Noise and Sound Safety Management

IMPLEMENTATION

Aim

To prescribe the responsibilities and actions required for the management of noise and sound on University premises and/or during University-related activities to ensure the University meets the requirements of the Health, Safety and Wellbeing (HSW) Policy and the relevant sections of the Work Health and Safety (WHS) Act 2012 (SA) and WHS Regulations 2012 (SA).

1 Objectives

1.1 To ensure that the risks arising from hazardous noise (see definitions) are identified, eliminated or, if that is not possible, controlled to prevent exposure to workers.

2 Scope and application

2.1 Inclusions

This process is applicable to all persons who undertake University of Adelaide related activities as a worker, and/or are employed or engaged by the University or affiliated with the University in any capacity as a worker as defined under the Work Health and Safety (WHS) Act 2012 (SA). This includes but is not limited to employees, title holders, volunteers, Higher Degree by Research (HDR) students, visitors or contractors where applicable.

2.2 Application

For the purpose of this chapter, references to noise include sound e.g. any sound created by music, speech, plant/equipment and/or the environment.

3 Process: Hazard Identification and assessment

	Person Responsible	Actions
3.1	**All workers**	☐ Report any work related noise and sound safety issue(s) you identify, which has the potential to expose you or others to hazardous noise (see Appendix A as a guide) in accordance with the Report a safety issue or incident HSW Handbook chapter to ensure appropriate investigation and follow-up.

3 Process: Hazard Identification and assessment

	Person Responsible	Actions
3.2	**Supervisor/ Person in control of the area/activity** (see definitions)	☐ Ensure any potential noise hazards (see definitions) in the School or Branch are identified in consultation with workers in the area. As a guide, refer to **Appendix A – Noise Hazard identification checklist.** **Where you have answered "yes" to any of the questions contained in Appendix A.** ☐ Conduct a risk assessment in accordance with the Hazard Management Handbook chapter and ensure as part of this process, a preliminary noise assessment is carried out using a non-integrating sound level meter as a minimum (available from the Central HSW Team), as an indicator. Refer to Appendix B1 – Common noise sources and their typical sound levels and Appendix B2 – Equivalent noise exposure limits as a guide. **Where you have identified any potential for exposure to hazardous noise (see definitions)** ☐ Arrange for a noise assessment to be conducted by a competent person (see definitions) in accordance with the Code of Practice "Managing noise and preventing hearing loss at work and AS/NZS 1269.1:2005 "Occupational noise management – Measurement and assessment of noise emission and exposure" in consultation with the local HSW Team. ☐ Ensure a noise assessment report is completed in accordance with the Code of Practice "Managing noise and preventing hearing loss at work (Appendix E)".

4 Process: Controlling the risks of hazardous noise

	Person Responsible	Actions
4.1	**Supervisor/ Person in control of the area/activity** (see definitions)	☐ Review the noise assessment report to identify the appropriate control measures. ☐ Seek assistance from the local HSW Team and/or Head of School/Branch (if assistance and/or additional resources are required) ☐ Record and implement the agreed control measures on the Risk Assessment template (commenced in 3.1) in accordance with the Hazard Management Handbook chapter, in consultation with the relevant workers. (Aim to eliminate the source of noise and sound completely if possible, or if not possible, minimise the risk in accordance with the hierarchy of control (e.g. substitution/isolation/engineering/administrative controls and/or provision of personal protective equipment [PPE]). Refer to Appendix C for examples of control measures and specific requirements under the Code of Practice for Managing noise and preventing hearing loss at work. Continued

