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ACOUSTICS PLUS

Proposed Installation of Mechanical Plant

16 Acton Street, London, WC1X

Environmental Noise Assessment

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Proposed Installation of Mechanical Plant	
Project Address:	16 Acton Street London WC1X
Project Reference:	102903

Issue/Revision Record

Issue:	Date:	Remarks:	Author:
1	16/06/2015	First Issue	Phil Huffer

	Signature:	Print:	Title:	Date:
Author:		**Phil Huffer**	**Principal Consultant**	**16/06/2015**
Reviewer:		**Andy Dodd**	**Senior Consultant**	**16/06/2015**

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 applicant, Heatherwick Studios, to consider and advise upon the noise implications of the proposed installation of mechanical plant.

1.4 The proposed installation consists of an Air Handing Unit and 2No. outdoor condenser units mounted on the flat roof of the property.

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 16 Acton Street, London, WC1X. The site, once redevelopment is complete, will consist of a building with B1 use arranged over 2 storeys. The site and its surroundings are shown in Figure 1 to 8.

2.2 It is proposed to install mechanical plant at roof level. The mechanical plant will consist of 1No. Air Handling Unit and 2No. external condenser units. The specification of the plant has been provided by Lamorbey Associates and will consist of:

(a) Air Handling Unit: 1No. Fläktwoods eQ Prime (size18)

(b) Office outdoor condenser: 1No. Mitsubishi PUMY-P100VHMB

(c) Server room outdoor condenser: 1No. Mitsubishi PUHZ-ZRP35VKA

2.3 The location of the proposed equipment is shown in Diagram 1 overleaf. This diagram also shows the location of noise sensitive façades nearby to the plant. This is considered to be the rear façades of properties facing on to Swinton Street for plant items (a) and (b) and the rear façades of properties facing on to Acton Street for plant item (c).

