



DEPARTMENT OF OCCUPATIONAL
SAFETY AND HEALTH
MALAYSIA

INDUSTRY CODE OF PRACTICE FOR MANAGEMENT OF OCCUPATIONAL NOISE EXPOSURE AND HEARING CONSERVATION 2019



FOREWORD

This Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 is promulgated under Section 37 of Occupational Safety and Health Act 1994 [Act 514] as a guidance to comply with the provisions of Occupational Safety and Health (Noise Exposure) Regulations 2019 [P.U. (A) 60/2019] which have been gazette on 01-03-2019, hereinafter is referred to as “the Regulations”. The Regulations is to replace Factories and Machinery (Noise Exposure) Regulations 1989 [P.U. (A) 1/1989].

In Malaysia, the most occupational diseases reported are occupational noise related hearing disorders (ONRHD). Even though the figures might due to an increase of awareness among employees or employers to report cases of diseases, but it also indicates that the cases of occupational diseases are increasing. The effect of ONRHD is cumulative, permanent and irreversible. Additionally, implication on financial aspect will be borne by the employees, their families, the employers and the Government.

Therefore, the Department of Occupational Safety and Health (DOSH) have amend the noise exposure limit and imposed a more practical standard to control the exposure of excessive noise to the employees at the place of work, together with more structured and workable arrangements through the Regulations and this ICOP.

This ICOP is a legally bound document to fulfill the requirements under the Regulations; and is intended to provide a practical guidance on how to comply with and implement the requirements of the Occupational Safety and Health (Noise Exposure) Regulations 2019. It is hoped that these documents would help to reduce the risks of ONRHD among employees.

Thank you.

**Director General
Department of Occupational Safety and Health
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GLOSSARY

CEP	continuing education program
DOSH	Department of Occupational Safety and Health
HCA	hearing conservation administrator
HCP	hearing conservation program
ICOP	industry code of practice
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MQA	Malaysian Qualifications Agency
ONRHD	occupational noise related hearing disorders
NEL	noise exposure limit
NIHL	noise-induced hearing loss
NRA	noise risk assessor
NRR	noise reduction rating
OHD	occupational health doctor
PHP	personal hearing protectors
SEG	similar exposure groups
SLM	sound level meter
STS	standard threshold shift

PREFACE

Occupational noise-induced hearing loss (NIHL) is a major compensable occupational disease in Malaysia which involves substantial economic burden. Exposure to excessive noise also entails largely unrecognized costs to organizations by way of increased employee turnover and absenteeism, lowered performance and possible contribution to accidents. The social handicaps of occupational noise related hearing disorders (ONRHD) to the affected individual are also severe.

ONRHD are irreversible and lead to communication difficulties, impairment of interpersonal relationship, social isolation and deterioration in quality of life. The family and others who are close to the affected person often experience secondary consequences from this condition. Hearing aid may benefit in overcoming some of the hearing impairment issues, but normal hearing can never be fully restored. For those people affected, a significant percentage suffers from tinnitus (ringing in the ears).

The Factories and Machinery (Noise Exposure) Regulations 1989 has come into force on the 1st February 1989. It has been a legislation of noise exposure management and control for industries in Malaysia mainly targeting factory workplace environment. Due to the rising number of ONRHD cases in industries other than manufacturing sector, the Department of Occupational Safety and Health (DOSH) has enacted the Occupational Safety and Health (Noise Exposure) Regulations 2019 to widen the current regulation's enforcement to all sectors under Occupational Safety and Health Act 1994 [Act 514].

Concurrently, the Department has also published the Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 to help industries to comply with the new regulation. The industry code of practice provides guidance to employers, employees and occupational safety and health (OSH) practitioners on how to identify excessive noise, assess the risk and implement control measures to reduce noise exposure at place of work.

TABLE OF CONTENT

Foreword		i
Acknowledgements		ii
Glossary		iii
Preface		iv
No	Content	Page
1.	OBJECTIVE	1
2.	SCOPE OF APPLICATION	1
3.	DEFINITIONS	1
4.	GENERAL PRINCIPLES	6
	4.1. Strategies	6
	4.2. Consultation	6
	4.3. Provision of information	6
	4.4. Employers' responsibilities	6
	4.5. Employees' responsibilities	7
	4.6. Responsibilities of designers, manufacturers, importers and suppliers of plant for use in a place of work	7
5.	HEARING CONSERVATION PROGRAM (HCP)	8
	5.1. Principles	8
	5.2. Objective of Hearing Conservation Program	8
	5.3. Components in Hearing Conservation Program	9
6.	IDENTIFICATION OF EXCESSIVE NOISE	10
7.	NOISE RISK ASSESSMENT	11
	7.1. Principles	11
	7.2. Noise measuring equipment	11
	7.3. Methodology of noise risk assessment	13
	7.4. Noise risk evaluation	20
	7.5. Noise risk assessment reports	20

8.	REDUCTION OF EXCESSIVE NOISE	21
	8.1. Principles	21
	8.2. Engineering control	21
	8.3. Administrative control	21
	8.4. Other control	22
9.	ENGINEERING CONTROL	23
	9.1. Implementation of engineering control	23
	9.2. New plant and places of work	23
	9.3. Existing plant and places of work	24
	9.4. Engineering control at the source	24
	9.5. Engineering control at transmission path	25
	9.6. Inspection and maintenance of engineering controls	26
10.	ADMINISTRATIVE CONTROL	27
	10.1. Implementation of administrative control	27
	10.2. Job rotation	27
	10.3. Distance	28
	10.4. Scheduling rosters	29
	10.5. Quiet areas	29
11.	HEARING PROTECTION	30
	11.1. Personal hearing protectors	30
	11.2. Selection of personal hearing protectors	30
	11.3. Inspection and maintenance	33
	11.4. Training on personal hearing protectors	33
	11.5. Hearing protection zones	33
12.	INFORMATION, INSTRUCTION AND TRAINING	34
	12.1. Information	34
	12.2. Instruction	34
	12.3. Training	34
	12.4. Training target group	35
13.	AUDIOMETRIC TESTING	36
	13.1. Principle	36
	13.2. Testing	36
	13.3. Audiometric report	37

	13.4. Medical examination and referral	38
	13.5. Notification	39
14.	REGISTRATION	40
	14.1. Noise Risk Assessor	40
	14.2. Audiometric test centre	43
15.	DUTIES	47
	15.1. Duties of designers	47
	15.2. Duties of manufacturers	47
	15.3. Duties of importers and suppliers	48
	15.4. Duties of Noise Risk Assessor	48
	15.5. Duties of Hearing Conservation Administrator	49
	15.6. Duties of Occupational Health Doctor	49
	15.7. Duties of audiometric technician	49
	15.8. Duties of audiometric test centre	50
	Appendices	
	APPENDIX 1: NOISE HAZARD IDENTIFICATION CHECKLISTS	51
	APPENDIX 2: GUIDELINES ON NOISE RISK ASSESSMENT REPORT WRITING	53
	APPENDIX 3: AUDIOMETRIC TESTING FLOW CHART	60
	APPENDIX 4: QUESTIONNAIRE FORM FOR AUDIOMETRIC TESTING	61
	APPENDIX 5: GUIDANCE NOTE FOR OCCUPATIONAL NOISE-RELATED HEARING DISORDERS	62
	APPENDIX 6: REPORT FOR OCCUPATIONAL DISEASES/POISONINGS	67
	APPENDIX 7: NOTIFICATION OF OCCUPATIONAL NOISE RELATED HEARING DISORDERS AT BASELINE AUDIOMETRIC TESTING AND REPEATED CASES	69

	APPENDIX 8: GUIDANCE FOR DESIGNERS, MANUFACTURERS, IMPORTERS AND SUPPLIERS ON THE PRESENTATION OF INFORMATION ABOUT NOISE LEVELS GENERATED BY PLANT	71
	APPENDIX 9: NOISE RISK ASSESSMENT SUMMARY REPORT	73

1. OBJECTIVE

The objective of this Industry Code of Practice (ICOP) is to provide guidance for compliance to the Occupational Safety and Health (Noise Exposure) Regulations 2019.

2. SCOPE OF APPLICATION

This industry code of practice (ICOP) applies to all places of work where persons are employed in any occupation at industrial sector covered under Occupational Safety and Health Act 1994 [Act 514].

3. DEFINITIONS

'**acoustic**' (or **acoustical**) means containing, producing, arising from, actuated by, related to, or associated with, sound;

'**standard threshold shift (STS)**' means an average shift of 10 dB or more at frequencies of 2000, 3000 and 4000 Hz compared to the baseline audiogram;

'**audiogram (including audiogramme)**' means graphical record drawn from the results of hearing tests with an audiometer, which charts the threshold of hearing at various frequencies against sound intensity in decibels;

'**baseline audiogram**' means the audiogram against which future audiograms are compared;

'**abnormal audiogram**' means an audiogram that shows a hearing loss, hearing impairment or permanent Standard Threshold Shift (STS);

'**hazard**' means anything that may result in harm to the hearing of a person;

'**excessive noise**' means daily noise exposure level exceeding 82dB(A) or daily personal noise dose exceeding fifty percent or maximum sound pressure level exceeding 115dB(A) at any time or peak sound pressure level exceeding 140dB(C);

'**practicable**' means 'practicable' as defined in the Occupational Safety and Health Act 1994;

'**sound**' means small fluctuations in the air pressure that result in a wave capable of exciting in a listener the sensation of hearing;

'**dB(A)**' means decibel–A–weighted, a unit of measurement of sound pressure level corrected to the A–weighted frequency scale by means of an electrical network having the characteristics specified accordingly by the International Electrotechnical Commission (IEC) using a reference sound pressure level of 20 micropascals;

'**dB(C)**' means decibel–C–weighted, a unit of measurement of sound pressure level corrected to the C–weighted frequency scale by means of an electrical network having the characteristics specified accordingly by the International Electrotechnical Commission (IEC) using a reference sound pressure level of 20 micropascals;

'**decibel (dB)**' means a dimensionless unit for expressing sound levels. It is based on the logarithm of the ratio between a measured and reference sound level;

'**approved**' means approved in writing by the Director General of Occupational Safety and Health;

'**occupational health doctor**' means a registered medical practitioner under the Medical Act 1971 with valid Annual Practising Certificate, who are also registered with Director General and possess a valid Occupational Health Doctor certificate;

'**noise dosimeter**' means an instrument for measuring noise exposure by automatically integrating sound pressure level over a measurement period and displaying the result on the dimensionless scale of noise dose. The instrument may be worn by the person concerned, or placed at a suitable location to estimate the noise exposure of one or more persons, stationary or otherwise;

'**occupational noise related hearing disorders**' means occupational related noise-induced hearing loss (NIHL), hearing impairment and permanent standard threshold shift (STS);

'**noise exposure limit**' means noise exposure limits defined in Regulation 6 of Occupational Safety and Health (Noise Exposure) Regulations 2019;

'**should**' means a recommendation;

'**shall**' means that a requirement is mandatory;

'**hearing impairment**' means the arithmetic average of the permanent hearing threshold level of an employee at 500, 1000, 2000 and 3000 Hz which is shifted by 25dB or more compared to the standard audiometric reference level;

'hearing loss' means partial or total inability to hear marked by a hearing threshold worse than 25dB at any audiometric test frequency. Hearing loss may be mild (26 to 40dB), moderate (41 to 70dB), severe (71 to 90dB) or profound (equal or more than 91dB);

'noise-induced hearing loss' means hearing loss arising from exposure to noise;

'Director General' means the Director General of Occupational Safety and Health appointed under subsection 5(1) of the Act;

'audiometric report' means a report that contains, but not limited to, the employee's personal and employment particulars, test date, employee's noise exposure level, relevant medical history and hobbies, audiogram, interpretation and recommendation as necessary;

'plant' means any machinery, equipment, appliance, implement or tool, and component thereof and anything fitted, connected appurtenant thereto;

'employer' means employer comes within the definition of 'employer' under the Occupational Safety and Health Act 1994 [Act 514];

'sound level meter (SLM)' means an instrument consisting of a microphone, amplifier and indicating device, having a declared performance, and designed to measure a frequency-weighted and time-weighted value of the sound pressure level;

'precision sound level meter' means a sound level meter equipped with an integrating function analysis of the frequency/octave-band spectrum which enable the meter to process a continuous, fluctuate or impulsive sound to give a single, integrated level for the sampling period;

'daily noise exposure level ($L_{EX,8h}$)' means the equivalent continuous sound pressure level corrected for a normal working day of 8 hours;

'sound pressure level' means the level, in decibels, calculated as 20 times the common logarithm of the ratio of a sound pressure to the reference sound pressure of 20 micropascals;

'equivalent continuous sound pressure level' means the theoretical continuous A-weighted sound pressure level which would produce an identical noise dose to an employee exposed to an actual varying A-weighted sound pressure level for the same duration as the actual A-weighted sound pressure level;

'peak sound pressure level' means the highest C-weighted instantaneous sound pressure level of any impact;

'employee' means employee comes within the definition of 'employee' under the Occupational Safety and Health Act 1994 [Act 514];

'personal hearing protectors' means a device worn by a person to prevent unwanted auditory effects from acoustic stimuli;

'medical examination' means an examination by an occupational health doctor which consist of medical history taking, physical examination and other relevant investigations to diagnose or rule out any occupational or non-occupational auditory disorder;

'noise risk assessor' means any person appointed by the employer and registered with the Director General and possess a valid certificate to carry out noise risk assessment;

'noise exposure' means the amount of sound pressure exposed to a person's unprotected ear;

'attenuation' means a reduction in the magnitude of sound;

'reverberation' means the persistence, by echo or reflection, of sound in an enclosure after the emission by the source has stopped;

'manufacturer' means one who is engaged in the business of making machinery and plant;

'hearing conservation administrator' means a person appointed by employer for the purpose of administering and supervising hearing conservation program;

'consultation' means the sharing of information and exchange of views between employers, employees or employee representative(s) on safety and health issues. It includes the opportunity to contribute in timely decision making to minimise the risk(s) of exposure to excessive noise;

'hearing conservation program' means a program structured to the specific needs of the organisation to prevent occupational noise related hearing disorders;

'audiometric testing centre' means a facility for the purpose of determining an employee's hearing threshold;

'risk' means the probability of harm occurring to the hearing of a person;

'quiet' means absence of exposure to sound levels exceeding 80dB(A);

'sound pressure' means the root-mean-square displacement in air pressure due to sound;

'place of work' means premises where persons work or premises used for the storage of plant or substance;

'audiometric test (or testing)' means the measurement of the hearing threshold levels of a person by means of monoaural pure tone air conduction threshold tests;

'employee representative(s)' means a person elected to represent a group of employees on the safety and health matters;

'hearing protection zones' means an area where employees may be exposed to Noise Exposure Limit (NEL) as stated in the Occupational Safety and Health (Noise Exposure) Regulations 2019;

4. GENERAL PRINCIPLES

4.1. Strategies

- 4.1.1. The most effective approach for controlling noise exposure is through the reduction of noise at source.
- 4.1.2. A comprehensive approach comprising risk identification, equipment and job redesign, training and education shall be adopted to effectively manage the risk of ONRHD and other noise-related health effects.

