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Acoustics — Hearing protectors —

Part 2:
Estimation of effective A-weighted sound pressure levels when hearing protectors are worn

Acoustique — Protecteurs individuels contre le bruit —

Partie 2: Estimation des niveaux de pression acoustique pondérés A en cas d'utilisation de protecteurs individuels contre le bruit

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www. iso. org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www. iso. org/iso/foreword. html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise.*

This second edition cancels and replaces the first edition (ISO 4869-2:1994) which has been technically revised. It also incorporates the corrected version ISO 4869-2:1994/Cor.1:2006.

The main technical changes are:

In the prior edition of the standard the *H*, *M*, *L*, and *SNR* values were computed from the group average data by frequency. In this edition, the values are computed subject by subject and then combined to provide both a mean value and a standard deviation value so that population distribution can be estimated. The sound attenuation values for the frequency 63 Hz have been excluded from the *H*, *M*, *L* and *SNR* calculation methods since this test frequency is optional in ISO 4869-1. Prior to rounding to the nearest integer, values derived using this edition deviate from those derived using the previous edition by less than 1 dB.

A list of all parts in the ISO 4869 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document estimates an “effective” level, i.e. the A-weighted sound pressure level at the head centre with the listener absent, minus the attenuation of the hearing protection devices. Effective values are estimated since those are required to assess noise hazard with respect to permissible noise exposure limits. An effective level differs from that in the ear canal since it has been converted to a sound-field value via the transfer function of the open ear. Effective levels are typically 5 dB to 10 dB less than ear canal levels depending on the spectrum of the incident noise.

Ideally, the A-weighted sound pressure level effective when a hearing protector is worn should be estimated on the basis of both the octave-band sound attenuation data of the hearing protector (measured in accordance with ISO 4869-1) and the octave-band sound pressure levels of the noise. It is recognized, however, that in many situations information on the octave-band sound pressure levels of the noise might not be available. Therefore, for many practical purposes, there is a need for simpler methods to determine the effective A-weighted sound pressure levels which are only based on the A- and C-weighted sound pressure levels of the noise. This document addresses both of these situations by specifying an octave-band calculation method as well as two alternative simplified procedures, the *HML* method and the *SNR* method.

The octave-band method is a calculation method involving the workplace octave-band sound pressure levels and the octave-band sound attenuation data for the hearing protector that is being assessed. Although it can be thought of as an "exact" reference method, it has its own inherent inaccuracies, since it is based upon mean sound attenuation values and standard deviations for a group of test subjects, and not the specific sound attenuation values for the individual person in question.

The *HML* method specifies three attenuation values, *H*, *M* and *L*, determined from the octave-band sound attenuation data of a hearing protector. These values, when combined with the C- and A-weighted sound pressure levels of the noise, are used to calculate the effective A-weighted sound pressure level when the hearing protector is worn.

The *SNR* method specifies a single attenuation value, the single number rating, determined from the octave-band sound attenuation data of a hearing protector. This value is subtracted from the C-weighted sound pressure level of the noise to calculate the effective A-weighted sound pressure level when the hearing protector is worn.

Due to the large spread of the sound attenuation provided by hearing protectors when worn by individual persons, all three methods are nearly equivalent in their accuracy in the majority of noise situations. Even the simplest method, the *SNR* method, will provide a reasonably accurate estimate of the effective A-weighted sound pressure level to aid in the selection and specification of hearing protectors. In special situations, for example especially high- or low-frequency noises, it is necessary to use either the *HML* or the octave-band method.

Depending on the choice of a certain parameter in the calculation process, various protection performances can be obtained. It should be noted that the protection performance values for all three methods are only valid when:

— the hearing protectors are worn correctly and in the same manner as they were worn by subjects when carrying out the ISO 4869-1 test;

— the hearing protectors are properly maintained;

— the anatomical characteristics of the subjects involved in the ISO 4869-1 test are a reasonable match for the population of actual wearers.

Thus, the principal source of potential inaccuracy in use of the three methods described in this document is the basic ISO 4869-1 input data. If the input data do not accurately describe the degree of protection achieved by the target population, then no calculation method will provide sufficient accuracy.

The uncertainty of the attenuation values and ratings is described in Annex E.

NOTE Differences of 3 dB or less in the determination of the effective sound pressure level for comparable hearing protectors are generally insignificant.

