Workplace Safety & Prevention Services®

INFORMATION

HEARING CONSERVATION/HEARING LOSS PREVENTION

Introduction

The risk of noise-induced hearing loss is often ignored until too late because:

- Hearing loss causes no pain
- Workers may feel discomfort and pain from excessive noise, but not from the hearing loss
- The loss can occur gradually, so that exposed workers don't notice until significant damage has occurred

Once damaged, hearing cannot be restored. Damaged hearing can affect job performance, health and productivity.

Job performance

Hearing impaired workers may pose a hazard to others and to themselves. They may misunderstand warnings and instructions.

Health

The non-auditory effects of noise may include:

- Anxiety
- Depression
- Fatigue
- Withdrawal from social activities
- Poor digestion
- Stress
- Poor self-image
- Higher blood pressure and heart rate (hypertension)

Personal productivity

If the job involves a lot of communication, hearing impaired workers may quit or transfer to another position rather than risk criticism or suspicion of incompetence.

Corporate productivity

Compensation premiums, surcharges and penalties can affect the workplace's productivity and financial health.

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Workplaces often contain many sources of noise. Left unchecked, these sources can cause serious harm and easily exceed legal limits. (For more on legal requirements, see 'Legislation')

Many options exist for controlling noise exposure. The best way to protect workers from exposure to excessive noise, and ensure workplaces meet their legal obligations, is to set up a hearing conservation and hearing loss prevention program.

Components of a Hearing Conservation/Hearing Loss Prevention Program

A hearing conservation/hearing loss prevention program is a planned, coordinated course of action implemented to prevent hearing loss. However, effective programs do more than prevent hearing loss. They can:

- Improve employee morale
- Create a sense of well-being
- Improve production values, and
- Reduce the incidence of occupational disease

Hearing conservation and hearing loss prevention programs include:

- Engineering controls to minimize the amount of sound energy generated
- Administrative controls or procedures for performing specific jobs or tasks
- Hearing Protection Devices
- Training in the following subjects:
  - Health effects of noise
  - Use, care and fit of hearing protection devices
  - Job procedures
  - Other program components, as required
- Periodic exposure monitoring
- Audiometric testing

Program Considerations

Appearing below are five considerations for developing and implementing a hearing conservation/ hearing loss prevention program.

- Design the program in consultation with joint health and safety committees
- Develop procedures for workplace monitoring and employee testing

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- Add criteria for minimizing noise output to purchasing policies
- Keep records of training, exposure monitoring and audiometric testing
- Review the program with the joint health and safety committee every year or whenever a new process or piece of equipment is introduced or whenever there is a change in legislation

Setting up a program

Setting up a program involves:

- Identifying areas in the workplace where high noise levels exist
- Assessing the levels to which workers are exposed
- Implementing a control program

Identifying Areas with High Noise Levels

Tip: if background noise makes it difficult to carry on a conversation, then the noise levels in that area probably exceed safe limits.

Preliminary ways to identify potentially unsafe areas include the following:

- Conducting a walk-through survey
- Tapping into others' experience by:
  - Reviewing journals, books and other publications on noise, especially those specific to your industry
  - Seeking employee input
  - Asking colleagues in similar workplaces to share insights

Common noise sources

The main sources of noise in most industries are:

- Grinding operations
- Machinery powered by compressed air (air jet noise)
- Fume extraction and ventilation fans
- Gears, especially those driving several pieces of equipment
- Tools (e.g., oxy-acetylene welding torches, pneumatic nail drivers)
- Squealing pigs

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- Night club music and crowds
- Kids screaming at amusement parks

Note: every workplace may have additional equipment or processes that emit noise.

Noise Sources and Corresponding Noise Levels

Processes	dBA*	Tools	dBA*
Air carbon arc cutting	120	Explosive fastening tools	131
Hammer mill	102	Tractor (under full load)	120
Punch press	100	Impact air guns	102
Arc welding	95	Riding mower	95 – 100
Material conveyor belt	95	Compressed air guns	98
Large tire curing press	93	Table saw	95
Plastic grinding machine	89	Chain saw (operating)	94 – 116
Bread slicing	85 – 90	Propane forklift truck	92
Laundry facilities	74	Paint spray gun	91
Office equipment	55	Blast-freezer/chiller	85 – 107
Dough-mixing	85	Orchard sprayer	85 – 100

*dBA (decibel A scale) is a measurement of sound pressure. (See 'Glossary' for more on hearing conservation/hearing loss prevention terminology.)

