Lee Cunningham Partnership

Acoustic Consultancy Report

63939/3/1/4
External Plant Assessment

Report Prepared For

Berkeley Civil Engineering Contractors Ltd
The Mill, Windmill Street
22 January 2014

Issued By

M Balsom MSc MIOA (D) (E)

Telephone
0118 918 6460
Facsimile
0118 918 6480

enquiries@lcpacoustics.co.uk
www.lcpacoustics.co.uk

LCP
Riverside House
3 Winnersh Fields
Gazelle Close
Winnersh
Wokingham
RG41 5QS

A division of CAICE
Acoustic Air Movement Ltd.

Company Registration Number
2790667
VAT Registration Number
GB614683632

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i) Executive Summary

New mechanical plant is to be installed at 11-14 Windmill Street, in London.

LCP has been commissioned by Berkeley Civil Engineering Contractors Ltd to carry out a background noise survey and to use the obtained data to assess the noise impact of the plant installation on surrounding noise sensitive receptors.

The design criterion is as follows:

44 dB $L_{Aeq, T}$ at 22m, nearest residential at rear of 28 Percy Street.

The design as proposed and assessed will achieve the required criteria; the emissions have been calculated as follows:

44 dB $L_{Aeq, T}$ at 22m, nearest residential at rear of 28 Percy Street.

This report concludes that the design criteria can be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By
1	8th November 2012	Initial Issue	BC
2	17th January 2014	Plant Assessment	MB
3	20th January 2014	Design change	MB
4	22nd January 2014	Minor change to text	MB

1 Introduction

New mechanical plant is to be installed at 11-14 Windmill Street, in London.

LCP has been commissioned by Berkeley Civil Engineering Contractors Ltd to carry out a background noise survey and to use the obtained data to assess the 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 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.

Photographs are shown in Appendix B.

2.2 Receiver Location

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

The nearest receiver with direct line of site to the plant area is 22m to the South of the site. This is shown in both the site plan in Appendix A and the photograph 'looking south' in Appendix B.

2.3 Local Noise Climate

The predominant local noise sources were plant on surrounding buildings and local traffic.

2.4 Measurements

The noise monitoring took place from the 22nd to the 23rd October 2012. The measurement period was considered sufficient to establish the lowest background noise levels corresponding to the operational period of the plant.

The weather conditions during the survey were predominantly calm and dry.

2.5 Measurement Results

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

Table 1: Lowest measured background noise levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 10\ mins}$ Night*
MP1	49

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

3 Evaluation of Design Criteria

3.1 Residential Design Criterion

3.1.1 Local Authority Requirements

The Local Authority Conditions state that the noise level from any fixed mechanical plant/activity shall not exceed 5 dB below the lowest measured background noise level.

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

3.1.2 Design Rating Level

On the basis of the above the design rating level shall therefore be:

Design Rating Level
Existing lowest $L_{A90,\ 10\ mins}$ - 5 dB

3.2 Commercial Design Criterion (BS8233:1999)

Design criteria for non-residential buildings have been derived from BS8233:1999.

For typical office environments, the rating level is $L_{Aeq,\ T}$ 55 dB at 1m from the façade of the receiver premises.

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

Receiver Premises	Approximate Distance (m)	Design Level $L_{Aeq,\ 24\ hr}$
Residential at rear of 28 Percy Street	22	44

4 Review of Design

The proposed plant consists of 6 Denco units (3 run, 3 standby).

The proposed plant shall be located on the 5^{th} floor roof on top of the building.

The plant area will be screened of with an acoustic barrier.

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

4.1 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 3: Predicted and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level $L_{Aeq,\ 24\ hr}$	Predicted Level $L_{Aeq,T}$
Residential at rear of 28 Percy Street	22	44	44