2.1 The location of the roof mounted plant is shown in Diagram 2 below.

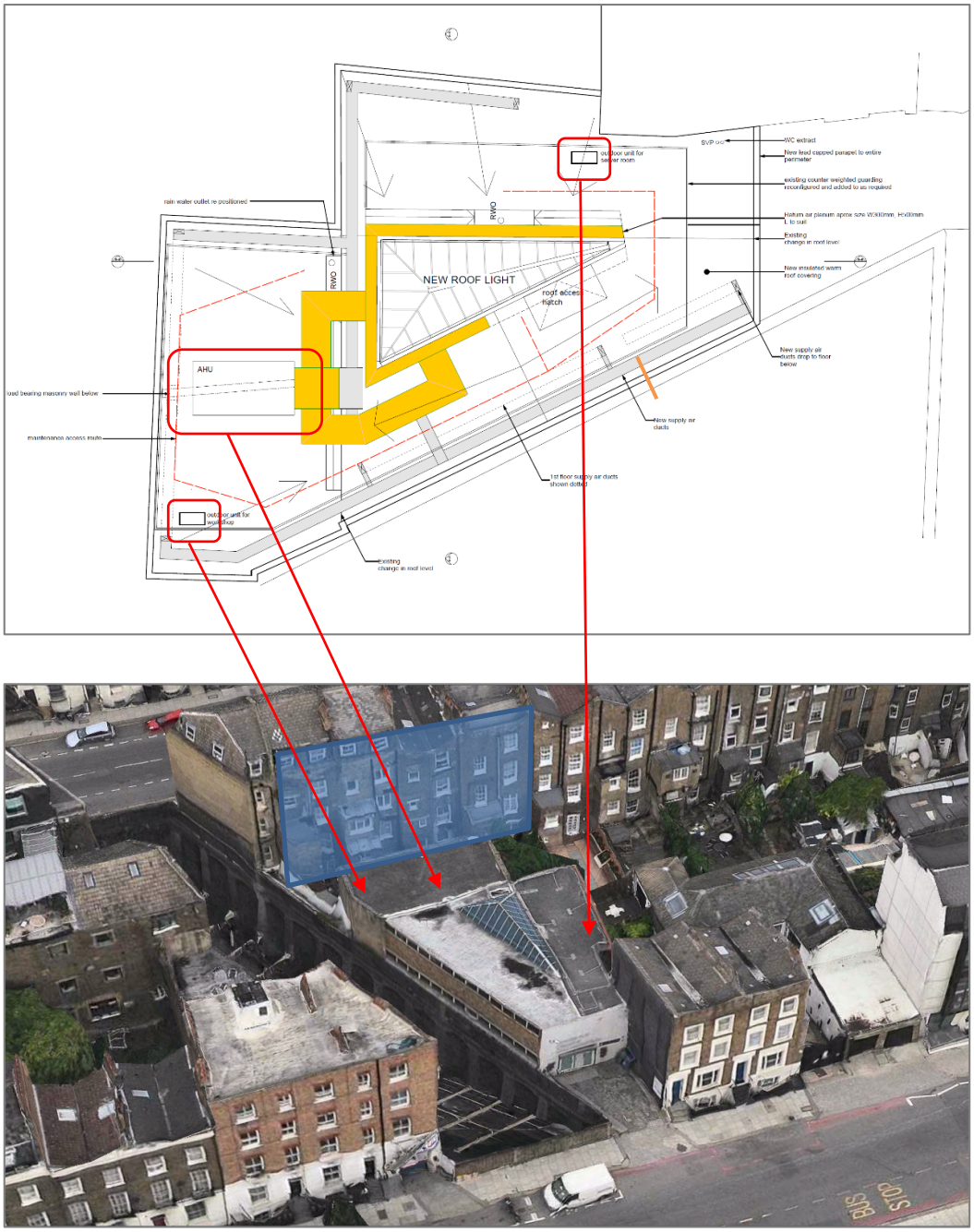


Diagram 2

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 at roof level on 16 Acton Street.

3.4 The particulars of the measurement exercise are recorded below:

Date:	9th March – 10th March 2015
Start Time:	13:14 hrs
Location:	roof level, 16 Acton Street
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 $L_{Aeq,T}$
07:00-23:00hrs	52 dB	60 dB
23:00-07:00hrs	41 dB	56 dB

Table 1

3.8 The proposed items of mechanical plant and their respective noise are as follows:

(a) Air Handling Unit: 1No. Fläktwoods eQ Prime (size18) AHU
Exhaust air – sound power level 86dBA
Fresh air – sound power level 70dBA

(b) Office outdoor condenser: 1No. Mitsubishi PUMY-P100VHMB
Sound pressure level 49dBA @ 1m

(c) Server room outdoor condenser: 1No. Mitsubishi PUHZ-ZRP35VKA
Sound pressure level 44dBA @ 1m

4. DESIGN CRITERIA

4.1 Information regarding the noise levels not to be exceeded by the proposed installation was provided by the LPA (London Borough of Camden). The design criteria is based on a typical planning condition that the LPA attach to applications of this nature.

Typical planning condition relating to mechanical plant

"Noise levels at a point 1 metre external to sensitive facades shall be at least 5dB(A) less than the existing background measurement (LA90), expressed in dB(A) when all plant/equipment (or any part of it) is in operation unless the plant/equipment hereby permitted will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps), then the noise levels from that piece of plant/equipment at any sensitive façade shall be at least 10dB(A) below the LA90, expressed in dB(A)."

4.2 It is expected that the proposed mechanical plant may have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum). The plant noise emission criteria that should not be exceeded is therefore 10dBA below the LA90, as shown in Table 2. These levels should not be exceeded at the nearest noise sensitive premises.

4.3 For mechanical plant items (a) and (b), the noise emission limit is only applicable between the hours of 07:00 and 22:00hrs (possible office hours). It is understood that these items of mechanical plant will not be operational outside of this period. For mechanical plant item (c), the noise emission limit will be at any time, as this condenser unit provides climate control of a server room.

Noise emission limit for mechanical plant 07:00 – 22:00hrs	Noise emission limit for mechanical plant (at any time)
42	31

Table 2

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(s).

6.2 Where necessary, acoustic mitigation measures such as the use of 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 Office AHU to the noise sensitive property adjacent;

(b) Noise Impact B – the egress of noise from the external condenser unit associated with the office climate control system to the noise sensitive property adjacent;

(c) Noise Impact C – the egress of noise from the external condenser unit associated with the server room climate control system to the noise sensitive property adjacent;

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

6.5 The ductwork system attenuation was calculated by considering the attenuation of sound energy produced by each component of the ductwork system. Detailed calculation sheets are contained in Appendix C.

Noise Impact (A) and (B)

6.6 Noise leaving the ductwork system and condenser unit was propagated to the nearest noise sensitive façade using point source propagation. The calculation exercise (attached as Appendix C) provided the following results at the nearest noise sensitive façade:

Source	L_{Aeq} dBA @ noise sensitive façade
(a) Air Handling Unit fresh air	27
(a) Air Handling Unit exhaust	41
(b) Office condenser unit PUMY-P100VHMB	31 [49-20Log_{10}(11)+3]
(c) Server room unit PUHZ-ZRP35VKA	22 [44-20Log_{10}(17)+3]
Cumulative noise level of items (a) and (b)	42dBA

Table 3

6.7 In order to comply with the requirements of the LPA, any cumulative noise from the proposed installation of the mechanical plant should not exceed a level of 42dBA (10dB below the lowest measured background noise over the operational hours of the plant) at 1m from the nearest noise sensitive facade.

6.8 The calculated cumulative noise impact of (a), (b) and (c) is L_{Aeq} 42dBA. The calculation exercise (Table 3) demonstrates that the proposed installation meets the LPA criteria.

Noise Impact (C)

6.9 In considering the propagation of noise from the condenser, consideration was given to point source propagation. The output level of the condenser was first corrected by +3dB to account for 1No. reflecting plane beneath the condenser unit.

