Noise & Vibration Consultants
4 Mulberry Place, Pinnell Road, London, SE9 6AR
Tel: **020 8859 0303** Fax: 020 8859 1211
Email: **info@acousticsplus.co.uk** Web: www.acousticsplus.co.uk

ACOUSTICS PLUS

Proposed Installation of Mechanical Plant

53 Fitzroy Park, London, N6 6JA

Environmental Noise Assessment

Author: Phil Huffer B.Sc. (Hons) MIOA
Principal Consultant

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Proposed Installation of Mechanical Plant	
Project Address:	53 Fitzroy Park London N6 6JA
Project Reference:	102638

Issue/Revision Record

Issue:	Date:	Remarks:	Author:
1	18/09/2014	First Issue	Phil Huffer
2	06/11/2014	Revisions to plant layout	Phil Huffer
3	14/02/2017	Revised drawings	Phil Huffer

	Signature:	Print:	Title:	Date:
Author:		**Phil Huffer**	**Principal Consultant**	**14/02/2017**
Reviewer:		**Andy Dodd**	**Senior Consultant**	**14/07/2017**

1. INTRODUCTION

1.1 Acoustics Plus Ltd (APL) is an independent firm of multi-disciplinary acoustic engineers. APL is engaged by both private and public sector clients.

1.2 APL is a registered member of The Association of Noise Consultants (ANC) and the author is a corporate member of The Institute of Acoustics (IOA).

1.3 APL has been instructed by the applicants M&E consultant, CBG Consultants, to consider and advise upon the noise implications of the proposed installation of externally located mechanical plant.

1.4 The proposed installation will consist of the following roof mounted plant:

- *3 No. Mitsubishi PUHZ-HW140YHA2 (Air source heat pumps)*
- *1 No. Nuaire AXB31B-41 Axial Kitchen Extract fan*
- *1 No. Mitsubishi PUHY-EP400SKM-A (A/C Condenser)*

1.5 It is understood the Local Planning Authority (LPA) require further information on noise levels from the proposed installation in order to fully assess the noise impact upon the surrounding neighbourhood.

1.6 This report provides the response to the LPA, on behalf of the Applicant.

2. BASELINE SITUATION

2.1 The Application Site (the "site") is situated at 53 Fitzroy Park, London, N6 6JA. The site slopes steeply from East to West. The current dwelling is developed over 3 storeys, two of these above street level and a lower ground floor at the back garden level. This 1950's flat roofed building is finished in white painted timber and brick, with wooden window and door frames.

2.2 The proposal for development is a new sustainable family house, built in a mixture of high quality traditional and contemporary materials.

2.3 The site location and its proximity to adjacent noise sensitive premises is shown in Diagram 1 below and in Figures 1 to 8 (attached).

Diagram 1

2.4 It is proposed to install 5No. items of mechanical plant in a designated plant area on the flat roof of the proposed property.

2.5 The proposed roof area together with the location for the roof mounted items of plant is shown in Diagram 2 overleaf.

