



Hearing Conservation Program

Prepared by Health, Safety & Well-being

Revised: July 2024

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SCOPE

This document is intended for all Western University workers, students, contractors, and all other persons who may work in an environment considered hazardous to their hearing. This includes activities which may produce hazardous noise in research labs and classrooms.

The Hearing Conservation Program was developed by Western's Office of Health, Safety & Well-being, which includes Health & Safety Consultants, Occupational Health Physician and Workplace Health Nurse.

Employees who have health-related concerns related to their work activities, or require audiometric testing information; contact Workplace Health at extension 85472.

Requests for noise assessments, information related to hearing protection devices, or information on the Ontario Legislation; contact Western's Health, Safety & Well-being Office at hsw@uwo.ca

PURPOSE

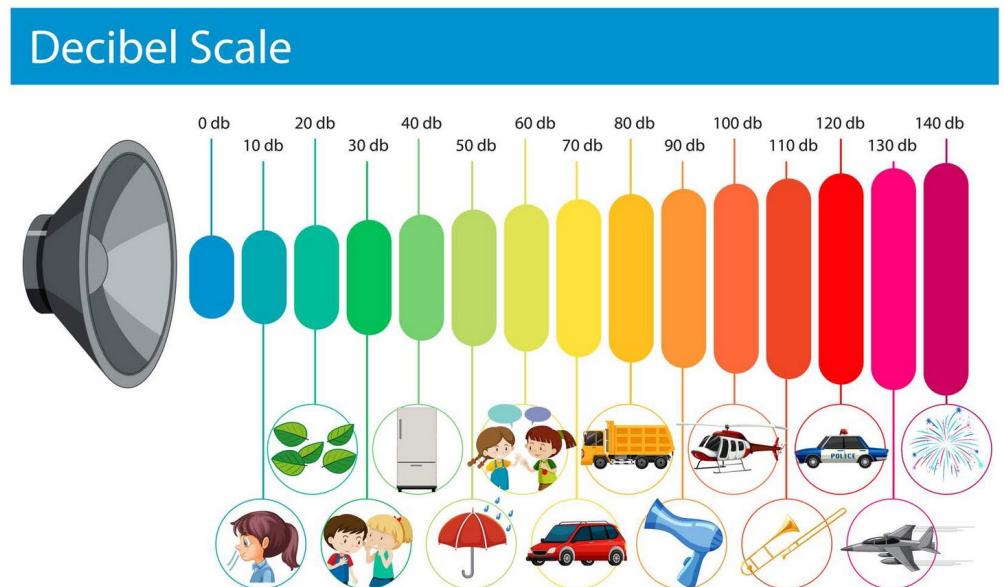
Ontario's [Occupational Health and Safety Act](#) (OHSA) legislates that employers have a duty to provide safe working conditions and take all reasonable precautions to protect the health and safety of workers. The purpose of Western University's Hearing Conservation Program (HCP) is to meet the requirements with OHSA [Ontario Regulation 381/15](#) and to reduce the likelihood that workers will develop occupational noise-induced hearing loss (NIHL) and/or other complications of noise exposure over time. The Program includes a strategy to identify noise hazards and invoke measures to protect all workers who are potentially exposed to high noise levels in the workplace. It also includes education and training in addition to audiometric testing and confidential record maintenance for affected workers.

NOISE AS A HAZARD

Noise is commonly identified as an occupational health hazard in many workplaces. Noise is produced when an object vibrates, creating waves that change the surrounding air pressure. These waves travel through space until they reach the ear, at which point, the sound waves are interpreted through our hearing mechanism and converted to information that can be relayed to the brain. While noise can be objectively measured, it is subjectively experienced by individuals. Meaning some people may be more sensitive, or less sensitive, to the same noise. However, the hearing mechanism is a very delicate system, and sounds approaching a defined threshold of volume/frequency/duration may damage human hearing, even if a person does not perceive that damage is occurring. This is why it is important to identify and measure noise hazards in the workplace, giving workers the opportunity to protect themselves prior to an exposure.

Nuisance noise may be irritating or annoying to some people but is not loud enough to be hazardous or associated with noise-induced hearing loss. Examples include road traffic, barking dogs, background music, office equipment, or even verbal speech. Nuisance noise is not covered by Western University's Hearing Conservation Program. Given the subjective nature of nuisance

noise, concerns of this type will be assessed separately, as required. Sound levels are measured in decibels (dB). Below is an illustration of common sounds and the sound pressure level associated with that sound.



