Hearing Conservation Procedures

Purpose

The University of Regina is committed to providing a safe and healthy work and educational environment for all members of the University community by ensuring that the Hearing Conservation Procedures are in place to minimize work related noise induced hearing loss.

The Hearing Conservation Procedures define and stipulate the responsibilities of all workplace parties involved in the development, administration and implementation of the procedures. The University strives to control excessive noise levels; however, certain operations and work areas may expose workers to significant noise levels.

Where feasible, workplace noise levels will be minimized by engineering and/or administrative methods. As a last resort, personal protective equipment in the form of hearing protectors will be required. Identified noise hazard areas shall be defined where the time weighted average (TWA) exceeds 85 dBA; the use of appropriate hearing protectors shall be mandatory in these areas.

Legislation

Part VIII of the Occupational Health and Safety Regulations require that the University of Regina must do everything reasonably practicable to bring noise exposure to 85dBA L_{ex} or less, and the work area noise level to 90 dBA or less. A change to the workplace environment, through design of the workplace, work processes, suitable work practices or administrative controls, is the primary method of noise reduction.

Definitions

Action levels are the levels of noise exposure at which an employee must be enrolled in the Hearing Conservation Program and provided with audiometric testing, appropriate hearing protectors, and training on noise hazards. The University of Regina, Health, Safety & Environment has set the action level at 85 dBA L_{ex}.

Audiogram is the graphical representation of an individual's ability to discern sound at the time of the audiometric test.

Audiometric testing is a hearing test that provides an audiogram which can be compared with prior or future audiograms to determine changes in hearing thresholds.

Decibel (dB) is a measure of expressing sound levels. Decibel is the base unit used to express the intensity of sound. The dB measurement is not linear, and for every increase of 3 dB the sound pressure, or noise level, actually doubles. For example, 83 dB is twice as loud as 80 dB.

dBA is the sound level measurement that approximates the “loudness” of tones most closely matching human noise perception and is measured using a sound level meter set to measure sound on the A-weighting scale.

dBA L_{ex} indicates the average decibel level measured on the A-weighting scale over an 8 hour period.
**Engineering controls** help reduce exposure to potential hazards either by isolating the hazard or by removing it from the work environment. Engineering controls include mechanical ventilation and process enclosure, and are preferred to other control measures such as the use of personal protective equipment.

**Noise** is any unwanted sound.

**Noise Induced Hearing Loss** is attributed to harmful levels of noise exposure and causes a reduction of the ability to discern sound due to inner ear damage.

**Supervisor** means a person who is authorized by the University of Regina to oversee or direct the work of employees or students.

**TWA** is the Time Weighted Average exposure level, determined by the Provincial government, to which a person can be safely exposed to for 8 hours a day, 5 days a week.

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**Responsibilities**

1. **Vice-President (Administration)** will:
   1.1 ensure the management support and leadership necessary to provide a safe and healthy working environment for staff and students, in compliance with the Health and Safety Policy.
   1.2 ensure that adequate resources are available to implement appropriate measures.

2. **Associate Vice-Presidents, Deans, Directors, Department and Unit Heads** will:
   2.1 ensure that the Procedures are communicated to the faculty and staff.
   2.2 require compliance with the Procedures.
   2.3 ensure audiometric testing is provided to employees exposed to action level noise levels, at the expense of the Department/Faculty and during work hours.
   2.4 ensure the identification and posting of areas or work processes where noise levels are greater than 80 dBA.
   2.5 require that, where noise levels cannot be reduced below 85 dBA L<sub>ex</sub>, hearing protectors are provided at no cost and used.
   2.6 ensure that where the need for hearing protection is identified the user has been provided with proper fitting instructions, correct use, and care of all hearing protectors.

3. **Supervisors** will:
   3.1 inform employees and provide at least two choices of approved hearing protectors where the noise levels are greater than 85 dBA Lex.
   3.2 ensure the identification and posting of areas or work processes where noise levels are measured to be greater than 80 dBA.
   3.3 require that, where noise levels cannot be reduced below 85 dBA L<sub>ex</sub>, hearing protectors are provided at no cost and used.
   3.4 ensure the employee is trained on the selection, use and maintenance of the hearing protectors.
   3.5 ensure provision of education on the effects of noise, the advantages and disadvantages of hearing protectors, and the purpose and process of audiometric testing.
3.6 ensure audiometric testing is provided every 2 years for employees regularly exposed, at work, to noise levels equal to or greater than, 85 dBA $L_{ex}$, or who regularly work in areas where noise levels are equal to or greater than 90 dBA.

3.7 ensure that the employee is provided with appropriate preparation prior to the audiometric testing.

