



# Hearing-Loss Prevention

Earmuffs and earplugs provide inexpensive protection from job-site noise

by Ron Joines

**Get in the habit of wearing hearing protection.** As with safety glasses and respirators, the biggest hurdle with hearing protection is remembering to put the things on. The earmuffs in the photograph have a noise-reduction rating of 27 decibels.

It's the end of a long day on a noisy finish-carpentry job. While trimming the laminate on a new countertop, your partner says, "Hand me the trout, eh?"

"What?" you say, incredulous, a perplexed look on your face. He's finally lost his mind, you think.

"The router," he says, louder this time. "Pass me the router."

Turns out he hasn't lost his mind but, rather, that you've lost a little of your hearing. You may be experiencing one of the early signs of noise-induced hearing loss, or NIHL. This type of hearing loss can be due either to long-term or to short-term exposure to high noise levels. One of the first signs of NIHL is an inability to distinguish common consonant sounds—in the example above the difference between an *r* and a *t*. As a result, people with NIHL usually recognize spoken words as garbled rather than as lower in volume. A word like *fist* may sound like *fish*.

There are no effective medical treatments for noise-induced hearing loss. Excessive noise damages the small hair cells that line the inner ear. This loss is usually permanent because, unlike most tissues in the body, the hair cells lining the inner ear do not grow back.

Hearing aids and other devices that amplify sound may not result in better understanding of speech if you have NIHL, just louder confusion. There are, however, effective alternatives to losing your hearing. Many inexpensive and simple methods exist both to prevent and to minimize hearing loss due to noise (photo facing page).

**Noise on the job site**—Recent estimates suggest that between 7 million and 10 million people work at jobs that expose them to hazardous noise levels. Many of these jobs are in the construction industry. Because of the magnitude of and the potential for work-related NIHL, the Occupational Safety and Health Administration (OSHA) has established guidelines for acceptable levels of noise exposure.

In the construction industry, OSHA considers exposure to an average of 90 decibels (db.) for an eight-hour workday to indicate the need for a program to protect against hearing loss (sidebar right). The OSHA-permitted duration of exposure to different noise levels without hearing protection is presented in Table 1 (top chart p. 76). As you can see, the amount of time considered to be safe decreases by one-half with every 5-db. increase in sound intensity.

Even at the level of protection mandated by OSHA, it is estimated that as much as 20% of the population still may experience some degree of hearing loss. This is because some people are more sensitive to loud sounds than others. So do not regard this table as the gospel; it merely represents general guidelines. When you calculate your safe-exposure time from this table, it is extremely important to be conservative.

Table 2 (bottom chart p. 76) compares the intensity of sound produced by many of the noise sources present on a job site. For reference, the intensities of some common sounds also are presented. The most widespread offenders in construction are power tools, compressors and

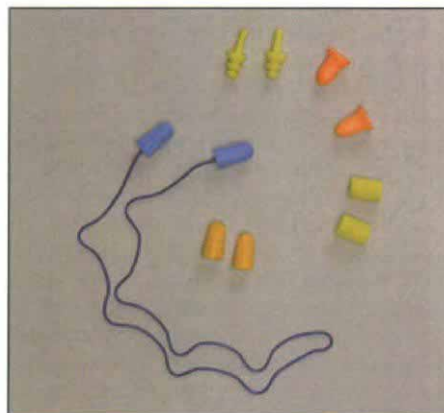
### **The science of sound and hearing loss**

Loudness levels are measured on a logarithmic scale called the decibel scale (db.). The lowest level on this scale, 0 db., was established at the lower level of human hearing. Zero db. does not mean that no sound is present but that most people are unable to hear it. The intensity of sounds measured on the decibel scale increases exponentially. For example, a 90-db. sound is 10 times as loud as a 80-db. sound. This exponential scale is used because the loudest sound that you can hear is more than 100 million times more powerful than the faintest sound your ears can detect.

Loud sounds can result in ear pain, ringing in the ears, dizziness and hearing loss. Injury due to loud noise can be temporary or permanent, depending on a variety of factors. One factor is the recovery time between injuries caused by loud noises. Our hearing typically takes from several minutes to several days to repair itself after exposure to loud noise.