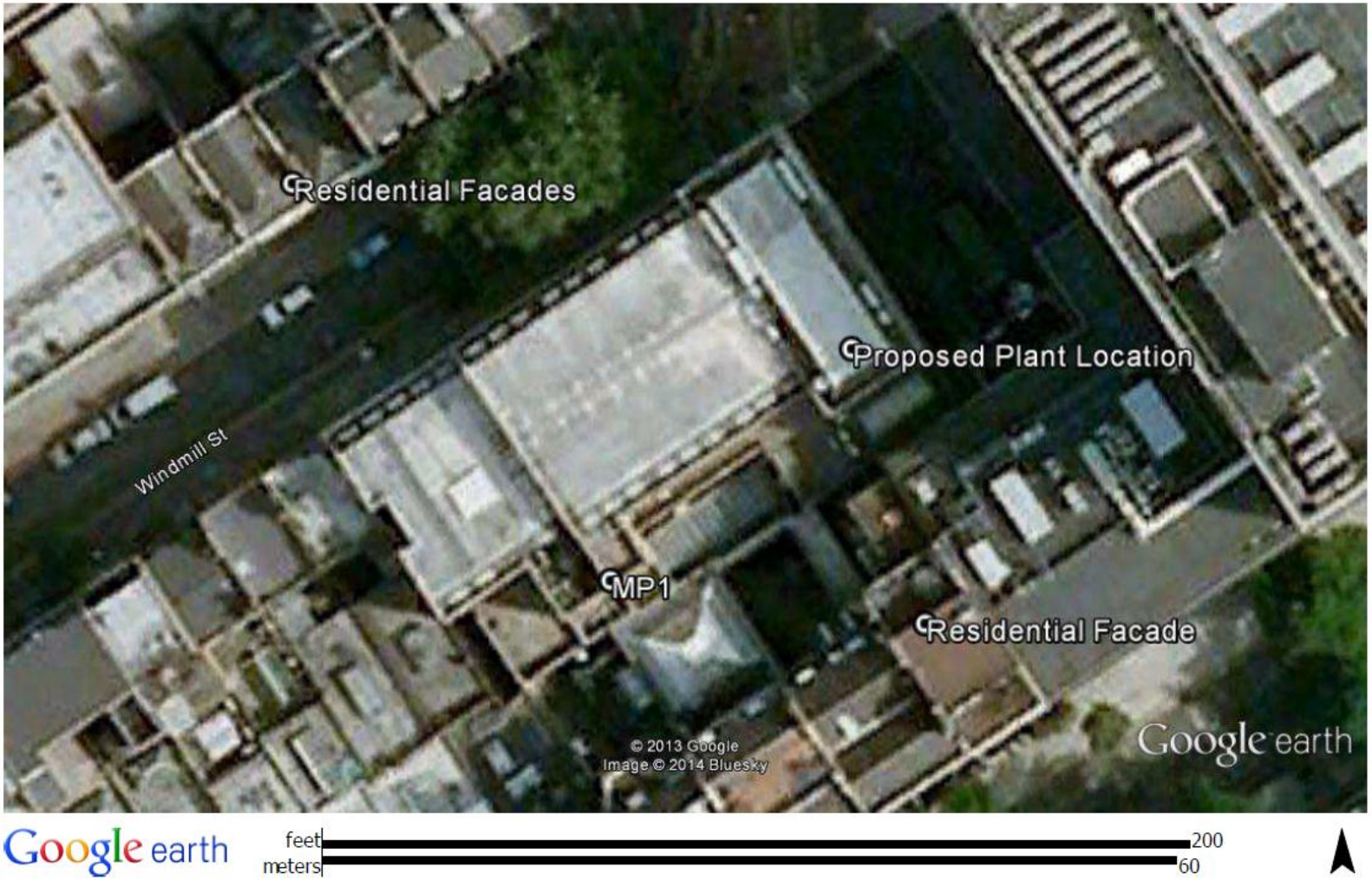
Plant noise level data used in this assessment are contained within Appendix D. Calculations are shown within Appendix E.

5 Conclusion

An environmental noise survey has been undertaken in order to establish the existing background noise levels local to the site generally in accordance with the method contained within BS4142: 1997.

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



Approximate measurement position (Latitude & Longitude) 51°31'6.93"N, 0° 8'1.57"W.

