

**Life Can be Loud -
Remember Your Hearing Protection**

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As a reader of *Tinnitus Today* you probably have more than a passing acquaintance with noise and its aural aftereffects. Not only can noise cause hearing loss, but tinnitus too. The two often go hand in hand. Noise usually exacerbates tinnitus. Many of us strive to avoid dangerous noise (generally accepted as regular exposure to sound levels above 85 dBA), but that is often impossible. Our daily activities often involve sound levels, sometimes just for short periods of time, that exceed accepted safe exposures or our own tolerance levels. Frequently tinnitus sufferers such as myself, find that even brief exposures above 85 dBA temporarily worsen tinnitus, especially in the case of impulsive sounds like hammering a nail or the applause of a live audience. An effective, although inelegant and inconvenient solution, is to put our fingers in our ears, which essentially creates about a 25-dB hearing protector.¹ A preferred alternative is a bona fide personal hearing protection device (HPD), generally an earplug or earmuff, or as an alternative, a semi-insert (earplug or pod-like tips on a lightweight spring-loaded band).

Today, more than ever, there are a wide variety of hearing protectors available in both consumer and professional markets. Following are a few ideas that I would like to share to help you choose and use those devices most effectively.

1. **Hearing protectors must be comfortable and well fitted.** You may have to try different types to find what is best for you. Be sure to carefully read the instructions and practice proper insertion. Two of the most common consumer complaints I receive about foam earplugs are “they don’t block enough sound,” and “they don’t stay in.” Nine times out of ten the reason for both is incorrect fitting. The goal is a proper, very tight and crease-free roll down, accompanied by a pinna pull to facilitate a full insertion well into the earcanal (see illustration). This takes practice. Without it, you will still get protection, but the fit is not as comfortable or secure, the noise attenuation not as great, and the occlusion effect more annoying (see item 6. below). 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 <http://www.aearo.com/html/industrial/tech01.asp#plug>.

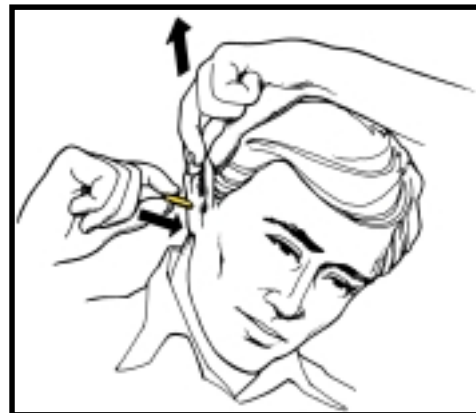


Illustration of the correct method of pulling the pinna (outer ear) by reaching over the head with the opposite hand to the ear being fitted.

Other types of HPDs also require correct use. See

¹ Did you ever need immediate and brief hearing protection with only one hand free? Reach over your head with your free hand to use a finger to block the opposite ear while lifting the shoulder of that same arm to press against and seal the ear that it naturally contacts.

E•A•RLog 19 for numerous suggestions on a broad range of products
<<http://www.aearo.com/html/industrial/tech01.asp#earlog>>.

2. **Don't get hung up on the Noise Reduction Rating (NRR)**, the government-mandated noise protection factor that must appear on all HPDs. It is based on optimized laboratory-based tests that, in practice, represent what only a few of the most motivated and best-trained users can achieve. During the test, the devices are worn for only brief periods, comfort is irrelevant, and especially for earplugs most users will rarely achieve the test results in practice. Unfortunately NRRs don't even necessarily rank order products in an appropriate manner. This means that small differences in NRRs, less than 4 or 5 dB should definitely be ignored. The more rigorous you are about fitting, the closer your achieved protection will approach the NRR, which is intended to indicate the approximate reduction in decibels (dB) of the overall sound level that the device can provide to those wearing the device in an optimal manner.

Your best bet is to simply use the NRR as an indicator that a product was designed for and tested for noise reduction. As a rough guide you can presume that devices with NRRs of 29 and greater are among those providing the highest possible protection, and those with NRRs of 16 and lower 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.

3. **The choice between an earplug and an earmuff is generally one of personal preference or ergonomics**, as both types, when well fitted, can block sounds similarly. However, the better earplugs typically outperform the better earmuffs at the lower frequencies, which are those below approximately 250 Hz, or in musical terms, middle C on the piano. Earplugs are of course more portable and less conspicuous to use in public places. Earmuffs are easier to put on and take off for short-term exposures, and for those who are averse to the idea of putting something in their ears, a more desirable solution. Semi-inserts are a compromise between the two, usually not as protective as plugs, but easier to don and doff, and convenient to store around the neck when not in use. The key is to use something that you like and fits your lifestyle.
4. **There are many basic styles of earplugs.** In the consumer market, those products that I am often asked about include roll-down foam (the foam is rolled into a tiny cylinder and inserted in the ear canal where it expands in place), premolded rubber-like plugs (usually with multiple flanges or sealing rings), formable wax or silicone slugs (the slug is pressed into the entrance of the ear canal), and custom-molded plugs (wherein a liquid with the consistency of thick honey is injected into the ear to make a custom-shaped device). Although all can work and block sound, there are a few things to keep in mind.

