Safety, Health and Environment National Authority

INDUSTRY GUIDANCE NOTE

TOPIC: **MANAGING NOISE AT WORK AND PREVENTING HEARING LOSS**			Reference Number: **IGN 6/2021**
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INDUSTRY GUIDANCE NOTE (IGN)

MANAGING NOISE AT WORK AND PREVENTING HEARING LOSS

1. SUMMARY

This guidance note is developed to raise awareness on noise induced hearing loss, the impact of noise in workplaces and the general responsibility of principals, occupiers, employers and self-employed persons in dealing with and mitigating for excessive and noisy work practices and activities at the workplace. Under the Third Schedule of the Workplace Safety and Health Order, 2009 (WSHO, 2009) noise induced deafness is specified as an occupational disease. The WSHO, 2009 also places a duty on every employer to take, so far as reasonably practicable, such measures are necessary to ensure the safety and health of his employees and of persons (not being his employees) who may be affected by any undertaking carried on by him at the workplace.

2. INTRODUCTION

This guidance note is in response to a general industry concerns related to noise induced hearing loss and the responsibility placed on principals, occupiers, employers and self-employed persons in dealing with and mitigating for excessive and noisy work practices and activities at the workplace.

The Workplace Safety and Health and Order 2009 (WSHO, 2009) sets the general framework to which all workplaces must comply in ensuring that the workplace is safe and without risks to the health and safety of the persons at work. Sections 11, 12, 14, 14A and 15 of WSHO, 2009 sets the duty of every employer, occupier, principal and persons at work to take, so far as is reasonably practicable, such measures as are necessary to ensure the safety and health and providing for a safe working environment.

Measures imposed as duties are to ensure the provision of and making arrangements available for the welfare of the persons at work, which include and are not limited to machinery used onsite, equipment, plant, article or process used by employees or persons at work, persons are adequately informed, trained and supervised and that equipment, plant and systems are maintained, thus allowing for a safe work place. A duty is also placed on persons at work to use machinery, safety protective equipment, co-operate with his employer or principal and any other person to such extent that no person at work including persons not at work is put in danger.

It is estimated that three in every four construction workers are considered to be exposed to hazardous noise levels on the jobsite. Prolonged exposure to noise levels in excess of 85dB is hazardous. It should be known to all, that hazardous noise has the potential to destroy or damage the ability of individuals to clearly hear, whilst also making it difficult to hear sounds, alarms, warning signals or instructions that could have a detrimental impact on the safety and health of such persons. Noise is an occupational exposure that can be managed and, in most cases, prevented by ensuring the right design arrangements, operational work practices and behaviours of persons at work. Permanent noise-induced hearing loss is incurable. Studies have shown that noise is

increasingly being linked to non-auditory health effects such as cardiovascular disease, stress and even sleep disturbance or deprivation.

The Safety, Health and Environment National Authority (SHENA) recommends all persons concerned that managing such risks in relation to noise can –

- protect workers from hearing loss and disabling tinnitus (ringing in the ears or head);
- ensure better and improved arrangements and means of communications and the ability of all to hear warning signals and alarms; and
- reduce stress at work and create an environment that can be more productive and harmonious.

As a minimum, every principal, occupier, employer and self-employed person should take steps to reduce noise exposure and where necessary,

- provide employees with personal hearing protection;
- ensure that noise limits are not exceeded and that equipment within the workplace is adequately maintained and used so as to ensure that noise limits are within tolerant levels;
- provide employees with information, instruction and training; and
- conduct health surveillance, so as to be able to monitor workers' hearing ability.

To protect hearing, employers must have a hearing conservation program or plan in place which begins with raising awareness, including engineering controls, administrative controls, and as a last line of defense consider personal protective equipment (PPE). Employers must be attentive to the fact that a worker's hearing loss is a safety hazard at the workplace.

3. LEGAL FRAMEWORK

Workplace Safety and Health Order, 2009 (WSHO, 2009)

Noise Induced Hearing Deafness is identified as an occupational disease under the Third Schedule of the WSHO, 2009

There are clear duties placed within the law, that requires that no person shall alter or modify any machinery or equipment or article which may contribute to the cause of occupational disease. Similarly, a duty is also placed on the occupier to prevent the alteration or modification of any machinery or equipment or article which may contribute to the cause of occupational disease (Section 25, WSHO, 2009).

A further duty is placed on an employer, occupier, registered medical practitioner or any other person to notify and to submit a report to SHENA, in the event of an occupational disease case in the workplace (Section 27, WSHO, 2009).

Workplace Safety and Health (Risk Management) Regulations, 2014

Regulation 3 places a general duty for every workplace, where the employer, self-employed person and principal shall conduct a risk assessment in relation to the safety and health risks posed to any person who may be affected by his undertaking in the workplace. This includes the need to ensure work activities as well as plant and equipment is risk assessed prior to installation and use to prevent inadvertent impact to employees due to increase in noise levels or any harm to the hearing of persons involved.

Workplace Safety and Health (Incident Reporting) Regulations, 2014

Under these regulations, a duty is placed on the employer and any registered medical practitioner to submit a report to SHENA, no later than 10 days after the diagnosis of an occupational disease case at a workplace (Regulation 6).

4. SCOPE AND RESPONSIBILITY

This guidance applies to all workplaces covered by the Workplace Safety and Health Order, 2009 where there is exposure to hazardous noise. It provides a useful reference to all persons and aids interested parties in ensuring noise control measures are in place so that no employees are exposed to excessive noise. Early consultation and identifying the potential risks can support the elimination or minimizing of risks, as well as reducing impacts and associated costs.

