Proposed Dwellings

53 Small Road

Silverdale, Auckland

ACOUSTICS

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Prepared for: Nation Shine Holdings Limited

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Document Control

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1 Introduction

This report has been prepared to assess the internal and external noise requirements for the proposed dwellings at 53 Small Road, in Silverdale, Auckland. The site for the proposed development will be a development of the eastern side of the site, with the larger western/central portion of the site being a consented mixed development of light industrial units. The proposed development comprises 17 stand-alone dwellings.

This report is intended as an acoustic assessment of the proposed development against the applicable standards for the subject site, including the Auckland Unitary Plan – Operative Version (AUP). This report:

- Identifies noise generating and receiving activities both within the development and for the surrounding environment in terms of regulatory zoning, and applicable noise regulations
- Assesses these activities against noise compliance criteria for the subject zones, and
- Proposes mitigation measures and strategies for compliance with the noise standards.

2 Site

2.1 Identification

The proposed development site is located in an area Business – General Business Zone. The area of development is proposed over a single site, however, will be subdivided to suit the development.

Figure 1 - Site Location

The proposed development covers the following land parcel(s): Lot 2 DP 590220.

2.2 Zoning

In accordance with the Auckland Unitary Plan – Operative Version, the subject site and adjacent sites are zoned *Business – General Business Zone*.

