SOUND ANALYSIS

Consultants in Noise and Vibration

Acoustic Consultancy Report
4279-ENV-ATN-1

Report on: 114-116 Fortress Road, London, NW5 2HL

Client: Direct Planning

16th June 2017

Analysis of Plant Noise to Atmosphere

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Introduction

Sound Analysis Ltd was appointed to carry out an Acoustic Survey to establish current background noise levels, and to calculate, for comparison, the airborne noise transmitted from the proposed Kitchen Extract and system to atmosphere, at 114 – 116 Fortress Road, London, NW5 2HL

1 General Arrangement

The Kitchen Extract System is contained within the building, and discharges at the side of the building. The nearest residential receptor is at 2.5m from the discharge.

2 Analysis Method.

The Sound Power level data for the Extract Fan, that has been provided, is used to calculate the resultant noise level at a position on the facade of the nearest residential property.

The units will potentially be operated seven days a week, between 08:00 to 23:00 hrs

3 Background Noise Survey

In order to produce a design target, background noise measurements were taken from 13:41 hrs on 12th June to 16:06 hrs on 13th June 2017, the full results of which are graphically shown in Appendix E

The following instrumentation and equipment was used during the testing:

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003.

- Svantek 949 Sound Level Meter S/N: 36121
- Svantek pre-amplifier SV12L S/N: 33636 with GRAS microphone capsule 40AE S/N: 58002

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10801 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz.

The general background noise was due to local traffic and plant on other premises, the weather was generally dry with light winds, and the location of the microphone is shown in Appendix D.

4 Measurement Results

The minimum levels measured over the period of measurement are as show in the following table, and all measured data is contained in Appendix E.

Period	L_{A90} 5min
08:00 to 23:00hrs	39.8 dB

Day 07:00 to 23:00hrs, Night 23:00 to 07:00 hrs

The units will operate from 08:00hrs to 23:00hrs the noise level data for that period will be used to assess the design target, namely L_{A90} 39.8 dB.

4.1.1 World Health Organisation Night Noise Guidelines for Europe (2009)

The WHO's document 'Night Noise Guidelines for Europe (NNG) states the following:

"*...it is recommended that the population should not be exposed to night noise levels greater than 40 dB of* $L_{night, outside}$ *during the part of the night when most people are in bed.*"

"*An interim target (IT) if 55 dB* $L_{night, outside}$ *is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons.*"

As the above guideline values consider the combined level of noise external to a façade (i.e. vehicular traffic, air traffic, building services noise etc, it is recommended that a criterion of 5-10 dB below these given levels is applied, depending on the particulars of the site in question.

4.1.2 World Health Organisation (WHO) Guidelines for Community Noise (1999)

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:Table 1: Guideline values for community noise, from Guidelines for Community Noise (WHO, 1999)

Specific Environment	$L_{Aeq, T}$ dB	Time Base (hours)	L_{Amax}, fast dB
Outdoor living area (serious annoyance, daytime and evening)	55	16	-
Outdoor living area (moderate annoyance, daytime and evening)	50	16	-
Dwelling, indoors	35	16	-
Inside bedrooms	30	8	45
Outside bedrooms	45	8	60
Outdoors in parkland and conservation areas*	-	-	-

* Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

4.1.3 BS8233:1999

Appropriate guidance is contained within BS8233: 1999: *Sound Insulation and Noise Reduction for Buildings – Code of Practice*. This British Standard sets out recommended noise limits for indoor ambient noise levels from continuous sources of noise, such as road traffic, ventilation and mechanical services noise. A summary of recommended internal noise levels in bedrooms is provided in Table 4.

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise. BS8233 gives internal criteria for bedrooms and living rooms for both 'reasonable' and 'good' resting/sleeping conditions.

Table 2: Recommended Indoor Ambient Noise Levels from BS8233: 1999

Bedrooms	Design Range $L_{Aeq, T}$	
	Good	Reasonable
Reasonable resting / sleeping conditions	30[a]	35
For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45dB L_{Amax}.		

5 Design Target

Local Council requirements in London, normally call for the design level to be 10dB below the measured lowest background noise level.

This results in the following L_{Aeq} design noise levels for nearest residential properties.

Lowest background level during the operating period was L_{A90} 39.8 dB, which results in a target design level of L_{Aeq} 28.8 dB

6 Data Provided.

The noise data for the Extract Fan is given in the form of Sound Power Level, and confirmed in Appendix together with the insertion loss of the proposed attenuators.

7 Method of Analysis.

In calculating the resultant noise level of the Extract Fan at the adjacent property, the current design of the system has been taken into account.

The calculated level, shown in Appendix B, for the overall sound level, from Extract Fan is indicated below, and is 10.8 dB(A) below the current lowest measured L_{A90} level.

