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Workplace Hearing Conservation; Occupational Health and Safety Aspects

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While some forms of hearing loss are hereditary and cannot be prevented, Noise Induced Hearing Loss (NIHL) is preventable. It is caused by overexposure to loud sounds. In some cases, the damage is only temporary, but repeated exposure to excessive noise for long periods can cause permanent damage. Until recently, noise-induced hearing loss was linked mainly to excessive noise in the workplace. However, some newer studies suggest that many teenagers and young adults have experienced permanent hearing loss caused by over-exposure to loud noise from various everyday activities.

So how much sound is safe? It depends on how loud and how long.

Audiologists measure the levels of different sounds with a unit called the A-weighted decibel or dBA. Sounds below 70 dBA pose no known risk of hearing loss, no matter how long you listen. You would hear this roughly if you were driving alone, at highway speeds in a family car, with the windows up and the radio off.

Listening time becomes an important risk factor for hearing loss when sound levels increase. **In general, the louder the sound, the less time it takes to pose risk to your hearing.**

Noise in the Workplace:

The Canadian Centre for Occupational Health and Safety (CCOHS*) states that noise is one of the most common occupational health hazards. Noise-induced hearing loss is an occupational disease recognized in the Workplace Safety & Insurance Act and most other workplace insurance schemes.

On the other hand, 'Nuisance' noise is usually controlled by municipal bylaws. This 'loud neighbours' noise may not harm your hearing but may harm your mental health.

Workplace noise is regulated under 3 Occupational Health and Safety regulated topics: Noise limits, Noise and hearing assessment, and Noise controls

1 Workplace safe noise limits:

In Ontario, Canada, the Occupational Health and Safety Act Noise Regulation 351-15 sets the safe limit of exposure to 85 decibels averaged over 8 hours.

Warning signs are required in an area where noise levels regularly exceed 85 decibels https://www.ontario.ca/laws/regulation/r15381?_ga=1.104229250.306671440.1457553175

85 dB 'A weighted' average is also used as the action limit by all other Canadian Provinces and Territories (and by USA's NIOSH), except Quebec and US OSHA who still use 90 dBA, and federally regulated workplaces (for example, airports and railroads) that use 87 dBA. A maximum peak pressure level of 140dBA is prescribed by all provinces except AB, SK, MB, ON, PEI, and Federally regulated workplaces. Some feel the peak sound pressure really has no value in estimating the sound exposure dose, whether music, industrial noise, or recreational noise since they are usually of very short duration - millliseconds in the case of a gunshot.

As an everyday example, the noise level Inside a car increases when one opens the windows, and it can exceed 85 decibels, and turning the music up so you can hear it over the wind raises the sound level even more. Loud noise above 120 dB of moderate duration may cause immediate harm to your ears.

Since noise exposure increases logarithmically with sound pressure (dB) the permissible exposure time is halved for usually every 3dB increase (doubling) in noise levels. This is the exchange rate, the amount by which the permitted sound level may increase if the exposure time is halved, used by all provinces except Quebec and US OHSA that uses 5 dBA exchange rate. This is important when selecting adequate hearing protection since higher exchange rates result in higher allowable noise levels.

Noise Exposure Limits when Criterion Level = 85 dBA		
3 dBA Exchange Rate	**Maximum Permitted Daily Duration (hours)**	**5 dBA Exchange Rate**
Allowable Level dBA	Allowable Level dBA	
85	8	85

88	4	90
91	2	95
94	1	100
97	0.5	105
100	0.25	110

If hazardous noise is suspected, workplace noise measurement is done using noise exposure surveys, required by OH&S regulations. CSA Standard Z107.56-94: Measurement of Noise Exposure is the main standard used in Canada and requires a calibrated integrating sound level meter for both the person and general area. Noise meter Smartphone apps can provide a general estimate at home but are considered unreliable for legal compliance purposes.

According to the Centres for Disease Control (CDC) a whisper has a sound pressure of ~30 dB, normal conversation ~60 dB, Inside a car on a highway or aircraft in flight ~ 70 dB, motorcycle engine ~95 dB, gunshot blast ~140dB. So, as a rule of thumb, If you need to shout to be heard, the surrounding noise level may be harmful.