Source	L_{Aeq} dBA @ noise sensitive façade
Mitsubishi PUHZ-ZRP35VKA @ 1m	44dB
Distance attenuation over 6m	-16dB
Reflecting plane	+3dB
Level at noise sensitive façade	31dBA

Table 4

6.10 In order to comply with the requirements of the LPA, any noise from the proposed installation of the server room condenser unit should not exceed a level of 31dBA (10dB below the lowest measured background noise over the operational hours of the plant) at 1m from the nearest noise sensitive facade.

6.11 The calculated noise impact of the server room condenser unit is L_{Aeq} 31dBA. The calculation exercise (Table 4) demonstrates that the proposed installation meets the LPA criteria.

7. CONCLUSION & MITIGATION MEASURES

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

7.2 No further mitigation measures (other than those detailed in this report) are required.

7.3 Lest there be any misunderstanding, the mitigation measures detailed are summarised as follows:

(a) AHU Exhaust duct – atmosphere side in-line attenuator (as per spec sheet);

(b) AHU Fresh Air duct – atmosphere side in-line attenuator (as per spec sheet);

Figures

Proposed installation of mechanical plant on roof of 16 Acton Street, London

Figure 1

Figure 2

Figure 3

Figure 4

Nearest noise sensitive façades

Figure 5

Figure 6

Nearest noise sensitive façades

Background noise monitoring location

Figure 7

Figure 8

Appendix A

AIR HANDLING UNIT eQ Prime

Project	19167 () / acton st		*Acon 2.8.150609.1*
AOC	ACON-01668300		
Unit	5 () / Unit for Issue		2015-06-09
Size	018		Page 3/20
Customer			
Customers ref.			
Our ref.	Duncan Goodall		
Supply air flow	1.68 m³/sec	Exhaust air flow	1.68 m³/sec
Ext. static pressure	200 Pa	Ext. static pressure	200 Pa
Voltage	3 x 400V + N, 50 Hz	Weight	1396 kg
Specific electric power demand	2.06 kW/(m³/s)	Dimensioned for wet condition	
Ref. density	1.2 kg/m³	Ref. altitude above sea level	0 m

SUMMARY

Functional sections in direction of air flow	v0 (m/s)	Et (%)	tw (°C)	ts (°C)	dP* (Pa)
Supply air:					
Connection section	0.0				90
Filter	2.6				124
Cooler	2.2		-4 / 26.2	29 / 23.1	248
Inspection section					0
Plenum fan		63.0	26.2 / 27.1	23.1 / 24	696
Connection section	0.0				0
General loss					34
Supply outlet					200
Exhaust air:					
Exhust inlet					200
Connection section	0.0				0
Filter	2.4				116
Cooler	2.3		22 / -4.5	25 / 31	284
Additional throttling					84
Inspection section					0
Plenum fan		62.1			761
Connection section	0.0				37
General loss					40

*Refers to the fan design case

SOUND POWER LEVELS

(standard: EN13053 ISO/CD 13347-2)

	Lw per octave band (dB)								LwA
Octave band (Hz)	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dB(A)**
Fresh air connection	63	64	75	65	63	60	56	56	70
Supply air connection	67	72	82	81	80	77	72	70	84
Extract connection	65	66	77	67	65	62	58	58	72
Exhaust connection	69	74	84	83	82	79	74	72	86
To surroundings	61	63	70	54	49	53	47	38	63

TOLERANCE

According to EN 13053 the LwA tolerance is 4dB. Octave band tolerances are presented in the tolerance table

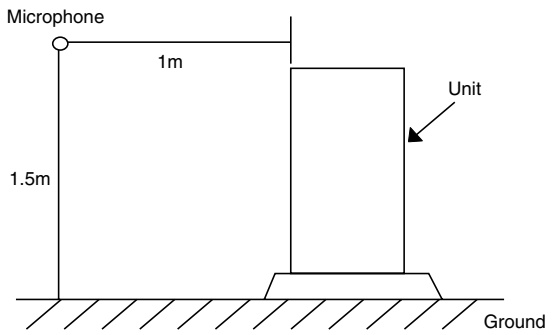
	Lw per octave band (dB)								LwA
Octave band (Hz)	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**dB(A)**
TOLERANCE	8	6	6	6	6	4	4	7	4

Frequency converters and motors mounted external are not included in the sound power levels

