

Personal Protective Equipment

Hearing Protectors

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How can I protect my hearing at work?

The most effective method of preventing noise-induced hearing loss (NIHL) is to eliminate the source of noise or to reduce noise at the source through engineering methods. However, in certain situations, these measures are not possible. In such workplaces, workers may need to wear hearing protectors to reduce the amount of noise reaching the ears.

What are some things I should know about selecting hearing protection devices?

People should wear a hearing protection device if the noise or sound level they are exposed to is close to or greater than the occupational exposure limits (OEL) for noise. For most jurisdictions, this occupational exposure limit is 85 decibels (A-weighted) or dBA. Hearing protectors reduce the noise exposure level and the risk of hearing loss when worn correctly.

If hearing protection is required, then a complete [hearing conservation program](#) should be implemented. A hearing conservation program includes [noise assessment](#), methods for [controlling](#) noise, hearing protector selection, worker training and education, audiometric testing, maintenance, inspection, record keeping, and program evaluation.

The effectiveness of hearing protection is reduced greatly if the hearing protectors do not fit properly, are not inserted or worn correctly, are worn only periodically, or are removed even for a short period of time. To maintain their effectiveness, the hearing protection should not be modified. Music earphones or headsets are not substitutes for hearing protectors and should not be worn where hearing protectors are required to protect against noise exposure.

Select hearing protection that is:

- Correct for the job. Refer to the Canadian Standards Association (CSA) Standard Z94.2-14 (R2024) “Hearing Protection Devices - Performance, Selection, Care and Use” or contact the agency responsible for occupational health and safety legislation in [your jurisdiction](#) for more information.
- Adequate for the protection or noise attenuation required. Check the manufacturer's recommendations.
- Compatible with other required personal protective equipment or communication devices.
- Comfortable enough to be worn.
- Appropriate for the temperature and humidity in the workplace.
- Able to provide adequate communication and audibility needs (for example, the ability to hear alarms or warning sounds).

What types of hearing protectors are available?

Earplugs are inserted in the ear canal. They may be premolded (preformed), moldable, rolldown foam, push-to-fit, or custom moulded. Disposable, reusable and custom earplugs are available.

Semi-insert earplugs consist of two earplugs held over the ends of the ear canal by a rigid headband.

Earmuffs consist of sound-attenuating material, soft ear cushions that fit around the ear, and hard outer cups held together by a headband.

How do I pick my hearing protectors?

The choice of hearing protectors is a very personal one and depends on a number of factors, including level of noise, comfort, and the suitability of the hearing protector for both the worker and the environment. Most importantly, the hearing protector should provide the desired noise reduction. It is a good practice to provide a choice of a number of different types and sizes when hearing protectors must be used.

If the noise exposure is intermittent, earmuffs are more desirable since they may be inconvenient to remove and reinsert earplugs.

How can I find out how much a hearing protector reduces noise exposure?

Manufacturers provide information about the noise-reducing capability of a hearing protector, referred to as a noise reduction rating (NRR) value. The NRR is based on laboratory conditions; therefore, calculations to de-rate the noise reduction rating should be done to reflect workplace conditions (see calculations below).

CSA Standard Z94.2-14 (R2024) "Hearing protection devices — Performance, selection, care, and use" defines noise reduction rating as "a single number rating that indicates the overall hearing protector attenuation, computed as the difference between the overall C-weighted level of a noise spectrum having equal energy per octave and the A-weighted noise levels under a hearing protector, using mean attenuation data less two standard deviations, derived from the experimenter-fit procedure of the 1974 edition of ANSI Z3.19 (withdrawn) as defined in EPA (1979)".

How do I use Noise Reduction Rating (NRR) values to determine the protection provided by a hearing protector?

The NRR, or other similar systems such as the single number rating (SNR), is a method to more accurately determine the effective exposure of a person when wearing a hearing protector. These rating systems attempt to estimate the actual sound protection provided by hearing protectors when worn in actual working environments (vs. laboratory testing situations). The "real world" results are often different than laboratory tests with the main reasons for this difference being poor fit, and lack of proper training, supervision, and enforcement. For these reasons, training on the correct fit and making sure users have a thorough understanding of hearing loss are important elements of the hearing conservation program.

Detailed calculations of the protection provided by a hearing protector involve using octave band analysis of the workplace noise and the noise attenuation provided by the hearing protector for noise in each octave band. Attenuation is defined by CSA Standard Z94.2-14 (R2024) "Hearing protection devices — Performance, selection, care, and use" as "the reduction in sound pressure level incident upon the ear due to the application of a hearing protector or, specifically, the change in hearing threshold level that results when a hearing protector is worn."

Calculating noise attenuation of hearing protection and de-rating noise reduction values (NRR)

Source: CSA Z94.2-14 (R2024) "Hearing protection devices — Performance, selection, care, and use" Table 2

Earplugs

Percent of NRR achieved: 50%

For use with dBA: $L_{eq} - [NRR (0.50) - 3] = XX \text{ dBA}$

For use with dBC: $L_{eq} - NRR (0.5) = XX \text{ dBA}$

Earmuffs

Percent of NRR achieved: 70%

For use with dBA: $L_{eq} - [NRR (0.7) - 3] = XX \text{ dBA}$

For use with dBC: $L_{eq} - NRR (0.7) = XX \text{ dBA}$

Dual Protection (use of earplugs and earmuffs)

Percent of NRR achieved: 65%

For use with dBA: $L_{eq} - [(NRR + 5) (0.65) - 3] = XX \text{ dBA}$

For use with dBC: $L_{eq} - (NRR + 5) (0.65) = XX \text{ dBA}$

The NRR used for dual-protection calculations is the higher of the individual NRRs of the two devices, or as specified by the manufacturer.