Source: Decibel Scale (freepik.com)

Auditory Health Effects of Noise Exposure

Permanent hearing loss is perhaps the most concerning auditory health effect of problematic noise exposure in the workplace, but it is not the only one. Below is a list of auditory health effects of noise exposure (Sheppard, A., 2020).

Temporary Threshold Shift (TTS) – Hearing loss that recovers to baseline within hours, days, or weeks after a noise exposure.

Permanent Threshold Shift (PTS) – Hearing loss that does not return to a normal baseline after a noise exposure is called a permanent threshold shift or permanent hearing loss. PTS can occur as a result of multiple and/or lengthy exposures to loud noise. Multiple episodes of TTS may progress over time to become PTS. When noise exposure has been the cause of PTS, is termed **noise-induced hearing loss (NIHL)**. When normal, age-related changes have been the cause of PTS it is referred to as **presbycusis**. Audiometry testing is an effective way to distinguish between NIHL and presbycusis.

Acoustic Trauma – This is injury to the inner ear as a result of exposure to high-decibel noise or a physical injury. Acoustic trauma results in disruption of sound wave transmission from the air to the inner ear and brain, and may be permanent.

Tinnitus – Otherwise known as “ringing in the ears,” tinnitus may be perceived as a humming, buzzing, ringing, or whistling sound that may be intermittent or constant, unilateral or bilateral. The most common cause of tinnitus is hearing loss.

Sound Distortion – This occurs when the sound that a person hears is significantly different than the noise produced at the origin of the signal.

Diplacusis – Otherwise known as “double hearing,” diplacusis is a hearing impairment that causes a person to hear the same sound differently in each ear, creating a disturbing two-sound experience.

Hyperacusis – This refers to reduced tolerance of normal-intensity, everyday sounds. Individuals with hyperacusis are very sensitive to noise and sounds often seem much louder than they really are, causing significant discomfort.



Exposure to hazardous noise can also result in, or significantly contribute to, non-auditory adverse health effects. These include stress, high blood pressure, sleep disturbances, cognitive dysfunction, and workplace safety concerns.

ONTARIO LEGISLATION

An employer’s responsibility to identify and manage noise exposure in the workplace is legislated in the OHSA: [Ontario Regulation 381/15](#).

Section 2(1) – Every employer shall take all measures reasonably necessary in the circumstance to protect workers from exposure to hazardous sound levels.

Section 2(2) – The protective measures shall include the provision and use of engineering controls, work practices and, subject to subsection (5), hearing protection devices.

Section 2(3) – Any measurement of sound levels in the workplace that is done in order to determine what protective measures are appropriate shall be done without regard to the use of hearing protection devices.

Section 2(4) – Without limiting the generality of subsections (1) and (2), every employer shall ensure that no worker is exposed to a sound level greater than an equivalent sound exposure level of 85 dB(A) $L_{ex,8}$.

Section 2(5) – Except in the circumstances set out in subsection (6), the employer shall protect workers from exposure to a sound level greater than the limit described in subsection (4) without requiring them to use and wear hearing protection devices.

Section 2(6) – Workers shall wear and use hearing protection devices appropriate in the circumstances to protect them from exposure to a sound level greater than the limit described in subsection (4) if engineering controls are required by subsections (1) and (2) and,

- a) Are not in existence or not obtainable;
- b) Are not reasonable or not practical to adopt, install or provide because of duration/frequency of the exposures or because of the nature of the process, operation or work;

- c) Are rendered ineffective because of a temporary breakdown of such controls; or
- d) Are ineffective to prevent, control or limit exposure because of an emergency.

Section 2(7) – Where practicable, a clearly visible warning sign shall be posted at every approach to an area in the workplace where the sound level, measured as described in subsection (3), regularly exceeds 85 dBA. *Note: In order to capture variations in noise level, Western's action limit for further investigation is 80 dBA.*

Definitions

Audiometry: A method of hearing assessment which tests an individual's ability to hear sounds of different intensities and frequencies. Audiometry detects early, asymptomatic noise-induced hearing loss before the affected individual is even aware that it is happening.

