



DEPARTMENT OF ENVIROMENT
MINISTRY OF NATURAL RESOURCES AND ENVIROMENT



**THE PLANNING GUIDELINES FOR
ENVIRONMENTAL NOISE LIMITS AND CONTROL**

**THE GUIDELINES FOR NOISE LABELING AND
EMISSION LIMITS OF OUTDOOR SOURCE**

**THE PLANNING GUIDELINES FOR
VIBRATION LIMITS AND CONTROL**

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FOREWORD



The Department of Environment hereby published 3 sets of documents to provide guidance on acceptable noise limits for various types of land use and human activities. ***The Planning Guidelines for Environmental Noise Limits and Control*** provide noise acceptance criteria for quantitative assessment of noise to define disturbance or otherwise. ***The Guidelines for Noise Labeling and Emission Limits of Outdoor Sources*** prescribes comprehensive methodology to measure and report noise emission from outdoor sources. ***The Planning Guidelines for Vibration Limits and Control*** gives vibration acceptance criteria for quantitative assessment of vibration.

It is hoped that these document could serve as useful guide to planners and decision makers at the state and local level as well as other organization, bodies and agencies involved or having responsibilities in the design and/or approval of town planing, infrastructure development, etc. so as to reduce the potential impact of noise affecting public health or causing annoyance or disturbance. Continuing efforts to improve the content and structures of these guidelines based upon feedback from users will be made from time to time.

In the publication of these documents, I would like with sincere appreciation to acknowledge the valuable expert contribution of the University of Technology Malaysia, in particular Prof. Dr. Mohd Salman Leong Bin Abdullah, the relevant agencies and all individuals in providing the necessary and relevant inputs, comments and recommendations towards the successful completion of the documents.



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AND
CONTROL**

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Scope

1. This document presents guidance and recommendations for

- (a) specifying noise limits in the environment for the protection of the public from excessive noise;
- (b) procedures on environmental noise measurements and impact assessment;
- (c) noise parameters for the assessment of different noise sources; and
- (d) noise abatement through planning and control.

For the purpose of these guidelines, definitions used are consistent with those given in ISO 1996/1, BS 661, and BS 3015. A glossary of definitions is also included in this document.

2. These guidelines present noise acceptance criteria upon which a quantitative assessment of noise could be made. This eliminates subjective judgment of parties involved, ambiguity in defining a disturbance, and places the assessment of a noise source on a measurement basis.

Purpose

3. The purposes of these guidelines are:
- (a) for planning purposes, typically by project proponents, local authorities, and consultants;
 - (b) to be used in noise impact assessments, and pre- and post EIA compliance verification;
 - (c) in quantifying a noise disturbance on a quantitative manner; and
 - (d) to offer an introductory treatise in environmental noise control.

Legislative Background

4. The Environmental Quality Act 1974 allows the Minister after consultation with the Environmental Quality Council, to define objectionable noise and to prescribe standards

for tolerable noise. The Act also stipulates that *"no person shall, unless licensed, emit or cause or permit to be emitted any noise greater in volume, intensity or quality in contravention of the acceptable conditions"*.

The Environmental Quality (Amendment) Act 1985 makes it mandatory for an Environmental Impact Assessment (EIA) on various activities scheduled by the Minister. Approval of such EIA and the projects in particular usually include maximum permissible noise limits at the affected areas that must be complied with during the construction phase of the project, and upon completion of the project.

5. The Department of Environment in these guidelines present recommendations upon which acceptable noise limits could be specified. In instances of new noise sources or projects, compliance to these limits may be made mandatory using legislative instruments available to the Department of Environment, and other authorities (Local Authorities, City Halls, etc).

6. Prior to these guidelines as presented here, acceptable limits had been set based on "Guidelines for Sitting and Zoning of Industries", and "Guidelines an Application for Permission to Install Generator Sets". These current guidelines supercedes noise limits set in the above documents; and presents a comprehensive and unambiguous manner upon which noise could be measured and assessed against the prescribed standards for all applications.

Noise Limits

7. Noise limits may be set based on either of the following, depending on circumstances:

- (a) an absolute limit based on the average level of noise which should not be exceeded in a specified time period;

(b) a relative limit based on the permitted increase in noise level with respect to the background level.

8. These limits may either be a single value over the relevant time periods, or different values for day and night. It may also be appropriate to set an evening value where the noise source lends itself to such control. The setting of an absolute limit is often desirable, but would require care in noise monitoring and assessment to ensure that unrelated or extraneous noises (which will increase the measured noise level) do not influence the assessment.

Relative limits in general are not appropriate where the permitted increase in noise over background is substantial, for example 15 dB or more. Because background noise varies during the day, the background noise level determined should be representative of a typical quiet period during the working day.

9. Acceptance limits for noise should be consistent with the environmental noise climate that currently exists at a location - such that an adverse impact on the environment and affected property are avoided, and at the same time maintain a reasonable balance with physical development and/or activities.

10. Recommended maximum permissible sound levels as measured at the real property boundary, and assessed under the respective land use, are given in Annex A.

Under normal circumstances, these sound levels shall apply to outdoor locations at the real property boundary of the receiver (typically residential areas, or other noise sensitive area). This shall include assessment of sound levels from road traffic, railways and other noise source(s). In instances of industrial noise sources in an industrial zone, the sound level shall be at the property boundary of the industrial site or plant under assessment.

11. Schedule 1 of Annex A prescribes maximum permissible sound level (L_{Aeq}) by

receiving land use for planning purposes and new development. These limits should be used for new industrial, commercial or housing areas; and/or development affecting such areas. Such limits are deemed to be a requisite in protecting public health and welfare with an adequate margin of safety.