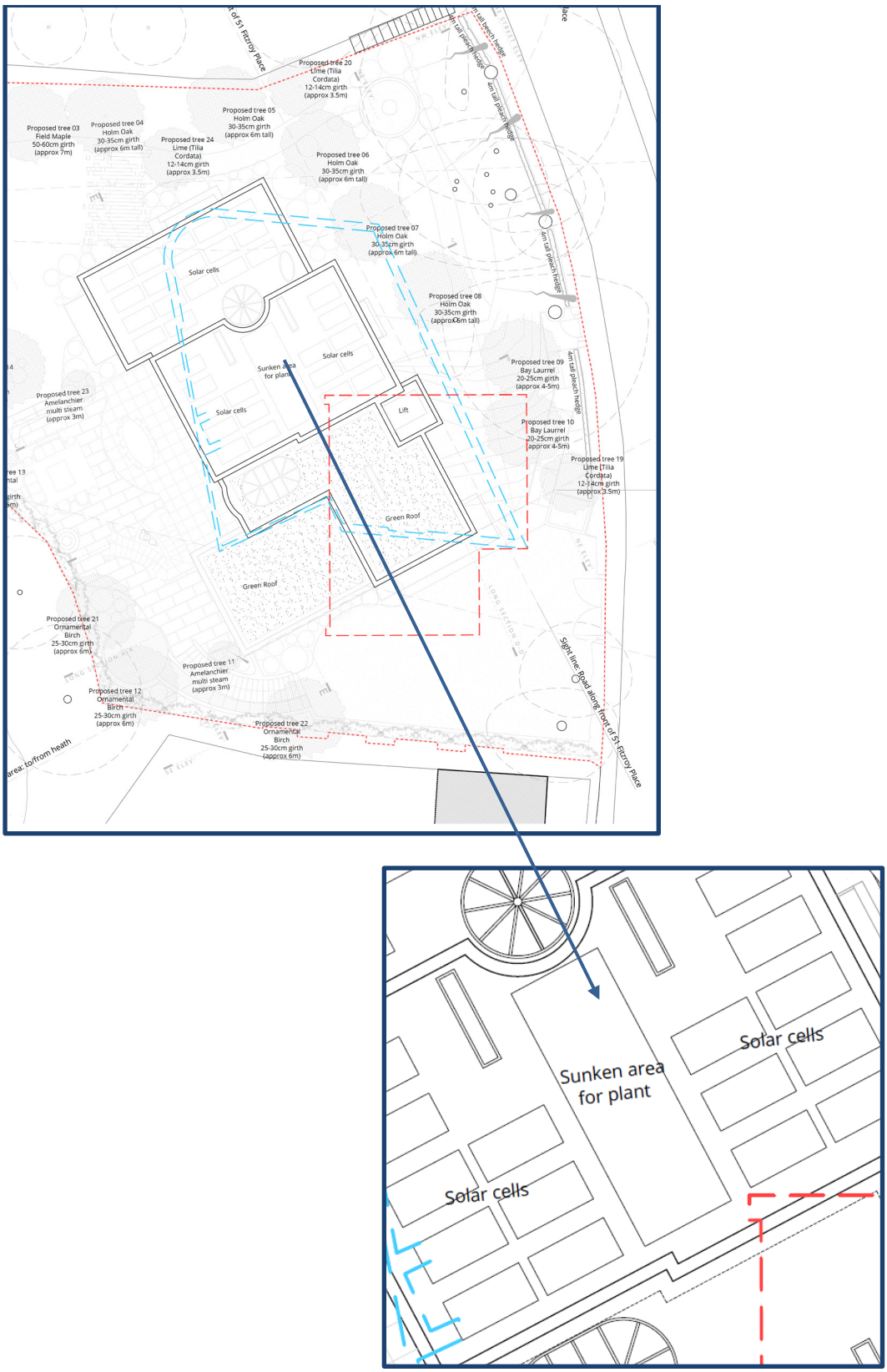

Proposed tree 20
Lime (Tilia Cordata)
12-14cm girth
(approx 3.5m)
Proposed tree 03
Field Maple
50-60cm girth
(approx 7m)
Proposed tree 04
Holm Oak
30-35cm girth
(approx 6m tall)
Proposed tree 05
Holm Oak
30-35cm girth
(approx 6m tall)
Proposed tree 24
Lime (Tilia Cordata)
12-14cm girth
(approx 3.5m)
Proposed tree 06
Holm Oak
30-35cm girth
(approx 6m tall)
Proposed tree 07
Holm Oak
30-35cm girth
(approx 6m tall)
Proposed tree 08
Holm Oak
30-35cm girth
(approx 6m tall)
Solar cells
Solar cells
Solar cells
Sunken area for plant
Lift
Green Roof
Green Roof
Proposed tree 09
Bay Laurrel
20-25cm girth
(approx 4-5m)
Proposed tree 10
Bay Laurrel
20-25cm girth
(approx 4-5m)
Proposed tree 19
Lime (Tilia Cordata)
12-14cm girth
(approx 3.5m)
Proposed tree 23
Amelanchier multi steam
(approx 3m)
Proposed tree 21
Ornamental Birch
25-30cm girth
(approx 6m)
Proposed tree 11
Amelanchier multi steam
(approx 3m)
Proposed tree 12
Ornamental Birch
25-30cm girth
(approx 6m)
Proposed tree 22
Ornamental Birch
25-30cm girth
(approx 6m)
4m tall pleach hedge
4m tall pleach hedge
4m tall pleach hedge
4m tall pleach hedge
Sight line Road along front of 51 Fitzroy Place
Sunken area for plant
Solar cells
Solar cells

Diagram 2

3. NOISE OUTLINE

3.1 In order to produce an environmental noise assessment, consideration must be given to the prevailing background noise in the locality of the installation.

3.2 Measurements of background noise were obtained over a 24 hour period at a location deemed representative of background noise levels experienced at the nearest noise sensitive façade.

3.3 The measurements obtained during the exercise were obtained in the rear garden at ground floor level.

3.4 The particulars of the measurement exercise are recorded below:

Date:	28th January 2014
Start Time:	12:30 hrs
Location:	rear garden, 53 Fitzroy Park
Weather:	No rain, light wind.

3.5 The measurements carried out during the exercise are recorded below:

L_{90} percentile level (dB re 20μPa) at 15 minute intervals

3.6 The measurements obtained during the exercise are presented in Appendix B.

3.7 Minimum background and average noise levels are shown in Table 1 below:

WHO period	Lowest $L_{A90,15min}$	Average $L_{Aeq,T}$
07:00-19:00hrs	40 dB	50 dB
19:00-23:00hrs	38 dB	48 dB
23:00-07:00hrs	29 dB	39 dB

Table 1

3.8 The noise level of the proposed plant was established from the data sheets provided (Appendix A) as follows:

a) 3 No. Mitsubishi PUHZ-HW140YHA2 ASHP L_p 53dBA @ 1m (per unit)
b) 1 No. Nuaire AXB31B-41 Axial Kitchen Extract fan L_w 69dBA
c) *1 No. Mitsubishi PUHY-EP400SKM-A A/C Condenser L_p 60dBA @ 1m*

4. DESIGN CRITERIA

4.1 Information regarding the noise levels not to be exceeded by the proposed installation of externally located mechanical plant was provided by the LPA (London Borough of Camden). The Local Development Framework 2010-2025 Section DP28 (Table E) Noise and Vibration states:

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dBA<LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dBA <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dBA<LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dBLAeq

Table 2

4.2 It is expected that the proposed condenser unit and ASHP's will not generate tonal noise although the kitchen extract system may contain continuous discrete notes (whine, hiss, screech, hum). The plant noise emission criteria that should not be exceeded is therefore based on Table 2 above and is shown in Table 3 below. These levels should not be exceeded at the nearest noise sensitive premises, considered to be the adjacent property.

Daytime, evening and night Kitchen extract system	Daytime & evening Condenser unit and ASHPs	Night Condenser unit and ASHPs
L_{Aeq} 19dB	L_{Aeq} 33dB	L_{Aeq} 24dB

Table 3

5. EQUIPMENT

5.1 All measurements were obtained using the following equipment:

- Norsonic Precision Sound Level Meter Type NOR140 Serial No. 1403466
- Rion Calibrator Type NC-74 Class 1 Serial No. 00410215

5.2 The relevant equipment carries full and current traceable calibration. The equipment, where necessary, was calibrated prior to and after the measurements were carried out.

6. CALCULATIONS

6.1 In order to predict the noise impact of the proposed installation of mechanical plant, consideration has been given to noise egress from the plant items to the nearest noise sensitive façade.

6.2 Where necessary, acoustic mitigation measures such as the use of acoustic enclosures and acoustic attenuators have been included in the calculation process to demonstrate compliance. Items of plant requiring mitigation measures have been highlighted within the conclusion.

6.3 The following noise impacts were considered:

(a) *Noise Impact A – the egress of noise from the condensing unit to the noise sensitive property adjacent (assumed to be at site boundary);*
(b) *Noise Impact B – the egress of noise from the ASHP units to the noise sensitive property adjacent (assumed to be at site boundary);*
(c) *Noise Impact C – the egress of noise from the kitchen extract fan to the noise sensitive property adjacent (assumed to be at site boundary);*

Noise Impact A

6.4 In considering the propagation of noise from the condenser, consideration was given to point source propagation.

6.5 Noise leaving the condenser unit was propagated over 25m to the nearest noise sensitive façade. The output level of the condenser was first corrected by +3dB to account for a reflecting plane beneath the condenser unit.

6.6 A further correction to account for building edge diffraction of -5dB was assumed. This was extracted from the Department of Energy and Climate Change Planning Standard MCS020. This correction was applied due to minimal line of sight from the windows of the residential property to the condenser unit.

6.7 The planning standard MCS020 states the following (Note 5):

"Note 5: Barriers between the heat pump and the assessment position (STEP 5)
A correction should be made for attenuation due to barriers between the air source heat pump and an assessment position. A correction will be necessary if an installer is unable to see an assessment position from the top edge of the air source heat pump. Use the following instructions to determine whether a correction is appropriate:

- *For a solid barrier (e.g. a brick wall or a fence) that completely obscures an installer's vision of an assessment position from the top edge of the air source heat pump attenuation of -10 dB may be assumed.*
- *Where a solid barrier completely obscures an installer's vision of an assessment position from the top or side edges of the air source heat pump, but moving a maximum distance of 25 cm in any direction to the air source heat pump allows an assessment position to be seen, attenuation of -5 dB may be assumed.*
- *If it is possible for an installer to see any part of an assessment position from the top or side edges of the air source heat pump no attenuation may be assumed."*

6.8 The calculation exercise provided the following results.

Standard mode (daytime)	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Mitsubishi PUHY-EP400SKM	67	66	63	57	54	49	43	40	60
Distance attenuation - 25m	-28	-28	-28	-28	-28	-28	-28	-28	
Reflecting plane	3	3	3	3	3	3	3	3	
Building edge diffraction	-5	-5	-5	-5	-5	-5	-5	-5	
Noise level at site boundary	37	36	33	27	24	19	13	10	30

Table 4

Low noise mode (night)	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Mitsubishi PUHY-EP400SKM	60	52	49	42	42	36	36	29	47
Distance attenuation - 25m	-28	-28	-28	-28	-28	-28	-28	-28	
Reflecting plane	3	3	3	3	3	3	3	3	
Building edge diffraction	-5	-5	-5	-5	-5	-5	-5	-5	
Noise level at site boundary	30	22	19	12	12	6	6	0	17

Table 5

6.9 In order to comply with the requirements of the LPA, any noise from the proposed installation of the condenser unit should not exceed a level of 33 dBA (5dB below the lowest measured daytime background noise) and 24dBA (5dB below the lowest measured night time background noise) at 1m from the nearest noise sensitive facade.

