Acoustic Consultancy Report

92309/3/1/2

External Plant Assessment

Report Prepared For

Wimberly Allison Tong & Goo (Uk) Ltd
7 Dials Warehouse
11 December 2018

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Contents

i) Executive Summary

New mechanical plant is to be installed at 7 Dials Warehouse, Earlham Street, London.

LCP has been commissioned by Wimberly Allison Tong and Goo Ltd to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The design criterion is as follows:

Day:	40 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Evening:	40 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Night:	37 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Commercial:	55 dB $L_{Aeq,\,T}$ at 16m, Commercial property towards the south of site.

The design as proposed and assessed will achieve the required criteria, the calculated rating levels are as follows:

Day:	33 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Evening:	33 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Night:	33 dB $L_{Aeq,\,T}$ at 55m, Residential property on Mercer Street;
Commercial:	44 dB $L_{Aeq,\,T}$ at 16m, Commercial property towards the south of site.

This report concludes that the design criteria can be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	11th December 2018	Initial Issue	RM	MB

1 Introduction

New mechanical plant is to be installed at 7 Dials Warehouse, Earlham Street, London.

LCP has been commissioned by Wimberly Allison Tong and Goo Ltd to carry out an acoustic environment survey and to use the obtained data to assess the potential noise impact of the plant installation on surrounding noise sensitive receptors.

The report details recommendations for necessary noise mitigation where necessary.

The guidance in this report is on the basis that the mechanical plant will be consistently operating over a 24 hour period.

2 Survey

2.1 Site Description

The site layout together with the measurement position is shown in the drawing contained within Appendix A.

2.2 Receiver Location

The site was surveyed to determine the location of the most affected receiver.

The nearest residential receiver to the plant area is 55m to the south west of the site. The nearest commercial receiver is 16m towards the south of the site. This is shown in the site plan in Appendix A

2.3 Local Noise Climate

The predominant local noise source was road traffic noise.

2.4 Measurements

The noise monitoring took place from the 03/12/2018 to the 04/12/2018. The measurement period was considered sufficient to establish the representative background sound levels corresponding to the operational period of the plant.

The weather conditions monitored during the survey are shown in the following table.

Table 1: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	5m/s
Wind Direction	NE
Cloud Cover	100%
Max. Temperature	14°C
Min. Temperature	0°C
Precipitation	Showers throughout the day.

2.5 Measurement Results

The measured statistical broad-band sound pressure levels are shown within Appendix B. The lowest background sound level(s) obtained being as follows:

Table 2: Lowest background sound levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 15\ mins}$ Day*	$L_{A90,\ 15\ mins}$ Evening*	$L_{A90,\ 15\ mins}$ Night*
MP1	50	50	47

* Day, Evening and Night periods are defined as between 07:00 - 19.00, 19.00 - 23.00 and 23:00 - 07:00 respectively.

3 Evaluation of Design Criteria

3.1 Residential Design Criterion

3.1.1 BS4142:2014

BS4142:2014 states that the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

Table 3: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Indication of a significant adverse impact
+ 5 dB	Indication of an adverse impact
0 dB	Indication of low impact

Certain acoustic features can increase the significance of impact. The specific sound level should be corrected if a tone, impulse or other acoustic feature is expected to be present.

Table 4: Corrections for acoustic features, subjective method

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	2	4	6
Impulsivity	3	6	9
Other Characteristics	3		
Intermittency	3		

Typically the acoustic feature correction would not be expected to exceed 10dB.

Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty.

3.1.2 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*."

It then goes on to say:

"*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*."

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

The WHO's 'Guidelines for Community Noise' gives the following relevant noise criteria:

Table 5: 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

The WHO's 'Guidelines for Community Noise' also gives the following general guidance on the expected sound insulation performance of a façade with a partly open window, it states that:

"*At night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB* L_{Aeq} *and 60 dB* L_{Amax}*, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.*"

3.1.4 BS8233:2014

The criteria offered in BS8233 for residential buildings are largely based on the recommendations made in the Guidelines for Community Noise.