Employer, Principal, Occupier, Self-Employed Person

Ensure that -

- a noise control plan and programme are in place to mitigate and control excessive noise;
- any plant, machinery or equipment is used within its design limits;
- design arrangements take account of noise levels and required controls;
- plant, machinery or equipment (including noise control systems or devices) are well-maintained in a fit for purpose and efficient manner at all times;
- employees are provided with information, instruction, equipment, training and supervision for them to perform their work; and
- adequate procedures and work practices are developed and implemented to deal with emergencies as well as for monitoring and promoting good work practices and use of PPE.

Workplace Safety and Health Officer, WSH Coordinator or Safety Officer

Ensure that -

- regular HSE inspections are conducted to verify the use of and implementation of equipment and work practices;
- he is readily available to assist the employer/ occupier of the workplace to identify and assess any foreseeable risk arising from the workplace or work process;
- there is adequate awareness and promotion of good work practices to eliminate and prevent noise induced hearing loss and to ensure the use of PPE; and
- employees adhere to company procedures and HSE policies.

Supervisors

Ensure that -

- employees are provided with suitable and fit for purpose PPE;
- any plant, machinery or equipment used is maintained according to company's and manufacturer's recommendations;
- there is clear and transparent reporting of defects and concerns; and
- there are investigations into and remediation of any defects and concerns raised by employees.

Employees

Ensure that -

- they cooperate with the employer in all activities related to hearing protection;
- all safety and personal protective equipment are used as prescribed;
- PPE and safe guarding equipment is not modified or altered;
- they report all defects and concerns with any plant, equipment or machinery to their supervisor; and
- they take good care and maintain any equipment or machinery provided to them.

5. SOUND MEASUREMENT

The complex pattern of sound waves heard by the human ear, are labelled as either noise, music, speech, etc. Hence, noise is unwanted sound. Sound is measured in sound pressure levels and variations of these levels are captured within a duration of time. Sound pressure is a basic measure of the vibration of air that makes up sound. The human ear can detect a wide range of sound and this sound or noise is measured in units called decibels [dB].

There is professional sound metering equipment [noise dosimeter or sound pressure level (SPL) meter] or sound level meter [SLM], available in the market, which can assist the employer in deciding the level of precautions and measures required for his workplace. Recommended sound level meters for measuring noise at work shall comply with a Class 2 IEC 61672 sound level meter or type 2 of ANSI S1.4-1983 (R2007), specifications for sound level meters with the accuracy of +- 2dBA. Noise level mapping should be conducted by a competent person.

Alternatively, seeking consultation from a recognized safety consultant, industrial hygienist or industrial hygiene technician who are certified and have the required sound level meter to conduct noise measurement and noise level mapping.

6. EFFECTS OF NOISE

Impairment and Hearing Loss

Noise within the workplace can have detrimental effects on a person's ability to hear, with the damage being either temporary or permanent, as well as being disabling to the individual. Hearing loss can be gradual over time due to exposure within the noisy working environment. Its damaging effects can also be immediate or sudden, and becomes apparent as a disability when individuals are unable to understand instructions and speech, or make sensible conversation or even use the phone coherently. Affected individuals may also develop tinnitus (ringing, whistling or humming in the ears), and this can affect sleep which can be distressing and disturbing.

Unsafe conditions

Noisy environments within the workplace can restrict and distract from effective communications and also affect hearing of warning signals and alarms. It can also affect the ability of persons to fully comprehend their own safety within the workplace which could have the potential of placing them in harms' way resulting in either injury or in more extreme cases, death.

7. RISK MANAGEMENT

Under the Workplace Safety and Health (Risk Management) Regulations, 2014, a risk assessment must be conducted and documented for all work activities, including noisy works, operations and processes. It is the responsibility of the employer and occupier to risk assess his activities and to ascertain whether risks exist that can have a detrimental impact on the hearing of their employees and that of persons who are not their employees eg. Visitors, public or contractors. Risk assessment should be reviewed and revised at least once every three (3) years. The first step of risk assessment involves hazard identification which can be qualitative and quantitative in nature.

7.1 HAZARD IDENTIFICATION

Identification of noise hazard in the workplace enables the employer, occupier and the principal to identify employees, workers and persons impacted by the activities, who may be exposed to excessive noise so that their exposure can be assessed. Identification of noise hazard shall involve participation of the affected employees and those who understand the works, operations or processes and have knowledge of the work situation.

For a quick assessment to identify if noise hazard is present at the workplace, the following should be considered (but not limited to) :

- Is your work place known to have noisy activities ongoing eg. Construction, woodworking, dismantling, demolition, road repair work, processing of or manufacture of plastics or textiles, fabrication work, bottling or canning, waste or recycling, forging or stamping, engineering work, paper or board making or other similar activities?
- Are there any noisy processes, for example, hammering, punching, pressing, stamping, grinding, cutting, or usage of pneumatic tools being carried out at the workplace?
- Is the noise intrusive – is it as noisy as a busy public road or vacuum cleaner or crowded public venue or restaurant? Is it noisy throughout the working day?
- Do the employees and persons onsite have to raise their voices when talking to be heard, as measured when they are about 2 metres apart?
- Is there any feedback from the employees regarding the difficulty of hearing warning shouts or alarms?
- Are the employees using power tools or machinery which are noisy for more than 30 minutes each day?
- Does any machine or equipment in the work area contain manufacturer's noise label that indicates that noise level generated by the machine or equipment can exceed 85 dB(A)?
- Are there specific impactful noises that occur at your work place eg. Use of hammers, pneumatic tools and equipment, explosive sources, detonators or other such noisy plant or equipment?
- Do you generally have loud alarms, warning sirens or sounds to raise awareness or alert employees to danger on the site?
- Does your work place depend on use of verbal communications for passing of instructions on a daily basis?
- Do your employees work in the close proximity of mobile equipment, machinery or vehicular traffic?