Mapping noise sources

Once you have identified noise sources, create a floor plan that shows:

- Equipment and workplace layout
- Areas where noise may be a problem
- Number of workers in those areas
- Noise control measures already in place (for examples of control measures, see 'Implementing a Control Program')

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Assessing Noise Levels

With the location of noise sources in hand, you can assess the level of noise to which workers are exposed. CSA Standard CSA Standard Z107.56-13, "Measurement of Noise Exposure", explains how to carry out measurements, what instruments are needed, and how to interpret results.

Three types of measurements are commonly carried out:

- Area noise level measurements
- Personal exposure measurements
- Frequency measurement

Area noise level measurements

Area measurements indicate the level of noise in the area at the time the measurement is taken. It can only determine exposure if the noise level is constant, and the exposed worker(s) stays in the area during the entire shift.

- **Equipment used:** a sound level meter.

Personal exposure measurements

Personal exposure measurements track exposure to noise over time (usually eight hours). The measurement is taken by equipment that calculates the total amount of sound energy received by a microphone.

- **Equipment used:** a personal dosimeter or an integrating sound level meter. Personal dosimeters are the preferred choice. Since they are worn by the workers, personal dosimeter measurements better reflect actual exposure.

Note: always take more than one personal exposure measurement, since noise levels often vary. Guidelines on the number of samples necessary, according to the accuracy required, appear in CSA Standard Z107.56-13.

Frequency measurement

Frequency measurement, also known as octave band analysis, helps in the:

- Design of noise absorbing enclosures
- Selection of personal protective equipment

This type of measurement is best done by a noise consultant, and is not necessarily for determining exposure.

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Ototoxic effects

Certain chemicals are toxic to hearing organs and the nerves that supply these organs. In work environments where there may be exposure to noise as well as certain chemicals (toluene, lead and manganese), noise-exposed workers may be at a higher risk of hearing impairment.

Implementing a Control Program

Having identified noise sources and calculated exposure levels, you can now decide what control methods best suit your workplace. Three options, in order of preference are:

- Engineering controls
- Administrative controls, and
- Hearing Protection Devices

Other elements of a control program include:

- Employee training,
- Hazard Communication (posting warning signs, notifying employees of noise levels) and
- Audiometric testing

Engineering controls

These control measures include:

- Modifying equipment to reduce noise output
- Absorbing the noise before it spreads
- Changing the frequency of the noise

Information on noise control measures for specific industries is scarce. However, the following measures apply to many pieces of equipment and many industry sectors:

- Using helical or other low noise gearing to reduce noise
- Using anti-vibration mounts and flexible drive couplings to prevent transmission of noise from one part to another
- Mounting motors and pumps on
- Anti-vibration mounts
- Building noise considerations into the design and selection of valves

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- Installing more flexible hosing to reduce hydraulic system noise
- Installing silencers to reduce noise from pneumatic tools
- Installing enclosures around noisy machinery
- Installing noise absorbing paneling on walls and ceilings

(See 'Additional Information' for more sources of information on engineering controls.)

Administrative controls

If noise cannot be reduced by engineering controls, then consider administrative controls to modify how work is performed. These measures include:

- Reducing exposure by limiting the time employees stay in a noisy area
- Performing noisy operations when the least number of workers are present e.g., during lunch or after shifts end
- Changing the way in which work is performed, e.g., minimizing the need to strike items or drop them into bins
- Routine maintenance of equipment
- Rotating workers

Note: worker rotation is a controversial option since it can be seen as merely distributing the risk among workers.

Personal protective equipment

If noise cannot be reduced by engineering controls or administrative methods, then provide hearing protection devices as personal protective equipment (PPE) and related training (see 'Training'). Hearing Protection devices can reduce the amount of noise reaching the ear by 8-15 dB.