Appendix B: Photographs

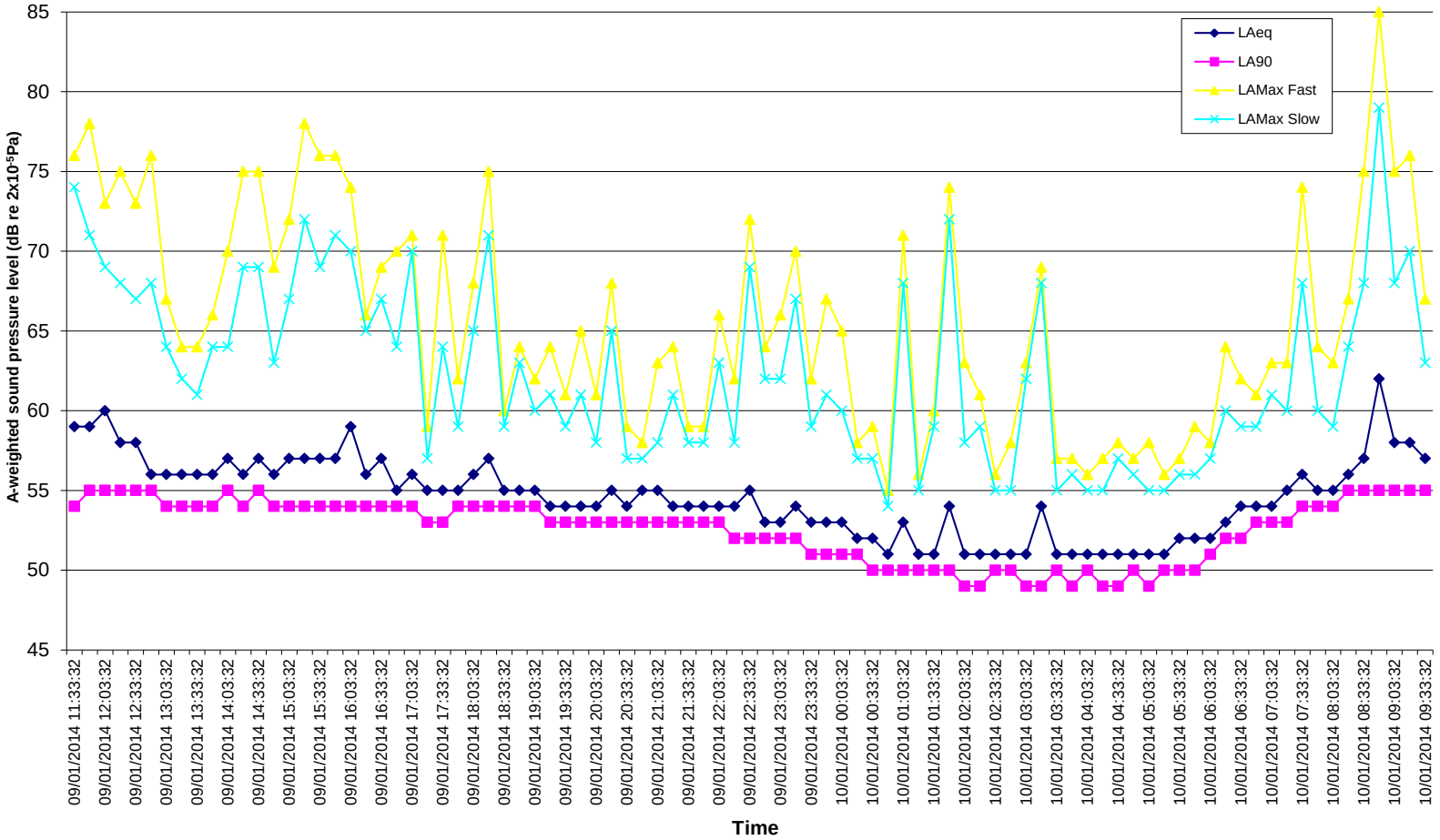
Looking northeast at the proposed plant location with 15 Windmill Street Offices Behind

Looking south at the nearest and most affected residential property

Looking west at the buildings on the north side of windmill street.

Looking north at the rear of the top floor of the development.

Appendix C: 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: 11207
- Svantek pre-amplifier SV12L S/N: 13260 with GRAS microphone capsule 40AE S/N: 75182

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 complying with Class 1 specification of BS EN 60942:2003, calibration level 94.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix D: Plant Data

Plant noise data used in the preceding assessment follow.

DESCRIPTION : Computer room close control air conditioning, providing N&1 cooling via indoor down flow units.

Ref	Manufacturer	Model	Heat of Rejection (kW)	Air Flow Rate (m^3/h)	Dimensions(mm) (LxWxH)	Weight (Kg)	Power Supply	Running Current(A)	Max. Current(A)	Power Consumptions (kW)	Refrigeration Type	Sound Level (d.BA)
CU-S01	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78
CU-S02	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78
CU-S03	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78
CU-S04	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78
CU-S05	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78
CU-S06	DENCO	DCRA50-EC	54.9	20000	2095x620x1088	135	400v/3Ph/50Hz	2	4	1.2	R410A	78

The sound power spectrum for this unit has been estimated based upon the supplied single figure broadband value.

Appendix E: Calculations

Project Information:

Project Number	**63939**

Calculation Information:

Source Description	**Denco DCRA50 (3 run, 3 Standby) Roof**
Receiver Description	**Nearesr residential**

Source Dimensions:

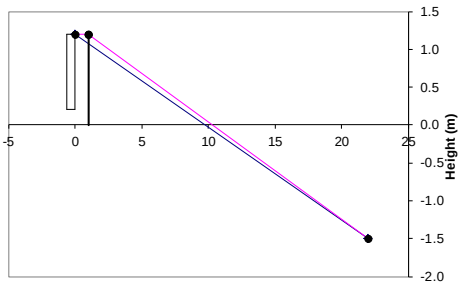
Description	Value	Units
Source height (dimension a) (1)	1.0	m
Source length (dimension b) (1)	2.0	m
Source depth	0.6	m

Barrier Loss:

Description	Value	Units
Source height (2)	1.2	m
Receiver height	-1.5	m
Barrier height	1.2	m
Source to barrier distance	1.0	m
Barrier to receiver distance	21.0	m
Calculated path difference	**0.01**	**m**