12. For new development (industrial, transportation: roads, rails) in areas of existing high environmental noise climate, the maximum permissible sound level (L_{Aeq}) at the receiver locations should not be higher than noise limits prescribed in Schedule 2. This schedule presents an absolute limit for the noise level L_{Aeq} based on the existing ambient percentile index L_{90} plus an allowable noise increment.

13. In instances where the existing noise climate (L_{Aeq}) is higher than the planning values of Schedule 1; or when the noise limits ($L_{Aeq} = L_{90} + \text{Factor}$) prescribed in Schedule 2 are lower than the existing noise climate, an acceptance criteria based on maintaining a noise level similar to the existing noise climate (existing L_{Aeq}) may be more appropriate. This acceptance criterion is tabulated in Schedule 3.

14. Recommended limiting sound levels (L_{Aeq}) from road traffic for proposed new roads and/or redevelopment of existing roads are given in Schedule 4.

15. Recommended limiting sound levels (L_{Aeq}) from railways including transit trains for new development or re-alignments are given in Schedule 5. A maximum permissible instantaneous maximum sound pressure levels for the transient pass-by noise is also stipulated. This is the single event maximum instantaneous noise limit permissible for the entire measurement duration.

16. Due to the intrusive but temporal nature of construction noise, maximum permissible sound levels (statistical centile L_{90} , L_{10} , and maximum instantaneous sound pressure level) for construction, maintenance and demolition works should be observed. These limits are stipulated in Schedule 6.

Assessment of the L_{10} and L_{max} levels are generally intended for impulsive or fluctuating noise sources (for example piling, pneumatic tools, etc).

Noise Measurements

17. Measurements of noise levels are often necessary for any of the following purpose:

- (a) assessing the existing noise climate.
- (b) assessing compliance to noise limits for noise limits for noise source(s) and/or project development.
- (c) assessing environmental impact and potential community response.

18. Noise measurements usually include the following:

- (a) background (ambient) sound pressure levels at a receiver location(s) and/or at the real property boundary of a noise source(s). These may be undertaken at a location(s) prior to a project development. It could also be undertaken in the absence of the noise source(s) (example with a plant or facility not operating).
- (b) sound pressure levels at a receiver location (s) and/or at the real property boundary of a noise source with the plant or facility operating and/or completion and operation of a project (highway, transit trains, industrial plant, etc.).
- (c) sound pressure levels of each noise source as may be required to evaluate the contribution of each source.

19. Noise measured indoors may also be undertaken, but is usually not desirable for environmental impact assessments of project development or noise source(s) unless otherwise required by prior conditions or assessment requirements. Measurement

indoors is governed by the severity of noise source, the sound insulation properties of the building, and acoustic characteristics of the interior space.

20. Procedures for measurement of sound levels in the environment and noise source(s) severity assessment as described in Annex B should be used. Guidance on the use and selection of an appropriate noise measurement parameter (indices) and sampling methods are also given in Annex B.

21. Because noise vary over time and have different characteristics, several indices are available to describe noise levels. The equivalent continuous noise level over a time period T ($L_{Aeq,T}$) is the preferred general purpose index for environmental noise. For road traffic noise $L_{A10, 18h}$ is still widely used; and to describe background noise $L_{A90, T}$ is appropriate.

22. To describe the sound insulation of a component of a building envelope (e.g. window) the acoustic rating R_w (BS 5821: Part 3: 1984) is appropriate. It is more difficult to specify the insulation of the whole building envelope because the value depends on different insulation values for the various building elements such as windows, walls and roof structure, as well as the type of noise source and its location.

Monitoring point(s)

23. Normally the noise assessment will be at the nearest noise-sensitive premises and the best position for the monitoring point(s) will often be outside the sensitive premises at the real property boundary. This however does not mean that the monitoring point must always be close to the premises. Noise assessment at times may refer only to noise from the source under consideration and not to the total measured value which may include, for example, traffic noise.

24. In situations when extraneous noise makes monitoring difficult it may be easier to monitor a suitably adjusted level at the

boundary of the site instead of outside the premises to be protected. This approach requires that the noise level at the boundary monitoring point is a reliable indicator of the level at the building to be protected and this may not be the case if the noise source is mobile. Monitoring points should be accessible to all parties concerned.

Noise Severity and Impact Assessment

25. Noise could be assessed against an absolute numerical noise limit (as proposed in Annex A), or alternatively assessed based on the relative increase of the noise levels with respect to a background noise level.

26. Assessment of noise levels against a noise limit is fairly straight forward, as it merely requires comparison of the measured noise level against the permissible sound pressure levels. Assessment of the impact of a noise level in the environment, and the anticipated community response to the noise could also be made by evaluating the magnitude by which the assessed noise level exceeds the existing ambient sound level.

27. The use of ISO-R 1996 Acoustics – “Assessment of Noise with Respect to Community Response” are recommended for community annoyance response evaluation. Procedures as adopted from ISO-R 1996 are described in Annex C.

Noise and Planning

28. The impact of noise should be considered in the planning of a project development, and in general be guided by these Guidelines.

For the purpose of the consideration of noise in planning, the following information may reasonably require:

- (i) the existing daytime and night-time (L_{Aeq}) equivalent sound levels for a representative sample of locations, existing noise zones; identification of the major sources of sound;

- (ii) any projected or proposed new or expanded sources of sound which may affect exposure of the site during three years following completion of the project and the projected future daytime and night-time (L_{Aeq}) equivalent sound levels; projected noise contours; and changes to existing noise zones at the site resulting from these new or expanded sources;

- (iii) where applicable, plans for noise attenuation measures on the site and/or of the structure proposed to be built, and the amount of sound attenuation anticipated as a result of these measures.