You should be considering and preparing a suitable risk assessment, that takes account of these risks and the potential impacts they have on your employees and those likely to be impacted by your activities.

7.2 RISK ASSESSMENT

When undertaking a risk assessment, you should be considering the following:

- Identify all employees and persons likely to be exposed to excessive noise and how they would be impacted;
- Identify whether there is risk to health and the safety of all individuals who may be impacted by your activities;
- Take account of the level of noise exposure and refer to available literature on noise limits;

- Review your actions that may be required to remain in compliance with the law, especially if you should be conducting noise measurements, providing employees with personal hearing protection, installing suitable insulating material or sound dampers, considering safer work practices; and
- Identify which employees require health monitoring or surveillance and the level of risk they are currently facing by the activities at the work place.

You are advised in all such conditions to document your risk assessment and this includes the actions you have taken, those you intend to take and how you intend to remain compliant with the law. The document should be kept by employer, self-employed person or principal for a period of not less than three (3) years. Such risk assessments should be reviewed routinely and should take account of the changes that might occur on the site, especially by the introduction of new equipment, noise controlling measures, changes to noise exposure or work practices.

7.3 RISK CONTROL

Where risk exists from exposure to loud noises in the workplace, employers and occupiers must take steps to identify alternative processes, measures, work practices and controls that will ensure the work is quieter or that persons are exposed to a lesser duration. By following good industry practices in managing the standard of noise-control, employers and occupiers would be better positioned in ensuring the health and safety of their employees. Employers and occupiers are advised to undertake noise mapping and inspections to ascertain the level of noise exposure, effectiveness of noise controlling measures and compliance of staff as they adhere to recommended procedures and safe work practices. Reference is made to *Appendix 1* for further details on recommended noise levels and impacts to be considered. Where employees or persons impacted by the activities at the workplace are anticipated to be exposed to higher levels of noise, measures must be taken to reduce such noise exposure to as low as reasonably practicable.

When considering measures to reduce noise exposure or the level of noise on site, employers or occupiers are advised to look for practical measures based on information from equipment suppliers, manufacturers and good industry practices with the aim to eliminate the risk altogether eg. Housing noisy equipment within a compartment or space, which restricts the noise from impacting persons in the vicinity.

Where elimination of the risk is not possible, the following may be considered as well –

- Using quieter equipment or quieter processes;
- Identifying engineering or technical controls to reduce, the noise produced by the process or equipment at source as referenced in *Appendix 2*;
- Incorporating or installing measures like screens, barriers, dampening equipment, absorbent materials, enclosures as a means to reduce the noise along its path to persons exposed;

- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operations for specific pieces of equipment or operations, especially mobile sources operating through community areas;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Reducing project traffic routing through community areas where possible;
- Siting permanent facilities away from community areas if possible;
- Creating a quieter environment by improving the design or layout within the workplace;
- Updating or improving work techniques to reduce noise levels;
- Restricting or reducing the duration of time spent by employees within the noisy environment.

Additionally, in order to reduce or stop worker exposure to chemicals (i.e. ototoxic chemicals) that may damage hearing –

- Use less toxic or non-toxic chemicals;
- Ensure workers wear gloves, long sleeves and eye protection when handling chemicals;
- Wear suitable respiratory equipment or other protective equipment, as required;
- Always read and follow all the chemical safety information and instructions from the safety data sheets or the manufacturer.

Ototoxic Chemicals are chemicals that can cause hearing loss. This occurs when the ototoxic substance is absorbed into the bloodstream and may damage the cochlea (inner ear) and may also damage the auditory nerve pathway to the brain, which can also lead to hearing loss and tinnitus. More details concerning ototoxic substances are provided within *Appendix 3*.

You should also ensure that plant, machinery and equipment is regularly inspected, serviced and be always well maintained. Finally, always ensure that employees are well informed of the work practices, safety measures and instructions required to maintain the site, whilst also monitoring and providing appropriate supervision to maintain the good work practices within the workplace. Employees and persons visiting your workplace are obliged to follow the safety measures prescribed and use the necessary noise-control measures provided.

Persons most susceptible to hearing damage are individuals with pre-existing hearing conditions, those with family history of deafness, pregnant women, children and young people.

Self-employed persons are recommended to follow the guidance provided in this document and to conduct their work in such a manner as to reduce exposure to noisy environments and undertake routine health monitoring when routinely exposed to loud noise as part of their work practices.

8. EXPOSURE LEVELS

As an employer or occupier, you should be reviewing and assessing the possible noise exposure to your employees or to those impacted by your activities. The daily personal noise exposure or 'dose' could be a combination of loud noises as well as duration of exposure to various kinds of noises that an individual would be exposed to within his working environment on any given working day. By assessing the noise levels, you would also be determining the likely peak sound levels or maximum noise that employees or persons are exposed to at the workplace on a daily and weekly basis as referenced in *Appendix 4 and 5*.

You should also take account of the following:

- The ongoing routine works and which is likely to be done;
- The work practices followed and how work is undertaken; and
- Whether there is potential for variances to occur in work activities from one day to the next.

You may consider utilising noise measurements, assessments or information from various sources, including noise mapping or measurement data from your own workplace, from a similar workplace or from data provided by equipment suppliers or manufacturers. Always remember, that in your assessment, you should not be accounting for the use of PPE, when assessing the level of noise exposure levels. You may also consider to calculate or assess noise exposure levels as an average over a week rather than a day, thus allowing for changes in work practices from day to day.

