Our Ref: 35834/HA Bv3

ALLAWAY ACOUSTICS
LIMITED

Client: Aura Consulting (UK) Ltd
288 Bishopsgate, London,
EC2M 4QP

Project: Lincoln's Inn, 2 New Square, London

Existing Environmental Noise Levels & Plant Noise Assessment (Basement)

Date of Survey: 12th-13th June 2012

Prepared By: Chris Swiejkowski BSc/MSc MIOA
Checked By: Andy Smith MIOA

Lincoln's Inn, 2 New Square, London
Existing Environmental Noise Levels (Basement)

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1. Introduction

1.1 Prior to the installation of new building services plant at this site, we have carried out an environmental noise survey to establish the existing minimum background noise levels.

1.2 This report describes the survey and details the results obtained.

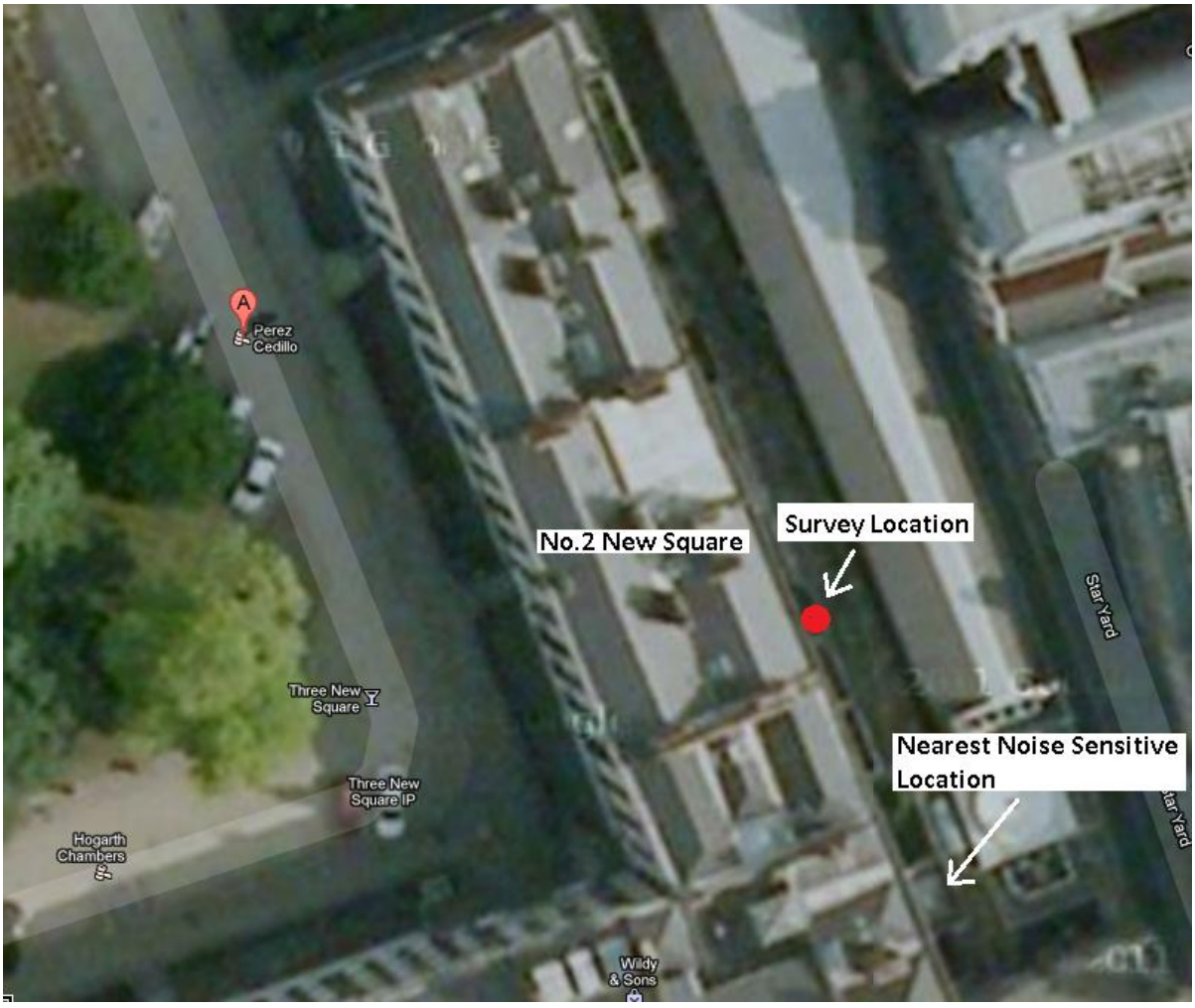
1.3 On the basis of the survey results, a target noise level will be determined for the proposed future plant.

2. Site Description

2.1 The site is located at No. 2 New Square, London. The building is surrounded by New Square to the west and adjacent buildings to the north, south and to the east (see site plan).

2.2 We have now been advised that the nearest noise sensitive location to be considered is the ground floor window of No. 3 New Square (see site plan/photos), which is approximately 3m away from the proposed plant location in the basement.

2.3 All plant will have the capability to operate 24-hours.



2.3.1 Site plan

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3. Survey

3.1 The survey was carried out between the hours of 12:30pm on Tuesday 12th June 2012 and 12:30pm on Wednesday 13th June 2012.

3.2 The weather during the survey period was warm with no winds and no rain. This was deemed not to have any significant effect on the measured noise levels.

3.3 To the best of our knowledge there were no roadworks or other unusual influences on traffic flow within the vicinity.

3.4 Noise levels were measured for 15-minute periods in the basement at the rear of No. 2 New Square building (see site plan/photos below indicating noise meter position). This represents the closest practical measuring position to the nearest noise sensitive receiver (in accordance with normal standard practice)

Photo 1

Photo2

3.5 Of the parameters measured, the L_{A90} gives the closest representation of the background level, as it is the level exceeded for 90% of the measurement period. The L_{AEQ} is an energy-averaged value, and the L_{A10} is indicative of traffic noise.

3.6 In addition to the A-weighted levels referred to above, representative octave-band spectra were also recorded so that the frequency distribution of the noise could be assessed.