29. The Project Proponent and any other Person(s) who would operate or cause to operate equipment, plant, process or activity with noise generation should undertake all reasonable measures to control the source of, or limit exposure to, noise. Such measures should be proportionate and reasonable, and may include one or more of the following:

- (a) land use compatibility: proposed operations shall be compatible with designated land use;
- (b) layout : adequate distance between source and noise-sensitive neighbours, building or area; the usage and designation of buffer zones shall be in accordance to Planning Guidelines issued by the Department of Environment from time to time; screening by barriers, (natural, man-made or otherwise) and other buildings;
- (c) engineering measures: reduction of sound at point of generation, containment of noise generated by adequate design of building envelope, and protection of adjacent noise-sensitive buildings by sound insulation or screening of the buildings;

- (d) administrative measures: limiting the operating time of noise source(s); restricting the activities and ensuring acceptable sound emission limits of noise source.

30. In instances where noise would be potential concern, the Project Proponent and/or parties responsible for the noise source or emissions should undertake sound propagation predictions to the environment using acoustic modelling techniques and/or algorithms such that the impact of noise could be assessed. The parameters used in the analysis shall include but are not limited to sound power level emissions (actual or estimated), directivity factors, ground effects, distance, meteorological influences, and transmission path.

Noise Control

31. The Project Proponent, and/or any other occupier of any industrial or trade premises, construction sites, and/or person(s) responsible for excessive sound generation should use the "best practical means" to minimise the sound generation and reduce its propagation to the environment.

32. Excessive sound generation is deemed to occur when noise levels above the noise limits prescribed in these Guidelines are exceeded. "Best practical means" in the context of these guidelines, shall include but not limited to:-

- (i) the size, design and inherent operation characteristics of the plant, equipment, process or activity;
- (ii) the adjustment of operational parameters to limit the intensity of sound emissions,
- (iii) the selection and usage of low sound power levels equipment;
- (iv) the provision if necessary, and appropriate use of sound attenuators,

acoustic plenum, and other acoustic filtering devices;

- (v) the provision if necessary, and appropriate use of acoustic enclosures and other sound enclosing devices;
- (vi) the provision if necessary, and appropriate use of screening barriers (man-made, natural or otherwise);
- (vii) the proper conduct and adequate supervision of operation; and
- (viii) regular and efficient maintenance of plant and control equipment.

33. In instances of high noise severity, the Department of Environment at its discretion may make it mandatory for the Project Proponent and/or noise source originator or person(s) responsible for the excessive sound generation to institute measures for reducing sound levels to comply with limits as prescribed in these Guidelines.

GLOSSARY

“commercial area/zone” A designated area/zone as approved or gazetted by the local authority under the relevant act, regulations, rules and by-laws made thereunder for the purpose of business, trading, financial, commercial and other similar activities.

“community” The body of people gathered or living in the same locality.

“construction” Any site preparation, assembly, erection, substantial repair, alteration, refurbishment, renovation or similar action, but excluding demolition, for or of public or private rights of-way, structures, utilities or similar property.

“dB (A)” The decibel unit of measurement of sound level corrected to the “A” weighted scale.

“decibel (dB)” A unit of measurement of sound level equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure of 20 micropascals.

“demolition” Any dismantling, intentional destruction or removal of structures, utilities, public or private right-of-way surfaces, or similar property.

“emergency work” Any work performed for the purpose of preventing or alleviating the physical trauma or property damage threatened or caused by an emergency.

“equivalent A-weighted sound level (L_{Aeq})” The constant sound level that, in a given situation and time period, conveys the same sound energy as the actual time-varying A-weighted sound. For the purpose of these Guidelines, the day time L_{Aeq} is the equivalent A-weighted sound level for the day time period of 7.00 am to 10.00 pm (0700 to 2200 hours) and the night time L_{Aeq} is the equivalent A-weighted sound level for the night time period of 10.00 pm to 7.00 am (2200 to 0700 hours).

“impulsive sound” Sound of short duration, usually less than one second, with an abrupt onset and rapid decay. Examples of sources of impulsive sound are explosions, drop hammer or driven impacts, and the discharge of firearms.

“industrial area” A designated area as approved or gazetted by the local authority for the purpose of siting industrial, manufacturing or processing plants, factories or facilities.

“licensing authority” The local authority or state agencies or agents of the State that grants licence, approval or similar permission for a specific activity.

“local authority” The local planning authorities, agencies, or agents of the State as defined in the Town and Country Planning Act, 1976 and such rules, regulations and by-laws made thereunder. These include City Halls, City Councils, Municipal Councils, Town Council and District Councils.

“mixed development area” A designated area as approved or gazetted by the local authority under the relevant act, regulations, rules and by-laws made thereunder, permitting business, commercial, trading or similar activities, together with residential uses.

“noise sensitive area or zone” Low density residential areas, schools, hospitals, and nursing homes, places of worship, religious buildings and courts of law.

“pure tone” Any sound which can be distinctly heard as a single pitch or a set of single pitches. A pure tone exist if the one-third octave band sound pressure level in the band with the tone exceeds the arithmetic average of the sound pressure levels of the two contiguous one-third octave bands by 5 dB for centre frequencies of 500 Hz and above, and by 8 dB for centre frequencies between 160 and 400 Hz, and by 15 dB for centre frequencies less than or equal to 125 Hz.