3.8 report to Health, Safety & Environment (HSE) whenever changes occur that may adversely affect the noise levels and when new hazardous noise levels are identified.

3.9 require compliance with the Procedures.

3.10 maintain all applicable records.

4. Employees exposed to noise will:

4.1 comply with the procedures regarding hearing protection.

4.2 participate in audiometric testing every 2 years when regularly exposed, at work, to noise levels equal to or greater than, 85 dBA $L_{ex}$ or regularly work in areas where noise levels are equal to or greater than 90 dBA.

4.3 use the hearing protectors in accordance with their training and instruction.

4.4 where required attend training sessions on noise hazards and controls, noise induced hearing loss and the hearing conservation procedures.

4.5 report any hearing protector problems and noise hazards to their supervisor.

5. Health and Safety Committee will:

5.1 support and promote implementation of the procedures and related education and training.

5.2 monitor the adequacy and effectiveness of the procedures.

6. HSE will:

6.1 provide expertise and advice to all levels of management, employees and students on matters pertaining to noise and hearing protection.

6.2 conduct noise exposure and survey assessments and identify areas or processes that require noise attenuation and/or posting.

6.3 receive, review and investigate all incidents related to noise and provide recommendations for corrective action.

6.4 maintain an accurate record of all employees’ Audiometric Tests.

6.5 ensure the procedures are kept current.

7. Certified Audiologist will:

7.1 communicate any identified standard threshold shifts to the employee, identifying the results of the audiometric test, and if necessary advising the employee to seek medical attention and undergo another audiometric test.

7.2 maintain audiometric test records that include:

- name and job classification of the employee
- date of the audiogram
- examiner’s name
- date of the last calibration of the audiometer
- employee’s most recent noise monitoring test results.

7.3 when requested, provide records of audiometric testing results, documentation of referrals, and reports to HSE to be placed on the employees official personnel file.

7.4 communicate any identified standard threshold shifts to HSE.
The Hearing Conservation Procedures have been developed to ensure that workers are protected from harmful exposures to noise. The Occupational Health and Safety Regulations require the University to, among other things, ensure the provision of appropriate hearing protectors, and arrange an audiometric test and appropriate counseling at least once every 24 months for each worker required or permitted to work in areas where noise levels are above 85 dBA $L_{ex}$ or regularly work in areas where noise levels are equal to or greater than 90 dBA.

Training
Education on the effects of noise, the advantages and disadvantages of hearing protectors, and the purpose and process of audiometric testing will be provided to all employees exposed to greater than 85 dBA $L_{ex}$ or regularly work in areas where noise levels are equal to or greater than 90 dBA. Training reminders will be posted in the workplace and on-line. A training program will be provided annually for each employee included in the hearing conservation plan.

Audiometric Testing
An audiologist, a physician or a registered nurse certified in audiometric testing will perform the audiometric test at no cost to participating employees. The employee’s department is responsible for scheduling the initial exam, preferably before the employee begins the job assignment, and subsequent exams every 24 months. This testing is to be conducted during a worker’s normal work time.

The audiometric test records must include:
- Name and job classification of the employee
- Date of the audiogram
- Examiner’s name
- Date of the last calibration of the audiometer
- Employee’s most recent noise monitoring test results

Preparation for Audiometric Testing
The supervisor should make arrangements to ensure that:
- the employee is advised to avoid exposure to loud noise (either on or off the job) for 14 hours before taking audiometric tests, and
- the employee does not work in an area in which the noise level exceeds 80 dBA for 14 hours before the test.

Noise Monitoring
Monitoring will be performed by HSE upon request of the supervisor of the affected department/faculty. HSE will determine amounts of noise to which an employee is exposed. Supervisors are required to notify employees exposed to 85 dBA Lex or above of the results of monitoring and of the steps being taken to protect the employee. Supervisors must ensure where noise levels are 80 dBA or above that the levels are posted. Monitoring shall be repeated whenever a change in production, process, equipment, or controls, may increase noise exposures.
Noise monitoring shall also be conducted at least every three years in suspected areas. If employees or supervisors suspect that anyone may be exposed to high noise levels, they are obligated to contact HSE and request noise monitoring.

Record Keeping
As required by law, HSE shall maintain an accurate record of all workplace noise level testing results and employee audiometric test results, which will be placed on the employees official personnel file.
Information provided below is from the University of Calgary – Hearing Conservation Program.

Sound vibrations travel through air, water, or solids in the form of sound waves. These waves are captured by the pinna of the outer ear and then transmitted through the auditory canal to the eardrum (Figure 1).

