

**NOISE CONTROL  
AND  
HEARING CONSERVATION  
PROGRAM**

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## **1.0 INTRODUCTION**

Noise is a major occupational hazard. Short-term exposure to excessive levels of noise can result in temporary hearing loss, ringing or buzzing in the ear, or sudden hearing damage caused by short a short burst of extremely loud noise; the long term effect is permanent hearing loss. Non auditory effects include stress and problems with oral communications. Both short and long term effects can be prevented by timely recognition and control of noise exposure.

The Ontario *Occupational Health and Safety Act* requires employers to identify and control workplace hazards and to take every precaution reasonable in the circumstances for the protection of workers. The *Regulations for Industrial Establishments* (Regulation 851) sets out minimum requirements for control of noise. The standards set out in this program are more restrictive than those specified in the Ontario regulation. They are based on the current recommendations of the American Conference of Government Industrial Hygienists and represent a current consensus of good occupational hygiene practice. These guidelines have been adopted by a majority of other jurisdictions in Canada and employers within Ontario.

The objective of this program is the identification and control of all noise hazard areas and the protection of all employees and students who have the potential to develop noise-induced hearing loss.

## **2.0 SCOPE AND APPLICATION**

This program applies to all employees who work in noise hazard areas or who have the potential to develop noise-induced hearing loss as a result of their occupation. Nuisance noise, which may be irritating or annoying to some people, but which is not loud enough to be associated with noise-induced hearing loss does not fall under this program.

## **3.0 CRITERIA FOR NOISE EXPOSURE**

### **3.1 Individual Exposure**

An individual is considered noise exposed if he/she has the potential to develop occupational noise-induced hearing loss. Regular exposure to noise levels greater than a time-weighted average of 85 dB(A) or an “equivalent” noise exposure as listed in Table 1, is associated with the development of noise-induced hearing loss.

The level of 85dB(A) is not a fine line between safe and hazardous noise exposures. Some individuals may be more susceptible to the effects of noise and may be at risk of developing noise-induced hearing loss when regularly exposed to sound levels between 80 and 85 dB(A). Although the risk between 80 and 85 dB(A) is lower than that associated with regular exposure to noise levels greater than 85 dB(A), employees who work in such situations should be informed and offered appropriate hearing protection.

**TABLE 1**
**NOISE EXPOSURE LIMITS WITHOUT HEARING PROTECTION**

<b>Duration per Day (hours)</b>	<b>Allowable Level dB(A)</b>
16	82
8	85
4	88
2	91
1	94
0.5	97
0.25	100
0.125	103
0	106

### **3.2 Noise Areas**

An area or location is considered a noise hazard if sound levels are regularly at or above 85 dB(A).

## **4.0 PROGRAM ELEMENTS**

### **4.1 Noise Hazard Assessment**

Noise hazard areas and noise exposed workers will be identified by the appropriate manager or supervisor in conjunction with the health and safety coordinator and the health and safety committee.

The health and safety coordinator will arrange for a survey of noise levels and personal noise dosimetry if required. The coordinator will maintain a list of noise hazard areas and conduct periodic resurveys. If workplace conditions potentially change noise levels at any time, the supervisor of the area should contact the health and safety coordinator for a re-survey of the area.

#### **4.2 Engineering Controls**

In any noise hazard area, the feasibility of instituting engineering controls to reduce noise levels should be the first consideration. This is best done at the design stage and when purchasing new equipment. When new equipment is purchased, the noise specifications should be checked and consideration given to applying engineering controls to reduce noise levels to below 85 dB(A) if possible.

Depending on the circumstances, possible engineering controls could include barriers, vibration damping, source isolation and sound absorbing enclosures.

#### **4.3 Administrative Controls**

Where engineering controls are not practical or feasible, or unable to reduce noise levels below 85 dB(A), administrative controls such as changes in work procedures, rescheduling of noisy activity or decreasing the duration of exposure should be considered.

Clearly visible warning signs must be posted at the approaches to an area where sound levels regularly exceed 85 dB(A). These warning signs must clearly indicate that the use of hearing protection is mandatory or provide the maximum exposure time from Table 1 where an individual may be in the area without hearing protection.

In situations where a piece of equipment or machinery presents a noise hazard, a sign must be affixed to the equipment, in a clearly visible location, indicating that the operator must wear appropriate hearing protection.

#### **4.4 Hearing Protection**

Hearing protection must be worn by workers where noise exposures could exceed the levels given in Table 1. Regardless of the limits in Table 1, hearing protection should be available to workers on request where noise levels exceed 80 dB(A). Appendix 3 provides guidance on the selection of proper hearing protection.

