Report VA2563.190128.NIA

3 Bloomsbury Place, London

Noise Impact Assessment

29 January 2019

Taylor Project Services
No 1 Cornhill
London
EC3V 3ND

01962 461016
0203 8650332
mail@ventaacoustics.com

registered company no. 10139494

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Attachments

Appendix A	Acoustic Terminology
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1. Introduction

It is proposed to install five new condenser units at ground floor level to the rear of 3 Bloomsbury Place, London.

Venta Acoustics has been commissioned by Taylor Project Services to undertake an assessment of the potential noise impact of these proposals in support of an application for planning permission.

An environmental noise survey has previously been undertaken for the same client on the adjacent building at 4 Bloomsbury Place to determine the background noise levels in the immediate locality. These levels are used to undertake an assessment of the likely impact with reference to the planning requirements of Camden Council.

2. Design Criterion and Assessment Methodology

2.1 Camden Council Requirements

Camden Council Environmental Health were consulted prior to the assessment. Camilo Castro-Llach confirmed that it would be suitable to use the survey data measured to the rear of 4 Bloomsbury Place in 2017 by PC Environmental for the same client.

Camden Council's Local Plan (adopted June 2017), Appendix 3, provides the following guidance regarding noise from Industrial and Commercial Noise Sources

> *A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).*

Existing Noise sensitive receiver	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

**10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required.*

In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

***levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.*

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted $L_{eq,5mins}$ noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

2.2 BS8233:2014

BS8233 *Guidance on sound insulation and noise reduction for buildings* provides guidance as to suitable internal noise levels for different areas within residential buildings.

The relevant section of the standard is shown below in Table 2.1.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq, 16\ hour}$	-
Dining	Dining Room	40 dB $L_{Aeq, 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16\ hour}$	30 dB $L_{Aeq, 8\ hour}$

Table 2.1 - Excerpt from BS8233: 2014 **[dB ref. 20µPa]**

3. Site Description

The site building is located in a long terrace of properties, with the most affected noise sensitive receivers are expected to be 4 Bloomsbury Place, London.

4. Environmental Noise Survey

As previously highlighted, a survey was undertaken on the adjacent building in 2017 for the same client which will be used as the basis for the assessment. The report is attached in Appendix B for reference.

4.1 Background Noise Levels

The background noise level is understood to be determined by road noise in the area.

The minimum background noise levels measured were:

Monitoring Period	Minimum $L_{A90,5min}$
07:00 – 23:00 hours	46 dB
23:00 – 07:00 hours	41 dB

Table 4.1 – Typical background noise levels **[dB ref. 20 µPa]**

4.2 Plant Noise Emission Limits

On the basis of the measured noise levels and the planning requirements of the Local Authority, and considering that it is not expected that tonal noise will be generated by the proposed plant units, the following plant specific sound levels should not be exceeded at the most affected noise sensitive receivers:

Monitoring Period	Design Criterion (L_{Aeq})
07:00 – 23:00 hours	36 dB
23:00 – 07:00 hours	31 dB

Table 4.2 – Specific sound pressure levels not to be exceeded at most affected noise sensitive receivers

5. Predicted Noise Impact

5.1 Proposed plant

The following plant is proposed for installation at ground floor level at the location indicated on site plan VA2563/SP1.

Plant Item	Quantity	Proposed Model
Condensers	4	Daikin RXYSCQ5TV1
Condenser	1	Daikin RXYSQ8TY1

Table 5.1 – Indicative plant selections assumed for this assessment.

Consulting the manufacturer's datasheets, the following noise emissions levels are attributed to the proposed plant items:

Plant Item	Octave Band Centre Frequency (Hz) Sound Pressure, L_p@1m (dB)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Daikin RXYSCQ5TV1	51	53	52	53	47	41	34	27	53
Daikin RXYSQ8TY1	60	63	55	52	49	48	42	34	56

Table 5.2 – Advised plant noise data used for the assessment.

5.2 Recommended Mitigation Measures

It is recommended that the plant area ventilation openings facing the identified noise sensitive receivers are attenuated. This assessment assumes that acoustic louvres having the following insertion loss are included in these plant room openings. This is typically provided by a proprietary acoustic louvre with a depth of 100mm.

Attenuation Component	Octave Band Centre Frequency (Hz) Acoustic Louvre Insertion Loss (dB)							
	63	125	250	500	1k	2k	4k	8k
100mm deep acoustic louvre	5	4	5	6	9	13	14	13

Table 5.3 – Recommended attenuation to ventilation openings.

All plant and ductwork should be fitted with anti-vibration mounts in accordance with the manufacturer guidelines. This is expected to control structureborne noise to the building to acceptable levels.

Please note that the above recommendations relate to acoustic issues only. It is recommended that professional advice confirming the suitability of these measures be sought from others with regards to issues such as airflow, structural stability and visual impact.

5.3 Predicted noise levels

The cumulative noise level at the most affected noise sensitive receiver, the first floor window to the rear of 4 Bloomsbury Place, some 16 meters away, has been calculated on the basis of the above information and assuming the recommended mitigation measures, with reference to the guidelines set out in BS4142:2014 / ISO 9613-2:1996 *Attenuation of sound during propagation outdoors - Part 2: General method of calculation.*

A summary of the calculations are shown in Appendix C.

Description	dB(A)
Plant noise criterion	31
L_p 1m from receiver	30

Table 5.4 – Predicted noise and level and design criteria at noise sensitive location

5.4 Comparison to NR35 Curve

As can been seen from the following comparison, the predicted noise levels at 1m from the most affected receiver are comfortably below the NR35 curve.

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
NR35	63	52	45	39	35	35	30	28
Predicted Level 1m from Receiver	33	36	31	30	21	14	6	-1

Table 5.5 – Comparison of predicted noise levels against the NR35 criterion

5.5 Comparison to BS8233:2014 Criteria

BS8233 assumes a loss of approximately 15dB for a partially open window. The external noise level shown in Table 5.4 would result in internal noise levels that achieve the guidelines shown in Table 2.1.

6. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the background noise climate in the locality of Bloomsbury Place, London in support of a planning application for the proposed introduction of new building services plant.

This has enabled noise emission limits to be set at the most affected noise sensitive receiver such that the proposed installation meets the requirements of Camden Council .

The cumulative noise emission levels from the proposed plant have been assessed to be compliant with the plant noise emission limits, with necessary mitigation measures specified.

The proposed scheme is not expected to have a significant adverse noise impact and the relevant Planning Conditions have been shown to be met.

Jamie Duncan MIOA

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.
L_{eq} :	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.