Using the general guidance from above, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in table 4 of BS8233 in order to obtain acceptable external noise levels.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

Table 6: External ambient noise levels for dwellings, based on BS8233, dB re $2x10^{-5}$ Pa

Activity	Location	Time period	
		07:00 to 23:00	23:00 to 07:00
Resting	Living Room	50 $L_{Aeq,16\ hour}$	-
Dining	Dining Room/area	55 $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	50 $L_{Aeq,\ 16\ hour}$	45 $L_{Aeq,\ 8\ hour}$

In addition to the above criteria, BS8233 goes on to say:

"*For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 $L_{Aeq,\ T}$, with an upper guideline value of 55 dB $L_{Aeq,\ T}$ which would be acceptable in nosier environments*."

The above criteria are in line with the recommendations made in WHO's 'Guidelines for Community Noise'.

3.1.5 Local Authority Requirements

The London Borough of Camden conditions state that the noise level from any fixed mechanical plant/activity shall not exceed 5 dB below the lowest measured background noise level at 1m externally to the nearest noise sensitive facade.

Where mechanical plant is tonal or intermittent, the design criterion must be reduced by a further 5 dB.

A noise sensitive development includes housing, schools, hospitals, offices, workshops and open spaces.

3.1.6 Recommended Residential Design Rating Level

On the basis of the above the recommended residential design rating level should therefore be:

Residential Design Rating Level
Lowest $L_{A90,\ 15\ mins}$ - 10 dB

3.2 Commercial Design Criterion (BS8233:2014)

External design criteria for non-residential buildings have been derived from BS8233:2014.

Using the general guidance from WHO, on the expected sound insulation performance of a façade with a partly open window, the criteria shown in the table below have been adapted from the criteria offered in tables 2 and 6 of BS8233 in order to obtain acceptable external noise levels.

The noise levels shown should be treated as overall noise levels, i.e., the combination of all existing noise levels at the site, and noise levels from any proposed plant or activity.

Table 7: External ambient noise levels for non-domestic buildings, based on BS8233, dB re $2x10^{-5}$ Pa

Activity	Location	Design Level $L_{Aeq,\ 16\ hr}$
Speech or telephone communications	Department store, cafeteria, canteen, kitchen	70

	Concourse, corridor, circulation space	70
Study and work requiring concentration	Library, gallery, museum	65
	Staff/meeting room, training room	60
	Executive office	55
	Open plan office	65
Listening	Place of worship, counselling, meditation, relaxation	50

3.2.1 Recommended Commercial Design Rating Level

On the basis of the above the recommended commercial design rating level should therefore be:

Commercial Design Rating level
$L_{Aeq,\ T}$ 55 dB

3.3 Design Rating Levels

The design levels to be adopted for this project are set out in the table below.

Table 8: Design rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	**Approximate Distance (m)**	**Design Level (Day)** $L_{Aeq,\ 12\ hr}$	**Design Level (Evening)** $L_{Aeq,\ 4\ hr}$	**Design Level (Night)** $L_{Aeq,\ 8\ hr}$
Residential property on Mercer Street	55	40	40	37
Commercial property towards the south of site	16	55	-	-

4 Review of Current Design

4.1 Current Design

The proposed plant shall be located on the roof within an existing plant enclosure and consists of 3 x Mitsubishi PUHZ-P100VKA condensers.

The proposed plant will have the capability to operate over a 24-hour period.

4.2 Calculated Results

Calculations of the predicted noise levels have been carried out with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in the table below.

Table 9: Design and predicted rating levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq,\ 12\ hr}$	Design Level (Evening) $L_{Aeq,\ 4\ hr}$	Design Level (Night) $L_{Aeq,\ 8\ hr}$	Predicted Level $L_{Aeq,T}$
Residential property on Mercer Street	55	40	40	37	33
Commercial property towards the south of site	16	55	-	-	44

Plant noise level data used in this assessment are contained within Appendix C.

Calculations are shown within Appendix D.