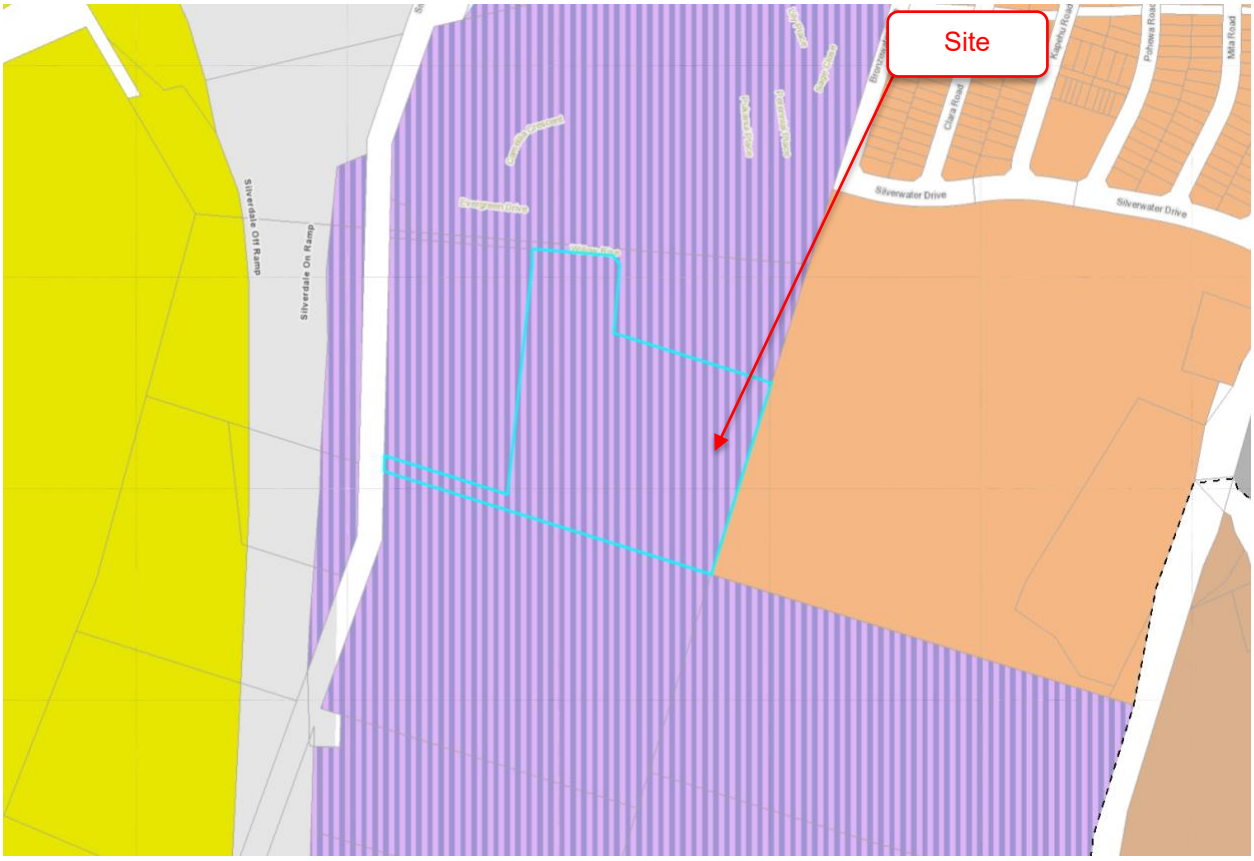

Figure 2 - Site Zoning

2.3 Topography

The following figure is indicative of the topography of the site.

