Bad Assumptions About Hearing Protection

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Any good proof is based upon assumptions: if the assumptions are good, the proof is valid. If the assumptions are bad, then the proof is worthless, or as writer Angelo Donghia puts it, “Assumption is the mother of screw-up.1”

In the world of personal protective equipment, bad assumptions are hazardous and often injurious. Unfortunately, despite 25 years of solid regulation, some persistent bad assumptions are very widespread in Hearing Conservation Programs (HCPs). Here are six of the most common bad assumptions about hearing protection for noise-exposed workers. Perpetuated unchecked, these assumptions torpedo an otherwise healthy Hearing Conservation Program, and leave the door open for hearing loss among workers exposed to hazardous noise.

Assumption 1: Hearing protection is self-explanatory.

Assuming that proper use of hearing protection is fairly intuitive (“just put it in your ear…”), many safety managers provide little or no training in how to use protection properly. Or they generously assume that workers will read the manufacturer’s instructions on the packaging.

A comprehensive study of HCPs in the United Kingdom revealed when Hearing Conservation training had been provided by posters or leaflets, less than half of the "trained" workers could recall the content.2 But repeated studies show that the most effective use of hearing protection comes after one-on-one training. Large group training in hearing protection seems to have little effect in proper usage; only individual training can be linked to high attenuation results.

Proper fitting steps are not complicated. A simple three step process conveys the essence of a proper fit for foam earplugs: Roll, pull, and hold. *Roll* down a foam earplug into a small crease-free cylinder, *pull* the outer ear up and back to open the ear canal, insert the earplug and *hold* in place while it expands.

For proper fit of earmuffs, move aside any thick hair, and seat the earmuff so that it encloses the entire ear. Avoid safety glasses with thick temple bars at the frames. For safety eyewear or prescription glasses with a thin frame (a width of 2mm or less at the temples where the earmuff cushion meets the frame), eyewear causes no significant decline in attenuation. But safety eyewear with wider frames causes noticeable gaps in the cushion seal, resulting in a loss of attenuation of 5-10 dB in some cases. (For additional information, see *Earmuffs & Safety Eyewear*, a technical bulletin posted on the Howard Leight website.3)

User-friendly instructions showing how to properly wear and care for hearing protectors are found in free training materials available from the Howard Leight website [1]. "How to fit" posters and a downloadable PowerPoint presentation can be useful supplements in your own Hearing Conservation training.

Assumption 2: Any earplug in the ear is blocking some noise.

It simply isn't true. An earplug just sitting in the bowl of the outer ear, without sealing the ear canal, is simply nice ear decor — but it is offering little protection from noise. In fact, attenuation measurements show that a poorly-fit earplug often creates a resonance cavity in the ear canal, actually increasing the noise level by a few decibels (similar to cupping your hand around your ear to hear better).

This is problematic for a safety manager who is trying to judge compliance visually. He/she might assume that any earplug that can be seen in a worker's ear must be doing some good, and focus more on the workers who are wearing no protection at all. In reality, a poorly-fit earplug offers no protection, just like the worker with no earplug.

Here is one visual cue of a proper earplug fit: when viewing yourself in a mirror straight ahead (or when looking at a co-worker face-to-face), a poorly-fit earplug is clearly visible protruding from the ear canal, while a properly-fit earplug is hardly visible.

For the user, a good self-test of proper fit of earplugs is easily performed. Prior to inserting your earplugs, press the palms of your hands tightly against your ears, and say some words out loud. Your own voice sounds louder and deeper when your ears are covered. Now insert your earplugs, and repeat that voice check. If the earplugs are properly fit, there will be very little difference in the sound of your voice when you cover and uncover your ears with your hands.

Assumption 3: An earplug halfway in the ear blocks about half the noise.

It seems plausible that if a well-fit earplug blocks 30 dB of noise, then a half-fit earplug must block 15 dB of noise. Unfortunately, the math of hearing protection does not work that way. Instead, a half-fit earplug is often providing 0 dB of attenuation.

