

## Préventex

**Association  
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INFORMATION  
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**Efficiency of hearing  
protection devices**

**Impact of fit on efficiency**

**Communication in a noisy  
environment**

**Pros and cons**

**Source: ASPME**

## HEARING PROTECTION

# Earmuffs or earplugs ?

Exposure to excessive levels of noise can lead to serious consequences on hearing capacity. In situations where it is impossible to comply with the standards set out in the *Rules regarding health and safety at work*, or as a temporary measure until required modifications are made, the management has an obligation to make hearing protection devices available to employees. However, providing hearing protection equipment

does not remove the obligation to research and implement permanent solutions to reduce noise at source.

When hearing loss prevention equipment becomes necessary, certain questions arise: "Do earmuffs offer better protection than earplugs? Which model is best?" It is not always simple to determine the true efficiency of specific devices and this newsletter hopes to shed some light on the subject.

**Here are the most common types of hearing protection devices (HPD)**

### EARMUFFS

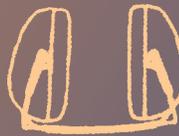
#### Earmuffs with headband

Ear cup thickness influences noise reduction potential



#### Earmuffs with neck band

Practical if wearing a headband creates a problem



#### Earmuffs attached to hard hat

More difficult to adjust



### EARPLUGS

#### Formable earplugs

To be crushed into shape before inserting into ear canal



#### Premolded earplugs

Available in different sizes to suit ear canal diameter



#### Cotton earplugs

Rarely used because of low efficiency



#### Custom molded earplugs

Molded to individual ear canal shape



#### Semi-insert earplugs

Ear canal caps



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2035, Victoria avenue, suite 203  
Saint-Lambert QC J4S 1H1  
Telephone: (450) 671-6925  
Fax: (450) 671-9267  
e-mail: info@preventex.qc.ca  
www.preventex.qc.ca

**General manager and newsletter editor**  
Jean-Marc Champoux

**Co-chairman (Employers)**  
Jacques Hamel  
Cavalier Textiles inc.

**Co-chairman (Unions)**  
Pierre-Jean Olivier  
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Indico Communication

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Imprimerie For inc.

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**Management must meet the noise standards set out in the Rules regarding health and safety at work by implementing the following measures, in the given order:**

- Reduce noise at source
- Insulate work stations exposed to the noise
- Soundproof work rooms

## EFFICIENCY OF HEARING PROTECTION DEVICES

Efficiency is generally measured in terms of the Noise Reduction Rating, which considers the attenuation of all frequencies and is expressed in decibels (dB), the noise measurement unit.

### THEORETICAL EFFICIENCY (LABORATORY TESTED)

The efficiency rating given by HPD manufacturers is tested in laboratories in accordance with American standard ANSI S 12.6-1984. This standard specifies that the tests are to be conducted on individuals with ear shapes likely to ensure proper fit of the device. Instructions are given to the subject to reach optimal noise attenuation. He or she remains immobile and wears the HPD while measurements are taken. Research has shown that the results obtained in this way are far superior to those observed in actual work environments.

### EFFICIENCY IN ACTUAL WORK SITUATIONS

The efficiency of HPD in “real life” situations is always lower than the theoretical rating provided by product manufacturers. In practice, earplugs and earmuffs cannot be fitted as tightly as in laboratory settings. It remains difficult, for instance, to apply instructions for inserting formable earplugs properly.

**In practice, hearing protection devices are more efficient for blocking out high frequencies (high-pitch sounds) than low frequencies (low-pitch sounds).**



**Roll between fingers to crush earplug**



**Insert by pulling on the ear to straighten ear canal**

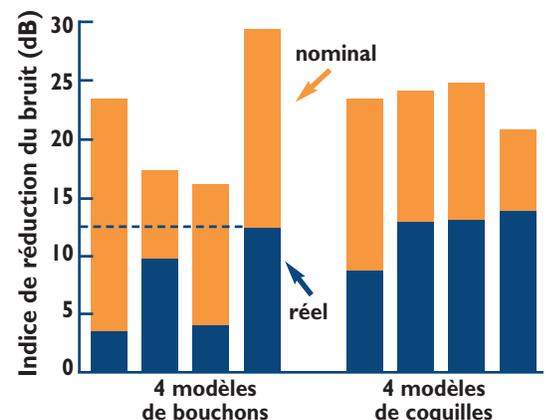


**Hold in place for 30 seconds**



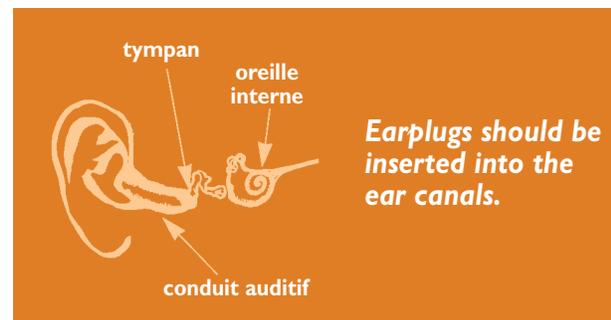
**Let go**

The following chart shows research findings that illustrate the gap between theoretical and actual NRRs. Many reasons, listed on the following page, can explain the discrepancy.



\* Berger, E.H., Lingren, F Current issues in hearing protection, Mosby, St-Louis, 1992

The dotted line in the chart shows that the theoretical rating given for one specific earplug model is 29 dB while the rating in a real work situation is only 12 dB.