4.2. Consultation

- 4.2.1. Consultation and cooperation between employers and employees pertaining to occupational noise exposure and its effects to workers' hearing are essential to the effective implementation of this ICOP.
- 4.2.2. The safety and health committees or employees representatives shall review all existing processes involving exposure to excessive noise, and participate in the development of systematic programs of equipment and job redesign. The introduction of changes in the place of work or in job design shall only occur following full consultation with employees.

4.3. Provision of information

- 4.3.1. Information shall be provided to employees, taking into account of the literacy, educational background and language proficiency.

4.4. Employers' responsibilities

- 4.4.1. Employer is responsible for ensuring that a safe working environment is established, and safe work practices are implemented and maintained. Employers shall ensure that:
 - (a) statutory requirements are complied with;
 - (b) a noise control plan and program of action are developed;
 - (c) all levels of management and employees are aware of the control measures to reduce exposure to noise;
 - (d) all employees cooperate in using agreed safe work practices;
 - (e) information on noise, the risks of exposure to noise and the appropriate control measures are disseminated in a manner appropriate to the place of work;

- (f) a comprehensive personal hearing protection program, including the selection of personal hearing protectors (PHP), and instruction to employees in their correct use and maintenance, is implemented; and
- (g) employees receive appropriate training and education when it is required.

4.4.2. Employers shall recognise the role of Hearing Conservation Administrator (HCA) in the management of noise and the protection of hearing at work. There shall be a close liaison between supervisor or safety and health committee representatives and other employees.

4.5. Employees' responsibilities

4.5.1. Employees shall comply with all statutory requirements and work procedures; and cooperate with employer in all activities related to protection of hearing and prevention of ONRHD.

4.6. Responsibilities of designers, manufacturers, importers and suppliers of plant for use in a place of work

4.6.1. Designers, manufacturers, importers and suppliers shall ensure that plant is designed and constructed so that its noise emission is as low as practicable when properly installed and used. Where necessary, research and development work shall be carried out to reduce noise emission.

5. HEARING CONSERVATION PROGRAM (HCP)

5.1. Principles

- 5.1.1. An employer shall protect employees who are exposed to excessive noise from the adverse health effects of noise. Every place of work shall implement a comprehensive Hearing Conservation Program (HCP), to prevent ONRHD among its employees over their entire working lifetimes. An employer shall ensure his employees participation by setting a high priority on HCP implemented at the place of work.
- 5.1.2. An effective HCP can eliminate or minimise noise hazard and prevent ONRHD. Full commitment by the management and active involvement by the workers are critical for the success of the HCP.
- 5.1.3. An employer shall appoint a HCA to assist the employer to manage, make decisions, correct deficiencies and enforce necessary actions in implementing the HCP, which includes but not limited to, policies, procedures, noise risk assessment, audiometric testing, training, noise controls, record keeping and program reviews.
- 5.1.4. The HCP shall be reviewed once a year to ensure its effectiveness.

5.2. Objective of Hearing Conservation Program

- 5.2.1. The objective of the HCP is to minimise the risk associated with excessive noise exposure and to prevent ONRHD by:
 - (a) Identifying the noise hazard and evaluating the risk involved;
 - (b) Implementing noise reduction measures, such as engineering control and administrative control;
 - (c) Providing suitable PHP and ensuring the proper use of the PHP by persons exposed to excessive noise;
 - (d) Training and educating persons involved in the HCP to raise their awareness of noise hazard;
 - (e) Conducting audiometric testing for detecting ONRHD;
 - (f) Keeping records of the measures taken to protect employees from noise hazard; and
 - (g) Evaluating the HCP to determine its effectiveness and identifying areas for improvements.
- 5.2.2. An effective HCP can eliminate or minimise noise hazard. Commitment by the management and active involvement by the employees are critical for the success of the HCP. Therefore, management shall take the appropriate steps to encourage employees'

participation in the development and implementation of the HCP.

5.3. Components in Hearing Conservation Program

There are five (5) components in HCP that comprises of: -

- (a) Noise risk assessment;
- (b) Noise reduction measures;
Noise reduction measures to be implemented at the place of work are based on the results of noise risk assessment and shall include:-
 - (i) Engineering control;
 - (ii) Administrative control;
 - (iii) Personal hearing protectors (PHP)
- (c) Audiometric testing;
- (d) Information, instruction and training; and
- (e) Recordkeeping.

6. IDENTIFICATION OF EXCESSIVE NOISE

- 6.1. Identification of excessive noise in a place of work enables employers to identify employees who may be exposed to excessive noise so that their exposures can be assessed.
- 6.2. Identification of excessive noise shall involve participation of the affected employees and those who understand the works, operations or processes and have knowledge of the work situation.
- 6.3. Employer shall conduct identification of excessive noise for each area in the workplace by nature of activities/work process using checklist provided in **Appendix 1**.
- 6.4. When it has been identified that excessive noise exists in the place of work as determined in paragraph 6.3., noise risk assessment shall be conducted.
- 6.5. The employer shall re-identify excessive noise, if there has been a change in the machinery, equipment, process, work, control measures or operation, in which any employee may be exposed to excessive noise. After the result of re-identification indicates possibility of excessive noise, employer shall conduct noise risk assessment.
- 6.6. The examples of changes mentioned in 6.5 are: -
 - (a) installation, modification or removal of machinery;
 - (b) a change in workload or equipment operating conditions likely to cause a significant change in noise levels;
 - (c) a change in building structure likely to affect noise levels; or
 - (d) modification of working arrangements affecting the length of time employees would spend in noisy place of works.
- 6.7. If the identification result shows no exposure to excessive noise, employer shall re-identify excessive noise not more than one year since the last identification of excessive noise.

7. NOISE RISK ASSESSMENT

7.1. Principles

- 7.1.1. If the identification of excessive noise indicates the need to carry out noise risk assessment, the employer shall appoint a noise risk assessor (NRA) who is registered with the Director General within one (1) month of the identification of excessive noise.
- 7.1.2. The objectives of noise risk assessment are to:
 - (a) identify all employees likely to be exposed to excessive noise;
 - (b) obtain information on noise sources and work practices that will help in the formulation of new measures that shall be taken to reduce noise;
 - (c) check the effectiveness of existing measures taken to reduce noise exposure;
 - (d) help in the selection of appropriate PHP;
 - (e) demarcate hearing protection zones; and
 - (f) determine the need for establishing and implementing HCP.
- 7.1.3. The noise risk assessment shall be reviewed:-
 - (a) not more than five (5) from the date of the previous noise risk assessment; or
 - (b) if directed by the Director General.

7.2. Noise measuring equipment

- 7.2.1. The noise measuring equipment shall comply with the standard determined by the International Electrotechnical Commission (IEC).
- 7.2.2. The compliance of the noise measuring equipment with the requirements of IEC 61672-1, IEC 61252 and other relevant standards shall be verified at intervals not exceeding 12 months by accredited laboratory or manufacturer.
- 7.2.3. Sound level meter (SLM) and noise dosimeter
 - 7.2.3.1. Measurement shall be made by integrating-averaging SLM and noise dosimeter.
 - 7.2.3.2. SLM including the microphone and associated cables, shall meet the requirement for IEC 61672-1, class 1 or class 2 instrumentation.
 - 7.2.3.3. Noise dosimeter including the microphone and associated cable, shall meet the requirement specified in IEC 61252.

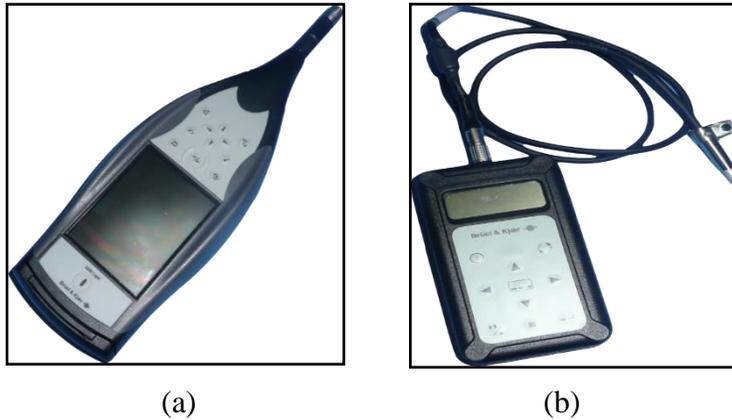


Figure 7.1: Example of (a) sound level meter and (b) noise dosimeter

7.2.4. Sound level calibrator

- 7.2.4.1. The sound level calibrator shall meet the requirements specified in IEC 60942, class 1.
- 7.2.4.2. Field calibration shall be performed before and after monitoring with a sound level calibrator at a quiet location as follows:
 - (a) At the start of each noise monitoring, a field calibration with appropriate adjustments shall be performed;
 - (b) At the end of the noise monitoring, a field calibration without adjustment shall be performed;
 - (c) If the reading at any frequency at the end of the noise monitoring differs from the reading of that frequency at the beginning by more than 0.5dB, the results shall be discarded; and
 - (d) NRA shall record field calibration reading of noise dosimeter and SLM.



Figure 7.2: Example of sound level calibrator

7.3. Methodology of noise risk assessment

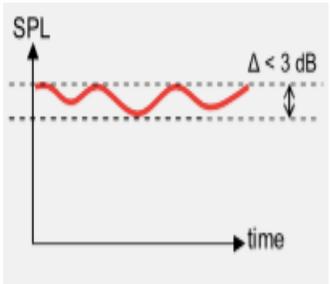
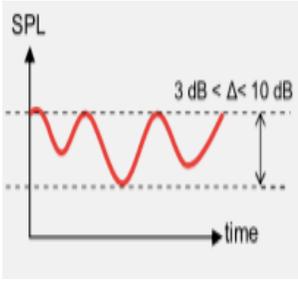
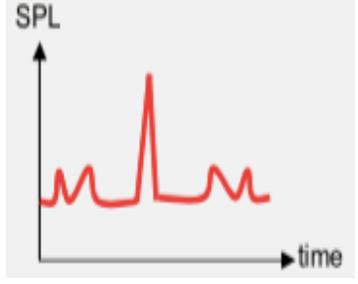
7.3.1. Noise risk assessment consists of area and personal monitoring.

7.3.2. Area monitoring

(a) Determining noise sources

- (i) Sources of noise levels must be monitored and recorded, including noise emitted by machines, especially those in the manufacturing sectors. Measurement of noise source levels ensures the priority for noise controls. Majority of the noisy machines generate noise similar to the patterns listed in **Table 7.1**.

Table 7.1: Type of noise

Type of noise	Steady Noise	Fluctuating Noise	Impulse/Impact Noise
			
Description	Noise levels are fairly steady and meter reading on slow response does not fluctuate more than 3 dB.	Noise levels are not steady and meter reading on slow response varies over a 3 to 10 dB range.	A sudden loud noise that differs greatly from the normal noise levels experienced in the workplace.
Sampling Method	A spot measurement, one (1) meter from the machine and the floor level (if possible). For each noise source, at least three (3) measurements shall be taken and the average result is recorded.		

- (ii) NRA shall record the noise levels in accordance with the recommended sampling method.
- (iii) It is recommended that noise levels be measured at different times during the task or at different areas having the same machine type or model to ensure that the variation in noise levels is captured.
- (iv) If it is not possible to follow the recommended sampling method, the NRA shall verify his method and justification shall be included as part of the Noise Risk Assessment Report.

(b) Noise mapping

- (i) Noise mapping is an important aid to visualize the work locations and noise exposure levels on a general layout plan of the workplace.
- (ii) The NRA shall measure the average sound pressure level by spot measurements of each machine and include the measurements in the final report.
- (iii) Noise mapping can be prepared by demarcating the workplace in the form of colour zone as shown in **Table 7.2:**

Table 7.2: Noise mapping colour zone

Sound Pressure Level	Colour zone
> 140dB(C)	Purple
> 115dB(A)	
> 85dB(A) to 115dB(A)	Red
> 82 dB(A) to 85dB(A)	Yellow
≤ 82dB(A)	White

7.3.3. Personal monitoring

- (a) Personal monitoring is conducted to measure the worker's exposure to noise during his entire work shift.
- (b) Noise exposure levels shall be determined in a manner that would accurately identify employees exposed to or likely to be exposed to excessive noise. Every employee who may be exposed to excessive noise must be included in the noise risk assessment activities. This can be achieved by grouping employees who have similar noise exposure (e.g., perform the same tasks, have similar job functions, or work in the same area), into similar exposure groups (SEG).
- (c) SEG shall be determined by NRA in consultation with the HCA, supervisor and employees. A well-defined SEG helps to minimize the variability of exposure monitoring data.
- (d) NRA shall justify the reasons for classifying each SEG and include the justifications as part of the Noise Risk Assessment Report.
- (e) After the SEG is defined, the most exposed employees from each SEG should be selected for personal monitoring.
- (f) NRA shall ensure the most exposed employee in each SEG is selected based on the following selection criteria:
 - (i) work directly with the noise source (tools, machinery, etc.);
 - (ii) work near or pass through areas with noise exposure; or
 - (iii) work in noise area for a long period of time.
- (g) Noise dosimeter must be set up as follows:
 - (i) Criterion Level: $L_c = 85\text{dB(A)}$;
 - (ii) Threshold Level: $L_t = 80\text{dB(A)}$;
 - (iii) Exchange Rate: $q = 3 \text{ dB}$;

- (iv) Time Constant = “Slow”;
- (v) Peak level = 140dB(C)

- (h) The microphone of dosimeter shall be mounted on the top of the shoulder at a distance of at least 0.1 m from the entrance of the external ear canal at the side of the most exposed ear and shall be approximately 0.04 m above the shoulder. The microphone and the cable shall be fastened in such a way that mechanical influence or covering by clothing do not lead to false results.