Noise Impact B

6.10 In order to predict the noise impact of the proposed installation of the Air Source Heat Pump units, consideration was given to point source propagation.

6.11 Noise leaving the ASHP's was propagated over 22m to the nearest noise sensitive façade. The output level of the ASHP's was first corrected by +3dB to account for a reflecting plane beneath the condenser unit.

6.12 A further correction to account for building edge diffraction of -5dB was assumed, as described in para 6.7 above.

6.13 The calculation exercise provided the following results.

Standard mode	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
PUHZ-HW140YHA2	61	55	52	51	48	43	37	30	53
3No. PUHZ-HW140YHA2	66	60	57	56	53	48	42	35	58
Distance attenuation - 22m	-27	-27	-27	-27	-27	-27	-27	-27	
Reflecting plane	3	3	3	3	3	3	3	3	
Building edge diffraction	-5	-5	-5	-5	-5	-5	-5	-5	
Noise level at site boundary	37	31	28	27	24	19	13	6	29

Table 6

6.14 In order to comply with the requirements of the LPA, any noise from the proposed installation of the ASHP's should not exceed a level of 24dBA (5dB below the lowest measured night time background noise) at 1m from the nearest noise sensitive facade.

Noise Impact C

6.15 In order to predict the noise impact of the proposed installation of the kitchen extract fan, consideration has been given to noise breakout through the kitchen exhaust termination (atmosphere side).

6.16 The calculation exercise utilised information provided by Nuaire (copy of the data sheet is provided in Appendix A).

6.17 Throughout the calculation exercise, guidance and formula were extracted from the authoritative publication *"Noise Control in Building Services" (published by SRL)*.

6.18 The ductwork system attenuation was calculated by considering the attenuation of sound energy produced by each component of the ductwork system. In order to meet the LPA noise criteria, a Nuaire long podded attenuator has been utilised. The acoustic attenuation required of the attenuator is shown in line 34 of the calculation sheets (contained in Appendix C).

6.19 Noise leaving the ductwork system at the duct discharge was propagated to the nearest noise sensitive façade using point source propagation. The calculation exercise (attached as Appendix C) provided the following result at the nearest noise sensitive façade:

Source	L_p dBA @ noise sensitive façade
Kitchen Extract system – discharge	19

Table 7

6.20 In order to comply with the requirements of the LPA, any noise from the proposed installation of the kitchen extract system should not exceed a level of 19 dBA (10dB below the lowest measured background noise over the operational hours of the plant) at 1m from the nearest noise sensitive facade.

7. CONCLUSION

7.1 The foregoing assessment indicates that the proposed installation will generally meet the requirements imposed by the LPA.

7.2 In order for the ASHP units to meet the LPA requirements, it is recommended that additional screening around the units is considered to ensure that there is no line of sight between the top of the units and the neighbouring properties. This screening should be solid and continuous around the units or around the whole plant area. This type of screening will readily provide the additional 5dB attenuation required to meet the LPA requirements.

7.3 If an alternative supplier or manufacturer of plant is chosen, the acoustic performance should be checked prior to installation to ensure that the installation will still meet the requirements imposed by the LPA.

7.4 In order to meet the LPA requirements, the following acoustic mitigation measures have been incorporated into the scheme. These must be included to ensure compliance with the LPA noise requirements.

(a) ASHP surrounded by solid screening. The height of the screen should be a minimum of 25cm above the height of the units.

(b) Kitchen extract system – fitted with Nuaire long-podded attenuator

Figures

Proposed installation of external mechanical plant, 53 Fitzroy Park

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

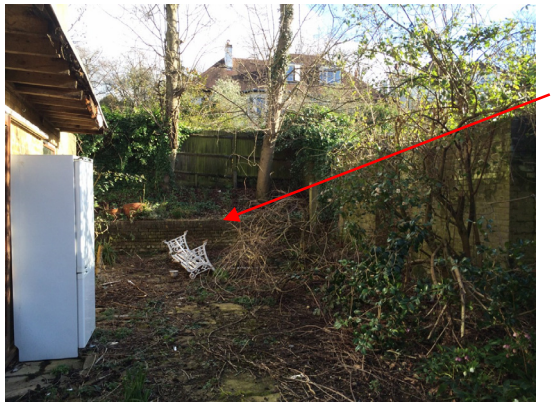


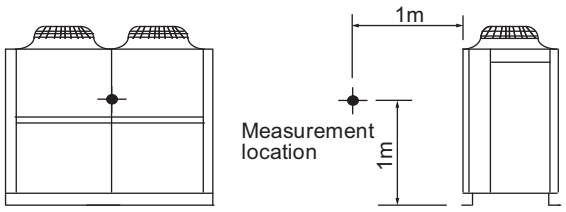
Figure 6

Figure 7

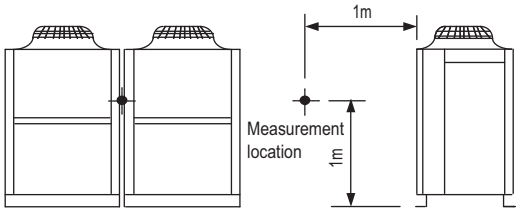
Figure 8

Appendix A

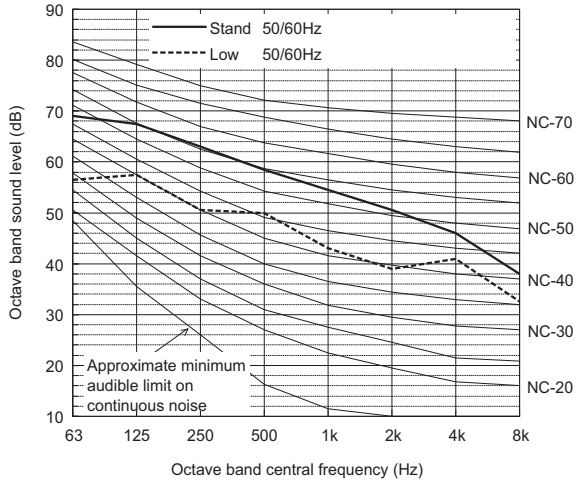
Measurement condition
PUHY-EP300YJM-A(-BS)



Measurement condition
PUHY-EP400YSJM-A(-BS)



