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Noise: a resounding problem

The ability to hear is one of our most precious gifts. Without it, it is very difficult to lead a full and productive life on or off the job. Noise-induced hearing loss is a permanent loss of hearing in both ears usually caused by exposure to prolonged or continuous hazardous noise. Present in all workplaces, noise is arguably one of the most common occupational and environmental hazards faced by workers today. Over the five-year period ending 2013, the cost for noise induced hearing loss claims for all sectors in Ontario exceeded $50 million per year, according to the Workplace Safety & Insurance Board.

What is sound/noise?

Sound is what we hear. Noise is any unwanted or unpleasant sound. The difference between sound and noise is in the ears of the listener. What is considered sound by one person may be noise to another.

Sound is energy in the form of vibration or pressure fluctuations. Vibrations are alternating high and low pressure impulses traveling outward in the form of waves. The rising part of the wave represents the high-pressure impulse and the declining part reflects the low-pressure impulse. These vibrations travel through the air as "sound waves". The motions of these sound waves pass the original energy from one air particle to the next until it reaches the ear.

What is hearing?

Hearing involves a complex series of chain reactions. The outer ear initially captures sound waves. The sound waves transmit through the auditory canal to the eardrum causing it to vibrate. These vibrations then transmit through three small bones in the middle ear into the oval window of the inner ear. They pass into the snail-shaped cochlea, where they move through a system of fluids triggering thousands of small, hair-like sensory cells that transform sound waves into nerve impulses sent to the brain and interpreted as sound.

The hearing mechanism in the ear is sensitive enough to detect even the smallest of sound waves. Loud sound damages hearing because the mechanism is very delicate.

The specific features of the sounds we hear depend on the frequency and amplitude (intensity, or loudness) of the sound waves.

The damage done by noise depends mainly on how loud it is and on the length of exposure. Frequency or pitch can also have some effect, since high-pitched sounds are more damaging than low-pitched ones.

Sound intensity or "loudness" is measured in units called decibels (dB), named after Alexander Graham Bell. The decibel scale is logarithmic rather than linear and is used to measure how much a sound exceeds a certain reference level. The reference level is usually the "threshold of hearing". Zero decibels is the threshold of hearing for most young adults.

A normal conversation takes place at about 50dB to 60dB. A wood shop noise level is about 100dB and a chainsaw noise measures about 110dB.

According to the Canadian Hearing Society and many others, "in no way should 85dBA be understood to be a safe level for unprotected exposure." In fact, the National Institute for Occupational Safety and Health (NIOSH) estimates prolonged exposure to noise at 100dB will result in 56 out of 100 workers suffering hearing loss. At 90dB, 29 workers of 100 will suffer hearing loss. At 85dB, 15 of 100 workers will suffer. Even at 80dB, three of 100 may sustain hearing loss.

What are the health effects of noise?

Noise can be hazardous in several ways. It damages hearing and causes stress. Hearing loss impairs work performance, interferes with social activity, and affects a person's ability to understand spoken sounds. Noise masks warnings of imminent danger jeopardizing safety both on and off the job. Noise can injure the ear in three ways, it can:

- damage the ear instantly (acoustic trauma);
- numb the ears temporarily (temporary threshold shift); or
- cause permanent damage over a period of time (permanent threshold shift).

Once hearing is lost it cannot be restored.

Workers suffering from noise-induced hearing loss can also experience continual ringing in the ears, called tinnitus.

Tinnitus can accompany all types of hearing loss—permanent and temporary, instant and gradual. Unfortunately, there is no cure for tinnitus.

Exposure to both noise and vibration increases the risk of hearing impairment. Similarly, some studies suggest regular exposure to heavy metals and solvents such as trichloroethylene and styrene, and other aromatic hydrocarbons found in some paints and cleaning solutions act on the nerves of the cochlea to hasten hearing loss.

A study commissioned by the Royal National Institute for the Deaf and the Trades Union Congress found that call centre workers in the United Kingdom are exposed to both acute intense noise and prolonged high-level noise through their headsets. As a result, the workers reported dulled hearing and tinnitus, some experiencing this effect for short periods, and others permanently. Tens of thousands of Ontarians are employed in call centres working under similar conditions.

What is the legislation?

Laws governing noise exist in both provincially and federally regulated workplaces. Federally, the Canadian Occupational Health and Safety Regulations, Part VII, regulates the level of sound workers can be exposed to at work.

Section (7.4) states no employee in a workplace shall be exposed to a noise exposure level that exceeds 87 decibels in any 24-hour period. Section (7.5) states employers shall wherever reasonably practicable use engineering controls, physical means, or administrative controls such as limiting the length of exposure, other than hearing protectors, to reduce exposure to sound to prescribed levels. If a worker may be exposed to sound greater than 87 decibels employers must provide them with hearing protection that meets CSA standards. Further, they must develop a training program in consultation with the joint health and safety committee (JHSC) on the fit, care and use of the hearing protection.