4 Process: Controlling the risks of hazardous noise

	Person Responsible	Actions
4.1	Supervisor/ Person in control of the area/activity (see definitions) (Continued)	☐ Monitor that the control measures are being followed by workers. ☐ Ensure all noise and sound related safety issues or incidents are reported in the on-line system and investigated in accordance with the incident investigation HSW Handbook chapter. ☐ Ensure audiometric testing is provided for any workers who are frequently required to wear hearing protection as an identified control measure for noise and sound that exceeds the exposure standard in accordance with section 5.1.
4.2	**All workers**	☐ Review and comply with the control measures in noise risk assessments prior to undertaking work in noisy workplaces or with noise and sound emitting plant, equipment, or items. ☐ Report plant/equipment or tasks which increase noise and sound levels to your Supervisor/person in control of the area/activity. ☐ Record all noise and sound related safety issues or incidents in the on-line system. ☐ Identify sources of noise and sound that may cause or contribute to hearing loss, and if necessary, assess the risks associated with these hazards in consultation with your Supervisor/person in control of the area/activity.

5 Process: Audiometric Testing

	Person Responsible	Actions
5.1	Supervisor/ Person in control of the area/activity (see definitions)	☐ Notify the Faculty Technical Services Manager/HR Manager (or Faculty Executive Manager where neither is appointed) or Head of Branch if your activity/area requires audiometric testing. ☐ Ensure where audiometric testing is required that it occurs within three months of the worker commencing work and that this requirement is recorded e.g. using a Training Plan or Schedule of Programmable Events (SPE). Starting audiometric testing before workers are exposed to hazardous noise (e.g. new starters or those changing jobs) provides a baseline for future test results. ☐ Ensure that any audiometric testing and assessment of audiograms is carried out by competent persons in accordance with the procedures in AS/NZS 1269.4:2014 "Occupational noise management – Auditory assessment". ☐ Ensure that monitoring of hearing with regular audiometric testing (i.e. at least every 2 years). Note: More frequent audiometric testing may be needed if exposure is at a high LAeq8h, which is equal to or greater than 100 dB(A). Continued

5 Process: Audiometric Testing

	Person Responsible	Actions
5.1	**Supervisor/ Person in control of the area/activity** (see definitions)	☐ Conduct audiometric testing in situations where workers are exposed to vibration, ototoxic substances, acoustic shock at such a level as to cause hearing loss in the workplace. (For further information see the Code of Practice "Managing noise and preventing hearing loss at work Appendix B"). ☐ Ensure before introducing an audiometric testing program, that workers and their health and safety representatives (where applicable) are consulted. It is important that it is understood the aim of the testing is to evaluate the effectiveness of control measures to protect hearing. ☐ Ensure, through use of Training Plan or SPE, regular follow-up audiometric tests are carried out at least every 2 years. These should be undertaken well into the work shift so that any temporary hearing loss can be detected. ☐ Ensure workers are given the results of their audiometric testing accompanied by a written explanation of the meaning and implications. ☐ Provide a copy of any audiometric testing reports to the Faculty Technical Services Manager/HR Manager (or Faculty Executive Manager where neither is appointed) or Head of Branch ☐ Ensure any safety issues/concerns are recorded into the University's on-line incident reporting system. ☐ Review risk assessments and control measures when audiometric assessments reveal changes in hearing levels or a worker reports a recent diagnosis of tinnitus. ☐ Ensure where workers are found to have sufficient hearing loss to interfere with the safe performance of their work, reasonable adjustments are made to the work environment and/or activity, in consultation with the local HSW Team and Central HSW Team (if required) and the adjustments are recorded on the incident report as part of the incident investigation process.
5.2	**Head of Faculty/School/Branch**	☐ Ensure funding is provided by the School/Branch for all audiometric testing.
5.3	**Contract Manager (Person engaging a contractor/the person managing the contract)**	☐ Ensure that any contractor related work activity for the University which could expose any person to hazardous noise and sound is managed in accordance with the Contractor Safety Management Handbook chapter.
5.4	**Faculty Technical Services Manager/HR Manager (or Faculty Executive Manager where neither is appointed) or Head of Branch**	☐ Ensure a copy of any audiometric testing reports are saved in the University's records management system and in accordance with the State Records Act.

