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Project:

UOL IALS Project

Title:

Plant Noise Impact Assessment

quietly moving forward

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0	01/02/2017	Stefan De Vito	Jon Mudd
1	09/11/2017	Stefan De Vito	Jon Mudd

CONTENTS:

1 INTRODUCTION

1.01 Environmental Equipment Corporation Limited has been commissioned by Fowler Martin to undertake a noise assessment of 10 No. *Mitsubishi* condenser units and 1 No. *Nuaire* AHU to serve the Charles Clore House at the Institute of Advanced Legal Studies, in the University of London.

1.02 This noise assessment has been conducted in accordance with the policies and requirements of the London Borough of Camden (LBC) and is based on a noise survey carried out at the site over a typical weekday period.

1.03 This assessment includes:

- the setting of plant noise limits in accordance with the requirements of LBC and national planning policy, standards and guidance; and
- the prediction of noise impacts at the worst affected noise sensitive receptors based on the proposed items of plant and their location.

1.04 This report is prepared solely for Fowler Martin. Environmental Equipment Corporation Limited accepts no responsibility for its use by any third party.

1.05 Whilst every effort has been made to ensure that this report is easy to understand, it is necessarily technical in nature. To assist the reader, an explanation of the terminology used in this report is contained in Appendix A.

2 SITE

2.01 Charles Clore House is a seven-storey educational building located at the south-side of the University of London's campus. With the exception of educational buildings associated with the University the surrounding area is predominantly residential.

2.02 The property is bound by the following:

- North – UCL Institute of Education as part of the same construction. There is a small greenhouse and garden on the roof;
- East – Bedford Way road, with the Tavistock Hotel an eight-storey building, beyond;
- South – Russell Square a public greenspace with a road around its perimeter; and
- West – 21 Russell Square an adjoining educational building with The Faber Building a five-storey student accommodation beyond this to the south west.

2.03 This application is for 10 No. *Mitsubishi* condenser units and 1 No. *Nuaire* AHU, which are to be located on the rooftop area, as presented in Appendix B.

2.04 The *Mitsubishi* condenser units are to be located within an open topped plant enclosure as specified in section 7.08 below.

2.05 The closest noise sensitive receptors to the proposed plant items are the following;

- The top-floor windows of the Tavistock Hotel to the East;
- The top-floor windows of 21 Russell Square; and
- The south-facing windows serving a greenhouse area which is part of UCL.

2.06 All other noise sensitive receptors are at a greater distance from the proposed location of the units, or are protected by more screening by the intervening structures, and as such will be subject to lower levels of noise.

3 GUIDANCE

3.01 Local and National Planning Policy for London Borough of Camden Council (LBC) are presented in Appendix C of this document.

3.02 A summary of the pertinent points relating to this application are presented below.

Noise from new plant affecting existing residential amenity is considered to be acceptable where:

- Daytime - its rating level is at least 10dB less than the existing background noise (in Gardens and at the facades of noise sensitive dwellings)
- Night time - its rating level is at least 10dB less than the existing background noise (at the facades of noise sensitive dwellings)
- Plant should be designed to be 15dB less than the background noise if and where it contains distinguishing tonal characteristics.

3.03 The criteria of Camden Council specifically relate to dwellings and they state for other premises suitable guidance should be used. The adjacent property is the UCL Institute of Education that has amenity spaces and windows to a greenhouse that could be affected by noise from the proposed new plant installation. We have therefore used guidance issued in *BB93: Acoustic design of schools: performance standards to set suitable design targets.*

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a weekday period, between 14:00 hours on Wednesday 21st December 2016 and concluded 08:30 hours the following day, to establish the existing noise levels at the site. The survey methodology and results are set out below.

4.02 Noise measurements have been carried out at the following position, as shown in Appendix B and described as being located at a height of approximately 1.5 metres above the top of the roof. The measurement was not located within 3.5 metres of any reflecting surfaces, other than the mounting surface.

