

PETRONAS TECHNICAL STANDARDS
HEALTH, SAFETY AND ENVIRONMENT

HEARING CONSERVATION PROGRAM
(GUIDELINE)

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PREFACE

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AMENDMENTS RECORD SHEET

Chap No.	Sect No.	Description	Issue No.	Date	Rev No.	Date	App by: (initial)
All	All	PTS 60.066 Noise	1	Jan 2005	0	0	IGA

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1. BACKGROUND

This PTS on "Hearing Conservation Program" has been developed to assist PETRONAS OPU/JV in the development, implementation and management of an effective hearing conservation program. It sets the standards for hearing conservation and outlines the essential elements of such program.

Noise is a common hazard and can be found in many workplaces. Over exposure to noise can lead to noise induced hearing loss, a condition that is irreversible and may reduce the quality of life of the affected worker. Thus, it is important for the employer to manage the hazards relating to noise so as to protect the health and welfare of its employees so far as reasonably practicable. Noise induced hearing loss remains a major health risk associated with specific PETRONAS OPU/JV operations.

In Malaysia, Factories and Machinery (Noise Exposure) Regulations 1989 is the applicable legal requirement subjected to noise. The noise limits specified under these regulations as in Part II are as follow:-

- Equivalent continuous sound level for 8-hour shift not exceeding 90 dB(A).
- Noise level not exceeding 115 dB(A) at any time.
- Impulsive noise not exceeding a peak sound pressure level of 140 dB.

The applicable legal limits to PETRONAS operations elsewhere is discussed in Section 3.

Hearing loss as a result of noise is determined by an individual's personal susceptibility and exposure, at work and elsewhere. This Guide therefore includes recommendations for the protection of hearing by:

- limitation of personal noise dose at work,
- identification of susceptible individuals.

These measures obviously cannot control exposure to noise outside of work and the recommended limits, therefore, cannot guarantee absolute protection. The Guide takes into account the most recent recommendations of the International Organization for Standardization (ISO).

2. INTRODUCTION TO NOISE

The word "noise" is often used to describe unwanted sound. The properties of sound can be given objectively in physical terms. Reactions of persons to noise, such as being annoyed, are mostly subjective and therefore difficult to predict; what sounds like music to one is noise to another. Very loud noise may not only be annoying but dangerous; it may damage the ear.

Sound travels through the air with a speed of approximately 344 m/s, depending on the temperature of the air.

Two main quantities are used to describe the nature of any particular sound - amplitude, which refers to the amount of sound and frequency, relating to the character of the sound. The amount of noise is described differently at the source side (in terms of sound power) and at the receiver (in terms of sound pressure).

2.1 Terminology

Some of the important terminology in the noise discussions is as follows:

- Sound power – Rate of production of acoustic energy
- Sound pressure – Pressure deviation from the local ambient pressure caused by a sound wave. The human ear can detect sound pressures over a range from 20 μPa to 20 Pascal (0.2×10^{-9} bar to 0.2×10^{-3} bar)
- Decibel – A logarithmic unit of measurement that expresses the magnitude of a physical quantity (usually power) relative to a specified or implied reference level
- Frequency – the number of cycles per second, expressed as Hertz (abbreviated to Hz)
- Equivalent sound pressure level – is the value of the sound pressure level of a continuous steady sound that, over a specified time, has the same mean square sound pressure as the sound under consideration whose level may vary with time
- Noise dose – Defined as the A-weighted equivalent sound pressure level received by a person over a specified period (usually an 8-hour working day)

The ear recognizes as tones periodic pressure fluctuations, which repeat themselves every cycle. The frequency of the sound is the number of cycles per second, expressed as Hertz (abbreviated to Hz).

The normal range of hearing in-healthy young adults varies somewhat, but generally pressure fluctuations are audible when their frequency lies between 16 Hz and 16,000 Hz. The principal range of human conversational frequencies is from 350 Hz to 3,500 Hz.

The human ear is not equally sensitive to all audible frequencies. It is most sensitive to frequencies between 1000 and 4000 Hz. Above and below this range it gradually becomes less sensitive. In order to make the reading of the sound level meter correspond somewhat to normal hearing, therefore, internationally standardized filters are employed, which are designed to filter approximately as the ear does.

The characteristics of the so-called A, B, C, and D filters are shown in Figure 1. Historically these various filters were each intended for use in a specific interval of sound levels. This was considered necessary since the characteristics of the ear also change with the level of sound. In practice, the B and D filters are hardly ever used for the evaluation of industrial noise. The A filter is now in general use for all levels of sound. The C filter finds some application in conjunction with the A filter, as a rough guide to the predominance of high or low frequencies. All filters can be used for both sound pressure levels and sound power levels which are then quoted as dB (A), dB (C) etc.

The "A-weighted sound pressure level" is commonly called the "noise level" and this convention is followed in this Guide.

