

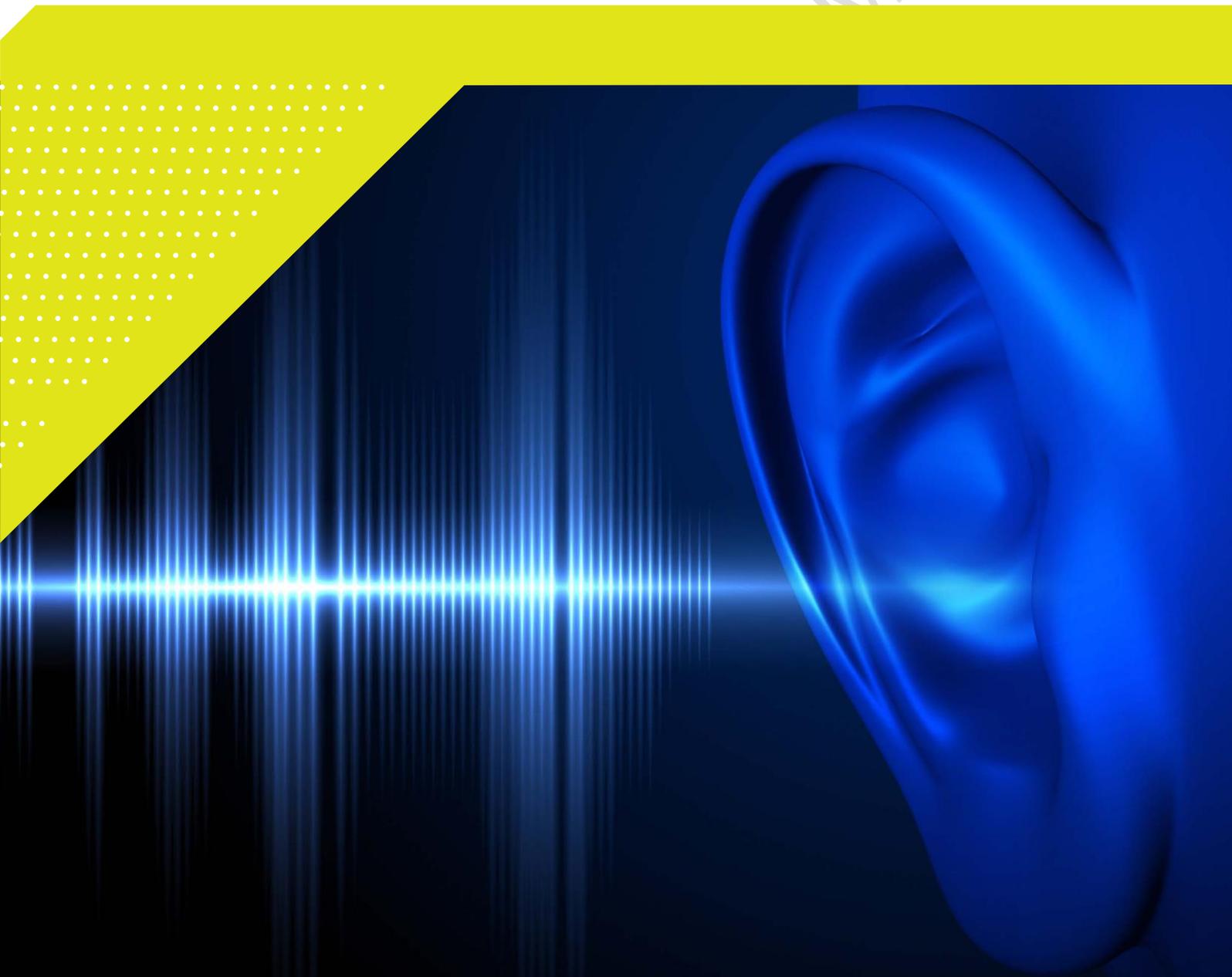
Compliance code

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# Noise

Edition 1  
June 2017

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## Preface

This Compliance Code (**Code**) provides practical guidance for those who have duties or obligations in relation to noise under the *Occupational Health and Safety Act 2004* (**OHS Act**) and Occupational Health and Safety Regulations 2017 (**OHS Regulations**).

The Code was developed by WorkSafe Victoria (WorkSafe). Representatives of employers and employees were consulted during its preparation. It was made under the OHS Act and approved by Robin Scott MP, Minister for Finance.

Duty holders under the OHS Act and OHS Regulations should use the Code together with this legislation.

While the guidance provided in the Code is not mandatory, a duty holder who complies with the Code will – to the extent it deals with their duties or obligations under the OHS Act and OHS Regulations – be considered to have complied with those duties or obligations.

If conditions at the workplace or the way work is done raise different or additional risks not covered by the Code, compliance needs to be achieved by other means. WorkSafe publishes guidance to assist with this at **worksafe.vic.gov.au**.

Failure to observe the Code may be used as evidence in proceedings for an offence under the OHS Act or OHS Regulations. However, a duty holder will not fail to meet their legal duty simply because they have not followed the Code.

A WorkSafe inspector may cite the Code in a direction or condition in an improvement notice or prohibition notice as a means of achieving compliance.

A health and safety representative (**HSR**) may cite the Code in a provisional improvement notice when providing directions on how to remedy an alleged contravention of the OHS Act or OHS Regulations.

Approval for the Code may be varied or revoked by the Minister. To confirm the Code is current and in force, go to **worksafe.vic.gov.au**.

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## PART 1 - INTRODUCTION

### Purpose

1. The purpose of this Code is to provide practical guidance to duty holders about how to manage health and safety risks associated with noise exposure in the workplace and comply with their duties under the OHS Act the OHS Regulations.

### Scope

2. This Code provides information about how to identify hazards and control risks associated with noise exposure in the workplace.
3. It is not possible for this Code to deal with every risk associated with noise exposure a duty holder may encounter at their workplace. The guidance in the Code should therefore be considered with regard to the particular characteristics and circumstances of the workplace.

### Application

4. This Code applies to employers and self-employed persons in any workplace in Victoria and to designers, manufacturers, suppliers and installers of plant and designers of structures and buildings in relation to noise. Additionally, the information contained in this Code may be useful for HSRs and employees including independent contractors.

**Note:** The word 'should' is used to indicate a recommended course of action, while 'may' is used to indicate an optional course of action. The words 'must', 'required' or 'mandatory' indicate a legal requirement that has to be complied with.

### Key terms <OHS Regulation 5>

**Audiological examination** means the testing and examination of a person's ear and hearing threshold for the purpose of establishing the type and cause of any hearing disorder.

**Audiometric test** means the measurement of a person's air conduction hearing threshold levels using an electro-acoustic instrument (audiometer) equipped with earphones, that provides pure tones of specified discrete frequencies at known hearing levels.

**Hearing protector** means a device that is designed for the purpose of protecting a person's hearing and that is either inserted into the ear canal, covers the ear canal entrance, or covers the entire ear.

**Noise exposure standard** means noise levels set by the OHS Regulations as the 8 hour equivalent continuous sound pressure of 85 decibels (A) measured in A-weighted-decibels referenced to 20 micropascals at an employee's ear position, or a C-weighted peak hold sound pressure level reading of 140 decibels(C) measured in decibels referenced to 20 micropascals at an employee's ear position.

**Sound power level** means the total sound energy radiated per unit time (eg by an item of plant), measured as decibels referenced to 1 picowatt using octave bands or an A-weighting.

**Sound pressure level** means the pressure fluctuations in air expressed in decibels, calculated as 20 times the logarithm to the base 10 of the ratio of the root mean square sound pressure (in pascals) to the reference sound pressure of 20 micropascals.

## Background

### What causes hearing loss?

5. Exposure to loud noise at work, through recreational pursuits, or from environmental factors can result in hearing loss. Some people are born with reduced hearing while others may lose their hearing as they age, through degenerative or non-degenerative disease, injury or from taking certain medications.

### How does noise damage hearing?

6. Most people's ears are very sensitive to noise. When sound enters the outer ear, it vibrates the eardrum. These vibrations pass into the inner ear via tiny bones where, eventually, delicate nerve cells convert the vibrations into messages which are sent to the brain. Noise can affect these nerve cells causing a temporary reduction in hearing. Most temporary hearing loss recovers within 24 hours under quiet conditions and may be accompanied by a ringing or buzzing in the ear, known as tinnitus.
7. If someone's ears are exposed to loud noise repeatedly over a period of time, the nerve cells in the inner ear may eventually die and not respond to sound. This condition is called **noise induced hearing loss** and usually occurs gradually over many years. At first, people may not notice any change in their hearing. Over the years as more of these nerve cells become damaged and die, the effect on hearing becomes noticeable, however, by this time the damage is irreversible. Noise induced hearing loss reduces a person's ability to hear high pitched sounds.

8. The degree of noise induced hearing loss that occurs is dependent on the level of noise, how long someone is exposed to it, and to some extent on individual susceptibility. Once damage to hearing occurs it cannot be repaired – only further damage can be prevented. Permanent hearing loss may also be accompanied by tinnitus.
9. Noise induced hearing loss may also result from exposure to sudden loud noises, such as explosions, gun shots or heavy hammering. These types of noises are commonly referred to as 'impulse' noises. If loud enough, exposure to sudden impulse noises can cause immediate permanent damage.

### **How can noise induced hearing loss affect someone?**

10. Noise induced hearing loss often results in a reduced ability to perceive high pitched sounds and conversation may start to sound muffled or incomprehensible. For example, it might become more difficult to hear high pitched alphabetical phonetic sounds, like in the letters 's', 'k', 'p' and 't'. Once hearing loss occurs, it becomes more difficult for a person to take part in their normal activities of daily living and employment. For example, a person might find it difficult to have a normal conversation, use the telephone or listen to music, the television or the sounds of nature. Consequently, they may become less confident in social and work situations, causing them to feel isolated because they are embarrassed or anxious about their inability to hear properly. Such effects may also decrease a person's efficiency at work and may cause accidents when instructions or warning signals cannot be heard or understood properly.

### **Can noise induced hearing loss be cured?**

11. Noise induced hearing loss is permanent and currently cannot be cured or repaired through medication or surgery. Hearing aids may only offer limited benefit.

### **What other effects are caused by excessive noise?**

12. There is a growing body of evidence which suggests that exposure to constant noise chronically interferes with concentration and communication and is a cause of non-auditory damage in the cardio-vascular, endocrine, metabolic, gastro-intestinal and neurological systems.
13. Both sudden bursts of noise and continuous noise are known to affect activities such as reading and writing. Productivity in workplaces may be affected if there is excessive noise, especially if employees suffer from noise induced hearing loss as a result of it.