4.03 This position is considered to be representative of the nearest windows to the proposed plant.

5 EQUIPMENT

5.01 The equipment used for the survey was as follows:-

- 01dB Metravib Black Solo Integrating Sound Level Meter conforming to Class 1 BS EN 61672, Type 1 BS EN 60804 & BS EN 60651: 1994;
- 01dB Metravib MCE 212 Condenser Microphone, PRE 21 S Pre-amp and Connecting Leads;
- 01dB Outdoor Microphone Kit and a
- Tripod.

5.02 The equipment holds current UKAS or equivalent accreditation and serial numbers as follows:

Sound Level Meter 01dB Black Solo	Serial No.	61719
	Calibration Date	5th May 2016
	Cal Certificate No.	U21536
½" MCE 212 Condenser Mic.	Serial No.	166397
	Calibration Date	5th May 2016
	Cal Certificate No.	21535
Calibrator CAL 21	Serial No.	34344442
	Calibration Date	5th May 2016
	Cal. Certificate No.	U21534

N.B. Copies of calibration certificates are available upon request.

5.03 The equipment was calibrated both before and after the survey with no difference noted in the levels.

6 RESULTS

6.01 The weather during the survey was suitable for noise measurement, it being dry with little wind for the duration of the survey.

6.02 Noise sources at the site include local and distant road traffic and distant plant. There were no other significant sources of noise during the survey.

6.03 A list of the levels measured is included in Appendix D and represented graphically in Appendix E.

6.04 A summary of the time averaged ambient levels and lowest measured background levels over the measurement periods are shown in Table 6.1. The minimum L_{A90} is the lowest fifteen minute measurement in the specified period.

Position	Period	Average $L_{Aeq,T}$ – dB	Minimum L_{A90} – dB
1	Day time (0700-1900 hrs)	54	49
	Evening (1900-2300 hrs)	54	48
	Night-time (2300-0700 hrs)	50	44

Table 6.1: Free-Field Measured Ambient and Lowest Background Noise Levels

7 PLANT ASSESSMENT

7.01 This application is for 1 No. *PURY-EP 750 YSNW-A* & 2 No. *PURY-EP 350 YNW-A Mitsubishi* VRF units; 6 No. *PUHZ-ZRP 250 YKA3* & 1 No. *PUMY-SP 122 VKM* condenser units 1 No. *Nuaire XBC65-H-LBC* AHU.
The plant items are to be located on the flat rooftop area, as presented in Appendix B.

7.02 Based on the standard requirements of LBC and the lowest measured background noise level in each time period, Table 7.1 sets out the recommended noise limits that the proposed items of plant should meet at the nearest dwellings.

7.03 Please note, that in accordance with the requirements of LBC, the proposed noise limits are based on being 10 dB below the measured background noise level.

Location	Period	Measured Existing $L_{A90,T}$	Proposed Noise Limit L_{Ar}
1	Day	49 dB	39 dB
	Evening	48 dB	38 dB
	Night	44 dB	34 dB

Table 7.1: Suggested Plant Noise Emission Limits Based on Lowest Measured L_{A90}, Free-field dB

7.04 Note that the limits suggested above are rating levels and as such any design should take into account the acoustic characteristics of the plant. In this instance the proposed units display none of the characteristics whereby the acoustic correction should be applied.

7.05 In the vicinity of the plant is a greenhouse serving the neighbouring UCL educational building. Taking a worst case that the greenhouse could be considered a teaching space such as for design and technology *BB93*: *Acoustic design of schools: performance standards* sets the upper limit of indoor ambient noise should be 40 dB(A). The greenhouse has non-openable sealed windows in the elevations facing the proposed plant. Typically, as a worst case a single glazed window can be expected to provide a minimum noise reduction of 25 dB. The following table therefore puts forward a maximum noise limit not to be exceeded at 1m from the windows of the greenhouse to ensure the guidance within BB93 is maintained.

Location	Period	Proposed Noise Limit L_{Ar}
UCL rooftop greenhouse	Day	65 dB
	Evening	
	Night	-

Table 7.2: Suggested Plant Noise Emission Limits (School) Based on *BB93*

7.06 Assuming the proposed items meet the noise limits set out in Table 7.1 and 7.2 noise will be below the NOEL with respect to the NPPF and will achieve the LOAEL (green) with respect to the criteria defined by LBC's Local Plan at the nearest noise sensitive receivers and would meet *BB93* guidelines for the school respectively.