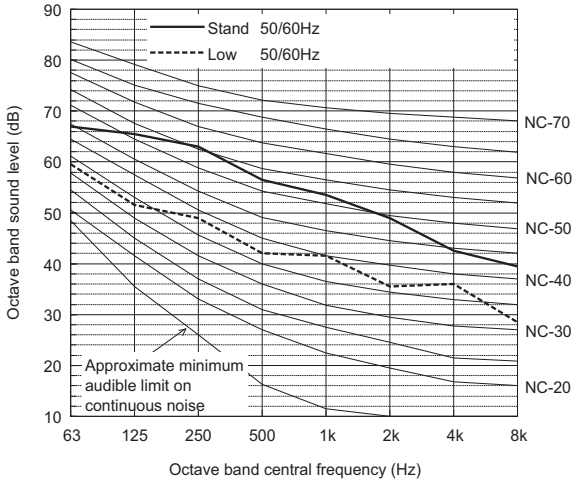
Sound level of PUHY-EP300YJM-A(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	69.0	67.5	63.0	58.5	54.5	50.5	46.0	38.0	61.0
Low noise mode	50/60Hz	56.5	57.5	50.5	50.0	43.0	39.0	41.0	32.5	51.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Sound level of PUHY-EP400YSJM-A(-BS)

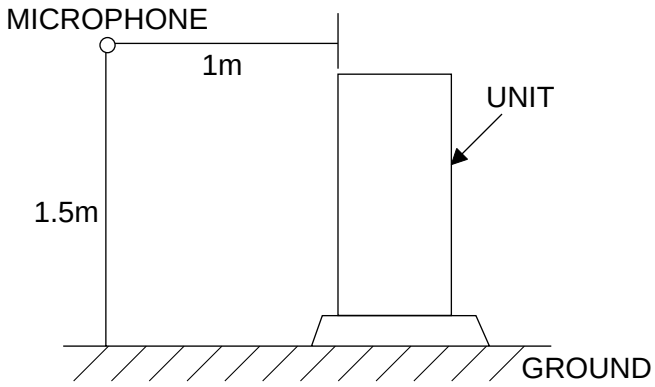


		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	67.0	65.5	63.0	56.5	53.5	49.0	42.5	39.5	60.0
Low noise mode	50/60Hz	59.5	51.5	49.0	42.0	41.5	35.5	36.0	28.5	47.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

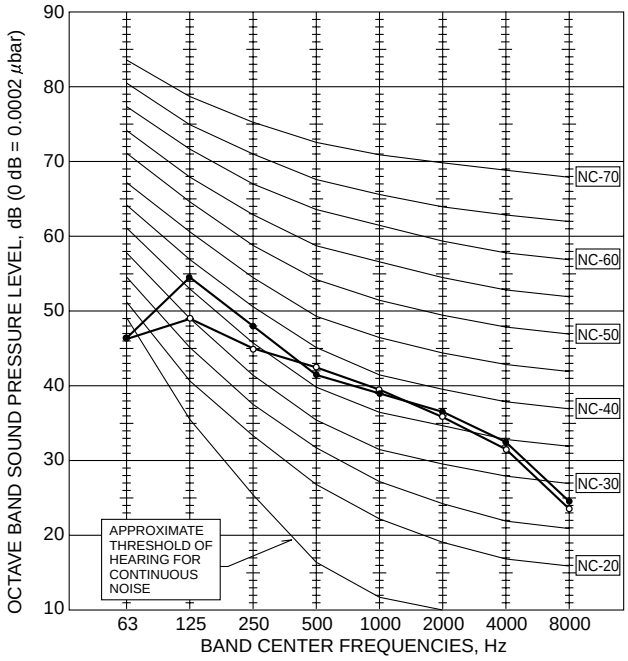
4 DATA

4-1. NOISE CRITERION CURVES



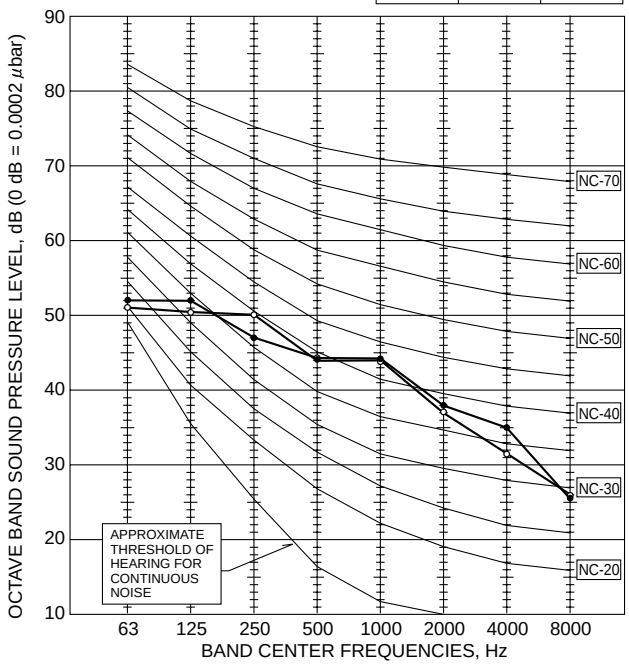
PUHZ-W50VHA(-BS)

MODE	SPL(dB)	LINE
COOLING	45	
HEATING	46	



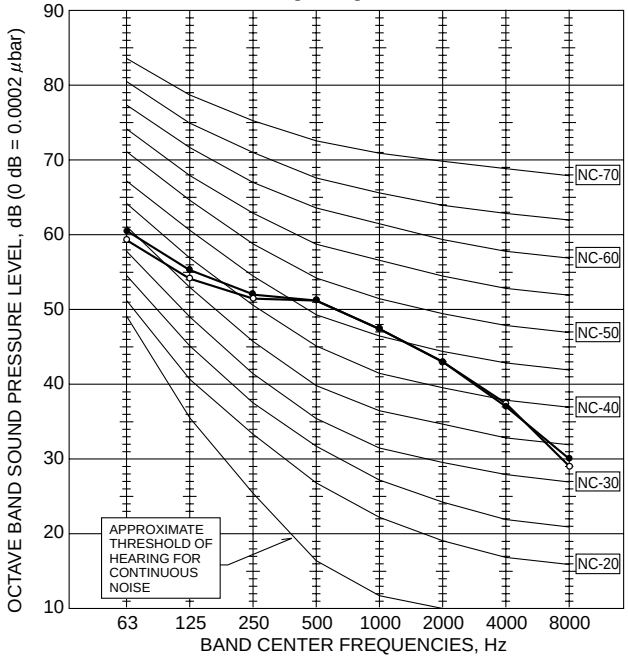
PUHZ-W85VHA(-BS)
PUHZ-W85VHAR1(-BS)