Noise levels also change with distance from the source. In a free field (free from other sound sources or reflections), sound pressure level decreases 6 dB – with the doubling of distance from the sound source. Staying a distance from the source at concerts and parties will reduce your noise exposure. Another example, If you are on a long flight, the Airbus A321 study shows that noise levels are higher in the rear of the cabin, near and behind the engines and propellers, and near windows. Moving to other locations in the cabin may reduce your noise levels when you have a choice.

Workplace noise controls follow the traditional ‘heiarchy of controls’

Our first choice is Engineered Controls in order of effectiveness: noise source elimination, substitution, enclosure and absorption. In this specialty the experts are acoustic engineers. Noise should be limited to acceptable levels by implementing engineered controls to the source, such as silencers, enclosures, or acoustical wrapping. In some cases, alterations to the workplace environment can be effective, such as using acoustically absorptive wall or ceiling panels or localized noise barriers.

The second control choice is PPE**:** where engineering modifications cannot adequately control excess noise, properly selected personal hearing protection (such as earmuffs and/or plugs) and training can be used. These are usually selected based on their Noise Reduction Rating (NRR), the sound reduction at the inner ear in decibels.

A common question is how to select the right hearing protector to reduce noise to a safe level.

Let’s use an example: The energy from a chainsaw registering 110 decibels can theoretically be reduced to 80 decibels at the inner ear wearing an NRR rated 30 dB device, **BUT** as the CSA Standard indicates only about 50% of the NRR is typically achieved with earplugs for various reasons, so 110 – 30dB divided by 2 = 95 so only expect noise reduction to 95dB. However, about 75% of the NRR is achieved by wearing earmuffs, so 110 – 22 = 88 dB protection, which is much

better.

PPE must be conveniently available and worn consistently to be effective. A good practice at home is to leave a set of earmuffs or earplugs on the lawnmower, weed trimmer, chainsaw, and near power tools, especially if used indoors in a small room.

Another common question is, what are the advantages and limitations of earplugs and earmuffs?

Both offer advantages and disadvantages.

Earplugs can be mass-produced or individually molded to fit the ear. In addition, they can be reusable or disposable. On the positive side, they are simple to use, less expensive than muffs, and often more comfortable to wear when in hot or damp work areas.

Earmuffs can vary with respect to the dome's material and depth and the headband's force. 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, yet not be too tight for comfort. Some advantages are that earmuffs usually provide greater protection than plugs, although this is not always true. In addition, they are easier to fit, generally more durable than plugs, and have replaceable parts.

Some disadvantages of earplugs are providing less noise protection than some earmuffs and should not be used in areas exceeding 105 dBA. They are not as visible as muffs, making it more difficult for supervisors to check if workers are wearing them. They must be properly inserted and hygienic to provide adequate protection.

Some disadvantages of earmuffs are they more expensive and are often less comfortable than plugs, especially in hot work areas. However, muffs and plugs can be worn together in areas with high noise levels to give better protection.

User preference is important since protection must be worn at all times to be effective. For example, hearing protectors must always be worn during noisy work to get the full benefit. The protection is substantially reduced if hearing protectors are removed for a short duration.

The following table gives the maximum protection for non-continuous use of an ideally fitted 100% efficient hearing protector. For example, when hearing protection is rated with an attenuation of 25 dB, if one takes off their hearing protector for 5 minutes in an hour, the maximum protection will be reduced to no more than 11dB.

Removal of hearing protectors severely reduces protection. UK Health and Safety Executive

Impact of removing hearing protection	
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

There’s one more complication: hearing protectors need to be properly maintained, especially earmuffs. So how should I care for my hearing protection device?

- First, follow the manufacturer’s instructions.
- Check for wear and tear before wearing
- Replace ear cushions or plugs that are no longer pliable (if they harden up)
- Replace when earmuff headbands when they are so stretched that they do not keep ear cushions snugly against the head, and disassemble earmuffs to clean:
- Wash earmuffs with a mild liquid detergent in warm water, then rinse in clear warm water, ensuring 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 and place them on a clean surface to air dry. (Check the manufacturer’s recommendations first to determine if the earplugs are washable.)

The following table summarizes the differences between earplugs and earmuffs (CCOHS*)

Earplugs

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

Disadvantages: -requires more time to fit -more difficult to insert and remove -require good hygiene practices -may irritate the ear canal -easily misplaced -more difficult to see and monitor usage

Earmuffs

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: -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, wearing glasses results in breaking the seal between the earmuff and the skin and results in decreased hearing protection.

References

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