## Who has duties?

14. **Employers** have a general duty to provide and maintain, so far as is reasonably practicable, a working environment for their employees that is safe and without risks to health. <OHS Act s21> To ensure that employers provide a working environment that is safe and without risk to health they must eliminate risks to health and safety so far as is reasonably practicable, and if it is not reasonably practicable to eliminate the risks to health and safety, reduce those risks so far as is reasonably practicable. <OHS Act s20>
15. Employers also must, so far as is reasonably practicable, monitor conditions at the workplace. <OHS Act s22>
16. Employers must also, so far as is reasonably practicable, ensure that members of the public are not exposed to risks to their health or safety arising from the business activities undertaken by the employer. <OHS Act s23>
17. An employer's general duties also extend to independent contractors engaged by the employer and any employees of an independent contractor. The duties may extend, for example, to persons engaged to work through a labor hire agency. However, these extended duties are limited to matters over which the employer has control or would have control if there was not an agreement in place purporting to limit or remove that control. <OHS Act s21(3) and s35(2)>.
18. Regulations that set out the way an employer complies with their duties to employees under s21 and s35 of the OHS Act also apply in respect to independent contractors engaged by the employer and any employees of the independent contractor in relation to matters over which the employers has control. <OHS Regulation 8(1)>.
19. Employers have a number of specific duties under the OHS Regulations to manage risks associated with noise exposure in the workplace, including the duty to ensure that employees and independent contractors:
  - are not exposed to noise exceeding the noise exposure standard <OHS Regulation 34>; and
  - are provided with audiometric testing (hearing tests), and in some cases audiological examinations <OHS Regulations 37 – 40>
20. Employers also have a duty to provide employees, including independent contractors with hearing protectors. If hearing protection is provided, employers must also ensure that appropriate signage, labelling of plant or other appropriate means are used to identify when and where the hearing protectors are to be worn are in the workplace. < OHS Regulations 34 – 35>

21. If employers design or modify their workplace, including any tool, machinery or plant used, they may also take on additional duties under the OHS Act. It is therefore recommended that employers read the part for designers; manufactures and suppliers (see Part 2 of this Code below). <OHS Act s27-30>

For information about what 'reasonably practicable' means when complying with Part 3 of the OHS Act, see the WorkSafe Position - 'How WorkSafe applies the law in relation to reasonably practicable' at [worksafe.vic.gov.au](http://worksafe.vic.gov.au).

22. A **self-employed person** must comply with *Part 3.2 – Noise* of the OHS Regulations in the same way as an employer. Self-employed persons must also ensure, so far as is reasonably practicable, that persons (eg members of the public) are not exposed to risks to their health and safety arising from the business activities of the self-employed person. <OHS Act s24 and OHS Regulation 11>
23. **Employees**, while at work, have a duty to take reasonable care for their own health and safety and that of others who may be affected by their acts or omissions in the workplace. Employees must also co-operate with their employer's actions to make the workplace safe (eg by following any information, instruction and/or training provided). <OHS Act s25(1)>
24. **Manufacturers and/or designers of plant** have a duty to design and manufacture plant in circumstances where they know or ought to reasonably know that the plant will be used at a workplace so that, as far as reasonably practicable, it is manufactured to be safe and without risks to health when used for the purpose for which it was manufactured. In complying with this duty, a manufacturer and/or designer must ensure that the sound power level is as low as is reasonably practicable, taking into account the noise emission and exposure. If the plant, when used for the purpose for which it was manufactured, may expose an employee to noise levels exceeding the exposure standard, the manufacturer must determine the sound power level of the plant, and ensure that this information is given to any person to whom it is supplied. <OHS Act s27 and s29 OHS Regulation 29, 30>
25. **Designers of buildings or structures** have a general duty to ensure, so far as is reasonably practicable, that buildings or structures are designed to be safe and without risks for people using them as workplaces. This includes risks associated with exposure to noise. <OHS Act s28>
26. **Suppliers** must ensure that plant they supply which they know, or ought to know is to be used in a workplace, is safe and without risks to health if used for a purpose for which it was designed, manufactured or supplied. When plant is supplied, it must be accompanied by any record stating the sound power level of the plant that the supplier receives from the

manufacturer. In addition, suppliers must provide people to whom they supply plant with adequate information about how to use it safely. <OHS Act s30, OHS Regulation 31(1)>

27. **Persons who install, erect or commission plant** who knows, or ought reasonably to know, that the plant is to be used in a workplace must ensure that nothing about the way the plant is installed, erected or commissioned makes its use unsafe or a risk to health, so far as reasonably practicable. This would include, for example, ensuring that plant is installed in accordance with designer or manufacturer specifications. <OHS Act s31>

## The risk management process

28. This Code outlines a **risk management process** (see Diagram 1) to help employers comply with their duties under the OHS Act and OHS Regulations. It involves the following steps:

- **Identifying** hazards associated with noise exposure in the workplace (see Part 3.1 of this Code)
- **Assessing**, where necessary, any associated risks (if unsure of appropriate risk controls)(see Part 3.2)
- **Controlling** risks associated with noise exposure in the workplace (see Parts 3.3)
- **Monitoring, reviewing**, and where necessary, **revising** risk controls (see Parts 3.3)

The risk management process



29. Note there are certain circumstances where each step of the risk management process must occur, see Part 2 and 3 of this Code for further information on these duties.

## Consultation

30. Employers must, so far as is reasonably practicable, consult with employees and HSRs, if any, on matters that directly affect, or are likely to directly affect, their health and safety. This duty also extends to independent contractors, including any employees of the independent contractor, engaged by the employer (see paragraph 17). <OHS Act ss35 – s36>

Employers should consult with employees (including independent contractors) to the extent that it is reasonably in all the circumstances. What is reasonably practicable will depend on a range of factors. For example, the size and structure of the business, the nature of the work, work arrangements (eg. shift work) and characteristics of employees (eg language or literacy) will all have an impact on the way consultation is provided.

31. Consultation should occur at each step of the risk management process. Employers who are required to consult must share information about the matter with employees (including independent contractors) and HSRs, give them a reasonable opportunity to express their views, and take those views into account before making decisions. <OHS Act s36>
32. Employers should consult with employees as early as possible when planning to:
- a. introduce new work or change existing work
  - b. select new plant
  - c. refurbish, renovate or redesign existing workplaces
  - d. carry out work in new environments.
33. Employers should also encourage employees to report any problems immediately so that risks can be managed before an injury occurs.
34. Employees may have practical suggestions or potential solutions that may be implemented.
35. See [worksafe.vic.gov.au](http://worksafe.vic.gov.au) for more information on consultation.

## **Information, instruction, training and/or supervision <OHS Act s21(2)(e), OHS Regulations 73>**

36. Employers must provide employees (including independent contractors) with any necessary information, instruction, training and/or supervision to enable them to perform their work in a way that is safe and without risks to health. <OHS Act s21(2)(e)>
37. Information, instruction and training should cover the nature of hazards associated with noise exposure in the workplace, and the risk management process, including the need for risk control measures, how to properly use them. For example, employees should understand the hazards associated with noise exposure in the workplace (including how to follow safety procedures, and use risk control measures implemented for their protection).
38. Employers should also supervise employees in relation to, for example, how to properly use and maintain personal protective equipment (PPE) such as earplugs. Employers must supervise where such supervision is necessary for safe work. Supervisors should take action to correct any unsafe work practice as soon as possible to prevent unsafe work practices becoming habitual. Supervisors should model safe work practices at all times to help create a culture of health and safety in their workplace.
39. Where employees undertaking the work are new and inexperienced, such as young employees, it would be reasonable to provide additional supervision.
40. The mix of information, instruction, training or supervision required will depend on the frequency, type of noise exposure in the workplace, and how much employees already know about the risks and necessary risk control measures. Training programs should be practical and 'hands on' and take into account any special needs of the people being trained (eg specific skills or experience, disability, language, literacy and age). These needs should be taken into account in the structure, content and delivery of training.
41. Training should be provided to:
  - employees and independent contractors who may be exposed to noise that may contribute to hearing loss
  - their managers and supervisors
  - workplace health and safety committees and HSRs
  - those responsible for the purchase of plant, noise control equipment, personal hearing protectors and for the design, scheduling, organisation and layout of work.

42. The contents of the training program should include:
- the health and safety responsibilities of each party at the workplace
  - how hearing can be affected by exposure to noise
  - the detrimental effects hearing loss and tinnitus have on the quality of life, both at work and socially
  - the tasks at the workplace that have the potential to give rise to hearing loss and the likely noise exposure level
  - how to use noise control measures
  - how to select, fit, wear, maintain and store personal hearing protectors
  - how to report defects in hearing protectors and noise control equipment or raise any concerns regarding noise
  - the purpose and nature of audiometric testing and audiological examinations.
43. If PPE is provided to control employee noise exposure in the workplace, supervision should include visual checks to ensure employees are using PPE where and when it is required.
44. Employers should review their training program regularly and also when there is change to work processes, plant or equipment; new control measures are implemented; changes are made to relevant legislation, or if any other issue may impact on the way the work is performed. Employers should also keep records of induction and training given to employees.
45. Refresher training should be provided as appropriate for a particular workplace. The frequency of refresher training should be determined having regard to the frequency with which employees and independent contractors are required to carry out tasks that may expose them to noise above the noise exposure standard.

## **PART 2 – DUTIES OF DESIGNERS, MANUFACTURERS, SUPPLIERS AND INSTALLERS OF PLANT**

### **Designers of plant <OHS Act s27>**

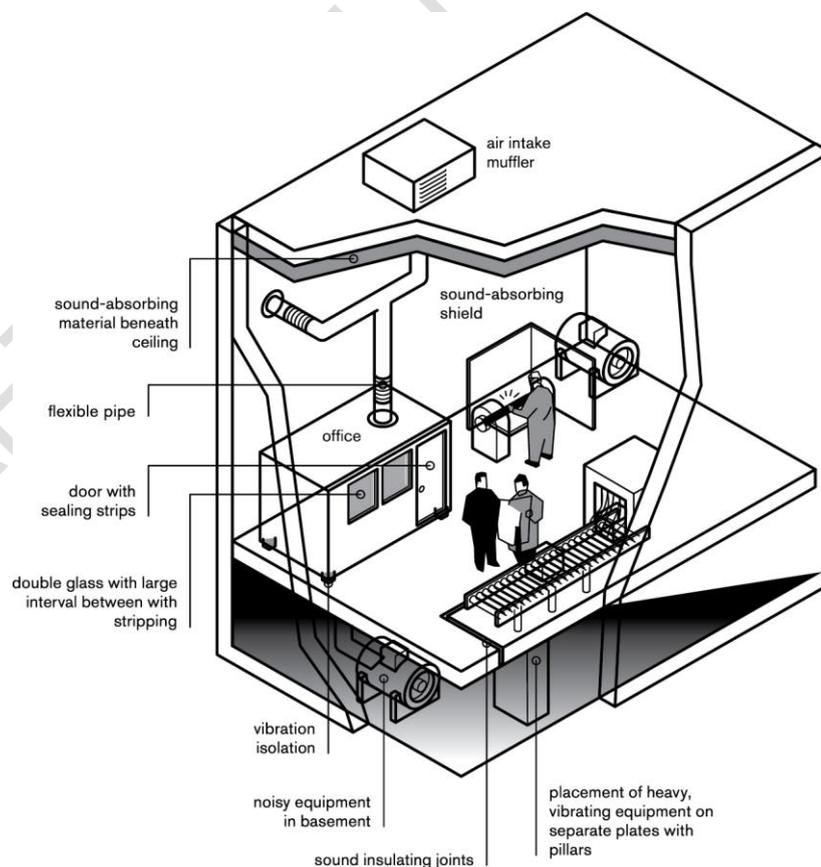
46. Designers of plant must design the plant so that its sound power level is as low as is reasonably practicable. <OHS Regulation 29>
47. Designers of plant should consider :
- level of noise exposure to operators when using the plant for 8-12 hours in a day
  - preventing or reducing the impact between machine parts
  - replacing metal parts with quieter plastic parts
  - combining machine guards with acoustic treatment
  - enclosing particularly noisy machine parts
  - selecting power transmission which permits the quietest speed regulation; for example, rotation-speed-controlled electric motors
  - isolating vibration-related noise sources within machines.
48. The following should be included in designs:
- good seals for doors
  - machines with effective cooling flanges that reduce the need for air jet cooling
  - quieter types of fans or placing mufflers in the ducts of ventilation systems
  - quiet electric motors and transmissions
  - pipelines for low flow speeds (maximum 5m/second)
  - ventilation ducts with fan inlet mufflers and other mufflers to prevent noise transfer in the duct between noisy and quiet rooms.
49. Methods of maintenance and servicing should be taken into account in noise control design.