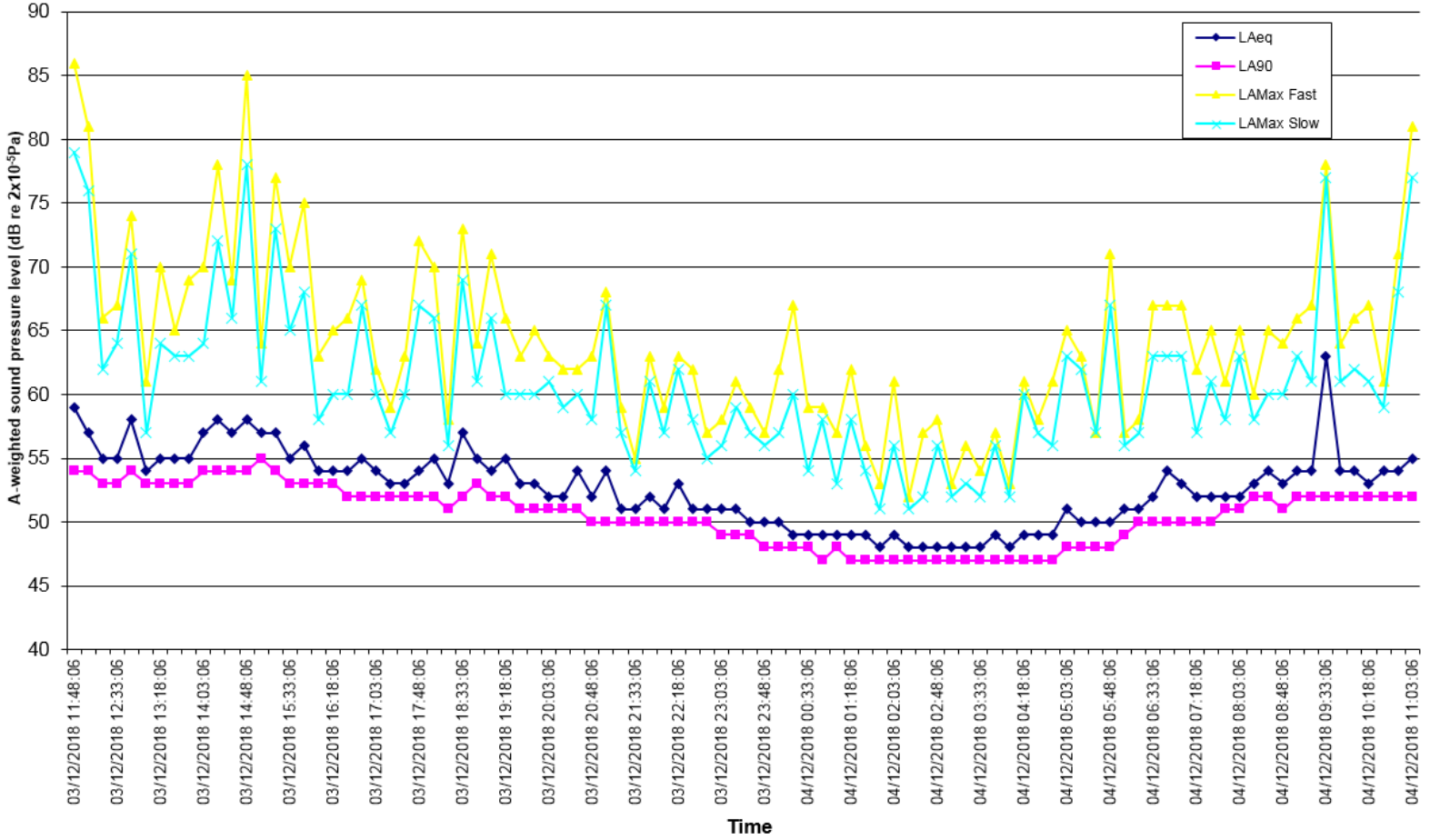
5 Conclusion

An environmental noise survey has been undertaken in order to establish the representative background sound levels local to the site generally in accordance with the method contained within BS4142: 2014.

Calculations have been carried out to determine the noise levels at the nearest receiver premises. The calculations show that the design criteria will be met.