Rectangular silencers EQSD, BAKR-1

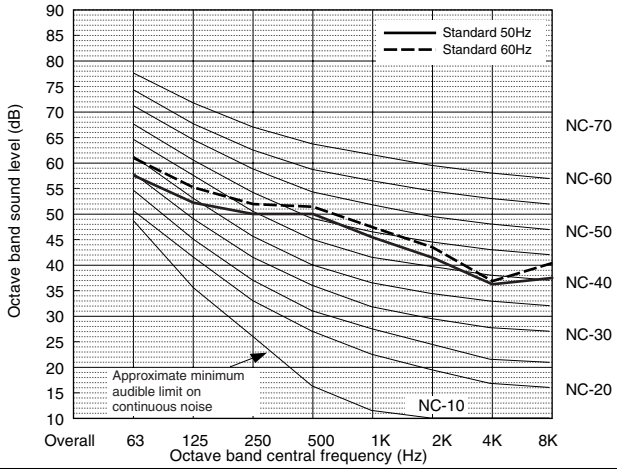
	Connection dimensions (mm)		Length (mm)	Daming (dB) according to ISO 7235:1991								Resistance factors (p-number)
				63	125	250	500	1k	2k	4k	8k	
080-040	800	400	1200	6	9	18	28	33	25	15	12	2,5
110-050	1000	500	1200	6	9	18	28	33	25	15	12	2,5
140-060	1400	600	1200	6	9	18	28	33	25	15	12	2,5
140-080	1400	800	1200	6	9	18	28	33	25	15	12	2,5
170-080	1700	800	1200	6	9	18	28	33	25	15	12	2,5
170-100	1700	1000	1200	6	9	18	28	33	25	15	12	2,5
200-080	2000	800	1200	6	9	18	28	33	25	15	12	2,5
200-100	2000	1000	1200	6	9	18	28	33	25	15	12	2,5
220-100	2200	1000	1200	6	9	18	28	33	25	15	12	2,5

Measurement condition
PUMY-P100,125,140YHM
PUMY-P100,125,140VHM



Sound level of PUMY-P140YHM,VHM

Ref. : P140YHM,VHM-VBN-050093

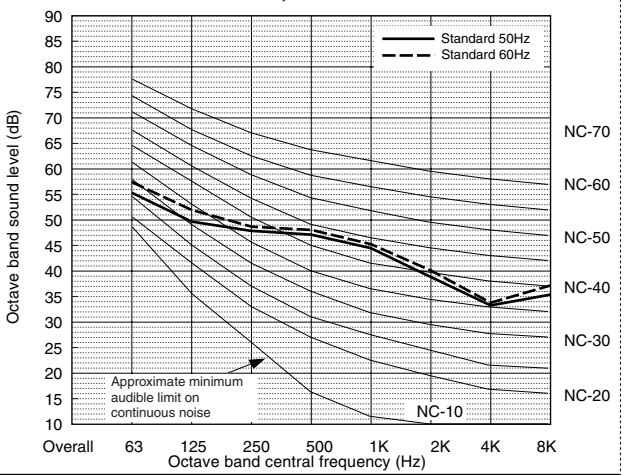


		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	dB(A)
Standard	50Hz	57.2	51.7	49.9	49.8	45.5	41.1	35.9	37.1	51.0
	60Hz	60.9	55.4	52.1	51.4	47.5	43.2	37.1	40.3	53.0
Night mode	50/60Hz	-	-	-	-	-	-	-	-	-

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

Sound level of PUMY-P100YHM,VHM

Ref. : P100YHM,VHM-VBN-050093

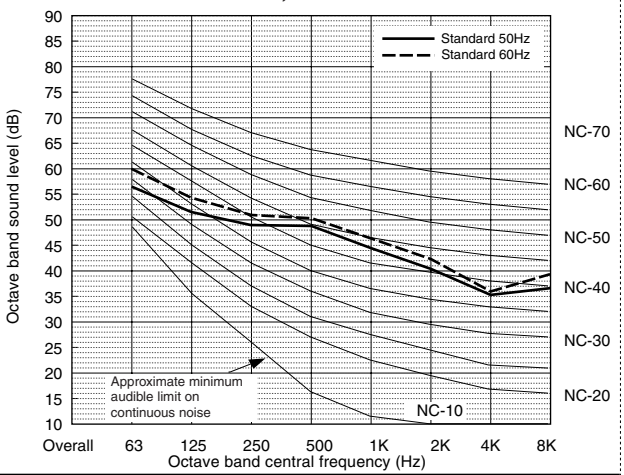


		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	dB(A)
Standard	50Hz	55.2	49.7	47.9	47.8	43.5	39.1	33.9	35.1	49.0
	60Hz	58.9	53.4	50.1	49.4	45.5	41.2	35.1	38.3	51.0
Night mode	50/60Hz	-	-	-	-	-	-	-	-	-

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

Sound level of PUMY-P125YHM,VHM

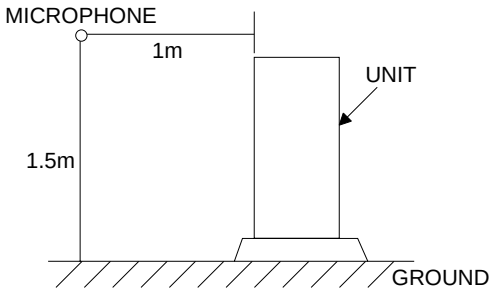
Ref. : P125YHM,VHM-VBN-050093



		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	dB(A)
Standard	50Hz	56.2	50.7	48.9	48.8	44.5	40.1	34.9	36.1	50.0
	60Hz	59.9	54.4	51.1	50.4	46.5	42.2	36.1	39.3	52.0
Night mode	50/60Hz	-	-	-	-	-	-	-	-	-