CSA: Canadian Standards Association

dB: Decibel. The dB is a logarithmic and dimensionless unit for measuring sound pressure levels.

dBA: A-weighted decibel. The dBA is a decibel scale used because it closely represents the manner in which the human ear responds to noise.

Exchange Rate: The increase in sound level for which permissible exposure time is halved, or the decrease in sound level for which permissible exposure time is doubled. In Ontario, the exchange rate is 3 dB. For example, If the maximum allowable exposure to an 85 dB noise is eight hours, then the exchange rate tells us that the maximum allowable exposure to an 88 dB noise is 4 hours and the maximum allowable exposure to an 82 dB noise is 16 hours.

Equivalent sound exposure level (L_{eq}): The continuous sound pressure level of noise averaged over a period of time which contains the same amount of energy as that generated by the actual and varying sound levels being measured. Because occupational noise is complex and worker exposure may fluctuate throughout the work shift, the sound levels need to be averaged over a sample period that is representative of the entire exposure. $L_{ex,8}$ is the equivalent sound exposure level (L_{eq}) of noise averaged over 8 hours, the length of a typical work shift.

HCP: Hearing Conservation Program

Impact Noise: A very short burst of loud noise followed by a period of quiet. Examples include, gun shots, hammering, a punch press, or cymbals. Impact noise events last for less than one second and are separated from the next event by at least half a second ([CCOHS - Noise](#)).

NIHL: Noise-induced hearing loss

Noise: In general, noise is defined as any unwanted sound. Noise control measures in Western University's Hearing Conservation Program target noise levels and noise exposures which are associated with noise-induced hearing loss (refer to the definitions for 'noise-exposed' and 'noise hazard area' for clarification).

Noise dosimetry: A noise assessment technique that measures an employee's personal noise exposure. It is particularly useful when employees work in a variety of noisy areas for short durations at a time or perform different noisy operations on any given day.

Noise-exposed: For the purpose of this Program, a person is considered noise-exposed if the 8-hour time-weighted average (TWA) meets or exceeds 85 dBA or an 'equivalent' exposure (using a 3 dB exchange rate).

Noise hazard area: An area where the sound levels regularly meet or exceed 85 dBA.

Noise surveys: An analysis of noise in a defined area. Noise surveys provide valuable information regarding sound levels in an area. The most common type is a general noise survey which measures sound levels in A-weighted decibels (dBA). Another important type of noise survey is octave band frequency analysis. This type of analysis assists in the selection of potential noise control measures.

Noise Reduction Rating (NRR): A single number rating that indicates the overall hearing protector attenuation, used to evaluate the effectiveness of hearing protection devices.

Nuisance noise: Noise which may be irritating or annoying to some people but is not loud enough to be hazardous or associated with noise-induced hearing loss. Examples include road traffic, barking dogs, background music, office equipment, or even verbal speech.

OHSA: Occupational Health and Safety Act

Permanent threshold shift (PTS): Also known as permanent hearing loss

Temporary threshold shift (TTS): Also known as temporary hearing loss

Time-weighted average (TWA): The time-weighted average is a measure of the average noise exposure over a typical 8-hour workday, taking into account the exchange rate and ignoring measurements below an identified cut-off level (Western's noise assessment uses an exchange rate of 3dB, and threshold level of 70 dB).

WSIB: Workplace Safety and Insurance Board. This agency is responsible for administering Ontario's Workplace Safety and Insurance Act, which provides benefits and compensation to workers who are injured or become ill as a result of their work.

Measurement

Any worker is considered noise-exposed if they have the potential to develop occupational noise-induced hearing loss. Regular exposure to sound levels greater than a time-weighted average of 85 dBA or an "equivalent" noise exposure using a 3 dB exchange rate is associated with the development of noise-induced hearing loss. A guideline to hazardous noise exposure levels can be reviewed in Appendix A: Occupational Exposure Limits for Workplace Noise.

An equivalent sound exposure level (L_{eq}) is 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 their total workday. The equivalent sound exposure level is determined in accordance with the formula provided in [Ontario Regulation 381/15](#) in which:

$L_{ex,8}$ is the equivalent sound exposure level in 8 hours,

Σ is the sum of the values in the enclosed expression for all activities from $i = 1$ to $i = n$,

i is a discrete activity of a worker exposed to a sound level,

t_i is the duration in hours of i ,

SPL_i is the sound level of i in dBA,

n is the total number of discrete activities in the worker's total workday

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

It is important to recognize that some individuals are more sensitive to the effects of noise and may be at risk of developing noise-induced hearing loss when regularly exposed to sound levels lower than 85 dBA. In order to capture variations in noise levels, Western's action limit for further investigation is 80 dBA.

