

A clinician's guide to noise-induced hearing loss

Noise-induced hearing loss (NIHL) is a hearing loss that typically occurs gradually over time due to prolonged exposure to excessive noise levels greater than 85 decibels (dBA). It may also occur from exposure to a very intense sound, such as an explosive blast or gun fire. This is referred to as an acoustic trauma and usually results in a sudden hearing loss.

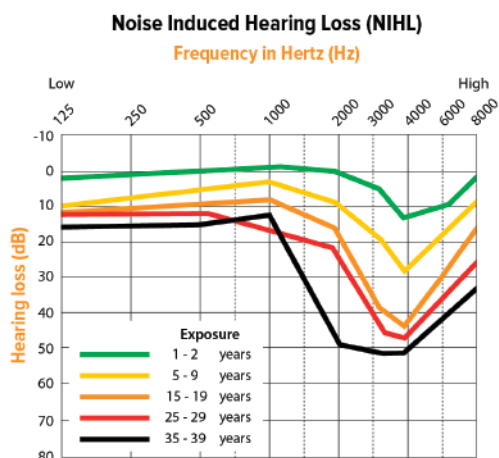
NIHL is permanent in nature because excessive noise damages the hair cells of the cochlea, resulting in a sensorineural hearing loss. Noise exposure affects both ears and usually causes a hearing loss at 3000, 4000 or 6000 Hz. It does not affect the low frequencies.

On an audiogram, the configuration of the hearing loss reveals a distinctive notch—typically greatest at 4000 Hz—sometimes referred to as a 'noise notch'. As exposure continues, the notch gradually deepens and widens, affecting surrounding frequencies.

NIHL increases most rapidly during the first 10-15 years of exposure with the rate of hearing loss declining over time. This is in contrast to the rate of presbycusis, or age-related loss, which accelerates over time.

NIHL usually affects both ears equally, but it may result in an asymmetrical hearing loss under unique circumstances. For example, an individual with a history of firearm use may have a greater loss in one ear due to the positioning of the head while shooting which may expose one ear to more noise than the other (the head shadow effect).

NIHL can be occupational (work-related) or non-occupational. Non-occupational noise exposure can occur at home (e.g., stereos, lawnmowers, and power tools) or during recreational activities (e.g., guns, motorcycles, concerts, iPods, ATVs, snowmobiles).



Occupational noise-induced hearing loss (ONIHL)

Occupational noise-induced hearing loss (ONIHL) is a hearing loss caused by excessive noise exposure in the workplace. Within Alberta, the occupational exposure limit (OEL) for noise is 85 decibels (dBA) averaged over an eight-hour day. This means that for limited periods, a worker can be exposed to noise levels higher than 85 dBA as long as the average exposure over eight hours does not exceed 85 dBA.

Continuous noise exposure tends to be more damaging than interrupted exposure to noise which permits the ear to have a period of rest and recovery. Noise exposure can be reduced through the use of a variety of hearing protection devices such as earplugs and earmuffs.

The risk of occupational noise-induced hearing loss (ONIHL) is low at exposure levels below 85 dBA (eight-hour time-weighted average) but increases significantly as exposures rise above this level.

Determining entitlement for occupational noise-induced hearing loss

Occupational noise-induced hearing loss has a very specific pattern on an audiogram and progresses in a predictable manner over time. In order to ensure a consistent approach to the diagnosis of occupational noise-induced hearing loss, WCB refers to the American College of Occupational and Environmental Medicine's (ACOEM) Guidance Statement on occupational noise-induced hearing loss (Kirchner et al., 2012) as well as the Guidelines on the diagnosis of noise-induced hearing loss for medicolegal purposes (Coles et. al, 2000).

A claim for ONIHL hearing loss may be accepted by WCB-Alberta when:

- The pattern of hearing loss shown on the audiogram is consistent with NIHL in accordance with the [American College of Occupational and Environmental Medicine's \(ACOEM\) Guidance Statement](#) on occupational noise induced hearing loss, and
- There is a clear history of prolonged occupational noise exposure in excess of the occupational exposure limit while the worker was working in Alberta, or was entitled to coverage under WCB-Alberta while working in a place other than Alberta.