#### **4.5 Education and Training**

All noise-exposed workers who are required to wear hearing protection must attend a training session with the health and safety coordinator. This training session will cover:

- Hazards of excessive noise
- Results of noise surveys in the work area
- Noise control strategies
- The proper selection and use of hearing protection

## **APPENDIX 1: Basic Information on Noise**

Noise is unwanted sound. The difference between sound and noise depends on the listener and the circumstances. The sound of amplified rock music can be a pleasurable sound to one person under certain circumstances, while the same level of sound in the workplace would be considered hazardous and subject to controls.

Sound is produced by vibrating objects and reaches our ears as waves in the air. As an object vibrates it causes slight changes in air pressure. These air pressure changes travel as waves through the air where they cause our ear drums to vibrate. The ear converts these vibrations into electrical impulses which they send to the brain which in turn interprets them as sound.

The two primary characteristics of sound which are important in the workplace are frequency and sound pressure.

### **Frequency**

Frequency is the rate at which the sound source produces sound waves. It is the number of times that a vibrating body completes one cycle of vibration. The unit for frequency is the hertz (1 Hz = 1 cycle per second). Low pitched or bass sounds have a low frequency, high pitched or treble sounds have a high frequency. The normal hearing range for a healthy young person is between 20 and 20,000 Hz. The sound of human speech is mainly in the range of 300 to 3,000 Hz.

### **Sound Pressure**

Sound pressure is the amount of air pressure fluctuation a noise source creates or the amplitude of the sound waves. We hear, or perceive, sound pressure as loudness. Sound pressure is expressed in units called pascals (Pa). A healthy young person can hear sound pressures as low as 0.00002 Pa. A normal conversation produces a sound pressure of 0.02 Pa. A gasoline powered lawn mower produces about 1 Pa.

Because this wide range of sound pressures is somewhat difficult to work with, they are converted to another unit called the decibel (dB), where the decibel is defined as:

$$\text{dB} = 20 \log (\text{sound pressure}/\text{reference pressure})$$

The reference pressure is the lowest pressure that the healthy young person can hear (0.00002 Pa). Therefore the sound pressure level ( $L_p$ ) of the quietest sound that a healthy young person can hear is:

$$L_p = 20 \log (0.00002/0.00002) = 20 \log (1) = 0 \text{ dB}$$

The sound pressure level in a very quiet room (0.002 Pa) is:

$$L_p = 20 \log (0.002/0.00002) = 20 \log (100) = 20 \times 2 = 40 \text{ dB}$$

The sound pressure level of a typical gas-powered lawn mower (1 Pa) is:

$$L_p = 20 \log (1/0.00002) = 20 \log (50,000) = 20 \times 4.7 = 94 \text{ dB}$$

### **A-Weighted decibels – dB(A)**

The human ear is not equally sensitive to all frequencies. If a person hears two sounds of the same sound pressure but different frequencies, one sound may appear louder than the other. This occurs because people hear high frequency noise much better than low frequency noise.

Noise measurement readings can be adjusted to correspond to this frequency dependence of human hearing. What is termed an A-weighted filter is built into the sound level meter to de-emphasize low frequencies. Decibels measured using this filter are A-weighted and are called dB(A). Noise regulations typically give exposure limits in dB(A).

This weighting serves two important purposes:

1. It gives a single number measure of noise level by integrating sound over all frequencies,
2. It gives a scale for noise level as perceived by the human ear.

Table A1 gives some typical noise levels in dB(A).



**TABLE A1**  
**TYPICAL NOISE LEVELS\***

<b>Noise Source</b>	<b>dB(A)</b>
Pneumatic chipper at 1 metre	115
Hand-held circular saw at 1 metre	115
Textile room	103
Newspaper press	95
Power lawn mower at 1 metre	92
Diesel truck 50 km per hour at 20 metres	85
Passenger car 60 km per hour at 20 metres	65
Conversation at 1 metre	55
Quiet room	40

\* Source: Canadian Centre for Occupational Health and Safety ([www.ccohs.ca](http://www.ccohs.ca))

**Noise Exposure Standards**

Noise exposure standards are not consistent throughout Canada. Standards are generally given as exposure-duration tables with the limits depending on two factors – the criterion level and the exchange rate.

**Criterion Level:**

The Criterion Level (Lc) is the steady noise level permitted for a full eight-hour work shift. It is set as that level above which there is a significant risk of noise-induced hearing loss for an individual exposed on an ongoing basis. The Ontario Industrial Regulations set this level at 90 dB(A), while most other jurisdictions in Canada as well as the American Conference of Governmental Industrial Hygienists set the level at 85 dB(A).

## Exchange Rate

The exchange rate is the amount by which the permitted sound level may increase if the exposure time is halved, or decreased if the exposure time is doubled. There are two exchange rates in common use – 3 dB(A) and 5 dB(A). The 3 dB(A) exchange rate is more conservative and it is the one used by most experts. The Ontario regulation uses 5 dB(A). Table A2 below compares the Ontario regulation with the more restrictive system employed by most other jurisdictions and adopted in this program.