In Ontario, regulations for Industrial Establishments, Mines and Mining Plants and the Offshore Oil and Gas Operators all address noise. However, these requirements have been revoked

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and replaced with a new Ontario Noise Regulation (O. Reg.381/15), which comes into effect on July 1, 2016.

The Farming Operations Regulation has also been amended so the new Noise Regulation will now apply to farming operations.

The new regulation also extends noise protection to the following new workplaces:

- construction projects
- health care facilities
- schools
- police services
- amusement parks.

Key requirements of the Noise Regulation include:

- prescribing, for workers exposed to noise, a maximum time-weighted exposure limit of 85 decibels over an eight-hour work shift;
- requiring employers to put in place measures to reduce workers' exposure based on a "hierarchy of controls", which could include engineering controls, work practices, and the use of personal protective equipment in the form of hearing protection devices; and,
- requiring employers who provide a worker with a hearing protection device to provide adequate training and instruction on the care and use of that device.

Many workers face exposure to varying sound levels over the course of their workday. The chart below estimates roughly the amount of time it takes to reach an equivalent eight-hour exposure of 85dB(A).

Table

Column 1 SOUND LEVEL in decibels	Column 2 DURATION hours of exposure per 24-hour day
80.25	24
81.5	18
82	16
83.25	12
84	10
85	8
86.25	6
88	4
89.25	3
91	2
92.25	1.5
94	1
97	30 min
100	20 min
101.8	10 min
104.8	5 min
111.8	1 min
114.8	30 seconds
Over 115	No exposure

The Occupational Health Clinics for Ontario Workers (OHCOW) performed these calculations based on the formula to determine "equivalent sound exposure level" in the updated Ontario Regulations for Industrial Establishments, Section 139(2).

The actual formula set out in the regulation is as follows:

$$L_{ex,8} = 10 \log_{10} \left(\frac{\left[\sum_{i=1}^{n} (t_i \times 10^{0.1\,SPL_i}) \right]}{8} \right)$$

It is also worth noting, OHCOW provides a mechanism on their website to help calculate total worker exposures when sound levels vary over time.

How can you control noise exposure?

At the source

The surest way of preventing noise-induced hearing loss is to eliminate noise hazards at the source. This is accomplished through engineering controls such as designing quieter machines, and modifying existing equipment. Isolating vibrating parts within a machine can reduce structure-borne sound. In this vein OHCOW recommends using helicoidal gears instead of toothed gears, avoiding discontinuities (elbows) or sharp edges in air streams, and using rubbery materials on all resonating parts.

Along the path

While waiting for the implementation of controls at the source, the next best control is one preventing noise from reaching the worker along the path. Controls along the path include the following:

- separating workers from the noise source;
- using sound-absorptive materials such as acoustic tiles;
- using mufflers to reduce noise from machines like air compressors; and
- erecting enclosures, or barriers around workstations and control rooms.

At the worker

This control method includes administrative and maintenance provisions as well as personal protective equipment (PPE). Examples of administrative controls include conducting noisy operations during non-working hours or job rotation from noisy areas to less noisy areas.

Though far from the best control method, employers often use PPE to protect workers against noise hazards because it is cheap and easy to implement. In order to be effective, hearing protection must:

- be adequate for the specific noise hazard;
- be maintained according to manufacturers' recommendations;
- fit and be comfortable;
- not create other health and safety hazards.

Ear protection is given a noise reduction number rate (NRR) shown as a number. The noise reduction rating is determined in a laboratory and may not reflect actual workplace use. To compensate users should mentally reduce numbers by about 25 per cent for muffs, 50 per cent for formable plugs and 75 per cent for ordinary plugs. For example a formable plug rated at an NRR of 29dB in application may only reduce noise by about 15dB. The Canadian Safety Association (CSA) also has standards on ear protection equipment.

Noise Abatement Program

In many cases a noise abatement program can significantly reduce noise, especially in workplaces where workers are exposed to high noise levels.

An effective noise program includes the following elements:

- a trained program coordinator;
- worker and JHSC training and education;
- worker involvement through the JHSC or worker representative;
- noise hazard information made available to the JHSC;
- noise surveys;
- an engineering program with dates, progress checks and reduction priorities;
- a maintenance program monitored by the JHSC; and
- annual review/evaluation of the program.

Programs should include training requirements covering the effects of noise on hearing, symptoms of hearing impairment, legislative requirements and strategies to eliminate or reduce noise.

NOTE: The Workers Health & Safety Centre offers training programs in support of workplace noise abatement programs. For information contact a Workers Health & Safety Centre near you.

To access the above-mentioned OHCOW resource(s), visit **www. ohcow.on.ca**.

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