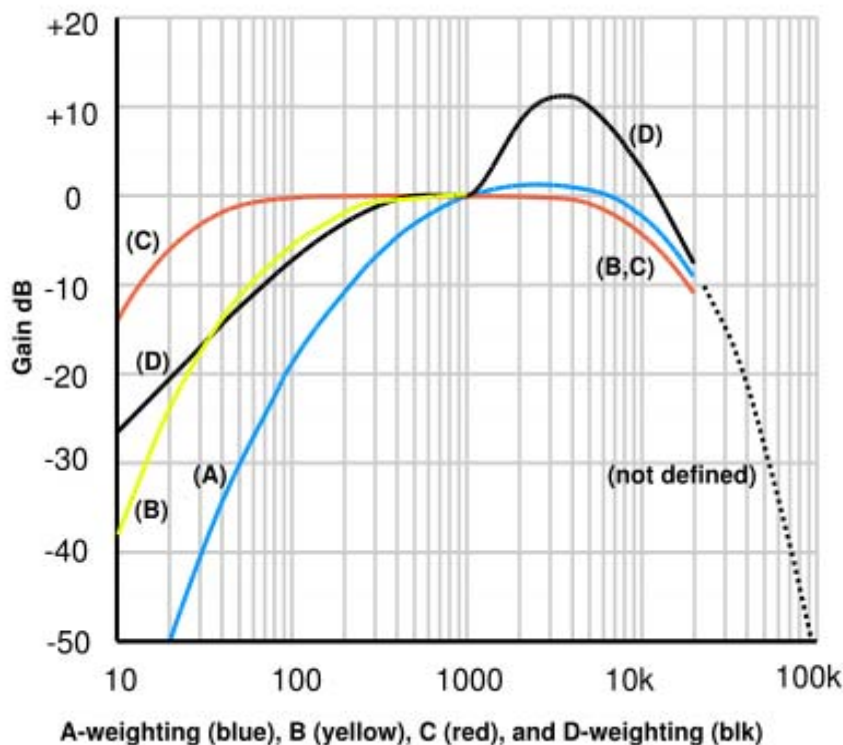


Figure 1: International standards A, B, C and D weighting curves for sound level meters

Although the dB (A) is a useful and well-recognized unit, it is insufficient for some specialist purposes. For calculation of community noise levels from sound power levels, for the design of noise abatement measures and for a precise prescription of hearing protection, it is necessary to have more detailed data on the frequency content of the sound. For this purpose the audible range is usually split into octave bands, each designated by its centre frequency. The standard series of octave band mid frequencies is 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz and 8 kHz. For an even more detailed analysis it is possible to use narrower bands, e.g. of 1/3 octave or of a fixed band-width of a few Hertz.

2.2 Type of Noise

The type of noise may be defined as follows:

- *Steady noise* - A noise with negligibly small fluctuations of level within the period of observation.
- *Non-steady noise* - A noise whose level shifts significantly during the period of observation.
- *Fluctuating noise* - A noise whose level varies continuously and to an appreciable extent during the period of observation.
- *Intermittent noise* - A noise whose level suddenly drops to the level of the background noise several times during the period of observation, the time during which the level remains at a constant value different from that of the background being of the order of 1 second or more.
- *Impulse noise* - A noise consisting of one or more bursts of sound energy each of duration less than about 1 second.
- *Quasi-steady impulse noise* - A series of noise bursts of comparable amplitude with intervals shorter than 0.2 second between the individual bursts.

3. NOISE EXPOSURE LIMITS

In those countries where matters dealt within this Guide are governed by statutory regulations or national codes of practice, these must of course be observed. Subject to this proviso, it is recommended that, where the advice in this Guide and national regulations differ, the more stringent requirements should be adopted. As for Malaysia it is mandatory to adhere to the “Factories and Machinery (Noise Exposure) Regulation 1989” which came into force on 1st February 1989.

Noise exposure limits should be adopted for the purpose of defining:

- the noise dose arising from continuous or intermittent, instantaneous or impulse noise.
- overriding limits for exposure of the unprotected ear to:
 - continuous noise
 - impulse noise.

The noise limits specified under these regulations as in Part II are as follow:-

- Equivalent continuous sound level for 8-hour shift not exceeding 90 dB(A).
- Noise level not exceeding 115 dB(A) at any time.
- Impulsive noise not exceeding a peak sound pressure level of 140 dB.

The limit under the Malaysian regulations is based on 5dB exchange rate. Some other international standards such as the American Conference of Governmental Industrial Hygienists (ACGIH) adopt limits based on a more stringent 3dB exchange rate.

4. EXPOSURE MONITORING

4.1 Instrumentation

In an exposure monitoring, Sound Level Meter (SLM), Personal dosimeter and Noise Calibrator will be used. The typical standard for the instrumentation is tabulated in Table I.

Table I: Standards for the noise measurement instrument

Instrument	Standards
Sound Level Meter	EN/IEC 61672, ANSI S1.43-1997, ANSI S1.4-1983, EN/IEC 61260 and ANSI S1.11-2004
Noise Dosimeters	CE Mark, EN 61252 and ANSI S1.25
Noise Calibrator	ANSI S1.40-1984 and IEC 942:1988 Class 1

4.2 Walkthrough Survey and Area Monitoring

A walkthrough survey shall be carried out to understand the process flow and to identify the high noise areas. A list of noise producing equipment shall be obtained for reference during the walkthrough survey.

In carrying out the area monitoring, the following steps may be opted:-

1. Calibrate the sound level meter before taking measurements at the site.
2. Ensure the settings are at 'fast' response and A-weighting.
3. Identify all noise sources and measure & record the average noise level produced using the sound level meter with the microphone pointed towards the noise source at a distance of one (1) meter from the individual noise source and one (1) meter above the floor.
4. Determine the 90 dB(A) level at various points surrounding the noise source. Record various representative points on the plant layout.
5. Then, determine the area where the noise level is between 90 dB(A) and 85 dB(A) and note the representative points.