It is also important that persons consider noise exposure when not at work because a cumulative exposure can lead to hearing damage, whether or not it is work-related. Sound exposure includes all the sounds heard during each day. Common off-hours exposure to high noise levels may include audio and video equipment [music, noisy hobbies, etc]. The employer should only be considering risk control measures within the workplace. Employees are, however, responsible for their own actions when not at work as well.

NOISE LEVEL GENERAL GUIDELINES		
RECEPTOR	ONE HOUR AVERAGE dB(A)	
	0700 - 2200	2200 - 0700
	DAYTIME	**NIGHT TIME**
Residential; Institutional; Educational	55	45
Industrial; commercial	70	70

Source: IFC World Bank Group General Environmental, Health and Safety (EHS) Guidelines

Reference may also be made to the Pollution Control Guidelines under the Department of Environment, Parks and Recreation Appendix 5 which provides recommended boundary noise levels for noise sensitive premises, residential and commercial premises.

Recommended noise levels (Based on an 8 hour work day)

Occupation / Workplace	Recommended limit
	dB(A)
School rooms	30 - 40
Open plan offices	35 - 45
Laboratories with routine work	35 - 50
Control stations	35 - 55
Health sector	30 - 45
Offices	45 - 60
Manufacturing workplaces, workshops	65 - 70

In Brunei Darussalam, additionally it is recommended that where there are educational institutions, workshops and laboratories involved with operational activities that have a potential to cause a noisy environment, sound proofing and insulating material should be provided by design, to ensure that the noise levels do not exceed 55 dBA at any point along the boundary of the premises.

9. ROLE OF EMPLOYER, OCCUPIER, MANUFACTURERS AND SUPPLIERS

It is the duty of the employer or occupier to maintain the process, plant, machinery or equipment especially if it is provided with an intention to control noise levels. Noise-control equipment must be maintained so as to always be effective. Maintenance plans should take account of such requirements with relevant arrangements in place for dealing with planned or corrective maintenance. The effectiveness of the noise-controlling equipment may be impaired by lack of proper maintenance or deviation from the measures required.

When purchasing or leasing equipment for use at your workplace, you should be considering its suitability and efficiency, not only in terms of productive output but also its impact to persons. By comparing data from various suppliers or manufacturers, you would be better informed on which equipment is quieter. Furthermore, when using the equipment, you should ensure that the noise data is relevant for the way you plan to use the equipment. A cautious stance is recommended when dealing with manufacturers' data, as there are many factors to be considered when dealing with noise exposure levels for your employees.

It would be prudent to ask the manufacturer or supplier, as a minimum, the following –

- Arrangements for installing or mounting the equipment, so as to ensure optimum use in the quietest context;
- Whether use of the equipment in different ways could result in changes or increased noise levels;
- How the equipment should be serviced and maintained so as to ensure that it operates according to its design and does not get noisier over time.

Section 16 of the Workplace Safety and Health Order, 2009 places a duty on manufacturers and suppliers of machinery or equipment used at work to ensure, so far as reasonably practicable, that

- information is provided and available for its safe use, which includes the precautions to be taken, information about any health hazards associated with the machinery or equipment and other necessary test data that is relevant for its safe use.

In addition, section 17 also places duties on persons who erect, install or modify machinery or equipment, to ensure that that such machinery or equipment is erected, installed or modified in such a manner that it is safe, and without risk to health, when properly used with the provision of necessary information and instruction to ensure the safety and health of those impacted by the machinery or equipment.

Regulation 6 of the Workplace Safety and Health (Incident Reporting) Regulations, 2014 places a duty on an employer to submit a report to SHENA not later than 10 days after receipt of the written diagnosis from a registered medical practitioner diagnosing an occupational disease. Noise induced hearing loss is identified as an occupational disease and must be reported.

Any registered medical practitioner, who diagnoses any employee with an occupational disease, shall, not later than 10 days after the diagnosis, submit a written report to SHENA.

10. PERSONAL HEARING PROTECTIVE EQUIPMENT (PPE)

As a follow up to the risk assessment and evaluation of the work activities at the workplace, the occupier or employer must then arrange to issue personal hearing protection to those individuals impacted and exposed to noise that is above the threshold or permissible exposure limits (PEL). Where noise levels are anticipated to exceed 80 dB(A) warning signage should be posted and employees warned of such concerns. Further mandatory notices should be posted with a clear policy implemented requiring the wearing of ear protection when noise levels are 85 dB(A) and above. Occupiers and employers are required to install sign posts 'Hearing Protection Area' and demarcate the boundaries clearly. Warning notices should be posted near rotating machinery and where other noisy equipment may be used, informing all that personal protective hearing equipment must be worn when operating the equipment or when in the vicinity of such equipment.

Hearing protection should be provided to employees:

- when and where additional protection is required as a short-term control measure or to minimise exposure and reduce the potential of hearing loss;
- as a protective measure but not as an alternative to controlling noise by technical or organisational means and arrangements;
- when the noise exposure exceeds the upper exposure limits;
- if they ask for it and where they are exposed to noise environments on a routine basis, even though the upper exposure limits are not breached.

Occupiers and employers must put in place arrangements and measures to ensure that employees wear and use their personal hearing protection as prescribed or according to its design. Employees may require training to ensure they comply with the requirements. Designation of specific areas where hearing protection must be

worn is strongly recommended. Employers and occupiers should also consider undertaking spot checks and inspections to verify compliance of these requirements within the workplace on a routine basis.