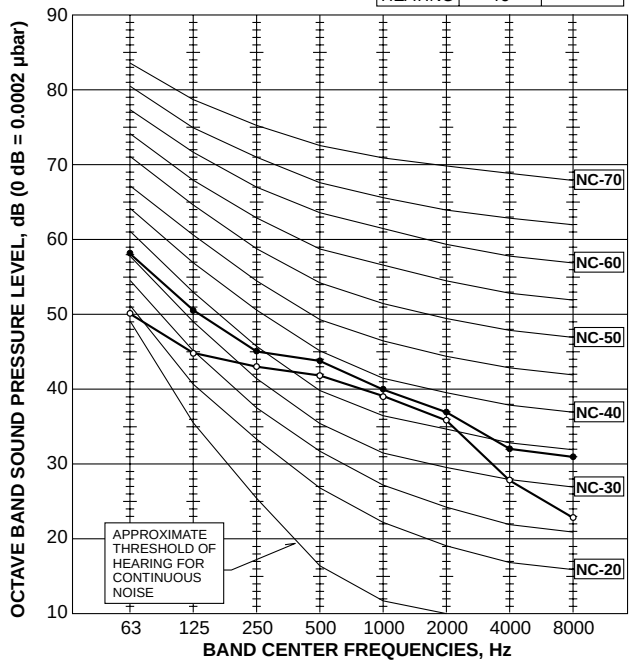
* When Night Mode is set, the A/C system's capacity is limited. The system could return to normal operation from Night Mode automatically in the case that the operation condition is severe.