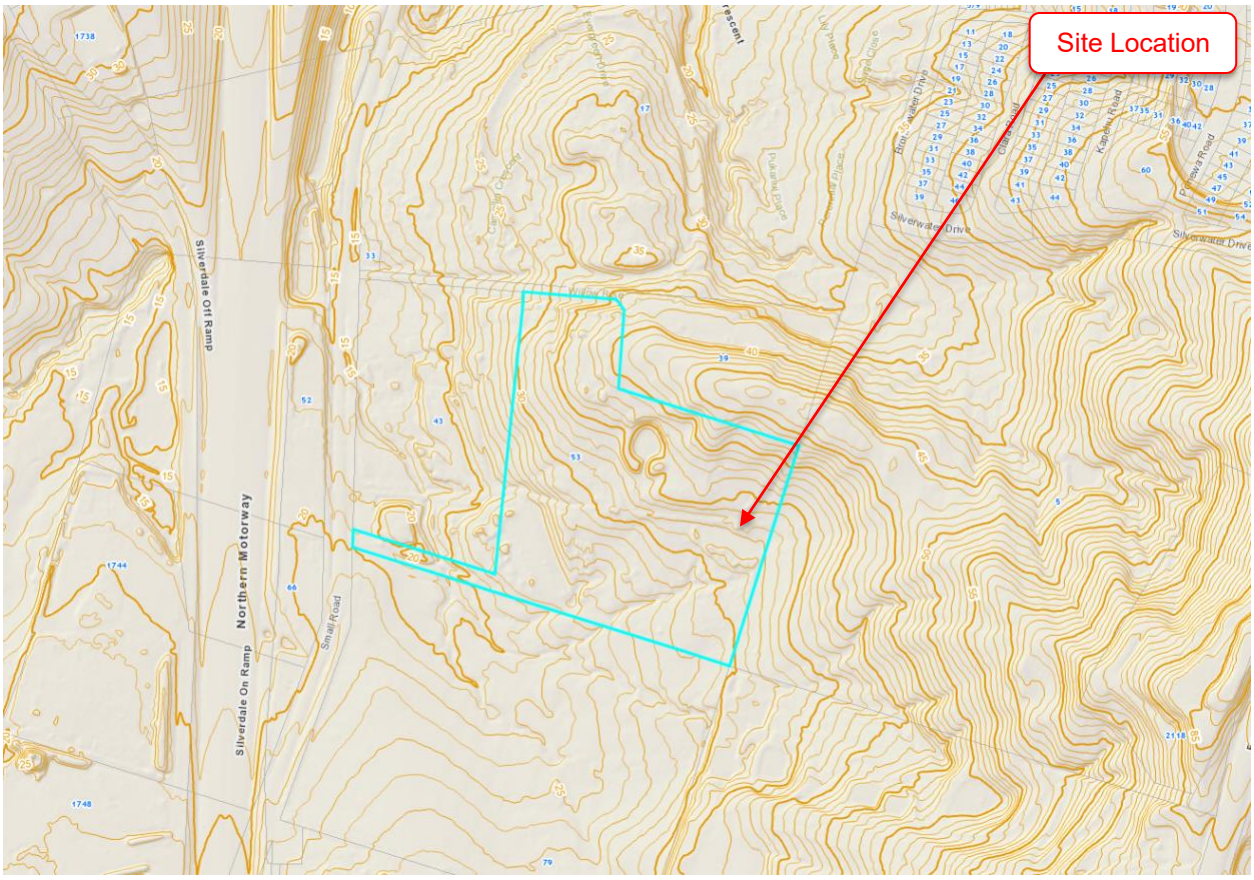

Figure 3 – Site Topography

3 Proposed Development

The proposed development includes 17 stand-alone, two-storey high dwellings. The following is a site plan and a representative of the proposed development.

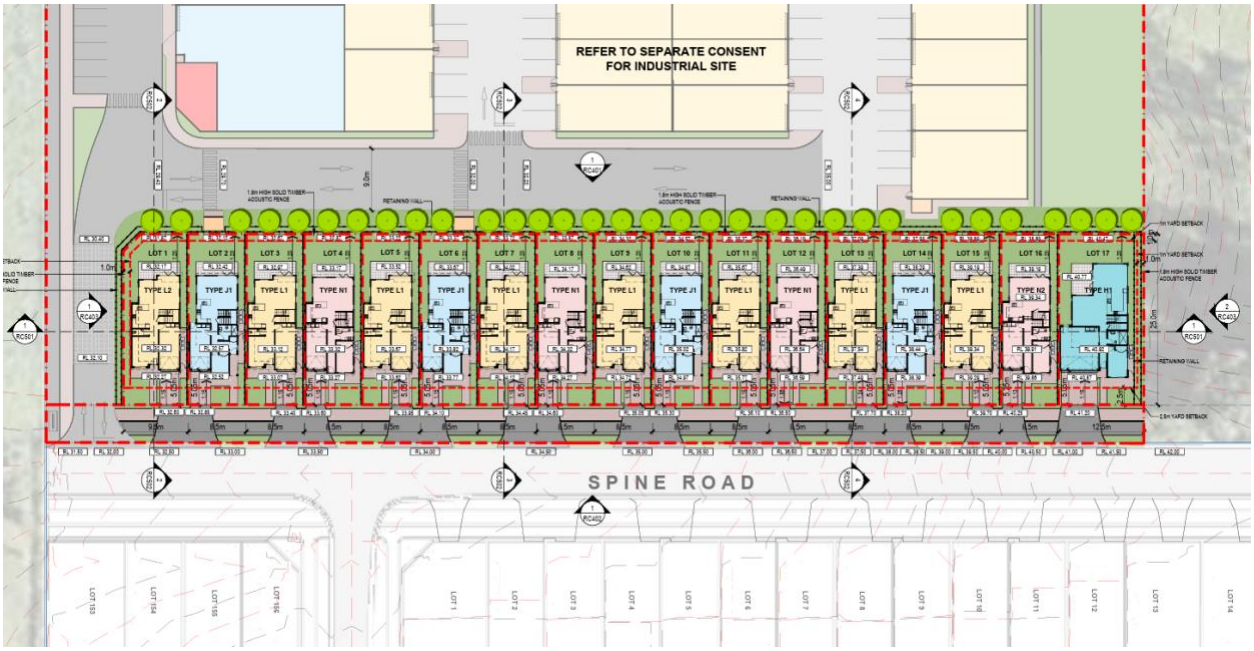

Figure 4 - Proposed Site and Ground Floor Plan

4 Operational Noise Standards

4.1 Noise Levels within Business – General Business Zone – AUP – E25.6.6

In accordance with the Auckland Unitary Plan (AUP) – E25.6.6, *the noise (rating) level arising from any activity in the Business – General Business Zone measured within the boundary of any other site in those zones must not exceed the limits in Table E25.6.6.1 Noise levels in the Business – General Business Zone below:*

Time	Business General Business Zone
All times	65dB L_{Aeq}

Table 1 - Noise Levels in Business – General Business Zones

No internal noise level requirements apply, with the Business – General Business Zone not being subject to the requirements of rule E25.6.9 or E25.6.10. Nevertheless, the internal noise level recommendations are applied to the acoustic assessment in accordance with the AS/NZS 2107:2016.