MODE	SPL(dB)	LINE
COOLING	48	
HEATING	48	



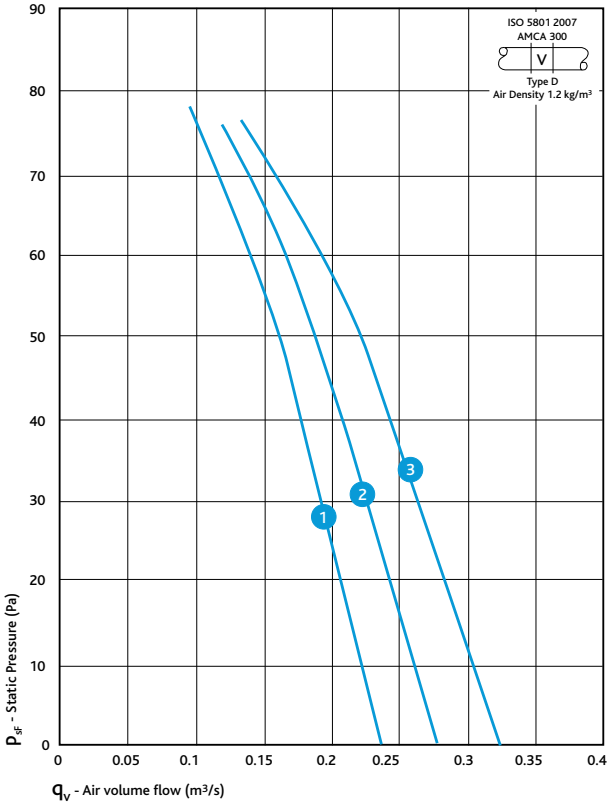
PUHZ-HW112YHA(-BS)
PUHZ-HW140VHA(-BS)
PUHZ-HW140YHA(-BS)
PUHZ-HW112YHA2(-BS)
PUHZ-HW140VHA2(-BS)
PUHZ-HW140YHA2(-BS)

MODE	SPL(dB)	LINE
COOLING	53	
HEATING	53	

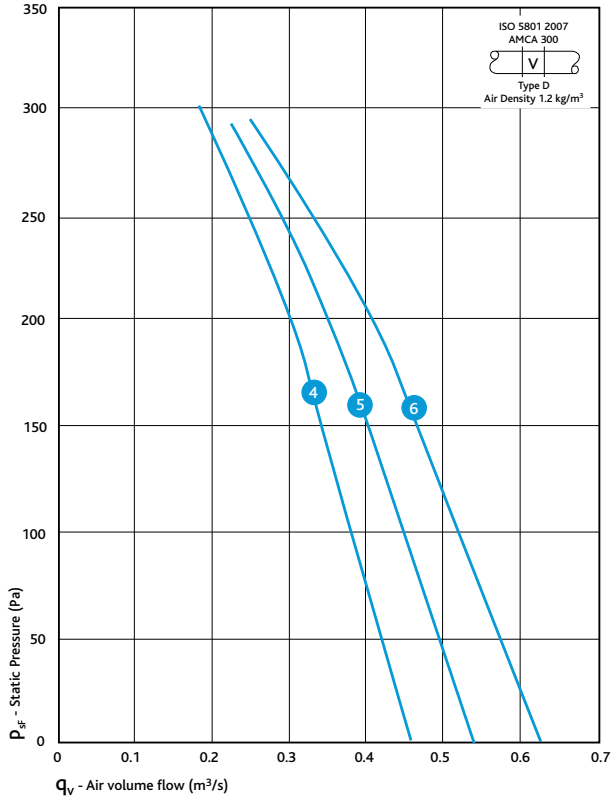


PERFORMANCE - BIFURCATED AXIAL FLOW UNITS - 315MM Ø

315mm Ø 4 Pole/1440 rpm



315mm Ø 2 Pole/2800 rpm



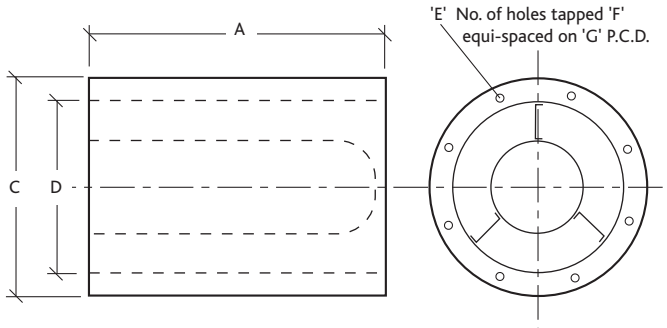
ELECTRICAL & SOUND

Curve No	Unit Code	Blade Angle°	Speed RPM	Unit kg	A.V. Set	Motor frame size	1 Phase (230V-50Hz) Motor kW	FLC amps	SC amps	3 Phase (400V-50Hz) Motor kW	FLC amps	SC amps	In-duct inlet sound power levels dB re 1pW Octave band mid frequency Hz 125	250	500	1K	2K	4K	8K	Breakout dBA@3m
315mm Ø - 4 Pole/1440rpm																				
1	AXB31B-41*A	25°	1430	22	NAV1	71	0.37	2.9	11.6	0.37	1.06	3.5	67	72	66	63	59	51	46	43
2	AXB31B-42*A	30°	1430	22	NAV1	71	0.37	2.9	11.6	0.37	1.06	3.5	71	76	69	67	62	55	50	46
3	AXB31B-43*A	35°	1430	22	NAV1	71	0.37	2.9	11.6	0.37	1.06	3.5	74	79	72	70	66	58	53	49
315mm Ø - 2 Pole/2800rpm																				
4	AXB31B-21*A	25°	2810	27	NAV1	80	0.55	3.8	17.1	0.55	1.36	5.8	72	81	78	78	74	66	61	55
5	AXB31B-22*A	30°	2810	22	NAV1	80	0.55	3.8	17.1	0.55	1.36	5.8	76	85	81	82	77	70	65	58
6	AXB31B-23*A	35°	2810	22	NAV1	80	0.55	3.8	17.1	0.55	1.36	5.8	79	88	84	85	81	73	68	61

Notes relating to the table: The electrical and sound information in the table is nominal. Breakout dBA@3m is spherical, free field.
Start currents (sc) are DOL other than for motors of 4kW and above which are Star Delta (T).
*Insert number for correct phase. 1 = 1 phase, 3 = 3 phase.

For ancillaries please refer to page 310.

