

HEARING PROTECTORS STANDARDS

Alberto Behar¹ and Willy Wong¹

IBBME, University of Toronto, 164 College Street, Toronto, ON,
Canada, M5S 3G9. alberto.behar@utoronto.ca

1. INTRODUCTION

A Standard is a written document published by a Standard institution that can be national or international. Examples of national institutions are the Canadian Standard Association (CSA) or the American National Standard Institute (ANSI) while the International Organization for Standardization (ISO) is an example of an international institution. In this presentation we will deal exclusively with standards from those three organizations.

All standards writing organizations are non-government, although they may get some funding for governmental sources. They provide mainly supporting functions (secretarial, publishing, etc.) while the writing is done by experts from the academia, manufacturers and users, all of them working ad honorem. Standards are reviewed periodically, usually once every 5 years by the same groups of experts.

Hearing protectors' standards can be divided in three groups:

- a) Measurement Standards, that deal with the characteristics to be measured,
- b) Applications Standards, that describe what to do with the results of the measurements, and
- c) Combination of both.

The principal issue with hearing protectors is to determine the sound level of the protected ear that is the sound level that reaches the tympanic membrane when the individual wears his protectors. For this purpose, what has to be measured is the hearing protectors' attenuation.

2. MEASUREMENT STANDARDS.

They describe how to measure the sound attenuation at the threshold of hearing protectors. The attenuation is defined as the difference in sound levels that elicit the threshold of hearing when the subject is protected and when he is not wearing the protector. Testing is done in a semi-anechoic room, using 1/3 octave bands of white noise at the seven audiometric frequencies between 125 and 8,000 Hz. The measurement is repeated three times on a number of subjects that vary between 10 and 20, depending on the type of protector being tested.

Thus the result of the measurement is a table containing attenuation and Standard Deviation at all 7 frequencies

Two standards belong to this category:

- a) ANSI/ASA S12.6-2008 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors, and

- b) ISO 4869-1:1990: Acoustics - Hearing protectors - Part 1: Subjective method for the measurement of sound attenuation

A variation of the above measuring process is described in:

- a) ISO 4869-3:2007 Acoustics - Hearing protectors - Part 3: Measurement of insertion loss of ear-muff type protectors using an acoustic test fixture.

This standard requires the use of an ATF, also known as an artificial head. The characteristic that is measured in this case is the insertion loss defined as the difference between the sound levels outside of the head and the one measured with the microphone contained in the device, when the protector is worn.

- b) ISO/TS 4869-5:2006 Acoustics - Hearing protectors - Part 5: Method for estimation of noise reduction using fitting by inexperienced test subject.

In this case, the test subjects are persons that have no experience in using hearing protectors. The protocol is also changed, so they do not receive instructions other than the one printed on the protectors' containers and,

- c) ISO/TR 4869-4:1998 Acoustics - Hearing protectors - Part 4: Measurement of effective sound pressure levels for level-dependent sound-restoration ear-muffs

The type of hearing protectors described here (mainly muffs) have a microphone on the outside, that captures the environmental sound level, that is amplified and fed into a loudspeaker inside the protector. The amplification is selective and it is equal to 0 when the inside noise level exceeds 85 dBA. Those protectors are useful in situations where the noise level is moderate, but can eventually exceed the 85 dBA limit. By amplifying the sound it improves the intelligibility of speech with the protector on.

3. APPLICATION STANDARDS

The standards in this group use the results from the measured standards to calculate the noise level of the protected ear in dBA.

- ISO 4869-2/Cor1:2006 Acoustics - Hearing protectors - Part 2: Estimation of effective A-weighted sound pressure levels when hearing protectors are worn - Corrigendum

This standard describes three different ways of this calculation, each one with a different precision. The more precise is also the more complex. It requires the

measurement of the ambient noise in 1/1 octave bands. The difficulty consists of obtaining a measurement that can be representative for the entire work day. The assumption being made is that the person is exposed at the same noise level and by the same spectral content continuously throughout the whole day. A second approach provides a calculation that limits the result to only three numbers that have to be combined to obtain the desired outcome. Finally, there is also the third procedure, much simpler than the previous two, where a one-number-estimate is subtracted from the ambient noise level measured in dBC.

ANSI/ASA S12.68-2007 Methods of Estimating Effective A-Weighted Sound Pressure Levels When Hearing Protectors are Worn.

This Standard also provides three methods, one of which is similar to the 1/1 octave band, mentioned above. The other two provides procedures for the calculation of two estimates. Each one is to be subtracted from the ambient noise level measured in dBA. Each one can predict the attenuation that given % of the protected population will experiment. It is recommended to be used for the upper 20% (the best protected) and the 80% for the general population. In such a way the person in charge of managing the Hearing Protectors' program in the workplace, knowing the degree

of knowledge and conscience of the personnel, can decide which number to use for the estimation of the noise level of the protected ear.

The approach in this Standard is accepted as the state of the art and it is possible that the ISO will be moving in the same direction in the near future.

4. COMBINATION STANDARD

CAN/CSA-Z94.2-02 (R2007): Hearing Protection Devices - Performance, Selection, Care, and Use.

This Standard is intended to serve as guidance to manufacturers and users alike. It specifies that the attenuation should be measured following the **ANSI/ASA S12.6-2008** Standard. It proposes two ways of calculating the noise level of the protected ear using two estimates. It is expected that in a revision that is due shortly, this Standard will follow the procedures in the **ANSI/ASA S12.68-2007**.

The Standard contains an extensive section for the user that includes information and orientation regarding the selection, care and use of the protector. In addition, there is information regarding the non-traditional protectors, their usage and application.