NOISE SAMPLING METHODS

Western University's Health, Safety & Well-being office is equipped to perform noise assessments. The Office has an integrating sound level meter and personal noise dosimeter. The 3M SE-402 Sound level Meter (SLM) can evaluate noise levels in a single, static environment or produced by a piece of equipment. The TSI Quest Edge 7 noise dosimeter is a wearable device to measure a worker's noise exposure levels. Both devices are used to assess compliance with applicable legislation and standards.



[TSI Quest SE-402 Sound Level Meter](#)



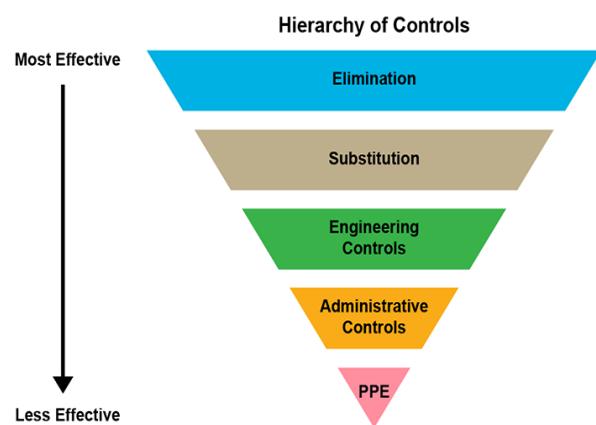
[TSI Quest - Edge 7 Noise dosimeter](#)

For accuracy of testing, these devices are calibrated using a 3M Acoustical AC-300 calibrator before and after each assessment and calibrated annually in a lab tested environment annually.

CONTROL MEASURES

In the workplace, Ontario Regulation 381/15, requires that employers ensure workers are not exposed to sound pressure levels greater than the equivalent sound exposure level limit of 85 dBA in the workplace, measured over an 8-hour workday. Western University has adopted 80 dBA as an action limit to investigate potential hazardous noise. A guideline to hazardous noise exposure levels can be reviewed in Appendix A: Occupational Exposure Limits for Workplace Noise.

The Hierarchy of Controls (Elimination, Substitution, Engineering, Administrative, and Personal Protective Equipment – PPE) is considered in determining which action(s) will reasonably control the noise exposure to reduce risk of injury. It is generally the best and preferred method to control noise at the source, and/or along the path, to reduce worker exposure. Control at the worker level with PPE is the least effective and should only be used if other methods are insufficient or are not reasonably practical to adopt.



Hearing Protection Devices

Health, Safety & Well-being provides Hearing Protection Devices (HPDs) when required, in compliance with Section 2(6); Section 4 of Ontario Regulation 381/15. As stated above, this level of control is used when other methods of control are insufficient or are not reasonably practical to adopt, as it is considered the least effective method of control and can have variable results if not worn correctly. Common types of HPDs provided are earplugs and earmuffs, shown in Table 1: Common Earplugs and Earmuffs. Devices used must comply with the CSA Standard Z94.2-14 “Hearing Protection Devices – performance, selection, care and use.”

Hearing Protection Devices are categorized and labeled according to a particular Class and/or Noise Reduction Rating (NRR). This is related to the attenuation of the HPD, which is the anticipated level of protection at the ear that would be provided by a properly functioning and fitted device. Both of these methods are considered in the selection of HPD at Western.

Class – the assignment of class to an HPD is the result of octave-band attenuation values measured in accordance with CSA Standard Z94.2-14, according to a defined attenuation range. The class is identified on packaging as (A/AL, B/BL, or C).

Noise Reduction Rating – also known as NRR, describes how well the hearing protection device will reduce the noise entering the ear. It is commonly listed on the package of hearing protectors. The NRR is generally an **overestimation** of the protection provided by the hearing protectors, which should be taken into account when selecting PPE.