Generally, the louder the sound that caused the damage, the longer the rest time it takes for hearing to return to normal. Most day-to-day noise overexposures go unheeded because the ringing in your ears or the dullness of your hearing returns to normal. You may have noticed this situation when you experience ringing in your ears after using a belt sander for 15 or 20 minutes. When overexposures occur repeatedly, they can add up, and no amount of rest will restore hearing.

Sound intensity is also a factor. Bursts of noise louder than 140 db., such as explosions or violent steam releases, can cause permanent damage after only a single exposure.—R.J.



**Earplugs are effective and inexpensive.** Earplugs fit into the ear canal. Premolded, flanged earplugs are shown at the top of the photo. The other plugs, including some corded plugs that can be worn around the neck when not in use, are soft, expandable foam.

earth-moving equipment. Do not forget radios and tape players; the volume often gets turned up so the music can be heard above tools, worsening the potential for hearing damage.

**If you have to shout to be heard, you need hearing protection**—Reducing the amount of noise you are exposed to is the simplest, safest and most effective way to prevent NIHL and to keep it from worsening. There are several ways to accomplish this goal.

First, whenever possible, purchase the quietest tools available. According to Leslie Banduch at Porter-Cable, the two major culprits of power-tool noise are motor-cooling fans and tool vibration. Also, Banduch said, a smooth-running tool—one with minimal vibration—will tend to be a quieter tool than one that vibrates a lot. Banduch said that in Europe there are regulations concerning how much noise a power tool can make. He speculated that this country is probably five years behind in the enactment of similar laws.

Another way to reduce noise exposure is to minimize the use of power tools and other noise sources in places where there is a lot of reverberation—places such as basements or other rooms with metal, stone or concrete walls. If it is practical, set up your cutting station outside, in a room where you open a couple of windows or in a garage where you can open the doors.

Another option is to reduce the total amount of time that you work with noisy equipment during the day. Ask yourself whether your compressor needs to run all day or whether you can cut all your multiples first thing in the morning.

These options, called administrative controls, are effective because they do not require us to do or remember anything. We don't have to bring hearing protection to the job, remember to use it, put it in properly, wear it throughout the day and clean it when we are done. Sometimes, however, administrative controls are impractical or ineffective. There are probably days when there is no way to avoid six or seven hours hunched over your circular saw or router. The next step, then, is for you to wear hearing protection.

There is a good rule of thumb for deciding whether you need to wear hearing protection: If you have to shout to carry on a conversation, the noise level is probably more than 90 db., and you should be wearing some kind of protection. As you can see from Table 2, most power tools emit levels of sound close to or higher than 90 db. Therefore, you should seriously consider using hearing protection with all power tools, regardless of how long you plan to use the tool.

**Three types of hearing protection**—How can you protect your hearing every day at work? The first thing to remember is that plain cotton stuck in your ears offers no protection against noise. Although many people use cotton, studies have shown that it is no better than no hearing protection. Three effective types of hearing protection are commonly available. The chart on p. 77 compares the features of the different types.

Inserts are plugs that fit into the ear canal. Semi-inserts are ear-canal covers held in place by a

**Table 1**  
**OSHA PERMISSIBLE NOISE**  
**EXPOSURES**

Duration per day in hours	Sound level in decibels (db.)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

The risk of NIHL increases with time. OSHA has determined how long you can be exposed to certain sound levels in decibels without risk to your hearing. Be conservative in your estimates, this table is only a guideline.

**Table 2**  
**COMPARISON OF COMMON**  
**NOISE SOURCES**

**Uncomfortably loud (>100 db.)**

Oxygen torch	121
Bulldozer	117
Rock concert	114
Chainsaw	110
Circular saw	102

**Loud (80-99 db.)**

Backhoe	98
Power mower	96
Jigsaw	94
Drill	93
Shouted conversation	90
Palm sander	87

**Moderately loud (60-79 db.)**

Clothes washer	76
Television	70
Vacuum cleaner	70
Freeway auto traffic	64

**Quiet (0-60 db.)**

Large transformer at 200 ft	58
Normal conversation	50

Loudness increases 100 times for every 10 db. This chart gives you an idea of how loud some common noise sources are. A chainsaw is about 400 times louder than a vacuum cleaner.

plastic band or other device. And earmuffs cover the entire ear.