6 Process: Provision of information, instruction and training

Person Responsible	Actions
6.1 Supervisor/Person in control of the area/activity	☐ Ensure the appropriate level of information, instruction and training is provided to those workers who may be exposed to hazardous noise or other agents that may contribute to hearing loss in accordance with the Provision of information, instruction and training chapter of the HSW Handbook and the Code of Practice "Managing noise and preventing hearing loss at work" – Section 1.3. ☐ Ensure, where Personal Protective Equipment (PPE) is required to be worn, that the worker is provided with specific information and/or instruction which includes: ☐ the nature of the hazardous noise associated with the work; ☐ instruction on how to select, fit, wear and use the PPE; ☐ the storage and maintenance requirements to ensure the equipment remains clean, hygienic and in good working order; ☐ Ensure where PPE is required to be worn, a record of the information/instruction provided for each worker in accordance with the Provision of information, instruction and training chapter of the HSW Handbook (Level 2).

7 Process: Records Management and Documentation

Person Responsible	Actions
7.1 Supervisor/ Person in control of the area/activity (see definitions)	☐ Ensure the following records are maintained for the duration of design, manufacture or physical ownership of any noise and sound emitting plant. ☐ Design records relating to noise and sound emissions; ☐ Manufacturing records (including testing) relating to noise and sound emissions; ☐ Any other information relating to noise and sound emissions supplied from or to the School/Branch. ☐ Ensure noise assessment reports are saved on the University's Records Management System and available on request.

8 Definitions

Competent person – is one capable of demonstrating a thorough understanding of:

- The objectives of the assessment;
- The basic physics of sound;
- The correct usage and limitations of sound-measuring instruments required to gather data for noise assessments;
- The information needed and methods used to determine occupational noise exposures;
- How to record results and explain them to people in the workplace;
- The method for evaluating personal hearing protectors;
- When to advise that someone with more specialised knowledge on noise measurement or noise control is required; and
- The relevant statutory requirements, codes of practice and standards used in Australia.

A competent person should also have a basic understanding of the:

- Mechanisms of hearing
- Harmful effects of noise; and
- Principles of engineering noise control and noise management measures.

Continued

8 Definitions (continued)

Decibel (dB) – is the unit for measuring sound levels.

Exposure standard for noise – is defined in the WHS Regulations 2012 (SA) as an LAeq,8h of 85 dB(A) or an LC,peak of 140 dB(C). There are two parts to the exposure standard for noise because noise can either cause gradual hearing loss over a period of time or be so loud that it causes immediate hearing loss. Any exposure above this peak can create almost instant damage to hearing.

Hazardous noise – in relation to hearing loss means noise and sound that exceeds the exposure standard for noise in the workplace.

LAeq,8h – means the eight hour equivalent continuous A-weighted sound pressure level in decibels, referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1. This is related to the total amount of noise energy a person is exposed to in the course of their working day. It takes account of both the noise level and the length of time the person is exposed to it. An unacceptable risk of hearing loss occurs at LAeq,8h values above 85 dB(A).

LC,peak – means the C-weighted peak sound pressure level in decibels, referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1. It usually relates to loud, sudden noises such as a gunshot or hammering. LC,peak values above 140 dB(C) can cause immediate damage to hearing.

Noise –a mechanical force or vibration which travels in waves through a medium such as solid, liquid or gas of a level strong enough to be heard.

Noise assessment – an assessment which helps to:
- identify which workers are at risk of hearing loss
- determine what noise and sound sources and processes are causing that risk
- identify if and what kind of noise and sound control measures could be implemented
- check the effectiveness of existing control measures.

A noise assessment should be done by a competent person in accordance with the procedures in AS/NZS 1269.1 Measurement and assessment of noise emission and exposure. The more complex the situation, the more knowledgeable and experienced the person needs to be.