Table 1: Common Earplugs and Earmuffs

Make and Model	NRR	Class	Image
3M x4A earmuffs	27	AL	
Moldex twist in earplugs	30	AL	
3M E-A-R soft earplugs	33	AL	

General use guidelines include the following:

- Manufacturer's instructions for use should be followed.
- Inspect the device regularly for wear and tear, and replace as needed.
- Always ensure a tight seal with the ear canal or against the side of the head is achieved.
- When handling and fitting HPDs, ensure that both the device and your hands are clean.
- When reusable HPDs are chosen, proper storage in a clean, suitable environment is critical.



Music playing devices increase the risk of noise exposure and distraction in the workplace that interfere with the ability to receive important sounds. Personal audio devices are not considered HPDs. These types of devices shall not be used.

More information on the selection of Hearing Protection Devices can be found at [CCOHS - Personal Protective Equipment](#).

Training

Training must be provided to every worker required to wear HPDs as outlined in Section 3 of Ontario Regulation 381/15. Training must include: the care and use of the device, including its limitations, proper fitting, inspection, and maintenance and, if applicable, the cleaning and disinfection of the device. In general, it is recommended to always follow the manufacturer's instructions for use of HPDs.

To meet the training requirement of the use of HPDs, Health, Safety & Well-being have created an online training module to provide the worker with general training and education on this topic. This module is available through Western's Human Resources - Required Training page.

A YouTube video is also available to demonstrate how to fit foam earplugs [Fitting Foam Earplugs](#).

The distribution and training of Hearing Protection Devices is required. It is the responsibility of the supervisor, in conjunction with Health, Safety & Well-being to maintain up-to-date records. Record keeping should include the following:

- The worker's name and Western ID number
- Department name and job title of worker
- Date of training and distribution of PPE
- Make and model of PPE provided
- Worker's signature

For additional information on training, materials and the selection of HPDs, please contact Health, Safety & Well-being at hsw@uwo.ca

SIGNAGE

Western University posts applicable signage in compliance with Section 2(7) of Ontario Regulation 381/15 which states that "a clearly visible warning sign shall be posted at every approach to an area in the workplace where the sound level regularly exceeds 85 dBA." Western University has adopted 80 dBA as an action level for further investigation of an area for signage requirements.

An example of signage can be found in Appendix B: Hearing Protection Must Be Worn. Signage is available through Western's Health, Safety & Well-being office at hsw@uwo.ca

AUDIOMETRIC SCREENING

An audiometry exam tests a person's ability to hear sounds of different volumes at different frequencies. Results of an audiometry exam are presented in an audiogram; this is a graph depicting the softest sounds a person can hear at different pitches. Repeated tests at regular intervals can identify if any changes have occurred in a worker's hearing which may be a result of noise exposure. Audiogram results play a role in determining how to implement noise control measures to prevent further damage.

Audiometric screening is conducted by the Workplace Health Office. This service is offered to workers who may be exposed to excessive noise levels in the workplace, as identified through Western's Hazard Communication Form completed by the immediate supervisor during the onboarding process, and any time a worker's duties change.

RESPONSIBILITIES

Leaders

Deans, Directors, Chairs, and Budget Unit Heads are responsible for ensuring that all components of the Hearing Conservation Program are implemented and enforced in noise hazard areas under their jurisdiction.

Supervisors

Supervisors must maintain records of noise hazard areas/operations and noise-exposed employees. If hearing protection is necessary, the Supervisor must enforce its use and be prepared to take appropriate disciplinary action in the event an employee does not comply with this requirement. Enforcing the proper use of HPDs should be viewed in the same manner as the enforcement of other types of personal protective equipment (safety glasses, hard hat, safety shoes/boots, etc.).

Supervisors, in conjunction with Health, Safety & Well-being team members, are responsible for the following:

1. Identifying noise hazard areas and workers who may be exposed to hazardous noise
2. Maintaining an up-to-date list of noise hazard areas/operations and noise-exposed workers
3. Ensuring that all noise-exposed employees complete the Hearing Conservation Program training
4. Taking appropriate steps to minimize the risk of noise-induced hearing loss, including, but not limited to, implementation of noise control measures where feasible and provision of appropriate hearing protection devices
5. Ensuring noise-exposed employees participate in the audiometric testing program scheduled by Workplace Health
6. Ensuring that all new employees who may be exposed to hazardous noise levels undergo audiometric testing at Workplace Health within the first few weeks of employment
7. Ensuring that any noise-exposed employees who have terminated employment with the University undergo audiometric testing at Workplace Health prior to departure

