

JobHealth Highlights

Technical Information for Occupational Health and Safety Professionals

Tinnitus and Hearing Protection: Fiction and Fact

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I pulled the trigger. My ears have never been the same since. All I could hear was ringing, constant, infuriating ringing, all the time, ringing, ringing, ringing. No matter what I did, where I went, who I was with, ringing. That one brief instance changed me forever.....

One brief instance, one unprotected gun shot, airbag deployment, or firecracker explosion can cause hearing loss, tinnitus, or both, which for some will become a permanent and devastating life-changing experience.

Sure, I have ringing in my ears all the time. It seems like I've had it all my life. I hardly notice it. It does seem to get louder after I have been around a lot of background noise. Once in awhile it keeps me awake at night, but I don't really think about it much.

A much more common story - adapting to life with tinnitus while challenging for some is merely a nuisance for others. Each person's tinnitus and circumstances are unique, but what is true for all those with tinnitus is that having good hearing protection options can make life in our noisy world more comfortable. And for those who don't have tinnitus, proper use of hearing protection may be the answer to remaining "tinnitus free" for life.

Misinformation and misconceptions about tinnitus and hearing protection are plentiful, so an overview of *fiction* and *fact* is a good place to start our discussion. While not an exhaustive list, Table 1 summarizes some common issues that are further explained below. First, a definition: tinnitus is a generic word for the perception of sound that is not associated with actual physical acoustic energy. It seems to come from inside the head and lasts for at least a few minutes at a time. It is commonly described as

ringing, chirping, roaring, buzzing, whooshing, hissing, frying bacon, peeping or something similar.

No one understands my tinnitus...

Actually, tinnitus is more common than you might think. Estimates suggest that from 6 – 17% of the population, or perhaps as many as 50 million Americans, have tinnitus. A much smaller percentage (about 3 - 7% of the general population) is bothered by tinnitus enough to seek medical attention. An even smaller percentage of people consider their tinnitus so debilitating that it keeps them from leading a “normal” life.

Chances are good that if you start asking your family members and friends, you will discover someone who has tinnitus and who can relate to your experience. People who have hearing loss, particularly noise-induced hearing loss, and the elderly population, are more likely to have tinnitus. A notable national organization dedicated to helping those with tinnitus is the American Tinnitus Association (ATA). Visit www.ata.org for current resources and to locate a local support network.

Disease or symptom?

Tinnitus is an indicator of abnormal function, but it is not a disease in and of itself. In this way it is similar to headache, elevated blood pressure, or dizziness, each of which signals something is wrong with the body, but none is a disease. Although tinnitus has been studied extensively, the cause and mechanics of tinnitus are not well understood. Because the ear detects sound and the brain processes it, it is generally accepted that both the hearing mechanism and the brain are involved with the origination of tinnitus. Some believe tinnitus is extra activity of the auditory neurons – in the nerve pathways of hearing. Tinnitus is often associated with certain medications, but interestingly having tinnitus is not more common among people who consume caffeine, nicotine, or alcohol. Things like the condition of one's health, noise exposure, and the degree of hearing loss are all correlated with the presence and the severity of tinnitus.

Tinnitus and hearing loss

Hearing loss and tinnitus often occur together, but tinnitus is not a *cause* of hearing loss. However, tinnitus may be an early indicator of damage to the auditory system, showing up before a loss of hearing is obvious. Certain ear diseases or conditions are more likely to exhibit accompanying tinnitus than others. People who have a history of loud noise exposure, Meniere's disease, otosclerosis, age-related hearing loss, sudden hearing loss or a benign growth on the hearing or balance nerve are at high risk of also having tinnitus. It is advisable for those with tinnitus and/or hearing loss to see a physician and audiologist to diagnose the condition and to explain treatment and management options. For those with a sudden onset of tinnitus or

hearing loss, the sooner you receive medical intervention the better the chances are for recovery.

