Annex 16.1

# Acoustics and Vibration Terminology Glossary, Definitions and Abbreviations

*(ERM)*

## *16.1 ACOUSTICS& VIBRATION - GLOSSARY OF TERMS AND DEFINITIONS*

### *16.1.1 What Is Noise and Vibration?*

Noise is often defined as unwanted sound but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of solid objects. The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

### *16.1.2 How To Measure and Describe Noise?*

Noise is measured using a specially designed 'sound level' meter which must meet internationally recognised performance standards. Audible sound pressure levels vary across a range of $10^7$ Pascals (Pa), from the threshold of hearing at 20μPa to the threshold of pain at 200Pa. Scientists have defined a statistically described logarithmic scale called Decibels (dB) to more manageably describe noise.

To demonstrate how this scale works, the following points give an indication of how the noise levels and differences are perceived by an average person:

0 dB - represents the threshold of human hearing (for a young person with ears in good condition);

50 dB – represents average conversation;

70 dB – represents average street noise, local traffic etc;

90 dB – represents the noise inside an industrial premises or factory;

140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

### *16.1.3 Acoustic Terminology & Statistical Noise Descriptors*

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dB(A). The A-weighting scale

follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise.

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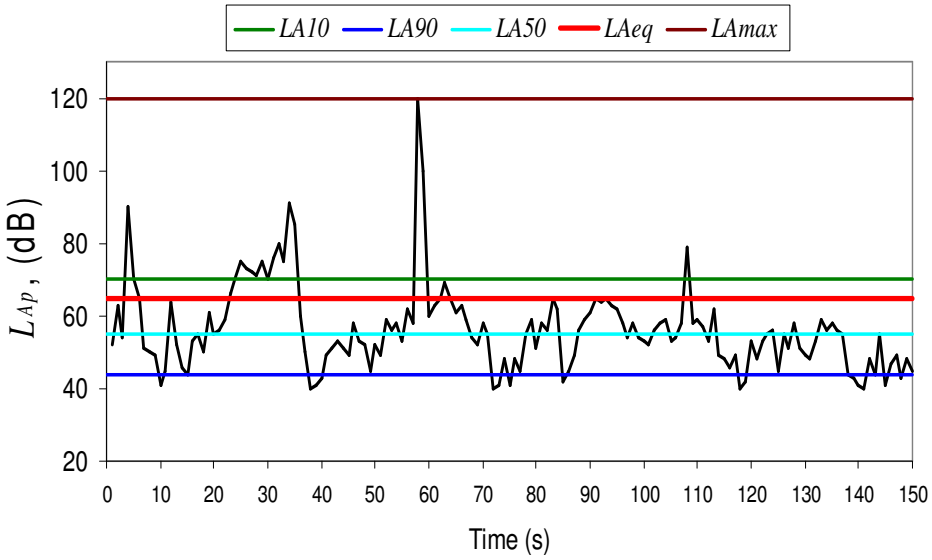
| **1/3 Octave** | Single octave bands divided into three parts |
| **Octave** | A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit. |
| **Ambient Noise** | The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant. |
| **A Weighting** | A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise. |
| **Decibel (dB)** | The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud. |
| **dB(A), dBA** | Decibels A-weighted. |
| **dB(C, dBC** | Decibels C-weighted. |
| **dB(Z), dB(L)** | Decibels Linear or decibels Z-weighted. |
| **Hertz (Hz)** | The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz. |
| **$L_{A10}$** | The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis. Typically used to assess the impact of an existing operation on a receiver area and is referred to as the cumulative noise levels at the receiver attributable to the noise source. |
| **$L_{A90}$** | The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis. |
| **$L_{Max}$** | The maximum of the sound pressure levels recorded of a measurement period.. |
| **$L_{Aeq, T}$** | Equivalent continuous sound pressure level with 'A' frequency weighting - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time. |

**LAN** Percentile level - a measure of the fluctuation of the sound pressure level with 'A' frequency weighting which is exceeded 'N' per cent of the measurement time.