Location	Overall Calculated dB(A)
Residential facade	28

8 Conclusion

The extract fan will have an attenuator fitted, to meet the design target and the performance requirement for this attenuator is shown in Appendix A, and the external ductwork should be lagged with BM5 barrier mat.

As the maximum overall noise level from discharge and duct radiated noise is 10.8 dB(A) below the lowest measured background noise level, complaints by the nearest residents would not be expected.

SOUND ANALYSIS

Appendix A – Fan Sound Power Level.

ELTA SCPP 500/4-1

Plant	Sound Power Levels re: 10^{-12} W									dB(A)
	63	125	250	500	1k	2k	4k	8k	Hz	
Fan Inlet	75	75	82	80	78	75	70	63	dB	62
Fan Outlet	76	76	82	79	79	77	73	67	dB	63

Extract Discharge	Extract Fan Attenuator Insertion Loss dB								
	63	125	250	500	1k	2k	4k	8k	Hz
Insertion Loss	4	10	16	26	29	29	29	20	dB

Appendix B – Extract Fan Sound Calculations

Client Direct Planning

Project Name Fortress Road

File No 4279 **Date:** 14.6.17

			63	125	250	500	1k	2k	4k	8k	dB(A)
ELTA Fan Sound Power	**SCPP500/4-1**		**76**	**76**	**82**	**79**	**79**	**77**	**73**	**67**	
No of Sources	1		76	76	82	79	79	77	73	67	
Overall In-Duct Lw			**76**	**76**	**82**	**79**	**79**	**77**	**73**	**67**	**84**
Ducting losses 14m @ 400 x 400		dB	9	9	5	2	2	2	2	2	
Bend losses 2 x 400		dB				2	4	6	6	6	
End reflection	0.3	m2	10	6	2						
Directivity correction	90	deg	2	4	5	8	10	11	11	11	
Rev Build Up Corrn		dB									
Distance to spec point	2.5	m	8	8	8	8	8	8	8	8	
Hemi or Spherical H/S	s		11	11	11	11	11	11	11	11	
		dB									
Result at spec distance		**dB**	**36**	**38**	**51**	**48**	**44**	**39**	**35**	**29**	**49**
	dB(A)	NR									
Specified Level		22	53	41	32	26	22	19	16	15	**32**
Other losses											
Insertion Loss reqd											
Applied Insertion Loss											
500 Circular - 600 long	Pod	dB	4	10	16	26	29	29	29	20	
Resultant Level		**dB**	**32**	**28**	**35**	**22**	**15**	**10**	**6**	**9**	**27**
		**									
		**									