“real property boundary” An imaginary line along the ground surface, and its vertical extension, which separates the real property owned by one person from that owned by another person, but not including intra-building real property divisions, as delineated in the land title appearing in the Certificate of Title.

“residential area” A designated area as approved or gazetted by the local authority for the purpose of human dwellings and residence. **“low density residential areas”** is defined as areas with a population of less than 75 persons per acre; **“suburban residential (medium density) areas”** is defined as areas with a population of 75 to 200 persons per acre; and **“urban residential (high density) areas”** is defined as areas with a population exceeding 200 persons per acre.

“rms sound pressure” The square root of the time averaged square of the sound pressure, denoted as P_{rms} .

“sound attenuator” or **“sound dissipative device”** An acoustic filtering device for the attenuation of sound energy for airborne

sound as transmitted to the atmosphere or surroundings of an equipment or sound source; such as muffler as used for engines exhausts, and silencer for air distribution equipment or enclosures.

“sound emission” Sound as emitted or discharged from a sound source(s).

“sound immission” Sound as propagated onto and received by a receiver from source(s) external to the receiver or real property boundary.

“sound level” The weighted sound pressure level obtained by the use of a sound level meter and frequency weighting network, such as A, B, or C as specified for sound level meters. If the frequency weighting employed is not indicated, the linear non-weighting level shall apply.

“sound pressure level” 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure to the reference pressure of 20 micropascals. The sound pressure level is denoted L_p or SPL and is expressed in decibels.

ANNEX A SCHEDULE OF PERMISSIBLE SOUND LEVELS

SCHEDULE 1

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) BY RECEIVING LAND USE FOR PLANNING AND NEW DEVELOPMENT

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Noise Sensitive Areas, Low Density Residential, Institutional (School, Hospital), Worship Areas.	50 dBA	40 dBA
Suburban Residential (Medium Density) Areas, Public Spaces, Parks, Recreational Areas.	55 dBA	45 dBA
Urban Residential (High Density) Areas, Designated Mixed Development Areas (Residential - Commercial).	60 dBA	50 dBA
Commercial Business Zones.	65 dBA	55 dBA
Designated Industrial Zones	70 dBA	60 dBA

SCHEDULE 2

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) OF NEW DEVELOPMENT (ROADS, RAILS, INDUSTRIAL) IN AREAS OF EXISTING HIGH ENVIRONMENTAL NOISE CLIMATE

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Noise Sensitive Areas, Low Density Residential	$L_{90} + 10$ dBA	$L_{90} + 5$ dBA
Suburban and Urban Residential Areas	$L_{90} + 10$ dBA	$L_{90} + 5$ dBA
Commercial, Business	$L_{90} + 10$ dBA	$L_{90} + 10$ dBA
Industrial	$L_{90} + 10$ dBA	$L_{90} + 10$ dBA

L_{90} is the measured ninety percentile sound level for the respective time period of the existing areas of interest in the absence of the proposed new development.

SCHEDULE 3

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) TO BE MAINTAINED AT THE EXISTING NOISE CLIMATE

Existing Levels	New Desirable Levels	Maximum Permissible Levels
L_{Aeq}	L_{Aeq}	$L_{Aeq} + 3$ dBA

SCHEDULE 4

LIMITING SOUND LEVEL (L_{Aeq}) FROM ROAD TRAFFIC (FOR PROPOSED NEW ROADS AND/OR REDEVELOPMENT OF EXISTING ROADS)

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Noise Sensitive Areas Low Density Residential Areas	55 dBA	50 dBA
Suburban Residential (Medium Density)	60 dBA	55 dBA
Urban Residential (High Density)	65 dBA	60 dBA
Commercial, Business	70 dBA	60 dBA
Industrial	75 dBA	65 dBA

SCHEDULE 5

LIMITING SOUND LEVEL (L_{Aeq}) FOR FROM RAILWAYS INCLUDING TRANSITS (FOR NEW DEVELOPMENT AND RE-ALIGNMENTS)

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am	L_{max} (Day & Night)
Noise Sensitive Areas, Low Density Residential Areas	60 dBA	50 dBA	75 dBA
Suburban and Urban Residential Areas	65 dBA	60 dBA	80 dBA
Commercial, Business	70 dBA	65 dBA	80 dBA
Industrial	75 dBA	65 dBA	NA

SCHEDULE 6

MAXIMUM PERMISSIBLE SOUND LEVELS (PERCENTILE L_N AND L_{MAX}) OF CONSTRUCTION, MAINTENANCE AND DEMOLITION WORK BY RECEIVING LAND USE

Receiving Land Use Category	Noise Parameter	Day Time 7.00 am - 7.00 pm	Evening 7.00 pm - 10.00 pm	Night Time 10.00 pm - 7.00 am
Residential (Note 2 **)	L_{90}	60 dBA	55 dBA	* (Note 1)
	L_{10}	75 dBA	70 dBA	*
	L_{max}	90 dBA	85 dBA	*
Commercial (Note 2 **)	L_{90}	65 dBA	60 dBA	NA
	L_{10}	75 dBA	70 dBA	NA
Industrial	L_{90}	70 dBA	NA	NA
	L_{10}	80 dBA	NA	NA

NOTES

- *1. At these times the maximum permissible levels as stipulated in the Schedule 1 for the respective residential density type shall apply. This may mean that no noisy construction work can take place during these hours.
- **2. A reduction of these levels in the vicinity of certain institutions such as schools, hospitals mosque and noise sensitive premises (apartments, residential dwellings, hotel) may be exercised by the local authority or Department of Environment.