Note: the actual reduction in exposure provided by hearing protection devices can vary from manufacturers' claims based on attenuation. Factors affecting the amount of protection provided include:

- How long the protection is worn
- How well it fits
- The material of construction
- The frequency of the noise. Low frequency noise causes PPE to vibrate and transmit the sound to the ear

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Selecting hearing protection devices

The table below indicates the class of hearing protector recommended for specific noise levels. Ensure that the protector is suitable for the noise level and noise frequency.

Z94.2-14 Hearing Protection Devices – Performance, Selection, Care and Use

Table 4 Selection of Hearing Protection Devices (HPDs) based on class and noise exposure, presuming a desired effective exposure of Lex, 8h = 85 dBA when the HPDs are worn..

$L_{ex,8}$ (dBA)	Recommended Class
≤ 90	C
> 90 up to and including 95	B or BL
> 95 up to and including 105	A or AL
> 105	Dual*

Source: CSA Standard Z94.2-14

Noise Exposure Level ($L_{ex,8}$): noise exposure over an 8-hour period.

* Dual hearing protection shall be used. A minimum of a Class B earmuff and a Class A earplug shall be used. Also, it is recommended that exposure durations be limited. As required by Clause 9.6.6.2, octave-band analyses shall be conducted for attenuation predictions, and more frequent audiometric testing shall be provided.

Note: The classes in Table 4 are the minimum classes required for a specified noise exposure; however, it can be difficult to find a suitable class C product, since few exist in the market today, so an HPD of a higher class may be selected.

Training

Training helps to ensure that workers benefit from and support the controls implemented, especially PPE. Conduct a training needs assessment to determine what content and level of training are most suitable for your employees.

Common training topics include:

- Health effects of noise
- Control measures in place to reduce
- Noise exposure
- Reasons for audiometric testing, plus the confidentiality of testing results

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- Proper selection, fit, use and care of hearing protection devices

Note: use examples and situations that apply to your workplace.

Audiometric testing

Ongoing audiometric testing helps to ensure your program is effective. Testing and analysis can identify why hearing loss has occurred, and how to prevent further loss. If the testing is being conducted by a consulting firm, provide the firm with exposure data and information on control measures in place.

Testing considerations

Timing – Test employees before they start working in a noisy area to set a benchmark for later tests. Conduct periodic testing as recommended by CSA Standard Z1007-16 Hearing Loss Prevention Program Management.

Accuracy – The following considerations help ensure accurate results:

- The tester must be qualified to conduct audiometric tests
- Tests must take place in a controlled environment, preferably a testing booth
- The instruments must be calibrated to ensure accuracy
- The results must be evaluated – either by examining individual audiograms, or by analyzing the results of a group of audiograms – using audiometric data base analytical techniques
- The participating employees must understand the importance of these tests

Discuss with prospective audiometric testing firms how they will meet these conditions (refer to CSA Standard Z1007.6-M90 (R2015), Pure tone Air Conduction Threshold Audiometry for Hearing Conservation).

Periodic exposure monitoring

Periodic monitoring of employee exposure can help indicate deficiencies in engineering and administrative controls, and reveal problems before they appear in audiometric test results (refer to CSA Standard Z1007.16, Hearing Loss Prevention Program Management).

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Legislation

Regulation 381/15: Noise

Specific requirements regarding noise exposure appear in Regulation 381/15: Noise under the Occupational Health and Safety Act. Every employer must ensure that a worker is not exposed to a sound level greater than an 'equivalent sound exposure level' of 85 dBA, $L_{ex,8}$. Where it is determined that workers are exposed to a sound level greater than an equivalent sound pressure level of 85 dBA over an 8hr period, the regulation also requires that:

- Protective measures are put in place, which includes the provision and use of engineering controls and work practices.
- Workers wear hearing protection devices appropriate in the circumstances provided that all engineering controls are not suitable as per the limitations listed in Regulation 381/15: Noise.
- Where it is practical, a clearly visible sign be posted at every approach to the area where the sound level regularly exceeds 85 dBA.

Table of Equivalent Noise Exposures

Steady Sound Level dBA	Duration	Steady Sound Level dBA	Duration
82	16 hours	97	30 minutes
85	8 hours	100	15 minutes
88	4 hours	103	7.5 minutes
91	2 hours	106	3.75 minutes
94	1 hour	109	1.88 minutes

Source: ACGIH book: 2016 edition of TLVs and BEIs.

