Appendix A15.1: Noise and Vibration Terminology

1.1 Introduction

1.1.1 This appendix provides definitions of some of the terms used in Chapter 15 (Noise and Vibration) to aid understanding.

1.1.2 Sound waves travelling through the air are regular disturbances in ambient atmospheric pressure. These pressure fluctuations, when of frequencies within the audible range, are detected by the human ear which passes nerve responses to the brain, producing the sensation of hearing. Noise has been defined in a variety of ways and is very much dependant on factors such as the listener's attitude to the source of the sound and their environment but is essentially any sound that is unwanted by the recipient.

1.1.3 The human ear is sensitive to a wide range of sound levels; the sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitude of the numbers involved, a logarithmic scale of decibels (dB) based on a reference level of the lowest audible sound is used.

1.1.4 Also, the response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequency to approximate human response. This is achieved by using filters to vary the contribution of different frequencies to the measured level. The A-weighting is the most commonly used and has been shown to correlate closely to the non-linear and subjective response of humans to sound.

1.2 Glossary of Terms

Noise: Unwanted Sound.

Vibration: Vibration is the periodic or repetitive back-and-forth motion of a particle when its equilibrium position has been disturbed.

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: Background noise is normally defined as the A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T (seconds), measured using a fast time weighting, F, and quoted to the nearest whole number.

Decibel: The range of audible sound pressures is approximately 2×10^{-5} pascals (Pa) to 200Pa. Using decibel (dB) notation presents this range in a manageable range, 0dB to 140dB.

Sound Pressure Level: The sound pressure level (L_p or SPL) is the instantaneous acoustic pressure and is measured in dB. Since the ear is sensitive to variations in pressure, rather than source power or intensity the measurement of this parameter gives an indication of the impact on people. The L_p is defined as:

$$L_p = 20 \times log_{10}\left(\frac{p}{p_0}\right)$$

Where:

- p is the root mean square (rms) pressure of the sound in question (Pa); and
- p_0 is the reference sound pressure level of 2 x10^{-5} Pa.

A-Weighting: The human ear does not respond uniformly to different frequencies; A-weighting is commonly used to simulate the frequency response of the ear. It is used in the assessment of risk of damage of hearing due to noise and is usually expressed with a capital A in the unit abbreviation (i.e. L_{Amax}, L_{Aeq}, etc.) or a capital A in brackets after a dB level, e.g. 3dB(A).

Frequency: Frequency is defined as the number of cycles per second and is denoted by Hertz (Hz). For sound this is subjectively perceived as pitch.

Frequency Spectrum: Analysis of the relative contributions of different frequencies that make up a noise.

Free-field: The term "free-field" is used to define noise levels that have been measured or predicted in the absence of any influence of reflections from nearby surfaces, other than the ground. In practice, a noise level is considered free-field if it is at a distance greater than 3.5m from any reflecting surfaces, other than the ground.

Façade Level: A façade level refers to noise levels at an assessment location 1m from the façade of a building or other reflective structure. The difference between the façade and free-field noise level depends on the distance from the reflecting surface, but it is generally accepted to be 2.5dB(A) at a distance of 1m.

$L_{Aeq,T}$: The equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level (dB) of a continuous steady sound within a specified time interval T (seconds), has the same rms sound pressure as a sound that varies with time.

$L_{A10,T}$: The A-weighted sound pressure level exceeded for 10% of the time during the measurement period. This is the noise index typically used to describe road traffic noise, for example, when calculating road traffic noise in accordance with the Department of Transport's and Welsh Office publication: Calculation of Road Traffic Noise (CRTN 1988).

$L_{A90,T}$: The A-weighted sound pressure level exceeded for 90% of the time during the measurement period. This is the noise index is typically used to define the underlying background noise level.

L_{Amax}: The maximum rms A-weighted sound pressure level occurring within a specified time period.

Fast Time Weighting: Fast time weighting indicates sound pressure level measurements undertaken using a 125-millisecond moving average time weighting period (i.e. L_{AFmax}).

Peak Particle Velocity: Peak Particle Velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. It is specified in millimetres per second (mm/sec). It should be noted that the PPV refers to the movement within the ground of molecular particles and not surface movement.