Employers should ensure that personal hearing protection is provided that at least reduces the noise exposure to below 85 dB(A). Where employees are exposed to variable noise exposure levels, they should be provided with hearing protection that protects them adequately for the worst situation or exposure anticipated.

10.1 SELECTION CRITERIA

The following should be considered by occupiers and employers when selecting suitable PPE for their employees -

- ensure that the equipment comes with a suitable protection factor;
- ensure the equipment is of a suitable standard i.e. CE-marked hearing protector meeting the requirements of the relevant part of BS EN 352;
- sufficient to ensure noise elimination however, that it does not become a restriction and isolates the wearer;
- take account of the working environment and activities involved, which shall include duration of wearing, hygiene considerations and levels of communications required whilst wearing the equipment;
- comfort of the wearer and its compatibility when used with other protective equipment, such as safety helmets, safety glasses or safety face shields or masks.

Equipment should be maintained at all times and checked that it is working effectively. Employees should immediately report defective equipment to their supervisors and should be trained in identifying defective equipment.

10.2 TYPES OF HEARING PROTECTION

a) EAR PLUGS

Earplugs fit into the ear or cover the ear canal. They are less visually intrusive than external hearing protection but need careful selection as they represent a very personal protection against specific noise sources under specific conditions. All earplugs should come with an indication of the theoretical noise reduction. The description of the reduction may be a single number or it may give an indication of the reduction at different frequencies. It should be remembered that the theoretical attenuation of 'off the shelf' earplugs is based upon a system of averaging and it is often appropriate to take a 'real world' view and assume that the reduction is 4 dB less than stated on the packet.

Instructions for all earplugs should give advice on the correct method of use as the seal created between the earplug and the ear is fundamental to its effectiveness. Where earplugs are supplied by an employer there is a duty to ensure that correct training is given as well.

(i) COMPRESSIBLE EAR PLUGS

COMPRESSIBLE EARPLUGS

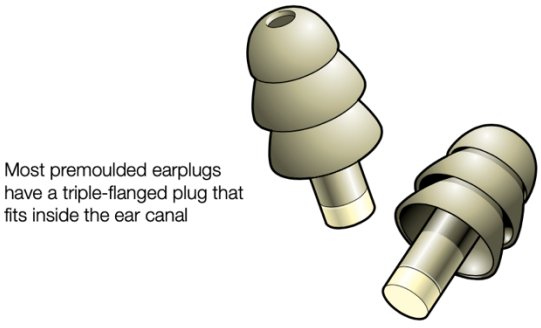
- Inexpensive and simple to use.
- Effectively protect against high sound levels.
- Smaller than earmuffs – can be carried in a pocket.
- More comfortable than earmuffs in hot working environments.

However, be advised of the following –

- May remove more high than low frequencies when used.
- Could interfere with vocal or speech communications.
- Require care when inserting into the ear canal to ensure effective protection.
- Prone to potential ear infection from dirty hands or reuse.

(ii) PREMOULDED EAR PLUGS (REUSABLE)

Generic, fit for use earplugs shaped for the average user's ear canal. These plugs are generally reusable but require regular cleaning.



PREMOULDED EARPLUGS

- Inexpensive and simple to use.
- Lasts longer than compressible earplugs.

- Available off the shelf.
- Reusable when kept clean.

(iii) CANAL CAPS/ SEMI-INSERT EAR PLUGS

Canal caps and semi-insert earplugs come on a headband. Canal caps (sometimes called semi-aural plugs) generally have rounded tips that cover the entrance to the ear canal, while semi-insert plugs generally have tapered tips that are pushed into the ear canal. Both types are convenient for situations where the hearing protection has to be taken on and off frequently. They are not designed for continuous use.

When exposed to routine work locations when hearing protection is recommended repeatedly with short-term exposure, ear-muffs and canal caps may be the preferred option, as they are easy to use, fit and remove and more likely to be used by employees in exposure areas.

SEMI-INSERT EARPLUGS

b) EAR MUFFS

Earmuffs (sometimes referred to as 'ear defenders') are hard plastic cups that fit over and surround the ears and are sealed to the head by cushion seals. Tension to help the seal is provided by a headband. They are easy to fit and use, once appropriate training is given, and their use is easily monitored. Helmet-mounted earmuffs may be appropriate for riggers. Earmuffs, like all hearing protectors, should be selected on the basis of comfort, practicality and hygiene to help ensure they are worn properly. Any attempt to alter the earmuffs or using damaged earmuffs could make them ineffective.

EAR MUFFS

- Inexpensive and simple to use.
- Easier to slip on and off than earplugs.
- More comfortable than earplugs when used in cold environments

However, be advised of the following –

- Heavier and more obtrusive than earplugs.
- Can be uncomfortable in warm or humid conditions.
- May not be effective when used with spectacles, long hair, beards and when worn with jewellery.

11. NOISE INDUCED HEARING LOSS

The effect of noise induced hearing loss (NIHL) occurs when there is excessive 'wear and tear' on the delicate inner ear structures. Injury can occur from an intense and brief sound eg. explosion, that is in excess of the capability of the human ear to be able to safely withstand or when exposed to a noisy environment for long durations of time eg. wood or carpentry shop.

The symptoms of NIHL may become apparent after long exposures and will gradually increase in its effect. In the early stages, a person may not be able to clearly hear children's voices and in time sounds may be distorted, with the person also finding it more difficult to understand speech. Such impacts may only become known by attending a hearing test. The diagnosis of which would be ascertained by a medical professional and should include a study of noise exposure history of the patient.

Some of the known impacts of hearing loss or damage are as listed below:

- ringing or buzzing in the ears or head (called tinnitus)
- elevated blood pressure
- fatigue
- stress
- social isolation from co-workers, family and friends.