7.07 The proposed units each have the following stated manufacturers noise levels:

VRF units

- *Mitsubishi PURY-EP 750 YSNW-A* 90 dB(A) Sound Power Level; and
- *Mitsubishi PURY-EP 350 YNW-A* 83 dB(A) Sound Power Level.

Condenser units

- *Mitsubishi PUHZ-ZRP 250 YKA 3* 62 dB(A) Sound Pressure Level at 1 m; and
- *Mitsubishi PUMY-SP 122 YKM* 54 dB(A) Sound Pressure Level at 1 m.

AHU

- *Nuaire XBC65-H-LBC* 38 dB(A) Breakout Sound Pressure Level at 3 m.
  70 dB(A) in-duct fresh air intake Sound Power Level;
  78 dB(A) in-duct fresh air intake Sound Power Level;

Copies of the manufacturer's plant data sheets are included in Appendix F.

7.08 The plant items are be in operation between the hours of 0700 – 2300 only.

7.09 The *Mitsubishi* condenser units are to be installed within a four-sided acoustic louvred screen that stands a minimum of 300 mm taller than the installed height of the tallest condenser. The combined insertion loss of the screen and acoustic louvre will be 9 dB(A) based on the octave band noise spectrum of the VRF condensers.

The AHU is to have in-line attenuators installed prior to atmosphere-side duct terminations designed to levels shown in Table 7.11.

7.10 Predicted noise levels have been calculated at the closest noise sensitive windows, the top-floor windows of the Tavistock Hotel and the top-floor windows of 21 Russell Square. The south-facing windows of the UCL greenhouse are also assessed to ensure compliance with the guidance contained within BB93.

7.11 Other residential receptors located further from the site will be subject to lower noise levels than those predicted at the above locations.

7.12 Tables 7.2 - 7.12 present the results of worst-case plant noise predictions at the worst-case locations.

Item	Noise Level	Notes
3 No. *Mitsubishi* VRF units	91 dB(A)	Cumulative sound power level
Off axis correction	- 4 dB	90° off axis correction from sound power level
Noise control	- 9 dB	Acoustic screen by EEC
Conformal of area Losses over 35 metres	- 42 dB	Distance to closest window
Total Noise Level	36 dB(A)	Tavistock Hotel

Table 7.2: The Top floor window of the Tavistock Hotel Plant Noise Calculation

Item	Noise Level	Notes
7 No. *Mitsubishi* condenser units	70 dB(A)	Cumulative sound pressure level at 1 m
Noise control	- 9 dB	Acoustic screen by EEC
Conformal of area Losses over 35 metres	- 27 dB	Distance to closest window
Total Noise Level	34 dB(A)	Tavistock Hotel

Table 7.3: The Top floor window of the Tavistock Hotel Plant Noise Calculation

Item	Noise Level	Notes
1 No. *Nuaire XBC65-H-LBC* Breakout noise	38 dB(A)	Sound pressure level at 3 m
Conformal of area Losses over 45 metres	- 22 dB	Distance to closest window
Total Noise Level	16 dB(A)	Tavistock Hotel

Table 7.4: The Top floor window of the Tavistock Hotel Plant Noise Calculation

Item	Noise Level	Notes
3 No. *Mitsubishi* VRF units	91 dB(A)	Cumulative sound power level
Off axis correction	- 4 dB	90° off axis correction from sound power level
Noise control	- 9 dB	Acoustic screen by EEC
Barrier Effect	- 7 dB	No line of sight to nearest noise sensitive window
Conformal of area Losses over 28 metres	- 40 dB	Distance to closest window
Total Noise Level	31 dB(A)	21 Russell Square

Table 7.5: The Top floor window of 21 Russell Square Building Plant Noise Calculation

Item	Noise Level	Notes
7 No. *Mitsubishi* condenser units	70 dB(A)	Cumulative sound pressure level at 1 m
Noise control	- 9 dB	Acoustic screen by EEC
Conformal of area Losses over 28 metres	- 25 dB	Distance to closest window
Barrier Effect	- 7 dB	No line of sight to nearest noise sensitive window
Total Noise Level	29 dB(A)	21 Russell Square