Workers in noise levels of 85-95 dB (close to the OSHA Permissible Exposure Limit of 90 dB time-weighted average) are routinely offered earplugs with Noise

Reduction Ratings of 30 dB or more. When worn properly, that 30 dB hearing protector can make the worker feel isolated — unable to hear warning signals, co-workers, machine maintenance sounds, or communication radios.

To hear critical sounds, workers will sometimes remove their earplugs about halfway, assuming they are still adequately protected. But in noise attenuation, any small channel or leak allows the noise to enter, and the protection quickly deteriorates from “all” to “none.” How do we protect a worker who does not need 30 dB of protection? Use hearing protectors with lower Noise Reduction Ratings. When used properly, a lower-attenuating earplug will provide protection without sacrificing communication ability.

In a series of research studies designed to find out why workers do not use their earplugs more consistently, NIOSH4 reports that the predominant reasons are inability to communicate (“I can’t hear my co-workers talking to me”), and interference with job performance (“I can’t hear the maintenance sounds from my machine, or warning signals”). The ideal hearing protector should not block all sound (overprotection), but rather reduce hazardous noise levels while still allowing a worker to hear the sounds that are critical to the job.

While there is no magic valve in hearing protectors that lets “good” sound in and keeps “bad” sound out, there are some hearing protectors that are more speech-friendly than others. These “uniform attenuation” hearing protectors attenuate all frequencies fairly equally, meaning speech and warning signals will sound more natural, rather than inaudible or distorted. Many users of uniform attenuation earplugs, for example, report they can still hear what they need to hear for their job performance.

Assumption 4. Cut the NRR in half to predict real-world protection.

Since the EPA promulgated its Noise Reduction Rating (NRR) on all hearing protector packaging since 1974, many studies have shown that attenuation achieved in the real-world is sometimes far below the laboratory NRR. There are a number of good reasons for this difference: users in the real-world might not receive proper training, or might adjust their hearing protectors for comfort rather than protection, or they may intentionally compromise the fit in order to hear co-workers and machine noises more clearly.

A 50 percent de-rating method, defined by OSHA to determine feasibility of engineering controls, is often misapplied to try to predict real-world protection for workers in a Hearing Conservation Program. Such de-rating is arbitrary and usually wrong!

Using a fit-testing system for earplugs, we visited eight industrial sites and measured real-world attenuation of 100 workers using earplugs from a variety of manufacturers. Workers were instructed to fit their earplugs just the same as they usually do. A Personal Attenuation Rating (PAR) was then measured on each ear. The PAR results showed that one-third of the workers achieved attenuation slightly higher than the published NRR, one-third of workers showed attenuation within 5 dB