4. Instrumentation

4.1 All measurements were obtained using a Norsonic NOR131 Sound Level Meter (s/n 1312779). This instrument conforms to IEC60651 and 60804 Type 1 specifications and to IEC61260 and 61672-1:2002 Class 1 specifications.

4.2 Before commencing the readings, the meter was checked for correct calibration with both the internal reference signal and an acoustic calibrator. The calibration was rechecked after the survey with no change noted.

4.3 To minimise environmental effects, the microphone was fitted with a windshield at all times.

5. Results

5.1 Full details of the results obtained are attached to this Report.

5.2 The minimum background (L90) noise level was 33dB(A) (04:47am) during the measurement period.

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6. Discussion

6.1 As per Camden Development Policies – Section 3, Table E (page 133), in order that plant noise does not increase existing noise levels it must by at least 10dB(A) lower than the measured background.

6.2 To this end, we would recommend that a limit of 23dB(A) be set as the plant noise limit. This limit should apply to the nearest noise sensitive location (approximately 3m from the proposed plant location)

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7. Plant assessment and calculations

7.1 We understand that two existing adjacent rooms located at basement level at the rear of No. 2 New Square will be utilised as plantrooms.

7.2 Within these plantrooms will be installed the following equipment; -

- Plantroom 1; 1No. Chiller model NXW0550*E*B*.
  Whilst this is a water cooled type unit, with no specific ventilation requirement, we understand that there is proposal for a ventilation opening to the room passing 1.2m3/s;

- Plantroom 2: 2No. Boilers model Broag QP65, and 1No. Pump model Magna D we understand that this will be sealed plantroom.

7.2.1 Proposed Chiller published plant data

Model: NXW0550°°°E°°N° (N = Dual Pump Run/Standby) (M = single pump)
Both are low head pumps .. items in yellow would be same for both .

Cooling		
Cooling capacity	kW	102.92
Input power	kW	29.62
Input current	A	62.66
E.E.R.	W/W	3.47
Pump input power	kW	1.10
Total input power	kW	30.72
Total input current	A	64.99
Condenser conditions:		
Condensing temperature	°C	50.00
Evaporator conditions:		
Inlet water temperature	°C	12.00
Change in water temperature	°C	6.00
Outlet water temperature	°C	6.00
Glycol mix	%	0.00
Water flow rate	l/s	4.0978
Available pressure	kPa	113.10
Refrigerant		R410A
Compressor type		Scroll
Number of compressors	n.	3
Number of cooling circuits	n.	2
Evaporator type		Plate
Number of evaporators	n.	1
Evaporator water connections		2"1/2
Refrigerant line	Ø mm	28
Liquid line	Ø mm	28
Maximum full load current	A	80.00
Starting current	A	245.00
Power supply		400V - 3 - 50 Hz
Sound data		
Sound power to EN ISO 9614-2	dB(A)	79.0
Sound pressure at 10 metres to EN ISO 3744	dB(A)	47.0
Sound pressure at 1 metres to EN ISO 3744	dB(A)	62.2

- Sound pressure in unrestricted range on reflecting plane (directivity factor Q = 2).

Sound power band middle frequency

	Octave band						
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
	50.5	57.7	72.4	76.3	72.4	65.8	54.2

Dimensional data		
Height	mm	1,835
Width	mm	800
Depth	mm	1,790
Net weight	kg	668

7.2.2 Proposed Boiler Broag QP65 published plant data

Technical data

BOILER TYPE	QUINTA PRO		30	45	65	90	115
GENERAL							
EC identification no.	PIN		0063CL3333				
Flow rate setting	Adjustable		Modulating, Start/Stop, 0 - 10 V				
Nominal output (Pn) Heating System (80/60°C)	Minimum maximum	kW	8.0-29.3	8.0-40.0	12.0-61.0	14.1-86.2	16.6-107
	Factory setting	kW	29.3	40.0	61.0	86.2	107.00
Nominal output (Pn) Heating System (50/30 °C)	Minimum maximum	kW	8.9-31.4	8.9-43.0	13.3-65.0	15.8-89.5	18.4-114
	Factory setting	kW	31.4	43.0	65.0	89.5	114
Nominal input (Qn) Heating System (Hi)	Minimum maximum	kW	8.2-30.0	8.2-41.2	12.2-62.0	14.6-86.0	17.2-110.2
	Factory setting	kW	30.0	41.2	62.0	86.0	110.2
Nominal input (Qn) Heating System (Hs)	Minimum maximum	kW	9.1-33.3	9.1-45.7	13.6-68.8	16.2-95.5	19.1-122.4
	Factory setting	kW	33.3	45.7	68.8	95.5	122.4
Heating efficiency under full load (Hi) (80/60 °C)	-	%	97.5	97.2	98.3	97.9	96.6
Heating efficiency under full load (Hi) (50/30 °C)	-	%	102.9	102.9	104.6	104.1	102.5
Heating efficiency under partial load (Hi) (Return temperature 60°C)	-	%	97.5	97.5	98.3	96.6	96.5
Heating efficiency under partial load (EN 92/42) (Return temperature 30°C)	-	%	107.7	107.7	108.9	108.1	107.1
DATA ON THE GASES AND COMBUSTION GASES							
Device categories	-	-	II2H3P				
Gas inlet pressure G20 (Gas H)	Minimum maximum	mbar	17 - 30				
Gas inlet pressure G31 (Propane)	Minimum maximum	mbar	37 - 50				
Gas consumption G20 (Gas H)	Minimum maximum	m3/h	0.9-3.3	0.9-4.4	1.3-6.6	1.5-9.1	1.8-11.7
Gas consumption G31 (Propane)	Minimum maximum	m3/h	0.3-1.3	0.3-1.7	0.5-2.5	0.6-3.5	0.6-4.7
NOx-Emission per year or (EN 483)	-	mg/kWh	35	37	32	45	46
Mass flue gas flow rate	Minimum maximum	kg/h	14-50	14-69	21-104	28-138	36-178
Flue gas temperature	Minimum maximum	°C	30-65	30-67	30-68	30-67	30-72
Maximum counter pressure	-	Pa	70	150	100	160	220
CHARACTERISTICS OF THE HEATING CIRCUIT							
Water content	-	l	5.5	5.5	6.5	7.5	7.5
Water operating pressure	Minimum	bar	0.8				
Water operating pressure (Open vented)*	Minimum	bar	0.3	0.3	0.3	0.3	0.5
Water operating pressure (PMS)	Maximum	bar	4.0				
Water temperature	Maximum	°C	110				
Water temperature (Open vented)*	Maximum	°C	95				
Operating temperature	Maximum	°C	90				
Operating temperature (Open vented)*	Maximum	°C	80				
Water resistance (Δ = 20K)*	-	mbar	70	90	130	140	250
ELECTRICAL CHARACTERISTICS							
Power supply voltage	-	VAC/Hz	230/50				
Power consumption-Full load	Maximum	W	39	68	88	125	199
Power consumption -Part load	Maximum	W	18	18	23	20	45
Power consumption-Standby	Maximum	W	5	5	6	4	7
Electrical protection index	-	IP	X4D				
OTHER CHARACTERISTICS							
Weight (empty)	Total	kg	53	53	60	68	69
	Mounting(1)	kg	50	50	57	66	67
Acoustic level at 1 meter	-	dB(A)	38	45	45	52	51