A competent person is one who has accurately calibrated noise measuring instruments and, through training and experience:
- understands what is required by the WHS Regulations for noise
- knows how to check the performance of the instruments
- knows how to take the measurements properly
- can interpret the results of the noise measurements.

Noise and sound hazards – include sound and vibration related activities which could result in hearing loss or other health effects; and substances which may cause hearing loss.

Ototoxic Substances – Exposure to some chemicals can result in hearing loss. These chemicals are known as ototoxic substances. Hearing loss is more likely to occur if a worker is exposed to both noise and ototoxic substances than if exposure is just to noise or ototoxic substances alone. See **Appendix C** for more details, including a list of common ototoxic substances.

Supervisor/Person in control of the activity/area
In the context of this chapter the supervisor has two meanings:
1. the line manager of a staff member or the supervisor of a higher degree by research student; or
2. any other individual (separate to the line manager/supervisor of a higher degree by research student) who has control of a laboratory, clinic, workshop, field activity or other activity in which the worker is participating or working. For example a Facility/workshop manager who has control of what is undertaken and/or who determines which workers may/may not work within the workshop they control. These supervisors also have the responsibility for the activities under their control. (Note: Control means that these individuals have the right to deny access to or stop any activity until they are satisfied that the activity can occur safely.)

Workplace – A workplace is a place where work is carried out for a business or undertaking and includes any place where a worker goes, or is likely to be while at work. The workplace includes a vehicle, vessel, aircraft or other mobile structure and any waters and any installation on land, on the bed of any water or floating on any waters [WHS Act 2012 (SA), Division 3, S8].

9 Performance Measures

The HSW Team will use performance measures to assist in identifying areas of success and/or where corrective action is required to meet the objectives and targets of this process.
The level of compliance with the chapter and effectiveness will be determined during the internal audit process.

10 Useful information and resources

10.1	**University related documents and Policies** **University HSW Handbook:** Chapter Hazard Management Chapter Plant/Equipment Safety Management Chapter Report a safety issue Chapter Incident, Investigation Information Sheet Personal Protective Equipment
10.2	**Related Legislation** • Work Health and Safety Act 2012 (SA) and WHS Regulations 2012 (SA) • Code of Practice - Managing noise and preventing hearing loss at work • AS/NZS 1269.1 Measurement and assessment of noise emission and exposure • AS/NZS 1269.3 Occupational noise management – hearing protector program • AS/NZS 1270 Acoustics – hearing protectors • AS/NZS 1269.4 - Occupational noise management - Auditory assessment
10.3	**Useful Web-links** • University incident reporting system • WA Code of Practice – Control of noise in the music entertainment industry • Nature of Orchestral Noise (The Journal of the Acoustical Society of America)

Appendix A

Noise and sound Hazard Identification checklist

The completion of this checklist demonstrates compliance with the requirements to conduct a Preliminary assessment in accordance with AS/NZS 1269.1 Measurement and assessment of noise emission and exposure It is to be completed if no previous assessment has been carried out or previous assessments are more than 5 years old.

School/Branch:			
Building/area:		**Room:**	
Item/Activity:			
Assessed by:	**Name of Supervisor/person in control**		
Date:			

Note: Answering 'Yes' to any of the following indicates the need to carry out a noise assessment if exposure to the noise and sound cannot be immediately controlled.
(In accordance with the Code of Practice Managing noise and preventing hearing loss at work)