For reference E25.6.10 will be targeted as a suitable design level for internal noise amenity. However, due to relatively unrestrictive noise limits in the Business – General Business Zone, night-time internal noise levels may be unobtainable relative to the permitted maximum. This is particularly true of the potential noise levels at low frequencies.

4.2 Internal Noise Levels – Noise Sensitive Spaces – AUP – E25.6.10

In accordance with the Auckland Unitary Plan (AUP) – E25.6.10, Noise levels received within noise sensitive spaces within Business – Town Centre Zone from the maximum permitted noise from neighbouring sites are as follows.

Unit Affected	Time	Noise Level
In bedrooms and sleeping areas within units containing activities sensitive to noise	**Between 11pm and 7am**	35dB L_{Aeq} 45dB at 63 Hz L_{eq} 40dB at 125Hz L_{eq}
Other noise sensitive spaces	**At all other times**	40dB L_{Aeq}

Table 2 - Noise Levels in noise sensitive spaces in the Business Zone

4.3 Business Zones Interface – AUP – E25.6.19

In accordance with the Auckland Unitary Plan (AUP) – E25.6.19, *the noise (rating) level and maximum noise level arising from any activity in the Business Zone measured or assessed at or within the boundary of any other site in the Residential Zones must not exceed the limits in Table E25.6.19.1*.

Time	Noise Level
Monday to Saturday 7am – 10pm	55dB L_{Aeq}
Sunday 9am – 6pm	
All other times	45dB L_{Aeq} 60dB L_{eq} at 63 Hz 55dB L_{eq} at 125 Hz 75dB L_{AFmax}

Table 3 - Noise Levels received at Residential Zones

5 Compliance Standards Summary

5.1 External Noise Levels

Location	Zone	Time	Limits
External – Neighbouring Building Façade	**Business – General Business Zone**	All times	65dB L_{Aeq}
External – Boundary	**Residential Zones**	Monday to Saturday 7am – 10pm	55dB L_{Aeq}
		Sunday 9am – 6pm	
		All other times	45dB L_{Aeq} 60dB L_{eq} at 63 Hz 55dB L_{eq} at 125 Hz 75dB L_{AFmax}

Table 4 - Noise limits at Neighbouring Receivers

5.2 Internal Noise Levels

Unit Affected	Time	Noise Level
In bedrooms and sleeping areas within units containing activities sensitive to noise	**Between 11pm and 7am**	35dB L_{Aeq} 45dB at 63 Hz L_{eq} 40dB at 125Hz L_{eq}
Other noise sensitive spaces	**At all other times**	40dB L_{Aeq}

Table 5 - Noise Levels in noise sensitive spaces in the Business Zones

6 Noise modelling

6.1 Metrics

In accordance with the Auckland Unitary Plan and NZ standards NZS6801, NZS6802, and NZS6803, the following metrics are used to quantify noise and vibrations:

- **L_{WA} [dB]**: A-Frequency Weighted sound power level. This metric is primarily used to describe the power output from a sound source for the purposes of modelling.
- **LA_{eq} [dB] or L_{eq} [dBA]:** A-Frequency Weighted time average sound level. This metric represents the full audio range weighted against the response of the human ear. This is the primary descriptor of noise for receivers.
- **LA_{max} [dB] or L_{max} [dBA]:** Maximum sound pressure level.

6.2 Building Construction Modelling

The following parameters are used for the purposes of assessment of noise levels and attenuation performance:

- Sound Insulation Prediction is done in accordance with EN12354/3 using Insul software Version 8.0.7.
- Assessment is based on attenuation of noise across the 1-Octave frequency range. While a single Standardised Sound Level Difference is provided for each combination, assessment of attenuation performance is based on the frequency based Sound Transmission Loss.
- Frequency distribution is based on entertainment noise in 1 Octaves

Worth noting here that a reduction of 10-15dBA is the maximum that can be achieved with windows open in a dwelling. To achieve higher attenuation levels, windows need to be closed and mechanical ventilation installed.