(1) Front panel removed

7.2.3 Proposed Pump – Magna D published plant data

MAGNA/UPE

Pump type	Single-phase MAGNA 25-60, 25-100, 32-60, 32-100, 40-100(D), 50-100	Single-phase MAGNA (D) 32-120, 40-120, 50-60, 50-120, 65-60, 65-120	Single-phase UPE	Three-phase UPE(D)
Enclosure class	IP 44 (IEC 85)	IP 44 (IEC 85)	IP 42	IP 42
Insulation class	F	F	H	H
External start/stop input	External potential-free switch.★ Screened cable. Maximum contact load: 5 V, 10 mA.	External potential-free switch. Screened cable. Maximum contact load: 5 V, 10 mA.	MC 40/60★ MB 40/60★	External potential-free switch. Screened cable. Maximum contact load: 5 V, 2.7 mA.
Setpoint signals	GENI module★	GENI module★	MC 40/60★ MB 40/60★	• **Max. and min. curve input** External potential-free switch. Screened cable. Maximum contact load: 5 V, 2.7 mA. • **Input for analog 0-10 V signal** External signal: 0-10 VDC. Maximum contact load: 1 mA.
Signal output	Internal potential-free changeover contact.★ Screened cable. Maximum contact load: 250 VAC, 2 A. Minimum contact load: 5 VDC, 1 mA.	Internal potential-free changeover contact. Screened cable. Maximum contact load: 250 VAC, 2 A. Minimum contact load: 5 VDC, 1 mA.	MC 40/60★	Internal potential-free change-over contact. Screened cable. Maximum contact load: 250 VAC, 2 A. Minimum contact load: 5 VDC, 1 mA.
Bus input	GENI module★ LON via GENIbus and G10 modules	GENI module★ LON module★	MB 40/60★	Grundfos GENIbus protocol. Screened cable. Lead cross section: 0.25 - 1 mm^2. Maximum cable length: 1200 m.
Supply voltage	1 x 230-240 V – 10 %/+ 6 %, 50/60 Hz, PE	1 x 230-240 V – 10 %/+ 6 %, 50/60 Hz, PE	1 x 230-240 V – 10 %/+ 6 %, 50 Hz, PE	3 x 400-415 V ± 10 %, 50 Hz, PE
	The pump requires no external motor protection.			
Earth leakage current	I_{leak} < 3.5 mA The leakage currents are measured in accordance with EN 60355-1.			
EMC	EN 61800-3.			

★ Expansion module

Sound pressure level

Pump type	Single-phase MAGNA 25-60, 25-100, 32-60, 32-100, 40-100(D), 50-100	Single-phase MAGNA (D) 32-120, 40-120, 50-60, 50-120, 65-60, 65-120	Single-phase UPE	Three-phase UPE(D)
Sound pressure level	≤54 dB(A)	≤54 dB(A)	≤43 dB(A)	≤54 dB(A)

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7.3 Calculations

For the design purposes, the external noise levels at a distance from the plantroom have been calculated from the equation:

L2 = L1 – R – 10logS – 20logR – 14dB

L2 – Sound Pressure Level in dB at a distance of r meters from plantroom wall;
L1 – Sound Pressure Level in dB inside the plantroom;
S – the area of wall/opening in m2;
R – Sound Reduction Index (SRI) of the plantroom wall/door, dB;

7.3.1 Basement Chiller calculations (plantroom 1)

Table 1 – Basement Chiller Noise Level Calculations within plantroom

Calculation of Plant Noise Level	Octave Band Centre Frequency								
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
Chiller Lw - NXW0550EN	-	51	58	72	76	72	66	54	
Chiller Dimensions H:1.835m W:0.8m D:1.79M									
Radiating Area Correction	-	10	10	10	10	10	10	10	
Distance Correction to 1m	-	-16	-16	-16	-16	-16	-16	-16	
Reverberant build up		6	6	6	6	7	8	8	
Resultant Room Level Lp (79dBA)		**51**	**58**	**72**	**76**	**73**	**68**	**56**	**79**

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Table 2 - Basement Chiller Noise Level Calculations via ventilation openıng – no acoustic treatment

	Octave Band Centre Frequency								
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
Room Lp (79dBA)		51	58	72	76	73	68	56	**79**
Correction for common partition: 0.96m2		-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	
Distance reduction to the nearest receiver 2m		-6	-6	-6	-6	-6	-6	-6	
		-14	-14	-14	-14	-14	-14	-14	
Correction for reflections/louvre location		9	9	9	9	9	9	9	
Lp at the nearest noise sensitive position (19dBA)		40	47	61	65	62	57	45	**68**
Target Noise Level									**23**
Excess over target									**45**

In order to achieve the specified target noise level of 23dB(A) at the nearest noise sensitive location, we would recommend that the plant room is equipped with solid acoustic door (we would offer our 45dB range metal door – see data sheet D140D in Appendix 1 for further details) and 2100mm long attenuator be installed to form ventilation opening, with the nominal cross section 1200mm x 800mm to suit 1.2m3/s @ 10-15Pa pressure drop (we would offer our A02E range silencers – see Appendix 1 for further details).