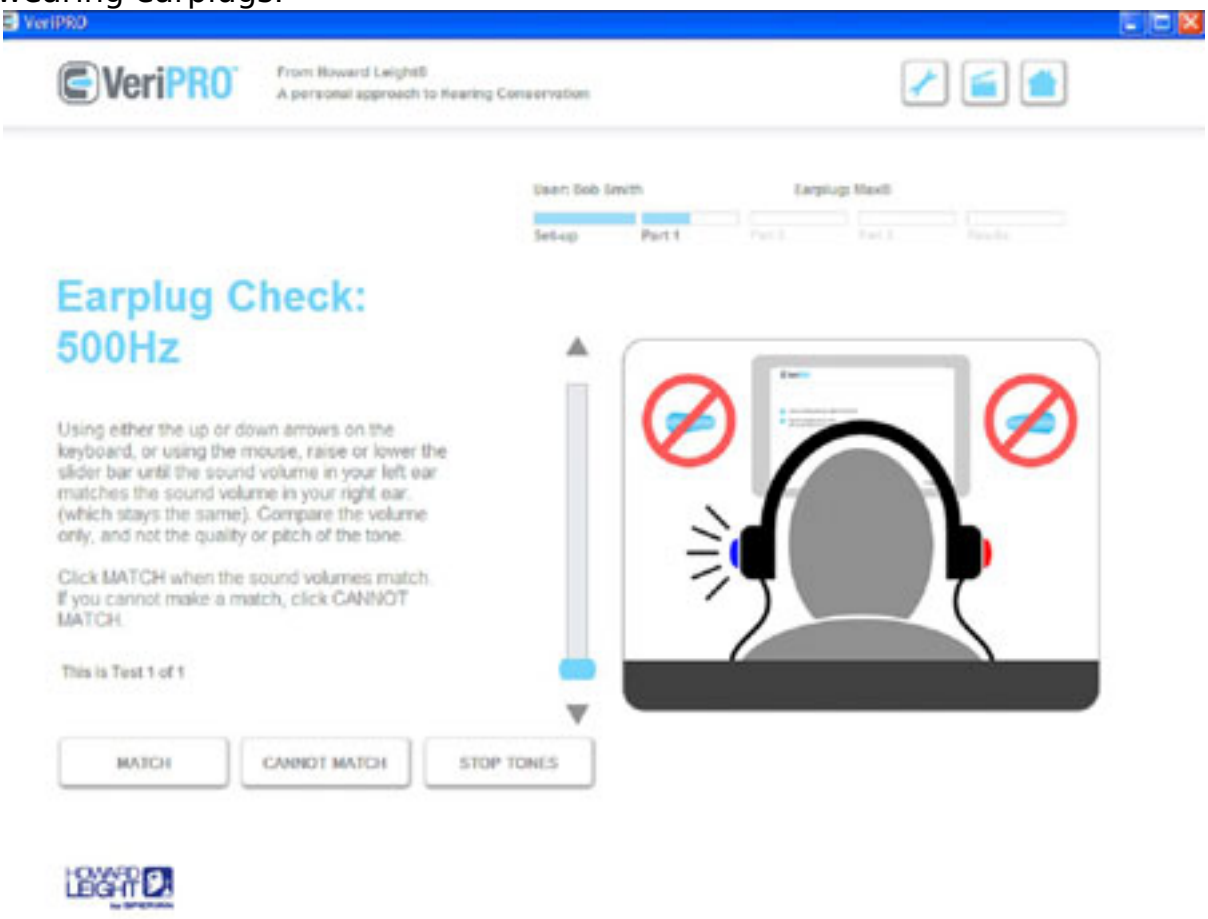
below the published NRR, and about one-third showed significantly lower attenuation (anywhere from 0 to 25 dB).

Recognizing this disparity between real-world and laboratory results, the EPA has announced its intention to update the NRR in the near future. Instead of a single-number attenuation rating (31 dB, for example), the new NRR label will likely show a two-number range of measured attenuation for a given earplug (18-29 dB, for example). The lower number indicates the expected attenuation for groups of workers with little or no training, while the higher number represents the expected attenuation for groups of workers with some individual training in hearing protector fitting.

Most experts agree that the new NRR range will provide a more realistic indicator to safety managers of how hearing protectors operate in the real world, but the new NRR still will not predict exactly how much protection an individual workers achieves. That would require individual fit testing, described below.

Assumption 5. There's no way to measure real attenuation on a worker wearing earplugs.

There definitely are several methods of measuring real-world attenuation on workers wearing earplugs.5 Instead of relying upon the population estimates of the NRR, a safety manager can now measure each worker's protection level. While each method of fit-testing has its own merits, one of the most popular methods is called VeriPRO. And as the name implies, it *verifies the protection* achieved by a worker wearing earplugs.



In the VeriPRO method, employees are given a special hearing test without their earplugs, and then repeat the test while wearing their right earplug, followed by their left earplug. The difference in the results of these three special hearing tests is a measurement of how much protection is being offered by the earplugs, *just as they were fit by the worker*. VeriPRO works with any earplug from any manufacturer, and a quiet test booth is not required to administer the test (it can be administered in a lunchroom or office).

Some workers in the Hearing Conservation Program may achieve a poor fit with the earplugs they are using. In these cases, there are two good options to improve protection:

1) VeriPRO offers short training videos showing the proper fitting techniques for nearly every style of earplug. Workers typically show an immediate improvement in attenuation when they are retested after watching the short training video.