Appendix B

Noise Survey

PC Environmental Ltd
11 Mill Court, Sawmills
Durley
Southampton SO32 2EJ
Phone 44 (0) 1489 891853
Fax 44 (0) 1489 895488

4 BLOOMSBURY PLACE, LONDON, WC1

Technical Note

Acoustic Assessment Report

23rd November 2017 Peter Clark

1. INTRODUCTION

1.1 A noise survey has been carried out at the commercial/office property 4 Bloomsbury Place, London, WC1. The property is to be extensively refurbished and a part of the proposed work includes the installation of air conditioning systems which will serve a number of the rooms at the property. The noise survey and assessment report is required to accompany a Planning Application for the installation of the external air conditioning units at the property. A total of FIVE external units are proposed such that three outdoor units are to be located in the rear courtyard at ground floor level with a further two smaller units located at roof level. For aesthetic and acoustics reasons, the rear courtyard units are to be located internal to an acoustic louvre screen/enclosure. 4 Bloomsbury Place lies close to the corner of Southampton Row and Bloomsbury Place itself and is a single property over five floors with a small extension at the rear. The majority of neighbouring properties are also commercial/office spaces although there is some residential properties nearby, the nearest is lower ground floor level of 3 Bloomsbury Place and the top floor also in 3 Bloomsbury Place. The rear courtyard of 4 Bloomsbury Place is shielded from neighbouring properties by high brickwork walls. At roof level, the proposed location of the units is such that it is shielded from neighbouring properties/areas of interest by roof-top parapet walls, chimney breasts and the roof access stairway. The nearest neighbouring areas for assessment purposes are (a) the neighbouring rear courtyard/garden of 5 Bloomsbury Place for the courtyard unit and (b) the roof-light in 3 Bloomsbury Place[1] with respect to the roof-mounted units.

1.2 The measurements have shown that the proposed installation meets with the requirements of the London Borough of Camden (LBC) Environmental Noise Policy and without the need for additional noise attenuation measures.

1.3 The site location and surroundings are given in Figure 1 below:

Figure 1: Site Location (© Google Maps) – 4 Bloomsbury Place (from rear)

[1] There is a single roof window in 5 Bloomsbury Place however this has not been considered in the assessment as the window serves an unoccupied attic storage area.

2.0 NOISE MEASUREMENTS

2.1 Environmental noise measurements were carried out from Thursday 26th October to Tuesday 31st October 2017. Sound level measurement equipment was installed in two locations at the property; (a) in the courtyard/garden at the rear of the property and (b) on the roof-top. In both cases the monitor was located close to the neighbouring properties and used to log noise levels over the five day period. The measurement equipment is listed below in Table 1.

Table 1 Environmental Noise Measurement Instrumentation

No.	Description
1.	Larson Davis Model 812 Sound Level Meter.
2.	Larson Davis Model 2541 1/2" Diameter Condenser Microphone.
3.	Larson Davis Model CAL200 Sound Level Meter Calibrator.

2.2 All acoustic equipment conforms to the relevant parts of BS EN 60651:1994 (equivalent to BS 5969:1981) for the requirements of Type 1 acoustic accuracy. Additionally, the relevant equipment conforms to the specifications contained within BS EN 60804:1994 (equivalent to BS 6698:1976) for integrating sound level meters.

2.3 In order to verify the correct operation of the equipment on site, an acoustic calibrator was applied during the course of the measurements. A maximum change of 0.1 dB(A) was noted, this can be considered as an insignificant change. The calibrator complies with the specifications of IEC 942:2003. The equipment was previously laboratory calibrated in January 2017.

2.4 Fast meter response was used for all measurements carried out during the course of the survey.

2.5 Noise levels are expressed in terms of continuous equivalent noise levels (L_{Aeq}) over an appropriate time period. The use of L_{Aeq} allows non-steady and non-continuous noise to be assessed and compared to the existing noise climate. L_{Aeq} is referred to as the ambient noise level. In addition to this background noise levels have also been measured and are expressed as L_{A90}. A full explanation of terminology commonly used in the measurement and assessment of noise levels is given in Appendix B at the end of this report.

3.0 RESULTS

3.1 Noise level measurements were carried out at 5 minute intervals during the survey period. Ambient (L_{Aeq}) and background (L_{A90}) noise levels were measured. Minimum noise levels for the day-time (07:00 to 19:00 hrs), evening time period (19:00 to 23:00 hrs) and night time period (23:00 to 07:00 hrs) have been determined. Results for each measurement location are summarised in Tables 2.1 and 2.2 below:

Table 2.1: Summary Results (Rear Courtyard/Garden)

	Day	Evening	Night
L_{A90}	56.6	55.7	54.3(40.5)*
L_{Aeq}	62.0	61.7	59.7

*Note: The lowest night time background noise level measured during the survey period was 40.5 dB(A) and occurred at 4.00am on Monday 30th October 2017.

Table 2.2: Summary Results (Roof)

	Day	Evening	Night
L_{A90}	58.5	57.3	55.6(46.0)*
L_{Aeq}	63.0	62.3	60.2

*Note: The lowest night time background noise level measured during the survey period was 46.0 dB(A) and occurred at 4.00am on Monday 30th October 2017.

3.2 Although the survey was not attended on a full time basis, it was noted that during site visits that noise from traffic using Southampton Row was dominant. The rear courtyard/garden of the property is relatively well-sheltered although noise from traffic on Southampton Row could still be heard. A full listing of measured noise data for the period is given in the graphs at the end of this report (Figure A1a and A1b) for each measurement location. Photographs showing the noise monitors in position at the property are shown in Figure A2a and A2b.

3.3 Noise level data for the units[2] to be installed at the property are given as follows: 2x Daikin RXYSQ8TY1 unit S.P.L. 55 dB(A) at 1m each and 1x Daikin 3MXS52E unit S.P.L. 47 dB(A) at 1m to be located in the rear courtyard at ground floor level and 2x Daikin RXYSCQ5TV1 units S.P.L.

[2] All noise level data are given as Sound Pressure Level measured 1m from the respective unit in either heating or cooling mode under anechoic conditions.