CIRCULAR ATTENUATORS



Standard Podded

PERFORMANCE, DIMENSIONS (mm) & WEIGHTS

			Dynamic Attenuation Octave band mid frequency (Hz)							Dimensions & Weights						
Dia.	Unit Code	Type	125	250	500	1K	2K	4K	8K	A	C	D	E	F	G	Weight Kg	Z
250mm	CA25SP	Standard - Podded	-2	-5	-13	-16	-17	-11	-8	250	450	250	4	M8	300	8.0	82
315mm	CA31SP	Standard - Podded	-3	-6	-14	-16	-17	-11	-8	315	515	315	8	M8	355	12.0	26.6
350mm	CA35SP	Standard - Podded	-3	-6	-14	-17	-17	-11	-8	355	555	355	8	M8	395	17.0	19.7
400mm	CA40SP	Standard - Podded	-3	-7	-14	-18	-16	-11	-8	400	600	400	8	M10	450	23.0	8.2
450mm	CA45SP	Standard - Podded	-4	-7	-15	-18	-16	-11	-8	450	650	450	8	M10	500	30.0	6.2
500mm	CA50SP	Standard - Podded	-4	-8	-15	-19	-15	-11	-8	500	700	500	12	M10	560	33.0	4.0
560mm	CA56SP	Standard - Podded	-5	-8	-16	-21	-14	-11	-8	560	760	560	12	M10	620	37.0	2.7
630mm	CA63SP	Standard - Podded	-5	-8	-16	-21	-14	-11	-8	630	830	630	12	M10	690	44.0	1.5
710mm	CA71SP	Standard - Podded	-6	-9	-17	-20	-14	-11	-9	710	910	710	16	M10	770	50.0	0.9
800mm	CA80SP	Standard - Podded	-6	-9	-18	-18	-14	-11	-9	800	1000	800	16	M10	860	105.0	0.55
900mm	CA90SP	Standard - Podded	-7	-10	-19	-17	-15	-11	-10	900	1100	900	16	M12	970	132.0	0.31
1000mm	CA100SP	Standard - Podded	-7	-11	-19	-17	-14	-11	-10	1000	1200	1000	16	M12	1070	160.0	0.22
1120mm	CA112SP	Standard - Podded	-8	-12	-20	-17	-13	-11	-10	1120	1320	1120	20	M12	1190	206.0	0.13
1250mm	CA125SP	Standard - Podded	-8	-12	-20	-17	-13	-11	-10	1250	1450	1250	20	M12	1320	269.0	0.08

Long Podded

PERFORMANCE, DIMENSIONS (mm) & WEIGHTS

			Dynamic Attenuation Octave band mid frequency (Hz)							Dimensions & Weights						
Dia.	Unit Code	Type	125	250	500	1K	2K	4K	8K	A	C	D	E	F	G	Weight Kg	Z
250mm	CA25LP	Long - Podded	-4	-10	-21	-27	-29	-19	-12	500	450	250	4	M8	300	16.0	82
315mm	CA31LP	Long - Podded	-5	-10	-23	-27	-29	-19	-13	630	515	315	8	M8	355	22.0	26.6
350mm	CA35LP	Long - Podded	-5	-11	-23	-28	-29	-20	-14	710	555	355	8	M8	395	31.0	19.7
400mm	CA40LP	Long - Podded	-6	-11	-24	-29	-27	-20	-15	800	600	400	8	M10	450	43.0	8.2
450mm	CA45LP	Long - Podded	-6	-12	-24	-30	-27	-21	-15	900	650	450	8	M10	500	55.0	6.2
500mm	CA50LP	Long - Podded	-7	-12	-25	-32	-26	-21	-17	1000	700	500	12	M10	560	61.0	4.0
560mm	CA56LP	Long - Podded	-8	-13	-26	-34	-25	-22	-18	1120	760	560	12	M10	620	68.0	2.7
630mm	CA63LP	Long - Podded	-8	-13	-26	-34	-25	-22	-18	1260	830	630	12	M10	690	80.0	1.5
710mm	CA71LP	Long - Podded	-9	-14	-27	-32	-25	-21	-18	1420	910	710	16	M10	770	91.0	0.9
800mm	CA80LP	Long - Podded	-10	-15	-29	-30	-25	-20	-17	1600	1000	800	16	M10	860	191.0	0.55
900mm	CA90LP	Long - Podded	-11	-16	-31	-29	-25	-20	-17	1800	1100	900	16	M12	970	241.0	0.31
1000mm	CA100LP	Long - Podded	-12	-17	-32	-29	-23	-19	-17	2000	1200	1000	16	M12	1070	291.0	0.22
1120mm	CA112LP	Long - Podded	-14	-18	-33	-29	-22	-18	-16	2240	1320	1120	20	M12	1190	373.0	0.13
1250mm	CA125LP	Long - Podded	-14	-18	-33	-29	-22	-18	-16	2500	1450	1250	20	M12	1320	490.0	0.081

Note: Air pressure drop of attenuator (Pa) = Z x Q^2 where Z = Factor listed in table above Q = air volume flow rate (m^3/s).