Figure 7.3: Position of microphone.

- (i) Any peak sound pressure levels recorded by noise dosimeter, which were not validated by observation, shall be investigated and commented on the report.
- (j) Measurement must reflect the normal operation of the work process: i.e. all types of noise present during normal operation must be included over the entire working shift. Measurement must be taken for full period of working hours.
- (k) Employee shall be observed during the measurements. At the end of the personal noise measurement, the validity of the measurement shall be examined by NRA so as to identify the different tasks and events logged by the dosimeter.
- (l) The validity of the measurements shall be checked by one or more of the following actions:
 - (i) Interviewing supervisor and workers;
 - (ii) Taking spot measurement to verify the levels measured using noise dosimeter;
 - (iii) An examination of the noise dosimeter log (time history) at the end of shift.
- (m) Sources of uncertainties need to be considered in order to reduce their influence as far as possible. Uncertainties can be caused both by errors and by natural variation

in the work situation.

- (n) The main sources of uncertainty in the result are:
- (i) Variation in the daily work, operating conditions, uncertainty in sampling, etc.;
 - (ii) Instrumentation and calibration;
 - (iii) Microphone position;
 - (iv) False contributions for instance from wind, airflows or impact on the microphone and the microphone rubbing on clothing;
 - (v) Contributions from non-typical noise sources, speech, music (radio), alarm signals and non-typical behavior.
- (o) Daily noise exposure level for the effective duration of the working day can be calculated using the following formula:

$$L_{EX,8h} = L_{eqTe} + 10 \log \left(\frac{T_e}{T_0} \right) dB(A)$$

Where;

L_{eqTe} is the A-weighted equivalent continuous sound pressure level for the effective duration of the working day;

T_e is the effective duration of the working day;

T_0 is the reference duration, $T_0 = 8$ hour;

Daily personal noise dose can be calculated using the following formula:

$$\text{Dose} = 100 \times \frac{T_e}{8} \times 10^{\frac{L_{eq}-85}{10}} \%$$

Example:

Working hours:	10 hours
Morning break:	20 minute
Lunch break:	45 minute
Tea break:	20 minute

From the monitoring conducted, worker was exposed to noise at 87dB(A) measured by noise dosimeter. Determine the effective duration, T_e for each scenario given, then calculate the daily noise exposure level, L_{EX} and daily personal noise dose.

Scenario A

Morning and tea breaks are taken at location within the workplace while lunch is taken at a fixed time outside the workplace. The measurement is not taken during lunch break.

Answer:

Effective duration of the working days, T_e is 10 hours – 45 minutes = 9.25 hours

$$L_{EX,8h} = 87 \text{ dB(A)} + 10 \log (9.25/8) \text{ dB(A)} = 87.6 \text{ dB(A)}$$

$$\text{Dose} = 100 \times (9.25/8) \times 10^{(87-85)/10} = 183.3 \%$$

Scenario B

Morning breaks, tea breaks and lunch are taken at location within the workplace. There is no designated area at the workplace for lunch. The measurement is taken during lunch time.

Answer:

Effective duration of the working days, T_e is 10 hours

$$L_{EX,8h} = 87 \text{ dB(A)} + 10 \log (10/8) \text{ dB(A)} = 88 \text{ dB(A)}$$

$$\text{Dose} = 100 \times (10/8) \times 10^{(87-85)/10} = 198.1 \%$$

Scenario C

Morning breaks, tea breaks and lunch are taken at location within the workplace. The worker lunch at canteen which situated in different building away from noise from the production area. The measurement is not taken during lunch time.

Answer:

Effective duration of the working days, T_e is 10 hours – 45 minutes = 9.25 hours

$$L_{EX,8h} = 87 \text{ dB(A)} + 10 \log (9.25/8) \text{ dB(A)} = 87.6 \text{ dB(A)}$$

$$\text{Dose} = 100 \times (9.25/8) \times 10^{(87-85)/10} = 183.3 \%$$

7.4. Noise risk evaluation

- 7.4.1. The process of evaluating noise risks shall include the result of noise exposure measurement, the sources of noise and the circumstances under which the risks occur.
- 7.4.2. Noise risk evaluations is done by comparing the personal monitoring result to the NEL as stipulated in the Occupational Safety and Health (Noise Exposure) Regulations 2019.
- 7.4.3. Evaluation of risks shall consider alternative processes, equipment, or working methods which would reduce the noise exposure or duration of exposure, current good practice or the standard for noise control within industry.
- 7.4.4. Findings of noise risk assessment shall be recorded.

7.5. Noise risk assessment reports

- 7.5.1. The content of noise risk assessment report shall include Introduction, Objective, Process Description, Instrumentation, Methodology, Result, Discussion, Recommendations and Conclusion. Refer to **Appendix 2** on noise risk assessment report writing.
- 7.5.2. Noise risk assessment report shall be kept at or near the premises to which they apply. Where this is not practicable, for example, such as construction works, the report shall be kept available at a designated office. Noise risk assessment reports shall be made available to management, safety and health committees and relevant authorities.

8. REDUCTION OF EXCESSIVE NOISE

8.1. Principles

- 8.1.1. There are several ways in which noise can be reduced, which can vary from one workplace to another. There is no standard single technique or solution that is appropriate for every situation.
- 8.1.2. Good understanding of plant operations and work processes is necessary to determine the most effective method of eliminating, minimizing or controlling the noise.
- 8.1.3. The employer should make an assessment whether the measure is practicable to reduce excessive noise by way of engineering control or administrative control and prepare a justification report. The report should consider the following factors:
 - (a) the scale of the noise problem and its impact on the business (including workers);
 - (b) cost and effort required to reduce noise exposure;
 - (c) effectiveness of planned control measures;
 - (d) the number of individuals who would benefit from those control measures.

8.2. Engineering Control

- 8.2.1. Engineering controls are plant, process or equipment that minimizes the exposure to excessive noise, suppress the level of exposure or limit the area of exposure. Types of engineering control include absorption, insulation, damper, silencer and vibration insulation.
- 8.2.2. The type of engineering control measures that will be installed should be assessed according to suitable methods, use and effectiveness, and maintenance of equipment. Employer should refer to acoustic experts or noise control supplier if necessary.

8.3. Administrative Control

- 8.3.1. Administrative controls are the way work is organised to reduce either the number of workers who are exposed or the duration of time they are exposed to noise.
- 8.3.2. Administrative control should be used when it is not possible to reduce noise exposure through engineering noise control measures.

8.3.3. Some administrative measures include:

- (a) increasing the distance between noise sources and workers – the further away the noise source is, the less harmful its effect on workers will be;
- (b) organizing schedules so that noisy tasks are performed when as few people as possible are present;
- (c) minimizing the number of individuals working in a noisy area – keeping individuals out of the area if their job does not require them to be there;
- (d) limiting the time workers spend in noisy areas by job design and job rotation; or
- (e) providing rest breaks in areas away from a noisy work environment.

8.4. Other control

8.4.1. If it is not practicable to reduce excessive noise by engineering control or administrative control, the employer shall take other effective measures including personal hearing protector.

9. ENGINEERING CONTROL

9.1. Implementation of engineering control

- 9.1.1. There are two basic engineering control measures for controlling noise levels:
 - (a) engineering control at the source; and
 - (b) engineering control at the noise transmission path.
- 9.1.2. The most effective way to control noise exposure is through effective implementation of engineering noise controls at the source.
- 9.1.3. If it is not possible to change or modify the noise-generating equipment or processes by engineering control at the source, engineering control at the noise transmission path between the source and the recipient, should be implemented.

9.2. New plant and places of work

- 9.2.1. The purchase of new plant, the design of the area in which it is to be installed and the design of new place of works generally, will provide opportunities for cost-effective noise control measures.
- 9.2.2. Invitations to tender for the supply of new plant shall specify a maximum acceptable level of noise as would suit the conditions in his place of work.
- 9.2.3. If plant is to be purchased directly, without tender, noise level information shall be obtained from suppliers to enable the plant with the lowest practicable noise level to be selected.
- 9.2.4. New places of work and installation sites for new plant in existing places of work, shall be designed and constructed to ensure that exposure to noise is as low as practicable.
- 9.2.5. If new plant is likely to expose person in the places of work to excessive noise, design features shall incorporate effective engineering control measures to reduce noise to level as low as practicable.

9.3. Existing plant and places of work

- 9.3.1. Once a noise risk assessment has been carried out and the necessity to reduce the noise exposure of employees is established, the task of controlling the noise can be addressed. Priority shall be given to those noise sources that contribute to the highest noise exposures affecting the largest number of people.
- 9.3.2. Noise exposure levels shall be reduced below the NEL specified in the Occupational Safety and Health (Noise Exposure) Regulations 2019.
- 9.3.3. Machinery which emits lower level of noise should be considered to be replaced if available and suitable.

9.4. Engineering control at the source

- 9.4.1. Engineering control at the source is the preferred method of permanently removing the problem of noise exposure due to machinery or processes at the places of work. Since all noise-emitting machines/process generate noise and vibration, the control of these noise problems may require modification, partial redesign or replacement of the noise-emitting plant.
- 9.4.2. When seeking a solution to a noise problem, an understanding of the operation of the machine or process is necessary in considering the possible control of the noise at source. Engineering noise control measures shall be specifically targeted at the machine and its parts, or towards the actual processes, including material handling systems.
- 9.4.3. General noise control solutions, which can be carried out on machines, are provided below:
 - (a) Eliminate or replace the machine or its operation by a quieter operation with equal or better efficiency;
 - (b) Replace the noisy machinery by installing newer equipment designed for operating at lower noise levels;
 - (c) Correct the specific noise source by minor design changes;
 - (d) A high standard of plant and equipment maintenance shall be provided to facilitate compliance with the Occupational Safety and Health (Noise Exposure) Regulations 2019 and reduce noise levels to as low as practicable. A good maintenance program can reduce the noise level due to badly worn bearings and gears, poor lubrication, loose parts, slapping belts, unbalanced rotating parts and steam or air leak. Plant and equipment resulting in excessive noise levels shall be repaired/replaced immediately;

- (e) Correct the specific machine elements causing the noise by a local source approach, rather than by consideration of the entire machine as a noise source;
- (f) Separate the noisy elements that need not be an integral part of the basic machine;
- (g) Isolate the vibrating machine parts to reduce noise from vibrating panels or guards.

9.4.4. In addition to engineering changes to machinery and parts, processes can be modified to reduce noise. Specific means of modification include the use of processes that are inherently quieter than the alternatives.

9.4.5. Material handling processes, in particular, can also be modified to ensure that impact and shock during handling and transport are minimised as far as possible.

9.5. Engineering control at transmission path

9.5.1. Engineering control at the noise transmission path includes isolating the noise-emitting object(s) in an enclosure, or placing them in a room or building away from the largest number of employees, and acoustically treating the area to reduce noise to the lowest practicable levels.

9.5.2. Alternatively, it may be desirable to protect the employee instead of enclosing the noise sources. In this case, design of the soundproof room or sound-reducing enclosures to the employee shall still follow the same principles.

9.5.3. The principles to be observed in carry out engineering control of the noise transmission path are listed below:

- (a) Distance is often the cheapest solution, but it may not be effective in reverberant conditions;
- (b) Erect a noise barrier between the noise source and the receiver; in some instances, a partial barrier can be used. In cases where either area has a false ceiling, care shall be taken to ensure that the dividing wall extends to the true ceiling and that all air gaps in the wall are closed and airtight;
- (c) Once the acoustical barrier is erected, further treatment, such as the addition of absorbing material on surfaces facing the noise source, may be necessary;
- (d) Walls and machine enclosures must be designed to minimise resonances which will transmit acoustical energy at the resonant frequency to the protected area;
- (e) Reduce, as far as possible, the reverberation of the room where noise is generated by the introduction of acoustically absorbent material(s).

9.6. Inspection and maintenance of engineering controls

- 9.6.1. A system shall be established to ensure regular inspection and maintenance of vibration mountings, impact absorbers, gaskets, seals, silencers, barriers, absorptive materials and other equipment used to control noise.

10. ADMINISTRATIVE CONTROL

10.1. Implementation of administrative control

10.1.1. Administrative control is defined as administrative methods or approaches that reduce exposure of workers to noise. It should also be used where engineering control measures solely is not practicable to comply with the NEL specified in the Occupational Safety and Health (Noise Exposure) Regulations 2019.

10.1.2. These measures may include job rotation, distance and scheduling rosters so that as few workers as possible are exposed to noisy operations, or providing quiet areas for rest breaks for employees exposed to noisy work.

10.2. Job rotation

10.2.1. When employing job rotation to reduce employee's noise exposure, a time/exposure analysis would need to be completed. This analysis would determine the total allowable time for each employee at a specific task, dictating when during the shift that rotation shall occur. It simply means limiting the time employees spend in noisy areas by moving them to quiet work areas before their daily noise exposure levels are exceeded. Daily exposure duration limit as shown in **Table 10.1**.

Table 10.1: Daily Exposure Duration Limit

NOISE LEVEL dB(A)	DAILY EXPOSURE DURATION LIMIT
82	16 hrs
83	12hrs 42 mins
84	10 hrs 5 mins
85	8 hrs
86	6hrs 21mins
87	5hrs 2 mins
88	4 hrs
89	3 hrs 10 mins
90	2 hrs 31 mins
91	2 hrs
92	1 hr 35 mins
93	1 hr 16mins
94	1 hr
95	48 mins

96	38 mins
97	30 mins
98	24 mins
99	19 mins
100	15 mins
101	12 mins
102	9 mins
103	7 mins 30 sec
104	6 mins
105	5 mins
106	3 mins 45 sec
107	3 mins
108	2 mins 22 sec
109	1 min 53 sec
110	1 min 30 sec
111	1 min 11 sec
112	56 sec
113	45 sec
114	35 sec
115	28 sec

10.3. Distance

10.3.1. Controlling noise exposure through distance is often an effective, yet simple and inexpensive administrative control. Specifically, for every doubling of the distance between the source of noise and the worker, the noise is decreased by 6dB.

$$\text{SPL}_2 = \text{SPL}_1 - 20 \log \left(\frac{R_2}{R_1} \right)$$

Where;

SPL₁: Sound Pressure Level at distance 1

SPL₂: Sound Pressure Level at distance 2

R₁: distance 1 from noise source

R₂: distance 2 from noise source

10.4. Scheduling rosters

10.4.1. Organising schedules so that noisy machines are operated during shifts when fewer workers are present.

10.5. Quiet areas

10.5.1. Quiet areas can also be provided, where workers can gain relief from occupational noise. Areas used for work-breaks and lunch rooms shall be located away from noise.