52 dB(A) at 1m each to be located at roof level (See attached data sheets shown in Figures A3). The nearest neighbouring window/area of interest for the rear courtyard unit to be assessed is the rear courtyard/garden of the neighbouring property (5 Bloomsbury Place). The roof-light in 3 Bloomsbury Place is the nearest window considered in the assessment for the roof-top units. Respective layouts are shown in Figures A4a and b. Calculated noise levels are as follows (see also Figure A5 at the end of this report):

Rear Courtyard Unit (with respect to the rear garden of 5 Bloomsbury Place)

- Total Unit S.P.L at 1m: 58 dB(A)[3]
- Attenuation from acoustic louvred screen: - 9 dB(A)[4]
- Barrier Attenuation from garden wall: -15 dB(A)[5]
- Distance correction (2m): - 6.0 dB(A)[6]
- Resultant predicted noise level: 28.0 dB(A)

Roof-top Units (with respect to roof-light in 3 Bloomsbury Place)

- Unit S.P.L. at 1m: 52 dB(A)
- 2 off units: + 3dB(A)
- Barrier/screening from parapet walls/chimney breast and access stairway walls: -10 dB(A)[7]
- Distance correction (3m): - 9.5 dB(A)
- Resultant predicted noise level: 35.5 dB(A)

[3] Total S.P.L. calculated from 2x units at 55 dB(A) and 1x unit at 47 dB(A)
[4] See Figure A6 at the end of this report for technical details of typical acoustic louvre
[5] Path length difference is calculated to be 1m
[6] 2m from location of proposed unit to 1m within neighbouring garden
[7] Path length difference is calculated to be 0.25m

3.4 The London Borough of Camden Local Plan (Adopted Version) Policy A4 "Noise and Vibration" states that *"The Council will seek to ensure that noise and vibration is controlled and managed"*. Furthermore the policy states that *"Developments should be have regard to Camden's Noise and Vibration Thresholds (Appendix 3)"*. Appendix 3; Table C "Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)" is listed below. In Table C;

- NOEL refers to "No Observed Effect Level"
- LOAEL refers to "Lowest Observed Adverse Effect Level"
- SOAEL refers to "Significant Observed Adverse Effect Level"

Each of these terms are described in greater detail in the National Planning Policy Framework and Planning Practice Guidance"

Existing Noise Sensitive Receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Dwellings	Garden used for main amenity (free field) and outside living or dining or bedroom window (façade)	Day	"Rating level" 10dB* below background	"Rating level" between 9 dB below and 5 dB above background	"Rating level" greater than 5 dB above background
Dwellings	Outside bedroom window (façade)	Night	"Rating level" 10dB* below background	"Rating level" between 9 dB below	"Rating level" greater than 5 dB above

		and no events exceeding 57 dB L_{Amax}	and 5 dB above background or noise events between 57 dB and 88 dB L_{Amax}	background and/or events exceeding 88 dB L_{Amax}

** 10 dB should be increased to 15 dB if the noise contains audible tonal elements (day or night) …*

3.5 The proposed air conditioning equipment does not attract the + 5 dB(A) correction referred to in *"BS4142" and Table C above* (i.e. contains no distinguishable discrete continuous note or distinct impulses)

3.6 It therefore follows that the criterion to meet is 30.5 dB(A)[8] for areas/windows at lower level and 36.0 dB(A)[7] for areas/windows at roof level (these noise levels being 10 dBA less than the lowest night-time background noise level measured in respective locations– see Tables 2.1 and 2.2 above). The proposed installation is shown to meet with the criterion without the need for further noise control.

3.7 London Borough of Camden Policy A4 Appendix 3 also states that in some cases *"… the Council will generally also require a NR curve specification of NR35 or below … 1 metre from the façade of the affected premises …"*. Detailed calculations (including frequency data) for each receptor is given in Figure A5 where the resulting noise levels are also plotted with reference to the NR35 spectrum.

[8] These levels being below the LOAEL as referred to in Appendix 3: Noise Thresholds of Camden Policy A4 and as such fall into the "Green" category *where noise is considered to be an acceptable level.*

4.0 CONCLUSION

4.1 A noise measurement survey and assessment has been carried out on the external air conditioning condensing units which are to be installed at 4 Bloomsbury Place, London WC1. A total of five units are proposed, three are to be located in the rear courtyard/garden with a further two smaller units located on the roof. For aesthetic and acoustic reasons, the units in the rear courtyard are to be located internal to an acoustic enclosure/screen.

4.2 The proposed installation has been shown to meet with the London Borough of Camden's acoustic criteria. No further noise control measures are required.

PC Environmental

APPENDIX A: GRAPHS AND FIGURES.

Figure A1a: Environmental Noise Data – 26th to 31st October 2017.