Appendix A: Site Plan

Appendix B: Measurement Data



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

- Svantek 959 Sound Level Meter S/N: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 241965

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N:10893 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Plant Data

Plant noise data used in the preceding assessment follow.

Table 10: Manufacturer's plant sound pressure data, dB re $2x10^{-5}$ Pa

Plant	Distance (m)	Octave Band Centre Frequency (Hz)								L_{PA}
		63	125	250	500	1k	2k	4k	8k	
PUHZ-P100VKA	1	59	55	54	52	48	46	40	31	54

Appendix D: Calculations

Residential property on Mercer Street:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62
2	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62
3	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB	Façade correction	dB
55.0	-43	19	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3
55.0	-43	19	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3
55.0	-43	19	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
2	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
3	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
Total		**38**	**34**	**33**	**31**	**27**	**25**	**19**	**10**	**33**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				55.0	-0.99	0	0	0	0	0	0	0	0
1.0				55.0	-0.99	0	0	0	0	0	0	0	0
1.0				55.0	-0.99	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
28	58	46	38	32	28	25	23	21	37

Barrier SRI		63	125	250	500	1k	2k	4k	8k	Rw
	Manual									0
	Unknown	100	100	100	100	100	100	100	100	101

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	-27	-20	-13	-9	-9	-8	-11	-19	-12
2	PUHZ-P100VKA	-27	-20	-13	-9	-9	-8	-11	-19	-12
3	PUHZ-P100VKA	-27	-20	-13	-9	-9	-8	-11	-19	-12
Total		-20	-12	-5	-1	-1	0	-4	-11	-4

Barrier Deration						63	125	250	500	1k	2k	4k	8k
					PUHZ-P100VKA	0	0	0	0	0	0	0	0
					PUHZ-P100VKA	0	0	0	0	0	0	0	0
					PUHZ-P100VKA	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
2	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
3	PUHZ-P100VKA	30	26	25	23	19	17	11	2	25
Total		**38**	**34**	**33**	**31**	**27**	**25**	**19**	**10**	**33**

Net barrier loss						63	125	250	500	1k	2k	4k	8k
					PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
					PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
					PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Commercial property towards the south of site:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62
2	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62
3	PUHZ-P100VKA	1.00	59	55	54	52	48	46	40	31	54	62

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	Reflections	dB	Façade correction	dB
16.0	-32	30	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3
16.0	-32	30	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3
16.0	-32	30	1	0	None	0	0	0	0	0	0	0	0	1	3	Yes	3

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
2	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
3	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
Total		**49**	**45**	**44**	**42**	**38**	**36**	**30**	**21**	**44**

Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Barrier Path Difference Loss: Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				16.0	-0.97	0	0	0	0	0	0	0	0
1.0				16.0	-0.97	0	0	0	0	0	0	0	0
1.0				16.0	-0.97	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
47	73	63	56	51	47	44	42	40	55

Barrier SRI		63	125	250	500	1k	2k	4k	8k	Rw
Manual										0
Unknown		100	100	100	100	100	100	100	100	101

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	-32	-26	-20	-17	-17	-16	-20	-27	-19
2	PUHZ-P100VKA	-32	-26	-20	-17	-17	-16	-20	-27	-19
3	PUHZ-P100VKA	-32	-26	-20	-17	-17	-16	-20	-27	-19
Total		-24	-18	-12	-9	-9	-9	-12	-20	-11

Barrier Deration										
PUHZ-P100VKA	0	0	0	0	0	0	0	0		
PUHZ-P100VKA	0	0	0	0	0	0	0	0		
PUHZ-P100VKA	0	0	0	0	0	0	0	0		

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
2	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
3	PUHZ-P100VKA	41	37	36	34	30	28	22	13	36
Total		**49**	**45**	**44**	**42**	**38**	**36**	**30**	**21**	**44**

Net barrier loss										
PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
PUHZ-P100VKA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		

Appendix E: 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).
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.	

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.

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.

Subjective Effect of Changes in Sound Pressure Level

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.