The eardrum vibrates in response to the pressure of the sound waves. The initial vibration causes the eardrum to be pushed inward by an amount equal to the intensity of the sound, so that loud sounds push the eardrum inward more than soft sounds. Once the eardrum is pushed inward, the pressure within the middle ear causes the eardrum to be pulled outward, setting up a back-and-forth motion.

Figure 1: Ear Diagram

The movement of the eardrum sets all three ossicles (hammer, anvil, and stirrup) in motion. The vibrating pressure of the stirrup (last ossicle) on the small opening leading to the inner ear sets the fluid in the cochlea in motion. The fluid motion causes a corresponding, but not equal, wavelike motion of the basilar membrane.

When the basilar membrane moves, it causes the small hairs on the top of the hair cells of the Corti to bend. The bending of the hair cells causes chemical actions within the cells themselves, creating electrical impulses in the nerve fibers attached to the bottom of the hair cells. The nerve impulses travel up the auditory nerve to the brain. Loud sounds cause a large number of hair cells to be moved and many nerve impulses to be transmitted to the brain.

A problem in any part of the ear may cause a hearing disorder or hearing loss. In general, hearing loss may be caused by a birth defect, an injury, or a disease.

**Hazard Identification**

Noise-induced hearing loss is one of the most common occupational illnesses; however it is often undetected because there are no visible effects. It usually develops over a long period of time and, except in very rare cases, there is no pain. A progressive loss of communication, socialization, and responsiveness to the environment occurs. In the early stages (when hearing
loss is above 2,000 Hertz (Hz)) the ability to understand or discriminate speech is affected. As hearing loss progresses into the lower frequencies, it begins to affect the individual's ability to hear sounds in general.

**Types of Hearing Loss**
The main types of hearing loss are conductive, sensorineural, or a combination of the two.

**Conductive Hearing Loss**
Any condition in the outer or middle ear that interferes with sound passing to the inner ear is classified as a conductive hearing loss. A conductive hearing loss can result from:

- Excessive wax in the auditory canal.
- A ruptured or heavily-scarred eardrum.
- Fluid in the middle ear.
- Dislocated or missing elements of the ossicular chain.
- Eustachian tube blockage.
- Otosclerosis (an abnormal growth of bone in the middle ear).

Work-related conductive hearing loss is not common, although it may occur occasionally as the result of accidents involving:

- An eardrum rupture or a break in the ossicular chain by a head injury.
- An explosion.
- A rapid pressure change in a decompression chamber.
- Penetration of the eardrum by a sharp object or fragment.

A significant number of conductive hearing losses are reversible through medical or surgical treatment.

**Sensorineural Hearing Loss**
Chronic noise-induced hearing loss is a permanent sensorineural condition that cannot be treated medically. "Sensory" hearing loss is associated with irreversible damage to the inner ear. The term "neural" suggests a degeneration of the neural elements of the auditory nerve. It is initially characterized by a declining sensitivity to high-frequency sounds, usually at frequencies above 2,000 Hertz (Hz).

Animal research studies indicate that after moderate exposures to noise, subtle effects may be noticed, such as:

- Twisting and swelling of hair cells.
- Disarray of the cilia on top of the hair cells.
- Detachment of the tectorial membrane from the cilia.
- Reduction of enzymes and energy sources in the cochlear fluids.

These are conditions that would reduce the sensitivity of the hair cells to mechanical motion. The system at this point is in a state of auditory fatigue. In order to initiate neural activity, more acoustic energy must enter the cochlea than did before the noise exposure.

As the severity of the noise exposure increases, the following changes increase in degree and eventually become irreversible (Figure 2a and 2b):

- Hairs become fused into giant cilia or disappear
- Hair cells and supporting cells disintegrate
- (Ultimately) the nerve fibres disappear
These damaging effects are increased in acoustic trauma, where a single noise exposure of relatively short duration but very high intensity occurs, such as an explosion. In this case, the system is vibrated so violently that its elastic limit has been exceeded. Attachments of the various elements of the organ of Corti are disrupted, hair cells are torn completely from the basilar membrane, and a temporary rupture of the reticular lamina may occur, allowing intermixture of fluids within the cochlea (poisoning those hair cells that may have survived the mechanical stress of the explosion).

**Effects of Noise**
The effects of noise can be simplified into three general categories, including primary effects, communication & performance effects and other health effects.

1. **Primary Effects**
The primary effects of excessive noise exposure may include:

   **Acoustic trauma** refers to a temporary or permanent hearing loss due to a sudden, intense acoustic or noise event, such as an explosion.

