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Acoustics — Methods for calculating loudness —

Part 3: Moore-Glasberg-Schlittenlacher method

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Foreword

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This document was prepared by Technical Committee ISO/TC 43, *Acoustics*.

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Introduction

Loudness and loudness level are two perceptual attributes of sound describing absolute and relative sensations of sound strength perceived by a listener under specific listening conditions. Due to inherent individual differences among people, both loudness and loudness level have the nature of statistical estimators characterized by their respective measures of central tendency and dispersion determined for a specific sample of the general population.

The object of this document is to specify a calculation procedure based on the physical properties of sound for estimating loudness and loudness level of sound as perceived by listeners with otologically normal hearing under specific listening conditions. This procedure seeks numbers that can be used in many scientific and technical applications to estimate the perceived loudness and loudness level of sound without conducting separate human observer studies for each application. Because loudness is a perceived quantity, the perception of which may vary among people, any calculated loudness value represents only an estimate of the average loudness as perceived by a group of individuals with otologically normal hearing.

This document describes a method for calculating the loudness of time-varying sounds from the input signal, which may differ for the two ears. This calculation method is based on Moore-Glasberg-Schlittenlacher loudness calculation algorithms[1] to [5]. The method allows calculation of two quantities:

a) The short-term loudness, which is the momentary loudness of a short segment of a sound, such as a word in a speech sound or a single note in a piece of music.

b) The long-term loudness, which is the loudness of a longer segment of sound, such as a whole sentence or a musical phrase.

For most everyday sounds, both the short-term loudness and the long-term loudness vary over time. The loudness of sounds with durations up to 2 s or 3 s is well predicted from the maximum value of the long-term loudness reached during presentation of the sound[4][6] to [8]. For long-duration stationary sounds, the long-term loudness based on the method described in this document is very close to the loudness determined using the method described in ISO 532-2[9]. Deviations can occur for sounds with strong amplitude fluctuations, such as noises with narrow bandwidth; for such sounds the calculated loudness is more accurate for this document than for ISO 532-2.

The method of loudness calculation described in this standard can be applied to signals of any duration. However, it does not directly give an output corresponding to the overall loudness impression of a sound scene or soundscape over a period of minutes, hours, or days, which is called the “overall loudness” in this standard. The output of the method of loudness calculation described in this standard can be post-processed to estimate the overall loudness of a sound scene.

NOTE Post-processing is outside the scope of this document, but some possible methods have been described[10] to [13].

This document describes the calculation procedure leading to estimation of the loudness and loudness level of time-varying sounds and provides executable computer programs. The software provided with this document is entirely informative and provided for the convenience of the user. Use of the provided software is not required for conformity with the document.

NOTE Equipment or machinery noise emissions/immissions can also be judged by other quantities defined in various International Standards (see e.g. ISO 1996-1[14], ISO 3740[15], ISO 9612[16], and ISO 11200[17]).