Table 3 - Basement Chiller Noise Level Calculations via ventilation opening c/w 2100mm long attenuator

	Octave Band Centre Frequency								
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
Room Lp (79dBA)	-	51	58	72	76	73	68	56	**79**
2100mm long attenuator effective IL	-	-22	-35	-48	-52	-50	-48	-40	
Correction for common partition: 0.96m2	-	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	
Distance reduction to the nearest receiver 2m	-	-6	-6	-6	-6	-6	-6	-6	
	-	-14	-14	-14	-14	-14	-14	-14	
Correction for reflections/louvre location	-	9	9	9	9	9	9	9	
Lp at the nearest noise sensitive position (19dBA)	-	18	12	13	13	12	9	5	**18**
Target Noise Level									**23**

Table 4 - Basement Chiller Noise Breakout via 45dB solid acoustic door

	Octave Band Centre Frequency								
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
Room Lp (79dBA)		51	58	72	76	73	68	56	**79**
45dB door SRI		26	35	43	51	51	50	45	
Correction for door area: 2.1m2		3.2	3.2	3.2	3.2	3.2	3.2	3.2	
Distance reduction to the nearest receiver 2m		-6	-6	-6	-6	-6	-6	-6	
		14	14	14	14	14	14	14	
Correction for reflections		9	9	9	9	9	9	9	
Lp at the nearest noise sensitive position (22dBA)		17	15	21	17	13	8	1	**22**
Target Noise Level									**23**

The above tables indicate that the target noise level will be achieved if the plant room is equipped with solid acoustic door and intake/discharge attenuator.

7.3.2 Boilers and Pump calculations (plantroom 2)

Table 5 - Basement Boilers Broag QP65 and Pump Magna D Noise Level calculation – no acoustic treatment

Plant	dB(A)
Boiler QP65 Lp (dBA)	45
Boiler QP65 Lp (dBA)	45
Pump Magna D	54
Room Lp	55
Correction for door area: 2.1m2	-3
Distance reduction to the nearest receiver 2m	-6
Correction for reflections	9
Lp at the nearest noise sensitive position	55
Target Noise Level	23
Excess over target	**32**

In order to achieve the specified target noise level of 23dB(A) at the nearest noise sensitive location, we would recommend that the plant room is equipped with solid acoustic door (we would offer our 45dB range metal door – see data sheet D140D in Appendix 1 for further details)

Table 6 - Basement Boilers Broag QP65 and Pump Magna D Noise Breakout via 45dB solid acoustic door

	dB(A)
Boiler QP65 Lp (dBA)	45
Boiler QP65 Lp (dBA)	45
Pump Magna D	54
Room Lp	55
45dB acoustic door SRI	45
Correction for common partition: 2.1m2	-3
Distance reduction to the nearest receiver 2m	-6
Correction for reflections	9
Lp at the nearest noise sensitive position	**9**

The above table indicates that the target noise level will be achieved if the plant room is equipped with solid 45dB acoustic door.

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7.3.3 Cumulative calculations for all plant stated above.

Table 8 – Cumulative Lp at the nearest noise sensitive receiver.

	dB(A)
Chiller Noise via attenuated vent path	18
Chiller Breakout Noise via acoustic door	22
Boilers Broag QP65 & Pump Mahna D	9
Resultant Lp at Receiver	**23**
Target Noise Level (23 dBA)	23

8. Conclusions

The above calculations show, that if the proposed plant is installed internally within suitably constructed plant rooms c/w solid acoustic doors and intake/discharge silencers (as proposed above) plantroom noise breakout will be controlled in accordance with the specified target noise level (section 6.2).

Please note that the final plantroom construction/finish (walls/roof etc.) must be suitable to maintain the acoustic performance of the acoustic door/attenuator accordingly.

…… ……

Chris Swiejkowski BSc/MSc MIOA **Andy Smith** MIOA

16 July 2012

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SCHEDULE OF RESULTS

Date of Survey: 12th-13th June 2012

RE: Lincoln's Inn, 2 New Square, London

Table 3 – Leq

	Octave Band Centre Frequency								
Time	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
12:32	56.0	56.0	53.4	52.5	52.6	52.3	49.8	45.3	58.5
12:47	49.5	51.7	52.1	51.3	47.9	42.5	34.8	28.0	52.6
13:02	54.1	56.5	56.3	55.1	52.4	47.8	40.8	26.2	57.0
13:17	51.3	52.4	52.7	51.5	48.3	42.5	31.7	22.5	52.9
13:32	48.4	50.0	49.3	49.5	47.0	41.6	32.3	24.1	51.2
13:47	49.1	51.6	49.4	49.2	46.9	41.7	31.8	23.2	51.2
14:02	57.5	59.6	56.9	56.1	52.0	46.4	37.0	26.5	57.1
14:17	52.7	54.1	52.7	51.6	48.8	44.3	38.5	29.6	53.6
14:47	49.4	51.8	50.7	49.7	47.9	42.8	35.8	27.9	52.1
15:02	49.0	52.4	51.8	50.6	48.8	44.0	38.4	31.9	53.0
15:17	49.3	51.6	51.7	50.9	48.9	43.9	38.0	30.5	53.1
15:32	49.5	51.7	51.3	50.3	48.2	42.9	35.9	34.0	52.5
15:47	50.2	55.6	51.5	50.1	48.3	44.4	37.4	22.8	52.8
16:02	52.2	54.0	53.0	51.5	49.2	43.6	35.2	24.8	53.5
16:17	49.7	52.2	50.8	49.9	47.6	42.5	34.2	23.0	51.9
16:32	49.0	51.4	50.8	50.2	47.8	41.7	32.3	22.5	51.9
16:47	48.8	50.6	49.7	49.1	47.3	41.4	30.6	20.5	51.2
17:02	50.1	52.1	51.7	50.6	48.8	43.5	32.5	20.4	52.8
17:17	48.7	50.2	49.8	49.0	47.2	41.3	30.6	20.2	51.1
18:02	48.4	50.9	50.8	49.6	47.1	41.1	30.1	19.4	51.3
18:32	48.6	52.2	50.4	50.9	48.9	43.8	35.3	19.5	52.9
18:47	48.9	51.0	49.8	49.6	47.3	41.9	30.7	19.0	51.4
19:02	48.0	49.5	49.6	49.1	47.1	41.3	30.1	19.1	51.1
19:17	47.9	51.6	49.4	48.7	46.7	41.1	30.4	19.0	50.8
19:32	48.3	50.2	49.6	48.6	46.5	41.5	29.9	18.7	50.7
19:47	48.4	50.5	50.0	49.5	47.2	42.0	30.3	18.7	51.4
20:02	48.1	51.0	50.0	49.3	46.9	42.0	31.7	23.3	51.3
20:17	48.3	50.5	49.9	49.4	47.2	41.8	30.5	18.6	51.3
20:32	49.3	50.5	51.3	50.5	47.8	41.9	30.8	20.1	52.1
21:02	49.4	51.1	50.7	49.1	46.8	41.5	32.9	21.0	51.2
21:17	47.8	50.2	49.5	49.1	47.0	41.5	30.5	19.0	51.1
21:32	47.3	49.4	49.2	48.6	46.3	40.9	30.0	18.7	50.6

