What is **hearing conservation?**

The equipment you operate at work, cars, airplanes, the television set — with all these things emitting sounds, it's a wonder you can hear yourself think.

People seem willing to take risks with their ears they would not take with other body parts. A person might wear a hard hat, steel-toed shoes and protective eyewear all day long on the job. He or she might never think of thrusting a hand or foot into an unguarded machine. By the same token, however, this same person might not even consider wearing a pair of ear plugs; feeling that he or she will get used to the noise or just tune it out.

But sound reaches a level where it becomes more than just an annoyance. Excessive noise levels can permanently destroy a person's hearing. Although you may tune out the annoyance factor mentally, your ears cannot do the same to the damaging effects of too much noise. Your ears do not get used to it. In addition to hearing damage, exposure to excessive noise levels can contribute to high blood pressure, changes in heart rhythm and breathing rate, stomach disorders, premature births and sleep disorders.

Roughly 30 million American workers are exposed to what the Occupational Safety and Health Administration (OSHA) considers excessive noise levels on the job. The largest at-risk employment groups are in manufacturing and transportation; followed by military personnel and construction, mining and agricultural workers.

Anatomy of the ear

The human ear has three components: outer, middle (tympanum) and inner (labyrinth). Normal hearing depends on the health of all three.

The outer ear consists of the pinna, which is the external, visible part; and the auditory canal. The middle ear contains the tympanic membrane, or eardrum, which separates the outer and inner portions.

The ear drum vibrates when struck by sound waves, sending sound impulses to the inner ear. Thousands of tiny hair cells (cilia) within the inner ear then transmit those sound impulses to the auditory nerves.

Types of hearing loss

Hearing loss falls into three categories:

- Conductive, resulting from damage to the ear drum, fluid in the middle ear (otitis media) or excessive wax buildup;
- Sensorineural, due to an impairment of the inner ear;
- Central, resulting from malfunction of the auditory nerve.

Sensorineural hearing loss is the most common form associated with excessive noise.

Exposure to steady, loud noise can flatten or disfigure the hair cells within the inner ear, or fuse them together, reducing their ability to transmit sound. This results in tinnitus, or ringing in the ears, and high-frequency hearing loss known as temporary threshold shift. This threshold shift can become permanent with habitual exposure to excessive noise levels.

Acoustic trauma or brief exposure to a sudden blast of noise, such as an explosion or gunshot, can also cause permanent hearing loss by tearing the organ of Corti in the inner ear.

Conductive hearing loss can also occur in the workplace, although it is not as frequent as sensory hearing loss and usually is not associated with noise. In the workplace, a blow to the head or an explosion, either of which can rupture the eardrum, can cause conduct hearing loss.

Neural hearing loss is often attributable to such factors as aging, disease, cerebrovascular accidents and brain injuries.

Sources of noise

A voice engaged in conversation produces about 60 decibels (dB)(A) of sound. The traffic on the freeway, about 70 dB(A). Your hairdryer will generate 80 db(A).
Any noise level exceeding these examples is potentially harmful to your hearing and health.

Examples include:

- Milling machine, 85 dB(A) (at about 5 feet away);
- Lawn mower, 95 dB(A) (near operator's ear);
- Textile loom, 105 dB(A) (at 5 feet);
- Pneumatic chipper, 115 dB(A) (at about 5 feet).

While a difference of a few decibels might seem insignificant; in reality each increase of six decibels doubles the sound pressure level and, thus, substantially increases the risk for all those exposed to the noise.

Hearing conservation program

A company's hearing conservation program must include at least the following provisions, according to OSHA (29 CFR 1910.95):

- Exposure monitoring, identification and notification of all employees exposed to excessive noise levels;
- Engineering or administrative control of noise exposure;
- Audiometric testing, including an initial audiogram and annual audiograms to gauge hearing loss in affected employees; and also to gauge the effectiveness of the company's hearing conservation procedures;
- Hearing-protection equipment for exposure to 85 dB(A) or more (8-hour time weighted average TWA);
- Training employees so they understand:
  a. the health effects of excessive noise;
  b. the purpose, advantages and disadvantages of various hearing-protetion devices;
  c. selection, fitting and care of hearing pro tectors;
  d. purpose and procedures of audiometric testing.
- Recordkeeping.