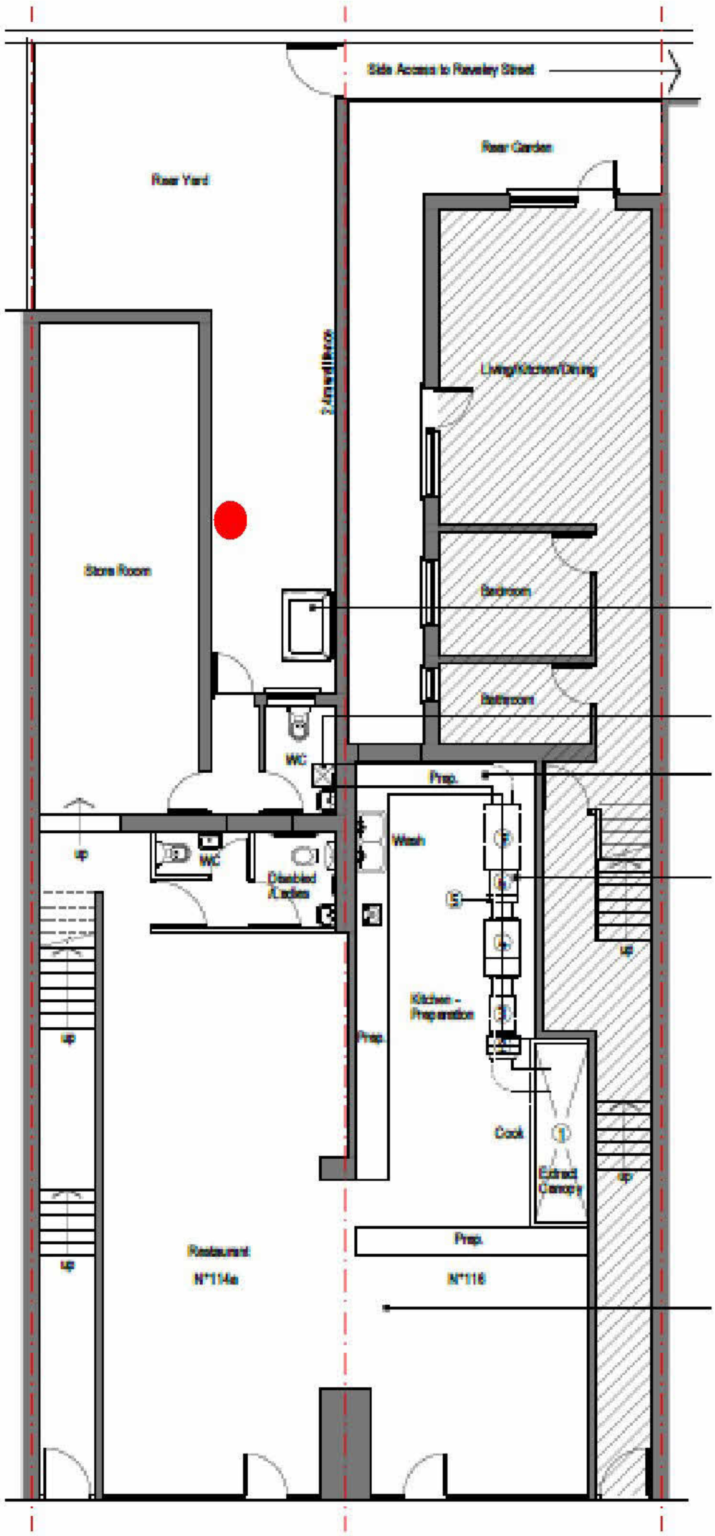
Check Breakout from rising duct

			63	125	250	500	1k	2k	4k	8k	dB(A)
Fan Sound Power Level at roof level			**72**	**66**	**66**	**51**	**46**	**42**	**38**	**41**	
Bend loss					0	2	4	6	6	6	
Ductwork gauge 18g		SRI	12	15	20	25	30	35	39	39	
5kg Barrier Mat	Yes	SRI	8	12	17	22	28	30	32	34	
Radiated Lw			**52**	**39**	**29**	**4**	**-12**	**-23**	**-33**	**-32**	
Radiating Area	14	m2	11	11	11	11	11	11	11	11	
Distance loss to	1.5	m	15	15	15	15	15	15	15	15	
Result at nearest property			**49**	**36**	**26**	**1**	**-15**	**-26**	**-36**	**-35**	**25**