Hazard identification questions		**Yes**	**No**
1.	Is a raised voice needed to communicate with someone about one metre away?	☐	☐
2.	Do your workers notice a reduction in hearing over the course of the day? (This may only become noticeable after work, for example, needing to turn up the radio on the way home)	☐	☐
3.	Are your workers using noisy powered tools or machinery?	☐	☐
4.	Are there noises due to impacts (such as hammering, pneumatic impact tools) or explosive sources (such as explosive powered tools, detonators)?	☐	☐
5.	Are personal hearing protectors used for some work?	☐	☐
6.	Do your workers complain that there is too much noise or that they can't clearly hear instructions or warning signals?	☐	☐
7.	Do your workers experience ringing in the ears or a noise sounding different in each ear?	☐	☐
8.	Do any long-term workers appear to be hard of hearing?	☐	☐
9.	Have there been any workers' compensation claims for noise-induced hearing loss?	☐	☐
10.	Does any equipment clearly have the capability of producing noise and sound levels equal to or greater than any of the following (this information may also be identified in manufacturer's information or on labels): (a) 80 dB(A) LAeq,T (T= time period over which noise is measured)? (b) 130 dB(C) peak noise level? (c) 88 dB(A) sound power level?	 ☐ ☐ ☐	 ☐ ☐ ☐
11.	Do the results of audiometry tests indicate that past or present workers have hearing loss?	☐	☐
12.	Are any workers exposed to noise and ototoxins (see definitions and Appendix D) in the workplace?	☐	☐
13.	Are any workers exposed to noise AND either hand-arm vibration (HAV) or whole-body vibration (WBV)?	☐	☐

Name and signature Supervisor/person in control of the area/activity (In accordance with AS/NZS 1269.1)

Appendix B1

Common noise sources and their typical sound levels in dB(A)

This table can be used to compare noise in the workplace with sounds that are as loud as or lounder than 85 dB(A).

(Reference - Code of Practice "Managing noise and preventing hearing loss at work")

Typical sound level in dB(A)	Sound source
140	Jet engine at 30 m
130	Rivet hammer (pain can be felt at this threshold)
120	Rock drill
110	Chainsaw
100	Sheet-metal workshop
90	Lawnmower
85	Front-end loader
80	Kerbside: Heavy traffic.
80	Lathe
70	Loud conversation
60	Normal conversation
40	Quiet radio music
30	Whispering
0	Hearing threshold

Orchestral Noise
For additional guidance and reference material for orchestral noise
Refer to the Journal of the Acoustical Society of America article by
Ian O'Brien (The Queensland Orchestra, The University of Queensland),
Wayne Wilson (School of Health and Rehabilitation Sciences, The University of Queensland)
Andrew Bradley (School of Information Technology and Electrical Engineering, The University of Queensland)
https://www.researchgate.net/publication/23150632_Nature_of_orchestral_noise

Which includes summarised data for Orchestra pits and various instruments.

Appendix B2

Equivalent Noise Exposure Limits

Whether the exposure standard (85 dB(A) averaged over eight hours) is exceeded depends on the level of noise and sound involved and how long workers are exposed to it.

Peak noise and sound levels greater than 140 dB(c) usually occur with impact or explosive noise such as sledge-hammering or a gun shot. Any exposure above this peak can cause almost instant damage to hearing.

The decibel scale is logarithmic. On this scale, an increase of 3 dB therefore represents a doubling (or twice as much) sound energy. This means that every 3 dB increase in noise and sound level can cause the same damage in half the time.

Table 1 provides examples of the length of time a person without hearing protection can be exposed before the standard (LAeq8h = 85 dB(A) is exceeded (as per the Code of Practice "Managing noise and preventing hearing loss at work").

Table 1: Equivalent Noise Exposures LAeq,8h = 85 dB(A)	
Noise Level dB(A)	Exposure Time
80	16 hours[1]
82	12hours[1]
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
103	7.5 minutes
106	3.8 minutes
109	1.9 minutes
112	57 seconds
115	28.8 seconds
118	14.4 seconds
121	7.2 seconds
124	3.6 seconds
127	1.8 seconds
130	0.9 seconds

1 The adjustment factor for extended work shifts shown in Table 3 of the Code is taken into account.

NOTE:
Shift durations of 10 hours or longer involve a degree of risk greater than that indicated by the 8 hour measurement LAeq,8h.
This increase in risk arises because of the additional damaging effect of continuous exposure to noise after 10 hours.
The risk may be further increased if there is reduced recovery time between successive shifts. For extended periods longer than eight hours refer to the adjusted exposure standards within the Code of Practice "Managing noise and preventing hearing loss at work.