Rear Courtyard/Garden

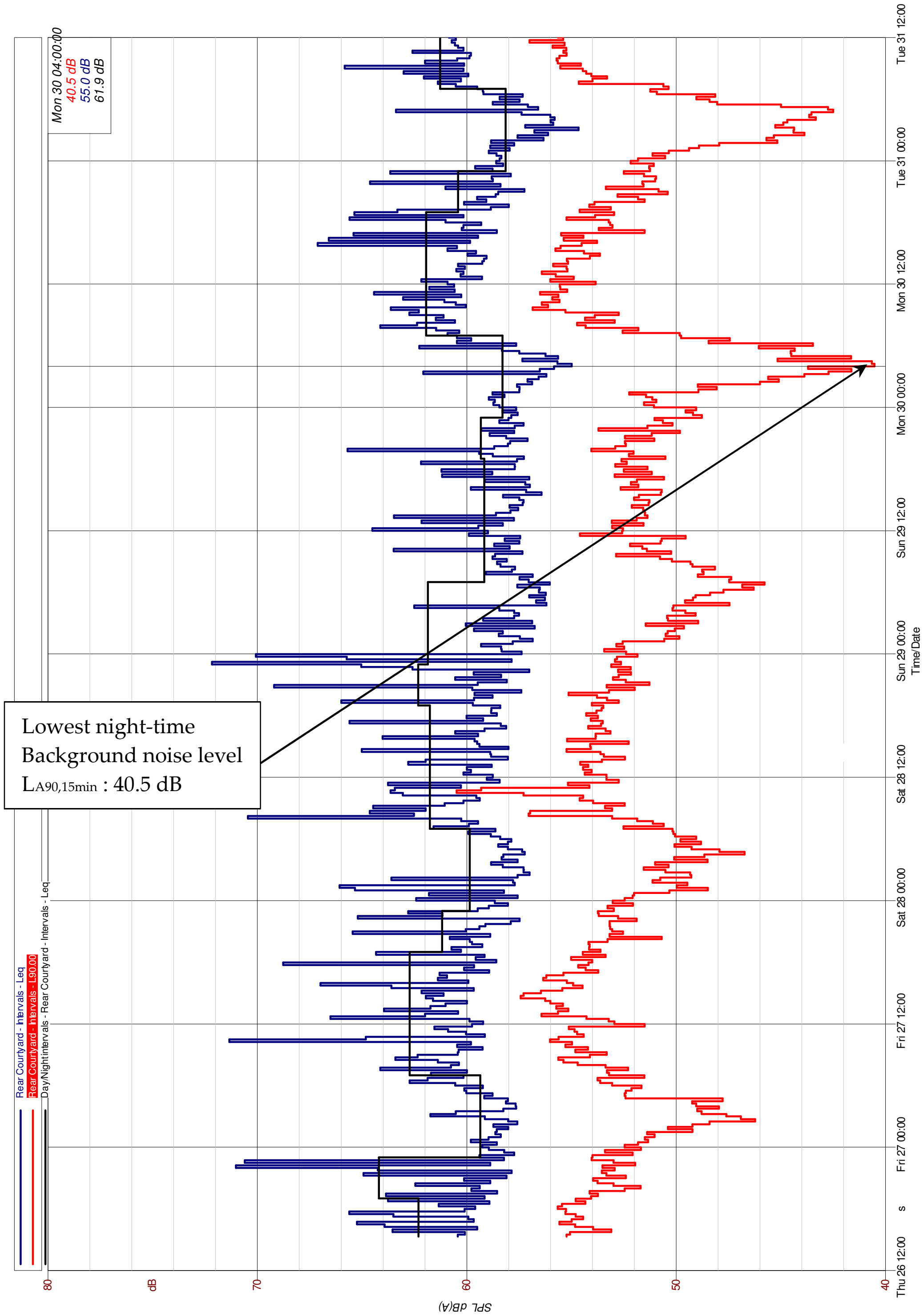


Figure A1b: Environmental Noise Data – 26th to 31st October 2017.