   **Tinnitus** describes the condition of "ringing in the ears." Individuals often describe the sound as a hum, buzz, roar, ring, or whistle. The inner ear or neural system produces the actual sound. The predominant cause of tinnitus is long-term exposure to high sound levels, though it can also be caused by short-term exposure to very high sound levels, such as gunshots. Non-acoustic events, such as a blow to the head, dietary issues, stress, jaw joint disorders, debris on the eardrum, or prolonged use of aspirin may also cause tinnitus. Many people experience tinnitus during their lives. Usually the sensation is only temporary; however, it can be permanent and debilitating. Diagnosis and treatment of tinnitus can be difficult because it is a subjective measurement.

   A **noise-induced temporary threshold shift** (NITTS) is a temporary loss in hearing sensitivity. NITTS may be the result of:
   - The acoustic reflex of the stapedial muscle.
   - Short-term exposure to noise.
   - Fatigue of the inner ear.

   With NITTS, hearing sensitivity will return to the pre-exposed level in a matter of hours or days, assuming that there is not continued exposure to excessive noise.
A noise-induced permanent threshold shift (NIPTS) is a permanent loss in hearing sensitivity due to the destruction of sensory cells in the inner ear. This damage can be caused by:
- Long-term exposure to noise.
- Acoustic trauma.

2. Communication and Performance Effects
The effects of excessive noise exposure on communication and performance may include:
- Difficulty understanding speech.
- Annoyance.
- Difficulty concentrating.
- Reduced efficiency.
- Low morale.
- Adverse social behaviour.

3. Other Health Effects
Other effects of excessive noise exposure may include:
- Quickened pulse rate; increased blood pressure; and narrowing of the body’s blood vessels as a result of noise may, over a long period of time, place an added burden on the heart.
- Abnormal secretion of hormones.
- Muscle tension.
- Ulcers.
- Loss of sleep.
- Fatigue.
- Stress reactions.

Causes of Hearing Loss
Hearing loss may be categorized in terms of possible cause.
1. Presbycusis: Hearing loss from the natural aging process causes a gradual hearing decline. It affects the ability to clearly hear high-pitched sounds such as children's voices, rustling leaves, and some musical instruments.
2. Noise-induced hearing loss:
   - Industrial hearing loss: Loss caused by work-related noise exposure.
   - Sociacusis: Loss attributed to the noises of everyday life.
   - Nosoacusis: Loss attributable to health deficiencies and diseases, including, hereditary progressive deafness, mumps, rubella, Meniere's disease, ototoxic drugs and chemicals, barotraumas and trauma from blows to the head.

Hazard Assessment
If there is a risk that workers may be exposed to noise at a work site in excess of 85 dBA L_{ex}, the supervisor must request that a noise assessment be conducted by HSE.

Hazard Control
There are various methods and equipment used to control noise in the workplace. The hierarchy of control that must be followed, as per the Saskatchewan OH&S Regulations is as follows: Engineering, Administrative and Personal Protective Equipment (PPE). In addition, substitution controls may be employed, as part of the engineering control measures.
1. **Engineering Controls**
   The best method of dealing with noise in the workplace is to reduce the noise at the source through the use of engineering controls. Engineering controls can eliminate the need for hearing protection, audiometric testing, and other elements of a hearing conservation program. Even if noise cannot be reduced to safe levels at the source, reducing noise increases the likelihood that hearing protection will be more effective in reducing noise exposure to below the 85 dBA exposure limit. Whenever practicable, one or more engineered options for noise control reducing worker exposure levels below the legislated limit should be implemented. Some possible options include:
   - **Reduction at Source** – Many potential noise problems can be solved by choosing quieter equipment. When new equipment is purchased, specifications should include either a limit on the noise, or a requirement for the supplier to provide noise performance data. If noise is not engineered out in the design stage, retrofitting existing equipment with noise control devices such as mufflers, silencers, special nozzles, or isolators can sometimes be effective in reducing the overall noise output.
   - **Enclosure of the Noise Source** – Enclosing the noise source is especially useful when the enclosure doubles as a safety guard or as an environmental control device. Enclosures reduce workers’ noise exposure by acting as a barrier and as a sound absorber. Noise reductions of 25 dBA are common with noise enclosures. The ceiling and walls should be lined with material that absorbs sound, otherwise noise will reverberate inside the enclosure and escape through small openings – often where workers are stationed. The size of all enclosure openings should be kept to a minimum.

2. **Administrative Controls**
   Education and training are the primary administrative controls for hearing protection. Administrative controls also include measures such as work-rest cycles, and infrequent work tasks. These controls are aimed at reducing the time a worker is potentially exposed to noise.

3. **Warning Signs**
   Workplaces in which the noise level exceeds 80 dBA TWA will have signs posted. The signs will provide the dBA reading for the equipment or area, the date the measurement was taken, and the initials of the person performing the measurements.