TESTING AND RATING OF HEARING PROTECTOR DEVICES – A REAL HEADACHE

Alberto Behar[1], and Willy Wong[1]
[1]Institute of Biomaterials & Biomedical Engineering, University of Toronto, 164 College Street, Toronto, Ontario, Canada

1. INTRODUCTION

Noise is often identified as the most common occupational hazard. Since the use of hearing protection devices (HPDs) is the popular choice for hearing loss prevention, it is easy to understand the importance of the standard CAN/CSA Z94.2 – R2007 "Hearing Protection Devices - Performance, Selection, Care, and Use" (Z94.2 further in this presentation).

Z94.2 is up for review by the Subcommittee SC1 of the Occupational Hearing Conservation Technical Committee S304 of the Canadian Standards Association. The work involves editorial changes as well as updating of the text. However, there is one fundamental issue to be sorted out: How to deal with testing and rating of protectors.

Specifying the laboratory testing procedure for the subjective measurement of attenuation of HPDs is very important, since it has a strong influence on the results. Different procedures may yield significantly different attenuation results.

The rating of the HPDs, on the other hand, provides a simple way for the calculation of the noise level of the protected ear. It is the parameter used by the safety personnel to choose a protector for a given noisy environment. Another very important HPD property is the comfort experienced by the user. However, there is no standard, Canadian or otherwise for its measurement.

Since the 1994 issue of Z94.2, new kinds of protectors have appeared. Some even operate following different principles. Examples of the new devices are active protectors, communication headsets, etc. Also, there are now systems that test the fit experienced by the individual wearer. Updating for these new products is an integral part of the review of Z94.2.

In this paper, however, we will limit to only the testing of the protectors and their rating. A very important development is expected to appear in the near future. It is the EPA's pending document on labelling of protectors [1]. It will have a huge impact on the way testing and rating are performed, impact that will be felt across the USA borders, at every place HPDs are manufactured and sold.

2. THE EXISTING Z94.2 STANDARD (R2007)

2.1 Testing

As per the existing Z94.2, protectors must be tested following procedures in ANSI S12.6 [2] that specifies two attenuation testing procedures, known as Method A and Method B.

Method A, referred to as "trained-subject fit", requires that test subjects be familiar with the protectors and their use and testing procedures. During the training phase, the experimenter actively guides the subject in achieving a good and reproducible fit through explanations of the manufacturer's instructions, demonstrations and physical assistance. For the actual testing, however, the subject must fit the HPD without assistance.

Method B, referred to as "inexperienced-subject fit", uses naïve subjects that are not familiar with protectors and their use. They must fit the protector by themselves using the instructions printed on the protectors' package. In case of earplugs available in multiple sizes, they must also select the size that is best for them based on the manufacturer's instructions.

Results from Method A are supposed to represent an optimum fitting scenario that could be accomplished by a motivated and proficient user. Method B, on the other hand, is meant to approximate realistic results for workers in hearing conservation programs.

Z94.2 stipulates that testing must be done following the Method B. However, it also accepts results from measurement performed following the now withdrawn ANSI S3.19 [3], which is performed using a direct experimenter-fit procedure.

2.2 Ratings

Z94.2 provides two types of ratings. The first one is calculated using results from attenuation testing performed as per ANSI S3.19 [3]. Accordingly, protectors are classified as "A", "B" and "C". Class "A" protectors are offering the highest attenuation. The class required is specified in Z94.2 determined according to the noise level in the workplace in such a way that the noise level of the protected ear be safe.

The second rating is the Grade system, based on a Single Number Rating, subject-fit 84th percentile (SF84), going from Grade 0 (the lowest) to 4 (the highest). The SF84 is calculated from the attenuation and standard deviation resulting from the Method B measurement procedure. When SF84 is subtracted from the noise level measured in dBC the result is the noise level of the protected ear, expressed in dBA.