Roof-top

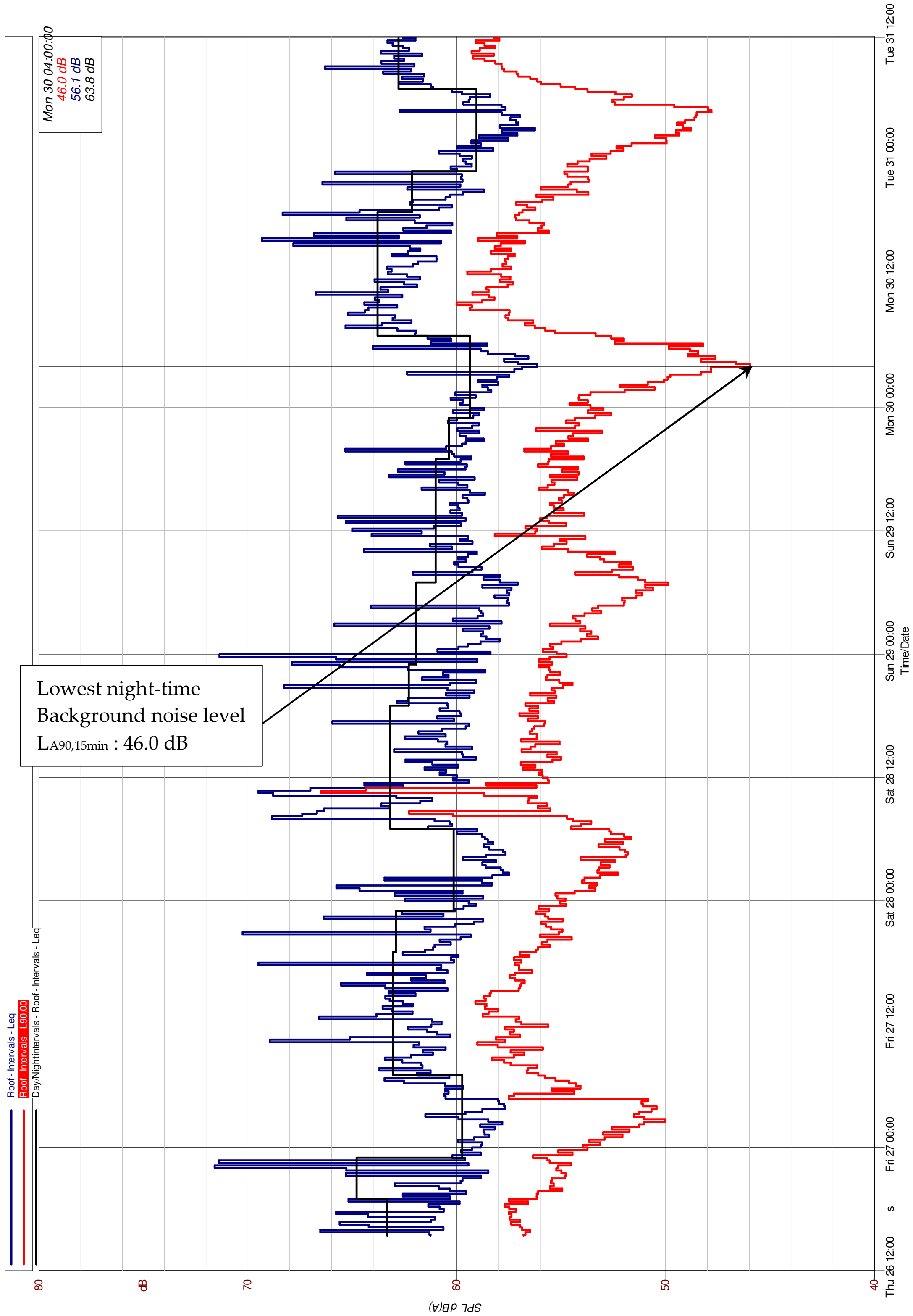


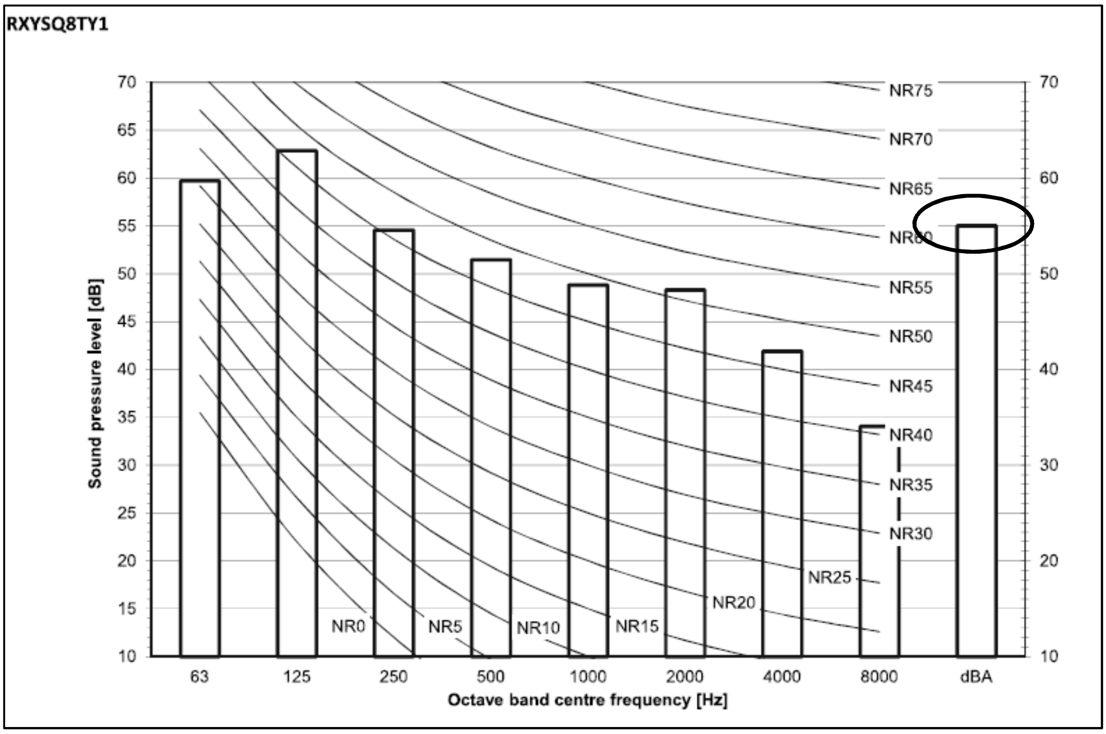
Figure A2a: Noise Monitoring Equipment in rear courtyard/garden of 4 Bloomsbury Place

Figure A2b: Noise Monitoring Equipment on roof 4 Bloomsbury Place

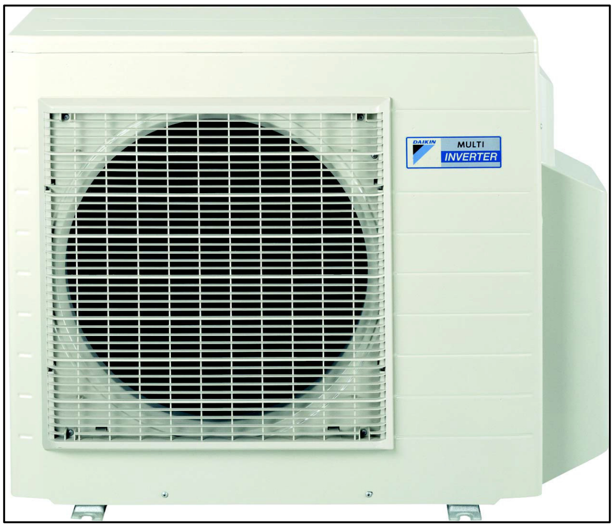
Figure A3: Equipment Noise Data

Rear Courtyard Unit

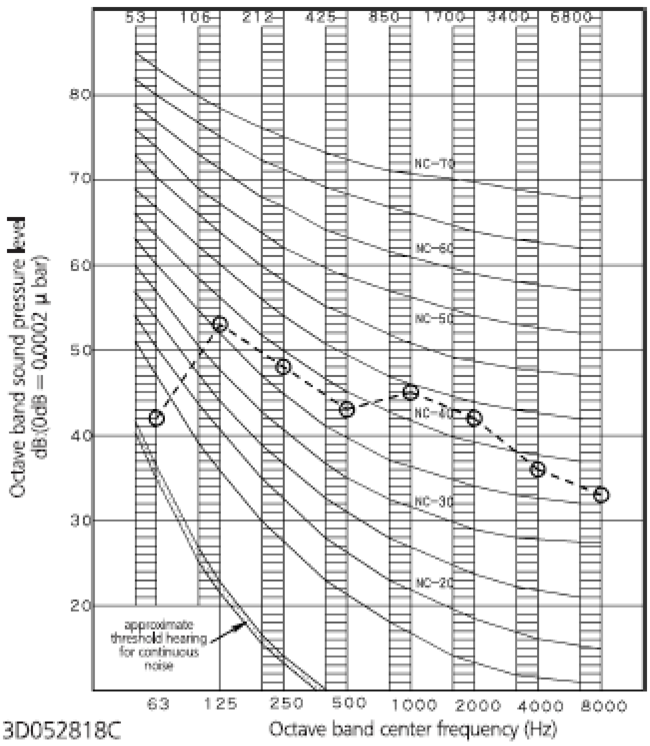
Daikin RXYSQ8TY1



Daikin 3MXS52E



3MXS52E (Heating)



3D052818C

NOTES

1 Overall (dB):
(B,G,N is already rectified)

2 Measuring place: Measured in an anechoic room

Scale	50Hz 220V~240V
A	47

Roof-top units:

Daikin RXYSCQ5 External Condenser Unit

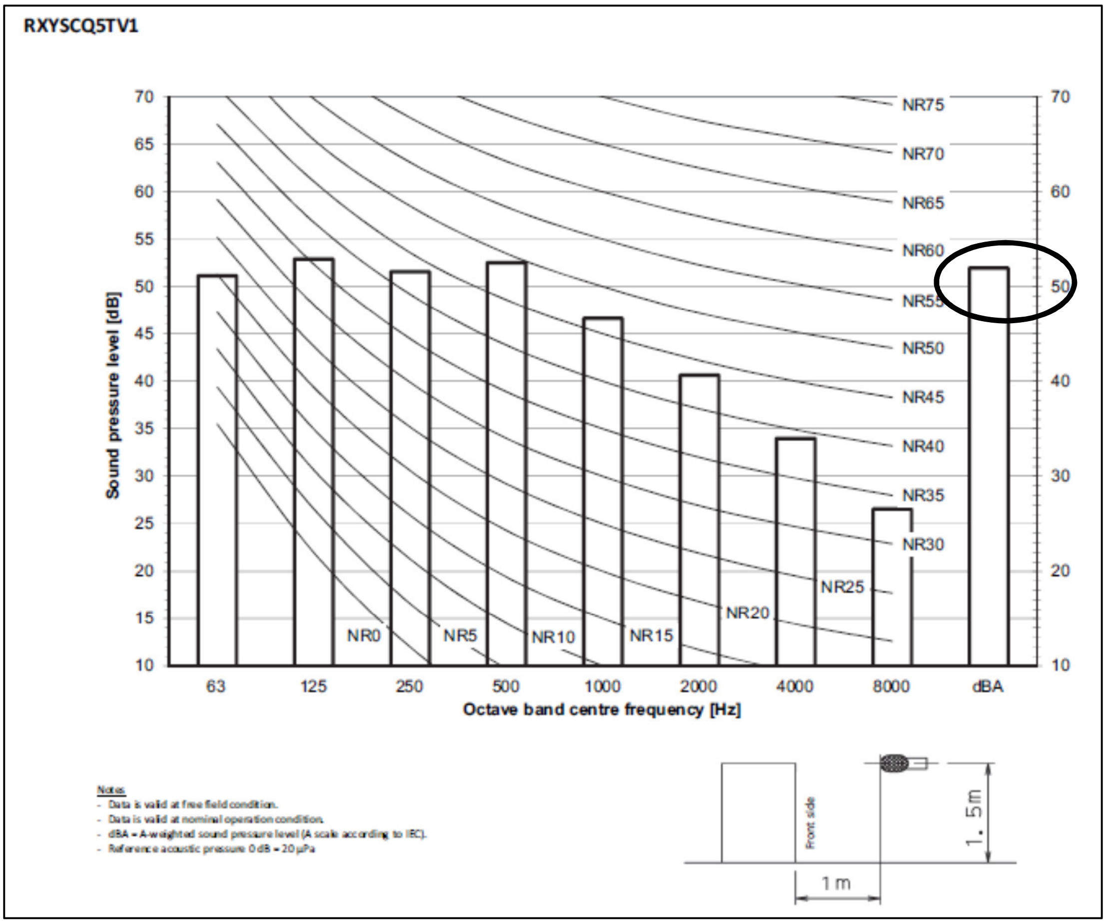
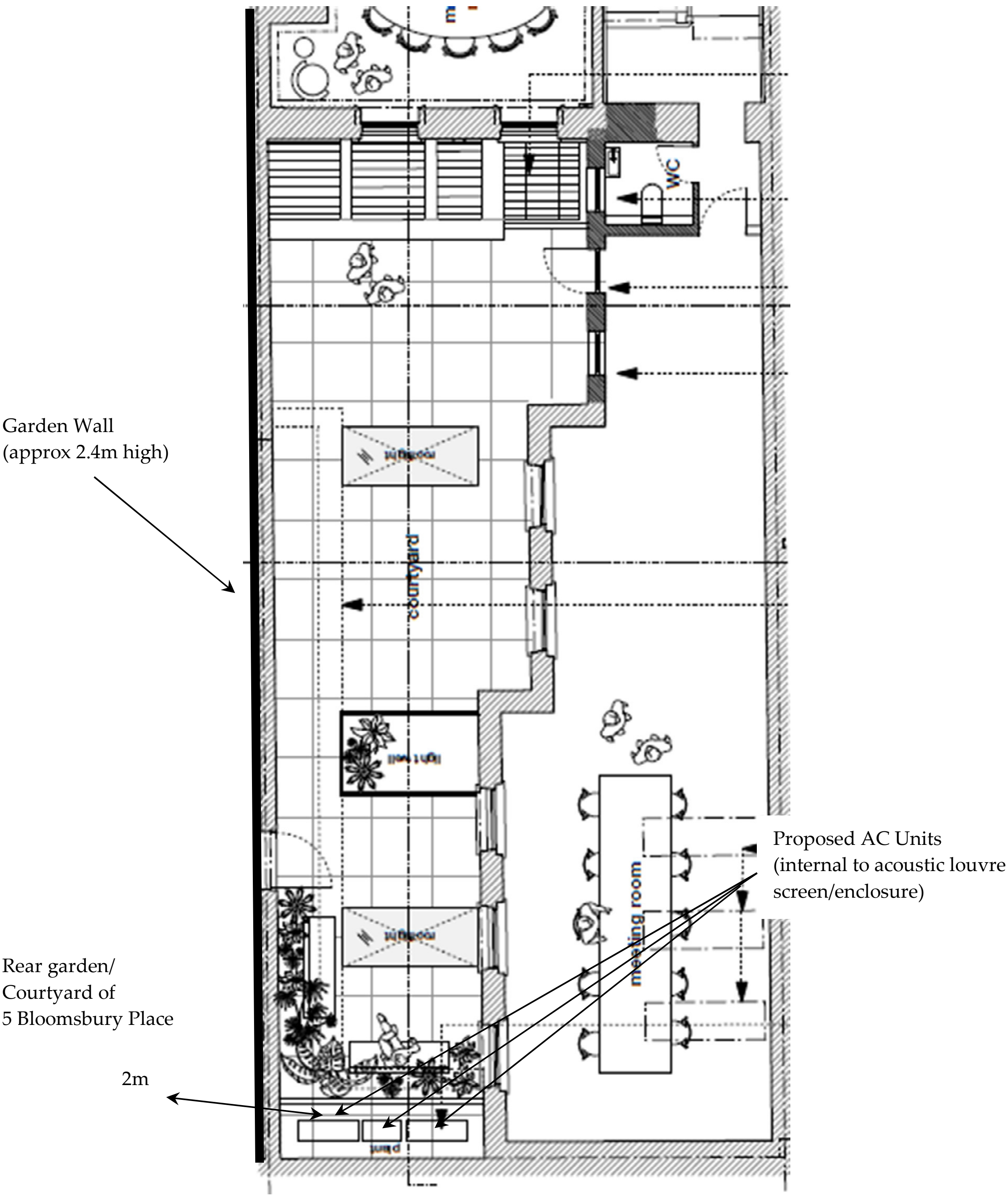
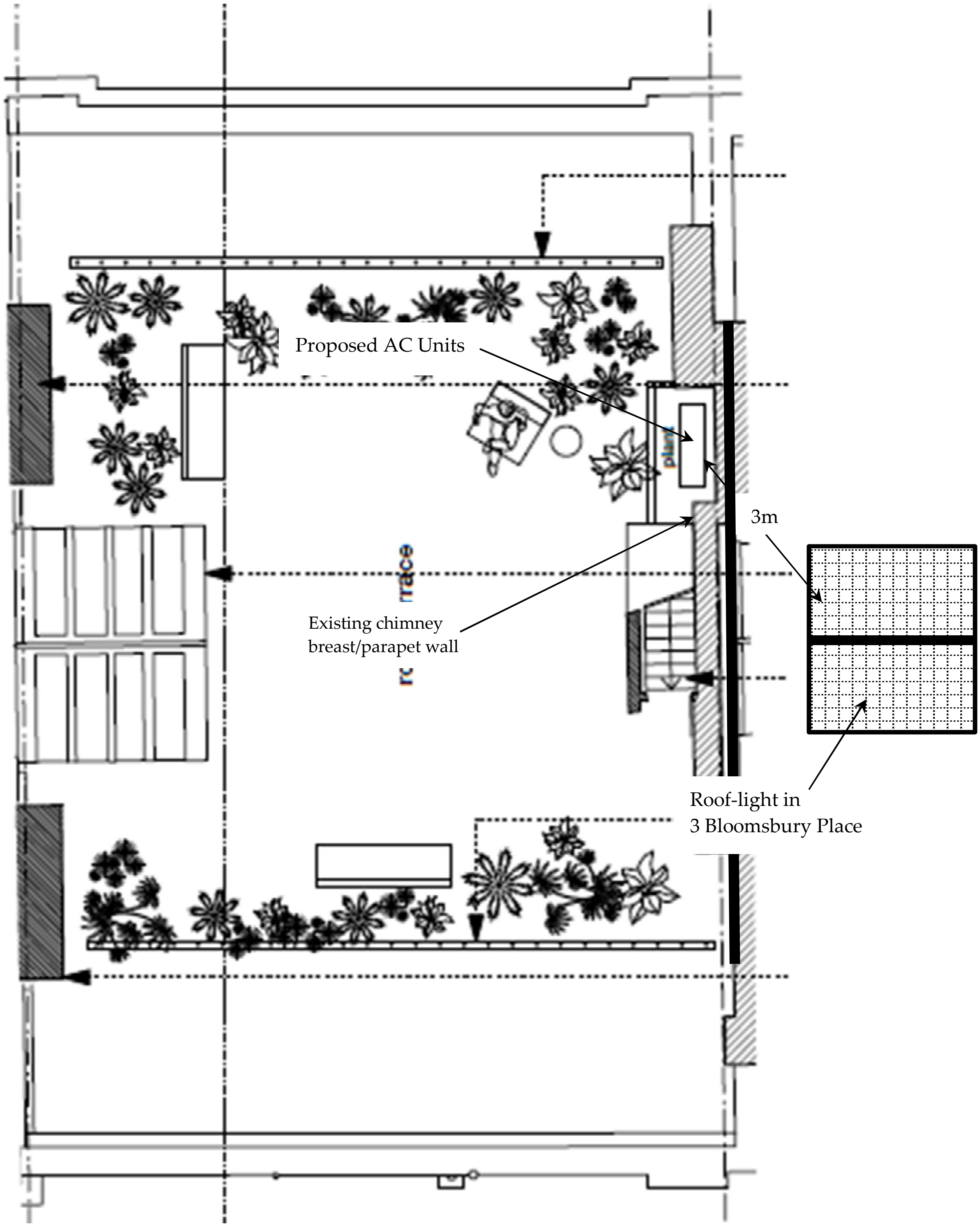