11. HEARING PROTECTION

11.1. Personal hearing protectors

- 11.1.1. Employer shall supply effective personal hearing protector (PHP) to be worn by employees, when engineering and administrative noise control measures do not reduce the exposure to noise below the NEL specified in the Occupational Safety and Health (Noise Exposure) Regulations 2019.
- 11.1.2. PHP shall not be used when noise control by engineering or administrative noise control measures is practicable. They shall be regarded as an interim measure while control of noise exposure is being achieved by these means.
- 11.1.3. The removal of PHP for even short periods of time can significantly reduce their effectiveness, hence cause inadequate protection. If there is a need to remove PHP, it shall be removed in areas below than 80dB(A), and shall be included as part of the PHP program.

11.2. Selection of personal hearing protectors

- 11.2.1. The employer shall provide PHP that are approved by Director General.
- 11.2.2. The employer shall ensure that the supplier provides full information on the attenuation values and makes this available to employees and HCA. Employer shall ensure that PHP will provide employee with reliable adequate protection.
- 11.2.3. The following criteria shall be considered when selecting PHP:
 - (a) Worker's noise exposure level;
 - (b) Hearing ability of the worker;
 - (c) Use of other personal protective equipment;
 - (d) Temperature and climate;
 - (e) Communication demands on the worker; and
 - (f) Physical constraints of the worker or work activity.

11.2.4. Estimated exposure calculation based on Noise Reduction Rating (NRR) is given below:

- (a) For **single protection** (only ear muffs or ear plugs are used), use the following formula:

$$NRR_{actual} = \frac{NRR - 7}{2}$$

$$Estimated\ exposure,\ dB(A) = L_{EX,8h}\ dB(A) - \left[\frac{(NRR - 7)}{2} \right]$$

Where;

- (i) $L_{EX,8h}$ is daily noise exposure level;
- (ii) 2 is de-rating factor (to lower the rating of a device, especially because of a deterioration in efficiency or quality).

Example:

A worker is exposed to daily noise exposure level, $L_{EX,8h} = 90\ dB(A)$ and given an ear plug have $NRR = 37$. Calculate the NRR_{actual} and the new estimated noise exposure after wearing the PHP.

Answer:

- (i)

$$NRR_{actual} = \frac{(37 - 7)}{2} = 15\ dB(A)$$

- (ii)

$$Estimated\ exposure,\ dB(A) = 90\ dB(A) - 15\ dB(A) = 75\ dB(A)$$

- (b) For **dual protection** (ear muffs and plugs are used simultaneously), use the following formula:

$$\textit{Estimated exposure, dB(A)} = L_{EX,8h} \textit{ dB(A)} - \left[\frac{(NRR_h - 7)}{2} + 5 \right]$$

Where;

- (i) NRR_h is NRR for the **higher** rated protector; and
- (ii) $L_{EX,8h}$ is daily noise exposure level.

Example:

Given: $L_{EX,8h} = 110 \text{ dB(A)}$
ear plug $NRR = 29$
ear muff $NRR = 25 \text{ dB}$

Calculate the estimated exposure.

Answer:

$$\textit{Estimated exposure, dB(A)} = 110 - \left[\frac{(29 - 7)}{2} + 5 \right] = 94 \text{ dB(A)}$$

Employer may use any recognized method to calculate noise reduction rating such as Single Number Rating (SNR), Sound Level Conversion (SLC₈₀).

- 11.2.5. Suitability for use in the type of working environment and the job involved shall consider the comfort, weight and clamping force of the PHP.

For example, ear plugs are difficult to use hygienically in work that requires them to be inserted with dirty hands. For such jobs, ear muffs might be better. On the other hand, ear muffs tend to be more uncomfortable in hot environments, or may make it difficult for the employee to enter a confined space, or to wear a helmet.

- 11.2.6. Individual fitting shall be checked especially when the employee is wearing other accessories which might affect the performance of the PHP.

For example, employee who wears spectacle whom are required to use earmuff need individual fitting. Disposable plugs do not need individual fitting, but the ability of the material to conform to the user's ear canal shall be taken into account.

- 11.2.7. The safety of the wearer and fellow employees shall also be considered during selection of PHP.

For example, the use of PHP shall be suitable with any other personal protective equipment that might be required, such as safety helmets or respiratory protective equipment. The wearing of PHP shall not block warning sounds such as emergency alarm. The use of PHP may make it more difficult for employees to hear sounds if they already have a hearing loss. Particular care should be exercised in such cases.

11.3. Inspection and maintenance

- 11.3.1. Employers shall ensure that PHP are regularly inspected, maintained, and readily made available.
- 11.3.2. Employees shall also inspect PHP regularly to detect, and report damage or deterioration.
- 11.3.3. Adequate provision shall be made for clean storage of PHP when not in use.

11.4. Training on personal hearing protectors

- 11.4.1. Employer shall provide information and training to the employees on the use, fitting, care and maintenance of hearing protectors at least once a year.

11.5. Hearing protection zones

- 11.5.1. Based on noise mapping, areas where persons may be exposed to noise levels exceeding the NEL shall be sign-posted as 'HEARING PROTECTION ZONES', and so far as practicable their boundaries shall be clearly demarcated and identified by means of an appropriate warning sign. No person shall enter a hearing protection zone during normal operation, unless wearing appropriate PHP.
- 11.5.2. Alternative arrangements shall be made to ensure that employees and others can recognise circumstances in which PHP are required where sign-posting is not practicable. Methods of achieving this include, but not limited to:
 - (a) attaching prominent warning notices to tools and equipment indicating that PHP must be worn when operating them;
 - (b) providing written and verbal instructions on how to recognise circumstances in which PHP are needed; and
 - (c) effective supervision of identified hearing protection zones.

12. INFORMATION, INSTRUCTION AND TRAINING

Employees who are exposed to excessive noise shall be provided with information, instruction and training so that they understand their responsibilities and the risks of noise exposure. Information, instruction and training program shall be updated to be consistent with changes in control measures and work processes.

12.1. Information

12.1.1. An employer shall ensure that any employee who is exposed to the excessive noise are well informed, on:

- (a) adverse effects to health resulting from excessive noise exposure;
- (b) social disadvantages of ONRHD;
- (c) noise control plan and program at place of work;
- (d) responsibilities of employers and employees;
- (e) procedure for reporting defects in plant or the place of work that are likely to cause exposure to excessive noise and signs of hearing damage; and
- (f) results of the noise risk assessment and audiometric testing.

12.2. Instruction

12.2.1. Employees shall follow all instructions given by the employer in particular, but not limited to the following:

- (a) co-operate with the employer and HCA;
- (b) wear and proper use PHP at all times; and
- (c) comply with any instruction or measure on risk of noise exposure.

12.3. Training

12.3.1. An employer shall provide training to all his employees on the following:

- (a) Occupational Safety and Health (Noise Exposure) Regulations 2019;
- (b) adverse effects of noise on hearing;
- (c) purpose and benefits of the HCP;
- (d) the purpose of PHP, the advantages, disadvantages and attenuation of various types of PHP, and instructions on their selection, fitting, use and care;
- (e) purpose and procedures of audiometric testing, including pre-test instructions;
- (f) explanation of the audiometric results and preventive measures;
- (g) the noise control plan and program at place of work.

- 12.3.2. In addition to the training sessions, discussions on hearing health topics can be included in the safety and health committee or management meetings.
- 12.3.3. All training shall be conducted in languages understood by all employees who are exposed to excessive noise.
- 12.3.4. The training content shall be reviewed periodically to ensure that it remains effective.
- 12.3.5. The effectiveness of the training can be determined through compliance with proper and consistent use of PHP, understanding the noise hazard, and its control and prevention.

12.4. Training target group

- 12.4.1. The needs of each target group are different. Hence, the content and methods of presenting training material shall be tailored to meet the specific needs of each group.
- 12.4.2. It is recommended that the training is not only aiming at the employees who are exposed to the excessive noise, but everyone in the place of work who is exposed to noise or involved in managing the risks from noise exposure which include:
 - (a) Employees, managers and supervisors;
 - (b) Members of safety and health committee;
 - (c) All personnel who are responsible for purchasing plant, noise control equipment and PHP; and
 - (d) All personnel who are responsible for designing the place of work layout.

13. AUDIOMETRIC TESTING

13.1. Principle

- 13.1.1. The hearing of employees exposed to noise can be monitored through regular audiometric examinations. Such testing in itself is not a preventive mechanism, and is only relevant in the context of a comprehensive HCP. Any changes in hearing levels over time revealed by audiometry shall be thoroughly investigated as to their cause(s) and the need for corrective action.
- 13.1.2. An audiometric testing program shall be available to any employee exposed to NEL.
- 13.1.3. The employer shall conduct audiometric test at no cost to the employees.
- 13.1.4. The flowchart for audiometric testing is summarized in **Appendix 3**.

13.2. Testing

- 13.2.1. All audiometric testing shall be conducted by a trained audiometric technician at an approved audiometric test centre.
- 13.2.2. An audiometric technician shall conduct a screening questionnaire to determine other factors which may affect the test results and the fitness of a worker for the test. This questionnaire is conducted before an audiometric test as **Appendix 4**.
- 13.2.3. Employer shall ensure that the audiometric testing shall be preceded by a period of quiet, that is, absence of exposure to sound level exceeding 80dB(A) of at least 14 hours without wearing any PHP.
- 13.2.4. Audiometric testing shall be repeated annually.
- 13.2.5. An audiometric test shall be of pure tone, air conduction, with test frequencies including 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz taken separately for each ear.
- 13.2.6. The audiometric testing shall include a valid baseline audiogram for all employees exposed to NEL.
- 13.2.7. The baseline audiogram shall be carried out within three (3) months of the employee commencing work which would expose to NEL.

- 13.2.8. The employer shall provide his employee's baseline audiogram on every annual audiometry for reference to the attending OHD.
- 13.2.9. The employer shall provide his employee's workplace personal noise exposure monitoring information to the audiometric test centre for establishing work-relatedness of hearing disorders.

13.3. Audiometric report

- 13.3.1. Audiometric report should contain the employee's personal and employment particulars, test date, employee's noise exposure level, relevant medical history and hobbies, audiogram, interpretation and recommendation as necessary.
- 13.3.2. All audiograms shall be interpreted by an Occupational Health Doctor (OHD). A guidance note for occupational noise-related hearing disorders is given in **Appendix 5**.
- 13.3.3. The audiometric report of an employee shall be submitted by the audiometric test centre to the respective employer within 30 days from the date of testing. The report shall also include requirements for the employer to retest employee with temporary STS.
- 13.3.4. The employer upon receiving notification of temporary STS shall:
 - (a) make appropriate arrangement to protect the hearing of an employee from further deterioration by ensuring the employee fulfills at least 14 hours of quiet state without PHP prior to the retest audiometry; and
 - (b) conduct a retest within three (3) months after the previous audiometric testing was carried out.
- 13.3.5. If an employee has a normal audiogram, the employer shall:
 - (a) inform the employee of his condition within 21 days after receiving the results; and
 - (b) continue the annual audiometric testing program.
- 13.3.6. If an employee has a hearing impairment, hearing loss or permanent STS, the employer shall:
 - (a) inform the employee of his condition within 21 days after receiving the results;
 - (b) provide the employee, if he has not been so provided, with a PHP; and
 - (c) refit and retrain the employee in the use of a PHP;
- 13.3.7. The baseline audiogram shall be replaced with the annual or retest audiogram if the annual or retest audiogram reveals:
 - (a) a permanent STS; or

(b) improved hearing threshold with respect to the baseline at two (2) or more test frequencies.

13.3.8. Summary of all audiometric report (baseline, annual and retest) for each calendar year shall be submitted by audiometric test centre to the Director General not later than 31st January of the following year. The summary shall include the following information:

- (a) report reference number;
- (b) date of audiometric testing;
- (c) name of workplace;
- (d) name and particular of employee;
- (e) total number of employees tested;
- (f) total number of employees with normal audiometric results;
- (g) total number of employees with hearing impairment;
- (h) total number of employees with NIHL;
- (i) total number of employees with temporary STS;
- (j) total number of employees with permanent STS;
- (k) total number of employees with other audiometric results;
- (l) other information required by Director General.

13.4. Medical examination and referral

13.4.1. If an employee has an abnormal audiogram, the attending OHD shall carry out a medical examination for that employee. The audiogram interpretation and medical examination of an employee shall be carried out by the same OHD.

13.4.2. The employer shall ensure his employees with abnormal audiogram undergo medical examination promptly after receiving audiogram interpretation from the OHD.

13.4.3. The medical examination shall consist of medical history taking, physical examination and other relevant investigations to diagnose or rule out any occupational or non-occupational auditory disorder as shown in **Appendix 6**.

13.4.4. The OHD shall conduct medical examination for all newly discovered hearing loss, hearing impairment or PSTS. Medical examination shall be repeated for a previously diagnosed NIHL or HI only if there is deterioration / “improvement” in the hearing status. This is applicable for a case of “previously diagnosed NIHL with HI and/or PSTS in current audiometry” and “a previously diagnosed HI with PSTS in current audiometry”.

13.4.5. The OHD, after examining the employee, shall decide whether a referral is necessary for further management.

13.5 Notification

- 13.5.1. If the OHD is of the opinion that an occupational related permanent STS, hearing impairment or NIHL has occurred, he shall notify the Director General within seven (7) days using an approved form and at the same time inform the employer.
- 13.5.2. The employer upon receiving audiometric report shall notify any occupational related permanent STS, hearing impairment and NIHL by using an approved form to the nearest Department of Occupational Safety and Health (DOSH) office within seven (7) days.
- 13.5.3. The notification to the nearest DOSH office shall include relevant information as shown in **Appendix 6** and a copy of the latest audiometric report.
- 13.5.4. Hearing impairment or NIHL identified in the baseline audiogram conducted within three (3) months of the employee commencing work which would expose him to NEL, is not required to be notified to DOSH. Notification is only required if the baseline audiogram conducted after three (3) months employee commencing work which would expose him to NEL.
- 13.5.5. Notification of a worker with occupational noise related hearing disorder to DOSH is only required to be repeated if there is a significant change in the worker's hearing threshold. This significant change is marked by the presence of a permanent STS in the worker's audiograms.
- 13.5.6. An example case for paragraph 13.5.4. and 13.5.5. is given in **Appendix 7**.