5-3. NOISE CRITERION CURVES



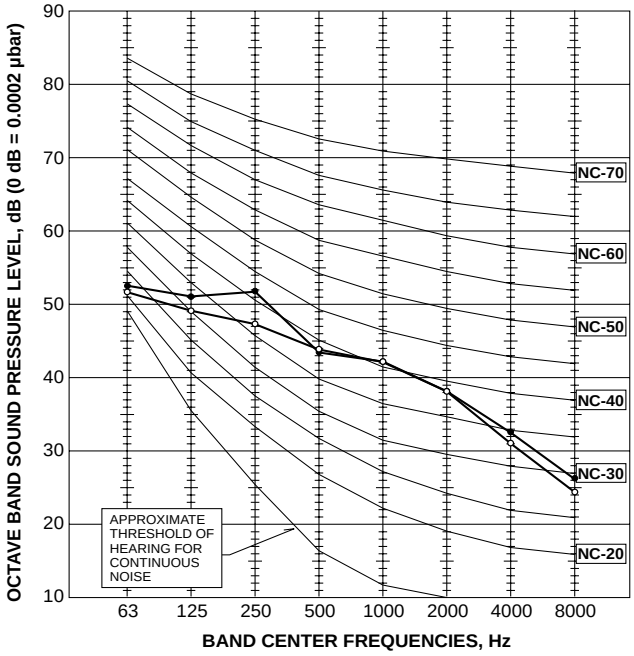
PUHZ-ZRP35VKA
PUHZ-ZRP50VKA

MODE	SPL(dB)	LINE
COOLING	44	○——○
HEATING	46	●——●



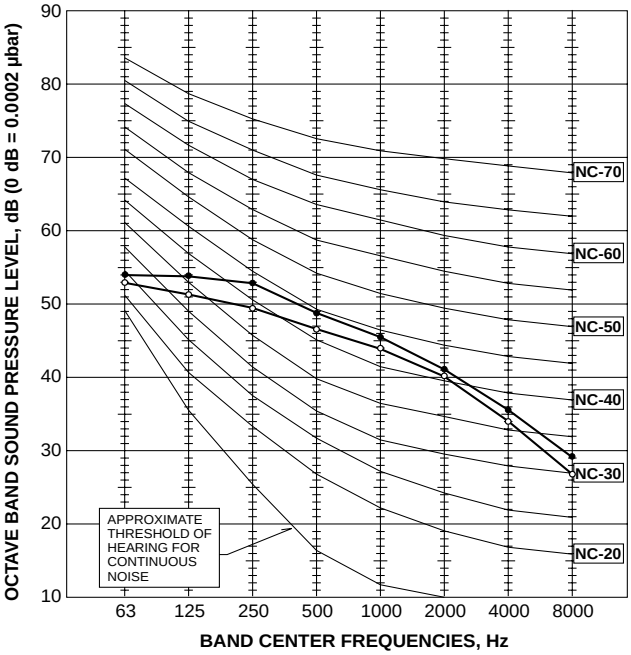
PUHZ-ZRP60VHA
PUHZ-ZRP71VHA

MODE	SPL(dB)	LINE
COOLING	47	○——○
HEATING	48	●——●



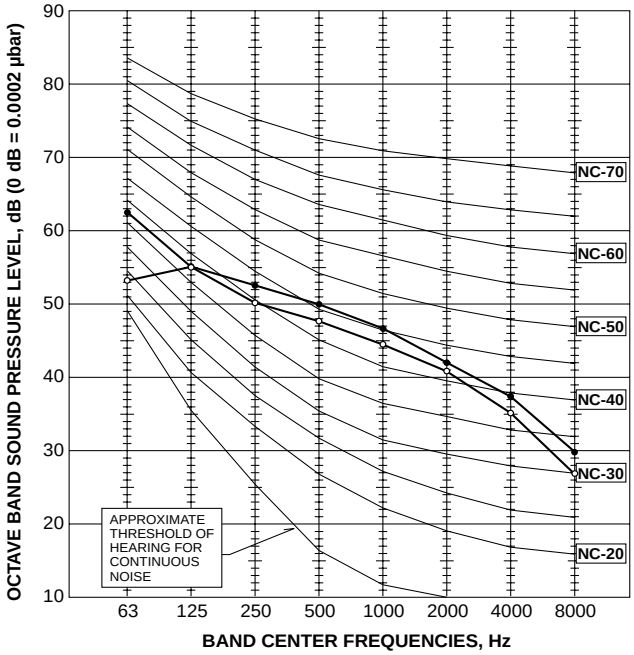
PUHZ-ZRP100VKA
PUHZ-ZRP100YKA

MODE	SPL(dB)	LINE
COOLING	49	○——○
HEATING	51	●——●



PUHZ-ZRP125/140VKA
PUHZ-ZRP125/140YKA

MODE	SPL(dB)	LINE
COOLING	50	○——○
HEATING	52	●——●



Appendix B

Background noise measurements obtained at roof level of 16 Acton Street, London, WC1X

No	Date & time	Filename	[hh:mm:ss]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	L10	L90
1	09/03/2015 13:14:36	@APL0001	00:15:00	92	53	61	63	55
2	09/03/2015 13:29:36	@APL0002	00:15:00	68	51	59	61	54
3	09/03/2015 13:44:36	@APL0003	00:15:00	73	52	59	61	54
4	09/03/2015 13:59:36	@APL0004	00:15:00	69	50	58	61	53
5	09/03/2015 14:14:36	@APL0005	00:15:00	69	50	58	61	53
6	09/03/2015 14:29:36	@APL0006	00:15:00	74	51	59	61	54
7	09/03/2015 14:44:36	@APL0007	00:15:00	76	51	60	62	54
8	09/03/2015 14:59:36	@APL0008	00:15:00	76	50	60	63	54
9	09/03/2015 15:14:36	@APL0009	00:15:00	71	49	60	63	53
10	09/03/2015 15:29:36	@APL0010	00:15:00	73	50	60	63	54
11	09/03/2015 15:44:36	@APL0011	00:15:00	70	48	59	61	54
12	09/03/2015 15:59:36	@APL0012	00:15:00	72	49	60	62	54
13	09/03/2015 16:14:36	@APL0013	00:15:00	75	49	59	62	53
14	09/03/2015 16:29:36	@APL0014	00:15:00	78	50	60	62	54
15	09/03/2015 16:44:36	@APL0015	00:15:00	78	51	61	64	54
16	09/03/2015 16:59:36	@APL0016	00:15:00	75	50	60	63	53
17	09/03/2015 17:14:36	@APL0017	00:15:00	72	51	60	63	54
18	09/03/2015 17:29:36	@APL0018	00:15:00	73	51	60	63	54
19	09/03/2015 17:44:36	@APL0019	00:15:00	81	51	61	63	55
20	09/03/2015 17:59:36	@APL0020	00:15:00	69	49	59	62	55
21	09/03/2015 18:14:36	@APL0021	00:15:00	70	50	60	62	54
22	09/03/2015 18:29:36	@APL0022	00:15:00	77	51	62	65	55
23	09/03/2015 18:44:36	@APL0023	00:15:00	74	51	60	63	54
24	09/03/2015 18:59:36	@APL0024	00:15:00	74	50	60	63	54
25	09/03/2015 19:14:36	@APL0025	00:15:00	77	50	59	62	54
26	09/03/2015 19:29:36	@APL0026	00:15:00	70	50	59	62	53
27	09/03/2015 19:44:36	@APL0027	00:15:00	69	50	59	62	53
28	09/03/2015 19:59:36	@APL0028	00:15:00	73	50	59	62	53
29	09/03/2015 20:14:36	@APL0029	00:15:00	89	49	61	62	52
30	09/03/2015 20:29:36	@APL0030	00:15:00	72	49	59	61	52
31	09/03/2015 20:44:36	@APL0031	00:15:00	69	48	59	61	52
32	09/03/2015 20:59:36	@APL0032	00:15:00	70	50	59	62	53
33	09/03/2015 21:14:36	@APL0033	00:15:00	69	50	58	61	53
34	09/03/2015 21:29:36	@APL0034	00:15:00	70	49	58	61	53
35	09/03/2015 21:44:36	@APL0035	00:15:00	74	49	59	61	53
36	09/03/2015 21:59:36	@APL0036	00:15:00	70	49	59	62	52
37	09/03/2015 22:14:36	@APL0037	00:15:00	69	49	58	61	52
38	09/03/2015 22:29:36	@APL0038	00:15:00	69	50	58	61	53
39	09/03/2015 22:44:36	@APL0039	00:15:00	71	50	59	62	52
40	09/03/2015 22:59:36	@APL0040	00:15:00	71	46	58	60	51
41	09/03/2015 23:14:36	@APL0041	00:15:00	69	45	58	62	50
42	09/03/2015 23:29:36	@APL0042	00:15:00	69	45	57	60	48
43	09/03/2015 23:44:36	@APL0043	00:15:00	70	45	58	61	49
44	09/03/2015 23:59:36	@APL0044	00:15:00	69	44	56	60	47
45	10/03/2015 00:14:36	@APL0045	00:15:00	79	43	57	59	48
46	10/03/2015 00:29:36	@APL0046	00:15:00	69	43	56	58	48
47	10/03/2015 00:44:36	@APL0047	00:15:00	68	43	56	59	47
48	10/03/2015 00:59:36	@APL0048	00:15:00	73	42	55	58	45