Hearing loss caused by exposure to loud sound is preventable. To reduce the risk of exposure and the potential of suffering noise-induced hearing loss, it is recommended to do the following:

- Understand that noise-induced hearing loss can lead to communication difficulties, learning difficulties, pain or ringing in the ears (tinnitus), distorted or muffled hearing, and an inability to hear some environmental sounds and warning signals;
- Identify sources of loud sounds (such as gas-powered lawnmowers, power tools, gunfire, or music) that can contribute to hearing loss and try to reduce your exposure;
- Adopt behaviours to protect hearing:
    - Avoid or limit exposure to excessively loud sounds
    - Turn down the volume of music systems
    - Move away from the source of loud sounds when possible
    - Use hearing protection equipment when it is not feasible to avoid exposure to loud sounds or reduce them to a safe level
- Seek hearing evaluation by a licensed audiologist or other qualified professional, especially if there is concern about potential hearing loss.

12. TRAINING AND INFORMATION

All employees should be adequately trained in the use, where required, of personal hearing protective equipment. They should be informed of the risks of being exposed to loud noises, short and long term hearing loss and their roles and responsibilities in regards to the use and maintenance of the equipment as well as defect reporting.

Employees should be informed, as a minimum, of the following:

- Anticipated risk and likelihood of noise exposure within the workplace;
- Potential harm that such noise exposure may have on their hearing ability, especially if they fail to adhere to the safety measures and procedures in place;
- Safety measures and precautions in place to mitigate for and control noise exposure;
- Procedures in place to be provided with personal hearing protection;
- Any relevant manufacturer's instructions for personal hearing protection to be followed;
- Where and when to use the hearing protective equipment;
- How to store, care for, maintain and frequently check their hearing protection equipment;
- Hygiene and cleanliness practices for hearing protection equipment;

- How to identify defects in noise-controlling equipment and hearing protective equipment;
- Their roles and responsibilities;
- What should be done to mitigate for such risks and be well informed on the use of the equipment provided;
- Arrangements in place by the organisation to monitor health through audiometry tests.

Employees should also be prepared to report concerns with their hearing to their supervisor, to ensure corrective action is taken in a timely manner.

13. HEALTH MONITORING

Employers have a duty of care for their employees and where there is potential exposure to noisy environments, employers should have health surveillance and monitoring arrangements in place. Employers are recommended to ensure that employees undertake pre-employment screening to ascertain fitness to work and condition of hearing. Employees at workplaces where there is excessive noise level of more than 85 dBA should undergo annual audiometry testing to ascertain the impact of excessive noise exposure and to prevent long term hearing loss.

Where any hearing damage is reported, employers should take relevant steps to prevent further damage and consider the medical advice available, which will also include but not be limited to reviewing the risk assessment, work practices and procedures, effectiveness of noise-control equipment and personal hearing equipment, health monitoring procedures as well as other safety measures previously considered.

Employers are advised to maintain records of health monitoring for employees in soft copy for the life of the organisation, whilst ensuring confidentiality is maintained.

APPENDIX 1: NOISE MAPPING AND INSPECTION

As an occupier or employer, you should be taking steps to ascertain that the noise levels within your workplace or establishment are within prescribed levels and do not create a nuisance or hindrance for your employees or for persons who are not your employees i.e. the public. Noise controlling equipment and arrangements as well as PPE will ensure that exposure limits are managed and controlled.

Lower Exposure Action Value [LEP,d or LEP,w]
The daily or weekly personal noise exposure 80 dB:
As a general rule of thumb, the noise level of 80 dB or more is sighted as intrusive however, normal conversation is possible between people 2 metres apart on a busy street, or being in the vicinity of a vacuum cleaner or inside of a crowded restaurant.

Upper Exposure Action Value [LEP,d or LEP,w]
The daily or weekly personal noise exposure of 85 dB:
As a general rule of thumb, the noise level of 85 dB is observed when a person is expected to shout to someone 2 metres away, and such exposure is experienced for more than 2 hours per day as a total, as a total exposure duration.

Peak Sound Pressure [LCpeak]
This is loud and impactful sound or noise levels that have a damaging affect, experienced as a daily or weekly exposure and can result in immediate or permanent hearing loss. The lower and upper action values for these are 135 and 137 dB respectively. Where employees are exposed to such noise levels, the occupier or employer must take action to reduce the noise levels, either by introducing noise controlling equipment, changing the site location of the source of the noise or reducing the duration of exposure of persons impacted with provision of suitable and effective PPE.

Some general noise level data as a comparison is listed below:

TASK	AVERAGE NOISE LEVEL [dB(A)]
Jet take-off, explosive gun shot	120 - 140
Chain saw, portable stereo, club or gym music, boiler room, sandblasting, heavy lorry (7m away)	100 - 120
Power tools, motorcycle, headphones, manufacturing plant, hydraulic press, pneumatic drill, school technical workshop	90 - 100
Lawnmower, dishwasher, computer room, busy restaurant or kitchen	75 - 90
City traffic, hair dryer, office equipment, cell phone, loud radio	70 - 80
Normal conversation	50 - 70
Carpentry	85 - 95