Where the affected premises are noise sensitive, the limits of the Schedule 1 shall apply.
3. In the event that the existing ambient sound level (L_{90}) without construction, maintenance and demolition works is higher than the L_{90} limit of the above Schedule, the higher measured ambient L_{90} sound level shall prevail. In this case, the maximum permissible L_{10} sound level shall not exceed the Ambient L_{90} level + 10 dBA, or the above Schedule L_{10} whichever is the higher.
4. NA = Not Applicable.

ANNEX B

PROCEDURES FOR MEASUREMENT OF NOISE IMMISSION LEVELS

1. Measurement equipment.

1.1 The measurement shall be made with a precision sound level meter which complies with the requirements of the IEC Publications 60651, 60804 and 61672 or thereafter, for the type of meters in Class 1.

1.2 The "A" weighting network, and "fast" time weighting response shall be used for sound pressure level measurements for equivalent L_{eq} and statistical centile readings.

1.3 Measurement for statistical centile levels (L_{10} , L_{90}) and maximum instantaneous level (L_{max}) shall be made using a sound level meter installed with statistical analysis functions, or alternatively computed from continuously monitored instantaneous sound pressure levels using data acquisition system for the stipulated time period.

1.4 Measurement for blasting and other explosion related activities shall be made using linear weighting network (dB Linear) for a peak value ("peak" time constant setting) with a "maximum hold" function of the sound level meter.

1.5 Other supplementary measurement(s) of impulsive sound, for the purpose of reporting and record keeping, shall be measured using an "impulse" time weighting response.

1.6 If a graphic level recorder is used the recorder shall be set with a writing speed which most closely approximates the "fast" time weighting response (for example, a writing speed of 100mm/s for a chart width of 50 mm).

1.7 The calibration of sound level meter shall be checked and adjusted according to the manufacturer's instructions or with a standard sound source (for example a pistonphone) at the beginning and at the end of each series of measurements. If the errors of the sound level meter obtained from these calibrations deviates by more than 1dB during a series of measurements, the measured results shall be considered invalid.

1.8 A wind shield approved by the microphone manufacturer shall be used. Measurements cannot normally be made if the wind speed exceeds 5m/s at the microphone position. For continuous remote monitoring, the wind speed shall be monitored concurrently with the sound levels.

2. Measurement locations.

2.1 Measurements for noise immision as propagated to the environment by a sound source shall be made at locations along or adjacent the real property boundary of the sound source, and/or at the receiver location.

2.2 Measurements shall be made at all strategic locations representative of the entire real property boundary, and at all locations affecting the community. These shall include but are not limited to locations at closest proximity to the sound source(s) affected by the noise of these source(s).

2.3 Measurements shall be made outdoors at 1.2 to 1.5 m above the ground and, if practical, at least 3.5m from walls, buildings or other sound reflecting structures. When circumstances dictate, measurements may be made at greater heights and closer to the wall (for example 0.5 m in front of an open window) and these special conditions indicated in the measurement records.

2.4 Care shall be taken to avoid influence on the result from other unwanted sound signals, for example noise from wind on the microphone of the measuring equipment, noise from electrical interference or noise from extraneous sources.

2.5 When the noise source is distant, the measured sound level may depend significantly on the climatic conditions. It is recommended that extreme climatic conditions be avoided. A typical value and an indication of the range of variation shall be obtained.

3. Measurement methods and parameters

3.1 Various methods of noise measurements and noise parameters are described in the annex. The method to be selected in a particular case will depend on the temporal variations of noise level, on the resources available and on the time period over which the noise is to be measured.

3.2 Sampling methods can be divided into three broad categories; and the selection of the method deemed most appropriate is dependent on the purpose and accuracy required of the monitoring.

(a) *Continuous day night sampling*

This procedure involves the continuous sampling of instantaneous sound pressure level for the entire duration of a day (0700 to 2200 hours) and/or night (2200 to 0700 hours) to obtain the day time $L_{Aeq, 15h}$ and night time $L_{Aeq, 9h}$.

Data sampling can be undertaken in a continuous mode (non-stop) for the entire day/night time period using an integrated sound level meter, or sampled continuously on an hourly basis and repeated continuously over the hours to

obtain the $L_{Aeq, 1h}$ levels, and the $L_{Aeq, day}$ and $L_{Aeq, night}$ computed from the hourly $L_{Aeq, 1h}$ noise levels time profile.

This procedure can be undertaken with a permanent monitoring station (but requires care to ensure that extraneous noise source unrelated to the events monitored do not influence the results); or undertaken manually.

(b) *Regular sampling repeated over a hourly basis*

This procedure involves the continuous sampling of instantaneous sound pressure level over a designated duration (for example 5 to 20 minutes) repeated over every hour. This procedure in essence limits data sampling over a shorter period of time per hour, thereby permitting measurements to be undertaken at more positions. Uncertainty and errors in the L_{Aeq} values are therefore inevitable.

(c) *A single sample*

This procedure is useful when it is only possible to visit the site for a limited period. The reliability of this technique can be improved by avoiding periods when the site is not operating normally (e.g. meal breaks).

3.3 The size of possible errors in estimates of L_{Aeq} values obtained by sampling will depend on the type of sampling technique adopted, the length of time for which the noise is sampled and the pattern of noise emitted by the site. The Table below provides some guidance on typical ranges of errors likely to be encountered when various sampling strategies are used. The figures quoted in the table are based on measurements at a number of building sites but may not be applicable for large sites where there are

very wide fluctuations in noise level (e.g. for some types of piling).