21:47	47.9	50.3	49.8	48.9	46.9	41.8	33.5	23.0	51.1
22:02	49.9	52.4	50.9	49.2	46.5	41.0	30.3	19.1	51.1
22:17	46.6	48.8	48.9	48.5	46.4	40.8	29.8	18.8	50.5
22:32	47.4	49.3	48.9	48.5	46.5	40.8	30.0	18.9	50.5
22:47	46.5	49.0	48.8	48.3	46.5	40.8	29.9	18.8	50.5
23:02	46.0	48.3	48.7	48.3	46.4	41.0	31.7	21.9	50.5
23:17	45.9	48.3	48.5	48.2	46.4	40.8	29.6	18.7	50.3
23:32	46.4	48.9	49.0	48.4	46.5	41.0	30.1	19.0	50.5
23:47	48.2	50.0	49.1	48.6	46.7	41.0	30.0	18.8	50.7
00:02	45.4	48.3	48.6	48.4	46.6	41.0	29.9	18.8	50.5
00:17	45.2	48.2	48.2	48.1	46.7	40.8	29.6	18.5	50.4
00:32	45.8	48.4	48.5	48.2	46.5	40.7	29.8	18.6	50.4
00:47	45.1	48.4	48.5	48.2	46.5	40.7	29.9	18.7	50.4
01:32	45.3	48.7	48.3	48.3	46.9	41.1	30.0	18.9	50.6
01:47	46.0	48.7	48.5	48.2	46.8	41.0	30.2	19.1	50.6
02:02	46.6	50.5	48.1	48.1	46.7	40.8	29.8	18.8	50.5
02:17	44.4	48.3	47.9	48.1	46.9	41.1	29.9	18.8	50.6
02:32	50.8	50.1	50.1	49.4	48.4	42.9	31.6	19.5	52.1
02:47	45.3	49.2	48.6	48.2	47.0	41.4	30.4	19.3	50.8
03:02	45.0	48.7	47.9	48.2	46.9	41.0	29.9	18.9	50.6
03:17	41.5	45.4	43.5	43.4	41.8	36.0	25.1	15.3	45.7
03:32	48.6	48.8	48.0	47.6	43.4	34.1	21.7	11.8	47.9
03:47	38.6	43.5	37.7	35.0	29.8	23.0	16.4	11.5	36.2
04:02	38.5	42.6	35.6	34.0	30.2	23.4	16.7	11.6	35.5
04:17	41.0	44.2	37.9	35.2	31.5	25.5	19.6	12.0	37.1
04:32	41.8	44.1	38.7	36.6	34.1	27.9	22.0	11.7	38.8
04:47	40.3	43.4	38.6	35.7	31.0	25.3	18.3	12.0	37.0
05:32	42.8	43.9	38.0	35.4	32.5	27.3	19.9	13.0	37.6
05:47	42.9	44.5	38.8	36.0	32.9	28.7	26.0	26.4	38.8
06:02	44.9	45.6	42.1	38.3	35.0	30.7	23.4	15.0	40.5
06:17	43.7	45.4	40.0	37.0	33.5	28.4	20.4	12.4	39.0
06:32	44.0	45.3	40.0	36.9	34.8	30.2	22.1	12.8	39.7
06:48	48.0	47.7	41.6	37.8	36.8	34.5	28.7	16.0	41.9
07:03	46.1	47.6	45.4	40.5	35.1	31.0	21.9	12.9	42.1
07:18	47.6	49.0	44.3	39.8	36.0	31.5	25.1	15.8	42.1
08:03	48.2	47.5	43.8	42.1	39.8	37.0	31.9	23.1	44.9
08:18	48.4	50.3	49.7	48.4	44.6	41.6	37.9	33.5	50.2
08:33	55.2	54.4	52.6	50.1	46.5	42.4	40.3	36.1	52.2
08:48	59.2	62.1	59.7	58.1	55.2	52.6	47.7	41.1	60.5
09:03	56.7	59.9	59.8	55.6	51.3	48.8	44.4	36.9	57.7
09:18	47.6	49.4	45.0	42.5	39.4	38.0	33.1	27.8	45.4
09:33	59.7	61.2	59.3	55.3	51.8	49.2	48.8	45.7	58.4
09:48	50.7	52.0	51.1	48.9	47.3	51.1	55.5	52.1	59.4
10:03	48.1	50.7	47.3	46.0	42.9	36.1	29.6	20.7	47.4
10:18	49.7	50.4	46.7	45.9	43.2	39.8	32.4	20.3	48.0
10:33	47.9	50.4	45.6	43.8	40.6	36.2	27.9	18.5	45.6

10:48	50.6	51.8	47.1	44.4	40.2	34.3	25.3	16.0	45.8
11:03	56.0	56.0	55.0	54.3	49.5	43.1	29.0	18.5	54.7
11:18	48.3	48.9	46.8	43.8	40.0	35.1	26.7	16.1	45.3
11:33	50.8	52.8	51.5	49.2	44.5	37.9	27.8	18.2	49.9
11:48	49.6	49.6	47.5	45.4	42.1	37.5	30.2	20.7	47.0
12:03	56.0	56.3	53.8	51.5	48.8	41.6	33.9	23.8	53.2
12:18	54.1	55.0	56.8	54.6	49.5	42.6	31.6	18.2	55.1
12:33	49.5	56.6	54.9	53.2	50.2	49.8	46.2	44.4	56.8