For example, if not specified by the manufacturer, if ear muffs provide an NRR of 26 dB and ear plugs provide an NRR of 33, the NRR considered for the calculations is 33 dB.

Note: Certain CSA Group standards are available for online viewing. To access these, you must first create an account with "CSA Communities".

Go to: "<https://community.csagroup.org/login.jsps?referer=%252Findex.jsps>"

Once you are logged in, click on the text below the "OHS Standards / View Access" graphic. Click on the jurisdiction of your choice to see the CSA Standards as referenced in that legislation.

Standards may also be purchased from CSA Group: "<https://www.csagroup.org/store/>"

As an example:

Earplugs

Measured workplace noise time-weighted average (TWA) exposure = 98 dBA
Earplug with NRR = 29 dB
Estimated noise exposure = $98 - [29(0.5) - 3] = 86.5$ dBA, which rounds to 87 dBA.

Earmuffs

Measured workplace noise time-weighted average (TWA) exposure = 96 dBA
Earmuff with NRR = 26 dB
Estimated noise exposure = $96 - [26(0.7) - 3] = 80.8$ dBA, which rounds to 81 dBA.

Dual Protection

Measured workplace noise time-weighted average (TWA) exposure = 107 dBA
Earplug with NRR = 33 dB
Earmuff with NRR = 26 dB
Estimated noise exposure = $105 - [(33+5)(0.65) - 3] = 83.3$ dBA, which rounds to 83 dBA.

CSA Standard Z94.2-14 (R2024) provides further guidance on how to apply NRR calculations.

What is a Single Number Rating (SNR)?

Both types of hearing protection offer advantages and disadvantages.

Earplugs can be mass-produced or individually molded to fit the ear. They can be reusable or disposable. On the positive side, they are simple to use, less expensive than earmuffs, and often more comfortable to wear when in hot or damp work areas. Some disadvantages are that they provide less noise protection than some earmuffs, and should not be used in areas exceeding 105 dBA. Earplugs are less visible than earmuffs, making it more difficult to confirm if they are worn. They must be properly inserted and inserted hygienically to provide adequate protection.

Earmuffs can vary with respect to the material and depth of the dome and the force of the headband. The deeper and heavier the dome, the greater the low-frequency attenuation provided by the protector. The headband must fit tightly enough to maintain a proper seal, but not be so tight that it compromises comfort. Some advantages are that earmuffs usually provide greater protection than plugs, although this is not always true. They are easier to fit, generally more durable than plugs, and they have replaceable parts. On the negative side, they are more expensive and often less comfortable than plugs, especially in hot work areas. In areas where noise levels are very high, muffs and plugs can be worn together to give better protection.

The following table summarizes the differences between earplugs and earmuffs.

Comparison of Hearing Protection	
Earplugs	Earmuffs
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with earmuffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas	Advantages: • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • requires good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	Disadvantages: • less portable and heavier • more inconvenient for use with other personal protective equipment. • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • may interfere with the wearing of safety or prescription glasses as it may break the seal between the earmuff and the skin, resulting in decreased hearing protection

Why is user preference so important?

The human side of hearing protection is critical because the effectiveness of the hearing protection ultimately depends on whether workers choose to wear it. Some people do not accept particular kinds of protectors; everyone is different, and the anatomy of the ear and ear canal can vary significantly from person to person.

It is a good idea for the employer to provide a number of different types and sizes of hearing protection from which workers can choose, keeping in mind any safety or hygienic reasons for not providing a particular kind of protector. That is, a particular type of protector should not be used if noise levels are too high or if it proves to be inadequate from a hygienic point of view. For example, earplugs that are used in a plant setting where people reuse them throughout the day, often reinserting them with dirty fingers, can introduce dirt and bacteria into the ears, causing ear infections.

The bottom line on hearing protection is worker preference. If the workers do not like the type of protection (for example, if it is uncomfortable, does not fit well, or is impractical), they will not wear it.

What should I know about the fit of my hearing protectors?

Follow the manufacturer's instructions. With earplugs, for example, the ear should be pulled outward and upward with the opposite hand to enlarge and straighten the ear canal, and the plug should be inserted with clean hands.

Make sure the hearing protector tightly seals within the ear canal or against the side of the head. Hair and clothing should not be in the way.

What happens to the protection level when hearing protectors are removed for short periods of time?

To get the full benefit, hearing protectors must be worn all the time during noisy work. If hearing protectors are removed, even for a short duration, the protection is substantially reduced. The following table gives the maximum protection provided for non-continuous use of an ideally fitted 100% efficient hearing protector. For example, when hearing protection is rated with an attenuation of 25dB, if one takes off their hearing protector for 5 minutes in an hour, the maximum protection will be reduced to no more than 11dB.

Impact of removing hearing protector	
Time removed (in 1 hr)	Maximum 25 dB protection is reduced to (dB)
0 min	no reduction
1 min	17
5 min	11
10 min	8
30 min	3
60 min	0

Source: Removal of hearing protectors severely reduces protection. Health and Safety Executive, UK (no date).

Hearing protectors must be used **ALL THE TIME** to get the full benefit.

How should I care for my hearing protection device?

- Follow the manufacturer's instructions.
 - Check hearing protection regularly for wear and tear.
 - Replace ear cushions or plugs that are no longer pliable.
 - Replace the device when the headbands are so stretched that they do not keep the ear cushions snugly against the head.
 - Disassemble the earmuffs to clean.
 - Wash earmuffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Ensure that the sound-attenuating material inside the ear cushions does not get wet.
 - Use a soft brush to remove skin oil and dirt that can harden ear cushions.
 - Squeeze excess moisture from the plugs or cushions, then place them on a clean surface to air dry. Check the manufacturer's recommendations first to find out if the earplugs are washable.
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