### **Designers of buildings and structures <OHS Act s28>**

50. Designers of buildings or structures (or part of a building or structure) have a duty to ensure, so far as is reasonably practicable, that buildings or structures designed to be used as a workplace are designed to be safe and without risks for people using them for this purpose.

51. For new buildings, designers should consider:

- the effect on noise levels of building reverberation, the building layout and location of workstations relative to any plant
- selecting the frame, floor and machine bases so that all sources of disturbance can be provided with effective vibration isolation. Heavy, noisy equipment requires rigid, heavy bases. It is also possible to isolate machine bases from direct contact with the rest of the building frame (see Figure 1)
- isolating noise sources such as plant rooms
- designing acoustic treatments for noisy areas, for example, cover ceilings (and walls in the case of very high ceilings) with sound-absorbing material, use floating floors
- using flexible construction joints as building elements
- designing walls, floors, windows and doors to provide the necessary sound transmission loss
- covering floors of office areas with carpets.



**Figure 1:** Examples of noise control measures in an industrial building

## Sound insulating separate rooms

52. With automation of processes, remote control from a separate room may be possible. Some control measures to consider during the design stage include:
- designing control rooms with materials having adequate transmission loss
  - providing good sealing around doors and windows
  - providing openings for ventilation with passages for cables and piping equipped with good seals.
53. Control rooms should be adequately ventilated with air-conditioning in hot working areas. Otherwise, there is a risk that the doors will be opened for ventilation, which would negate the effectiveness of the room in reducing the noise exposure level for people inside.

## Manufacturers of plant <s29 OHS Act>

54. Manufacturers of plant must, so far as is reasonably practicable, manufacture the plant so that its sound power level is as low as reasonably practicable by taking noise emission and exposure into account. If, when used in a workplace for a purpose for which it was manufactured, the plant may expose an employee to noise above the exposure standard, the manufacturer must:
- determine the sound power level of the plant, and
  - provide a record of the sound power level to any person to whom they supply the plant. <OHS Regulation 30>
55. This information will help purchasers choose plant with low noise levels. Manufacturers must also provide adequate information about:
- the purpose(s) for which the plant or substance was manufactured
  - the results of any testing or examination of the plant
  - any conditions necessary to ensure that the plant is safe and without risk to health if it is used for a purpose for which it was manufactured. <OHS Act s29(1)(c)(i)-(iii)>
56. Manufacturers should manufacture plant:
- using the safety measures specified by the designer
  - using materials and techniques that minimise the risk of hearing loss by reducing noise to the lowest level reasonably practicable – eg the use of quieter nylon gears instead of steel.

## **Suppliers of Plant <s30 OHS Act>**

57. Suppliers must ensure, so far as is reasonably practicable, that plant they supply is safe and without risks to health if used in a workplace for a purpose for which it was designed, manufactured or supplied. They must also give adequate information about the purpose of plant and how to use it safely, to each person to whom they supply the plant. <OHS Act s30(1)>
58. Suppliers of plant must take any reasonably necessary action to obtain a record that states the sound power level of the plant from the person from whom the plan was acquired. This record must be provided when they supply the plant. <OHS Regulation 31>
59. Suppliers should also provide manufacturers information about:
  - control measures to minimise exposure to noise associated with the plant
  - how to maintain the plant to ensure safe use and operation.

## **Installers of Plant <s31 OHS Act>**

60. Installers must ensure, so far as reasonably practicable, that plant is installed in a way that prevents its use being unsafe or a risk to health. For example, installers should ensure that installation is undertaken according to the designer's specifications. Isolating vibrating sources of noise may involve installing large heavy machines on separate bases or in such a way that they do not directly contact the remainder of the building structure. <OHS Act s31>

## PART 3 – DUTIES OF EMPLOYERS

### PART 3.1 HAZARD IDENTIFICATION – EXPOSURE STANDARD

61. The potential for noise to be hazardous is not always obvious. Hazard identification is a way of finding out which work activities have the potential to contribute to hearing loss. Exposure to noise is cumulative and an employee may perform a number of noisy work activities over time which, in combination, may expose them to noise that could affect their hearing.
62. Ways of identifying noise hazards should include:
- regularly walking around the workplace
  - identifying noise sources and which tasks or processes produce loud noise
  - talking to employees and observing how things are done.
63. Information regarding noise levels should also be obtained from manufacturers or suppliers of plant and equipment used at the workplace.
64. Employers should check whether any employees have made any compensation claims for hearing loss and if any hearing loss or tinnitus has been found during audiometric testing. If an employee's hearing has been affected in the workplace, it may indicate there is a noise issue at the workplace. See Part 3.4 of this Code for more information about audiometric testing.

#### Noise exposure standard

65. The OHS Regulations set a noise exposure standard or 'level' of 85 dB(A) averaged over an eight hour period, and a maximum or peak noise level of 140 dB(C). (Note: dB is the abbreviation for the decibel – the unit used for sound pressure levels on a logarithmic scale).

The complete **noise exposure standard** as set out in the OHS Regulations is:

- (a) the eight hour equivalent continuous sound pressure level of 85 dB(A) measured in A-weighted decibels referenced to 20 micropascals at an employee's ear position, or
- (b) the C-weighted peak hold sound pressure level reading of 140 dB(C) measured in decibels referenced to 20 micropascals at an employee's ear position. <OHS

Regulation 5>

66. If employees are exposed to noise that exceeds the exposure standard, the workplace is too noisy.

67. Noise may be a problem in a workplace if, for example, any of the following occurs:
- employees have to raise their voice to communicate at a distance of one meter and/or
  - employees have a temporary reduction in hearing or ringing in the ears after leaving work for the day

A checklist is provided at **Appendix B** to help identify noise hazards in the workplace.

68. If it is not clear whether there is a noise problem, some spot noise measurements may help. Table 1 below lists some common noise sources and their approximate noise levels. However, actual levels in the workplace may vary significantly from these figures.

**Note:** If, based on reasonable grounds, there is uncertainty as to whether the noise exposure standard is exceeded, the employer **must** conduct a noise determination. See Part 3.2 of this Code for more information.

| Table 1: Common noise sources and their typical sound levels |  |
|--|--|
| Typical sound level in dB                                    | Sound source   |
| 140  | Jet engine at 30m (pain can be felt at this threshold) |
| 130  | Rivet hammer (pain can be felt at this threshold)      |
| 120  | Rock drill   |
|  | Angle grinding   |
| 110  | Chain saw  |
| 100  | Sheet-metal workshop                                   |
| 90   | Lawn-mower   |
|  | Welding  |
| 85   | Front-end loader                                       |
|  | Listening to a personal music player in a quiet room   |
| 80   | Kerbside Heavy traffic                                 |
|  | Lathe  |
| 70   | Loud conversation                                      |
| 60   | Normal conversation                                    |
| 40   | Quiet radio music                                      |
| 30   | Whispering   |
| 20   | Quiet urban room                                       |
| 10   | Rustling leaves  |
| 0  | Hearing threshold                                      |

## How long can people be exposed to noise before the exposure standard is exceeded?

69. Whether the noise exposure standard is exceeded depends on the level of noise involved and how long a person is exposed to it. The peak noise level of 140 dB(C) usually relates to instantaneous, impact or impulse noise such as a gunshot, plane taking off, or hammering. Any exposure above the peak is thought to create almost instant damage to structures of the ear resulting in noise induced hearing loss.
70. Decibels are not like normal numbers; they cannot be added or subtracted in the normal way. The decibel scale is logarithmic. On this scale an increase of three decibels represents a doubling of sound energy. This means someone exposed to 88 decibels for eight hours is exposed to twice as much noise as someone exposed to 85 decibels for eight hours.
71. Table 2 below demonstrates the combinations of various exposure levels and the total length of time someone can be exposed to noise before the standard is exceeded.

**Table 2 – Equivalent noise exposures**

| Exposure level dB | Exposure time |
|-------------------|---------------|
| 85                | 8 hrs         |
| 88                | 4 hrs         |
| 91                | 2 hrs         |
| 94                | 1 hr          |
| 97                | 30 min        |
| 100               | 15 min        |
| 103               | 7.5 min       |
| 106               | 3.8 min       |
| 109               | 1.9 min       |
| 112               | 57 sec        |
| 115               | 28.5 sec      |
| 118               | 14.3 sec      |
| 121               | 7.1 sec       |
| 124               | 3.6 sec       |
| 127               | 1.8 sec       |
| 130               | 0.9 sec       |

72. Table 2 above shows that someone being exposed to 85 dB for eight hours is equivalent to someone being exposed to 88 dB for four hours. In both cases the exposure standard is not being exceeded. However, exposure to 88 dB for more than four hours would exceed the standard. Similarly, if a person uses a grinder that generates 121 dB, the exposure standard will be exceeded after only seven and a half seconds. See paragraph 86-88 and Table 3 in Part 3.2 of this Code for information about the noise exposure standard and extended work shifts.

**Note:** When considering exposure levels, employers must not take into account the effect of any hearing protectors being worn. <OHS Regulation 32(2)>

DRAFT - PUBLIC COMMENT

## PART 3.2 –DETERMINING EXPOSURE TO NOISE

73. A noise determination (assessment) can help an employer assess:

- whether the noise exposure standard is exceeded
- who is at risk of losing their hearing, and
- what is causing that risk

**When** conducting a noise determination, the employer must consult with affected employees and any HSR. <OHS Act s35, 36> – see also Part 1 of this Code – “Consultation”

### When is a noise determination required?

74. An employer must conduct a determination of an employee’s exposure to noise if, based on reasonable grounds, there is uncertainty as to whether the employee is or may be exposed to noise that exceeds the noise exposure standard. <OHS Regulation 32> Uncertainty may arise when noise in the work environment is variable, there are multiple sources of noise and the duration of an employee’s exposure varies.
75. The employer must not take into account the effect of any hearing protectors worn in determining whether employee’s exposure to noise is or may exceed the exposure standard. <OHS Regulation 32>
76. For more information about identifying noise problems, and the noise exposure standard see **Appendix B – Noise Hazard Identification Checklist.**

### Who can perform a noise determination?

77. A noise determination should be done by a suitably qualified person. The more complex the situation, the more knowledgeable and experienced the person needs to be. Some employers may be able to do the determination themselves, but many will need someone like a consultant to do it for them.
78. A determination should be carried out by a person who has the appropriate noise measuring instruments and who, through training and experience:
- understands what is required by the OHS Regulations
  - knows how to calibrate the instruments prior to and during testing
  - knows how to use the instruments and take the measurements properly, and
  - can interpret the results of the noise measurements.

Persons who may be suitably qualified to do a noise determination include occupational health and safety consultants, occupational hygienists, acoustical consultants and hearing conservation consultants.

## How should a noise determination be done?

79. Guidance on how to do a noise determination can be found in AS/NZS1269.1 Occupational noise management *Measurement and assessment of noise immission and exposure*.
80. A noise determination may be simple or complex depending on what is causing the noise and the nature of the work. A noise determination should be done during a typical workday and must take into account the following factors:
  - the level of noise to which the employee is exposed
  - the duration of exposure
  - plant and other sources of noise at the workplace
  - systems of work at the workplace (ie how the job is done), and
  - any other relevant factors. <OHS Regulation 32(3)(a)>
81. Where employees' exposure to noise varies from day to day, the determination should take that into account. As a general rule, the worst case scenario should be measured.
82. Measurements should be taken at the employee's ear position, using suitable equipment that has been calibrated. Noise measurements should be taken at 0.1 to 0.2 meters from the ear canal entrance over a period of time that is representative of the process, activity or work pattern being assessed. The period should take into account significant variations in the level and duration of noise exposure at the workplace.
83. In most situations the use of a hand-held integrating sound level meter will produce the most useful information. In situations where employees are highly mobile or access for the person taking the measurement is difficult or unsafe, it may be more appropriate to use personal sound exposure meters (dose meters).
84. Noise measurements should include the combined noise levels of all the tools, machines and processes that would normally be used at the same time as well as background noise including ventilation systems, cooling compressors and circulation pumps. To identify which noise sources contribute most to employee exposure, the noise from each source or work activity should also be measured separately.