Table 7.6: The Top floor window of 21 Russell Square Building Plant Noise Calculation

Item	Noise Level	Notes
1 No. *Nuaire XBC65-H-LBC* Breakout noise	38 dB(A)	Sound pressure level at 3 m
Conformal of area Losses over 34 metres	- 20 dB	Distance to closest window
Total Noise Level	18 dB(A)	21 Russell Square

Table 7.7: The Top floor window of 21 Russell Square Building Plant Noise Calculation

Item	Noise Level	Notes
3 No. *Mitsubishi* VRF units	91 dB(A)	Cumulative sound power level
Off axis correction	- 4 dB	90° off axis correction from sound power level
Noise control	- 9 dB	Acoustic screen by EEC
Conformal of area Losses over 15 metres	- 35 dB	Distance to closest window
Total Noise Level	41 dB(A)	UCL Greenhouse

Table 7.8: Window of UCL Greenhouse Plant Noise Calculation

Item	Noise Level	Notes
7 No. *Mitsubishi* condenser units	70 dB(A)	Cumulative sound pressure level at 1 m
Noise control	- 9 dB	Acoustic screen by EEC
Conformal of area Losses over 15 metres	- 20 dB	Distance to closest window
Total Noise Level	41 dB(A)	21 Russell Square

Table 7.9: The Top floor window of 21 Russell Square Building Plant Noise Calculation

Item	Noise Level	Notes
1 No. *Nuaire XBC65-H-LBC* Breakout noise	38 dB(A)	Sound pressure level at 3 m
Conformal of area Losses over 4 metres	- 2 dB	Distance to closest window
Total Noise Level	36 dB(A)	UCL Greenhouse

Table 7.10: Window of UCL Greenhouse Plant Noise Calculation

Item	Tavistock Hotel	21, Russell Square	UCL Greenhouse
3 No. *Mitsubishi* VRF units	36 dB(A)	31 dB(A)	41 dB(A)
7 No. *Mitsubishi* condenser units	34 dB(A)	29 dB(A)	41 dB(A)
1 No. *Nuaire XBC65-H-LBC* Breakout noise	16 dB(A)	18 dB(A)	36 dB(A)
1 No. *Nuaire XBC65-H-LBC* Fresh Air Intake noise	21 dB(A)	17 dB(A)	40 dB(A)
1 No. *Nuaire XBC65-H-LBC* Exhaust noise	26 dB(A)	22 dB(A)	45 dB(A)
Total Noise Level	**38 dB(A)**	**34 dB(A)**	**48 dB(A)**

Table 7.11: Total plant noise levels calculation at noise sensitive receivers

Property	Period	Proposed Noise Limit L_{Ar}	Predicted $L_{Aeq,T}$	Exceedance of noise limit
Tavistock Hotel	Daytime	39 dB	38 dB(A)	- 1 dB
	Evening	38 dB		0 dB
	Night-time	34 dB	-	-
21 Russell Square	Daytime	39 dB	34 dB(A)	- 5 dB
	Evening	38 dB		- 4 dB
	Night-time	34 dB	-	-
UCL Greenhouse	Daytime	65 dB	48 dB(A)	- 17 dB
	Evening			
	Night-time	-	-	-

Table 7.12: Assessment of Predicted Noise Levels Based on Proposed Noise Limit, Free-field dB(A)

7.13 It can be seen from the above tables that the noise limits are not exceeded during any period of proposed operation.

7.14 Assuming that the proposed plant and acoustic screen is included in the installation, predicted noise levels will meet the requirements of the Local Authority during all periods of operation and at the closest noise sensitive receptors.

7.15 With respect to the NPPF, achieving the noise limits would be classified as being below the NOEL and meeting the limits of the LOAEL as defined by LBC and would be significantly below the guidance values within education buildings as specified within BB93. Furthermore, the noise levels within the amenity space adjacent to the greenhouse will be below 50 dB(A) which complies with the current guidance contained within current British Standards for noise in external areas.

7.16 The proposals are therefore expected to meet the 'Green' criterion in line with LBC Local Plan whereby noise emissions are considered to be acceptable and would satisfy the guidelines issued in *BB93*.