Figure A4a: Layout Drawing (Ground Floor)



Extract from Johanna Molineus Architects Drawing 257.04.101 Revision D

Figure A4b: Layout Drawing (Roof)



Extract from Johanna Molineus Architects Drawing 257.04.105 Revision C

Figure A5: Detailed Calculations and NR curves

4 Bloomsbury Place

Rear Courtyard

Octave Band Frequency

	63	125	250	500	1k	2k	4k	8k	A
1. Daikin RXYSQ8TY1									
1.1 2x SPL at 1M	63.0	65.0	58.0	55.0	51.0	50.0	45.0	37.0	
A-weighting	-26.0	-16.0	-9.0	-3.0	0.0	1.0	1.0	-1.0	
	37.0	49.0	49.0	52.0	51.0	51.0	46.0	36.0	57.9
2. Distance									
5 BP Garden (2m)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	
3. Screening etc									
Garden Wall	-10.0	-13.0	-15.0	-18.0	-20.0	-21.0	-23.0	-25.0	
Acoustic Louvre	-4.0	-5.0	-6.0	-9.0	-12.0	-17.0	-11.0	-10.0	
4. Receptor SPL									
5 BP Garden (2m)	17.0	25.0	22.0	19.0	13.0	7.0	6.0	-5.0	28.0

4 Bloomsbury Place

Roof-top

Octave Band Frequency

	63	125	250	500	1k	2k	4k	8k	A
1. Daikin RXYSQ8TY1									
1.1 2x SPL at 1M	54.0	55.0	54.0	55.0	49.0	44.0	37.0	31.0	
A-weighting	-26.0	-16.0	-9.0	-3.0	0.0	1.0	1.0	-1.0	
	28.0	39.0	45.0	52.0	49.0	45.0	38.0	30.0	55
2. Distance									
3 BP Garden (3m)	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	
3. Screening etc									
Parapet Wall/Chimne	-6.0	-7.0	-8.0	-10.0	-13.0	-15.0	-17.0	-19.0	
4. Receptor SPL									
3BP Rooflight	12.5	22.5	27.5	32.5	26.5	20.5	11.5	1.5	34.9

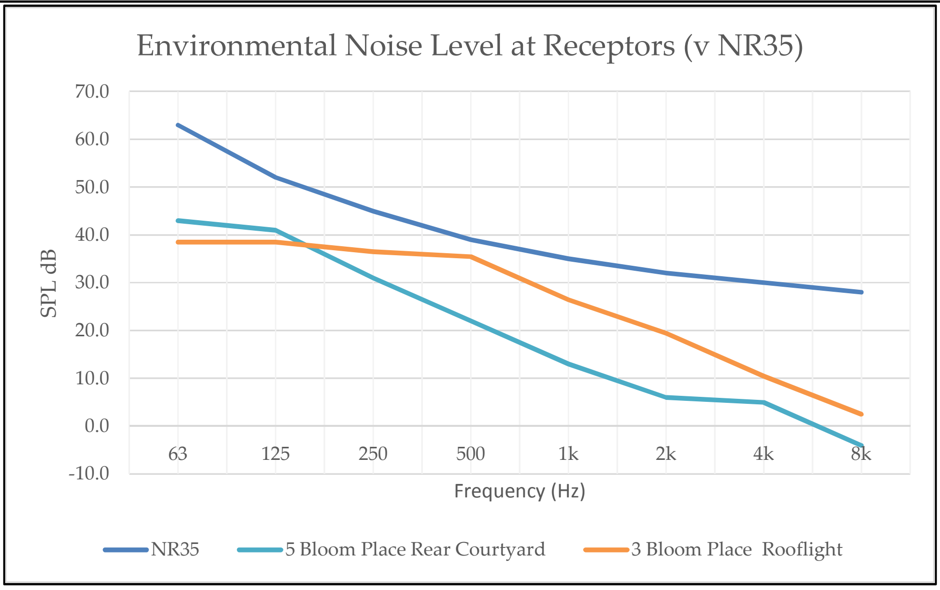


Figure A6: Acoustic Louvres Specification (Typical)

EEC Acoustic Louvres

APPEARANCE

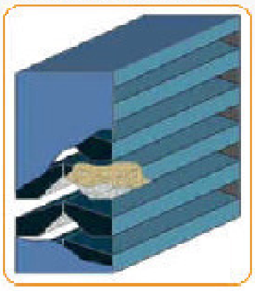
EEC Acoustic Louvres can be manufactured to accommodate the various dimensional and appearance requirements a building project may demand.