Foam plugs, as noted above, require some skill to insert properly. However, they are forgiving and even when not inserted optimally will provide a reasonable noise-blocking seal, though one that is not as secure or effective as otherwise could be achieved. Overall, they tend to be the most comfortable and effective style of earplug, providing protection equivalent to high-attenuation earmuffs.

Premolded plugs can also seal well, but as a group tend to be somewhat less comfortable and protective. Unlike foam plugs that can be inserted very deeply with little discomfort, deeper and more protective fittings of premolded earplugs tend to be less acceptable. Formable plugs made of wax or silicone can only seal at the entrance of the canal. This both limits the noise exclusion they can provide, primarily in the low frequencies, and also creates a large occlusion effect as discussed in 6, below. Custom earmolds, which can be among the most comfortable of earplugs, are more expensive, and contrary to intuition are not normally the most protective. Taking a good impression and making a well-fitting mold requires training, skill, and attention to detail.

5. **When worn in moderate noise HPDs will make tinnitus more apparent** for those who already experience it, since the ambient noise that normally partially masks the tinnitus will be substantially eliminated by the noise reduction of the HPD. However, in higher noise levels enough sound will usually penetrate the hearing protector to provide a degree of masking or covering up of your tinnitus. Use of the HPD will help keep the noise from worsening the tinnitus, and once the protector is removed the masking provided by ambient sounds will immediately return.

6. Whenever you properly fit an earplug or earmuff you will experience a change in the perception of your voice and body sounds. They become fuller, boomier, or hollow-sounding, and muffled. This is due to the **occlusion effect** (OE) which is easily demonstrated by sealing your earcanals with your thumbs while reading this sentence aloud. The OE is both a nuisance to HPD wearers, that can be minimized by proper selection and fitting (deeper-seated plugs reduce the OE), and an aid to wearers to use as a fit test; its presence indicates a proper seal. See E•A•RLog 19 for more information <<http://www.aearo.com/html/industrial/earlog.htm>>.

7. Many noise exposures only require 10 dB of noise reduction, so **don't overprotect** with very high attenuation products unless you simply prefer the extra quieting they provide, and won't be troubled by the greater degree of isolation they will create between you and the sounds around you. An excellent, but expensive product I often wear is the ER-15 Musicians Earplug™ (cost in excess of \$100/pair, see <<http://www.etymotic.com/>>). This custom molded earplug requires two trips to an audiologist to create and fit, but in return provides a very comfortable, truly high-fidelity hearing protector that blocks sounds equally, regardless of their pitch, to avoid the muffling effect so common with conventional products.

An alternative, much less expensive one-sized product (about \$10/pair), with nearly equivalent sound

quality can purchased off the shelf - Professional Musician E•A•R® Plugs

<<http://www.aosafety.com/hbc/music.htm>, or <http://www.etymotic.com/>>. Like the ER-15 it avoids excessive protection and is ideal for music exposures and many public entertainment events.

8. Tinnitus sufferers sometimes turn to “high-technology” solutions such as earmuffs that incorporate **active noise reduction** (ANR; sometimes also called noise cancellation). This method takes sound picked up underneath the earmuff cup and processes it so that it can be reintroduced via a small earphone to actually cancel the incoming sound. The applications are limited and only effective for low-frequency sound below about 400 Hz, such as the loud rumbling engine noise inside a light aircraft.

Another application for ANR is in earmuffs designed to provide an earphone listening experience while reducing nuisance noise. Such devices are useful for travel applications such as in commercial aircraft when you want to listen to music or the movie soundtrack while at the same time reducing the sound of the noise in the cabin. However, for a high degree of noise protection, ANR offers little that can't be achieved with a conventional and much less costly passive (non-electronic) device.

9. **Listen to your ears** to make sure you are getting the protection you need. If, immediately following a noise exposure you experience increased tinnitus, or for those blessed with normally quiet ears, you experience the onset of tinnitus, the noise was too loud for your ears. Regular exposures of that nature will likely lead to hearing loss and permanent or increased tinnitus. Another, post-exposure effect that indicates inadequate protection is if your hearing seems dulled or your ears feel full after an exposure. Again, the indication is that the exposure was too great and there is potential for permanent effects. In such cases you should re-check how well you fitted your hearing protection, and/or consider using a more protective product, and if you still experience noise aftereffects, reduce the severity, duration, or repetition of your exposures.

Once you have selected a hearing protection device and learned to wear it properly, the key is to have it available when needed. Since you can't always predict when you will be exposed to noise, keep your HPDs handy, just like you might carry a pair of sunglasses. Obviously this type of use dictates an earplug-type of device due to its portability. I find foam plugs are small, lightweight, and easy to store in jacket or pants pockets or a travel bag, and if lost the cost for replacement is trivial. However, many times they are more protective than I require and so I like to also have available one of the low-attenuation “high-fidelity” protectors such as a Musicians earplug as well. My goal is to assure that I always have handy the protection I need, when I need it.

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