14. REGISTRATION

Audiometric test centre (ATC) and noise risk assessor (NRA) shall register with the Director General of DOSH.

14.1 Noise Risk Assessor

14.1.1. Registration procedure.

14.1.1.1. An applicant for Noise Risk Assessor shall fulfil the following general requirements: -

- (a) Malaysian citizen;
- (b) has one (1) year working experience in noise risk assessment or noise exposure monitoring;
- (c) has not convicted of an offence under Occupational Safety and Health Act 1994 [Act 514] or regulations made there under;
- (d) certified medically fit by registered OHD; and
- (e) application for registration shall be made within three (3) years after passed the NRA examination.

14.1.1.2. An applicant for NRA shall fulfil the following specific requirements: -

- (a) i) possesses minimum a Diploma in Science, Diploma in Engineering or Diploma in Occupational Safety and Health accredited by Malaysian Qualifications Agency (MQA); and
- ii) has attended NRA course and passed the examination conducted by approved training provider;

OR

- (b) i) possesses minimum a Diploma in Industrial Hygiene accredited by MQA; and
- ii) has passed the NRA examination conducted by approved training provider;

OR

- (c) i) a certified Industrial Hygienist as recognized by the American Board Industrial Hygiene (ABIH) or bodies recognized by Director General; and

- ii) has passed the NRA examination conducted by approved training provider;

14.1.1.3. Application for registration as NRA shall be forwarded to Director General together with a copy of the following documents:

- (a) academic or professional qualification certificate;
- (b) National Registration Identity Card (NRIC);
- (c) details of working experience in noise risk assessment or noise exposure monitoring, verified by employer(s);
- (d) NRA course attendance certificate;
- (e) NRA examination certificate; and
- (f) certificate of fitness by registered OHD.

14.1.2 Renewal procedure

14.1.2.1. The applicant who are intended to renew the application as NRA shall fulfil the following requirements:

- (a) must be active in conducting his duties as NRA with at least one (1) assessment performed every year;
- (b) has obtained 30 Continuing Education Program (CEP) points for a period of three (3) years;
- (c) has attended NRA refresher course and pass the examination conducted by approved training provider;
- (d) certified medically fit by registered OHD;
- (e) has not convicted of an offence under Occupational Safety and Health Act 1994 [Act 514] or regulations made there under; and
- (f) application for renewal of registration must be made at least three (3) months before the expiry date of the current registration.

14.1.2.2. The certificate of NRA competency shall not be renewed if NRA fails to submit renewal application within one (1) year from the expiry date of the current registration. Applicant shall re-attend NRA course and pass the examination conducted by approved training providers before submitting the new application for registration.

14.1.2.3. Application for NRA renewal shall be forwarded to Director General together with the following items:

- (a) list of noise risk assessment conducted within the existing registration validity period;

- (b) a copy of noise risk assessment report conducted within 12 months preceding the registration expiry date;
- (c) document of CEP attended;
- (d) a copy of NRA refresher course attendance certificate;
- (e) a copy of NRA refresher course examination certificate; and
- (f) certificate of fitness by registered OHD.

14.1.3. Registration validity

- 14.1.3.1. Successful applicant will be registered for a maximum period of three (3) years.
- 14.1.3.2. The Director General may refuse to approve the renewal application if NRA failed to fulfil the renewal requirement.
- 14.1.3.3. NRA whom his registration was not renewed, shall re-attend NRA course and pass the examination conducted by approved training providers before submitting new application for registration.
- 14.1.3.4. The Director General may revoke the registration of NRA before the expiry date of his registration, if:
 - (a) violate the work ethic and professionalism;
 - (b) failed to discharge his duties as NRA;
 - (c) registration was obtained by fraud or misrepresentation;
 - (d) declared bankrupt;
 - (e) convicted of an offence under the Occupational Safety and Health Act 1994 [Act 514] or any regulations made thereunder; or
 - (f) violate any of the terms or conditions of registration.
- 14.1.3.5. NRA whom his registration was revoked is not eligible to register as NRA for a period of three (3) years from the revocation date.

14.1.4. Processing fee

- 14.1.4.1. The new registration and renewal processing fee is RM100 for each application.

14.2. Audiometric test centre

14.2.1. Audiometric test centre shall fulfill the following requirement:

14.2.1.1. Static audiometric testing centre shall consist of facilities including:
(a) an adequately ventilated and illuminated audiometric test rooms;
(b) an audiometer with patient signal switch; and
(c) electrical voltage stabilizer.

14.2.1.2. Mobile audiometric testing centre shall consist of facilities including:
(a) an adequately ventilated and illuminated audiometric test rooms;
(b) an audiometer with patient signal switch;
(c) electrical voltage stabilizer;
(d) precision SLM Type/Class 1;
(e) sound calibrator Type/Class 1; and
(f) artificial ear set.

14.2.1.3. The facilities listed under paragraph 14.2.1.2. which were approved for a designated mobile audiometric test centre shall be used for that particular audiometric test centre only.

14.2.1.4. Measurement of the background sound pressure level (dB) in an audiometric test room shall be carried out to ensure it meets the Maximum Allowable Octave-Band Sound Pressure Level as specified in the **Table 14.1** as following:

Table 14.1: Maximum Allowable Octave-Band Sound Pressure Levels for audiometric test rooms

Octave-Band Centre Frequency (Hz)	500	1000	2000	4000	8000
Sound Pressure Level (dB)	27	30	32	42	45

14.2.1.5. The audiometer shall be calibrated to follow the requirements of ISO 389: Acoustics – Reference zero for the calibration of audiometric equipment.

14.2.1.6. The calibration requirements in paragraph 14.2.1.4. and 14.2.1.5. shall be conducted by audiometric calibration service provider at approved location by DOSH annually or as directed by the Director General.

- 14.2.1.7. The Precision SLM and sound calibrator Type/Class 1 shall be calibrated annually by the manufacturer or a laboratory accredited by Department of Standard Malaysia.
- 14.2.1.8. The Director General shall be notified of any changes regarding the approved audiometric test centre, including:
- (a) appointed audiometric technician;
 - (b) appointed OHD;
 - (c) owner of audiometric test centre;
 - (d) change in the location of static audiometric testing centre; and
 - (e) facilities of the Static and mobile audiometric testing centre.

14.2.2. Registration procedure

- 14.2.2.1. Application for registration shall be submitted to Director General with the copy of following items:
- (a) Static audiometric testing centre:
 - (i) design drawing and location plan of audiometric test room;
 - (ii) calibration report of audiometric test room and audiometer by audiometric calibration service provider;
 - (iii) training certificate of audiometric technician from supplier or any training provider recognized by DOSH;
 - (iv) OHD registration certificate;
 - (v) audiometric testing procedures including format of test results.
 - (vi) audiometric technician appointment letter; and
 - (vii) OHD appointment letter.
 - (b) Mobile audiometric testing centre:
 - (i) Vehicle Ownership Certificate as Mobile Services Clinic from Road and Transport Department;
 - (ii) audiometric test room design drawing endorsed by vehicle inspection company appointed by Malaysian Government;
 - (iii) valid calibration report for 'Precision Sound Level Meter Type/Class 1' and 'Sound Calibrator Type/Class 1' by manufacturer or laboratory accredited by Department of Standards Malaysia;
 - (iv) format calibration report of audiometric test room and audiometric measuring equipment;
 - (v) procedure to conduct measurement on background sound level in audiometric test room and calibration of audiometer;

- (vi) training certificate of a technician from supplier or any training provider recognized by DOSH;
- (vii) audiometric testing procedures including format of test results.
- (viii) OHD registration certificate;
- (ix) audiometric technician appointment letter; and
- (x) OHD appointment letter.

14.2.3. Registration renewal

14.2.3.1. Application for renewal shall be forwarded to Director General together with the copy of following items:

- (a) calibration report of audiometric test room and audiometer;
- (b) latest calibration report for 'Precision Sound Level Meter Type/Class 1', 'Sound Calibrator Type/Class 1' by manufacturer or laboratory accredited by Department of Standards Malaysia (for mobile audiometric testing centre);
- (c) additional related information as following: -
 - (i) OHD certificate and appointment letter;
 - (ii) audiometric technician appointment letter and his training certificate.

14.2.3.2. Application for registration renewal shall be submitted to the Director General at least one (1) month before the expiry date of the current registration.

14.2.4. Registration validity

14.2.4.1. Successful applicant will be registered for a maximum period of one (1) year provided that the calibration certificate is valid within the period.

14.2.4.2. The Director General may revoke the registration before its expiry date or refuse to renew the registration, if:

- (a) sound pressure levels in the audiometric test room exceed the Maximum Allowable Octave-Band Sound Pressure Levels for Audiometric Test Rooms;
- (b) location of static audiometric test room or audiometer has been changed/relocated without approval from Director General;
- (c) any facility of the audiometric test centre is not complying to the requirement in paragraph 14.2.1.1. or 14.2.1.2.;
- (d) the registration was obtained by fraud or misrepresentation; or

(e) audiometric test centre failed to discharge its duties.

15. DUTIES

15.1. Duties of designers

15.1.1. Designer shall:

- (a) have a basic understanding of noise control principles, noise specifications, transmission of noise and effects of noise;
- (b) obtain agreement with client on noise control and establish budget which allow for effective noise control at design stage;
- (c) be able to design internal and external noise controls by controlling at the source.
- (d) ensure that the manufacturer receives complete written instructions, specifications and drawings;
- (e) consider the effect of building reverberation, the building layout and the location of workstations on the noise levels of plant;
- (f) consider the transmission of noise through structures and ducts;
- (g) design for acoustical plant rooms and control rooms where appropriate;
- (h) design acoustic treatments for external environmental control in a way that will reduce internal noise and vice versa.

15.2. Duties of manufacturers

15.2.1. Manufacturers shall:

- (a) construct plant according to specifications and drawings provided by designer;
- (b) carry out tests to determine noise emission level by each plant. If noise exist, the following method should be considered to reduce noise emission level: -
 - (i) improve manufacturing tolerances, for example reduce speed of machinery, reduce the material falling distance;
 - (ii) use of more highly damped material;
 - (iii) application of acoustic damping, absorbing or barrier;
 - (iv) redesign the plant;
 - (v) other relevant noise control method.
- (c) provide adequate information to purchaser/employer as following: -
 - (i) the proper use or operation of the plant;
 - (ii) noise levels as results of the proper use or operation of the plant;
 - (iii) method used to reduce noise when operating plant;
 - (iv) design limitation;
 - (v) proper erection and installation of the plant; and

- (vi) the means of installation, maintenance and use of the plant that will enable it to generate the lowest practicable noise levels.

15.3. Duties of importers and suppliers

15.3.1. Importers and suppliers shall:

- (a) obtain relevant noise information from manufacturer for all plant supplied;
- (b) conduct noise testing if no data available in order to establish noise hazard information;
- (c) ensure that all plant is supplied complete with noise reducing equipment;
- (d) provide adequate information to purchaser/employer as following: -
 - (i) the proper use or operation of the plant;
 - (ii) noise levels as results of the proper use or operation of the plant;
 - (iii) method used to reduce noise when operating plant;
 - (iv) design limitation;
 - (v) proper erection and installation of the plant; and
 - (vi) the means of installation, maintenance and use of the plant that will enable it to generate the lowest practicable noise levels.

15.3.2. Guidance for designers, manufacturers, importers and suppliers on the presentation of information about noise levels generated by plant is provided in **Appendix 8**.

15.4. Duties of Noise Risk Assessor

15.4.1. Noise Risk Assessor shall:

- (a) conduct noise risk assessment at the place of work as required by the Occupational Safety and Health (Noise Exposure) Regulations 2019 within valid registration period;
- (b) ensure valid calibration of the noise measuring equipment used for noise risk assessment;
- (c) notify Director of the respective DOSH state at least 14 days before conducting any noise risk assessment;
- (d) complete and furnish a full report of the noise risk assessment to the employer within 30 days upon completion of the assessment;
- (e) present findings of the assessment and recommendations on noise control to the employer within 30 days upon completion of the assessment; and
- (f) submit noise risk assessment summary report (as per **Appendix 9**) to the Director General within 30 days upon completion of the assessment.

15.5. Duties of Hearing Conservation Administrator

- 15.5.1. The Hearing Conservation Administrator shall be responsible to assist the employer in the implementation of HCP at place of work. He shall possess good communication skills and be able to interact with the employees to discuss the noise problems and preventive measures or solutions.
- 15.5.2. The HCA shall coordinate all aspects of the program and possess basic knowledge on:
- (a) each component of HCP; and
 - (b) relevant provisions of the Act 514, Occupational Safety and Health (Noise Exposure) Regulations 2019 and ICOP for Management of Occupational Noise Exposure and Hearing Conservation 2019.
- 15.5.3. Duties of the HCA involve coordinating, monitoring its progress, assessing its performance, evaluating its effectiveness and reviewing it at regular intervals all the components of HCP.

15.6. Duties of Occupational Health Doctor

- 15.6.1. Occupational Health Doctor shall:
- (a) ensure the audiometric testing conducted by audiometric technician in accordance with the procedures and legal requirements;
 - (b) interpret audiograms and diagnose hearing disorders accordingly;
 - (c) notify occupational noise-related hearing disorders to the Director General;
 - (d) revise baseline audiogram of an employee if necessary;
 - (e) refer an employee with hearing disorder to establish diagnosis or for further treatment if needed and follow them up;
 - (f) instruct the employer to repeat the audiometric testing of an employee with STS within three (3) months from the date of previous audiometric test;
 - (g) perform medical examination for an employee with an abnormal audiogram;
 - (h) instruct the employer to refit and retrain in the use of PHP for an employee with hearing impairment, hearing loss or permanent STS;
 - (i) inform an employee with an abnormal audiogram regarding his condition and educate him on best practices to conserve hearing.

15.7. Duties of audiometric technician

- 15.7.1. Audiometric technician shall be under supervision by OHD. Audiometric technician shall:
- (a) conduct audiometric testing within the valid registration period of audiometric test centre;

- (b) ensure audiometers and related equipment are functioning properly;
- (c) collect information regarding a worker's conditions which may affect the test results and determining his fitness for the test;
- (d) visually examine worker's ears to look for signs of infection, excessive ear wax or any other physical condition that may affect the test;
- (e) describe the purpose and procedure of test;
- (f) perform audiometric test for each ear separately;
- (g) maintain a relevant record for each audiometer that includes calibration records;
- (h) ensure workers' medical information is kept confidential; and
- (i) provide other support services for OHD and related healthcare professionals.