**TABLE A2**

### COMPARISON OF NOISE EXPOSURE STANDARDS

<b>Lc = 85 dB(A) Exchange Rate – 3dB(A)</b>	<b>Maximum Permitted Daily Duration (hours)</b>	<b>Lc = 90 DB(A) Exchange Rate = 5 dB(A)</b>
85	8	90
88	4	95
91	2	100
94	1	105
97	0.5	110
100	0.25	115

**APPENDIX 2: Noise Measurement**

The most common instruments used for measuring noise are the sound level meter (SLM) and the noise dosimeter.

**Sound Level Meter**

A sound level meter consists of a microphone, electronic circuits and a readout display. The microphone detects the small air pressure variations associated with the sound and the readout displays the sound level in decibels. Sound level meters are classified as Type 1 or Type 2 with the primary difference being in the accuracy of the meter. Type 1 meters are accurate to  $\nabla$  1dB while Type 2 are accurate to  $\nabla$  2 dB. Type 2 meters are less expensive and are sufficiently accurate for industrial field evaluations.

Measurements using a sound level meter are made for initial surveys of a workplace and when the noise level remains constant and worker exposure to the noise is well-defined in time and location.

**Workplace sound level measurements should be taken with a Type 2 sound level meter set on slow response using the A-weighted filter. The instrument should be calibrated before and after each testing session to ensure measurement accuracy.**

- Measurements should be taken with the instrument held at arms length at the ear level of the employee.
- A number of measurements should be taken in the work area to determine maximum and minimum levels and indicate them on a plan of the workplace.
- A noise survey map should be made drawing contour lines of equal sound level and indicating the areas where the sound level exceeds 85 dB(A).

**Noise Dosimeter**

A noise dosimeter is a small, light device that clips to a person's belt, with a small microphone that fastens to the person's collar, close to an ear. The individual wears the dosimeter for the duration of a work shift. The dosimeter stores the noise level information and carries out an averaging process. It is useful when the noise level varies in duration and intensity throughout the work shift. The readout of the dosimeter is usually expressed as a percentage of the maximum permitted exposure. For purposes of this noise control program the noise dosimeter should have the following settings:

- $L_c = 85$  dB(A)
- Exchange rate = 3 dB(A)

### APPENDIX 3: Selection of Hearing Protection

Noise-induced hearing loss may be prevented through the effective use of appropriate hearing protection. Hearing protection must protect against the level of noise hazard, provide a comfortable fit, and comply with CSA Standard Z94.2-M1984, *Hearing Protectors*.

It is also important that workers receive appropriate training prior to the initial use of hearing protection.

There are two general categories of hearing protection devices – earmuffs and earplugs.

#### **Earmuffs**

Earmuffs are external hearing protection devices consisting of a headband and earcups. The earcups are cushioned and are intended to fit snugly against the side of the head. The earcup must completely encircle the ear in order to provide a good seal and protect the inner ear. Earmuff fit can be compromised by the use of other safety equipment such as glasses, goggles and hard hats so care must be taken to ensure a proper fit. Earmuffs must comply with CSA Standard Z94.2-M1984.

Earmuffs must be regularly inspected and maintained in good condition. Earcup cushions which are cracked, hardened must be replaced. The headband must maintain adequate tension against the ear or it must be replaced.

#### **Earplugs**

Earplugs are hearing protection devices which are inserted into the ear canal. Earplugs must fit snugly and seal the ear canal to provide adequate noise attenuation to protect the inner ear. Earplugs must comply with CSA Standard Z94.2-M1984.

There are a variety of different earplugs available but the most common types are expandable foam or preformed plugs with flanges. To get the best fit, the ear should be pulled back with the opposite hand to straighten the ear canal and the earplug inserted with clean hands. Earplugs can work loose through the day and therefore should be resealed periodically.

Earplugs are either disposable (used only once) or reusable. With proper care the latter can be used for up to six months. Reusable earplugs must be regularly inspected and cleaned (washed with mild soap and allowed to dry in a clean

environment). If the earplug becomes hard or is not able to provide a good seal, the earplugs must be replaced.

**Selection of Hearing Protection**

Hearing protectors are classified as Class A, B or C based on the minimum noise attenuation at various assigned frequencies. Class A provides the highest level of attenuation across the test frequencies, Class B provides the next highest level of attenuation and Class C provides the least attenuation.

The following Table provides recommended hearing protection for various noise levels.

<b>Time Weighted Average Noise Exposure</b>	<b>Recommended Class of Hearing Protection</b>
TWA less than 85 dB(A)	Hearing protection not required
TWA up to 89 dB(A)	Class C
TWA up to 95 dB(A)	Class B
TWA up to 105 dB(A)	Class A
TWA up to 110 dB(A)	Class A earplug + Class A or Class B earmuff
TWA greater than 110 dB(A)	Class A earplug + Class A or Class B earmuff and limited exposure