6.3 Acoustic Modelling

An environmental model has been constructed for the area using CadnaA version 2025 computer modelling program. The modelling method for noise propagation over distance is based on the international standard ISO 9613: "Acoustics – Attenuation of sound during propagation outdoors" methodology.

- The model allows importing digital ground elevation contours and data to define the topography and data for each of the noise sources.
- The program then calculates the L_{Aeq} dB level, which is the basis of the Unitary Plan noise limits.

7 Noise Sources

7.1 Ambient Noise

The site is located within a Business – Business Centre Zone and is therefore there are no internal noise level requirements. Nevertheless, the internal noise levels are recommended to meet the internal noise levels of E25.6.10, based on the maximum permitted noise for the zoning.

Note that acoustic fencing is proposed along the boundary shared with the neighbouring consented industrial activities to the west. This will provide some reduction of the noise, in particular from truck traffic noise. However, noise levels will be elevated at the upper level facades, predicted to reach up to 57dB LAeq at the most exposed facades.

7.2 Mechanical Plant

All mechanical plant shall be designed, selected, positioned and shielded to control noise at any receiver to within the required compliance standards.

Earcon will aid in reviewing the selection and where necessary mitigation/attenuation of the mechanical plant in due course.

8 Recommendations

Based on the noise modelling from the combination of difference noise sources, and to achieve compliance with the required standards, the following is recommended.

8.1 Building Envelope

8.1.1 Façade

The proposed façade construction is fibre cement weatherboards. The external walls will be complete with thermal insulation batts (R1.8 minimum) and 10mm standard plasterboard. Such a construction is rated above STC 50 and is acoustically suitable.

8.1.2 Glazing

For all habitable rooms, the following example configuration would achieve compliance with internal noise levels.

- Glazing with manufacturer attenuation of:
    - Bedrooms: STC/Rw: 38 (e.g. Laminated IGU 6.38 mm laminate glass / 12mm AS / 6mm float glass or equivalent.)
    - All other habitable spaces STC/Rw: 31 (e.g. 6mm float glass / 6mm AS / 6mm float glass or equivalent.
- The STC rating takes into account the inclusion of acoustic fencing on the boundary.
- Window suites / frames are required to be complete with compressible weather seals.
- Mechanical Ventilation required in all habitable spaces where windows are required to be closed.

In order to meet the internal noise levels, where all windows of all the habitable spaces need to be closed, mechanical ventilation is required. We would like to clarify that the windows may be openable, i.e. those are not necessarily fixed windows, but would need to achieve the above performance when closed.

8.1.3 Roof

The roofing construction is profiled longrun metal roofing is acoustically suitable. The construction shall be complete with internal ceiling lining of 1x13mm Noiseline Plasterboard and thermal insulation batts (R2.2 minimum required for acoustics).

It is required that penetrations for light fittings in the ceilings of habitable areas at the top floor are to be restricted to 1x130mm diameter recessed light in the ceiling per $2m^2$ in order for sound insulation not to be adversely affected. The acoustic criterion also requires all penetrations to be acoustically sealed.

8.2 Ventilation

It is required that all habitable spaces are required to be provided with mechanical ventilation and/or a cooling system in accordance with the Auckland Unitary Plan standards applicable to new dwellings in business zones.

9 Building Services

9.1 Noise to Boundary Design Criterion

The average maximum noise level L_{Aeq} as measured at or within the boundary shall be restricted to an average maximum noise level as indicated in Table E25.6.8.1 of the Unitary Plan when measured at the boundary of the site.