Controlling the risks where hazardous noise and sound has been identified

Examples of hierarchy of control measures and specific requirements
(Extract from the Code of Practice Managing noise and preventing hearing loss at work.)

The following information is provided for the supervisor or person in control of the activity/area to assist in the selection of appropriate control measures to manage the risk of exposure. (Please record the specific details of the control measure when documenting your risk assessment so that the workers can identify the requirements.)

Elimination	• Remove the hazardous noise and sound (e.g. the plant/equipment) or stop the activity.
If elimination is not possible	
Substitution	Replace a hazard or hazardous work practice with something that gives rise to a lesser risk. For example: • Substitute plant/equipment or processes that are quieter, replace ototoxic substances with other less harmful products
Isolation	Isolate or separate the hazard or hazardous work practice from any person exposed to it. For example: • Isolate the source of noise and sound from people by using distance, barriers, enclosure and sound-absorbing surfaces • Building enclosures or soundproof covers around noise and sound sources • Using barriers or screens to block the direct path of sound • Locate noise and sound sources further away from workers • Use remote controls to operate noisy plant/equipment from a distance.

Engineering	Engineering controls are physical control measures.
	For example:
	• Modify the plant/equipment and process to reduce the noise and sound.
	  • Eliminate impacts between hard objects or surfaces through cushioning or separation
	  • Minimising the drop height of objects or the angle that they fall onto hard surfaces
	  • Using absorbent lining on surfaces to cushion the fall or impact of objects
	  • Fitting exhaust mufflers on internal combustion engines
	  • Fitting silencers to compressed air exhausts and blowing nozzles
	  • Ensuring gears mesh together better
	  • Fixing damping materials (such as rubber) or stiffening to panels to reduce vibration
	  • Fitting sound-absorbing materials to hard reflective surfaces
	  • Changing fan speeds or the speeds of particular components
	  • Changing the material the equipment or its parts are made of (for example change metal components to plastic components)
	  • Selecting tyre types that are suitable for the ground surface or terrain;
	  • Installing vibration-minimising seats on mobile plant.
	• Maintenance
	  • Check for badly worn bearings and gears, poor lubrication, blunt blades, loose parts, unbalanced rotating parts and steam or air leaks.
	  • Check vibration mountings, impact absorbers, gaskets, seals, silencers, barriers and other equipment.

Controlling the risks where hazardous noise has been identified

Administrative	• Change the way in which the task is completed
	For example:
	  • bending metal in a vice or a press is quieter than hammering it into shape;
	  • welding is generally quieter than riveting
	  • gluing is quieter than hammering in nails
	  • clipping is quieter than stapling; and
	  • lowering materials in a controlled manner is quieter than dropping them on hard surfaces.
	• Organise schedules so that noisy work is done when only a few workers are present
	• Notifying workers and others in advance of noisy work so they can limit their exposure
	• Keeping workers out of noisy areas if their work does not require them to be there
	• Using job rotation to limit the time workers spend in noisy areas by moving them to quite work or providing quiet areas for rest breaks, before their daily noise exposure levels exceed the exposure standard.
	• Provide the appropriate level of information, instruction and training to protect all workers from the risks to their health and safety in accordance with the Code of Practice "Managing noise and preventing hearing loss at work".
	(Also see the requirements for the provision of information, instruction and training in the proper use and wearing of PPE and the storage and maintenance of PPE.)
	
	Note – where admin controls are relied on, the Supervisor/Person in control of the area/activity is to conduct regular checks to ensure that the control measures are being complied with.

PPE	• Personal hearing protectors, such as ear-muffs or earplugs, high quality headsets with acoustic shock protection devices
	(Noting, that they should be used in the following circumstances:
	  • When the risks arising from exposure to noise and sound cannot be eliminated or minimised by other more effective control measures
	  • As an interim measure until other control measures are implemented; and
	  • Where extra protection is needed above what has been achieved using other noise and sound control measures.
	