Estimation of daily $L_{A\text{eq}}$ according to sampling technique

Sampling techniques	Daily $L_{A\text{eq}}$ estimated within (95% confidence)
	dB(A)
5 min every 1h	± 2.5
20 min every 1h	± 1.5
Single 20 min sample	$\pm 5^*$
Single 60 min sample	$\pm 3^*$

Source: BS 5228 Part 1: 1984

* These figures assume that measurements are only taken when the site is working normally (e.g. not during meal breaks).

3.4 For compliance verification and record keeping, the sampling period should be continuous to cover the entire twenty four hour day cycle to obtain the respective day time, evening and night time noise levels.

3.5 For preliminary EIA and/or evaluation of continuous sound sources, a sampling period of not less than 20 minutes for each hour period to be repeated hourly over the day/evening/night to obtain an hourly profile, and thereafter the computed L_{eq} is acceptable. This approximation is not acceptable for transient impulsive sound source(s) typical in construction sites or activities.

3.6 Measurements for equivalent sound levels (L_{eq}) and statistical centile levels (L_{10} , L_{90} , and including L_{max}) shall be undertaken with continuous sampling for the entire time period of interest, i.e. day time, evening, and night time.

4. Number and duration of measurements.

4.1 At least three measurements should be carried out at each measuring location.

For continuous monitoring over a complete 24 hours cycle (for day and night time $L_{A\text{eq}}$) a single continuous 24 hours measurement per measuring location is often acceptable if the noise source generation at the day of measurement is deemed representative of the source(s).

4.2 The measurements shall be considered valid if the range of three measurements made immediately one after the other is not greater than 2 dB for steady state noise.

The arithmetic mean value given by these measurements shall constitute the result.

4.3 For transient or impulsive noise, the highest L_{max} value as obtained shall be taken as the maximum instantaneous level occurring over the period of measurement. It is however recommended that repeat measurements be undertaken where feasible to confirm repeatability of this reading.

4.4 For compliance verification and record keeping the measurements should be undertaken by the Project Proponent for every day for a minimum of two weeks.

4.5 In the interest of protection of public, including abatement for community annoyance response, the Department of Environment may at its discretion require permanent or semi-permanent long term monitoring for sound to be undertaken by person(s) responsible for excessive noise generation consistent with the period or duration the sound source(s) may be in operation or anticipated to be a nuisance.

5. Noise mapping

5.1 For the purpose of assessment and planning approval, noise mapping in the form of noise zones is usually required. Noise zones should clearly show sound level with respect to the location of the site and sound source(s).

5.2 Noise zones may be obtained and presented in sound level ranges of 5 dBA L_{Aeq} increment (for example 40-45 dBA, 45-50 dBA, etc.).

5.3 The mapping of noise zones without the influence of the noise source(s) under evaluation should be obtained, and compared with noise zones with the subsequent contribution of the above said noise source(s).

5.4 Detailed noise contours for further assessment may be required as and when necessary.

6. Record keeping

6.1 The following information should be recorded and kept for record purposes.

(a) The measured values of L_{Aeq} and, where appropriate $L_{pA, max}$ or L_{10} ,

L_{90} , together with details of the appropriate time periods.

(b) Details of the instrumentation and measurement methods used, including details of any sampling techniques, position of microphone(s) in relation to the site and system calibration data.

(c) Any factors that may have adversely affected the reliability or accuracy of the measurements.

(d) Plans of the site and neighbourhood showing position of plant, associated buildings and notes of site activities during monitoring period(s).

(e) Notes on weather conditions, including, where possible, wind speed/direction, temperature, relative humidity, presence of precipitation, etc.

ANNEX C

PROCEDURES FOR ASSESSMENT OF COMMUNITY ANNOYANCE RESPONSE

1. These procedures as prescribed herein are intended to assess sound with respect to community annoyance response, and are in general guided by the International Organisation for Standardisation ISO R 1996 Acoustics - "Assessment of Noise with Respect to Community Response".

2. The sound level of the offending sound source(s) shall be measured (or estimated as the case may be for a new project development, process or activity). The equivalent "A" weighted fast response sound level (L_{eq}) shall be used for quantifying the sound emission of the source. Normalisation for peak factor associated with impulsive sound, spectrum character for tonal content of the sound, and duration of the Table 1 shall be undertaken. The normalised sound level

(as corrected for the characteristic features of the sound) yields the rating sound level (L_r).

3. The noise criterion of the receiver (community) shall be taken as the existing ambient sound level at the real property boundary of interest in the absence of the offending sound source(s) but shall include prevailing environmental noise sources prior to the introduction of the new sound source(s). The existing ambient sound level is defined as the mean minimum sound level at this location and time (in the absence of the noise which is alleged to be offending), and shall be taken as the ninety percentile (L_{90}) "A" weighted fast response level. The L_{90} levels for day time, night time (and evening time) period shall be so quantified.

4. Exceedance of the rating sound level (L_r) above the noise criterion (L_{90}) is computed as $L_r - L_{90}$ dBA. This exceedance quantifies anticipated impact and community reaction to the offending sound source(s), and is tabulated in Table 2.