The table outlines the maximum permissible daily exposure duration for the steady sound levels provided. For example, if a worker is exposed to a steady sound level of 88 dBA, the maximum permissible daily exposure duration is 4 hours. Any additional noise exposure that would cause the 85 dBA $L_{ex,8}$ exposure limit to be exceeded would require control measures to protect the worker's hearing.

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Note: The regulation requires that every employer take all measures reasonably necessary in the circumstances to protect workers from exposure to hazardous sound levels. Engineering controls should be first attempted before implementing a Personal Protective Equipment program. See Regulation 381/15: Noise, for further specifications on when workers are required to wear and use hearing protection devices. Refer to the Regulation for specific legislative requirements (http://www.e-laws.gov.on.ca)

Standards

Canadian Standards International, formerly the Canadian Standards Association, has developed many standards related to noise. These standards list the procedures, required instruments and method of analyzing measurements. A list of standards appears in 'Additional Information'.

Additional Information

The following is a list of sources that can provide further information.

Standards

- CSA Standard Z94.2-14, (updated 2014) "Hearing Protection Devices – Performance, Selection, Care and Use"
- CSA Standard Z107.4-M86 (R2001), "Pure Tone Air Conduction Audiometers for Hearing Conservation and for Screening"
- CSA Standard Z107.53-M1982 (R2004), "Procedure for Performing a Survey of Sound due to Industrial, Institutional or Commercial Activities"
- CSA Standard Z107.56-13, "Procedures for the Measurement of Occupational Noise Exposure"
- CSA Standard Z107.6-M90 (R2015), "Pure Tone Air Conduction Threshold Audiometry for Hearing Conservation
- CSA Standard Z1007-16, Hearing Loss Prevention Program Management

Websites

- Canadian Centre for Occupational Health and Safety: www.ccohs.ca
- American Conference of Governmental Industrial Hygienists: www.acgih.org
- Ontario Ministry of Labour: www.labour.gov.on.ca
- The Agricultural Health and Safety Network, Canadian Centre for Health and Safety in Agriculture (CCHSA), University of Saskatchewan: http://www.cchsa-ccssma.usask.ca/ahsn/HEARING_Book_Cover.pdf

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Glossary

Attenuation – a reduction of sound pressure level incident upon the ear.

dB (decibel) – a measurement of sound pressure where 0 dB is defined as being the faintest sound that a person with normal hearing can hear. This measurement scale is not additive. For example, an increase from 10 to 20 dB does not mean that the sound pressure has doubled. Instead, it means that the sound pressure has increased by a factor of 10.

dBA (decibel A scale) – a measurement of sound pressure that has been modified to take into account that the ear is not equally sensitive to all frequencies.

Equivalent sound exposure level – the steady sound level in dBA which, if present in a workplace for eight hours in a day, would contain the same total energy as that generated by the actual and varying sound levels to which a worker is exposed in his or her total work day, determined in accordance with the formula set out in subsection (2). Regulation 381/15: Noise.

Impact noise or impulsive noise – a noise of short duration where the sound pressure level rises very rapidly to a peak and decays to background level (e.g., hammering metal plate, nail gun).

NRR (Noise Reduction Rating) – a single number representing the attenuation value for a given hearing protection device (i.e., ear plug, ear muff, etc.). These numbers are developed in ideal laboratory conditions and may not represent the true attenuation of the hearing protection device when worn by a worker, due to variability in exact fit, imperfect seal due to movement of jaw or perspiration, deterioration of device over time, and does not account for any modification made by the wearer.

Noise – unwanted sound that causes harm, either by causing hearing loss or stress, or interferes with communication.

Sound energy – the amount of energy transmitted to the ear by noise.

Sound pressure – the fluctuations in air pressure caused by noise. The louder the noise, the greater the changes in air pressure. These fluctuations cause the ear drum to vibrate.

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How can WSPS help?

Our occupational hygiene specialists provide the following services:

- Noise level surveys
- Qualitative assessments
- Area and personal noise exposure assessments
- Assistance with meeting legislative requirements
- Workplace program audits and training

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