For most home and work use, one of the best and most popular all-around choices for comfort and noise reduction is inserts. Inserts are also called earplugs, aural-insert protectors or just plugs. They come in two forms: foam inserts and premolded earplugs (photo p. 75). Premolded plugs are reusable, flanged plugs that are simply inserted into the ear. Foam inserts are rolled and compressed into tiny cylinders that, once inserted, slowly expand to provide a custom fit. Ideally, plugs can reduce noise exposure by as much as 33 db. However, they require training in insertion techniques to achieve good results.

To insert a foam earplug properly, begin by rolling the plug between your fingertips into a thin, crease-free cylinder. Immediately insert the plug into the ear canal. As with all earplugs, fitting is easier if the outer ear is pulled upward and outward with the opposite hand (left photo, facing page). Plugs should be inserted in the right ear with the right hand and vice versa. It may be necessary to hold the plug in place for a moment while it expands and completely blocks the ear canal. Earplugs should be cleaned with soap and water after use, and most plugs should be discarded after several uses.

Semi-inserts are foam plugs attached to a plastic or metal band that loops over your head. The band makes semi-inserts ideal for intermittent exposures to loud noises because they can be worn easily around your neck when not in use. And they're easy to use: Simply place the plugs in your ears, and the compression band holds them in place (center left photo, facing page). Typically, semi-inserts do not achieve as tight a seal with the ear canal as earplugs provide, and they can allow sound to leak through. As a result, they generally have a noise-reduction rating that is 5 db. to 10 db. lower than foam earplugs. Like foam earplugs, the semi-inserts must be cleaned periodically.

Earmuffs are bulkier than other alternatives, but they can be as effective as foam inserts. Muffs consist of two cup or dome-shaped protectors that fit over your entire external ear. The muffs keep out sound by sealing against the head with a cushion or pad. This kind of hearing protector is rated to provide up to 29-db. reduction in noise transmission, and it is simple to use. Some styles can be worn in a variety of positions: over the head, under the chin or behind the head (right photos, p. 77). Some companies make muffs that clip onto hard hats. When buying earmuffs, look to see whether the ear cups swivel on the headband. Muffs with cups that don't swivel can be worn only on top of your head. Typically, earmuffs worn with the band on top of the head provide greater sound reduction.

Earmuffs tend to cause perspiration more easily than other types of hearing protection. This perspiration can lead to discomfort and slippage. And if a variety of ear protection is hot and uncomfortable on your head, you might be inclined to remove the device.

Under OSHA law, most employers must offer at least two types of hearing protection, free of charge, to employees exposed to high noise lev-

els. The logic behind this requirement is that no single type of protection is best-suited for all people because of variations in job tasks, ear shapes and other factors. You should try several types of ear protection to determine what device best suits your needs.

In addition to proper fit, you should check the degree of noise reduction that the hearing protection provides.

**The reality of noise-reduction ratings-**

Manufacturers of hearing-protection devices routinely provide noise-reduction ratings (NRR), which they obtain under controlled laboratory conditions. Conceptually, testing for NRR is simple. First, manufacturers determine the minimum level of sound that people can hear without any hearing-protection devices. Then they measure how much louder the sound needs to be for subjects to hear it while wearing protection. The difference in these two points is a measure of the NRR of the device.

This process requires the testing of many people, several times each, at different sound frequencies, using methods specified by the American National Standards Institute. The NRR then is usually printed on the outside of the product's packaging.

In reality, most people do not obtain the listed amount of protection from these devices. Sweating, slippage and a less-than-ideal fit usually reduce the NRR by roughly half; these factors allow sound to leak past the hearing protection where it meets your skin or head. To allow for these limitations, OSHA's guidelines lower the manufacturer's NRR by 7 db. and then divide the new rating in half. This number estimates the real-world effectiveness of hearing protection. Thus, an earmuff rated at 30-db. reduction in the lab provides about 11.5 db. of noise reduction on the job site: 30 db.-7 db. = 23 db. 23 db. ÷ 2 = 11.5db.

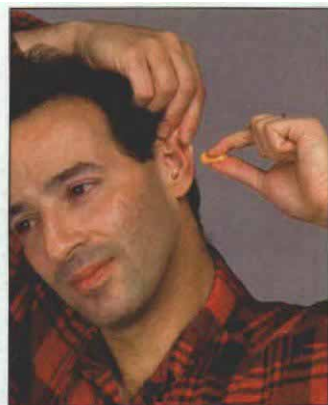
When choosing among the various types of protection, do not make your decision based on the NRR if products differ by only a couple of decibels. There is no real difference in effectiveness until the NRRs differ by 4 db. to 5 db. In a situation where the NRRs are roughly the same, you should make your choice based on both comfort and convenience.