Employees

Employees exposed to hazardous noise levels are responsible for the following:

1. Completing the Hearing Conservation Program Training
2. Participating in the audiometric screening program
3. Proper use and care for hearing protection devices provided
4. Reporting noise concerns to their supervisor

Health, Safety & Well-being

Health, Safety & Well-being is responsible for the following:

1. Defining, implementing and administrating Western's Hearing Conservation Program
2. Facilitating noise exposure assessments in work areas

3. Providing technical services and advice regarding noise control measures and hearing protection
4. Providing appropriate Hearing Conservation Program training and education
5. Reviewing the Hearing Conservation Program on an annual basis and updating as required

Workplace Health

Workplace Health is responsible for the following:

1. Assessing the hearing status of employees enrolled in the program at prescribed intervals (baseline, every 1-2 years, at exit) and following a hazardous exposure
2. Administering audiometric screening and maintaining confidential employee health records
3. Reporting cases of suspected occupational NIHL and/or other complications of noise exposure (including but not limited to tinnitus, sound distortion, diplacusis, & hyperacusis) to the Safety & Wellness Coordinator

Joint Occupational Health & Safety Committee (JOHSC)

JOHSC is responsible for:

1. Review and consultation of the Hearing Conservation Program
2. Incorporating “Hearing Protection Required” areas in JOHSC inspections of the workplace
3. Participating as needed in incident investigation relating to noise exposure

RECORDS

Records of noise level surveys, training, distribution of HPDs, and audiometric testing of those enrolled in Western’s Hearing Conservation Program will be maintained in accordance with confidentiality requirements and applicable legislation, to assist in facilitating external audits by regulatory agencies and investigation of claims for noise induced hearing loss, when required.

PROGRAM ADMINISTRATION

The Hearing Conservation Program will be assessed on a 12-month cycle with input from JOHSC. The effectiveness of the program will be determined by compliance observed during workplace inspections; training compliance; data analysis of Accident/Illness/Incident Reports related to noise exposure; and WSIB claims for noise induced hearing loss. This will also include a review by Workplace Health of the collective results of the workers’ annual audiograms.

RESOURCES

A guide to the Noise Regulation under the Occupational Health and Safety Act

- <https://www.ontario.ca/document/guide-noise-regulation-under-occupational-health-and-safety-act/regulation#section-5>

Canadian Centre for Occupational Health and Safety

- [CCOHS - Noise](#)

Canadian Centre for Occupational Health and Safety

- [CCOHS - Personal Protective Equipment](#)

Canadian Standards Association. (2019). *Hearing protection devices – Performance, selection, care and use* (CSA Standard Z94.2-14). Mississauga, ON: CSA Group

Environmental Scan of Hearing Conservation Programs from:

- Carleton University
- McMaster University
- University of Ottawa

Freepik.com

- Decibel Scale - <https://www.freepik.com/>

Occupational Health & Safety Act

- <https://www.ontario.ca/laws/statute/90o01>

Occupational Health Clinics of Ontario workers Inc.

- [Noise-Induced Hearing Loss \(NIHL\)](#)

Ontario Regulation 381/15: Noise

- <https://www.ontario.ca/laws/regulation/150381>

Sheppard, A. et al., (2020). Occupational Noise: Auditory and Non-Auditory Consequences. Int. J. Environ. Res. Public Health 2020, 17(23), 8963.

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7729999/>

Workplace Safety & Insurance Board: Noise is a hazard

- [WSIB - Tone it down](#)

Appendix A: Occupational Exposure Limits for Workplace Noise

Sound Level (in dB(A))	Duration (85 dBA L _{ex,8}) (hrs/24 hr day)	Duration (80 dBA L _{ex,8}) (hrs/24 hr day)
80.25	24	7½
81.5	18	5⅔
82.0	16	5
83.25	12	3¾
84.0	10	3¼
85.0	8	2½
86.25	6	2
88.0	4	1¼
89.25	3	1
91.0	2	40 min
92.25	1½	30 min
94.0	1	20 min
95.0	47 min	15 min
97	30 min	16 min
100	15 min	4.72 min
102	9.45 min	2.98 min
103	7.50 min	2.36 min

Appendix B: Hearing protection must be worn - sign