3. THE EPA PROPOSAL

EPA is proposing protectors to be tested as per ANSI S12.6-2008 Method A. The result of the measurement is then used for the calculation of Noise Level Reduction Statistic (NRS) according to ANSI S12.68-2007 [4] that is different from the by now infamous Noise Reduction Rating (NRR). The difference consists in:

a) Two ratings (instead of one) are calculated, corresponding to the protection obtained by 20% and 80% of users. The NRS_{A20} corresponding to the 20% of users with the highest A-weighted noise reduction. as would be typical of highly motivated and proficient users. Most of the users (80%) will only achieve the lower value or NRS_{A80}. As an example if the two ratings are NRS_{A80} of 18 dB and NRS_{A20} of 32 dB, 20% of the users will have an A-weighted noise reduction of 32 dB or more, while 80% will have 18 dB or more.

   This, of course, creates a problem when trying to achieve an optimum selection.. Because of the large NRR spread (18 – 32 dB), there will be individuals that will be overprotected since their noise level of the protected ear will be way below the limit of 70 dBA (recommended as the lowest sound level limit to avoid overprotection). Another problem is how to make the decision of using the higher or the lower number in a given workplace.

b) The noise level of the protected ear is calculated as a difference between the ambient noise level measured in dBA and the NRS.

c) NRSs will be calculated using an ad hoc calculator, designed by EPA/NIOSH that uses a bank of 100+ workplace noises.

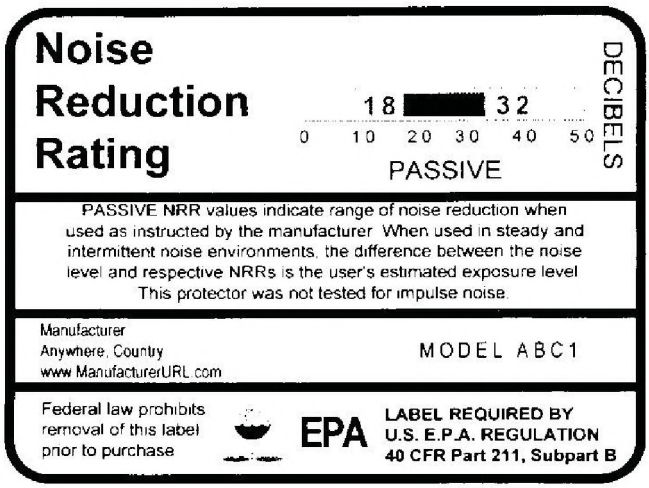

Figure 1. Example EPA Label

Manufacturers will have to label their products using a standardized, EPA designed label, as in the example shown in Figure 1. It is expected that the new EPA rule will be enacted some time in 2012.

4. THE TASK AT HAND

SC1 has now to make decisions regarding both issues: attenuation testing and protector rating.

One option is to eliminate the Class rating and to keep the Grade system. By doing so, there will be almost no changes for the Z94.2 users, since the Class rating is seldom used. However, if the EPA recommendation is approved, manufacturers will have to measure their products using the Method A. That will be the end of the Grade system, since it requires the use of SF_{84} that can only be calculated from measurement results using Method B.

The second option will be to include the existing NRR as rating. NRR was never included in the Z94.2 because of the overly optimistic and unrealistic results. However, this is the most widely used and well known rating, although many users wrongly subtract NRR from the ambient noise level measured in dBA, instead of dBC. Eventually, NRR could be derated using the NIOSH procedure.

Finally, there is the option of doing nothing and keeping both Grade and Class until the EPA comes with the new rule. All the other sections of the Z94.2 will be reviewed, since they will not be affected by the new development.

REFERENCES

[1] FR Part 211 Product Noise Labelling Hearing Protection Devices; Proposed Rule. Federal Register / Vol. 74, No. 149 / Wednesday, August 5, 2009 / Proposed Rules.

[2] ANSI/ASA S12.6–2008: American National Standard Methods for the Measuring the Real-Ear Attenuation of Hearing Protectors

[3] ANSI/ASA S12.68–2007: American National Standard Methods of Estimating Effective A-Weighted Sound Pressure Levels When Hearing Protectors are Worn

[4] ANSI/ASA S3.19–1974 (R1990): American National Standard Method for the Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Christian Giguère for reviewing the manuscript and providing most useful suggestions.