85. The Ready Reckoner in **Appendix C** may be used to work out the total  $L_{Aeq,8h}$  for combinations of noise levels and exposure duration for each work activity and the relative importance of each.

### Extended work shifts

86. Shift durations of 10 hours or longer involve a degree of risk greater than that indicated by the eight hour measurement  $L_{Aeq,8h}$ . This increase in risk arises because of the additional damaging effect of continued exposure to noise at or after 10 hours. The risk may be further increased if there is reduced recovery time between successive shifts.
87. If employees work shifts of 10 hours or more and there is continued exposure, the adjustment factor for extended shifts as set out in AS/NZS 1269.1 (see Table 3) should be added to the measured  $L_{Aeq,8h}$  before comparing it with the 85 dB(A) exposure standard for noise.

**Table 3: Adjustments for extended work shifts**

| Shift length                       | Adjustment added to measured $L_{Aeq,8h}$ dB(A) |
|------------------------------------|---|
| Less than 10 hrs                   | + 0   |
| 10 hrs or more to less than 14 hrs | + 1   |
| 14 hrs or more to less than 20 hrs | + 2   |
| 20 hrs or more                     | + 3   |

88. For example, if an employee works 12-hour shifts and the typical  $L_{Aeq,8h}$  has been determined to be 93 dB(A), an additional one decibel is added to give an adjusted  $L_{Aeq,8h}$  of 94 dB(A). Hence the employees'  $L_{Aeq,8h}$  exceeds the exposure standard for noise by 9 dB(A). For a fully worked example, see **Appendix C**.

### Representative determinations

89. If there are several employees that are exposed to identical sources of noise and their exposure is likely to be the same, then an employer may determine their noise exposure by conducting a representative determination in relation to one or more of those employees.

<OHS Regulation 32(4)>

## Spot noise measurements

90. A spot measurement using a sound level meter or a smart phone application is a quick or brief measurement taken at a particular spot that gives an indication of the sort of noise levels present. This type of measurement taken next to a particular machine may provide some useful information about the noise emitted from the machine. However, a spot noise assessment on its own it is not sufficient to complete a noise determination because in most cases it does not represent an employee's actual exposure.
91. A noise level for a machine provides very little useful information on its own. This is because most employees don't spend all day in one fixed position; the measurement at the machine would not reflect the employee's actual exposure for the whole day. Therefore it is not possible to compare the result with the noise exposure. Further, it is important to note that spot measurements using a smartphone application may often not provide accurate readings as they rely on the quality of the smartphone microphone and often do differentiate between noise frequencies.

## Noise contour maps

92. Noise contour maps show the different noise levels in various areas of the workplace. This information is often used to mark out areas on the factory floor to show where hearing protectors need to be worn.
93. While this type of information is useful in showing where hearing protection is required to be worn, it does not represent actual employee exposure. Therefore it is not a replacement for a proper determination under the OHS Regulations. Employees' actual exposure depends on how much time they spend in a particular area and what they do. Employees do not usually spend all day in one fixed position. They move around and are exposed to various sources of noise throughout the course of performing their employment duties . Noise levels in a particular area also change throughout the day depending on what is happening and so a contour map is only an indication of the type of noise levels that may be present in a particular area. Noise contour maps are just a tool to help manage noise problems.

## Record of determination <OHS Regulation 33>

94. An employer who makes a determination of exposure to noise at the workplace must make a written record of the determination which:
  - contains the results of the determination and that describes how the employer has taken into account:
    - the level of noise to which the employee is exposed

- the duration of exposure
- plant and other sources of noise at the workplace
- any other relevant factors
- is kept for as long as it remains relevant
- is readily accessible to:
  - a HSR
  - any employee to whom the determination relates.

95. The written record of determination should contain enough information to show that it was done properly with the appropriate factors being taken into account. The report should include information on the level of noise to which an employee is exposed, the sources of this noise, how the job is done and how long employees are exposed to the noise. Details on the type of equipment used to do the measurements, whether it was calibrated, where the measurements were taken and over what period of time are also important in the interpretation of the results. The checklist in **Appendix G** can be used as a guide to what to include in a noise determination report.

96. The information recorded is also useful when reviewing the determination. It will be difficult to work out if the determination remains valid if it is not clear what happened during a determination that was done many years ago. Details may be lost if they have not been recorded adequately. If a determination is reviewed and it can be shown that it remains valid, it does not have to be repeated. If it cannot be demonstrated that the determination still applies, a noise determination will have to be repeated.

## PART 3.3 –RISK CONTROL

97. Employers must ensure that, so far as is reasonably practicable, no employee is exposed to noise exceeding the noise exposure standard, by implementing specified risk control measures. The measures for controlling risk are ranked from the most effective to the least effective level of control, protection and reliability. This ranking is known as the hierarchy of control (see Table 4). <OHS Regulation 34>

**Table 4 – The hierarchy of control**

| Level  | Action   |
|--|--|
| 1. Eliminate source of noise   | <i>Eliminating the source of the noise to which an employee is exposed</i> eg ceasing the use of a noisy machine.  |
| 2. Reduce the exposure of the employee to noise by: <ul style="list-style-type: none"> <li>• substitution</li> <li>• engineering controls</li> </ul> <p><i>NOTE: An employer may use a combination of these control measures in this category.</i></p> | <p><i>Substituting quieter plant or processes</i> eg introducing a process to glue wood in place rather than hammering in nails.</p> <p><i>Using physical engineering controls to reduce an employee's exposure to noise</i> eg using absorbent lining on surfaces to cushion the fall or impact of objects.</p> |
| 3. Reduce the exposure of the employee to noise using administrative controls  | <i>Putting systems of work in place which help to reduce exposure to noise</i> eg limiting the time employees spend in noisy areas by moving them to quiet work areas before their daily noise exposure levels exceed the exposure standard.   |
| 4. Reduce the exposure of an employee to noise by providing hearing protectors   | <i>Providing hearing protectors to protect employees from exposure</i> eg providing earmuffs or earplugs to employees on a construction site.  |

98. Under the hierarchy of control employers must consider and apply each type of control measure so it controls employee exposure to noise so far as is reasonably practicable before considering and applying the one below it. Employers must work their way down the hierarchy until employees' exposure does not exceed the exposure standard. This means that employers cannot give employees hearing protectors without first trying to fix the noise problem using higher level control measures. However, hearing protectors may need to be used as an interim measure until the noise problem can be controlled with higher level controls. Often it will be necessary to use a combination of measures to effectively control noise problems.
99. It is worth noting that if noise can be controlled without relying on hearing protectors, then audiometric testing does not have to be provided. Where hearing protectors are required to make sure that employees' exposure does not exceed the noise exposure, standard testing must be provided. For more information about hearing tests see Part 3.4 of this Code. <OHS Regulation 36>

## **Eliminating the source of the noise**

100. The most effective way to control noise is to eliminate the source of noise completely, for example by:

- getting rid of noisy plant that is not needed or replacing it with quieter plant
- eliminating noisy processes that are no longer needed
- eliminating the need for noisy processes such as cutting or grinding off excess material
- purchasing pre-cut or pre-fabricated materials

## **Reducing exposure to noise**

101. Employers must ensure that employees are not exposed to noise above the exposure standard. If it is not reasonably practicable to eliminate the source of noise, an employer must, so far as is reasonably practicable, reduce the exposure of the employee to noise above the exposure standard by substitution of plant or process or by using engineering controls, or a combination of both.

## **Substituting quieter plant or processes**

102. One of the most effective long-term ways of reducing noise at work is to introduce a purchasing policy to choose the quietest plant for the job. This can be done by obtaining noise information (sound power level data) from the manufacturer, importer or supplier of plant and comparing it to determine the quietest plant. Refer to **Appendix D** – ‘Select Quiet’ Guide for information about purchasing quieter equipment.

103. At times, the quietest plant available may still be too noisy. In these situations, it may be necessary to review and substitute current work processes with more effective ones such as

- using welded construction in large-scale fabrications instead of riveted construction
- bending steel by using a pneumatic or hydraulic process instead of hammering it into shape
- lowering materials in a controlled manner rather than throwing them or letting them fall via gravity
- brushing metal swarf off instead of using a compressed air gun
- using a vacuum to clean up work areas instead of using compressed air to blow away debris

- using pop rivets instead of hot rivets set by traditional hammering

## Engineering controls

104. Engineering controls can be an effective way to reduce an employee's exposure to noise. Employers should understand how plant and work systems operate and identify plant and processes that cause noise in order to determine the best possible way of reducing, minimising or controlling noise at its source.
105. Examples of engineering controls include:
- eliminating impacts between hard objects or surfaces
  - 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 of exhaust mufflers on internal combustion engines
  - fitting silencers to compressed air exhausts
  - isolating (using rubber mounts and flexible connections) a vibrating noise source to separate it from the surface on which it is mounted
  - ensuring gears mesh together better
  - fixing damping materials (such as rubber) or stiffening to panels to reduce their tendency to vibrate
  - building enclosures or sound proof covers around noise sources
  - fitting sound absorbing materials to hard reflective surfaces
  - reducing flow, speed or pressure of particular plant components such as fans
  - changing the material the equipment or its parts are made of (for example change from metal components to plastic components).
  - avoiding sudden changes in pressure, speed or direction of flow in plant.
106. For more detailed information on some of the noise control measures listed above (including illustrations) refer to **Appendix E** – Engineering control measures.

## Written record of control

107. An employer must make a written record that describes the actions necessary to implement higher order risk controls (such as substitution quieter plant or processes) if it not reasonably practicable to implement these higher order risk controls within six months. The written record

must describe the actions necessary to implement the risk control measure/s and when these actions will be carried out. <OHS Regulation 34(8)>

108. For example, if a new, quieter piece of plant is on order but will not arrive at the workplace for six months a written record of control should be created.
109. An employer that makes a written record of control must ensure that the record is accessible to any employee affected by the proposed control measure and HSRs (if any) responsible for any designated work groups affected by the proposed control measure. <OHS Regulations 34(10)>

## **Maintenance of plant and equipment**

110. Regular maintenance of plant and equipment is essential as it will deteriorate with age and can become noisier. Check for changes in noise levels – badly worn bearings and gears, poor lubrication, blunt blades, loose parts, unbalanced rotating parts and steam or air leaks all create noise that can be reduced with good maintenance. Engineering controls such as vibration mountings, impact absorbers, gaskets, seals, silencers, barriers and other equipment should be regularly inspected and maintained.

## **Administrative controls**

111. If an employer has, so far as is reasonably practicable, tried to eliminate the source of, or reduce exposure to, noise and an employee is still exposed to noise that exceeds the noise exposure standard, an employer must reduce the exposure of the employee to noise by using administrative controls. Administrative control measures involve adjusting the way work is organised to reduce the number of employees affected, the level of noise or the length of time that employees are exposed to excessive noise.
112. Some administrative measures include:
  - increasing the distance between noise sources and employees
  - separating quiet areas away from areas with noisy plant and processes
  - doing noisy work out of normal working hours if possible
  - minimising the number of employees working in noisy areas
  - providing quiet areas for rest breaks for employees exposed to noisy work
  - sign posting noisy areas and restricting access
  - rotating employees between noisy and quiet jobs.