## IMPACT OF FIT ON EFFICIENCY

The difference between theoretical and actual ratings is mainly due to faulty adjustment. This can be influenced by several factors.

Earplugs may not fit properly because:

- ◆ Instructions for insertion were not strictly followed.

For example, earplugs that are not inserted deeply into the ear canal will be less efficient.

- ◆ The shape of the ear canal does not allow for adequate adjustment.

For example, earplugs are spherical and do not fit well into oval-shaped ear canals.

- ◆ The person wearing the earplugs has abundant ear hair and the device does not fit tightly into the ear canal.

- ◆ Earplugs move along with the movements of the jaws. In real work situations workers should be able to talk, swallow, move their head, etc. These movements can make earplugs slide out of the ear canal.

Earmuffs may not fit properly because:

- ◆ The individual has large jaws, protruding bones, a narrow skull, etc. These physical features can prevent even pressure on the skull from the earmuffs cushions.

- ◆ The person wears eyeglasses and this creates a gap in the earmuff cushions, reducing efficiency.

- ◆ Cushions are resting on a thick layer of hair, which impairs the efficiency of ear cups.

Considering all the factors listed above, it becomes practically impossible to obtain an actual NRR as high as the theoretical rating given by manufacturers.

## COMMUNICATION IN A NOISY ENVIRONMENT

Workers will sometimes remove their hearing protection device intermittently to communicate with others. This can severely affect the level of noise protection over a full day's work. For instance, if an individual wearing a HPD with an actual rating of 10 dB in a noisy environment removes the device for a total of 50 minutes in the course of eight-hour work day, the NRR comes down by 3 dB and the true rating becomes only 7 dB.

Some protection devices are designed to make communication easier, such as premolded earplugs with flanges or earmuffs with electronic systems. In any case, verbal communication in noisy environment is difficult, with or without HPDs.



There are sophisticated radio systems available on the market, which may be useful in situations where

communication is essential like traffic control or rolling bridge operation.

**The US Occupational Safety and Health Administration (OSHA) recommends reducing the theoretical NRR by 50% to obtain a realistic assessment of actual efficiency. If the rating supplied by the product manufacturer is 24 dB, for example, an actual NRR of 12 dB should be expected.**

## PROS AND CONS

In short, the efficiency of well-adjusted earplugs is practically equivalent to that of well-adjusted earmuffs. The main thing is to select a device that can be properly fitted. However, each HPD has particular advantages and disadvantages. They are listed here:

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	ADVANTAGES	DISADVANTAGES
<b>Earmuffs</b> 	<ul style="list-style-type: none"> <li>• Practical for intermittent wear</li> <li>• Less easy to lose</li> <li>• Easier to fit than earplugs</li> <li>• Can be worn in cases of ear infections or surgery</li> <li>• Slightly higher attenuation of low frequencies than earplugs</li> </ul>	<ul style="list-style-type: none"> <li>• Uncomfortable in excessive heat (even with absorption cushions)</li> <li>• Reduces efficiency if wearing eyeglasses or a hat, or if skull is oddly shaped, jaw is large, etc.</li> <li>• Uncomfortable pressure on skull</li> </ul>
<b>Custom molded earplugs</b> 	<ul style="list-style-type: none"> <li>• Easier to insert and more comfortable than other types of earplugs because molded to individual ear canal shape</li> <li>• Longer lasting than formable earplugs (approx. 3 years)</li> <li>• Proper molding guarantees proper fit</li> <li>• No need to manipulate portion inserted into ear canal (lower risk of infection)</li> </ul>	<ul style="list-style-type: none"> <li>• Regular maintenance required (washing with mild soap and drying)</li> <li>• Molding needs to be done by professionals (faulty molding = faulty fit)</li> <li>• Cannot be worn in case of ear disease</li> </ul>
<b>Formable earplugs</b> 	<ul style="list-style-type: none"> <li>• Inexpensive</li> <li>• Better fit than premolded earplugs or semi-inserts</li> </ul>	<ul style="list-style-type: none"> <li>• Formable earplugs are easily contaminated by contact with dirty ears or hands</li> <li>• Possible itching reaction</li> </ul>
<b>Premolded earplugs</b> 	<ul style="list-style-type: none"> <li>• No need to manipulate portion inserted into ear canal (lower risk of infection)</li> <li>• Inexpensive</li> <li>• Can be washed and reused many times</li> </ul>	<ul style="list-style-type: none"> <li>• Must be renewed regularly to avoid insertion of particles in ears</li> <li>• Cannot be worn in case of ear disease</li> <li>• Instructions for insertion must be strictly followed to maximize efficiency</li> </ul>
<b>Semi-inserts (ear canal caps)</b> 	<ul style="list-style-type: none"> <li>• Practical for intermittent wear</li> <li>• Can be washed and reused many times</li> <li>• No need to manipulate portion inserted into ear canal (lower risk of infection)</li> </ul>	<ul style="list-style-type: none"> <li>• Premolded earplugs need to be adapted to the shape of the ear canal</li> <li>• Reduced efficiency for hairy ear canals</li> <li>• Efficiency of semi-inserts is limited because caps simply rest on ear canal openings</li> </ul>
<b>Cotton earplugs</b> 		<ul style="list-style-type: none"> <li>• Very low efficiency</li> </ul>