15.8. Duties of audiometric test centre

15.8.1. Audiometric test centre shall:

- (a) make arrangement with employer with regards to audiometric testing program;
- (b) ensure audiometric testing conducted within the valid registration period of audiometric test centre;
- (c) ensure that the audiometric testing is only be carried out on employee after the employee is being put in a state of quiet of at least 14 hours without the aid of PHP;
- (d) notify at least two (2) weeks before conducting any audiometric testing program to Director of the respective DOSH state office;
- (e) submit a report of the result of audiometric testing to the employer within 30 days from the date of audiometric testing;
- (f) notify the Director General of any changes regarding the approved audiometric test centre, including:
 - (i) appointed audiometric technician;
 - (ii) appointed OHD;
 - (iii) owner of audiometric test centre;
 - (iv) change in the location of static audiometric testing centre;
 - (v) facilities of the static and mobile audiometric testing centre;
- (g) ensure regular maintenance and annual calibration of audiometric test centre facilities;
- (h) maintain a good recordkeeping of audiometric testing; and
- (i) submit a summary of all audiometric report for each calendar year to the Director General not later than 31st January of the following year.

NOISE HAZARD IDENTIFICATION CHECKLISTS

Organisation/Company Name: _____

DOSH registration number: _____

Nature of Activities/Business: _____

Work Area/Location/Plant/Process: _____

‘Yes’ to any of the following indicates the possibility of excessive noise.

Hazard Identification Questions	Yes	No
1. Is a raised voice needed to communicate with someone about one meter away?	<input type="checkbox"/>	<input type="checkbox"/>
2. Do your employees notice a reduction in hearing over the course of the day? Example: Need to turn up the radio on the way home, etc.	<input type="checkbox"/>	<input type="checkbox"/>
3. Are your employees using noisy powered tools or machinery? Example: Power tool/noisy machinery – drill, air compressor, etc.	<input type="checkbox"/>	<input type="checkbox"/>
4. Are there noises due to impacts-or explosive sources? Example: (a) noise due to impact – hammer, pneumatic impact tools (b) explosive source – explosive powered tools, detonators, etc.	<input type="checkbox"/>	<input type="checkbox"/>
5. Are personal hearing protectors (PHP) used for some work?	<input type="checkbox"/>	<input type="checkbox"/>
6. Do your workers 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 your workers experience ringing in the ears or sound heard differently in each ear?	<input type="checkbox"/>	<input type="checkbox"/>
8. Has any employee start experiencing difficulties in hearing after working here?	<input type="checkbox"/>	<input type="checkbox"/>

<p>9. Does any equipment have manufacturer's information (including labels) indicating noise levels greater than any of the following:</p> <p>(a) peak sound pressure level of 140dB(C)?</p> <p>(b) sound pressure level of 82dB(A)?</p>	<input type="checkbox"/>	<input type="checkbox"/>
<p>10. Is the latest noise risk assessment indicates exposure to Noise Exposure Limit?</p>	<input type="checkbox"/>	<input type="checkbox"/>

Assessed by: _____
(name & designation)

Verified by: _____
(employer's name)

Date: _____

Company's Stamp: _____

GUIDELINES ON NOISE RISK ASSESSMENT REPORT WRITING

A. NOISE RISK ASSESSMENT

The Occupational Safety and Health (Noise Exposure) Regulations 2019 requires employer to conduct noise risk assessment. The purpose is to determine whether any of his employees are exposed to excessive noise. Since this is a preliminary requirement to determine further compliance with the employee exposure monitoring requirements, Noise Risk Assessor (NRA) are reminded to conduct the noise risk assessment in all aspect with high degree of professionalism. Deviation from such ethical practice may result in the employer taking wrong course of action which may lead to repercussion in the future.

In order to avoid such incident, NRA shall be thorough in categorizing employees into similar exposure groups (SEG) and carefully selecting the high risk employee to represent the exposure for the group. The instrument used shall at all-time meet the specified level of accuracy while during monitoring adequate sampling time shall be taken to minimize the spasmodic variation in noise level. A repeat of the monitoring shall be carried out if the competent person feels that the results obtained are not representative.

B. TITLE PAGE

- Type of assessment;
- Name, address and DOSH registration number of the workplace;
- Name and registration number of the NRA;
- Date of assessment.

C. CONTENT

(a) Introduction

- Particular of the workplace:
 - (i) Name;
 - (ii) Address; and
 - (iii) DOSH registration number.
- Date of assessment;
- Name and registration number of NRA;
- The purpose of the assessment.

(b) Objective

- Relate to the purpose of assessment.

(c) Process Description

- Briefly describe the workplace process flowchart and description.

(d) Instrumentation

- List down the noise measuring equipment used, serial number and calibration validity period.

(e) Methodology

- Briefly describe procedure for:
 - (i) Area Monitoring:
 - Noise mapping (zoning);
 - Type of noise (steady, impulse, fluctuate etc.).
 - (ii) Personal Monitoring:
 - Identify of all employees in the workplace according to job classification;
 - Identification of SEG;
 - Justification of employee’s selection for assessment;
 - Number of employees monitored and justification;
 - An explanation of the personal monitoring procedures;
 - Sampling duration;
 - Working hours and number of shift;
 - Type of exposure (steady, impulse, fluctuate etc.).

(f) Result

- Summary of monitoring data in tabulated form
 - (i) Area Monitoring;

Table A1: Result of area monitoring

Working Area	Job Specification & Task	Number of Employees	Number of Employees Monitored	Source of Noise	Type of Noise	Noise Level

Result of area monitoring shall be illustrated by noise mapping in the form of colour zone as shown below:

Noise mapping colour zone

Sound Pressure Level	Colour zone
> 140dB(C)	Purple
> 115dB(A)	
> 85dB(A) to 115dB(A)	Red
> 82 dB(A) to 85dB(A)	Yellow
≤ 82dB(A)	White

(ii) Personal Monitoring;

Table A2: Result of personal monitoring

SEG	Employee Name	Working Area	Sampling Duration	Dose _{Te} %	L _{eqTe}	L _{EX,8h}	Max Level	Peak Level

(g) Discussions

- Existing control measures, if any;
- Comment on noise mapping;
- Comment on any result exceeding or below than excessive noise and NEL (Maximum Level, Peak and Daily Noise Exposure Level);
- Contribution factors for result exceeding or below than excessive noise, and NEL (Maximum Level, Peak and Daily Noise Exposure Level).

(h) Recommendations

- Recommendations shall be presented in **Table A3** as following;

Table A3: Recommendations of control measure

SEG	L _{EX,8h}	Max Level	Peak Level	Noise source	Type of control measure	Existing control measure	Recommended control measure ¹
					Engineering		
					Administrative		
					PHP		
					Others		

Note: ¹ Please state the references

- Recommendations in **Table A3** shall be specific to the SEG's area of work, for example: -
 - Describe specific methods of engineering control based on engineering control principles of absorption, insulation, damper, silencer and vibration isolation;
 - Noise reduction rating (NRR) required for personal hearing protectors (PHP);
 - daily exposure duration limit for employee job rotation.

- Besides that, recommendations shall also include other provisions of the regulations to be complied, such as: -
 - employees to be placed on an audiometric testing program;
 - employees to be given information, instruction and training on hearing conservation program (HCP);
 - areas to be posted with warning signs (HEARING PROTECTION ZONES) and the requirement to wear PHP.

(i) Conclusion

(j) Signature, Name and Registration Number of the Noise Risk Assessor (NRA)

(k) Appendix

- Process flowchart;
- Layout plan for machinery and employees;
- Noise mapping;
- Data sheet and calculation;
- Computer print-out detail results of measurement;
- A latest copy of instrumentation calibration certificate;
- A copy of NRA certificate;
- Form A – Employer's confirmation that report has been presented.

DATA SHEET: PERSONAL NOISE EXPOSURE MONITORING

Name of Workplace:

Date of Assessment:

Employee Data	General Information
Name: I/C Number: Age: Designation: Working Area: Working Duration: Break: Effective duration of working day:	Job Description: Remarks: Wearing any PHP: YES / NO Type: NRR of existing PHP: No. of employees in the SEG:
Sampling Data	Result
Dosimeter Serial No.: Initial calibration (dB): Time start: Time stop: Pause time: Run time: Final calibration (dB):	Peak level, dB: Max level, dB (A): A-weighted equivalent continuous sound pressure level for the effective duration of the working day, L_{eqTe} : $L_{EX, 8h}$: Dose _(T) hours (%):

$$L_{EX,8h} = L_{eqTe} + 10 \lg \left(\frac{T_e}{T_0} \right) \text{ dB(A)}$$

$$\text{Dose} = 100 \times \frac{T}{8} \times 10^{\frac{L_{eq}-85}{10}} \%$$

Results:

Exceed excessive noise of 82dB(A) = YES / NO

Daily noise exposure level exceeds 85dB(A) = YES / NO

Exceed Max Level: YES / NO

Exceed Peak Level: YES / NO

Date :

Workplace :
.....
.....

Contact Person:

Ref: REPORT ON NOISE RISK ASSESSMENT

This is to certify that noise risk assessment for the above premise has been **conducted and report has been presented** to the top management and Safety and Health Committee members on the

2. Noise Risk Assessor appointed shall: -
 - (a) complete and furnish a full report of the noise risk assessment to the employer within thirty (30) days upon completion of the assessment;
 - (b) present findings of the assessment and recommendations on noise control to the employer within thirty (30) days upon completion of the assessment; and
3. The employer has to take action to control exposure **within thirty (30) days upon receiving the assessment report** if the assessment report indicates the employee exposed to excessive noise.
4. The employer shall inform DOSH state office on the action taken within 30 days.

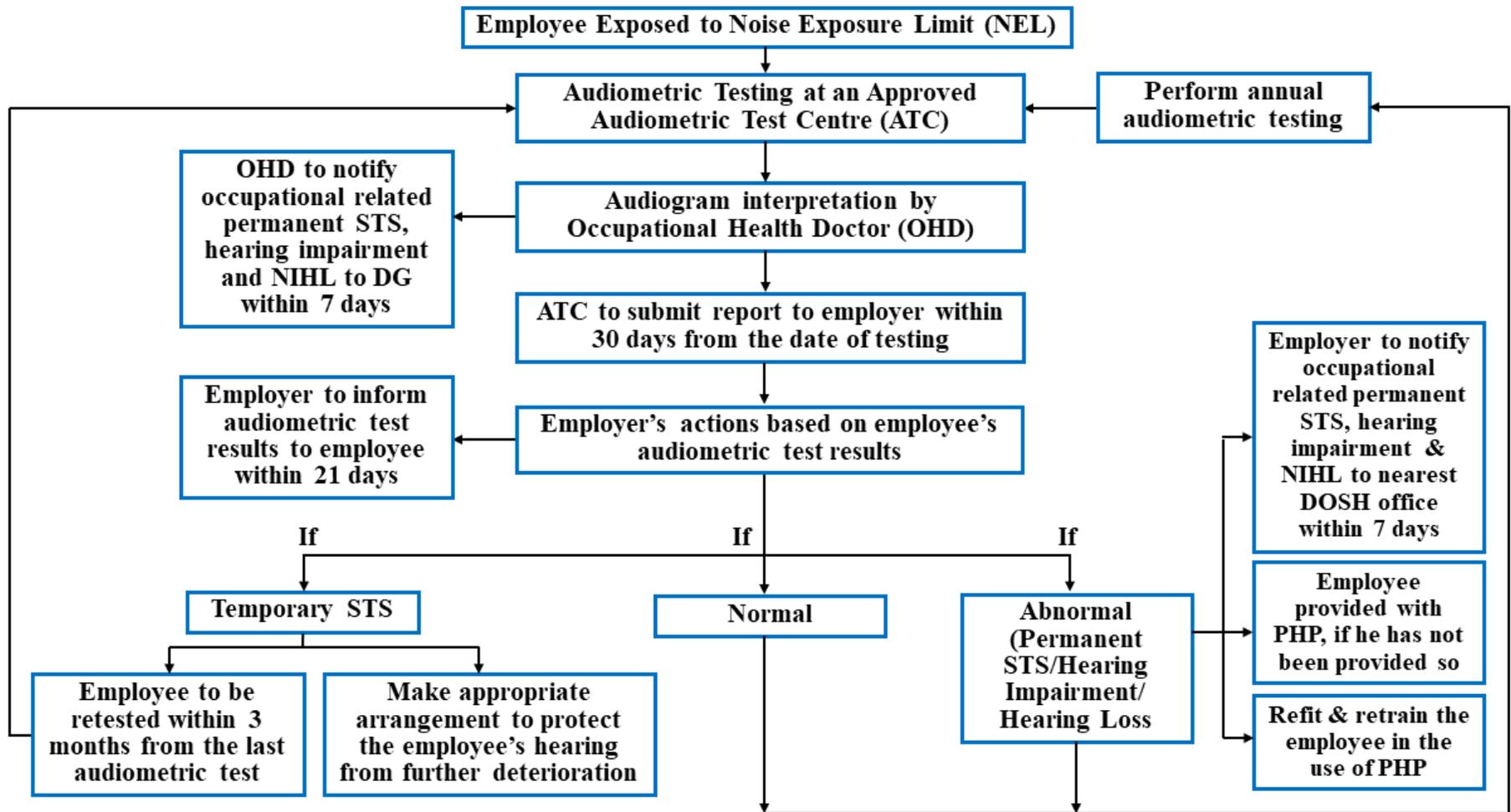
.....
Signature of Noise Risk Assessor
Registration No.:

Date of Assessment: From to

Assessment Report Received by:

Name :
Designation :
Date of receipt report :
Signature :