## **Provision of hearing protectors**

113. Hearing protectors such as earmuffs or earplugs, must be used when higher level controls, including elimination, substitution, engineering or administrative measures have been put in place, so far as is reasonably practicable, but employees are still exposed to noise above the exposure standard.
114. In some cases, hearing protectors may also need to be used as an interim measure until more permanent higher level control measures are implemented.

## **Selecting hearing protectors**

115. When selecting hearing protectors, an employer must consider the nature, level and duration of noise and the systems of work at the workplace – it is important to provide adequate protection without overprotecting. Overprotection makes useful sounds such as warning signals hard to hear and can put an employee's personal safety at risk. When several employees are exposed to identical sources of noise at the workplace and their exposure is likely to be the same, employers may select hearing protectors for those employees by taking into account the factors listed above in respect of one or more of those employees.
116. Employers should also consider:
- whether they comply with AS/NZS 1270 Acoustics – hearing protectors;
  - the suitability for the type of working environment and the systems of work. For example, earplugs are unhygienic when rolled up and inserted into the ear with dirty hands; in these circumstances earmuffs are more appropriate. However, earmuffs can be uncomfortable to wear in hot environments and can make it difficult for the employee to wear a helmet;
  - the comfort, weight and clamping force of the personal hearing protector.
117. The individual fit of personal hearing protectors to the user is critical for optimum protection. Wearing additional work equipment—such as hard hats, dust masks and eye protection—may affect the performance of a hearing protector. The fit of hearing protectors should be checked while the user is wearing regular work equipment. Employees wearing spectacles should be fitted with hearing protectors while wearing the spectacles.
118. Personal hearing protectors should be selected and maintained in accordance with AS/NZS 1269.3 Occupational noise management – hearing protector program. Good quality hearing protectors will generally include information about how to maintain them. Employers should involve employees in the selection process and offer a reasonable choice from a range of types. It is important that the hearing protector chosen is worn at all times in noisy areas.

119. Suppliers of hearing protectors should provide the full information on the attenuation (reduction in sound) likely to be provided such as the  $SLC_{80}$  ratings, class and octave band attenuation values. The attenuation values should be derived from attenuation measurements made in accordance with AS/NZS 1270 Acoustics – hearing protectors.

### **Hearing protector signs and labels**

120. When hearing protectors are required to be provided under the OHS Regulations, the employer must clearly identify, by signs, labelling of plant or other appropriate means when and where they are to be worn. <OHS Regulation 35>
121. Areas where people need to wear hearing protection must be sign-posted as hearing protector areas and the boundaries of these areas should be clearly defined. Employees and other persons, including managers and visitors, should not enter these areas without wearing appropriate personal hearing protectors, regardless of how short the time they stay in the hearing protector area.
122. Where sign-posting is not appropriate, make other arrangements to ensure that employees and others know when personal hearing protectors are required. For example:
- attach prominent labels to tools and equipment indicating that personal hearing protectors should be worn when operating them
  - provide written and verbal instructions on circumstances in which personal hearing protectors are needed.
123. Employers should provide adequate training and supervision to ensure that hearing protectors are worn when needed.

### **Maintaining risk controls <OHS Regulation 18>**

124. Employers must ensure that control measures are properly installed (if applicable), used and maintained. The purpose of maintaining control measures is to ensure that they perform as originally intended and continue to prevent or adequately control exposure to noise.

Maintenance of control measures should include:

- frequent inspections
- visual checks to ensure that they are being properly applied by employees and independent contractors
- testing of equipment
- preventative maintenance of engineering controls and PPE

- any necessary remedial work to ensure physical controls continue to operate effectively.

125. Sometimes it may be necessary to improve, extend or replace existing control measures to ensure they continue to provide adequate control of risk.

126. Employers should have a maintenance procedure in place to ensure that any defects in control measures are detected as early as possible.

### **Maintenance of hearing protectors**

127. Personal hearing protectors should be regularly inspected and maintained to ensure they remain in clean, workable condition. The inspections should check that:

- ear-muff seals are undamaged
- the tension of headbands is not reduced
- there are no unofficial modifications
- compressible ear-plugs are soft, pliable and clean.

128. If disposable ear-plugs are used, they should only be worn once.

129. Employers should provide employees with training, information and instruction in the proper use, fit, care and maintenance of personal hearing protectors. Employers should also:

- specify the need to wear hearing protectors in safety procedures
- place someone in charge of issuing and making sure replacements are readily available
- carry out spot checks to ensure that employees are wearing their hearing protectors when required and are using them correctly
- ensure all managers and supervisors set a good example and wear personal hearing protectors at all times when in hearing protector areas.

### **Review and revision of risk controls <OHS Regulation 36>**

130. It is important to monitor risk controls to ensure they remain effective. Employers must ensure that any measures implemented to control an employee's exposure to noise are reviewed and, if necessary, revised in the following circumstances:

- before any alteration is made to plant used or a system of work that is likely to result in exposure to noise above the noise exposure standard;

- if an audiological examination report states that an employee has suffered hearing loss that is likely to be due to exposure to noise;
- after the occurrence of any notifiable incident that involves exposure to noise above the exposure standard
- if for any other reason, the risk control measures do not adequately control noise exposure to a level at or below the exposure standard, or
- after receiving a request for review from a HSR. A HSR can make a request if they believe, on reasonable grounds, that:
  - any of the circumstances listed above exist
  - the employer has failed to properly review the risk controls, or
  - in conducting a review of or revising the risk controls, the employer has failed to take into account any of the circumstances listed above.

See [worksafe.vic.gov.au](https://www.worksafe.vic.gov.au) for more information about incident notification and duties of employers to report fatalities, serious injuries and incidents.

## **PART 3.4 – AUDIOMETRIC TESTING AND AUDIOLOGICAL EXAMINATIONS**

### **Audiometric testing <OHS Regulations 19, 36>**

131. Audiometric testing involves measuring a person's hearing levels using an electro-acoustic instrument (audiometer) equipped with earphones. If an employer is required to provide hearing protectors to control an employee's exposure to noise above the noise exposure standard, they must also provide audiometric testing. Testing must be provided for the employee at the employer's cost and the employee must be provided with information about the purpose, and the type or nature of the testing.
132. Audiometric testing must be provided within three months of an employee starting work that requires hearing protectors, at least every two years and at any time when reasonably requested by a HSR of the employee's designated work group.

### **Conducting audiometric testing**

133. Employers required to provide audiometric testing should ensure that it is performed by a person who has the appropriate training or qualifications and has relevant experience. The testing may be conducted within, or external to the workplace. Persons who perform audiometric testing should also have a sound knowledge of the OHS Regulations. Persons who may meet these criteria include:
- ear, nose and throat specialists
  - audiologists, and
  - persons who have successfully completed an appropriate industrial screening audiometry course and have maintained practical experience.
134. Equipment (audiometers) used by persons doing hearing tests should comply with and be calibrated in accordance with any relevant standards such as AS 2586: Audiometers.
135. Employers should refer to AS/NZS 1269.4 Occupational Noise Management Part 4: Auditory Assessment for information about general audiometry, reference and monitoring audiometry and required testing procedures. Employers may also consult with audiometric service providers for more information about what steps employees should take prior to and after audiometric testing.

136. Employers should ask the audiometric service provider to compile a report or provide test results to enable the comparison between consecutive audiometric tests. Each employee tested must be given a copy of their own report as soon as reasonably possible after the employer receives it. Employers should be aware that the audiometric tests they provide will be considered by hearing loss assessors in the event an employee makes a claim for impairment benefits. It is important to ensure that there is enough detail in test reports to establish that the audiometric testing was conducted in accordance with AS/NZS 1269.4 Occupational Noise Management Part 4: Auditory assessment.

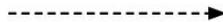
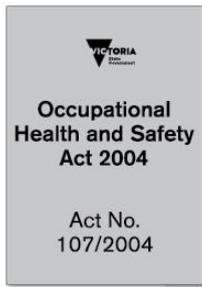
### **Audiological examinations <OHS Regulations 20(2)(a), 38 & 39>**

137. If the results of two or more audiometric tests over a period not exceeding two years indicate a reduction in hearing levels equal to or greater than 15dB at 3000, 4000 or 6000 Hz, an employer must provide for the employee to undergo an audiological examination as soon as reasonably possible.
138. An audiological examination involves examining a person's ear and assessing their hearing levels to establish the type and cause of any hearing disorder. Examinations should be provided by a suitably qualified person such as an audiologist or an ear nose and throat specialist. Employers must ensure they receive a report from the audiological examination provider for each employee tested that contains the examination results and states whether the employee has suffered hearing loss that is likely to be due to exposure to noise. Each employee must be given a copy of their own report as soon as reasonably possible after the employer receives it.
139. If the result of the audiological examination indicates that the cause of the hearing loss is likely to be due to exposure to noise then the employer must review and, if necessary, revise, risk control measures that have been put in place to control the employee's exposure to noise.

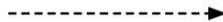
### **Record keeping <OHS Regulations 20, 40>**

140. Employers must retain any audiometric test results and audiological examination reports as a confidential record for as long as the affected employee is employed by the employer. Copies of reports must be given to the employees to whom they relate.
141. An employer must also, on request, provide a HSR with aggregate results of the most recent audiometric tests relating to the HSR's designated work group. However, the results provided must not contain information that identifies the employees tested or from which the employee's identity could be reasonably obtained.

# APPENDIX A – The Compliance Framework



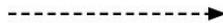
**The Occupational Health and Safety Act** sets out the key principles, duties and rights in relation to occupational health and safety.



**The Occupational Health and Safety Regulations** specify the way in which a duty imposed by the Act must be performed, or prescribe procedural or administrative matters to support the Act (eg requiring licences for specific activities, the keeping of records or giving notice).



**Compliance Codes** provide practical guidance to duty holders. If a person complies with a provision of a Compliance Code, they are deemed to comply with the Act or regulation duty covered by the Code provision. However, Compliance Codes are not mandatory, and a duty holder may choose to use some other way to achieve compliance.



**WorkSafe Positions:** These are guidelines made under Section 12 of the Act that state how WorkSafe will apply the Act or regulations or exercise discretion under a provision of the Act or regulations. WorkSafe Positions are intended to provide certainty to duty holders and other affected parties.



**Non-statutory guidance:** Includes information published by WorkSafe aimed at building people's knowledge and awareness of OHS issues, risks to health and safety, and the disciplines and techniques that can be applied to manage and control risks. Non-statutory guidance is not mandatory, nor does it provide any 'deemed to comply' outcomes for duty holders. This guidance does, however, form part of the 'state of knowledge' about OHS.

