INTERNATIONAL STANDARD

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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

Reference number
ISO 4869-2:1994(E)

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4869-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

ISO 4869 consists of the following parts, under the general title *Acoustics — Hearing protectors*:

— *Part 1: Subjective method for the measurement of sound attenuation*

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

— *Part 3: Simplified method for the measurement of insertion loss of ear-muff type protectors for quality inspection purposes* [Technical Report]

— *Part 4: Methods for the measurement of sound attenuation of amplitude-sensitive hearing protectors*

Annexes A, B, C, D and E of this part of ISO 4869 are for information only.

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Introduction

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 part of ISO 4869 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 straightforward calculation method involving the workplace octave-band sound pressure levels and the octave-band sound attenuation data for the hearing protector which 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 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 reduction, 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 may, however, be advantageous 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 part of ISO 4869 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.

NOTES

1 Differences of 3 dB or less in the determination of the effective sound pressure level for comparable hearing protectors are insignificant for the purposes of distinguishing between the hearing protectors.

2 Caution should be exercised to avoid the selection of hearing protectors which provide unnecessarily high attenuation. Such devices might cause communication difficulties or be less comfortable than ones with lower sound attenuation and therefore they might be worn for less of the time.

Acoustics — Hearing protectors —

Part 2:
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1 Scope

This part of ISO 4869 describes three methods (the octave-band, HML and SNR methods) of estimating the A-weighted sound pressure levels effective when hearing protectors are worn. The methods are applicable to either the sound pressure level or the equivalent continuous sound pressure level of the noise. Although primarily intended for steady noise exposures, the methods are also applicable to noises containing impulsive components. These methods are not suitable for use with peak sound pressure level measurements.

The octave-band, H, M, L or SNR values are suitable for establishing sound attenuation criteria for selecting or comparing hearing protectors, and/or setting minimum acceptable sound attenuation requirements.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4869. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4869 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4869-1:1990, *Acoustics — Hearing protectors — Part 1: Subjective method for the measurement of sound attenuation.*

IEC 651:1979, *Sound level meters.*

3 Definitions

For the purposes of this part of ISO 4869, the definitions given in ISO 4869-1 and the following definitions apply.

3.1 protection performance: The percentage of situations for which the A-weighted sound pressure level effective when the hearing protector is worn is equal to or less than the predicted value.

The value is designated by adding a subscript to the attenuation values according to the different methods, e.g. H_{80}, M_{80}, L_{80}, SNR_{80}.

NOTES

3 The value of protection performance is often chosen to be 84 % [corresponding to the constant $\alpha = 1$ (see clause 5)]. In this case, the subscripts to the attenuation values may be omitted.

4 A situation is a combination of a particular individual wearing a given hearing protector in a specific noise environment.

3.2 effective A-weighted sound pressure level, L'_{Ax}: For a specified protection performance, x, and a specific noise situation, the A-weighted sound pressure level effective when a given hearing protector is worn, calculated in accordance with any of the three methods specified in this part of ISO 4869.

3.3 predicted noise level reduction, PNR_x: For a specified protection performance, x, and a specific noise situation, the difference between the A-