Table 4 – L10

	Octave Band Centre Frequency								
Time	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
12:32	50.3	53.0	52.8	51.7	47.9	43.6	38.5	32.2	53.3
12:47	51.1	53.7	54.6	53.6	49.6	44.1	36.7	29.0	54.6
13:02	53.2	55.8	56.9	55.6	53.4	47.8	40.5	28.8	57.9
13:17	54.9	55.3	56.9	54.8	50.5	44.4	33.4	24.5	56.3
13:32	50.2	51.3	50.2	50.3	47.6	42.3	32.7	25.1	51.8
13:47	51.1	53.1	50.4	50.0	47.6	42.5	32.8	24.9	51.8
14:02	53.6	55.1	54.7	53.1	49.8	43.9	35.7	29.8	54.6
14:17	53.7	55.3	54.6	53.4	50.6	45.4	36.9	32.2	55.2
14:47	51.2	53.4	52.2	50.9	48.9	43.3	36.5	29.6	53.2
15:02	51.0	54.4	53.6	52.2	50.4	45.0	38.9	30.9	54.7
15:17	51.3	53.4	53.6	52.9	51.0	46.4	41.3	33.1	55.3
15:32	51.5	53.1	52.0	50.5	47.9	42.6	33.9	27.7	52.3
15:47	51.2	53.1	51.6	50.5	48.0	42.6	32.6	23.2	52.2
16:02	55.5	56.0	55.3	53.7	51.2	45.0	34.9	25.8	55.7
16:17	51.5	53.7	51.6	50.7	48.2	42.5	32.3	22.5	52.5
16:32	51.0	53.1	51.6	50.6	48.0	42.4	32.4	23.0	52.3
16:47	50.5	52.1	50.5	49.8	47.8	41.9	31.2	21.2	51.6
17:02	52.9	54.6	53.7	50.7	47.8	42.2	32.0	21.6	52.5
17:17	50.3	51.5	50.6	49.6	47.6	41.8	31.3	21.2	51.5
18:02	50.3	52.8	52.9	50.8	47.7	41.8	30.7	20.2	52.3
18:32	49.9	52.7	50.8	50.3	48.0	42.0	30.9	20.2	52.0
18:47	50.5	52.5	50.9	50.3	47.7	41.9	30.8	19.8	51.8
19:02	49.5	50.8	50.5	49.8	47.5	41.9	30.8	19.8	51.5
19:17	49.3	51.2	50.4	49.6	47.3	41.8	31.3	19.7	51.4
19:32	50.0	52.1	50.6	49.5	47.2	42.3	30.6	19.3	51.4
19:47	50.7	51.7	51.2	50.1	47.2	42.2	30.9	19.3	51.6
20:02	50.2	52.0	50.8	49.8	47.1	42.1	31.1	19.7	51.5
20:17	49.9	50.9	50.2	49.6	47.1	42.0	30.6	19.3	51.3
20:32	50.7	52.1	51.1	50.0	47.3	42.0	30.9	19.4	51.5
21:02	52.1	53.1	51.6	49.9	47.3	41.9	31.0	19.7	51.7
21:17	49.7	52.1	50.4	49.7	47.3	42.1	31.0	19.6	51.5
21:32	49.0	50.7	50.3	49.6	47.0	41.6	30.6	19.3	51.2

21:47	49.9	52.1	51.5	50.3	47.7	42.9	34.4	22.0	52.3
22:02	50.4	52.3	50.9	50.0	47.2	41.8	30.8	19.5	51.7
22:17	48.3	50.1	49.9	49.4	47.0	41.5	30.4	19.2	51.0
22:32	49.8	50.7	50.0	49.4	47.1	41.6	30.7	19.4	51.1
22:47	48.2	50.3	49.9	49.3	47.1	41.6	30.6	19.4	51.0
23:02	47.7	49.6	49.8	49.3	47.0	41.5	30.2	19.3	51.0
23:17	47.5	49.5	49.5	49.1	46.9	41.5	30.2	19.2	50.9
23:32	48.4	50.4	50.2	49.3	47.1	41.7	30.6	19.4	51.1
23:47	49.0	50.3	50.1	49.6	47.3	41.7	30.5	19.2	51.3
00:02	47.1	49.5	49.6	49.3	47.2	41.7	30.4	19.3	51.1
00:17	47.0	49.5	49.2	49.0	47.3	41.5	30.1	18.9	51.0
00:32	47.4	49.6	49.6	49.2	47.2	41.4	30.4	19.1	51.0
00:47	46.8	49.7	49.5	49.1	47.1	41.5	30.7	19.4	51.0
01:32	47.0	49.9	49.4	49.2	47.5	41.7	30.6	19.4	51.1
01:47	47.3	49.9	49.6	49.1	47.4	41.6	30.7	19.5	51.1
02:02	47.0	50.1	49.2	49.1	47.3	41.4	30.2	19.2	51.0
02:17	46.1	49.5	48.9	49.0	47.5	41.7	30.3	19.2	51.1
02:32	49.0	51.1	50.4	50.0	48.2	42.4	31.2	20.0	51.9
02:47	47.0	50.5	49.7	49.2	47.6	42.1	30.9	19.8	51.3
03:02	46.5	49.9	48.9	49.1	47.5	41.7	30.3	19.4	51.1
03:17	45.3	49.1	48.3	48.4	47.0	41.2	30.1	19.0	50.7
03:32	50.1	50.3	51.2	49.9	45.2	35.9	20.7	15.0	50.1
03:47	40.3	44.4	36.9	35.0	31.0	23.2	16.7	15.0	36.4
04:02	40.3	44.1	36.5	35.3	31.2	24.2	17.2	15.0	36.3
04:17	41.5	45.2	39.8	36.3	31.5	25.0	18.0	15.0	37.8
04:32	44.5	45.7	41.9	39.5	33.4	24.9	17.7	15.0	40.1
04:47	42.5	45.7	41.7	38.6	32.2	27.1	18.8	15.0	39.4
05:32	44.3	45.6	40.2	37.2	34.8	29.0	21.3	15.0	39.8
05:47	44.9	45.9	41.0	37.9	34.9	31.5	28.7	17.8	41.0
06:02	45.8	47.3	45.2	40.3	37.0	32.1	24.4	18.1	42.3
06:17	45.1	47.1	41.6	38.3	34.6	29.4	20.8	15.0	40.0
06:32	46.1	46.6	41.4	38.1	36.5	31.8	22.6	15.0	41.1
06:48	51.7	49.7	44.3	40.2	38.4	34.4	28.0	16.6	43.8
07:03	49.1	50.8	50.0	44.5	37.2	32.8	24.1	15.0	45.8
07:18	50.3	50.6	46.5	42.1	38.9	34.2	27.3	16.0	44.8
08:03	50.7	48.8	46.6	43.8	42.0	39.6	34.4	22.9	47.3
08:18	50.7	52.2	50.2	48.0	44.9	42.1	36.4	30.1	50.4
08:33	58.2	56.9	54.9	51.8	47.8	42.3	33.4	24.4	53.6
08:48	60.0	63.7	58.3	56.2	53.5	48.5	41.0	32.9	58.7
09:03	51.9	54.9	50.8	47.2	43.0	38.2	32.3	24.1	49.1
09:18	50.0	51.5	47.2	44.6	41.1	37.0	30.6	20.1	46.6
09:33	51.6	52.6	49.0	48.1	45.6	42.2	35.7	26.8	50.7
09:48	53.0	53.5	50.1	46.6	42.4	37.7	30.4	20.8	48.3
10:03	50.5	52.1	49.7	47.3	44.0	38.1	30.1	19.9	48.8
10:18	50.8	51.2	48.3	47.3	42.8	38.3	30.7	20.7	48.4
10:33	49.6	51.7	46.7	44.2	39.9	35.7	28.5	19.2	45.7

