

## Hearing protection attenuation

### Is more really better?

**When choosing hearing protection, people tend to look at Table IA in Canada's hearing protection standard and declare that Class A protectors must be the best because they offer the highest attenuation — end of discussion. But this approach is full of problems, not the least of which is its potential to discourage the use of hearing protection.**

By Christine Harrison

**N**oise is the most prevalent hazardous environmental factor in industry (Phaneuf and Hetu, 1990). It is not surprising, therefore, that noise-induced hearing loss is the most common permanent occupational disease in industrialized countries (Hem and Getty, 1991). In recognition of the need to put an end to this highly preventable disease, many industrial countries have instituted hearing conservation programs, which usually contain the following elements:

- (1) identifying hazardous areas through a noise survey;
- (2) eliminating or reducing noise at the source;
- (3) posting warning signs;
- (4) providing appropriate hearing protection devices (HPDs);
- (5) providing periodic hearing tests;
- (6) educating workers as to the effects of noise exposure and the need for consistent use of HPDs for all on- and off-the-job noise exposures; and
- (7) — one that many in the hearing conservation field would add — compensating and rehabilitating workers suffering from occupational noise-induced hearing loss.

It is the fourth of these components that I will focus on — providing appro-



Photo: Courtesy of Blisom

**An active nonlinear (or electric) hearing protection device has a microphone on the outside of the earmuff, which transmits sound to the inside via a small speaker.**

priate hearing protection devices. On the surface, this may look like one of the more straightforward elements in a comprehensive hearing conservation program. It is not. In fact, because of improper selection, fewer workers are wearing their hearing protection — and thus exposing themselves to potential hearing loss — than might otherwise be the case.

#### What is an HPD?

In British Columbia, we define an HPD as a device that will "...reduce, or attenuate, the level of noise reaching the ear by blocking the ear canal or by covering the "ear" (Workers' Compensation Board of British Columbia, 1989). There are two main types of HPDs — earmuffs and earplugs.

#### What is appropriate?

The tricky part for most of us is defining and applying the concept of appropriate HPDs. *How* exactly is this determined? HPDs are rated according to Standard Z94.2, *Hearing Protectors*, of the Canadian Standards Association (CSA). The standard assigns each HPD to one of three classes of protection based solely on attenuation values: Class A, Class B and Class C. Class A protectors have the greatest attenuation, Class B less than A, and Class C less than B. Attenuation figures are obtained at independent test laboratories (usually in the United States) by the manufacturers of the products and are easily available; they are typically printed on sales brochures. The CSA hearing standard contains a "Table AI," which gives the recommended class of HPD for certain noise exposures (see Table I on page 51).

I hesitate to include this table because

too much emphasis is placed on it as the single determining factor in the selection of HPDs. Note that the noise exposure portion of the table refers to the eight-hour equivalent noise exposure of individual workers, not the noise level of pieces of machinery or equipment.

For example, an industrial chainsaw can produce sound levels in excess of 110 dBA, but due to work stoppages throughout the day, the eight-hour equivalent (also called Leq8 or Lex) is closer to 102 dBA. When reading the table, it is the "102" that applies, not the "110+."

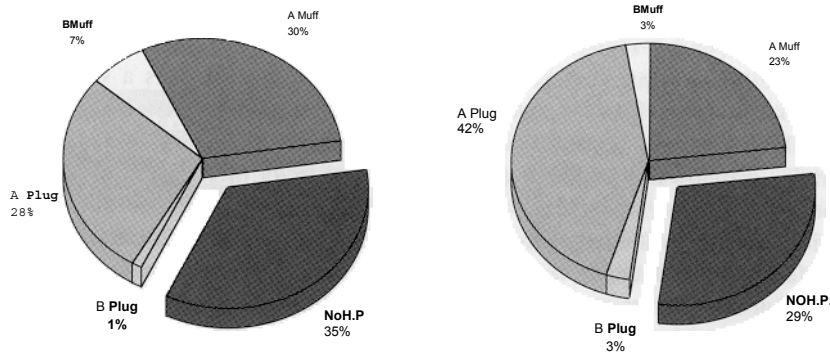
This is a very common misconception about how to use the table and has led to the inappropriate notion of "classes of noise." I have heard workers and employers refer to areas of a worksite as "Class A areas." They mean the noise level of equipment in those areas exceeds 95 dBA and, by misinterpreting the table, assume that workers must wear Class A hearing protection. The inappropriate application of this table is a constant source of aggravation for the occupational audiologists at the B.C. WCB in our interactions with industry.

