audiometric frequency, and Addendum 2 to ISO 389:1985 therefore specified RETSPL values for that frequency.

Moreover, it had been considered desirable to harmonize intermediate frequencies used in pure-tone audiometry with the preferred frequencies in acoustics as specified in ISO 266. Addendum 2 therefore specified RETSPL values at all preferred frequencies in one-third-octave steps in the frequency range from 125 Hz to 8 000 Hz. Details of the derivation of the RETSPL values are given in annex A for further information. The data of Addendum 2 were also incorporated in ISO 389:1991.

The RETSPL value specified at 750 Hz is intended for calibration of audiometers providing pure tones of a fixed frequency of 750 Hz. The other RETSPL values specified are primarily intended for calibration of pure-tone audiometers having a continuously variable frequency, but they may also be used in other applications, for example for establishing reference levels for masking noise. The frequencies given in ISO 389:1985 and Addendum 2 are consistent with the frequencies used in ISO 389-3 for the specification of the standard reference zero for the calibration of bone conduction audiometers. Three sets of RETSPL values were specified. Two of these concern the same earphone models as in ISO 389:1985. The third set of RETSPL values were specified for supra-aural earphones other than those covered by ISO 389:1985 but which fulfil the requirements specified in ISO 389/Add. 1.
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Introduction

Each part of ISO 389 specifies a specific reference zero for the calibration of audiometric equipment. The present part 1 is applicable to audiometric equipment for the transmission of pure tones by air conduction and supra-aural earphones. ISO 389-2 is applicable to audiometric equipment for the transmission of pure tones by air conduction and insert earphones. ISO 389-3 is applicable to pure-tone bone-conduction audiometers, ISO 389-4 specifies reference levels for narrow-band masking noise, and ISO 389-7 specifies reference levels for presentation in free and diffuse sound fields.

The first edition of ISO 389 specified a standard reference zero for the scale of hearing threshold level applicable to pure-tone air conduction audiometers in terms of the response of certain models of earphone measured on an artificial ear or coupler of stated type. Five of these earphone-coupler combinations corresponded with those used at that time in standardizing laboratories in France, Germany, the United Kingdom, the USA and the USSR. In a second set of values, the corresponding reference equivalent threshold sound pressure levels (RETSPL) for eleven audiometric earphones were given, referred to a single type of coupler, the National Bureau of Standards, Washington, USA type 9A coupler, which was later specified in IEC 303:1970 (now IEC 60303).

Most of the earphone-coupler combinations mentioned in the first edition of ISO 389 are now no longer in use. The ISO member bodies of the countries primarily concerned with those types of standard earphones and artificial ears agreed to eliminate obsolete data. This was done in the second edition of ISO 389. It contained only RETSPL values for two earphone models still widely in use for audiometric purposes, namely Telephonics type TDH 39 with cushion type MX 41/AR (or model 51) and Beyer type DT 48, both in conjunction with an acoustic coupler complying with IEC 303:1970.

The two remaining sets of data differ mainly as a consequence of differences between the acoustical properties of the coupler and those of the average human ear.

For the same reason, the RETSPL for an earphone of a model not covered by ISO 389 could not be inferred from the data given in that International Standard. Until then it had been necessary to obtain the appropriate values by subjective comparison with one of the specified models of earphone.

In principle, RETSPL values would be rendered independent of earphone model if they were referred to an artificial ear having acoustical properties exactly simulating those of the average human ear. A device designed with this aim in view was standardized in 1970 in IEC 318:1970 (now IEC 60318).
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Use of the standard reference zero specified in Addendum 1 obviated the need for subjective calibration of supra-aural audiometric earphones which meet the broad requirements specified, and thus promoted agreement and uniformity in the expression of hearing threshold levels throughout the world, without inhibiting the development of improved models of supra-aural earphone.

The data of Addendum 1 were incorporated in ISO 389:1991.

In both ISO 389 and ISO 389/Add. 1, the RETSPL values were specified for pure tones in octave steps from 125 Hz to 8 000 Hz and for the intermediate audiometric frequencies 1 500 Hz, 3 000 Hz and 6 000 Hz. However, in addition, 750 Hz is sometimes used as an intermediate audiometric frequency, and Addendum 2 to ISO 389:1985 therefore specified RETSPL values for that frequency.

Moreover, it had been considered desirable to harmonize intermediate frequencies used in pure-tone audiometry with the preferred frequencies in acoustics as specified in ISO 266. Addendum 2 therefore specified RETSPL values at all preferred frequencies in one-third-octave steps in the frequency range from 125 Hz to 8 000 Hz. Details of the derivation of the RETSPL values are given in annex A for further information. The data of Addendum 2 were also incorporated in ISO 389:1991.

The RETSPL value specified at 750 Hz is intended for calibration of audiometers providing pure tones of a fixed frequency of 750 Hz. The other RETSPL values specified are primarily intended for calibration of pure-tone audiometers having a continuously variable frequency, but they may also be used in other applications, for example for establishing reference levels for masking noise. The frequencies given in ISO 389:1985 and Addendum 2 are consistent with the frequencies used in ISO 389-3 for the specification of the standard reference zero for the calibration of bone conduction audiometers. Three sets of RETSPL values were specified. Two of these concern the same earphone models as in ISO 389:1985. The third set of RETSPL values were specified for supra-aural earphones other than those covered by ISO 389:1985 but which fulfil the requirements specified in ISO 389/Add. 1.
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