8 CONCLUSIONS

8.01 Fowler Martin has appointed Environmental Equipment Corporation Limited to undertake a noise assessment for 10 No. *Mitsubishi* condenser units and 1 No. AHU to serve the Charles Clore House at the Institute of Advanced Legal Studies, in the University of London

8.02 The assessment has been carried out in accordance with national planning guidance and the requirements of the LBC, and is based on an environmental noise survey conducted at the site over a mid-week period.

8.03 A noise assessment has been undertaken to evaluate the potential noise impact of the proposed condensers at the closest existing noise sensitive receptors.

8.04 Plant noise limits have been set based on the methodology contained in BS4142, the results of a background noise survey and the requirements of LBC, to control the noise from the proposed plant items. In accordance with the LBC, the noise limit has been set 10 dB below the lowest measured background noise level.

8.05 The greenhouse of the educational building (UCL) has also been assessed to ensure the guidance contained within *BB93* has been satisfied.

8.06 Predictions have shown that the proposed noise criterion is met at all assessment locations during all periods of the plant's proposed operation, assuming, the *Mitsubishi* condenser units are fitted within an acoustic screen providing a minimum performance of 9 dB(A) to the VRF condenser noise and that the identified duct terminations are fitted with in-line attenuation.

8.07 Assessing the site in accordance with the principles of the National Planning Policy Framework has shown that predicted noise levels would be below the level at which no effects are observed to occur, the NOEL and will be below the LOAEL as defined in LBC's Local Plan, Appendix 3.

8.08 On the basis of this assessment it is considered that noise does not pose a material constraint to the operation of the plant items.

APPENDIX A

GLOSSARY OF TECHNICAL TERMS

TECHNICAL TERMS AND UNITS

Decibel (dB) - This is the unit used to measure sound. The human ear has an approximately logarithmic response to sound over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure levels, intensities and power levels. The logarithms used are to base 10; hence, an increase of 10 dB in sound pressure level corresponds to a doubling in perceived loudness of the sound.

Sound Power Level (SWL) - This is a function of the noise source alone and is independent of its surroundings. It is a measure of the amount of sound power output measured in decibels.

Sound Pressure Level (SPL) - This is a function of the source and its surroundings and is a measure of the sound pressure at a point in space. For example, a sound pressure level measured at 1 metre from a sound source of certain sound power in reverberant room will not be the same as the sound pressure level a 1 metre from the sound source measured in open space.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a range of approximately 20 Hz to 20 KHz and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For finer analysis, each octave band may be split into one-third octave bands.

"A" Weighting - A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used weighting is the "A" weighting. The "A" weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content.

Noise Rating (NR) Curves - The "A" weighted sound pressure level cannot be used to define a spectrum or to compare sounds of different frequencies. NR curves convey frequency information in a single-figure index. This is done by defining the maximum permissible sound pressure level at each frequency for each curve. To measure the noise rating of a given environment, the SPL is measured in octave or one-third octave bands and the noise rating is then the highest NR curve touched by the measured levels.

Intermittency and Time-Weighting - The degree of annoyance caused by a noise also depends on its duration and intermittency of a noise. Intermittent, impulsive or repetitive noises tend to be more annoying than continuous noises. Various time-weightings have been derived to measure sounds of differing intermittences and these can be measured directly on modern equipment. The most common time-weightings in use are as follows:-