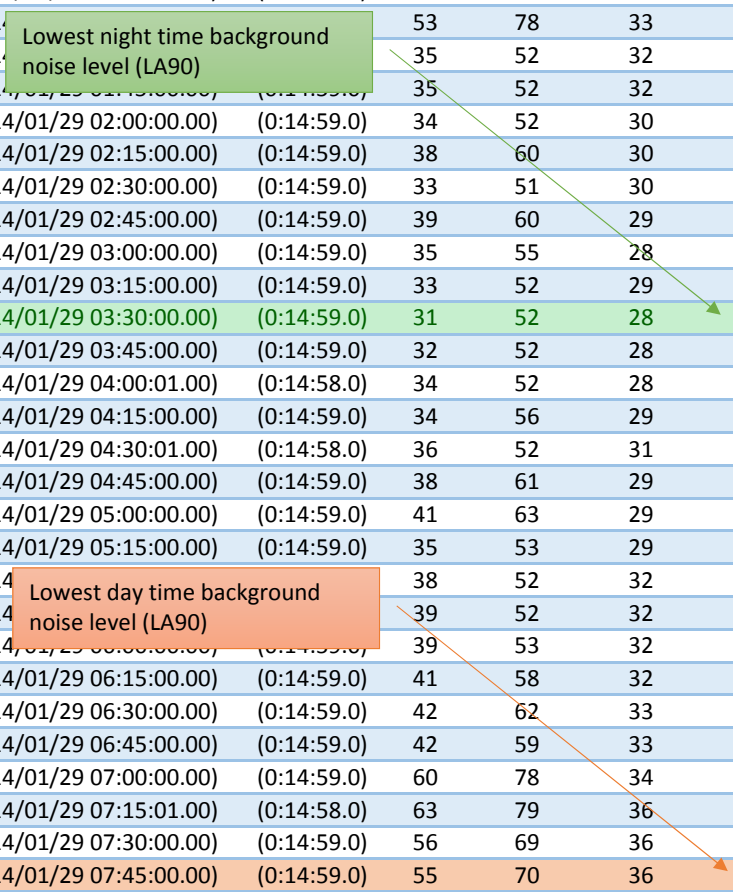
Appendix B

Background noise measurements obtained at rear of 53 Fitzroy Park, London, N6

File	Date	Duration	LAeq	LAFmax	LAFmin	LAF,90
NOR140_8183105_140128_0001.NBF	(2014/01/28 12:19:55.00)	(0:10:4.0)	64	91	40	43
NOR140_8183105_140128_0002.NBF	(2014/01/28 12:30:01.00)	(0:14:58.0)	58	89	40	42
NOR140_8183105_140128_0003.NBF	(2014/01/28 12:45:00.00)	(0:14:59.0)	50	75	41	43
NOR140_8183105_140128_0004.NBF	(2014/01/28 13:00:00.00)	(0:14:59.0)	52	70	41	43
NOR140_8183105_140128_0005.NBF	(2014/01/28 13:15:01.00)	(0:14:58.0)	47	66	40	42
NOR140_8183105_140128_0006.NBF	(2014/01/28 13:30:00.00)	(0:14:59.0)	51	76	42	44
NOR140_8183105_140128_0007.NBF	(2014/01/28 13:45:00.00)	(0:14:59.0)	50	69	42	44
NOR140_8183105_140128_0008.NBF	(2014/01/28 14:00:00.00)	(0:14:59.0)	51	69	42	44
NOR140_8183105_140128_0009.NBF	(2014/01/28 14:15:00.00)	(0:14:59.0)	49	70	41	43
NOR140_8183105_140128_0010.NBF	(2014/01/28 14:30:00.00)	(0:14:59.0)	53	69	41	44
NOR140_8183105_140128_0011.NBF	(2014/01/28 14:45:00.00)	(0:14:59.0)	51	68	41	43
NOR140_8183105_140128_0012.NBF	(2014/01/28 15:00:00.00)	(0:14:59.0)	49	66	41	43
NOR140_8183105_140128_0013.NBF	(2014/01/28 15:15:00.00)	(0:14:59.0)	48	65	42	44
NOR140_8183105_140128_0014.NBF	(2014/01/28 15:30:00.00)	(0:14:59.0)	50	69	42	44
NOR140_8183105_140128_0015.NBF	(2014/01/28 15:45:00.00)	(0:14:59.0)	49	72	42	44
NOR140_8183105_140128_0016.NBF	(2014/01/28 16:00:00.00)	(0:14:59.0)	52	73	43	45
NOR140_8183105_140128_0017.NBF	(2014/01/28 16:15:00.00)	(0:14:59.0)	47	68	42	44
NOR140_8183105_140128_0018.NBF	(2014/01/28 16:30:00.00)	(0:14:59.0)	48	63	42	44
NOR140_8183105_140128_0019.NBF	(2014/01/28 16:45:01.00)	(0:14:58.0)	44	56	40	42
NOR140_8183105_140128_0020.NBF	(2014/01/28 17:00:00.00)	(0:14:59.0)	45	62	40	42
NOR140_8183105_140128_0021.NBF	(2014/01/28 17:15:00.00)	(0:14:59.0)	50	69	42	43
NOR140_8183105_140128_0022.NBF	(2014/01/28 17:30:00.00)	(0:14:59.0)	51	69	42	44
NOR140_8183105_140128_0023.NBF	(2014/01/28 17:45:00.00)	(0:14:59.0)	49	69	41	43
NOR140_8183105_140128_0024.NBF	(2014/01/28 18:00:00.00)	(0:14:59.0)	53	75	42	43
NOR140_8183105_140128_0025.NBF	(2014/01/28 18:15:00.00)	(0:14:59.0)	50	69	41	42
NOR140_8183105_140128_0026.NBF	(2014/01/28 18:30:00.00)	(0:14:59.0)	48	72	39	41
NOR140_8183105_140128_0027.NBF	(2014/01/28 18:45:00.00)	(0:14:59.0)	44	63	38	40
NOR140_8183105_140128_0028.NBF	(2014/01/28 19:00:00.00)	(0:14:59.0)	49	67	39	41
NOR140_8183105_140128_0029.NBF	(2014/01/28 19:15:00.00)	(0:14:59.0)	52	70	40	42
NOR140_8183105_140128_0030.NBF	(2014/01/28 19:30:00.00)	(0:14:59.0)	48	72	40	41
NOR140_8183105_140128_0031.NBF	(2014/01/28 19:45:01.00)	(0:14:58.0)	46	63	40	41
NOR140_8183105_140128_0032.NBF	(2014/01/28 20:00:00.00)	(0:14:59.0)	43	55	40	41
NOR140_8183105_140128_0033.NBF	(2014/01/28 20:15:01.00)	(0:14:58.0)	44	56	39	41
NOR140_8183105_140128_0034.NBF	(2014/01/28 20:30:01.00)	(0:14:58.0)	43	61	39	40
NOR140_8183105_140128_0035.NBF	(2014/01/28 20:45:00.00)	(0:14:59.0)	48	69	39	41
NOR140_8183105_140128_0036.NBF	(2014/01/28 21:00:00.00)	(0:14:59.0)	49	72	36	38
NOR140_8183105_140128_0037.NBF	(2014/01/28 21:15:00.00)	(0:14:59.0)	41	55	36	38
NOR140_8183105_140128_0038.NBF	(2014/01/28 21:30:00.00)	(0:14:59.0)	48	66	37	39
NOR140_8183105_140128_0039.NBF	(2014/01/28 21:45:00.00)	(0:14:59.0)	49	70	38	40
NOR140_8183105_140128_0040.NBF	(2014/01/28 22:00:00.00)	(0:14:59.0)	44	60	38	39
NOR140_8183105_140128_0041.NBF	(2014/01/28 22:15:00.00)	(0:14:59.0)	51	71	38	41
NOR140_8183105_140128_0042.NBF	(2014/01/28 22:30:01.00)	(0:14:58.0)	54	68	42	47
NOR140_8183105_140128_0043.NBF	(2014/01/28 22:45:00.00)	(0:14:59.0)	53	62	43	46
NOR140_8183105_140128_0044.NBF	(2014/01/28 23:00:00.00)	(0:14:59.0)	48	67	40	41
NOR140_8183105_140128_0045.NBF	(2014/01/28 23:15:00.00)	(0:14:59.0)	42	54	39	40
NOR140_8183105_140128_0046.NBF	(2014/01/28 23:30:00.00)	(0:14:59.0)	41	52	38	39
NOR140_8183105_140128_0047.NBF	(2014/01/28 23:45:00.00)	(0:14:59.0)	41	52	38	39
NOR140_8183105_140129_0001.NBF	(2014/01/29 00:00:00.00)	(0:14:59.0)	39	52	37	38
NOR140_8183105_140129_0002.NBF	(2014/01/29 00:15:00.00)	(0:14:59.0)	40	53	37	38