	PPE for use of firearms
	Due to the risk of immediate hearing loss in work situations that involve exposure to peak noise and sound levels that exceed 140 dB(c) and notwithstanding any higher level controls used, the Supervisor/Person in control of the activity/area should select hearing protectors as detailed in Appendix B of AS/NZS 1269.3:2005, which advises:
	  • Hearing protectors having a classification of five shall be used for exposure to impulse noise and sound from impacts, small-calibre weapons or tools; and
	  • Well fitted earplugs having a classification of at least three, in combination with ear-muffs of any classification, shall be worn for exposure to impulse noise and sound from large-calibre weapons and blasting.
	
	Where PPE is used, the Supervisor/Person in control of the area/activity is to ensure:
	• the equipment is selected to minimise risks by ensuring that the equipment is:
	  ☐ Suitable for the nature of the work and any hazard associated with the work
	  ☐ Suitable size and fit and reasonably comfortable for the worker who is to use or wear it; and
	  ☐ Maintained repaired and replaced so that it continues to minimise risk to the worker, and ensuring that the equipment is clean, hygienic and in good working order.
	☐ the worker is provided with the appropriate level of information and instruction in the proper use and wearing of PPE and the storage and maintenance of PPE in accordance with the Provision of information, instruction and training chapter of the HSW Handbook.
	☐ That personal hearing protectors are selected and maintained in accordance with AS/NZS 1269.3:2005 "Occupational noise management – hearing protector program" and Code of Practice for Managing noise and preventing hearing loss at work.

Ototoxic Substances Information

Exposure to some chemicals can result in hearing loss. These chemicals are known as ototoxic substances. Hearing loss is more likely to occur if a worker is exposed to both noise and ototoxic substances than if exposure is just to noise or ototoxic substances alone.

There are three major classes of ototoxic substances: solvents, heavy metals and asphyxiants. Work activities that commonly combine noise and ototoxic substances include:

- painting
- printing
- boat building
- construction
- furniture making
- fuelling vehicles and aircraft
- manufacturing, particularly of metal, leather and petroleum products
- degreasing
- fire-fighting
- weapons firing

Some medications have also been identified as ototoxic substances. These include some anti-cancer, anti-inflammatory, anti-thrombotic, anti-malarial, anti-rheumatic and antibiotic drugs. Quinine and salicylic acids (such as aspirin) are also considered to be ototoxic substances.

Table D1 below lists those ototoxic substances most commonly used in workplaces. Some of these can be absorbed through the skin and are considered particularly hazardous.

Exposure standards for chemicals and noise have not yet been altered to take account of increased risk to hearing. Until revised standards are established, it is recommended that the daily noise exposure of workers exposed to any of the substances listed in Table D1 be reduced to 80 dB(A) or below. They should also undergo audiometric testing and be given information on ototoxic substances.

Control measures such as substitution, isolation and local ventilation should be implemented to eliminate or reduce chemical exposures. Personal Protective Equipment should be used to prevent skin and respiratory absorption when other controls are insufficient.

Appendix D1

Ototoxic Substances Information

Table D1: Common ototoxic substances

Type	Name	Skin Absorption
Solvents	Butanol	Yes
	Carbon disulphide	Yes
	Ethanol	
	Ethyl benzene	
	n-heptane	
	n-hexane	
	Perchloroethylene	
	Solvent mixtures and fuels Stoddard solvent (white spirits)	Yes
	Styrene	
	Toluene	Yes
	Trichloroethylene	Yes
	Xylene	
Metals	Arsenic	
	Lead	
	Manganese	
	Mercury	Yes
	Organic tin	Yes
Others	Acrylonitrile	Yes
	Carbon monoxide	
	Hydrogen cyanide	Yes
	Organophosphates	Yes
	Paraquat	