Living with tinnitus

Most people learn to live with tinnitus without any treatment. However, for a small percentage, tinnitus is such a chronic and unpleasant experience that seeking relief is essential. Hearing the message from a healthcare provider, “there is nothing you can do about it, just learn to live with it,” can be devastating. True, there is no cure today for tinnitus, no magic pills, surgery, or diet to silence the internal, unwanted sounds, but there is hope for treatment and/or management of the condition. Initially, an evaluation should be conducted to identify the underlying condition causing the tinnitus. If this condition can be medically or surgically treated, then the tinnitus may be substantially improved or eliminated. In circumstances where there is no medical treatment available, as in the case of tinnitus arising from permanent noise-induced hearing loss, there are still options available to help manage the tinnitus. The two basic approaches are: 1) lessen the awareness of the tinnitus and 2) relieve the stress and negative emotional reactions that it triggers. Some tinnitus therapies utilize both strategies by incorporating counseling, education and the use of competing sound intended to distract one from constantly hearing the tinnitus. The overarching goal is to return to the pre-tinnitus quality of life.

Unfortunately, many studies have concluded there isn't one best treatment option. It isn't uncommon for people who are desperate to find help to fall prey to advertisements and false promises. Consulting a professional organization of audiologists or physicians with specialty training in tinnitus treatment is recommended. See Table 2 for more information.

Tinnitus and hearing protection

Exposure to loud noise is one of the most common causes of hearing loss and chronic tinnitus. Generally speaking, the louder the noise and the longer the time of exposure, the greater the risk for hearing damage (noise-induced hearing loss) and its common side effect: tinnitus. Proper use of hearing protection when you are exposed to loud noise is essential – *especially* if there is some hearing loss and tinnitus already present. You should use hearing protection whenever it is so loud you must shout in order for the person next to you to hear you clearly (roughly 85 dBA), and especially in the presence of high-level impulse noise such as that produced by gunfire or explosions. Because loud sound can aggravate existing tinnitus, it may be advisable to use hearing protection at lower noise levels, for example when you have to talk loudly for the person at arms length from you to understand (roughly 80 dBA).

Which hearing protector?

Not all hearing protectors are created equal. With many options of styles, colors, and materials, selection can be a bit overwhelming. Basic types of hearing protectors are “roll-down” foam earplugs, push-to-fit foam earplugs, flanged or premolded earplugs, custom-made earplugs, “banded” earplugs and earmuffs.

- Traditional foam earplugs require some skill to insert properly since they must be rolled into a small cylinder before they are inserted into your ears. However, they are forgiving and, even when not inserted optimally, can provide a reasonable noise-blocking seal. If worn correctly, traditional foam earplugs tend to be the most comfortable and effective style of earplug, providing noise reduction that rivals high-attenuation earmuffs.
- Push-to-fit foam earplugs are easier to use than traditional foam since they don't need to be rolled before inserting them into your ears, yet they can provide similar levels of comfort and protection.
- Premolded earplugs are made of an elastic material that can be washed and reused for a longer time than foam earplugs. Although they can seal well, they tend to be somewhat less comfortable and less protective than foam earplugs. They can't usually be inserted as deeply as foam earplugs without discomfort, and they require repositioning to maintain the acoustic seal in the ear canal.
- Custom-made earplugs are much more expensive than non-custom types and, contrary to intuition, are usually not the most protective. Even so, for some applications and individuals, custom-made earplugs may be a great choice for comfort, ease of use, and adaptability.
- Banded (also called concha seated and semi-aural) earplugs are primarily intended for intermittent-use applications since they easily store around the neck while not in use.
- Earmuffs are easy to use, quick to put on and take off for short-term exposures and provide warmth, which is welcome in cold environments. Also, earmuffs are an ideal solution for people who object to putting something inside their ears.