2) Perhaps a different earplug should be tried. In a field study of real-world fit, many workers received 20-30 decibels more protection simply by trying a different earplug.6

Using a fit-test method like VeriPRO to verify attenuation, a safety manager can document exactly how much protection a worker receives with a given earplug. The result is a Personal Attenuation Rating (PAR). But that PAR is specific only to that earplug, that worker, and that particular fit. Fit-testing might not be feasible for some employers to administer on every noise-exposed worker in the facility, but it is certainly feasible for new hires, or workers demonstrating a significant threshold shift in their audiometric testing. OSHA regulations require these workers to be retrained and refit with appropriate hearing protection, and the fit-test systems available now allow employers to accomplish that very effectively.

Assumption 6. There's no way to measure the noise dose of a worker under the hearing protectors throughout their workday

Ideally, the best way to know if a worker is protected from hazardous noise is to take a noise dosimetry measurement *under* the hearing protectors — that is, place a microphone at the eardrum. This concept of in-ear dosimetry is now available in a product called QuietDose.

Noise dosimetry is typically measured by clipping a microphone on the collar of a noise-exposed worker. The dosimeter samples the noise levels throughout the day, and accurately gives a reading at end of shift showing the noise dose of the worker for that day. A dose over 100 percent exceeds OSHA's Permissible Exposure Limit of 90 dB for 8 hours, while a noise dose of 50 percent is defined by OSHA to be the Action Level at which Hearing Conservation measures are implemented. But such ambient dosimetry measurements tell us nothing about the noise level reaching the eardrum under the hearing protectors.

QuietDose uses dual miniature microphones, each inserted under the earplug or earmuff, to measure the noise dose at the eardrum. If a worker has a proper fit of

the hearing protectors, the noise dose will be safe — under 50 percent for the workshift. But if the worker has an inadequate fit, or removes the protectors repeatedly in high noise, the resulting noise dose at the end of the workshift will be excessive. This immediate feedback gives the worker (and safety manager) the critical information to make immediate corrections. In a typical Hearing Conservation Program, it takes several years of audiometric testing to ascertain whether a worker has lost hearing due to workplace noise. But using in-ear dosimetry, any worker can know immediately and precisely whether hazardous noise levels are reaching the eardrum. And if we can stop the noise exposure at the eardrum, we have stopped the hearing loss.

Bad assumptions sink many well-intentioned safety initiatives. But avoiding these simple bad assumptions about hearing protection helps a Hearing Conservation Program stay on solid ground, and do just what it is designed to do: prevent noise-induced hearing loss.

About Brad K. Witt, MA, CCC-A

Brad Witt is the Director of Hearing Conservation at Sperian Hearing Protection in San Diego, CA. He has a B.S. in Communication Disorders from Brigham Young University, and an M.A. in Audiology from Northwestern University. For fourteen years, he managed a hearing conservation practice in California, providing OSHA-standard services at 175 locations. He has served as President of the National Hearing Conservation Association (NHCA), and in his present position, manages the Acoustical Laboratory at Howard Leight, and provides training to professional groups in all aspects of hearing conservation. His 150+ hearing conservation seminars in behalf of Sperian Hearing Protection the past three years have been presented in fifteen countries.

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1. *NY Times*, 20 Jan 1983.

2. “Behavioural studies of people’s attitudes to wearing hearing protection and how these might be changed.” Research report 028 of the Institute of Occupational Medicine (2002), Edinburgh, UK.

3. http://www.howardleight.com/bestpractices/educate [2]

4. Morata, Thais, “Issues of Hearing Protection Devices Used in Manufacturing and Mining,” viewed at http://www.cdc.gov/niosh/topics/noise/pubs/presentations/MorataASA2003.ppt

5. See *Fit Testing Ear Plugs* by L. Hager in June 2006 *OH&S*.

6. B. Witt, *Why are Joe’s Earplugs Working?* Presentation at the 32nd annual conference of the National Hearing Conservation Association, February 17, 2007,

Savannah, GA.

Links:
[1] http://www.howardleight.com/
[2] http://www.howardleight.com/bestpractices/educate