Concrete • Chipping / drilling • Floor finishing • Grinding • Concrete worker	 85 - 110 80 - 85 85 - 110 85 - 95
Driving a dumper or roller	85 - 100
Formwork	90 - 95
Labouring: • Concrete pour • Digging • Shovelling • Shuttering • Angle grinding / cutting	 95 - 100 100 - 120 90 - 95 88 - 92 90 - 110
M&E general installation	85 - 95
Piling • Operator • Worker	 85 - 100 100 - 120
Reinforcement work	85 - 90
Tower crane operator	75 - 87
Plumber	79 - 92
Track maker	80 - 98
Fitter	79 - 93
Road maker	79 - 107
Specialised civil engineering worker	82 - 95
Corrosion protectors	74 - 107
Agriculture and Forestry	70 - 102
Drinks (incl bottling)	85 - 100
Meat	80 – 110
Milling	85 - 100
Bakery	85 - 92
Dairy	85 - 95
Confectionery	85 - 95
Metal Manufacture	80 - 125
Printing Sector	88 - 90
Quiet work in school	50 - 60
School rooms	60 - 80
Recreational areas, sports and music lessons	80 - 95

Nurseries	75 - 85
High School technical workshops and swimming pools	90 – 105
Hospital Wards	62 – 105
Computer area in an office	80
General offices	45 - 60

Note: Without proper precautions and arrangements in place, noise exposure levels of 85 dB or higher experienced over an 8 hour period of time can cause permanent hearing loss.

Health Impact from noise sources

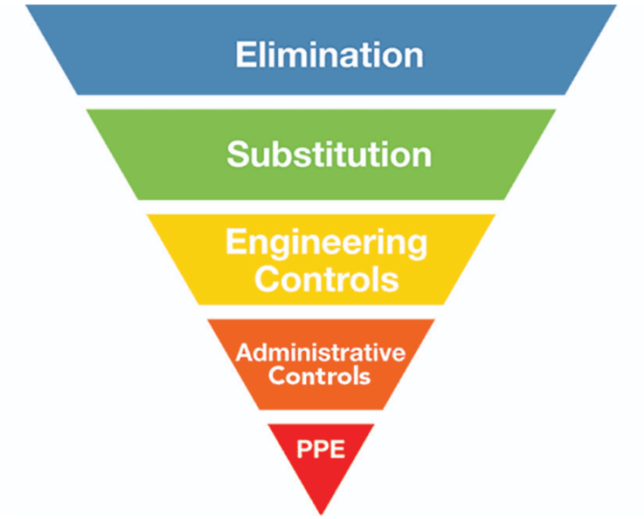
Level	Noise source	Health effects
140dB	Jet plane take off, firecracker, gun shot	Sudden damage to hearing
130dB		Pain threshold exceeded
120dB	Ambulance siren, pneumatic drill, carnivals	Hearing loss, tinnitus
110dB	Karaoke events, birthday parties	Hearing loss, tinnitus
100dB	Motor cycle at 50km/h	Hearing loss, tinnitus
90dB	Heavy goods vehicle at 50km/h	Hearing loss, tinnitus
85dB	Hearing protection recommended in industry	Hearing loss, tinnitus
75dB		Cardiovascular effects
70dB		Sleep disturbances
65dB		Stress effects
60dB		Annoyance
55dB	Desirable outdoor level	None
50dB	Normal conversation level	None
40dB	Quiet suburb	None
30dB	Soft whisper	None
20dB	Normal conversation level	None

Source: Nopher, a European Commission concerted action to reduce the health effects of noise pollution. http://www.ucl.ac.uk/noiseandhealth/EC%20Brochure1.pdf

Employers and occupiers should routinely review work activities and practices to ascertain that noise control measures remain in place and within tolerant levels. Noise surveys conducted across the work force can be found to be of value and beneficial in reviewing the current conditions on the site and any potential impacts that might become a concern in the future. Site inspections should be undertaken at a frequency that is determined by the occupier and based on the risk of exposure and the potential to cause harm to employees or the public. Inspections should cover all aspects of the risk assessment and verify that work practices continue to take account of the noise control measures for which identified requirements may be considered as mandatory e.g. use of PPE, closure of barrier doors to ensure the isolation of noise source.

APPENDIX 2: ENGINEERING CONTROL MEASURES

As has been documented earlier, occupiers and employers should take appropriate steps to reduce exposure to noise, consider such measures that are reasonably practicable and provide for a safer workplace. By following the hierarchy of controls as shown in the figure below, occupiers and employers would be advised of the actions that should be taken to address any concerns at the workplace.



Elimination: Remove the hazard

Substitution: Replace the hazard

Engineering Controls: Isolate people from the hazard

Administrative Controls: Change the way people work

Personal Protective Equipment: Protect the worker with PPE

Common noise control and reduction measures are listed below:

- design changes to a process, component or machine;
- segregating noisy machines from employees;
- damping machine parts to reduce vibration;
- isolation of machinery using anti-vibration mountings;
- use of silencers, for example on pneumatic exhausts;
- reviewing work practices to improve noise control;
- implementation of noise exclusion zones thus ensuring that you limit access to noisy areas;
- placing of noisy stationery equipment at a distance from work areas;
- rotating workers within a noisy environment, thus reducing the noise exposure to within tolerable limits;
- enclosure or provision of insulated containment for noisy machines;

- use of screens or barriers between noise sources and employees;
- provision of noise refuges or noise-protected areas for employees;
- fitting sound absorbing materials to work areas;
- when re-equipping, specify noise requirements and look to purchase equipment that is quieter by design.

Most of all, ensure good supervision is maintained to ensure work practices and noise control measures are adhered to at all times. Good maintenance of equipment and consistent monitoring of control measures is strongly recommended. Additionally, occupiers and employers are recommended to install proper signage that is suitable in providing warning as well informing their employees and the public of the concerns related to the workplace, procedures, and any requirements to use personal protective equipment.