10:48	53.5	53.6	49.4	46.0	41.4	35.9	28.0	16.9	47.4
11:03	58.3	58.9	58.4	57.3	52.6	45.7	32.4	19.9	57.7
11:18	50.7	50.8	49.1	46.2	42.4	37.4	29.4	18.2	47.8
11:33	53.3	54.0	52.0	49.7	45.1	38.9	29.4	19.1	51.1
11:48	52.2	51.8	50.1	47.6	44.2	39.2	31.9	23.0	49.1
12:03	51.7	53.5	52.6	52.1	47.1	40.7	32.5	23.1	52.8
12:18	51.6	53.2	50.2	49.4	44.4	38.3	30.4	19.9	49.8
12:33	48.6	51.3	48.4	46.8	43.5	38.0	32.7	24.2	48.6

Table 5 – L90

	Octave Band Centre Frequency								
Time	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1.0 k**	**2.0 k**	**4.0 k**	**8.0 k**	**dB(A)**
12:32	43.8	46.9	42.9	40.7	37.4	32.5	24.6	17.1	42.9
12:47	45.8	49.0	47.8	46.4	42.2	37.0	29.9	20.1	48.0
13:02	46.1	49.1	48.5	48.5	46.4	41.0	30.3	19.8	50.7
13:17	45.4	48.3	48.1	47.9	46.2	40.7	30.0	19.5	50.3
13:32	45.2	48.1	48.0	47.9	46.1	40.6	30.0	19.7	50.3
13:47	46.1	49.4	48.1	47.8	46.1	40.7	30.3	19.9	50.3
14:02	46.7	49.9	48.8	48.1	46.3	40.9	30.6	20.5	50.6
14:17	46.8	49.3	48.8	48.0	46.4	40.9	30.5	20.1	50.6
14:47	46.1	48.8	48.5	47.7	46.1	40.5	29.9	19.7	50.3
15:02	45.8	48.8	48.6	47.8	46.0	40.4	29.8	19.7	50.2
15:17	46.1	48.9	49.0	48.1	46.3	40.7	30.1	19.7	50.5
15:32	45.9	48.8	48.9	47.8	46.1	40.5	29.8	19.4	50.3
15:47	46.1	49.2	48.9	47.9	46.1	40.6	29.9	19.2	50.4
16:02	46.9	49.9	49.2	48.3	46.4	40.8	30.1	19.5	50.6
16:17	46.2	48.8	48.6	47.9	46.1	40.3	29.6	18.8	50.3
16:32	46.0	48.8	48.4	47.7	46.0	40.1	29.5	18.7	50.1
16:47	45.4	48.1	48.3	47.7	46.1	40.2	29.4	18.5	50.2
17:02	46.0	48.3	48.5	47.8	46.2	40.3	29.6	18.7	50.2
17:17	45.5	48.2	48.4	47.6	46.2	40.3	29.6	18.7	50.2
18:02	45.5	48.2	48.3	47.7	45.9	40.1	29.1	18.0	50.1
18:32	45.1	48.1	47.9	47.5	45.9	40.1	28.9	17.8	50.0
18:47	45.1	47.7	48.1	47.5	45.9	40.1	29.1	18.0	50.0
19:02	44.5	47.3	48.1	47.6	45.9	40.1	29.2	18.1	50.0
19:17	44.8	47.5	48.0	47.6	45.9	40.2	29.3	18.2	50.0
19:32	44.9	47.6	48.0	47.4	45.6	40.4	29.0	17.9	49.9
19:47	44.6	47.3	47.9	47.6	45.8	40.4	29.1	17.9	50.0
20:02	44.6	47.3	48.0	47.5	45.6	40.2	29.0	17.9	49.9
20:17	44.5	47.4	47.8	47.6	45.6	40.2	28.9	17.8	49.9
20:32	44.6	47.3	47.8	47.5	45.7	40.1	29.0	17.9	49.9
21:02	44.9	47.7	48.1	47.5	45.9	40.3	29.2	18.0	50.0
21:17	44.4	47.4	47.7	47.5	45.8	40.3	29.2	18.1	50.0
21:32	44.2	47.3	47.8	47.5	45.7	40.1	29.1	18.0	49.9
21:47	44.7	47.8	47.7	47.5	45.8	40.2	29.0	18.0	49.9