## APPENDIX B – Noise Hazard Identification Checklist

Description of work location:

Activities at workstation:

Assessed by:

Date:

Answering 'yes' to one or more of the questions in the table below may indicate that there is a noise problem at your workplace. A noise determination must be carried out if there is uncertainty (based on reasonable grounds) that the noise exposure standard is or may be exceeded in your workplace.

| Hazard identification questions   | Yes                      | No                       |
|---|--------------------------|--------------------------|
| 1. Is a raised voice needed to communicate with someone about one metre away?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Do employees 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) | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Are employees using noisy powered tools or machinery?  | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Are there noises due to impacts (such as hammering, pneumatic impact tools) or explosive sources (such as explosive powered tools, detonators)?                                | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Are personal hearing protectors used for some work?  | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Do employees complain that there is too much noise or that they can't clearly hear instructions or warning signals?  | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Do employees experience ringing in the ears or a noise sounding different in each ear?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Do any long-term employees appear to be hard of hearing?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Have there been any workers' compensation claims for noise-induced hearing loss?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Does any equipment have manufacturer's information (including labels) indicating noise levels equal or greater than any of the following:                                     | <input type="checkbox"/> | <input type="checkbox"/> |
| (a) 80 dB(A) $L_{Aeq,T}$ (T= time period over which noise is measured)?   | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) 130 dB(C) peak sound power level?   | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) 88 dB(A) sound power level?   | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Do the results of audiometry tests indicate that past or present employees have hearing loss?   | <input type="checkbox"/> | <input type="checkbox"/> |

## APPENDIX C – Ready Reckoner

Tables B1 to B3 provide a simple way of working out an employee's  $L_{Aeq,8h}$  (eight-hour equivalent continuous sound pressure level) if you know the noise level and duration of each of the noisy tasks carried out by the employee during the work shift.<sup>1</sup>

From Tables B1 or B2 you read off the number of “noise exposure points” that correspond to a particular task's noise level and exposure duration. Table B1 is for noise levels between 75 and 105 dB(A) and Table B2 is for higher noise levels between 95 and 125 dB(A).

For example, a task producing a noise level at the employee's ear of 93 dB(A) that is done for two lots of 30 minutes in a shift (i.e. one hour total) produces 80 noise exposure points. Another task with a noise level of 120 dB(A) for one minute during the shift produces 670 points.

These points can be added (in the normal arithmetic way) to give the total exposure points for the shift. Table B3 is then used to convert the total points to the  $L_{Aeq,8h}$ .

In the example above, if these were the only noisy tasks carried out by the employee, the points total is 750 and (from Table B3, rounding to the nearest whole decibel) the  $L_{Aeq,8h}$  for the employee is 94 dB(A).

This calculated  $L_{Aeq,8h}$  value can be compared with the exposure standard for noise i.e.  $L_{Aeq,8h} = 85$  dB(A). Additionally, noise exposure points can be used to prioritise the noise control program by showing which tasks make the greatest contribution to the total noise exposure.

In the example above the employee's  $L_{Aeq,8h}$  is greater than the standard, so noise control action is needed. Although it only lasts for one minute, the 120 dB(A) task contributes more than eight times as much as the other task to the total exposure and so should be the first one tackled.

In this scheme the exposure standard for noise –  $L_{Aeq,8h} = 85$  dB(A) – is 100 points.

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<sup>1</sup> Based on Health and Safety Executive UK guidance material with the points used in the tables derived from procedures in AS/NZS1269.1

## APPENDIX C – Ready Reckoner

**Table B1: Exposure points for 75-105 dB(A)/15minutes – 12 hours**

**Table B1: Exposure points for 75 – 105 dB(A)/15minutes – 12 hours**

| Sound Level<br>L <sub>Aeq,T</sub> dB(A) | Duration of exposure per shift |        |      |      |      |       |       |       |
|---|--------------------------------|--------|------|------|------|-------|-------|-------|
|   | 15 min                         | 30 min | 1 h  | 2 h  | 4 h  | 8 h   | 10 h* | 12 h* |
| 105                                     | 320                            | 640    | 1270 | 2530 | 5060 | 10120 | 12650 | 15180 |
| 104                                     | 250                            | 500    | 1000 | 2010 | 4020 | 8040  | 10050 | 12060 |
| 103                                     | 200                            | 400    | 800  | 1600 | 3200 | 6400  | 8000  | 9600  |
| 102                                     | 160                            | 320    | 640  | 1270 | 2540 | 5070  | 6340  | 7600  |
| 101                                     | 130                            | 250    | 500  | 1010 | 2010 | 4030  | 5040  | 6040  |
| 100                                     | 100                            | 200    | 400  | 800  | 1600 | 3200  | 4000  | 4800  |
| 99                                      | 80                             | 160    | 320  | 640  | 1270 | 2540  | 3180  | 3810  |
| 98                                      | 63                             | 130    | 250  | 500  | 1010 | 2020  | 2520  | 3030  |
| 97                                      | 50                             | 100    | 200  | 400  | 800  | 1600  | 2000  | 2410  |
| 96                                      | 40                             | 80     | 160  | 320  | 640  | 1270  | 1590  | 1910  |
| 95                                      | 32                             | 63     | 130  | 250  | 510  | 1010  | 1260  | 1520  |
| 94                                      | 25                             | 50     | 100  | 200  | 400  | 800   | 1000  | 1210  |
| 93                                      | 20                             | 40     | 80   | 160  | 320  | 640   | 800   | 960   |
| 92                                      | 16                             | 32     | 63   | 130  | 250  | 510   | 630   | 760   |
| 91                                      | 13                             | 25     | 50   | 100  | 200  | 400   | 500   | 600   |
| 90                                      | 10                             | 20     | 40   | 80   | 160  | 320   | 400   | 480   |
| 89                                      | 7.9                            | 16     | 32   | 64   | 130  | 250   | 320   | 380   |
| 88                                      | 6.3                            | 13     | 25   | 50   | 100  | 200   | 250   | 300   |
| 87                                      | 5.0                            | 10     | 20   | 40   | 80   | 160   | 200   | 240   |
| 86                                      | 4.0                            | 8.0    | 16   | 32   | 64   | 130   | 160   | 190   |
| 85                                      | 3.2                            | 6.3    | 13   | 25   | 50   | 100   | 130   | 150   |
| 84                                      | 2.5                            | 5.0    | 10   | 20   | 40   | 80    | 100   | 120   |
| 83                                      | 2.0                            | 4.0    | 8.0  | 16   | 32   | 64    | 80    | 96    |
| 82                                      | 1.6                            | 3.2    | 6.3  | 13   | 25   | 51    | 63    | 76    |
| 81                                      | 1.3                            | 2.5    | 5.0  | 10   | 20   | 40    | 50    | 60    |
| 80                                      | 1.0                            | 2.0    | 4.0  | 8.0  | 16   | 32    | 40    | 48    |
| 79                                      | 0.8                            | 1.6    | 3.2  | 6.4  | 13   | 25    | 32    | 38    |
| 78                                      | 0.6                            | 1.3    | 2.5  | 5.0  | 10   | 20    | 25    | 30    |
| 77                                      | 0.5                            | 1.0    | 2.0  | 4.0  | 8.0  | 16    | 20    | 24    |
| 76                                      | 0.4                            | 0.8    | 1.6  | 3.2  | 6.4  | 13    | 16    | 19    |
| 75                                      | 0.3                            | 0.6    | 1.3  | 2.5  | 5.1  | 10    | 13    | 15    |

## APPENDIX C – Ready Reckoner

**Table B2: Exposure points for 95-125 dB(A)/5 seconds – 10 minutes**

**Table B2: Exposure points for 95 – 125 dB(A)/5 seconds – 10 minutes**

| Sound Level<br>L <sub>Aeq,T</sub> dB(A) | Duration of exposure per shift |        |        |        |       |       |       |        |
|---|--------------------------------|--------|--------|--------|-------|-------|-------|--------|
|   | 5 sec                          | 10 sec | 15 sec | 30 sec | 1 min | 2 min | 5 min | 10 min |
| 125                                     | 180                            | 360    | 530    | 1050   | 2110  | 4220  | 10540 | 21080  |
| 124                                     | 140                            | 280    | 420    | 840    | 1680  | 3350  | 8370  | 16750  |
| 123                                     | 110                            | 220    | 330    | 670    | 1330  | 2660  | 6650  | 13300  |
| 122                                     | 90                             | 180    | 260    | 530    | 1060  | 2110  | 5280  | 10570  |
| 121                                     | 70                             | 140    | 210    | 420    | 840   | 1680  | 4200  | 8390   |
| 120                                     | 56                             | 110    | 170    | 330    | 670   | 1330  | 3330  | 6670   |
| 119                                     | 44                             | 88     | 130    | 270    | 530   | 1060  | 2650  | 5300   |
| 118                                     | 35                             | 70     | 110    | 210    | 420   | 840   | 2100  | 4210   |
| 117                                     | 28                             | 56     | 84     | 170    | 330   | 670   | 1670  | 3340   |
| 116                                     | 22                             | 44     | 66     | 130    | 270   | 530   | 1330  | 2650   |
| 115                                     | 18                             | 35     | 53     | 110    | 210   | 420   | 1050  | 2110   |
| 114                                     | 14                             | 28     | 42     | 84     | 170   | 330   | 840   | 1680   |
| 113                                     | 11                             | 22     | 33     | 67     | 130   | 270   | 670   | 1330   |
| 112                                     | 8.8                            | 18     | 26     | 53     | 110   | 210   | 530   | 1060   |
| 111                                     | 7.0                            | 14     | 21     | 42     | 84    | 170   | 420   | 840    |
| 110                                     | 5.6                            | 11     | 17     | 33     | 67    | 130   | 330   | 670    |
| 109                                     | 4.4                            | 8.8    | 13     | 26     | 53    | 110   | 270   | 530    |
| 108                                     | 3.5                            | 7.0    | 11     | 21     | 42    | 84    | 210   | 420    |
| 107                                     | 2.8                            | 5.6    | 8.4    | 17     | 33    | 67    | 170   | 330    |
| 106                                     | 2.2                            | 4.4    | 6.6    | 13     | 27    | 53    | 130   | 270    |
| 105                                     | 1.8                            | 3.5    | 5.3    | 11     | 21    | 42    | 110   | 210    |
| 104                                     | 1.4                            | 2.8    | 4.2    | 8.4    | 17    | 33    | 84    | 170    |
| 103                                     | 1.1                            | 2.2    | 3.3    | 6.7    | 13    | 27    | 67    | 130    |
| 102                                     | 0.9                            | 1.8    | 2.6    | 5.3    | 11    | 21    | 53    | 110    |
| 101                                     | 0.7                            | 1.4    | 2.1    | 4.2    | 8.4   | 17    | 42    | 84     |
| 100                                     | 0.6                            | 1.1    | 1.7    | 3.3    | 6.7   | 13    | 33    | 67     |
| 99                                      | 0.5                            | 0.9    | 1.3    | 2.7    | 5.3   | 11    | 27    | 53     |
| 98                                      | 0.4                            | 0.7    | 1.1    | 2.1    | 4.2   | 8.4   | 21    | 42     |
| 97                                      | 0.3                            | 0.6    | 0.8    | 1.7    | 3.3   | 6.7   | 17    | 33     |
| 96                                      | 0.2                            | 0.5    | 0.7    | 1.3    | 2.7   | 5.3   | 13    | 27     |
| 95                                      | 0.2                            | 0.4    | 0.5    | 1.1    | 2.1   | 4.2   | 11    | 21     |