Background noise measurements obtained at rear of 53 Fitzroy Park, London, N6

File	Date	Duration	LAeq	LAFmax	LAFmin	LAF,90
NOR140_8183105_140129_0003.NBF	(2014/01/29 00:30:00.00)	(0:14:59.0)	38	51	36	37
NOR140_8183105_140129_0004.NBF	(2014/01/29 00:45:00.00)	(0:14:59.0)	49	70	34	36
NOR140_8183105_140129_0005.NBF	(2014/01/29 01:00:00.00)	(0:14:59.0)	37	52	34	35
NOR140_8183105_140129_0006.NBF	(201		53	78	33	34
NOR140_8183105_140129_0007.NBF	(201		35	52	32	33
NOR140_8183105_140129_0008.NBF	(201		35	52	32	34
NOR140_8183105_140129_0009.NBF	(2014/01/29 02:00:00.00)	(0:14:59.0)	34	52	30	32
NOR140_8183105_140129_0010.NBF	(2014/01/29 02:15:00.00)	(0:14:59.0)	38	60	30	31
NOR140_8183105_140129_0011.NBF	(2014/01/29 02:30:00.00)	(0:14:59.0)	33	51	30	31
NOR140_8183105_140129_0012.NBF	(2014/01/29 02:45:00.00)	(0:14:59.0)	39	60	29	30
NOR140_8183105_140129_0013.NBF	(2014/01/29 03:00:00.00)	(0:14:59.0)	35	55	28	30
NOR140_8183105_140129_0014.NBF	(2014/01/29 03:15:00.00)	(0:14:59.0)	33	52	29	30
NOR140_8183105_140129_0015.NBF	(2014/01/29 03:30:00.00)	(0:14:59.0)	31	52	28	29
NOR140_8183105_140129_0016.NBF	(2014/01/29 03:45:00.00)	(0:14:59.0)	32	52	28	30
NOR140_8183105_140129_0017.NBF	(2014/01/29 04:00:01.00)	(0:14:58.0)	34	52	28	30
NOR140_8183105_140129_0018.NBF	(2014/01/29 04:15:00.00)	(0:14:59.0)	34	56	29	30
NOR140_8183105_140129_0019.NBF	(2014/01/29 04:30:01.00)	(0:14:58.0)	36	52	31	33
NOR140_8183105_140129_0020.NBF	(2014/01/29 04:45:00.00)	(0:14:59.0)	38	61	29	31
NOR140_8183105_140129_0021.NBF	(2014/01/29 05:00:00.00)	(0:14:59.0)	41	63	29	31
NOR140_8183105_140129_0022.NBF	(2014/01/29 05:15:00.00)	(0:14:59.0)	35	53	29	31
NOR140_8183105_140129_0023.NBF	(2014		38	52	32	34
NOR140_8183105_140129_0024.NBF	(2014		39	52	32	34
NOR140_8183105_140129_0025.NBF	(2014		39	53	32	33
NOR140_8183105_140129_0026.NBF	(2014/01/29 06:15:00.00)	(0:14:59.0)	41	58	32	34
NOR140_8183105_140129_0027.NBF	(2014/01/29 06:30:00.00)	(0:14:59.0)	42	62	33	35
NOR140_8183105_140129_0028.NBF	(2014/01/29 06:45:00.00)	(0:14:59.0)	42	59	33	36
NOR140_8183105_140129_0029.NBF	(2014/01/29 07:00:00.00)	(0:14:59.0)	60	78	34	39
NOR140_8183105_140129_0030.NBF	(2014/01/29 07:15:01.00)	(0:14:58.0)	63	79	36	40
NOR140_8183105_140129_0031.NBF	(2014/01/29 07:30:00.00)	(0:14:59.0)	56	69	36	39
NOR140_8183105_140129_0032.NBF	(2014/01/29 07:45:00.00)	(0:14:59.0)	55	70	36	38
NOR140_8183105_140129_0033.NBF	(2014/01/29 08:00:00.00)	(0:14:59.0)	56	69	37	40
NOR140_8183105_140129_0034.NBF	(2014/01/29 08:15:00.00)	(0:14:59.0)	52	65	38	41
NOR140_8183105_140129_0035.NBF	(2014/01/29 08:30:00.00)	(0:14:59.0)	51	69	40	43
NOR140_8183105_140129_0036.NBF	(2014/01/29 08:45:00.00)	(0:14:59.0)	51	64	42	44
NOR140_8183105_140129_0037.NBF	(2014/01/29 09:00:00.00)	(0:14:59.0)	51	68	43	45
NOR140_8183105_140129_0038.NBF	(2014/01/29 09:15:00.00)	(0:14:59.0)	49	66	42	44
NOR140_8183105_140129_0039.NBF	(2014/01/29 09:30:00.00)	(0:14:59.0)	51	65	42	45
NOR140_8183105_140129_0040.NBF	(2014/01/29 09:45:00.00)	(0:14:59.0)	51	68	42	45
NOR140_8183105_140129_0041.NBF	(2014/01/29 10:00:00.00)	(0:14:59.0)	48	65	42	44
NOR140_8183105_140129_0042.NBF	(2014/01/29 10:15:00.00)	(0:14:59.0)	47	61	43	45
NOR140_8183105_140129_0043.NBF	(2014/01/29 10:30:00.00)	(0:14:59.0)	50	65	43	45
NOR140_8183105_140129_0044.NBF	(2014/01/29 10:45:00.00)	(0:14:59.0)	48	63	43	44
NOR140_8183105_140129_0045.NBF	(2014/01/29 11:00:00.00)	(0:14:59.0)	48	63	41	43
NOR140_8183105_140129_0046.NBF	(2014/01/29 11:15:00.00)	(0:14:59.0)	53	69	42	45
NOR140_8183105_140129_0047.NBF	(2014/01/29 11:30:00.00)	(0:14:59.0)	52	69	42	44
NOR140_8183105_140129_0048.NBF	(2014/01/29 11:45:00.00)	(0:14:59.0)	53	73	41	44
NOR140_8183105_140129_0049.NBF	(2014/01/29 12:00:00.00)	(0:14:59.0)	55	74	43	46
NOR140_8183105_140129_0050.NBF	(2014/01/29 12:15:00.00)	(0:14:59.0)	49	69	40	43
NOR140_8183105_140129_0051.NBF	(2014/01/29 12:30:00.00)	(0:14:59.0)	47	61	40	43



Appendix C

ACOUSTICS PLUS

CONTRACT TITLE: 53 Fitzroy Park, London, N6
SOUND SOURCE: Kitchen extract
MAKE & TYPE: Nuaire AXB31B-41

					OCTAVE BAND CENTRE FREQUENCY (Hz)								
OVERALL Lw					63	125	250	500	1k	2k	4k	8k	dBA
UNIT Lw					67	67	72	66	63	59	51	46	69
LENGTH (m)	C or R	x (mm)	x (mm)										
1.00	C	200-400			0.07	0.10	0.10	0.16	0.23	0.23	0.23	0.23	
BENDS													
NUMBER	TYPE	SIZE (mm)											
BRANCHES & DUCT X-SECTIONAL AREAS													
OTHER ATTENUATION													
long podded cylindrical attenuator					5	5	10	23	27	29	19	13	
(extracted from Nuaire Accessories catalogue)													
END REFLECTION SIZE (mm)													
315mm					11	7	3	1	0	0	0	0	
Lw LEAVING SYSTEM					51	55	59	42	36	30	32	33	51
Room Volume (m^3)				10000	-26	-26	-26	-26	-26	-26	-26	-26	
Mid-Frequency RT (s)				0.01	-20	-20	-20	-20	-20	-20	-20	-20	
REVERBERANT SPL					5	9	13	-4	-10	-16	-14	-13	5
Distance to Listener				25	-39	-39	-39	-39	-39	-39	-39	-39	
Directivity (flush/corner)				0.04	2	4	6	7	8	8	8	9	
DIRECT SPL					14	20	26	10	5	-1	1	3	18
RESULTANT TOTAL SPL					14	20	26	10	5	0	1	3	19
NR DESIGN CRITERION				20	51	39	31	24	20	17	14	13	
Additional Attenuation Required					0	0	0	0	0	0	0	0	