Appendix C: Location Map

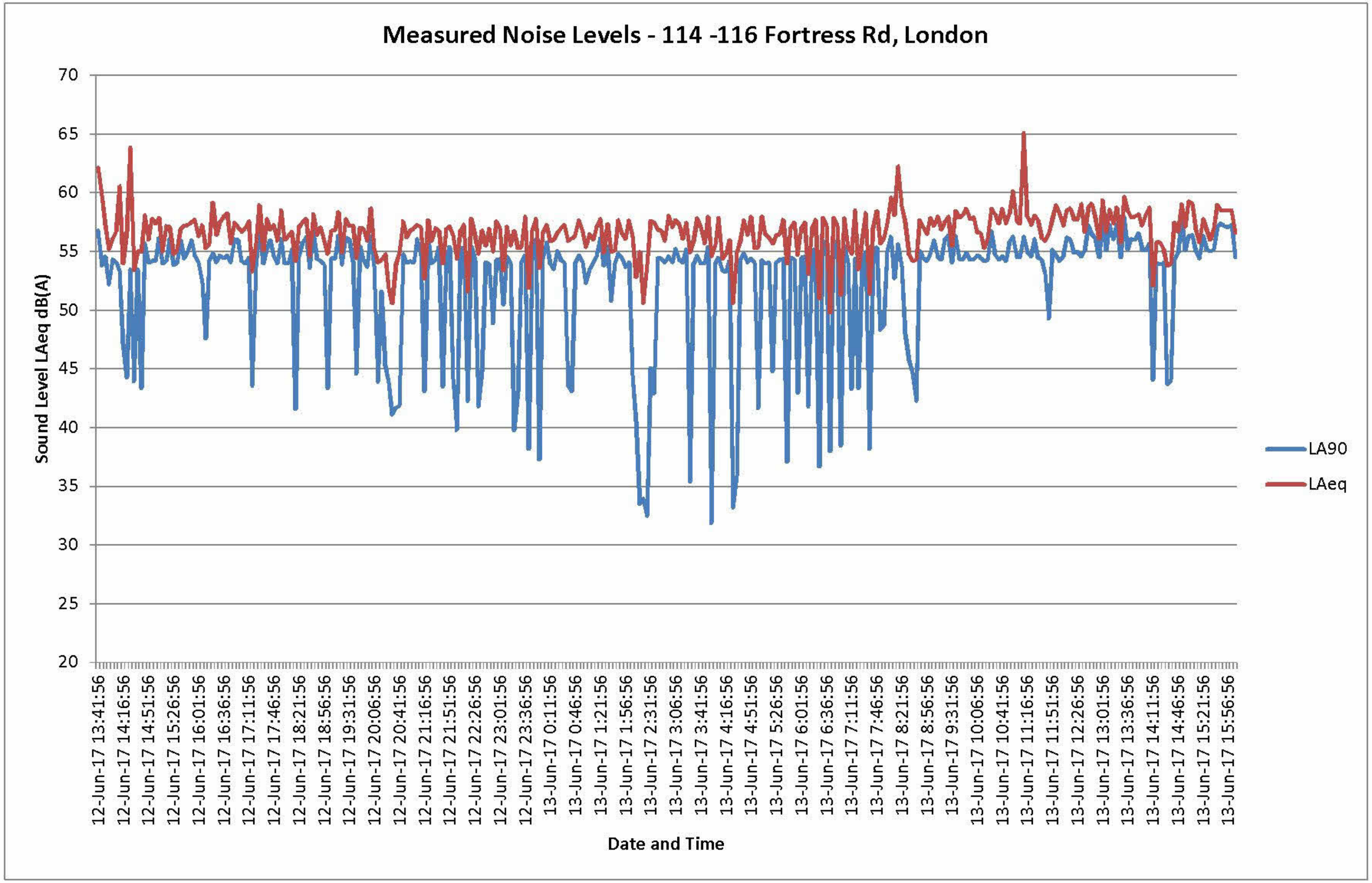
Appendix D: Layout Drawing

Measurement position



PROPOSED GROUND FLOOR PLAN

Appendix E: Measured Noise Levels



Appendix G: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

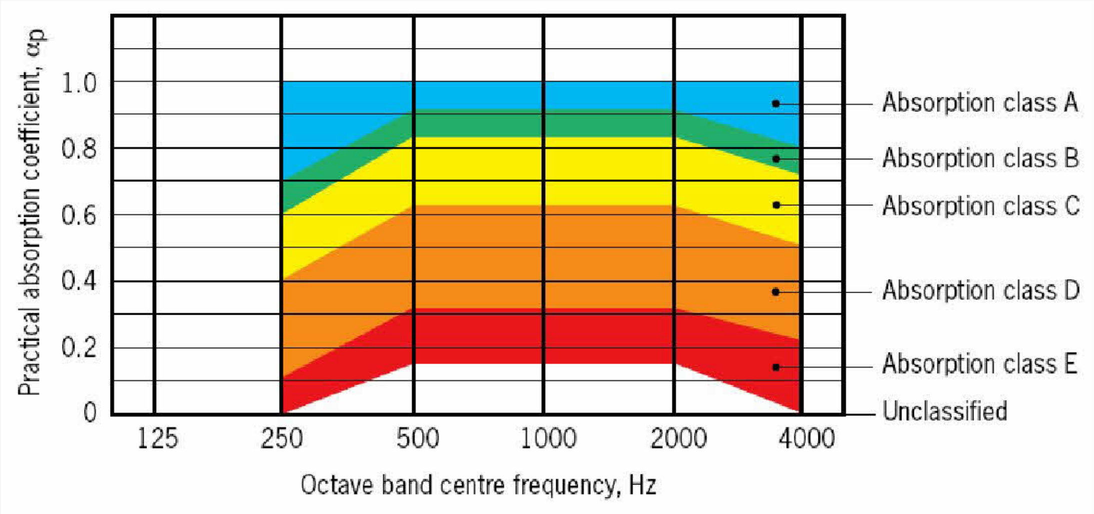
'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

Ambient Noise

The total noise level including all 'normally experienced' noise sources.

dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

D_{nTw}+C_{tr}

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in L'_{nTw}.

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The ‘A’ weighted maximum measured noise level. Can be measured with a ‘slow’ (1 sec) or ‘fast’ (0.125 sec) time weighting.

L_{Amin}

The ‘A’ weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L	Is the spatially averaged impact sound pressure level measured in a receive room.
L'_{nT}	Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.
L'_{nTw}	Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

Speech Intelligibility, Speech Transmission Index (STI)

Speech intelligibility is the measure of how well a speaker's voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

Subjective Effect of Changes in Sound Pressure Level

A basic example to illustrate the assessment of difference in noise levels follows.

A background noise survey is undertaken that yields a lowest background noise level of L_{A90} 30 dB.

As the existing background noise level is low, a rating level for new plant noise of $L_{Aeq,\,T}$ 30 dB is set.

After calculation, the plant noise is predicted to achieve $L_{Aeq,T}$ 30 dB at the nearest residential property.

After the addition of the plant predicted noise level (or Rating Level), the new overall ambient noise level will be 33 dB. The background noise level measured originally will therefore be increased by 3 dB. In terms of the subjective impression of an increase of this order, the change in levels will be 'just perceptible'.

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.