APPENDIX 3: OTOTOXIC SUBSTANCES

Hearing loss is most likely to occur when an employee or worker is exposed to a combination of ototoxic substances, or a combination of substances and noise.

There are 3 major classes of ototoxic substances –

- Asphyxiants e.g., acrylonitrile, carbon monoxide, hydrogen cyanide;
- Heavy metals e.g., arsenic, lead, manganese; and
- Solvents e.g., butanol, carbon disulphide, ethanol.

These chemical substances can be absorbed into the body through various means, these are:

- Skin absorption;
- Inhalation; and
- Ingestion (due to poor hygiene practices at work).

There are various work practices that commonly involve a combination of noise and chemicals, these are not limited to those mentioned below:

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

Additionally, there are some medicines which are also considered as or identified as ototoxic substances, and these include anti-cancer, anti-inflammatory, anti-thrombotic, anti-malarial, anti-rheumatic, and antibiotic drugs. Quinine and salicylic acids (such as aspirin) are also considered as ototoxic substances.

Where employees or workers are exposed to or can be potentially exposed to ototoxic substances, occupiers and employers must ensure that employees or workers are not exposed to noise levels exceeding 80 dB(A). They shall also undergo audiometric testing annually and be provided with information pertaining to ototoxic substances. Occupiers and employers shall also ensure that suitable and fit for purpose personal protective equipment is provided that ensures skin protection and prevents respiratory absorption when other controlling measures are insufficient or inadequate.

Source: NSW Government of Australia.

APPENDIX 4: ESTIMATING DAILY NOISE EXPOSURE

Sound pressure level, L_{Aeq} (dB)	*Duration of exposure (hours)*								*Total exposure points*	*Noise exposure $L_{EP,d}$ (dB)*
	¼	*½*	*1*	*2*	*4*	*8*	*10*	*12*		
105	320	625	1250							
104	250	500	1000							
103	200	400	800							
102	160	320	630	1250						
101	125	250	500	1000						
100	100	200	400	800					3200	100
99	80	160	320	630	1250				2500	99
98	65	125	250	500	1000				2000	98
97	50	100	200	400	800				1600	97
96	40	80	160	320	630	1250			1250	96
95	32	65	125	250	500	1000			1000	95
94	25	50	100	200	400	800			800	94
93	20	40	80	160	320	630			630	93
92	16	32	65	125	250	500	625		500	92
91	12	25	50	100	200	400	500	600	400	91
90	10	20	40	80	160	320	400	470	320	90
89	8	16	32	65	130	250	310	380	250	89
88	6	12	25	50	100	200	250	300	200	88
87	5	10	20	40	80	160	200	240	160	87
86	4	8	16	32	65	130	160	190	130	86
85		6	12	25	50	100	125	150	100	85
84		5	10	20	40	80	100	120	80	84
83		4	8	16	32	65	80	95	65	83
82			6	12	25	50	65	75	50	82
81			5	10	20	40	50	60	40	81
80			4	8	16	32	40	48	32	80
79				6	13	25	32	38	25	79
78				5	10	20	25	30	20	78
77					8	16	20	24	16	77
76					6	13	16	20		
75					5	10	13	15		

Instructions:

- For each task or period of noise exposure in the working day look up in the table on the left the exposure points corresponding to the sound pressure level and duration (e.g. exposure to 93 dB for 1 hour gives 80 exposure points);
- Add up the points for each task or period to give total exposure points for the day;
- Look up in the table on the right the total exposure points to find the corresponding daily noise exposure (e.g. a total exposure points for the day of 280 points gives a daily noise exposure of between 89 and 90 dB).

$L_{EP,d}$ Daily personal noise exposure level. It is averaged over an 8-hour period rather than the actual time in the work environment.

L_{Aeq} The 'equivalent' continuous noise level that would deliver the same noise dose as a varying level over a given period, and is a good way of describing the average level of noise.

APPENDIX 5: ESTIMATING WEEKLY NOISE EXPOSURE

Daily noise exposure, $L_{EP,d}$ (dB)	*Points*						
	Day 1	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6*	*Day 7*
95	1000	1000	1000	1000	1000	1000	1000
94	800	800	800	800	800	800	800
93	630	630	630	630	630	630	630
92	500	500	500	500	500	500	500
91	400	400	400	400	400	400	400
90	320	320	320	320	320	320	320
89	250	250	250	250	250	250	250
88	200	200	200	200	200	200	200
87	160	160	160	160	160	160	160
86	130	130	130	130	130	130	130
85	100	100	100	100	100	100	100
84	80	80	80	80	80	80	80
83	65	65	65	65	65	65	65
82	50	50	50	50	50	50	50
81	40	40	40	40	40	40	40
80	32	32	32	32	32	32	32
79	25	25	25	25	25	25	25
78	20	20	20	20	20	20	20

Total exposure points	*Weekly noise exposure $L_{EP,w}$ (dB)*
5000	95
4000	94
3200	93
2500	92
2000	91
1600	90
1300	89
1000	88
800	87
630	86
500	85
400	84
320	83
250	82
200	81
160	80
130	79
100	78

Instructions:

- For each working day in the week look up in the table on the left the exposure points corresponding to that day's noise exposure (e.g. a noise exposure on Day 1 of 90 dB gives 320 points);
- Add up the points for each day worked to give total exposure points for the week;
- Look up in the table on the right the total exposure points to find the corresponding weekly noise exposure (e.g. a total exposure points for the week of 2000 points gives a weekly noise exposure of 91 dB).

$L_{EP,w}$ Weekly personal noise exposure level. It is averaged over a period of 8 hours for 5 work days (40 hours) by measuring the noise exposure on each of 7 days, then dividing the result by 5.

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