WCB considers the following characteristics typical of ONIHL (in accordance with the ACOEM guidelines):

- The hearing loss is sensorineural.
- The hearing loss occurs in both ears.
- The hearing loss is similar in both ears.
- The first sign of ONIHL is a notch on the audiogram at 3000, 4000 or 6000 Hz with recovery at 8000 Hz.
- The notch initially develops at 3000, 4000 or 6000 Hz and affects adjacent frequencies with continued noise exposure. As exposure continues, the notch gradually deepens and widens.
- In the early stages of NIHL, the average hearing thresholds in the lower frequencies at 500, 1000 & 2000 Hz is better than the average thresholds at 3000, 4000 and 6000 Hz, and the hearing level at 8000 Hz is better than the deepest part of the notch. This is in contrast to presbycusis (age-related hearing loss), which produces gradual, down-sloping pattern of high-frequency hearing loss with no recovery at 8000 Hz.
- Noise exposure does not produce a loss greater than 40 dBHL in the lower frequencies.
- Noise exposure does not produce a loss greater than 75 dBHL at high frequencies.
- Hearing loss due to noise exposure increases most rapidly during the first 10-15 years of exposure. The rate of hearing loss decelerates as the hearing thresholds increase.
- Noise-induced hearing loss does not progress after the noise exposure is discontinued.
- In the absence of noise, or other medical conditions, changes in hearing follow the same degree and rate as age-related hearing changes in the general population.
- Word recognition scores are usually fairly good (greater than 75 per cent).

WCB does not consider the following characteristics typical of ONIHL:

- Hearing loss in the low to mid-frequencies.
- Hearing loss is flat across frequencies.
- There is a profound hearing loss (greater than 80 dBA).
- The hearing loss is asymmetric (greater in one ear).

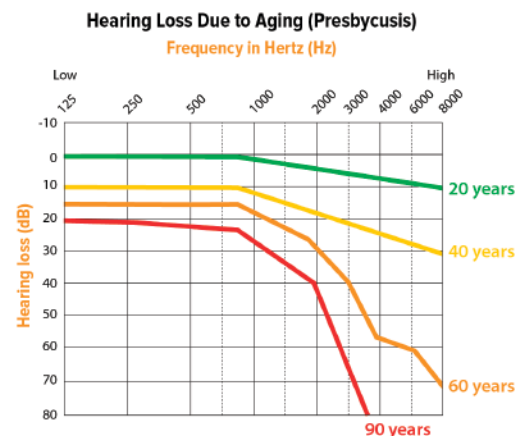
- Rapid hearing loss late in a working career (ONIHL develops gradually, but most rapidly in the first 10-15 years of exposure).
- Hearing loss progresses significantly in spite of appropriate hearing protection.
- Hearing loss does not continue to deteriorate after noise exposure is removed. Hearing loss that occurs after the noise exposure is removed is related to other factors.
- Hearing loss that occurs during exposure to noise levels below 85 dBA (eight-hour time-weighted average) is not noise-related.

Cause and effect relationship

To establish a cause and effect relationship between noise exposure and hearing loss, the pattern and progression of the audiogram(s) must be consistent with the characteristics of occupational noise induced hearing loss. Additional factors that are considered include:

- **The client's age.** The pattern and progression of age-related hearing loss (ARHL) is different than that of NIHL. ARHL is characterized by a gradually sloping pattern. The hearing loss usually begins in the high frequencies, then progresses to the middle and low frequencies with advancing age. The rate of hearing loss begins slowly and accelerates over time, especially after age 60.

In the absence of noise exposure and other non-occupational etiology, hearing loss follows the same degree and rate as age-related hearing changes in the general population. Research shows that by age 80, there is no difference in hearing between noise exposed and non-noise exposed populations.



- **Test-retest variability.** Slight variations in test results are common. There is high variability in hearing thresholds on screening audiograms; therefore, thresholds may be up to 5 dB worse in the high frequencies and 20 dB worse in the low frequencies. Screening results are typically less accurate than diagnostic audiograms due to the following:
 - Less controlled test environments.
 - Workers are subject to temporary threshold shifts (TTS).
 - Workers may be subject to collapsing canals with over-the-ear headphones.

The overall pattern and progression of hearing loss will be taken into account when multiple audiograms are submitted for review.

- **Other causes of hearing loss.** There are a number of causes of hearing loss besides noise exposure and the aging process. Other causes of hearing loss may include head injuries, viral infections, autoimmune inner ear disease, genetics, hereditary hearing loss that runs in families, Meniere's disease, middle ear disease, ear infections, or impacted earwax. Additional factors that have associations with the risk of hearing loss include cardiovascular disease, cerebrovascular disease, smoking, diabetes, kidney disorders and ototoxic medications.
- **Other causes of notching.** The 4000 Hz dip seen on pure tone audiograms is often observed in the early stages of noise-induced hearing loss, or acoustic trauma. However, not all notches are caused by noise exposure. A notch can occur with various diseases (such as viral infections), head injuries, hereditary hearing loss, ototoxicity, acoustic trauma, acoustic neuroma, perilymphatic fistulas, and barotrauma. In many cases the cause is unknown.