Time	Noise Level
At all times	65dB L_{Aeq}

Table 6 – Auckland Unitary Plan Noise limits: Reference Table E25.6.6.1

9.2 Background Noise Design Criteria

Mechanical services to be designed and acoustically treated to meet the following design criteria:

Space	Noise Level L_{Aeq}
Bedrooms	30 dB
Other habitable spaces	35 dB
Toilets	45 dB

Table 7 – Recommended Internal Noise Levels

9.3 Mechanical Services acoustic treatment

The table below summarises the indicative acoustic treatment in place. The detailed acoustic treatment will be coordinated with the Mechanical Engineer and Contractor in due course.

Noise source	Location	Acoustic treatment
Toilet & Laundry exhaust fans	One system for each apartment	Attenuators on discharge of the fan as required & Vibration isolation
Fresh air fans	One system for each apartment	Attenuators on discharge of the fan as required & Vibration isolation
Kitchen extract fan	Kitchen Hood	Multi speed control for the fan
Heat pumps	Central rooftop plant	Multi speed control, Vibration isolation and acoustic screening

Table 8 – Typical Mechanical Plant Acoustic Treatment

10 Conclusions

Provided the recommendations of this report are implemented, the subject development would be compliant with relevant noise standards and internal noise levels recommendations based on the Auckland Unitary Plan.

Glossary of Terms- Acoustics

Ambient Noise: the total noise, at a given place, a composite of sounds from many sources near and far.

Asymmetric: a waveform not identical on both sides of the mean or zero line, lacks symmetry.

Average: in acoustics where dB levels are extensively used, average may not mean adding up the values and then dividing by the number of samples.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

In acoustical measurements, Sound Pressure Level is often measured in octave bands, and the centre frequencies of these bands are defined by ISO - 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz to divide the audio spectrum into 10 equal parts.

The sound pressure level of sound that has been passed through an octave band pass filter is termed the octave band sound pressure level.

One-third Octave Bands, there are three similar bands in each octave band.

1/1, 1/3, 1/6, 1/12, and 1/24 octaves are all used in acoustics.

Background Noise: the noise at a given location and time, measured in the absence of any alleged noise nuisance sources, also known as Residual Noise.

Broadband Noise: also called wideband noise - noise whose energy is distributed over a wide section of the audible range as opposed to Narrowband Noise.

Class 1: precision grade sound level meters for laboratory and field use - also known as Type 1.

Continuous Spectrum: sound spectrum whose components are continuously distributed over a given frequency range.

Frequency Weighted Sound Levels: Frequency weightings correlate objective sound measurements with the subjective human response. The human ear is frequency selective; between 500 Hz and 6 kHz our ears are very sensitive compared with lower and higher frequencies.

A-weighting: the A-weighting filter covers the full audio range - 20 Hz to 20 kHz and the shape is similar to the response of the human ear at the lower levels

C-weighting: a standard frequency weighting for sound level meters, commonly used for higher level measurements and Peak - Sound Pressure Levels.

Z-weighting: Z for 'Zero' frequency weighting, which implies no frequency weighting. In reality the range is 10 Hz to 20 kHz ±1.5 dB.

dB Level: is the Logarithm of the ratio of a given acoustic quantity to a reference quantity of the same kind. The base of the logarithm, the reference quantity, and the kind of level must be indicated.

decibel: dB : a relative unit of measurement widely used in acoustics, electronics and communications. The dB is a Logarithmic unit used to describe a ratio between the measured level and a reference or threshold level of 0dB. The ratio may be Sound Power, Sound Pressure, voltage or Sound Intensity, etc.

Deltatron ®: trade name for IEPE - Integrated Electronics Piezoelectric.

FFT: Fast Fourier Transform : a digital signal processing technique that converts a time record into a narrow band constant bandwidth filtered spectrum. Measurements are defined by specifying the frequency span and a number of lines (or filters).

Frequency: f : the number of times that a Periodic function or vibration occurs or repeats itself in a specified time, often 1 second - cycles per second. It is usually measured in Hertz (Hz).

Frequency Analysis: analysing an overall broadband noise to identify the different contributions in different parts of the audio spectrum. Typically the analysis in made using 1/1-Octave, 1/3-Octave or narrow band (FFT) Analysis.