TABLE 1 - Corrections to the measured (or predicted) sound level in dB (A)

Characteristic features of the sound		Correction dB(A)
Peak factor	Impulsive noise (e.g. from piling)	+5
Spectrum character	Audible tone components present (e.g. whine)	+5
Duration of the sound as a percentage of the relevant time period	Between :	
	100 and 56	0
	56 and 18	-5
	18 and 6	-10
	6 and 1.8	-15
	1.8 and 0.6	-20
	0.6 and 0.2	-25
	Less than 0.2	-30

TABLE 2 - Anticipated community response to noise

Amount in dB(A) by which the rating sound level L_r exceeds the noise criterion	Anticipated community response	
	Impact	Description
0	None	No observed reaction
5	Little	Sporadic complaints
10	Medium	Widespread complaints
15	Strong	Threats of community action
20	Very Strong	Vigorous community action

ANNEX D

CODE OF PRACTICE TO MINIMISE NOISE DISTURBANCE

No person should unreasonably make, continue, or cause to be made or continued, any noise disturbance. Lawful non-commercial public speaking and public assembly activities conducted on any public space or public right-of-way are exempted.

In the context of these Guidelines, noise disturbance shall mean any sound which:

- (i) endangers or injures the safety or health of human or animals; or
- (ii) annoys or disturbs a reasonable person of normal sensitivities; or
- (iii) endangers or intrudes onto personal or real property boundary; or
- (iv) exceeds the existing ambient equivalent A-weighted sound level (L_{Aeq}) by 10 dBA during the day time, and/or 5 dBA during the night time; or
- (v) exceeds the sound level limits as prescribed herein in these Guidelines.

(1) Construction

Project Proponents or any other Person(s) should not operate or permit the operation of any tools or equipment used in construction, maintenance, or demolition work:

- (a) Between the hours of 10.00 p.m. and 7.00 a.m. the following day on weekdays or at any time on weekends or public holidays, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone, except for emergency work of public service, and utilities.

- (b) At any other time such that the sound level at or across real property boundary exceeds the stipulated maximum permissible sound levels as defined in the Second Schedule of Annex A for the daily period of operation.

- (c) The use of low noise (and vibration) generation equipment, process or activity shall be required in noise sensitive areas.

- (d) Procedures for noise control in accordance to BS 5228: Part 1 (Noise Control on Construction and Open Sites: Part 1 Code of Practice for Basic Information and Procedures for Noise Control) should be used.

(2) Industrial Sites

- (a) Project Proponents and any other Person(s) should not operate or permit the operation of equipment or facilities in an industrial site such that noise levels exceed the maximum permissible limits as prescribed in the Guidelines.

- (b) Equipments or facilities located outdoor, exhaust, discharge vents, ventilation openings which generate excessive noise should be fitted with sound attenuators, enclosures or barriers as deemed appropriate.

(3) Transportation

- (a) Project Proponents of new highways, road re-development or expansion, and rail or transit trains system(s) should minimize noise intrusion to residential areas and noise sensitive premises with alignments offering the maximum possible buffer zones and/or natural shielding.

- (b) In urban or suburban areas where a meaningful buffer zone is not possible, or/and when noise immission to affected receivers exceed maximum permissible limits as prescribed in the Guidelines the use of shielding (man made or natural barriers) may be required. Man made

barriers should be aesthetically compatible with the surroundings.

(4) Loudspeakers and Sound Reinforcement Systems

(a) Sound amplified system, public address system, or similar device should not be used between the hours of 10:00 p.m. and 7:00 a.m. the following day, such that the sound therefrom creates a noise disturbance across a residential real property boundary or within a noise sensitive zone.

(b) Sound amplified systems used in conjunction with mosques and other places of religious worship shall be exempted.

(5) Radios, television sets, musical instruments and other devices

The operation or playing of any radio, television, phonograph, musical instrument, sound amplifier, or similar device which produces, reproduces, or amplifies sound should not be:

(a) in such a manner as to create a noise disturbance across a real property boundary or within a noise sensitive zone, except for activities open to the public and for which a permit has been issued by the appropriate licensing authority;

(b) in such a manner as to create a noise disturbance at 15 meters from such device, when operated in or on a motor vehicle on a public right-of-way or public space, or in a boat on public waters;

(c) in such a manner as to create a noise disturbance to any person other than the operator of the device, when operated by any passenger on a common carrier.

(6) Entertainment noise

Person(s) who organise, or operate a business or permit the hosting of activities, within their private property or public right of way, should ensure that these activities

would not create a noise disturbance from their entertainment and recreational activities which result in sound levels exceeding maximum permissible limits as prescribed in these Guidelines.

(7) Street Vendors

The offer for sale, to purchase or sell anything by shouting or outcry within any residential or commercial area when licensed by the appropriate licensing authority should not be between the hours of 7.00 a.m. and 10.00 p.m., or in such a manner as to cause a noise disturbance.

(8) Loading and unloading

Person(s) when licensed by the local authority should not load, unload, open, close or engage in activities related to other handling of goods, cargo, boxes, crates, containers, building materials, garbage or similar objects between the hours of 10.00 p.m. and 7.00 a.m. the following day, or in such a manner as not to cause a noise disturbance across a residential real property boundary or within a noise sensitive zone.

(9) Stationary non-emergency signaling devices

(a) The sounding of any electronically-amplified signal from any stationary bell, chime, siren, whistle, or similar device, intended primarily for non-emergency purposes, from any place, should not be more than 5 minutes in any hourly period.

(b) Devices used in conjunction with places of religious worship are exempted.

(10) Emergency signaling devices

(a) The sounding the outdoors of any fire, burglar, or civil defense alarm, siren, whistle or similar stationary emergency signaling device for testing, except for emergency purposes, should occur at the same time of day each time such a test is performed, but not before 8.00 a.m. or

after 10.00 p.m. Any such testing should use only the minimum cycle test time. In no case should such test time exceed 60 seconds.

(b) The sounding of any exterior burglar or fire alarm or any motor vehicle burglar alarm should automatically terminate within 5 minutes of activation.