The louvres can be designed and constructed to be installed in the exterior fabric of buildings or as complete acoustic enclosures to house noise emitting plant. Also supplied are acoustic louvred fully openable single and double doors.

Special materials and finishes available include stainless steel, anodised aluminium and painted to the complete BS colour range.

Louvres are supplied, in single bank modules (LA1) or back-to-back "chevron" modules (LA2) ranging from 150mm to 600mm deep.

CONSTRUCTION



Built to the highest quality and specification, all EEC acoustic weather louvres will have outer casings of not less than 1.2mm galvanised mild steel sheet.

The louvre blades and outer faces of the top and bottom support sections will not be less than 0.7mm galvanised mild steel sheet. The inner absorptive faces will not be less than 0.7mm galvanised perforated mild steel sheet.

The acoustic infill will be in-organic, non-hydroscopic, flame, moisture and vermin proof mineral wool with a minimum density of 48Kg/m 3 and packed under compression to prevent voids due to settlement.

PERFORMANCE

The overall acoustic performance for single and double bank acoustic louvres varies depending on the free area, louvre blade design and the noise spectrum from the attenuated plant item.

Typical SRI figures for standard Acoustic Louvre configurations are presented below

Frequency - Hz	63	125	250	500	1K	2K	4K	8K
LA1 SRI - dB	6	7	10	13	17	19	13	11
LA2 SRI - dB	9	10	14	20	30	33	32	30

AERODYNAMICS

It is generally recommended to avoid excessive regenerative noise from the louvres that air flow pressure losses across the louvres be kept below 20 Pa. This again varies on the final specification of each louvres, however no acoustic louvre should be run faster than 2.5 m/s.

quietly moving forward

NOISE AND VIBRATION CONTROL SPECIALISTS

EEC Limited, Richmond House, Churchfield Road, Walton-on-Thames, Surrey KT12 2TP
t: 01932 230940 f: 01932 230941 e: info@eecnoisecontrol.co.uk www.eecnoisecontrol.co.uk

APPENDIX B: GLOSSARY OF NOISE TERMS AND UNITS.

1.0 Noise

1.1 The sounds that we hear are as a result of successive air pressure changes. These air pressure changes are generated by vibrating sources, such as train engines or wheels, and they travel to a receiver, i.e. the human ear, as air pressure waves.

1.2. The human ear is capable of detecting a vast range of air pressures, from the lowest sound intensity that the normal ear can detect (about 10^{-12} watts/m^2) to the highest that can be withstood without physical pain (about 10 watts/m^2). If we were to use a linear scale to represent this range of human sensitivity it would encompass more than a billion units. Clearly this would be an unmanageable scale yielding unwieldy numbers.

1.3. The scale can be compressed by converting it to a logarithmic or Bel scale, the number of Bels being the logarithm to the base 10 of one value to another (as applied by Alexander Graham Bell to measure the intensity of electric currents). The Bel scale gives a compressed range of 0 to 12 units which in practice is a little too compressed. A more practical operating range of 0 to 120 is obtained by multiplying by 10, ie. 10 x Bel, which produces the scale units known as decibels or dB.

1.4. Examples of typical sound intensity levels within the decibel range of 0 to 120 dB are listed below:

Commercial four-engine jet aircraft at 100m	120dB
Riveting of steel plate at 10m	105dB
Pneumatic drill at 10m	90dB
Circular wood saw at 10m	80dB
Heavy road traffic at 10m	75dB

Male speech, average, at 10m	50dB
Whisper at 10m	25dB
Threshold of hearing, 1000Hz	0dB

1.5. Due to this logarithmic scale noise levels have to be combined logarithmically rather than arithmetically. For example, two equal sound sources of 70 dB each, when operated simultaneously, do not produce a combined level of 140 dB but instead result in a level of 73 dB, ie. A rise of 3dB for each doubling of sound intensity. Subjectively, a 3dB change does not represent a doubling or halving of loudness; to make a sound appear twice as loud requires an increase in sound pressure level of about 10dB.

1.6. The subjective loudness of noise can be measured by applying a filter or weighting which equates to the frequency response of the human ear. This is referred to as an A-weighting and when applied results in noise levels expressed as dB(A).

1.7. dB(A) noise levels can be measured using a variety of noise indices. The index which correlates best with human response due to machinery noise is the L_{Aeq} this is the A-weighted L_{eq} which is referred to as the 'equivalent continuous noise level' and is a measure of the total sound energy generated by a fluctuating sound signal within a given time period.

APPENDIX C

VA2563 - Bloomsbury Place, London

Noise Impact Assessment

		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
Daikin RXYSCQ5TV1	Lp @ 1m	51	53	52	53	47	41	34	27	**53**
Number of Plant	4	6	6	6	6	6	6	6	6	
100mm louver loss		-5	-4	-5	-6	-9	-13	-14	-13	
Distance Loss	To 16m	-24	-24	-24	-24	-24	-24	-24	-24	
Level at receiver		**28**	**31**	**29**	**29**	**20**	**10**	**2**	**-4**	**28**

		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	dB(A)
Daikin RXYSQ8TY1	Lp @ 1m	60	63	55	52	49	48	42	34	**56**
Number of Plant	1	0	0	0	0	0	0	0	0	
100mm louver loss		-5	-4	-5	-6	-9	-13	-14	-13	
Distance Loss	To 16m	-24	-24	-24	-24	-24	-24	-24	-24	
Level at receiver		**31**	**35**	**26**	**22**	**16**	**11**	**4**	**-3**	**24**

	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Cumulative Level at Receiver	33	36	31	30	21	14	6	-1	30 dB(A)
NR35 Curve	63	52	45	39	35	32	30	28	
Difference from NR 35	-30	-16	-14	-9	-14	-18	-24	-29	