AUDIOMETRIC TESTING FLOW CHART

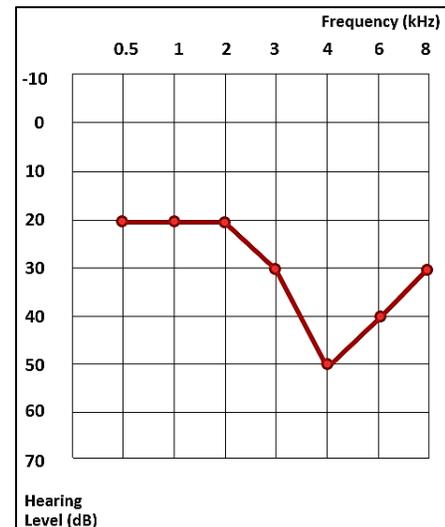


QUESTIONNAIRE FORM FOR AUDIOMETRIC TESTING	
NAME : _____ AGE : _____ IC/PASSPORT NO.: _____	SEX : Male (<input type="checkbox"/>) / Female (<input type="checkbox"/>) COMPANY : _____ SECTION : _____
<p>CAUTION: Do not proceed with audiometric testing if the worker has conditions that may affect the test results (Example: cold, giddiness, tinnitus etc.).</p> <p>Please tick <input checked="" type="checkbox"/> whichever relevant.</p> <p>1. Were you exposed to loud noise within 14 hours prior to today's test? YES <input type="checkbox"/> NO <input type="checkbox"/></p> <p>CAUTION: If "YES", please abort and reschedule testing with an advice to avoid loud noise 14 hours prior to test.</p>	<p>9. Do you play loud musical instruments? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____</p> <p>10. Have you worked in noisy jobs in the past? (jobs where you had communication difficulty due to noise)? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____</p> <p>11. Were you wearing personal hearing protectors (PHP) at that time (referring to Q10)? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, type of PHP : _____</p> <p>12. Have you had an audiometric test before? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, when: _____ and where : _____</p> <p>NOTE: An answer of "YES" for Q2-Q6, "MORE THAN ONCE A YEAR" for Q7, "MORE THAN 2 HOURS PER WEEK" for Q8, "ROCK BAND/SYMPHONY ORCHESTRA" for Q9 and its' significance may indicate on how the test results will be interpreted. Question 10, 11 and 12 are meant to reflect a suspicion of a pre-existing hearing disorder and the worker's knowledge about audiometric testing.</p> <p>NORMAL <input type="checkbox"/> ABNORMAL <input type="checkbox"/> If YES, please detail: _____</p> <p>CAUTION: The audiometric testing shall be aborted and rescheduled if any significant abnormality detected in the visual examination of the ear (e.g.: active ear discharge/excessive cerumen/ wax impaction etc.). A referral to a doctor for further intervention may be necessary before repeating the test.</p> <p>NOTE: Please explain clearly the audiometric testing procedure to the worker. This form is to be compiled with the audiometric report for review by the OHD.</p> <p><u>AUDIOMETRIC TECHNICIAN</u></p> <p>SIGNATURE : _____</p> <p>NAME : _____</p> <p style="text-align: right; font-size: small;">[Adapted from: Annex A of ISO 389-9: 2009 (E)]</p>
<p>2. Have you suffered any illness that has affected your hearing (e.g.: infection, tinnitus, discharge etc.)? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____</p> <p>3. Have you ever had an ear operation or any other major operation that affected your hearing? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____</p> <p>4. Have you ever taken any medication (tablets or injections) that affected your hearing? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____ (e.g.: chainsaw, firecrackers, explosion, gunfire, motorcycles)? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, what kind: _____ and how often : _____</p> <p>6. Any family history of hearing loss/disorders? YES <input type="checkbox"/> NO <input type="checkbox"/> If YES, please detail: _____</p> <p>7. Do you attend night clubs/pubs/discotheques or pop/rock concerts? NEVER <input type="checkbox"/> ONCE A YEAR <input type="checkbox"/> MORE THAN ONCE A YEAR <input type="checkbox"/></p> <p>8. Do you use a personal stereo (e.g.: walkman/ iPod)? NEVER <input type="checkbox"/> LESS THAN 2 HOURS PER WEEK <input type="checkbox"/> MORE THAN 2 HOURS PER WEEK <input type="checkbox"/></p>	

GUIDANCE NOTE FOR OCCUPATIONAL NOISE-RELATED HEARING DISORDERS**1. Noise-Induced Hearing Loss (NIHL)**

Noise-induced hearing loss has the following characteristics: -

- i. The cochlear hair cells in the inner ear are mainly affected, thus NIHL is **always sensorineural and irreversible**.
- ii. It is **typically bilateral** (most noise exposures are symmetrical). An unilateral hearing loss may be caused by factors such as exposure to firearms noise with head shadowing effect, blast of explosives, unilateral or greater conductive hearing loss in one ear ('protective effect' against exposure to excessive noise), unilaterally poorly fitted hearing protection or genuine asymmetrical noise exposure (an employee may be exposed to noise from machines placed nearer to one side of his ear or an ambulance driver may experience unilateral hearing loss due to siren noise exposure to the affected ear).
- iii. The first sign of NIHL is a **"notch"** at 3000, 4000 or 6000 Hz with recovery at 8000 Hz. This notch initially develops at one frequency of **3000, 4000 or 6000 Hz and affects adjacent frequencies** with continued noise exposure. This notch gradually deepens and widens as exposure continues.
- iv. In early NIHL, the average hearing thresholds at the lower frequencies of 500, 1000, and 2000 Hz are better than the average thresholds at 3000, 4000 and 6000 Hz and the **hearing level at 8000 Hz is usually better than the deepest part of the notch**.
- v. **Hearing loss greater than 75 dB in high frequencies and greater than 40 dB in lower frequencies** is not usually caused by noise exposure alone.
- vi. Hearing loss due to noise exposure increases most rapidly **during the first 10 to 15 years of exposure**, then the hearing loss rate decelerates as the hearing threshold increases.
- vii. **The risk of NIHL is felt to be low at exposures below 85 dB** (8-hour time-weighted average) but increases significantly as exposures rise above this level.



2. Hearing Impairment (HI)

Hearing impairment is defined as **the arithmetic average of the permanent hearing threshold level of an employee at 500, 1000, 2000 and 3000 Hz which is shifted by 25 dB or more compared to the standard audiometric reference level.** This standard audiometric reference level is 0. **A baseline audiogram is not necessary** to determine hearing impairment as there are no differences in hearing threshold level calculated from the baseline audiogram. An example of hearing impairment calculation is shown below: -

- (a) Results of an employee's annual audiogram threshold values are shown by the table below (right ear only): -

Frequency (Hz)	Annual audiogram threshold (dB)
500	20
1000	35
2000	30
3000	30
4000	40
6000	35
8000	25

(Note: all threshold values are for illustrative purposes only)

- (b) Calculating the arithmetic average of the permanent hearing threshold level at 500, 1000, 2000 and 3000 Hz frequencies.

$$\text{Arithmetic average} = \frac{[20 + 35 + 30 + 30]}{4} = \underline{28.8 \text{ dB}}$$

- (c) Conclusion: Hearing impairment has occurred over the right ear as the arithmetic average is more than 25 dB. Similar calculation need to be applied to determine hearing impairment for the left ear.

3. Standard Threshold Shift (STS)

A standard threshold shift (STS) is a **change in the hearing threshold compared to the baseline audiogram of an average of 10 dB or more at 2000, 3000 and 4000 Hz**. A standard threshold shift may be **temporary** or **permanent** in nature. A temporary standard threshold shift is known as auditory fatigue where the shifted hearing threshold shows progressive reduction (improvement in hearing threshold) with the passage of time when the employee is no longer exposed to noise. A permanent standard threshold shift (PSTS) is irreversible and remains throughout the life time of the affected employee. The presence of a temporary threshold shift is a **risk indicator that permanent NIHL** will likely occur if noise exposure continues. Each employee's audiogram must be compared to their baseline audiogram to determine if a standard threshold shift has occurred. Examples of STS calculation are shown below: -

Example 1

(a) Results of an employee's audiogram threshold values are shown by the table below (right ear only): -

Frequency (Hz)	Baseline audiogram threshold (dB)	Annual audiogram threshold (dB)	Difference
500	5	5	0
1000	5	5	0
2000	0	10	+10
3000	10	25	+15
4000	15	35	+20
6000	10	15	+5
8000	10	15	+5

(Note: all threshold values are for illustrative purposes only)

(b) There are changes in hearing threshold of 10, 15 and 20 dB respectively at 2000, 3000 and 4000 Hz frequencies.

(c) Calculating the average changes in threshold at 2000, 3000, and 4000 Hz frequencies

$$\text{Average shift} = \frac{[10 + 15 + 20]}{3} = \underline{15 \text{ dB}}$$

(d) The STS is +15dB; hearing has deteriorated over the right ear (depending on professional discretion, the baseline audiogram should be revised if persistent after retest). Similar calculation need to be applied to determine standard threshold shift for the left ear.

Example 2

(a) Results of an employee’s audiogram threshold values is shown by the table below (right ear only): -

Frequency (Hz)	Baseline audiogram threshold (dB)	Annual audiogram threshold (dB)	Difference
500	5	5	0
1000	5	0	-5
2000	0	-10	-10
3000	5	-10	-15
4000	10	0	-10
6000	10	5	-5
8000	5	5	0

(Note: all threshold values are for illustrative purposes only)

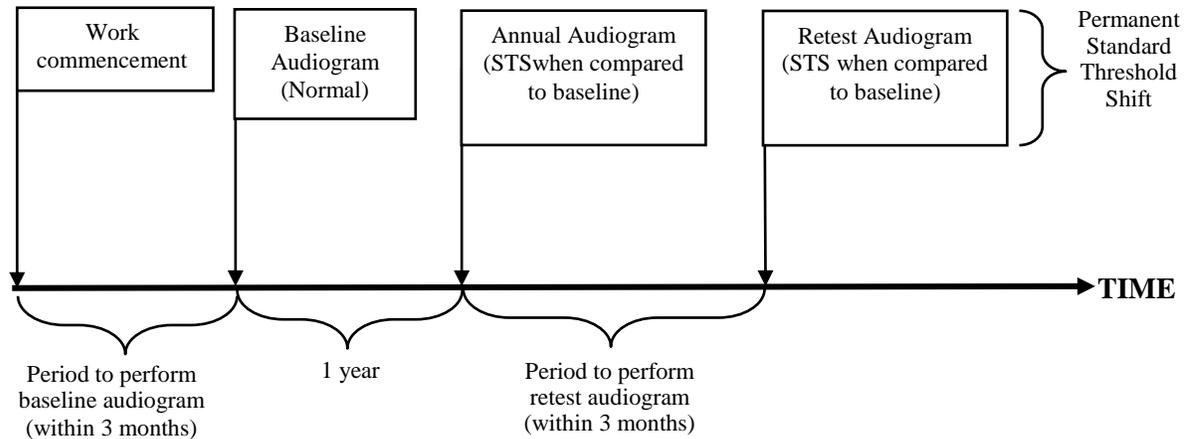
(b) There are changes in hearing threshold of -10, -15 and -10 dB respectively at 2000, 3000 and 4000 Hz frequencies

(c) Calculating the average changes in threshold at 2000, 3000, and 4000 Hz frequencies

$$\text{Average shift} = \frac{[(-10)+(-15)+(-10)]}{3} = \underline{-11.7 \text{ dB}}$$

(d) The STS is -11.7 dB; hearing has “improved” (depending on professional discretion, the baseline audiogram should be revised if persistent after retest). Similar calculation need to be applied to determine standard threshold shift for the left ear.

A permanent standard threshold shift is determined by the **persistence of a standard threshold shift in a retest audiogram** within an interval of 3 months. The diagram below explains this condition:



Age adjustment/correction factors are not required to be applied for the purpose of determining occupational noise-related PSTS, hearing impairment and NIHL that shall be notified to the Director General or nearest DOSH office.

REFERENCES

1. "BC Diseases News" (n.d.) describes asymmetrical hearing loss and noise exposure. Retrieved from <https://www.bc-legal.co.uk/bc-disease-news/item/asymmetrical-hearing-loss-and-noise-audiogramexposure.html>
2. Le, T. N., Straatman, L. V., Lea, J., & Westerberg, B. (2017). Current insights in noise-induced hearing loss: a literature review of the underlying mechanism, pathophysiology, asymmetry, and management options. *Journal of Otolaryngology-Head & Neck Surgery*, 46(1), 41.
3. Maltby, M. (2007). *Occupational Audiometry*. Routledge.
4. Mirza, R., Kirchner, D. B., Dobie, R. A., Crawford, J., & ACOEM Task Force on Occupational Hearing Loss. (2018). Occupational noise-induced hearing loss. *Journal of occupational and environmental medicine*, 60(9), e498-e501.
5. Morata, T.C., Byrne, D.C., Rabinowitz, P.M. (2011). Noise exposure and hearing disorders. In Levy, B. S., Wegman, D. H., Baron, S. L., & Sokas, R. K. (Eds.), *Occupational and Environmental Health* (6th ed., pp.461-473). New York, NY: Oxford University Press.
6. Occupational Safety and Health Administration. *Appendix IV: A. Audiometric testing program, Noise and Hearing Conservation Technical Manual*. Retrieved from https://www.osha.gov/dts/osta/otm/noise/hcp/audiometric_testing.html#sts.
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REPORT FOR OCCUPATIONAL DISEASES/POISONINGS
INFORMATION REQUIRED FOR NOISE RELATED HEARING DISORDERS

(This report is required to be attached with notification form)

PART A : EMPLOYEE DETAILS	
Name :	Age :
IC/Passport No. :	Sex :
Nationality :	Job Title :
Company :	Work Unit :

Please fill or tick whichever relevant

PART B : MEDICAL HISTORY	
Personal Exposure Monitoring :	_____ dB(A); Date of Monitoring: ___/___/___ <i>[Please refer to personal exposure monitoring of individual/similar exposure group (SEG) in the Noise Risk Assessment Report]</i>
Current Illness (Symptoms) :	_____
Smoking :	Yes <input type="checkbox"/> , _____ Pack-years No <input type="checkbox"/>
Past ear disease e.g. Infection, discharge :	Yes <input type="checkbox"/> , Please specify: _____ No <input type="checkbox"/>
Past head injury/ accident/ surgery :	Yes <input type="checkbox"/> , Please specify: _____ No <input type="checkbox"/>
Past medical history :	Yes <input type="checkbox"/> , Please specify: _____ No <input type="checkbox"/>
Ototoxic medications/ chemical exposure :	Yes <input type="checkbox"/> , Please specify: _____ No <input type="checkbox"/>
Hobbies with noise exposure & significance :	Diving <input type="checkbox"/> , _____ Karaoke <input type="checkbox"/> , _____ Loud music <input type="checkbox"/> , _____ Shooting <input type="checkbox"/> , _____ Musical Instrument <input type="checkbox"/> , _____ Others <input type="checkbox"/> , _____ _____
Use of personal hearing protectors (PHP) :	Ear Plug <input type="checkbox"/> Combination <input type="checkbox"/> Ear Muff <input type="checkbox"/> None <input type="checkbox"/>