There are several other items I would like to point out about the hearing protection standard:

- (1) The class of HPD is recommended, not required.
- (2) The table of recommended classes is not a mandatory part of the standard; that is, a user may disregard the table.
- (3) The standard mentions that other factors besides noise exposure should be taken into account when selecting an HPD. These include hearing loss (if any), use of other protective equipment, anatomical peculiarities (head size or shape, ear canal size or shape), and comfort.
- (4) Hearing protectors must be provided on an individualized or personalized basis.

These provisions in the standard are rarely appreciated and even more rarely applied in industry. Most people get only as far as the table and assume that since Class A HPDs have the most attenuation, they must provide the most protection. They then decree that Class A is the "best," issue it to everyone, and stringently enforce the wearing of it — end of discussion.

**Figure 1**  
**Hearing protection use**  
*(All industry in British Columbia)*



**Is this approach a problem?**

Yes! A comparison of HPD use in industry in B.C. between 1981 and 1991 helps explain why (see Figure 1 above). This information was collected during the annual hearing test that employers of the province provide to all noise-exposed workers. The records have been stored on computer since 1978. Recorded HPD use among workers is reflected by the number of workers who were tested. In 1981, 74,720 were tested and in 1991, 142,022 were tested.

While it is encouraging to see the non-use of hearing protection ("No HP") drop from 35 per cent to 29 per cent, 29 per cent non-use is still unacceptable. Note, too, the relatively low use of Class B protection in

both 1981 and 1991: eight per cent and six per cent respectively.

We estimate that 90 per cent of B.C. workers are exposed to daily equivalent noise levels (Leq8 or Lex) of less than 95 dBA. According to the CSA standard, Class B protection is recommended for this level of exposure. The use of Class C protection is so limited that we do not collect this information.

**Why are 29 per cent of workers involved in hearing conservation programs not using hearing protection?**

We have not yet been able to conduct formal research with our workers about why

**Table 1**

**Selection of Hearing Protectors**

Maximum equivalent Noise level, dBA	Recommended class of hearing protection
<ul style="list-style-type: none"> <li>Leq less than 85 dBA</li> </ul>	<ul style="list-style-type: none"> <li>No protection required</li> </ul>
<ul style="list-style-type: none"> <li>Leq up to 89 dBA</li> </ul>	<ul style="list-style-type: none"> <li>Class C</li> </ul>
<ul style="list-style-type: none"> <li>Leq up to 95 dBA</li> </ul>	<ul style="list-style-type: none"> <li>Class B</li> </ul>
<ul style="list-style-type: none"> <li>Leq up to 105 dBA</li> </ul>	<ul style="list-style-type: none"> <li>Class A</li> </ul>
<ul style="list-style-type: none"> <li>Leq up to 110 dBA</li> </ul>	<ul style="list-style-type: none"> <li>Class A plug + Class A or Class B muff</li> </ul>
<ul style="list-style-type: none"> <li>Leq more than 110 dBA</li> </ul>	<ul style="list-style-type: none"> <li>Class A plug + Class A or Class B muff and limited exposure</li> </ul>

they resist using HPDs, but I have 16 years of experience in occupational audiology and collect much anecdotal information. My sources include workers, employers, health and safety personnel, audiometric technicians, salespersons, physicians, and more. The most common complaints I hear about HPDs, from users and non-users alike, are the following:

.I cannot hear warning signals or speech. .I cannot perform the job confidently or efficiently.

.The heat and weight of the protection device is excessive (largely among ear-muff wearers).

.The HPD is incompatible with wearing other protective devices.

Yes, we have a problem — 29 per cent of workers involved in hearing conservation programs in B.C. do not use hearing protection. Furthermore, not all of the other 71 per cent are happy with the HPDs that their employers provide.

These workers receive annual hearing tests. In B.C., this also means annual counselling about the extent of their hearing loss (if any) and annual counselling about the importance of wearing hearing protection. In addition, employers must provide HPDs at their expense (Workers Compensation Board of British Columbia, 1980). What this suggests is that worker inability to pay for HPDs or the lack of knowledge about the need for HPDs cannot explain the resistance to wearing them.