**SPL, Lp** **Sound pressure level** - The level of sound pressure; expressed in decibels, as measured by a standard sound level meter with a microphone. This differs from $L_W$ in that this is the received sound as opposed to the sound 'intensity':

where p is the rms sound pressure in pascals and $p_o$ is the sound reference pressure at 20 µPa ($2 \times 10^{-5}$).

**SWL, Lw** **Sound power level** - This is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment:

where W is the sound power in watts and $W_o$ is the sound reference power at $10^{-12}$ watts.

### 16.1.4 *British Standard 4142: Method for rating industrial noise affecting mixed residential and industrial areas - Specific Terms*

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| **Ambient noise** | Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. |
| **Background noise level** $L_{A90,T}$ | The 'A'-weighted sound pressure of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T, measured using the time weighting, F, and quoted to the nearest whole number of decibels. |
| **Measurement time interval**, Tm | The total time over which measurements are taken. |
| **Rating level,** $L_{Ar,Tr}$ | The specific noise level plus any adjustment for characteristic features of the noise. |
| **Reference time interval,** Tr | The specified interval over which an equivalent continuous 'A'-weighted sound pressure level is determined. |
| **Residual noise** | The ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise. |
| **Residual noise level,** $L_{Aeq,T}$ | The equivalent continuous 'A' –weighted sound pressure level of the residual noise. |
| **Specific noise level,** $L_{Aeq,Tr}$ | The equivalent continuous 'A'-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval. |
| **Specific noise source** | The noise source under investigation for assessing the likelihood of complaints. |

### *16.1.5 Terms to Describe the Perception of Noise*

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- differences in noise levels of less than approximately 2 dB(A) are generally imperceptible in practice;
- differences in noise levels of around 5 dB(A) are considered to be significant; and
- differences in noise levels of around 10 dB(A) are generally perceived to be a doubling (or halving) of the perceived loudness of the noise.

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

**Inaudible/ Not Audible** the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured LA90 background noise level, potentially by 10 dB or greater;

**Barely Audible** the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured LA90 or LAeq noise level, depending on the nature of the source e.g. constant or intermittent;

**Just Audible** the noise source and/or event may be defined by the operator. However there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator;

**Audible** the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator; and

**Dominant** the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified

based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

**Constant** this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement;

**Intermittent** this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting at regular intervals for the duration of the noise measurement e.g. car pass-bys; and

**Infrequent** this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement e.g. a small number of aircraft are noted during the measurement.

## *16.2 GLOSSARY AND DEFINITIONS - VIBRATION*

The following terms are often used to describe measured vibration levels.

**Acceleration** the change in velocity over time. Acceleration is dependant on the velocity and the frequency of the vibration event (velocity is a vector), as such acceleration changes in two ways - magnitude and/or direction. Acceleration is measured in the unit; m/s2;

**Geophone** the transducer/device or accelerometer typically used to measure vibration.

**MIC** Maximum Instantaneous Charge or explosive charge mass (kg) detonated per delay (any 8ms interval).

**PPV** Peak Particle Velocity, the highest particle velocity which is recorded during a particular vibration event over the three (3) axes. PPV is measured in the unit, mm/s;

**SD** The scaled distance (m) for airblast and ground vibration from the charge to the receiver and is defined as:

$$SD = \frac{D}{MIC^{0.33}}$$ for calculating airblast; and

$$SD = \frac{D}{MIC^{0.5}}$$ for calculating vibration;

## *16.3 ABBREVIATIONS*

| | |
|---|---|
| **AS/NZS** | Australian/ New Zealand Standard |
| **BAT** | Best Available Techniques/ Technology |
| **BPM** | Best Practicable Means |
| **BS** | British Standard |
| **CRN** | Calculation or Railway Noise Method (1995) |
| **CRTN/ CoRTN** | Calculation of Road Traffic Noise (1988) |
| **IoA** | Institute of Acoustics (UK) |
| **LA** | Local Authority |
| **MPG** | Mineral Planning Guidance |
| **NECs** | Noise Exposure Categories |
| **PPG** | Planning Policy Guidance |
| **SEPA** | Scottish Environment Protection Agency |
| **WHO** | World Health Organisation |