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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Acoustics — Normal equal-loudness level contours

Acoustique — Lignes isosoniques normales

Reference number
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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 226 was prepared by Technical Committee ISO/TC 43, *Acoustics*.

It cancels and replaces ISO Recommendation R 226 : 1961 and ISO 454 : 1975, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Acoustics — Normal equal-loudness level contours

0 Introduction

Curves defining relations between frequencies of pure tones or narrow bands of noise and their sound pressure levels for the condition of constant loudness level (equal-loudness level contours) express a fundamental property of the human auditory system, and are of basic importance in the field of psychological acoustics.

In common with other subjective phenomena, loudness relations vary in detail from person to person but, for a group of persons within a restricted age band and free from hearing impairments, a value for the central tendency can be determined to characterize the group. This International Standard gives curves applicable to otologically normal persons in the age group from 18 to 30 years.

The data specified in this International Standard primarily relate to continuous pure tones heard under conditions of binaural listening in free progressive plane waves with the subject directly facing the source of sound (frontal incidence), and with the sound pressure level measured in the free progressive wave at the centre position of the listener's head but with the listener absent. For other conditions of listening or other configurations of sound field, different relations exist between loudness level and sound pressure level. One example of another sound field configuration is a diffuse field. The relation between frontal incidence and diffuse field together with the resulting equal-loudness level function for narrow bands of noise in a diffuse sound field are specified in annex C to this International Standard.

NOTE — The relation between frontal incidence and diffuse field was given in ISO 454; with the inclusion of this relation in this edition of ISO 226, ISO 454 has become superfluous and has been withdrawn (see the "Foreword").

The hearing threshold may be considered as a special case of equal-loudness level, and the corresponding threshold sound pressure levels [minimum audible field (MAF)] are included in this International Standard. It should be emphasized that the minimum audible field differs from the audiometric zero specified in ISO 389, since the latter refers to monaural listening through earphones with sound pressure levels referred to specified couplers and artificial ears. Direct comparison between the data in ISO 389 and in this International Standard is therefore not appropriate.

1 Scope and field of application

This International Standard specifies the relations existing, for the condition of equal-loudness level, between the sound pressure levels and frequencies of pure (sinusoidal) continuous tones in the following conditions :

- a) the source of sound is directly in front of the listener (frontal incidence);
- b) the sound field in the absence of the listener consists of a free progressive plane wave;
- c) the sound pressure level is measured in the free progressive plane wave in the absence of the listener;
- d) the listening is binaural;
- e) the conditions of equal-loudness level are determined by the modal value of the judgements of an adequately large group of listeners;
- f) the listeners are otologically normal persons in the age group from 18 to 30 years inclusive.

The relations are expressed by means of an equation in bilinear form, with the sound pressure level as the independent variable and the loudness level as the dependent variable, for the preferred frequencies in the one-third octave series from 20 to 12 500 Hz inclusive.

NOTES

1 In accordance with convention, the reference dependent variable is taken to be the sound pressure level of a 1 000 Hz tone, i.e. the loudness level expressed in phons. However, the form of the equation remains unchanged (but with transformed coefficients) if the variables are interchanged or if a tone of another frequency in the preferred one-third octave series is taken as the reference.

2 The data in this International Standard are approximately equal to equal-loudness level relations between narrow bands of random noise, not exceeding the auditory critical bandwidth.

3 Without extrapolation of the experimental data, the upper limit of the frequency range could not be extended to the next preferred frequency in the one-third octave series. For further information regarding the range from 12 500 to 15 000 Hz, see [1].