

Hearing Protection Devices

Hearing-protection devices are barriers that reduce the amount of sound energy transmitted to the inner ear. It is important that hearing protection devices be selected, fitted and used properly so that employees are adequately protected from noise.

There are two types of hearing protection devices — insert type and muff-type. The insert-type protector attenuates noise by plugging the external ear canal. The muff-type protector encloses the ear lobe to provide an acoustical seal. The effectiveness of such devices depends on several factors that are related to the manner in which the sound energy is transmitted through or around the device. There are four pathways by which sound can reach the inner ear when hearing-protection devices are worn. These are:

- Seal leaks
- Material leaks
- Hearing-protection device vibration
- Conduction through bone and tissue

Small air leaks in the seal between the hearing protector and the skin can greatly reduce the effectiveness of the hearing protection device. This is the most common problem with the use of hearing protection.

A second transmission pathway for sound is directly through the material of the hearing protector. The device will attenuate or prevent the passage of most of the sound energy, but still allows some to pass through.

A third pathway for sound to be transmitted to the inner ear develops when the device is set into vibration in response to exposure to external sound energy.

If the ear canal were completely closed with a 100% attenuating hearing-protection device, some sound could still reach the inner ear by bone conduction. A perfect hearing-protective device cannot provide more than 50 dB of sound attenuation due to bone conduction of sound.

Personal hearing-protection devices are of four types:

- Enclosure
- Aural insert
- Superaural
- Circumaural

Enclosures — These devices entirely enclose the head and the maximum attenuation that they can provide is about 35 to 50 decibels. Wearing hearing protectors and then adding a head-enclosing helmet can achieve an additional 10 dB of attenuation of sound to the ears.

Aural inserts — Aural inserts are most commonly called earplugs. They are inexpensive but their service life is short, ranging from a single use to several months' use. This type of protector is manufactured in many different configurations and is made from such materials as rubber, plastics, fine fibrous

glass down, and wax-impregnated cotton. Ear plugs can be preformed or premolded or can be custom molded to an individual employee's ear canals.

Superaural protectors — These hearing protectors seal the external opening of the ear to achieve noise attenuation. They are made of a soft, rubber-like material that is held in place by a head band or suspension assembly. Tension in the band holds the device against the edges of the ear canal.

Circumaural hearing protectors — Circumaural hearing protectors are most commonly known as earmuffs. They fit over the entire external ear, including the lobe, and seal against the side of the head with a suitable cushion or pad. The ear cups are made of molded rigid plastic and are lined with an open, cell-type foam material. A spring-loaded suspension assembly or headband generally holds the cups in place.

Each type of hearing protection device has advantages and disadvantages that must be considered when choosing a device for a particular application. Earplugs are cheap and can be used with long hair, glasses and under caps. Fitting can be a problem and training in proper use is critical since a tight seal of the ear canal is required. It can be difficult for a supervisor to assess proper use and fit from a distance and hygiene can be a concern if employees with dirty hands are handling the plugs. Ear muffs provide a more reliable fit and do not require as much skill and training in proper fitting and use. They can be uncomfortable and sweaty in hot environments and can be too big and bulky in tight spaces.

When employees help select their own equipment they are more willing to wear it. Employees should be provided with a number of types of hearing protection devices to choose from when training and fitting is conducted.

Estimating adequacy of hearing protectors

When choosing a particular type of hearing protector the noise attenuation of the protector is critical. Noise exposures should be reduced to levels below 85 dBA. Attenuation is the difference in decibel levels between an observer wearing hearing protection and one without the hearing protection device. Attenuation is a measure of the protection afforded by a particular hearing protection device.

The most convenient method of estimating the adequacy of hearing protector attenuation is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). The NRR must be shown on the hearing protector package. The NRR is compared to an individual worker's noise exposure in order to assess the adequacy of the attenuation of a given hearing protector. NRR are determined in ideal laboratory environments. The NRR under actual use conditions in the workplace is significantly less and should be taken into account when determining the adequacy of a specific hearing protection device. The procedure for finding the actual attenuation according to OSHA is as follows:

- Subtract 7 dB from the NRR of the hearing protection device
- Apply a 50% safety factor

Example: If the noise exposure of an employee is 95 dBA and we choose a hearing protector with a NRR of 21, then:

$$\text{Attenuation} = (21-7) \times 50\% = 7 \text{ dBA}$$

So the protection afforded by these hearing protectors is:

$$95 \text{ dBA} - 7\text{dBA} = 88 \text{ dBA}$$

The protection is inadequate since we need the protection to result in an exposure below 85 dBA.

If we choose hearing protection with an NRR of 29, then our effective exposure is:

$$\text{Attenuation} = (29-7) \times 50\% = 11 \text{ dBA}$$

The protection afforded by the hearing protectors is:

$$95 \text{ dBA} - 11 \text{ dBA} = 84 \text{ dBA}$$

Since the exposure is below 85 dBA, the hearing protection is adequate for the operation.

In situations when noise exposure exceeds 105 dBA, employees should wear dual hearing protection. This includes the use of both ear muffs and ear plugs together.

Enforcement of utilization

In addition to selection, fitting and training of employees in the proper use of hearing protection, motivation and enforcement of the use of hearing protection is fundamental to a successful Hearing Conservation Program. Managers and supervisors must actively enforce safety policy including the use of hearing protection. Enforcement needs to be firm, equitable and consistent. Front line supervisors should be held responsible for the performance of their employees and must set an example by wearing their own hearing protection devices in designated areas.

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