Background noise measurements obtained at roof level of 16 Acton Street, London, WC1X

No	Date & time	Filename	[hh:mm:ss]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	L10	L90
49	10/03/2015 01:14:36	@APL0049	00:15:00	65	42	53	56	45
50	10/03/2015 01:29:36	@APL0050	00:15:00	77	41	54	56	45
51	10/03/2015 01:44:36	@APL0051	00:15:00	64	39	53	57	43
52	10/03/2015 01:59:36	@APL0052	00:15:00	60	40	52	56	44
53	10/03/2015 02:14:36	@APL0053	00:15:00	65	39	52	55	43
54	10/03/2015 02:29:36	@APL0054	00:15:00	82	39	59	58	43
55	10/03/2015 02:44:36	@APL0055	00:15:00	70	38	51	54	41
56	10/03/2015 02:59:36	@APL0056	00:15:00	65	38	51	55	41
57	10/03/2015 03:14:36	@APL0057	00:15:00	67	38	52	56	41
58	10/03/2015 03:29:36	@APL0058	00:15:00	64	38	53	57	42
59	10/03/2015 03:44:36	@APL0059	00:15:00	69	37	52	56	41
60	10/03/2015 03:59:36	@APL0060	00:15:00	63	38	52	56	42
61	10/03/2015 04:14:36	@APL0061	00:15:00	63	39	50	54	42
62	10/03/2015 04:29:36	@APL0062	00:15:00	70	39	54	57	43
63	10/03/2015 04:44:36	@APL0063	00:15:00	61	39	52	56	43
64	10/03/2015 04:59:36	@APL0064	00:15:00	70	41	55	58	45
65	10/03/2015 05:14:36	@APL0065	00:15:00	69	42	55	58	47
66	10/03/2015 05:29:36	@APL0066	00:15:00	69	42	56	59	48
67	10/03/2015 05:44:36	@APL0067	00:15:00	67	41	56	59	47
68	10/03/2015 05:59:36	@APL0068	00:15:00	70	43	58	61	49
69	10/03/2015 06:14:36	@APL0069	00:15:00	70	47	59	61	52
70	10/03/2015 06:29:36	@APL0070	00:15:00	69	46	59	61	51
71	10/03/2015 06:44:36	@APL0071	00:15:00	74	44	59	62	52
72	10/03/2015 06:59:36	@APL0072	00:15:00	78	48	60	63	54
73	10/03/2015 07:14:36	@APL0073	00:15:00	70	49	60	63	54
74	10/03/2015 07:29:36	@APL0074	00:15:00	70	48	60	63	53
75	10/03/2015 07:44:36	@APL0075	00:15:00	83	48	62	64	53
76	10/03/2015 07:59:36	@APL0076	00:15:00	70	49	59	62	53
77	10/03/2015 08:14:36	@APL0077	00:15:00	76	48	60	63	54
78	10/03/2015 08:29:36	@APL0078	00:15:00	76	48	60	62	53
79	10/03/2015 08:44:36	@APL0079	00:15:00	75	47	60	63	54
80	10/03/2015 08:59:36	@APL0080	00:15:00	77	46	61	64	54
81	10/03/2015 09:14:36	@APL0081	00:15:00	78	48	60	63	53
82	10/03/2015 09:29:36	@APL0082	00:15:00	71	48	60	64	54
83	10/03/2015 09:44:36	@APL0083	00:15:00	73	47	59	62	52
84	10/03/2015 09:59:36	@APL0084	00:15:00	70	49	59	62	53
85	10/03/2015 10:14:36	@APL0085	00:15:00	70	49	59	62	53
86	10/03/2015 10:29:36	@APL0086	00:15:00	70	51	59	61	53
87	10/03/2015 10:44:36	@APL0087	00:15:00	73	51	58	61	53
88	10/03/2015 10:59:36	@APL0088	00:15:00	69	51	58	61	53
89	10/03/2015 11:14:36	@APL0089	00:15:00	73	49	60	64	53
90	10/03/2015 11:29:36	@APL0090	00:15:00	75	50	61	64	54
91	10/03/2015 11:44:36	@APL0091	00:15:00	75	50	59	61	53
92	10/03/2015 11:59:36	@APL0092	00:15:00	70	50	59	62	53
93	10/03/2015 12:14:36	@APL0093	00:15:00	77	50	59	62	52
94	10/03/2015 12:29:36	@APL0094	00:15:00	72	49	58	61	52
95	10/03/2015 12:44:36	@APL0095	00:15:00	73	50	60	63	53
96	10/03/2015 12:47:37	@APL0096	00:03:01	75	52	60	63	54