You may have to experiment among different types of earplugs and earmuffs to find what is best for you. The “right choice” is the one which blocks sound, is convenient to carry with you, and is comfortable enough to wear consistently. It isn't necessary to buy the most expensive product because effective protection can be achieved with simple, less expensive options. To ensure that you are choosing devices designed to reduce your noise exposure, look for the Noise Reduction Rating (NRR) on the product packaging. Products with an NRR have been developed, studied, and objectively measured using scientifically accepted laboratory procedures. These products are preferable to make-shift devices like cotton balls or wadded-up paper that allows hazardous sound to penetrate into the ear. However, don't get hung up on the actual NRR; small differences between NRRs of 4 or 5 decibels (dB) won't make a significant difference in the overall performance.

Most important for good performance is how well you fit the product to your ear; the better the fit, the greater the protection. A poor fit means less protection due to air leaks, or worse, no protection if the earplugs stay in your pocket instead of your ear. As a rough guide, you can presume that devices with NRRs of 29 dB and greater are capable of providing the highest possible protection. Those with NRRs of 16 dB and lower are likely to provide modest protection. The lower values of protection are often quite sufficient (and even preferred) for common recreational exposures other than shooting or the loudest of rock concerts.

Learning to fit your ears with hearing protectors is made easier with demonstrations. Visit

www.e-a-r.com/hearingconservation/video_main.cfm for short instructional videos on fitting earplugs. An in-depth brochure called *Tips and Tools for Fitting and Using E•A•R™ Foam Earplugs*, applicable to all brands and types of roll-down foam earplugs is available at www.e-a-r.com/hearingconservation/booklet_main.cfm. Other types of hearing protectors also require correct use. See EARLog 19 for numerous suggestions on a broad range of products www.e-a-r.com/hearingconservation/earlog_main.cfm.

Hearing with hearing protection

Hearing protectors block the external sound from entering the ear but don't totally stop all sound from getting through. Conventional hearing protectors filter out more of the high pitches than the low pitches, which alters the sound quality. Furthermore, the sounds inside the head seem different to you when you are wearing hearing protectors; your voice and body sounds become fuller, boomy, hollow-sounding, and muffled. This is called the occlusion effect. To experience this, try sealing your earcanals with your thumbs and read this sentence aloud while listening to your voice. Fitting the hearing protectors more deeply in the earcanals will minimize the occlusion effect and the sound will be more natural.

More is better?

Not always. People use hearing protection for many different reasons and in many environments: to protect hearing from hazardous occupational noise, while shooting firearms, to improve their ability to concentrate on reading in an airport, or perhaps to sleep during the day when neighborhood children are playing outside. Some of these situations require hearing protection to reduce noise to a safe level, but others simply use hearing protection to block out unwanted or annoying sounds. Interestingly, people with tinnitus often rely on background noise to interfere with the sound of the tinnitus. Limiting the background noise with hearing protection may make the tinnitus seem more noticeable. This is likely to be more of a problem in low-noise environments or with hearing protectors that provide more noise reduction. When noise is loud enough to require hearing protection for safety reasons (greater than 85 dBA), the hearing protection can block hazardous noise while still allowing enough sound to pass to still provide distraction from the tinnitus. Remember, changes to the awareness of the tinnitus due to the use of hearing protection are temporary; using hearing protection appropriately will prevent long-term noise-induced damage and potential worsening of the tinnitus.

The amount of noise reduction needed depends on both the purpose for using hearing protection and the background noise level. To decide if “more is better” think about the reason you are using hearing protection and choose a product that works for that specific environment. Many noise exposures only require about 10 dB of noise reduction for adequate protection from noise damage. So, unless you simply prefer the extra quieting that maximum noise reduction will provide, you can choose a product with lower noise reduction and not be troubled by being isolated from the sounds around you.

An excellent choice for taking the edge off of annoying sounds while still allowing easy communication is the ER-15 Musicians Earplugs™ (see www.etymotic.com). Although more expensive, at over \$100/pair, this custom molded earplug is comfortable to wear and sounds more natural because it reduces all pitches of sound equally and avoids the muffling effect so common with conventional products. An alternative, much less expensive product (about \$15/pair), is a “one-size-fits-most” flanged earplug that can be purchased off the shelf – E•A•R™ Hi-Fi earplugs (also called ER-20 earplugs). Like the custom ER-15, the Hi-Fi earplugs are intended for adequate and not maximum protection and thus are ideal for music exposures and many public entertainment events.