22:02	44.0	47.2	47.6	47.6	45.6	40.0	29.0	17.9	49.9
22:17	44.0	47.2	47.6	47.4	45.7	40.0	29.1	18.0	49.8
22:32	43.9	47.0	47.5	47.4	45.8	40.0	29.1	18.1	49.9
22:47	43.8	47.3	47.5	47.3	45.8	40.1	29.2	18.2	49.9
23:02	43.4	46.8	47.3	47.3	45.8	40.1	29.0	18.0	49.8
23:17	43.3	46.8	47.3	47.2	45.7	40.1	29.0	18.0	49.7
23:32	43.7	46.9	47.7	47.4	45.8	40.2	29.3	18.3	49.9
23:47	43.4	47.1	47.5	47.4	46.0	40.3	29.4	18.3	50.0
00:02	43.1	47.0	47.4	47.3	46.0	40.3	29.3	18.2	49.9
00:17	42.8	46.7	47.0	47.1	46.1	40.2	29.1	18.0	49.9
00:32	42.9	47.0	47.3	47.2	45.9	40.0	29.1	18.1	49.8
00:47	42.5	46.9	47.2	47.2	45.8	40.0	29.2	18.1	49.7
01:32	42.7	47.2	47.1	47.3	46.3	40.4	29.5	18.3	50.1
01:47	43.0	47.2	47.3	47.3	46.2	40.3	29.7	18.7	50.0
02:02	42.4	47.0	46.8	47.1	46.2	40.2	29.3	18.3	49.9
02:17	42.2	46.9	46.7	47.1	46.3	40.4	29.4	18.3	50.0
02:32	43.1	47.8	47.5	47.5	46.5	40.7	30.0	18.9	50.3
02:47	42.8	47.5	47.3	47.2	46.4	40.7	29.8	18.8	50.2
03:02	42.5	47.2	46.7	47.1	46.2	40.3	29.3	18.4	50.0
03:17	35.8	40.3	35.2	33.0	28.7	22.1	15.2	14.8	34.7
03:32	37.2	40.2	35.0	33.3	28.9	21.1	15.0	14.8	34.7
03:47	35.6	41.9	34.4	32.9	28.3	21.8	15.7	14.8	34.5
04:02	35.8	39.4	34.4	32.0	28.3	20.5	14.9	14.8	33.8
04:17	36.0	42.4	35.4	32.8	28.6	21.6	15.6	14.8	35.0
04:32	36.9	42.1	34.9	33.4	28.4	21.6	15.6	14.8	34.8
04:47	36.7	38.9	33.8	32.0	27.9	20.4	14.9	14.8	33.4
05:32	37.9	40.2	35.1	33.1	28.9	21.6	15.0	14.8	34.7
05:47	38.7	42.5	36.1	33.8	29.4	23.1	16.5	14.8	35.5
06:02	40.1	43.4	38.6	35.9	32.2	26.9	19.0	14.8	38.0
06:17	40.4	42.3	38.4	35.5	31.8	26.6	18.5	14.8	37.5
06:32	40.5	43.7	38.2	35.3	31.9	26.9	18.9	14.8	37.7
06:48	40.8	43.7	38.2	35.3	31.8	26.8	18.8	14.8	37.5
07:03	41.6	43.5	39.1	35.7	32.2	26.8	18.6	14.8	37.9
07:18	41.8	44.4	39.8	36.5	32.5	27.1	18.9	14.8	38.5
08:03	42.3	44.4	39.9	37.1	33.6	28.9	20.5	14.8	39.4
08:18	42.5	44.9	40.5	37.5	34.2	29.4	21.0	14.8	40.2
08:33	43.5	45.3	41.3	38.4	34.1	28.5	20.2	14.8	40.3
08:48	45.2	47.6	42.9	39.3	35.1	29.7	21.2	14.8	41.7
09:03	43.6	45.3	41.6	38.8	34.8	29.4	21.1	14.8	40.7
09:18	43.3	45.4	41.6	39.0	34.7	29.4	20.8	14.8	40.8
09:33	44.2	46.1	41.8	39.2	35.0	29.9	21.2	14.9	41.0
09:48	43.7	45.4	41.7	39.0	34.9	29.5	20.9	14.8	40.8
10:03	43.7	45.9	42.3	39.6	35.2	29.9	21.2	14.8	41.3
10:18	43.6	46.0	42.0	39.4	35.2	29.8	21.0	14.8	41.1
10:33	44.2	46.8	42.2	39.4	35.4	29.7	20.9	14.8	41.3
10:48	44.2	46.0	42.0	39.4	35.1	29.5	20.6	14.8	41.2

11:03	45.1	48.1	44.0	41.3	37.1	30.9	21.2	14.8	43.0
11:18	44.2	45.9	43.5	40.3	36.3	30.5	21.6	14.8	42.0
11:33	44.5	46.8	42.8	40.5	36.5	31.1	22.0	14.8	42.1
11:48	43.6	45.8	43.3	40.9	36.6	31.3	22.7	14.9	42.6
12:03	44.4	47.0	42.8	40.2	36.5	31.4	22.8	14.9	42.3
12:18	44.2	47.8	42.7	39.8	35.6	29.7	20.7	14.8	41.7
12:33	42.9	45.0	42.0	39.3	35.5	29.6	20.6	14.8	41.1

Notes; All readings sound pressure level dB re: $2x10^{-5}$ Nm^{-2}.

Appendix 1

ALLAWAY ACOUSTIC
LIMITED

ACOUSTIC TERMINOLOGY

DECIBEL (dB) - The Decibel is a logarithmic unit used to express ratios of quantities such as sound pressure level or sound power. The logarithmic nature of the unit means that decibel values cannot be added or subtracted in the usual way.

dBA or LA - The A weighted scale is used to take account of the fact that the human ear is more sensitive to sounds at high frequencies than sounds at low frequencies. "A" weighted sound pressure level (sound level) measurements correspond roughly to the subjective impression of loudness of the average listener.

LAEQ - The LAEQ index is used as a method of averaging temporally or spatially varying sound levels. At a given position, it may be defined as the notional sound level which contains the same amount of acoustical energy as the actual (time varying) sound level over the same measurement period. The LAEQ is gaining acceptance for many types of noise assessment, and is now referred to within BS4142 (used to assess the likelihood of justifiable environmental noise complaints), and also within the Noise at Work Regulations 1989.

LAMAX - The LAMAX is the maximum sound pressure level (sound level) recorded during any given measurement period.

LA10 - The LA10 is the sound level that is exceeded for 10% of the measurement period and is commonly used to describe road traffic noise, since it has been found to correlate reasonably well with complaint thresholds.

LA90 - The LA90 is the sound level that is exceeded for 90% of the measurements period, and is generally considered to describe the background noise, since it inherently excludes the sounds of transient events.