Frequency Band: a continuous range of frequencies between two limiting frequencies.

Hertz: Hz : the unit of Frequency or Pitch of a sound. One hertz equals one cycle per second.

Impact Sound: the sound produced by the collision of two solid objects. Typical sources are footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building.

Infrasound: sound whose frequency is below the low-frequency limit of audible sound (about 16 Hz).

Integrating (of an instrument): indicating the mean value or total sum of a measured quantity.

kHz: kilohertz : 1 kHz = 1000 Hz = 1000 Hertz.

LA: A-weighted, Sound Level.

LA10: is the noise level just exceeded for 10% of the measurement period, A-weighted and calculated by Statistical Analysis.

LA90: is the noise level exceeded for 90% of the measurement period, A-weighted and calculated by Statistical Analysis.

LAn: noise level exceeded for n% of the measurement period with A-weighted , calculated by Statistical Analysis - where n is between 0.01% and 99.99%.

LAeq: A-weighted, equivalent sound level. A widely used noise parameter describing a sound level with the same Energy content as the varying acoustic signal measured - also written as dBA Leq

LAF: A-weighted, Fast, Sound Level.

LAFmax: A-weighted, Fast, Maximum, Sound Level.

LAFmin: A-weighted, Fast, Minimum, Sound Level.

LAIeq: A-weighted, Impulse, Leq, Sound Level.

LAmax: A-weighted, Maximum, Sound Level

LAS: A-weighted, Slow, Sound Level.

LASmax: A-weighted, Slow, Maximum, Sound Level.

LASmin: A-weighted, Slow, Minimum, Sound Level.

LC: C-weighted, Sound Level.

LCE: C-weighted, Sound Exposure Level

LCeq: C-weighted, Leq, Sound Level

LCF: C-weighted, Fast, Sound Level.

LCFmax: C-weighted, Fast, Maximum, Sound Level.

LCpeak: C-weighted, Peak, Sound Level.

Leq: Equivalent Sound Level

Lpeak: Peak Sound Level

LZ: Z weighted, Sound Level.

LZE: Z-weighted, Sound Exposure Level

LZeq: Z-weighted, Leq, Sound Level.

LZF: Z-weighted, Fast, Sound Level.

LZFmax: Z-weighted, Fast, Maximum, Sound Level.

LZFmin: Z-weighted, Fast, Minimum, Sound Level.

Multi-spectrum: a one or two-dimensional array of spectra, consisting of two or more spectra that were recorded during the same measurement

Narrowband Noise: noise which has its energy distributed over a relatively small section of the audible range.

Natural Frequency: the frequency at which a resiliently mounted mass will vibrate when set into free vibration. The frequency of oscillation of the free vibration of a system if no Damping were present.

Noise: any sound that is undesired by the recipient. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources. Interference of an electrical or acoustical nature.

Octave: a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.

Octave Band analyser: an instrument that measures Sound Levels in octave bands.

Peak-to-Peak: the amplitude difference between the most positive and most negative value in a time waveform, that is, the total Amplitude.

Piezoelectric: PE : any material which provides a conversion between mechanical and electrical energy. Piezo is a Greek term which means 'to squeeze'. If mechanical stresses are applied to a piezoelectric crystal, then an electrical charge results. Conversely, when an electrical voltage is applied across a piezoelectric material, the material deforms.

Pitch: is a subjective auditory sensation and depends on the frequency, the harmonic content, and to a lesser extent on the loudness of a sound.

Spectrum: the description of a sound wave's resolution into its components of frequency and amplitude.

Third Octave Band: Octave bands sub-divided into three parts, equal to 23% of the centre frequency. Used when octave analysis is not discrete enough. Divides the audio spectrum into 33 or more equal parts with Constant Percentage Bandwidth filter.

Tone: sound or noise recognisable by its regularity. A simple or Pure Tone has one frequency. Complex tones have two or more simple tones, the lowest tone frequency is called the Fundamental, the others are Overtones.

Vibration: mechanical oscillations occur about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random.