Another popular approach to controlling unwanted noise is *active noise reduction* (ANR; sometimes also called noise cancellation). This method depends on electronics to process the sound that travels through the hearing protector. The sound

is modified and reintroduced through a small earphone that partially cancels the incoming sound. This technology works well for low-frequency sound below about 400 Hz, such as the loud rumbling engine noise inside aircraft or military vehicles. It has many commercial and military applications. For consumers who want enhanced listening experiences, ANR is most often used in earphones or earplugs that can be coupled to listening devices. Such devices are useful for enjoying music or sound tracks while reducing unwanted noise in an aircraft cabin or subway car. If a high degree of noise protection is needed, less-expensive non-electronic insert earphones (i.e., earplugs) that seal well in the earcanal can be used instead of an ANR device.

Life can be loud...

Make sure you are getting the protection you need. If immediately following a noise exposure you experience increased or sudden onset of tinnitus, or if your hearing seems muffled or fuzzy, the noise was too loud. Regular exposures like that will probably lead to hearing loss and/or permanent or increased tinnitus. Since you can't always predict when you will be exposed to noise, keep your hearing protection handy, just like you might carry a pair of sunglasses. Having appropriate hearing protection options for different listening situations is also helpful. Earplugs are small, lightweight, and easy to store in a pocket or travel bag. You can even bring an extra pair or two for someone else who is caught unprepared. After all, the fact is replacing earplugs is easy, but replacing hearing is still fiction.

Table 1 – Tinnitus: fiction and fact	
FICTION	FACT
No one can understand how bad my tinnitus is.	Tinnitus is more common than you think. Start talking to others and you are likely to find someone close to you who has a similar experience.
Tinnitus is a disease.	Tinnitus is a symptom.
Tinnitus causes hearing loss.	Tinnitus commonly accompanies hearing loss, but is not the cause of hearing loss.
Nothing can be done about tinnitus. One just has to learn to live with it.	There is no tinnitus <i>cure</i> , but <i>something</i> can be done. Sometimes the underlying condition causing the tinnitus can be medically treated. Or, as is the case for noise damage, there are a variety of management approaches that can provide tinnitus relief.
I already have tinnitus, so I don't need to protect my hearing.	Using hearing protection can prevent the onset or aggravation of tinnitus and hearing loss.
All hearing protection is the same.	There are many different types of hearing protection, and the "best" one may be different for each person.
The higher the number on the hearing protection package, the better.	The degree of sound reduction varies, depending on many things, including how well the hearing protector fits the ear. The number on the package is not the only thing to consider when choosing the best protector for you.
Using hearing protection will make my tinnitus worse.	Tinnitus may <i>temporarily</i> be more apparent while wearing hearing protection, especially with hearing protectors that provide higher noise reduction and/or in lower ambient noise. But hearing protectors may help prevent the noise from permanently making the tinnitus worse with time.
More noise reduction is always better.	The hearing protection choice depends on the purpose for using it and the background noise level.

Table 2 - Tinnitus and hearing protection resources	
American Academy of Audiology	www.howsyourhearing.org
American Speech-Language-Hearing Association	www.asha.org/public/hearing/Tinnitus-Management
American Tinnitus Association	www.ata.org
American Academy of Otolaryngology-Head and Neck Surgery	www.entnet.org/HealthInformation/tinnitus.cfm
3M hearing conservation and hearing protection fitting information	www.e-a-r.com/hearingconservation
Etymotic Research, Inc. (high fidelity earplugs)	www.etymotic.com/ephp/er20.aspx
National Institutes of Health	www.nidcd.nih.gov/health/hearing/tinnitus
National Hearing Conservation Association	www.hearingconservation.org
Oregon Hearing & Science University Tinnitus Clinic	www.ohsu.edu/xd/health/services/ent/services/tinnitus-clinic/index.cfm

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