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**Table B3: Conversion**

**Table B3: Conversion**

| Total exposure points | 10 sec | Notes   |
|-----------------------|--------|---|
| 32000                 | 110    | 1. If there is only one source of noise exposure, a quick glance at the background colour of the table cell corresponding to the sound level and duration of exposure will tell you if the employee is:<br>(a) above the LAeq,8h 85 dB(A) exposure standard – <b>Red</b><br>(b) well below the LAeq,8h 85 dB(A) standard – <b>Green</b><br>(c) marginal (between LAeq,8h 80 and 85 dB(A)) – <b>Yellow</b> |
| 25420                 | 109    |   |
| 20190                 | 108    |   |
| 16040                 | 107    |   |
| 12740                 | 106    | 2. For durations of exposure not listed in the table, add together the points from two durations that together give the same duration. For example, for five hours at 95 dB(A), add together the points for four hours at 95 dB(A) and one hour at 95 dB(A), i.e. 510 + 130, giving a total of 640 points.  |
| 10120                 | 105    |   |
| 8040                  | 104    |   |
| 6400                  | 103    |   |
| 5070                  | 102    | 3. The tables can be extended to include both higher and lower sound levels. A change of 10 dB(A) results in a tenfold change in the points. For example, one hour exposure at 108 dB(A) will give 10 times the points for one hour at 98 dB(A), that is, 2500 points.  |
| 4030                  | 101    |   |
| 3200                  | 100    |   |
| 2540                  | 99     |   |
| 2020                  | 98     | 4. For shift lengths of 10 hours or more (*), the adjustments listed in Table 3 should be added to the LAeq,8h before comparing the result with the exposure standard for noise.  |
| 1600                  | 97     |   |
| 1270                  | 96     |   |
| 1010                  | 95     |   |
| 800                   | 94     |   |
| 640                   | 93     |   |
| 510                   | 92     |   |
| 400                   | 91     |   |
| 320                   | 90     |   |
| 250                   | 89     |   |
| 200                   | 88     |   |
| 160                   | 87     |   |
| 130                   | 86     |   |
| 100                   | 85     |   |
| 80                    | 84     |   |
| 64                    | 83     |   |
| 51                    | 82     |   |
| 40                    | 81     |   |
| 32                    | 80     |   |
| 25                    | 79     |   |
| 20                    | 78     |   |
| 16                    | 77     |   |
| 13                    | 76     |   |
| 10                    | 75     |   |

## APPENDIX C – Ready Reckoner

*Example: Carpenter working a 10.5-hour shift using tools and machines listed below.*

| Machine/Process                 | Measured Sound Level $L_{Aeq,T}$ dB(A) | Duration per shift |
|---------------------------------|--|--------------------|
| Circular Saw – cutting hardwood | 94                                     | 2 h                |
| Planer – planing hardwood       | 100                                    | 3 h                |
| Power Drill – drilling hardwood | 87                                     | 4 h                |
| Hammering nails into wood       | 98                                     | 10 min             |
| Background                      | 70                                     | 1 h 20 min         |

If you want to quickly see if the carpenter is exposed above the  $L_{Aeq,8h} = 85$  dB(A) noise standard, look up points for 94 dB(A) and 2 h in Table B1. You will see that the cell is red, so you know without going any further that the carpenter is exposed to noise above the standard.

If you want to actually work out the carpenter's 8h-equivalent continuous noise level,  $L_{Aeq,8h}$ , then use Tables B1, B2 and B3 as below:

| Machine/Process                 | Measured Sound Level $L_{Aeq,T}$ dB(A) | Duration per shift | Points                  |
|---------------------------------|--|--------------------|-------------------------|
| Circular Saw – cutting hardwood | 94                                     | 2 h                | 200                     |
| Planer – planing hardwood       | 100                                    | 3 h                | 2 h – 800<br>1 h – 400  |
| Power Drill – drilling hardwood | 87                                     | 4 h                | 80                      |
| Hammering nails into wood       | 98                                     | 10 min             | 42                      |
| Background                      | 70                                     | 1 h 20 min         | 1 h – 0.4<br>20 m – 0.1 |
| <b>Total</b>                    |  | <b>10.5 h</b>      | <b>1522.5</b>           |

From Table B3:  $L_{Aeq,8h} = 97$  dB(A), but as the shift is 10.5 hours, an adjustment of +1 dB(A) is needed, hence the adjusted  $L_{Aeq,8h} = 98$  dB(A).

# APPENDIX D – ‘Select Quiet’ Guide for Selecting Quieter Equipment

## Purpose

The purpose of this guide is to provide advice to employers on what to consider when selecting quieter plant for the workplace.

The advice should be used when selecting plant or parts for use in workplaces such as compressed air nozzles, compressors, generators, motors, saw blades, grinders, fans, vehicles, purpose built process plant, presses, power tools, and various types of pneumatic tools.

## Why select quieter plant?

Selecting quieter plant is one of the most effective ways of reducing noise. Plant that is 3 decibels quieter might not seem like a big difference but it can reduce employee noise exposure levels by half.

Selecting quieter plant is generally cheaper than selecting noisier plant in the long term. Noisier plant usually needs to be modified later in some way to reduce noise. In addition, hearing protection often needs to be provided to employees using noisy plant which means hearing tests need to be performed. These measures can often be quite costly so any means to avoid them are usually more cost effective.

While it is not always possible to select ‘quiet’ plant it is always possible to select the ‘quietest’ plant available.

## Before selecting new equipment

Before selecting quieter plant, it is worth looking at a task carefully and seeing if it needs to be done at all and whether there is a quieter way of doing it. For example, when bending metal bars into shape use a hydraulic process rather than a large hammer. It may also be possible to make improvements in the production process to avoid the need to have to grind off any rough bits when cutting metal. These alternatives may prove to be a more effective option both in terms of expense and the level of noise reduction achieved. That is, in some cases the quietest equipment available may still be very noisy.

## Getting noise information on plant

Ask manufacturers or suppliers of plant for sound power level data when considering selecting plant for use in a work environment. The ‘sound power level’ is a measure (in decibels) of the sound energy of plant. Think of sound power as a bit like the power or capacity of an engine.

In Victoria, manufacturers of plant that may cause employees’ exposure to exceed the noise exposure standard when used for its intended purpose, are required to test that plant and provide a record of the sound power level. Suppliers of that plant must then provide the ‘sound power level’ information from the manufacturer.

## Questions to ask suppliers or manufacturers when buying plant

Ask potential suppliers/manufacturers for sound power level data and compare the options.

If plant is to be supplied through a tender process, specify a maximum acceptable noise level. Refer below for advice on “What to include in a noise specification”.

In addition to sound power level data, it may also be useful to ask manufacturers and suppliers the following questions:

- Are there quieter models of the same plant?
- Does the quieter plant have any additional safety features? If so, what are they?
- Are there any specific maintenance and service requirements?
- Are there any optional extras that can be purchased to further reduce noise?
- What costs are involved?

## APPENDIX D – ‘Select Quiet’ Guide for Selecting Quieter Equipment

Even though quieter plant may be more expensive to purchase, the plant is usually better built and has noise reducing features included.

Features to look for when selecting quiet plant include:

- higher manufacturing tolerances/precision
- sound absorbing insulation or damping material included (eg rubber or polyethylene)
- gears that mesh together better
- fans that are quieter
- better mountings and flexible connections
- secure parts that reduce vibration
- minimal reverberation within the unit itself
- tolerance for greater loads
- less impact noises produced in operation
- the use of quieter processes (eg hydraulic processes that often dampen noise)
- sound enclosures for noisy parts or employees
- parts or attachments constructed of noise absorbing material (eg rubber or polyethylene), and
- remote controls that allow employees to remain a safe distance from the source of the noise.

### What if the information is not available?

The information may not be available where the supplier is dealing with an overseas or interstate manufacturer that has not determined the sound power level.

If the plant to be selected is manufactured by a Victorian manufacturer, they are legally required to provide sound power level data if the use of their plant may expose employees to noise exceeding the noise exposure standard when the plant is used for its intended purpose.

If a supplier cannot provide noise information because it is not available from an overseas or interstate manufacturer, it may be possible to arrange for noise measurements to be made on the same plant being used elsewhere or at the supplier's premises. The supplier may have already done such measurements. If not, the supplier may meet or share the costs of getting the measurements, as the information may be useful for other potential purchasers and for promotional purposes.

If a supplier or manufacturer is not providing the information required, look at whether the same or similar plant is available from other suppliers or manufacturers.

### How can information on noise (sound power levels) be used?

#### *Comparing different brands of plant*

Sound power level data can be used to compare different brands of plant to enable employers to select the quietest plant so long as other safety aspects are at least equivalent.

Ask the supplier or manufacturer the following questions:

- What standard (if any) was the plant or plant tested against? For some types of plant there may be specific International or Australian Standards that specify a particular test procedure. Testing in different ways may give different results which cannot be compared.
- Was the data collected some distance away or at the operator position?

## APPENDIX D – ‘Select Quiet’ Guide for Selecting Quieter Equipment

- What work was being undertaken during the testing (including materials handled etc)?
- What were the test conditions (for example whether free running or under load)?

### *Estimating noise levels in the workplace*

When introducing new plant, consider the impact they will have in the workplace. Take into account such things as:

- the number of plant to be introduced
- where the plant is to be used
- how plant is to be used (eg operating speed, what is to be processed or cut etc)
- how long plant is to be used for
- whether employees work close to the plant or some distance away
- the number of employees likely to be affected
- whether employees are exposed to it for a few minutes a day or 8 hours a day
- existing background noise levels

The sound power level can be used to predict or estimate the noise levels likely to be generated in a particular environment. In some circumstances (eg in an otherwise quiet workplace), the sound power level may provide a rough estimate of the noise level when the plant is used in the workplace. However, as a general rule, add approximately 6 decibels to get an estimate of what the actual noise levels may be.

When two equally loud noise sources are positioned near each other, it normally causes an increase of 3 decibels. For example, two piece of plant producing 88 dB(A) each would be expected to produce a combined noise level of 91 dB(A). The resulting noise levels will be even higher if there are more than two piece of plant operating next to each other or there are other noise sources in the vicinity that produce similar noise levels.

The distance of employees to plant can make a significant difference to their noise exposure. Obviously the closer employees are to plant generating noise, the higher their exposure. As a rough guide, there will be an increase of 6 decibels as the distance between the person and the noise source halves. For example: if the noise level (sound pressure level) is 91 dB(A) 4 metres from plant, then the noise level is likely to be 97 dB(A) at 2 metres from the piece of plant.

Even if new plant will produce noise levels above the exposure standard when used in the workplace, the plant may still be considered if it is the quietest available.

### **What to Include in a Noise Specification**

The following is a guide to assist employers in putting together noise specifications when purchasing plant through a tender process. This process can become complex and expertise may be required to assist in:

- determining the actual specifications
- providing guidance on what is available and what is technically possible and
- interpreting data received.

## APPENDIX D – ‘Select Quiet’ Guide for Selecting Quieter Equipment

### Noise levels:

Tenders should:

- specify the acceptable sound power level
- specify noise levels (sound pressure levels (dB(A)) at a particular position(s) measured over an appropriate number of operating cycles
- specify peak noise levels  $L_p(C)$  if appropriate (eg for impulse or impact type noise generated by such devices as pneumatic tools, explosive powered tools and impact devices such as presses). The OHS Regulations specify a peak sound pressure level of 140 dB(C).

### Position of measurements:

The position usually specified for noise measurements is the operator's ear position. However, for some plant (such as a plant which there is no fixed employee position or plant with a built-in operator's enclosure) it may be important to know the noise levels at other points around the plant so that exposure of the employee, and the effects on others in the workplace, can be properly assessed. In these cases, specify that noise should be measured at points around the plant at a height of 1.5 metres above the floor and/or access platform(s) and 1.0 metre from the plant itself, ignoring small projections.

### Operating conditions:

The operating conditions to be specified depend on the nature of the plant and its intended use and include such factors as speed, load, tooling, material being processed and feed rate. Specify whatever conditions are likely to result in the highest noise emission. If it is not known what these might be, specify a range of typical operating conditions and base decisions on the highest level.