Reference level is base of barrier

Plant and Barrier Layout:



Distance to Receiver:

Description	Value	Units
Barrier Present	Y	
Distance to Receiver (no barrier) (3)		m

Barrier Acoustic Details:

Description		Octave Band Centre Frequency (Hz)								Rw	Units	Ref
		63	125	250	500	1000	2000	4000	8000			
Barrier Sound Reduction Index	Unknown	100	100	100	100	100	100	100	100	101	dB	
Barrier Attenuation (4)		-5	-5	-5	-5	-6	-7	-8	-10			
Deration		0	0	0	0	0	0	0	0			
Net Barrier Loss		**-5**	**-5**	**-5**	**-5**	**-6**	**-7**	**-8**	**-10**			

Calculated Noise Level at Receiver:

Description				Octave Band Centre Frequency (Hz)								A	Units	Ref
				63	125	250	500	1000	2000	4000	8000			
Source Noise Data (Lw) (5)	Reference distance		m	90	83	78	74	71	69	67	65	78	dB	
Calculated Source Lw (6)				90	83	78	74	71	69	67	65	78	dB	1
Distance Attenuation (from Lw)	Distance to receiver	22.2	m	-35	-35	-35	-35	-35	-35	-35	-35		dB	1
Net Barrier Loss				-5	-5	-5	-5	-6	-7	-8	-10		dB	2,3
Number of sources		3		5	5	5	5	5	5	5	5		dB	3
Façade Correction (3dB) (8)				3	3	3	3	3	3	3	3		dB	
Noise Level at Receiver (Lp)				**58**	**51**	**45**	**41**	**38**	**35**	**31**	**28**	**44**	**dB**	

Required Criteria:

Description	Criteria Type	Value		Octave Band Centre Frequency (Hz)								A	Units	Ref
				63	125	250	500	1000	2000	4000	8000			
Limiting Noise Criteria	dBA	44		**62**	**52**	**45**	**40**	**36**	**33**	**31**	**29**	**44**	dB	
Excess						**0**	**2**	**2**	**2**	**0**		**0**	**dB**	

Suggested Noise Mitigation (9)

Additional Noise Reduction (e.g. enclosure)		Octave Band Centre Frequency (Hz)								A	Units	Ref
		63	125	250	500	1000	2000	4000	8000			
Noise Reduction Loss (10)	None	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		dB	
Resultant Noise Level		**58**	**51**	**45**	**41**	**38**	**35**	**31**	**28**	**44**	dB	
Remaining Excess				**0**	**2**	**2**	**2**	**0**		**0**	**dB**	

Reference 1	"Note on two common problems of sound propogation"	E.J. Rathe	Journal of Sound and Vibration	1969
Reference 2	"Calculation of Road Traffic Noise"		Department of Transport	1988
Reference 3	IOA Diploma Formula Sheet Edition 5			2003

Appendix F: Glossary

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

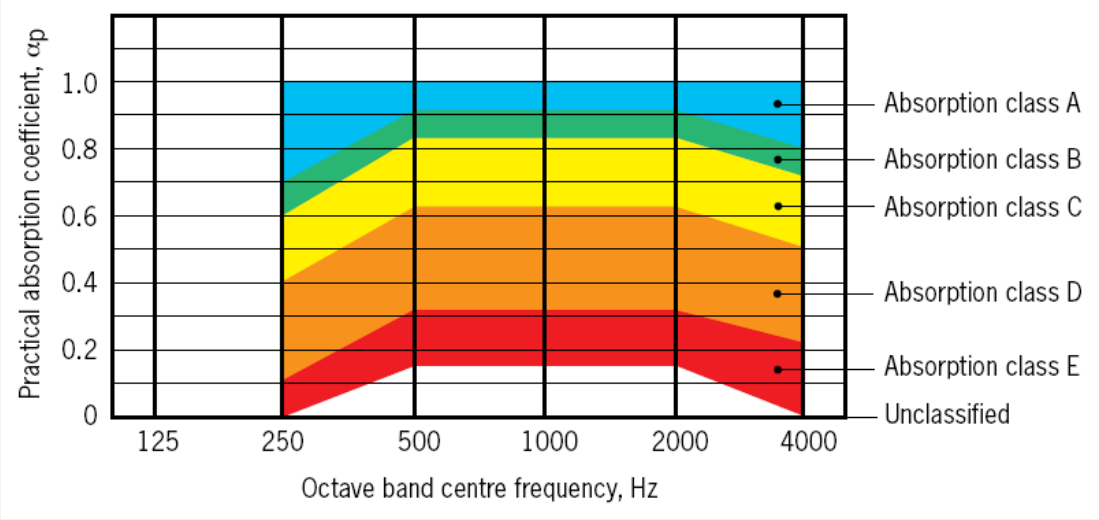
'A' Weighting

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

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.