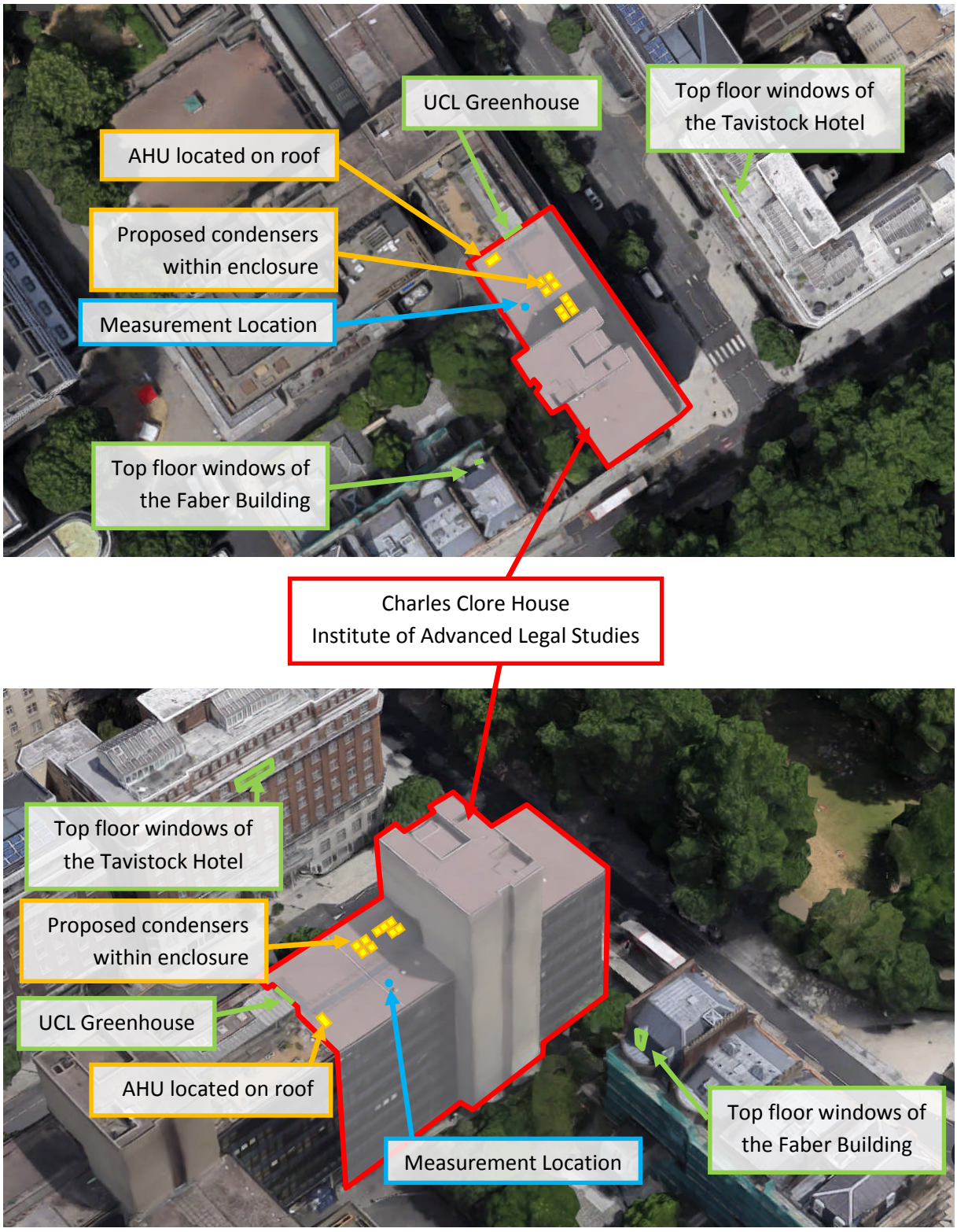
L_{90} This is the sound pressure level exceeded for 90% of the measurement period. It is widely used to measure background noise levels.

L_{10} This is the sound pressure level exceeded for 10% of the measurement period. It is widely used to measure traffic noise. For a given measurement period, the L_{10} level is by definition greater than or equal to the L_{90} level.

L_{eq} The equivalent continuous noise level is often used to measure intermittent noise. It is defined as the notional steady noise level that would contain the same acoustic energy as the varying noise. Because the averaging process used is logarithmic, the L_{eq} level tends to be dominated by the higher noise levels measured.

APPENDIX B

SITE PLAN
&
MEASUREMENT LOCATION



APPENDIX C

PLANNING POLICY AND GUIDANCE

PLANNING POLICY AND GUIDANCE

Planning Policy Camden Borough Council

London Borough of Camden's planning policy is set out in a range of documents that constitute its 'development plan'. This includes its **Local Plan** and proposed supplementary planning guidance (SPG's) documents. The Local Plan was adopted on 3 July 2017 and has replaced the 'Core Strategy' and 'Camden Development Policy' documents; as the basis for planning decisions and future development in the borough. The SPG's are in the process of being updated at time of writing (Sept 2017).