Appendix C

ACOUSTICS PLUS

CONTRACT TITLE: 16 Acton Street
SOUND SOURCE: Exhaust connection
MAKE & TYPE: Flaktwoods eQ Prime 018

					OCTAVE BAND CENTRE FREQUENCY (Hz)								
OVERALL Lw					63	125	250	500	1k	2k	4k	8k	dBA
				UNIT Lw	69	74	84	83	82	79	74	72	86
LENGTH (m)	C or R	x (mm)	x (mm)										
1.00	R	400-800	800-1500		1.48	0.99	0.49	0.26	0.23	0.23	0.23	0.23	
BENDS													
NUMBER	TYPE	SIZE (mm)											
BRANCHES & DUCT X-SECTIONAL AREAS													
OTHER ATTENUATION													
Rectangular silencer					6	9	18	28	33	25	15	12	
END REFLECTION SIZE (mm)													
600x1200mm					4	1	0	0	0	0	0	0	
				Lw LEAVING SYSTEM	58	63	66	55	49	54	59	60	64
Room Volume (m^3)				10000	-26	-26	-26	-26	-26	-26	-26	-26	
Mid-Frequency RT (s)				0.001	-30	-30	-30	-30	-30	-30	-30	-30	
				REVERBERANT SPL	2	7	10	-1	-7	-2	3	4	8
Distance to Listener				11	-32	-32	-32	-32	-32	-32	-32	-32	
Directivity (flush/corner)				0.72	3	5	6	7	8	9	9	9	
				DIRECT SPL	29	36	40	30	25	31	36	37	41
				RESULTANT TOTAL SPL	29	36	40	30	25	31	36	37	41
NR DESIGN CRITERION				35	63	52	45	39	35	32	30	28	
Additional Attenuation Required					0	0	0	0	0	0	6	9	

ACOUSTICS PLUS

CONTRACT TITLE: 16 Acton Street
SOUND SOURCE: Fresh Air Connection
MAKE & TYPE: Flaktwoods eQ Prime 018

					OCTAVE BAND CENTRE FREQUENCY (Hz)								
OVERALL Lw					63	125	250	500	1k	2k	4k	8k	dBA
			UNIT Lw		63	64	75	65	63	60	56	56	70
LENGTH (m)	C or R	x (mm)	x (mm)										
1.00	R	400-800	800-1500		1.48	0.99	0.49	0.26	0.23	0.23	0.23	0.23	
BENDS													
NUMBER	TYPE	SIZE (mm)											
BRANCHES & DUCT X-SECTIONAL AREAS													
OTHER ATTENUATION													
Rectangular silencer					6	9	18	28	33	25	15	12	
END REFLECTION SIZE (mm)													
600x1200mm					4	1	0	0	0	0	0	0	
				Lw LEAVING SYSTEM	52	53	57	37	30	35	41	44	50
Room Volume (m^3)			10000		-26	-26	-26	-26	-26	-26	-26	-26	
Mid-Frequency RT (s)			0.001		-30	-30	-30	-30	-30	-30	-30	-30	
				REVERBERANT SPL	-4	-3	1	-19	-26	-21	-15	-12	-6
Distance to Listener			11		-32	-32	-32	-32	-32	-32	-32	-32	
Directivity (flush/corner)			0.72		3	5	6	7	8	9	9	9	
				DIRECT SPL	23	26	31	12	6	12	18	21	26
				RESULTANT TOTAL SPL	23	26	31	12	6	12	18	21	26
NR DESIGN CRITERION			35		63	52	45	39	35	32	30	28	
Additional Attenuation Required					0	0	0	0	0	0	0	0	