(11) Explosives, firearms, and similar devices

Person(s) unless duly authorised by law or carrying out legitimate duties as an armed personnel should not use or fire explosives, firearms, or similar devices which create impulsive sound so as to cause a noise disturbance across a real property boundary or on a public space or right-of-way.

(12) Domestic power tools

The operation of any mechanically powered, or otherwise, saw, drill, sander, grinder, lawn or garden tool, or similar device used outdoors in residential areas should not be between the hours of 10.00 p.m. and 7.00 a.m. the following day, or cause a noise disturbance across a residential real property boundary.

(13) Vehicle or motorboat repairs and testing

Activities relating to the repair, rebuilding, modification or testing any motor vehicle, motorcycle, or motorboat should not cause a noise disturbance across a residential real property boundary or within a noise sensitive zone.

(14) Low frequency noise

(a) Project Proponent or industrial plant operators should not operate or cause to be operated on private property any source of sound in such a manner as to create a low frequency noise disturbance.

(b) A low frequency noise disturbance is deemed to occur if the sound immission level measured at the real property boundary with a linear (non-weighted) scale exceeds the "A"-weighted scale level by 30 dB or more.

ANNEX E

STATUTORY INSTRUMENTS, STANDARDS AND OTHER GUIDANCE

Statutory instruments

(1) The Environmental Quality Act

Under the Environmental Quality Act, 1974 (Amendment), 1985, there are several provisions that could be utilized to control and abate the noise pollution problems. The following are statements of the Environmental Quality Act, 1974.

Section 21:

The Minister, after consultation with the Council, may specify the acceptable conditions for the emission of noise into any area, segment or element of the environment and may set aside any area, segment or element of the environment within which the emission is prohibited or restricted.

Section 23:

1. No person shall, unless licensed, emit or cause or permit to be emitted any noise greater in volume, intensity or quality in contravention of the acceptable conditions specified under section 21.

2. Any person who contravenes subsection (1) shall be guilty of an offence and shall be liable to a fine not exceeding five thousand ringgit or to imprisonment for a period not exceeding one year or to both and to a further fine not exceeding five hundred ringgit a day for everyday that the offences is continued after a notice by the Director General requiring him to cease the act specified therein has been served upon him.

Section 8A:

The Director General or any other officer duly authorized by him, has the power to test and prohibit use of vehicle.

Section 51:

The Minister after consultation with the Council may make regulations for or with respect to:

- (i) prohibiting the use of any equipment, facility, vehicle, or ship capable of causing pollution or regulating the construction, installation or operation thereof so as to prevent or minimize pollution, and
- (ii) defining objectionable noise and prescribing standards for tolerable noise.

(2) Environmental Quality (Motor Vehicle Noise) Regulation, 1987

This regulation stipulates permissible noise emission from motor vehicles as measured in accordance to procedures stated here in the regulations.

(3) Guidelines for Siting and Zoning of Industries

The existing guidelines only give daytime and night-time noise limits based on maximum sound levels according to category of industries. This is insufficient because internationally accepted noise indices being used worldwide are based on A-weighted continuous equivalent sound level, L_{Aeq} .

(4) Local Government Act 1976

The Local Government Act 1976 and the various Town Board Enactment also contain provisions enabling due action to be taken against, including prosecution of owners or occupiers of premises, whether public or private, emitting noise that are deemed to be a nuisance. For the purpose of quantifying the acceptable noise levels, limits based on the best judgment of these Authorities had been used. Noise limits to

be used by these Authorities could now be based on these Guidelines.

(5) Minor Offences Ordinance 1953

Minor Offences Ordinance 1953 prohibits noise after 11.00 p.m., and the police are empowered to act forthwith on complaints. Annoyance and nuisance could be assessed based on procedures presented in this guideline.

(6) Civil Aviation Act

Under the Civil Aviation Act, aircraft and airport authorities are absolved from paying compensation for nuisance noise only if the aircraft and airport authorities are operated in conformance with international civil aviation procedures.

(7) The Factories and Machinery (Noise Exposure) Regulations 1989

The Regulations came into force on February 1, 1989. It was formulated under the Factories and Machinery Act, 1967, aimed at minimizing workers exposure to noise in their working environment. These Regulations stipulate maximum allowable noise limits in the workplace, and worker's allowable noise exposure dosage.

- ISO 1996 Part 2 1987: Acquisition of data pertinent to land use (amended 1998)
- ISO 1996 Part 3 1987: Application to noise limits

It defines the basic terminology including the central Rating Level parameter and describes best practices for assessing environmental noise.

ISO 9613 – Prediction of Environmental Noise

ISO 9613 “Acoustics – Attenuation of Sound during Propagation Outdoors” is divided into 2 parts:

- ISO 9613 Part 1 1993: Calculation of the absorption of sound by the atmosphere
- ISO 9613 Part 2 1996: General method of calculation

It defines an octave-based calculation method based on point sources with a defined sound power level. Line sources can be built up with point sources.

Standards

ISO 1996 – Assessment of Environmental Noise

ISO 1996 “Acoustics – Description and Measurement of Environmental Noise” is a central standard within environmental noise assessment, acting as a reference work on the subject. It is divided into 3 parts:

- ISO 1996 Part 1 1982: Basic quantities and procedures

BS 5228: Part 1 1984

Noise control on construction and open sites. Part 1: Code of practice for basic information and procedures for noise control.

BS 5228 Part 1 gives recommendations for basic methods of noise control relating to construction sites and other open sites where having work activities and operation are carried out.