**Double up hearing protection for extreme**

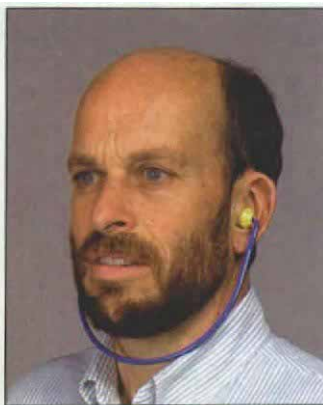
**conditions**—Combinations of hearing protection can be used for exposure to loud noises such as jackhammers or cutting torches. The most commonly used combination is foam inserts worn underneath earmuffs. But figuring out the NRR of the added protection is not just a matter of simply adding the two NRRs together. A variety of factors acts together to determine the final level of protection. However, here's a good guide to use when wearing earplugs with a NRR of 25 db.: Adding earmuffs with a 25-db. rating may only reduce the noise dose by another 5 db. or 6 db.

The table at the top of the facing page compares the general types of hearing protection based on comfort, price, effectiveness and other conditions. Foam inserts and premolded

**Inserts**



**Semi-inserts**



**Earmuffs**



**Earmuffs on hard hat**



**COMPARISON OF HEARING-PROTECTION DEVICES**

Type	NRR (db.)	Cost	Size	Comfort	Wearability	Interference
Inserts	21-33	\$1-\$2	Regular, large	Objectionable to some people	Only in healthy ears	None
Semi-inserts	17-25	\$4-\$7	One size fits all	Objectionable to some people	Only in healthy ears	None
Earmuffs	19-29	\$9-\$25	One size fits all	Objectionable to some people, may be hot	Can be worn with ear infections	Some glasses; some headgear; some long, thick hair

**Hearing-Protection Manufacturers**

Many companies make hearing-protection devices. If your local lumberyard or hardware store doesn't have any devices that are comfortable for you, check in the Yellow Pages under *Safety Equipment and Clothing*. The following is a list of manufacturers and dealers of the devices used in the compilation of this article.

**3M Occupational Health and Environmental Safety Division**  
 3M Center  
 275-6W-01  
 St. Paul, Minn. 55144  
 (800) 328-1667  
 3M makes a full line of hearing protection, including foam plugs, corded foam plugs, muffs and hard-hat mounted muffs.

**Northern Safety Co. Inc.**  
 P. O. Box 4250  
 Utica, N. Y. 13504  
 (800) 631-1246  
 Along with all sorts of other safety devices, Northern's catalog lists more than 30 different hearing protectors. It even sells a sound-level meter if you want to take your own decibel readings.

**Peltor Inc.**  
 Peltor Park  
 63 Commercial Way  
 East Providence, R. I. 02914  
 (401) 438-4800  
 Peltor makes high-quality earmuffs, including muffs attached to safety face shields and muffs with built-in two-way radios or FM radios.

**Tasco Corp.**  
 37 Tripps Lane  
 Riverside, R. I. 02915  
 (800) 343-2311  
 Tasco makes muffs, earplug inserts and headgear that incorporate earmuffs with face shields and hard hats.

earplugs have been grouped together under inserts because they have similar characteristics.

**Using the tables in a real-life situation**—Let's plug in some of the numbers from the charts to give you an idea of how well hearing protection works on a job site. Suppose that you work with a chainsaw, which, as you can tell from Table 2, makes 110 db. of noise. Based on Table 1, you know that you can safely work at this sound level without hearing protection for only 30 minutes before your hearing becomes damaged. You se-

CALCULATING NOISE EXPOSURE	
Chainsaw noise	110 db.
Safe exposure time	30 min.
Earmuff NRR	27 db.
Reality factor #1	-7 db.
Reality factor #2	20 db./2
Effective noise reduction	10 db.
Chainsaw noise with earmuff	100 db.
Safe exposure time	120 min.

lect an earmuff rated at 27-db. NRR. How long can you safely operate the chainsaw now?

Doing the simple math outlined in the box to the left shows that with the earmuffs, you can work four times longer without increasing your risk of hearing loss. If you were to use the earmuffs with foam inserts, your safe time would be even longer. □

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