**So what's wrong with these workers?**

The issue is not what is wrong with these workers, but rather what is wrong with the approach to the provision of HPDs? I submit that it is the "Class A is best" approach that is the problem. Examination of any attenuation figures will reveal that traditional HPDs are more effective at reducing high frequency sounds than low frequency sounds. If we know that both human speech as well as many machine sounds contain both high and low frequency sounds, then it follows that conventional HPDs will alter, or distort, the signal. Couple this distorting effect with the excessively high attenuation of Class A protectors, and you have a recipe for worker rejection and non-use. And the workers are reporting this loud and clear.

The contention here is that conventional Class A HPDs are not necessarily the best choice for workers. This is a concern for all workers, but even more so for workers with hearing impairments (Abel, 1992). Even without hearing protection, their hearing loss may cause speech and machine sounds to sound distorted. This problem may be compounded by the use of an HPD (Abel, et al., 1982, Berger, 1992).

### What is the solution?

First, abandon the conventional approach to the provision of HPDs. I do not advocate abandoning the so-called conventional HPD, just the rigid, non-personalized approach that is all too common. Consider each worker as an individual who requires personalized fitting of his or her HPD. Second, consider other types of HPDs. Many manufacturers acknowledge the limitations of conventional HPDs and are designing products that attempt to address communication difficulties specifically.

### What are these "new" non-conventional HPDs?

**Lower overall attenuation:** There are HPDs that provide moderate as opposed to maximum attenuation. This is not a new concept, just a recognition of the existence and potential usefulness of Class B (or even Class C) protectors. Examples of Class B protectors include earmuffs, earplugs and a type of earplug sometimes known as a canal-cap.

**Built-in communications systems:** Many manufacturers produce, or will modify, HPDs that incorporate protection along with communications capabilities. These devices can be hands-free, hard-wire, or PM wireless systems. Many types are available, using both earmuffs or earplugs.

**Flat attenuation:** Hearing protectors are available that provide equal attenuation at all frequencies — allowing the spectral, or frequency, relationship of the signal to be preserved and not distorted. Originally designed for musicians, I foresee great

potential for the application of these protectors in industry. Both custom-molded and pre-molded versions are available, with attenuations ranging from 15 to 25 dB.

**Nonlinear attenuation:** There are two types of these HPDs -passive and active nonlinear (Berger, 1992). The passive HPD usually has a sharp-edged opening that permits sound to come through. At low levels of outside noise, this protector offers a certain amount of attenuation; above a certain external noise level, usually 120 dB, the attenuation of the HPD increases. Passive non-linear HPDs are available as earmuffs or as custom-molded earplugs.

The active nonlinear HPD is also known as an electronic HPD. A microphone picks up sound outside the earmuff and transmits it to the inside of the earmuff via a small speaker. A volume control permits actual amplification of outside sounds and can be adjusted for more or less amplification. When the sound inside the earmuff gets to about 85dB, the electronics start to act as a limiting device

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and do not permit further amplification.

It is important to point out that two versions of this HPD are sold: monaural (one external microphone) and stereo (two external microphones). The stereo version should be used by workers who need to locate the source of sounds (Noble, et al., 1990).

### Why not get rid of conventional HPDs and just select one of these new types?

I stress that there is no single solution to the problems experienced by users and non-users of HPDs. Many workers are quite happy, productive and safe using conventional hearing protection. However, it is clear that a conventional approach is not suitable for everyone - in my opinion, for no one. I make a clear distinction between conventional HPDs and a conventional approach to the provision of HPDs—they are not the same.

None of the protectors I have discussed is a cure-all. All workers must

be viewed as individuals with individual needs, and I bring these newer technology protectors to your attention as options to be considered. The current CSA standard has very valuable advice in its Appendix A. I advise you to read it and take it to heart.

A very prominent figure in audiology, Dr. Aram Glorig, once said the best protector is the one which is worn. Given that there are many differences among workers, it seems reasonable to deduce that a variety of HPDs are needed to satisfy individual needs. We must expand, not reduce, the selection available to each worker.

I firmly believe that more is better - not more attenuation, but more choice.

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