Exposure limits

OSHA's permissible exposure limit for noise is 90 dB(A) based on an eight-hour TWA. The action level is set at 85 dB(A) The National Institute for Occupational Safety & Health (NIOSH), meanwhile, recommends lowering the exposure limit to 85 db(A).

You must include employees exposed to noise exceeding OSHA's 85 dB(A) action level in a hearing conservation program that includes auditory testing, monitoring, training and hearing-protection equipment.

When workplace noise reaches the 90 dB(A) threshold, hearing protection use is mandatory and companies must use engineering controls to abate the problem if economically feasible.

Engineering controls

The best way to prevent noise-induced hearing and health problems, naturally, is to rid the workplace of the noise sources or otherwise reduce the level of noise reaching the employee.

Above 90 dB(A), OSHA says you must implement engineering controls if economically feasible. Replacing noisy equipment may or may not be a viable option. If you are seeking to purchase new equipment, outline certain noise-reduction specifications that the manufacturer must meet.

If replacing noisy machinery with quieter-running equipment is not a realistic option, you can use several basic engineering methods to control excessive noise. Three common methods are barriers, enclosures and absorbent materials.

Barriers are made of many materials, including plywood, plexiglass, concrete, wood, sheet metal or glass. The effectiveness of each material is measured in terms of transmission loss or the number of decibels it blocks. For example, if the sound level is 100 dB(A) on one side of the barrier and 90 dB(A) on the other, the transmission loss is 10 dB(A).

One example of the enclosure method is building plywood walls around a machine. Include a plexiglass window with an opening through which the worker can operate the machine. By covering the inside walls of the enclosure with an absorbent material you may reduce significantly the sound level reaching the worker.

To be effective, you must use enclosures in combination with sound-absorbent materials. These can include fiberglass insulation, foamlike substances, egg crate-shaped or quilt-like acoustic materials and vinyl.

Certain other factors influence the effectiveness of engineering controls in reducing sound levels. These include:

- Work environment. It is easier to combat noise from a single source than from a large facility full of machinery;
- Building acoustics. Carpeted floors, acoustic-tile ceilings and fabric-covered walls muffle sound much better than concrete floors, concrete or brick walls and metal ceilings;
- Wave length. It is easier to deflect high-frequency (short sound wave) noise such as that emitted by a saw or the release of compressed air than low-frequency (long sound wave) noise such as that coming from a fan or rotating mechanism like a flywheel.

Hearing-protection devices

When you cannot eliminate noise from the workplace, earplugs and earmuffs are the most basic defense against excessive noise.

Earplugs are made of foam rubber, silicon or similar materials. The user can premold, custom-mold, or form to fit the ear canal. Ear muffs resemble a stereo headset and fit over the outer ear.

Earmuffs may be more comfortable in many cases. Neither method, however, is more effective than the other. The best hearing protector is the one the worker will use. That usage will depend on such factors as convenience, comfort, level of belief in the equipment's effectiveness, and the continued ability to hear important audio cues or signals.

Hearing-protection devices are laboratory tested and assigned a noise-reduction rating (NRR) of anywhere from 15 to 38 decibels.

The actual protection provided may be far less than the NRR indicates, however, as conditions and situations vary. For example, equipment that does not fit or is worn incorrectly is less effective. So it is better to err on the side of safety. According to NIOSH, for a more accurate noise-attenuation value:

- Subtract 25 percent from the NRR for earmuffs;
- Subtract 50 percent for formable earplugs;
- Subtract 75 percent for other earplugs.

In extreme noise situations it is advisable to wear earmuffs over earplugs. However, it only provides five to 10 dB(A) of additional protection.

Administrative controls

When engineering controls are not feasible or are not sufficient to reduce noise levels, we recommend administrative controls as job rotation. For example, limit each employee to a minimum of two hours a day at noisy tasks, like operating a jackhammer or punch press. Have each employee work the rest of the time in a quiet area.

Round-the-clock threat

Don't think that excessive noise is just a workplace hazard. The effects of noise are cumulative; they do not end when the job is done.

On the drive home your radio may be playing too loudly. When you get home, you still have to mow the lawn or saw some two-by-fours. Maybe you hunt or target-shoot in your spare time.

Any of these examples can be as harmful as the noise exposure you endure at work. So keep hearing-protection equipment at home to protect your ears during leisure-time activities, too.