Equal loudness level contours below 1 kHz

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Binary equal-loudness levels and the threshold of hearing have been measured on 25 otological normal-hearing subjects. In the frequency range from 50 Hz to 1 kHz the measurements were made in the free field for frontal sound incidence. From 20 to 100 Hz the experiments were made in a pressure field chamber with an inner volume for the test subjects of approximately 1 m³. The experiment is made with pure tones at each of the third octave frequencies in the frequency range. Loudness levels between 20 and 100 phon are measured. The data are going to be used for the standardization work in the Working Group ISO/TC43/WG1 for a revision of the international standard ISO 226.


Air versus bone conduction loudness balance testing was performed at the frequencies 0.25, 0.5, 0.75, 1.2, and 4 kHz in three groups of subjects: normal-hearing subjects, subjects with pure sensorineural hearing loss, and subjects with mixed hearing loss. The subjects were fitted with earphones (Koss portaPro) and a percutaneous bone transducer (HC-380) or an audiometric transducer (B71). Narrow-band noise was presented interchangeably between the earphones and the bone transducer. Balance testing was performed at each frequency and at different levels (30–80 dB HL in 10-dB steps) in the following manner: The sound pressure from the earphones was fixed and the subject under test adjusted the output level from the bone transducer for equal loudness similar to the procedure used in the conventional ABLB test. Preliminary results and their interpretation will be presented.


The current international standard of the equal-loudness level contours specified in ISO 226 is found to involve large errors, especially for frequencies below 1 kHz. In the past 10 years, a series of experiments has been conducted for full revision of ISO 226 in ISO/TC 43. At the final stage of this project, the new equal-loudness level contours should be drawn from available data points. To do this, the use of an appropriate model for loudness perception is actually useful. A loudness function is proposed by combining that proposed by Lachner and Burger to express the steepness near threshold with the two-stage model proposed by Attneave to consider the loudness-comparison process. Equal-loudness levels are then estimated according to the following procedure. (1) Parameters of the loudness function is estimated from the experimental data by the nonlinear least-squares method. (2) The estimated parameters are smoothed along the frequency axis with B-spline functions. (3) The equal-loudness level contours are calculated by using estimated parameters and the threshold of the hearing curve. Through this procedure, the new equal-loudness level contours are determined from the experimental data obtained hitherto.