### Acoustical conditions:

The acoustical conditions may be specified in three ways:

1. The first option is to specify that the noise of the plant is to be measured under agreed conditions in an environment similar to the proposed installation site. In practice, the manufacturer's or supplier's workplace will often meet this requirement.
2. A second option, appropriate for major purchases by tender, is to specify that the maximum acceptable noise level is not to be exceeded when the plant is installed and operating in the intended workplace. This puts the onus on the manufacturer to take the acoustical characteristics of the specific workplace into account when responding to the tender invitation. In order to do this, the tenderer should inspect the installation site. If unable to do so, the tenderer would need to ask for relevant details such as the dimensions of the installation site, the size and placement of nearby plant, benches and other fittings and the nature of floor, wall and ceiling materials. If a tenderer neither inspects nor requests details, treat the tender with caution.
3. A third option is to specify that the noise of the plant is to be measured in a standard acoustical environment, such as one of those defined in a relevant Australian, New Zealand or International Standard for machine noise measurement.

# APPENDIX E – Engineering Control Measures

The following are 10 simple noise control techniques that have wide application across industry. In many cases they will produce substantial noise reductions quickly and cheaply, with little or no effect on normal operation or use of plant.<sup>2</sup>

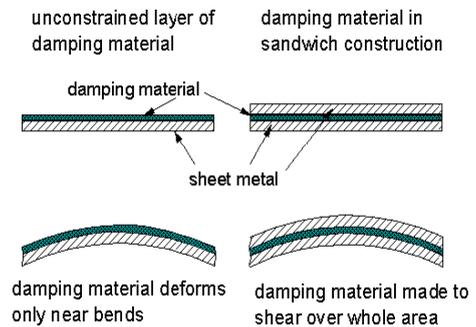
## 1. DAMPING

**Typical applications** - Chutes, hoppers, machine guards, panels, conveyors, tanks

### Technique

There are 2 basic techniques:-

- unconstrained layer damping where a layer of bitumastic (or similar) high damping material is stuck to the surface
- constrained layer damping where a laminate is constructed



Constrained layer damping is more rugged and generally more effective. Either re-manufacture guards, panels or other components from commercially available sound deadened steel or buy self-adhesive steel sheet. The latter can simply be stuck on to existing components (inside or outside) covering about 80% of the flat surface area to give a 5 - 25 dB reduction in the noise radiated (use a thickness that is 40 per cent to 100 per cent of the thickness of the panel to be treated).

**Limitations:** the efficiency falls off for thicker sheets. Above about 3mm sheet thickness it becomes increasingly difficult to achieve a substantial noise reduction.

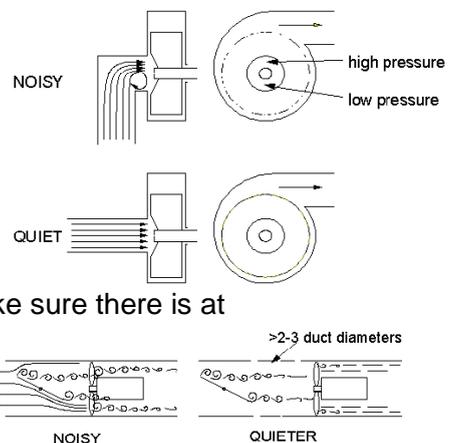
## 2. FAN INSTALLATIONS

**Typical applications** - Axial flow or centrifugal fans.

### Technique

Maximum fan efficiency coincides with minimum noise. Any fan installation feature that tends to reduce fan efficiency is therefore likely to increase noise. Two of the most common examples are bends close to the fan (intake side in particular) and dampers close to the fan intake or exhaust.

Ideally, for maximum fan efficiency and minimum noise, make sure there is at least 2 - 3 duct diameters of straight duct between any feature that may disturb the flow and the fan itself. Noise reductions of 3 -12 dB are often possible.



## 3. DUCTWORK

**Typical applications** - Extraction, ventilation, cooling, openings in walls and enclosures.

### Technique

Instead of fitting silencers, it is often possible to achieve a 10 - 20 dB reduction in airborne noise from a duct or opening by lining the last bend in the ductwork with acoustic absorbent (foam or rockwool / fibreglass). Alternatively, construct a simple absorbent lined right-angled bend to fit on the opening. Ideally, either side of the bend should be lined along a length equivalent to twice the duct diameter. Where flow velocities are high (> 3m/s), consider using cloth faced absorbent. Duct vibration can usually be treated by damping (as above).

<sup>2</sup> Source Health and Safety Executive UK

# APPENDIX E – Engineering Control Measures

## 4. FAN SPEED

**Typical applications** - Axial or centrifugal flow fans.

### Technique

Fan noise is roughly proportional to the 5th power of fan speed. So in many cases it is possible to achieve a large noise reduction from a small drop in fan speed by changing control systems or pulley sizes and re-setting dampers. The following table provides a guide to the trade-off that can be expected.

| FAN SPEED REDUCTION | NOISE REDUCTION |
|---------------------|-----------------|
| 10%                 | 2 dB            |
| 20%                 | 5 dB            |
| 30%                 | 8 dB            |
| 40%                 | 11 dB           |
| 50%                 | 15 dB           |

## 5. PNEUMATIC EXHAUSTS

### Technique

Almost invariably it is possible to reduce pneumatic exhaust noise permanently by 10 - 30 dB by fitting effective silencers. The following are the practical points that can make the difference between success and failure:-

- *back pressure* : fit a larger coupling and silencer
- *clogging* : fit a straight-through silencer that cannot clog (and has no back pressure)
- *multiple exhausts* : manifold them into a single, larger diameter pipe fitted with the rear silencer from virtually any make of car (from your local tyre and exhaust fitter). Typically 25 dB reduction.

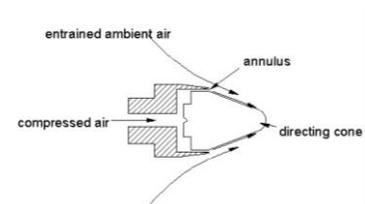
**Note** : a well designed silencer will not increase system back pressure.

## 6. PNEUMATIC NOZZLES

**Typical applications** - Cooling, drying, blowing

### Technique

In most cases, it is possible to replace existing nozzles (usually simple copper pipe outlets) for quiet, high efficiency units. These not only reduce noise levels by up to 10 dB, but also use less compressed air. The types of nozzle to look out for are entraining units (schematic at right) from various manufacturers and in a variety of sizes.

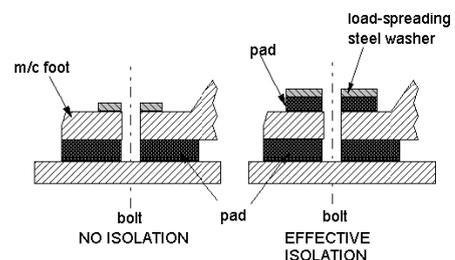


## 7. VIBRATION ISOLATION PADS

**Typical applications** - Machine feet, pumps, mezzanine installations

### Technique

Mounting motors, pumps, gearboxes and other items of plant on rubber bonded cork (or similar) pads can be a very effective way of reducing transmission of vibration and therefore noise radiated by the rest of the structure. This is particularly the case where vibrating units are bolted to steel supports or floors. However, a common error with the use of these pads is for the bolt to "short-circuit" the pad, resulting in no isolation. Additional pads should be fitted under the bolt heads as shown.



There are many types of off-the-shelf anti-vibration mounts available, for instance rubber/neoprene or spring types. The type of isolator that is most appropriate will depend on, among other factors, the mass of the plant and the frequency of vibration to be isolated. Any supplier of anti-vibration mounts will be able to advise you on this.

## APPENDIX E – Engineering Control Measures

### 8. EXISTING MACHINE GUARDS

#### Technique

The existing guards on many machines can often be improved to provide a significant noise reduction. The two principles involved, which must be used in combination, are:-

i. *Minimise gaps*

Reducing by half the “gap” open area in a set of guards can reduce the noise by 3 dB. If you can reduce the openings (flexible seals, additional close fitting panels etc) by 90 per cent, then a 10 dB noise reduction is possible.

ii. *Acoustic absorbent*

Lining a significant proportion of the inside of the guards with acoustic absorbent (foam, rockwool / fibreglass) will reduce the noise “trapped” by the guards.

Consequently, less noise will escape through any gaps. Failure to line the inside of the guards could result in an increase in noise at the operator’s position if the gaps have been minimised as in (i) above.

In most cases, both sets of modifications can be tested in mock-up form using cardboard (and wide tape) to extend the guarding and temporarily fitting areas of acoustic foam inside. Not only does this process help with the practical aspects (access, visibility etc), but it usually also provides a very good indication of the noise reduction that can be expected. Guard vibration radiated as noise can also be treated via damping (as above).

### 9. CHAIN & TIMING BELT DRIVES

#### Technique

Noisy chain drives can often be replaced directly with quieter timing belts. Within the range of timing belts available, there are also quiet designs that use different tooth profiles to minimise noise. There is also a new design of belt for applications where noise is critical which uses a chevron tooth pattern to provide very quiet running. Noise reductions in the range of 6 - 20 dB are often possible using this approach.

### 10. ELECTRIC MOTORS

#### Technique

Most companies have large numbers of electric motors used on anything from fans to pumps to machine tools. However, it is not very common knowledge that general duty motors are available (at little or no cost premium) that are up to 10 dB(A) or more quieter than typical units as direct replacements. The best approach is to feed these motors into the system over a period of time so that all replacement motors are quiet motors.

## **APPENDIX F – Further Information - Standards Referenced**

The references listed are not incorporated into this Compliance Code; they are included to provide an indication of sources of additional information. This means the references do not form part of this Compliance Code. Note that some references may have legal status in their own right.

*AS/NZS1269.1 Measurement and assessment of noise immission and exposure*

*AS/NZS 1270 Acoustics – hearing protectors*

*AS/NZS 1269.3 Occupational noise management – hearing protector program*

*AS 2586: Audiometers*

*AS/NZS 1269.4 Occupational Noise Management Part 4: Auditory Assessment*

DRAFT - PUBLIC COMMENT

## APPENDIX G – Checklist – Noise Determination Report

| Checklist – what should be included in a noise determination report   | Tick if present          |
|---|--------------------------|
| <b>When</b>   |                          |
| Date of assessment  | <input type="checkbox"/> |
| <b>Who</b>  |                          |
| Name of assessor  | <input type="checkbox"/> |
| Background/qualifications of assessor   | <input type="checkbox"/> |
| <b>Equipment used</b>   |                          |
| Type of equipment used to take measurements   | <input type="checkbox"/> |
| Calibration details (if, when and how) for equipment used   | <input type="checkbox"/> |
| <b>How the noise measurements were taken</b>  |                          |
| Where measurements were taken (general area or operator ear position)   | <input type="checkbox"/> |
| Period of time over which the measurements were taken   | <input type="checkbox"/> |
| <b>What was assessed</b>  |                          |
| The area, plant, process, activity and employees that were assessed   | <input type="checkbox"/> |
| <b>Sources of noise</b>   |                          |
| The sources (plant/processes/jobs) of the noise   | <input type="checkbox"/> |
| Whether all the noise sources operating at the time were taken into account   | <input type="checkbox"/> |
| Whether there were any significant noise sources not operating during the assessment  | <input type="checkbox"/> |
| <b>Systems of work</b>  |                          |
| Brief description of how the job is done  | <input type="checkbox"/> |
| Hours of work   | <input type="checkbox"/> |
| Whether assessment is for a normal/typical day or for a worst case scenario   | <input type="checkbox"/> |
| <b>Results</b>  |                          |
| The results of the measurements in terms of the levels and duration   | <input type="checkbox"/> |
| Interpretation of the results   | <input type="checkbox"/> |
| <b>Any other relevant factors</b>   |                          |
| Information on any specific safety measures in place during the assessment (note – an employer must not take into account the effect of any hearing protectors being worn in a noise determination) | <input type="checkbox"/> |
| Where relevant, information about the environment   | <input type="checkbox"/> |