PART C : PHYSICAL EXAMINATION	
External Ear :	Normal <input type="checkbox"/> Abnormal <input type="checkbox"/> , Please specify: _____
Middle Ear (Otoscopy) :	Normal <input type="checkbox"/> Abnormal <input type="checkbox"/> , Please specify: _____

Tuning Fork Test WEBER <i>Centralization (Midline)</i> : <input type="checkbox"/> <i>Lateralization</i> To Left Ear : <input type="checkbox"/> To Right Ear : <input type="checkbox"/>		RINNE Left Ear : Positive <input type="checkbox"/> Negative <input type="checkbox"/> Right Ear : Positive <input type="checkbox"/> Negative <input type="checkbox"/>	
Impression :		Conductive Hearing Loss <input type="checkbox"/> Sensorineural Hearing Loss <input type="checkbox"/> Mixed Hearing Loss <input type="checkbox"/>	

PART D : CONCLUSION			
Conclusion : <i>[Please refer Current & Baseline Audiometric Report and Questionnaire Form for Audiometric Testing]</i>	Occupational Hearing Impairment		<input type="checkbox"/>
	Occupational Permanent Standard Threshold Shift		<input type="checkbox"/>
	Occupational Noise-Induced Hearing Loss		<input type="checkbox"/>
	Age-related Hearing Loss (Presbycusis)		<input type="checkbox"/>
	Others: _____		

PART E : RECOMMENDATIONS	
Repeat audiometry after treatment	<input type="checkbox"/>
Continue annual audiometry	<input type="checkbox"/>
Education & training	<input type="checkbox"/>
Provision of PHP	<input type="checkbox"/>
Referral to specialist for further management	<input type="checkbox"/>
Notification to DOSH	<input type="checkbox"/>
Others: _____	

PART F : REMARKS	
Note/Comments: <hr/> <hr/> <hr/> <hr/>	

Name, Signature & Stamp of OHD:

Date:

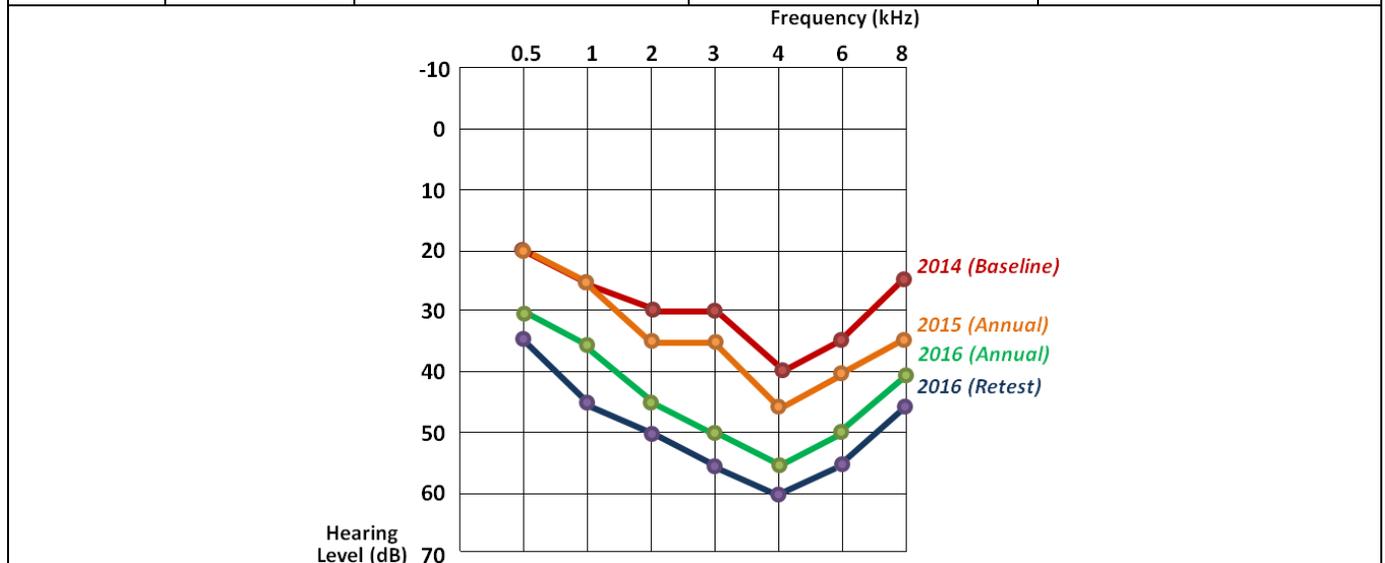
I acknowledge that the doctor attending me has explained the results of above examinations and their implications and I hereby authorize the doctor to disclose the information in this form to my employer/ representative & DOSH if necessary	
Employee Signature	:
Name	:
IC / Passport No.	:
Date	:

**NOTIFICATION OF OCCUPATIONAL NOISE-RELATED HEARING DISORDER AT
BASELINE AUDIOMETRIC TESTING AND REPEATED CASES**

8.1 Illustrative Example of Occupational Noise-Related Hearing Disorder at Baseline Audiometry.

Year	2014	2015		2016			
Frequency (Hz)	Baseline audiogram threshold (dB) (within 3 months of commencing work)	2015 Annual audiogram threshold (dB)	Changes of threshold between annual and baseline (2014)	2016 Annual audiogram threshold (dB)	Changes of threshold between annual and baseline (2014)	2016 Retest audiogram threshold (dB) (within 3 months of 2016 annual audiogram)	Changes of threshold between retest and baseline (2014)
500	20	20	0	30	+10	35	+15
1,000	25	25	0	35	+10	45	+20
2,000	30	35	+5	45	+15	50	+20
3,000	30	35	+5	50	+20	55	+25
4,000	40	45	+5	55	+15	60	+20
6,000	35	40	+5	50	+15	55	+20
8,000	25	35	+10	40	+15	45	+20

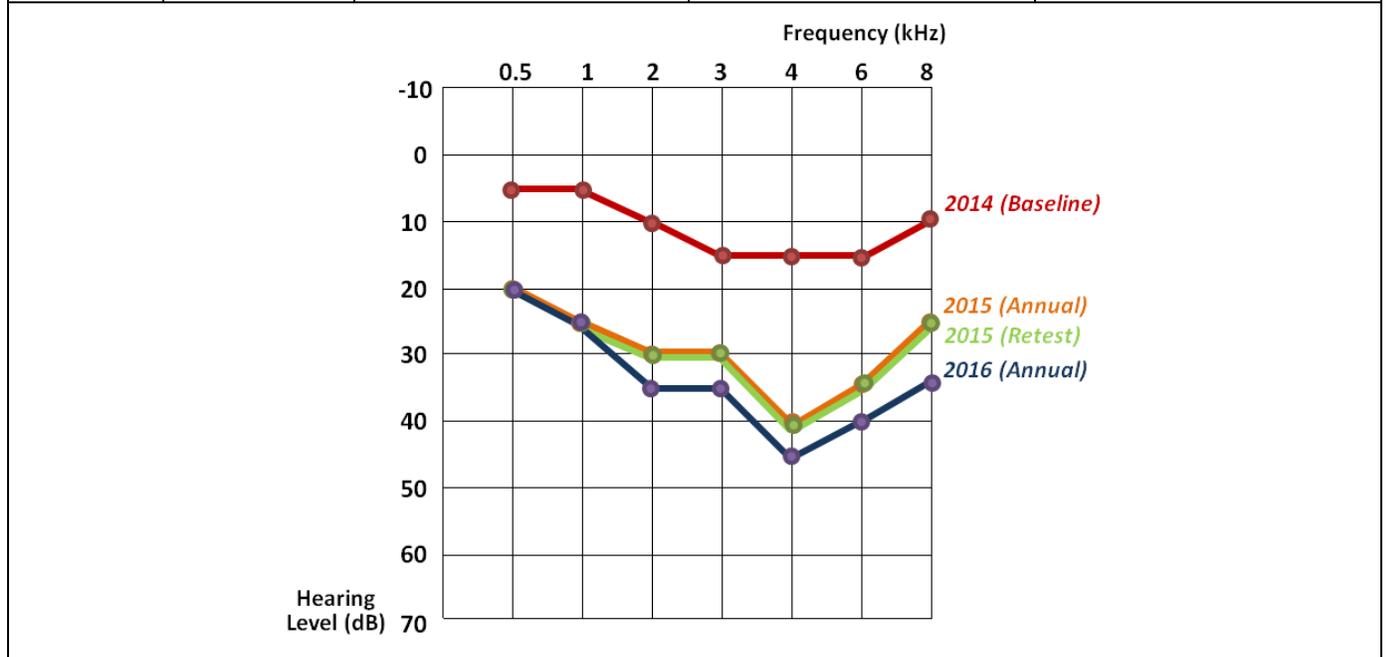
HI (Arit. Average)	Yes (26.3)	Yes (28.8)	—	Yes (40.0)	—	Yes (46.3)	—
STS(Ave. Shift)	—	No (5.0)		Yes (16.7)		—	—
PSTS(Ave. Shift)	—	—	—	—	—	Yes (21.7)	
NIHL (Pattern)	Yes (Notching at 4kHz with recovery)	Yes (Notching at 4kHz with recovery)	—	Yes (Notching at 4kHz with recovery)	—	Yes (Notching at 4kHz with recovery)	—
Revision of Baseline	—	No		—		Yes (Baseline thresholds revised to 2016 retest audiogram as PSTS occurred)	
Notification to DOSH	Not required (unable to establish current work relationship)	Not required (no significant change in the hearing threshold)		Not required (need to confirm PSTS first)		Required (NIHL + Hearing Impairment + PSTS)	



8.2 Illustrative Example of Repeated Cases of Occupational Noise-Related Hearing Disorder.

Year	2014	2015				2016	
Frequency (Hz)	2014 Baseline audiogram threshold (dB) (within 3 months of commencing work)	2015 Annual audiogram threshold (dB)	Changes of threshold between annual and baseline (2014)	2015 Retest audiogram threshold (dB) (within 3 months of 2015 annual audiogram)	Changes of threshold between retest and baseline (2014)	2016 Annual audiogram threshold (dB)	Changes of threshold between 2016 annual and baseline (2015)
500	5	20	+15	20	+15	20	0
1,000	5	25	+20	25	+20	25	0
2,000	10	30	+20	30	+20	35	+5
3,000	15	30	+15	30	+15	35	+5
4,000	15	40	+25	40	+25	45	+5
6,000	15	35	+20	35	+20	40	+5
8,000	10	25	+15	25	+15	35	+10

HI (Arit. Average)	No (8.8)	Yes (26.3)	—	Yes (26.3)	—	Yes (28.8)	—
STS (Ave. Shift)	—	Yes (20.0)		—	—	No (5.0)	
PSTS (Ave. Shift)	—	—	—	Yes (20.0)		—	—
NIHL (Pattern)	—	Yes (Notching at 4kHz with recovery)	—	Yes (Notching at 4kHz with recovery)	—	Yes (Notching at 4kHz with recovery)	—
Revision of Baseline	—	—		Yes (Baseline thresholds revised to 2015 audiogram as PSTS occurred)		—	
Notification to DOSH	—	Deferred (to confirm PSTS first)		Required (NIHL + Hearing Impairment + PSTS)		Not required (no significant change in the hearing threshold)	



**GUIDANCE FOR DESIGNERS, MANUFACTURERS, IMPORTERS AND SUPPLIERS ON
THE PRESENTATION OF INFORMATION ABOUT NOISE LEVELS GENERATED BY
PLANT**

1. Purpose

The purposes of this guidance material are:

- (a) To assist designers, manufacturers, importers and suppliers in providing appropriate and adequate information on noise levels generated by plant;
- (b) To assist purchasers to make an informed choice when purchasing plant, by being able to assess and, where possible, compare suppliers' noise level information. This information will usually be obtained from tests under standardized conditions. The plant may, however, generate different noise levels in the workplace and it is the responsibility of the employer purchasing the plant to assess noise levels in the workplace. The purchase of plant shall occur through the consultative mechanisms in the place of work, as part of a strategy to reduce noise levels in the place of work.

2. Appropriate and adequate information on noise

- (a) Obtained according to good measurement practice as defined in any relevant general international standard. This ensures a reasonable standard of accuracy;
- (b) Presented in a clear, understandable format;
- (c) Complete and unambiguous technical information;
- (d) Noise likely to be emitted by plant under typical conditions of usage.

3. Minimum Information

The minimum noise level information which shall be supplied to the purchaser is listed below:

- (a) **Supplier's details** (for example, name, local address, telephone and/or fax number, e-mail).
- (b) **Manufacturer's details** (for example, name, address, telephone and/or fax number, e-mail).
- (c) **Details of the plant tested** (including any noise controls, for example, make, model, serial number, relevant capacity/rating).
- (d) **Sound pressure level or sound power level.**
- (e) **Date issued.**

The manufacturer/supplier when requested, shall provide a full test report consisting information similar in paragraph 3(a) – 3(e)above, and additional information as below:

- (a) **Title or number of specific test standard or code followed** (if any) and details of any departures from the standard. For example, if a machine needed to be mounted differently to the method given in the standard, the alternative mounting should be described.
- (b) **Details of operating conditions** if not specified in the standard, or if no specific test standard is available for the type of plant being tested. For example, test machine load, speed, type of material processed, details of installation and mounting of test machine, details of test environment, description of measurement instrumentation and procedure. Reference to a test report containing this information will suffice.
- (c) **Measurement position(s)** (for example, operator's ear position or 1 metre from machines).
- (d) **Frequency weighting** (for example, A, C or linear).
- (e) **Time weighting** (for example, slow, fast or impulse)

NOISE RISK ASSESSMENT SUMMARY REPORT

Name of Noise Risk Assessor		Competent Person Registration No	
Name of Workplace		Report Reference No. / ID	
Workplace's Address		Date of Assessment	<i>Start:</i> <i>End:</i>

SEG	Work Area /Section	Number of Employees Exposed	Noise Source	Area Monitoring Results	Personal Monitoring Results			Control Measures		
					L _{EX,8h}	Peak Level	Maximum Level	Type	Existing	Recommendations by NRA
								Engineering		
								Administrative		
								Hearing Protectors		
								Others		
								Engineering		
								Administrative		
								Hearing Protectors		
								Others		