Policy A4 – *Noise and Vibration* outlines the following aims:

> *The Council will seek to ensure that noise and vibration is controlled and managed.*
>
> *Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*
>
> *We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.*

Appendix 3 of the Local Plan outlines noise thresholds for both noise generating and noise sensitive developments and identifies three basic design criteria upon which the acceptability of any proposal is likely to be assessed:

- Green – where noise is considered to be at an acceptable level.
- Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
- Red – where noise is observed to have a significant adverse effect.

In the context of National Planning Policy Framework and Noise Policy Statement for England, Camden Council consider the above criteria to fall into three associated categories in terms of their noise 'effects':

- LOAEL Green
- LOAEL to SOAEL Amber
- SOAEL Red

Table C of Appendix 3 defines the target noise levels for mechanical services plant and machinery:

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	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 Leq,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.

National Planning Policy Framework and the Noise Policy Statement for England

The Department for Communities and Local Government published the National Planning Policy Framework (NPPF) on 27th March 2012 and upon its publication, the majority of planning policy statements and guidance notes were withdrawn, including Planning Policy Guidance 24 Planning and Noise, which previously presented the government's overarching planning policy on noise.

The NPPF contains four aims, which are set out at paragraph 123 in Section 11 of the document, titled *Conserving and enhancing the natural environment*:

> *"Planning policies and decisions should aim to:*
>
> *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
>
> *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
>
> *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
>
> *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

The Department for Environment Food and Rural Affairs published the Noise Policy Statement for England (NPSE) in March 2010. The explanatory note of NPSE defines the following terms used in the NPPF:

> *"NOEL – No Observed Effect Level*
>
> *This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
>
> *LOAEL – Lowest Observed Adverse Effect Level*
>
> *This is the level above which adverse effects on health and quality of life can be detected.*
>
> *2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.*
>
> *SOAEL – Significant Observed Adverse Effect Level*
>
> *This is the level above which significant adverse effects on health and quality of life occur."*

The NPSE does not define any of the above effect levels numerically.

The NPSE presents the Noise Policy Aims as:

> *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy and sustainable development:*
>
> *avoid significant adverse impacts on health and quality of life;*
>
> *mitigate and minimise adverse impacts on health and quality of life; and*
>
> *where possible, contribute to the improvement of health and quality of life."*

It can be seen that the first two bullet points are similar to Section 11 of the NPPF, with a third aim that seeks to improve health and quality of life. The NPSE later expands on the Noise Policy Aims, stating:

> *2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).*
>
> *2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.*
>
> *2.25 This aim* (the third aim)*, seeks where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."*

It is clear that noise described in the NPSE as SOAEL that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, termed the LOAEL, but not so high that it leads to significant adverse effects.

British Standard 4142

To assess the acceptability of the resultant noise levels we have consulted the relevant standards. BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' has been used to assess the likelihood any adverse impacts based on the resultant noise level from the new plant item, including any corrections for the character of the noise against the existing background noise level.

BS4142 gives guidance on assessing the likelihood of adverse impacts by calculating a 'rating level' of the new noise source and comparing its magnitude at noise sensitive locations to the existing or underlying background noise level. The background noise level is subtracted from the 'rating level' to assess the likelihood of complaints:

- The greater the difference the greater the likelihood of complaints.
- A difference of around +10dB or more is an indication of a significant adverse impact, depending on the context.
- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background noise level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low sound impact, depending on the context.

This assessment is carried out over a one hour period for the daytime and a fifteen minute period for the night-time. For the purposes of the standard it states that daytime and night-time are typically 07:00 to 23:00 hours and 23:00 to 07:00 hours respectively.

The 'rating level' of the noise source is obtained taking the following factors into consideration:

- The new plant noise (the specific noise) is measured or predicted in terms of L_{Aeq}.
- An additional correction shall be included if the noise contains a distinguishable, discrete continuous note, if the noise contains distinct impulses or if the noise is irregular enough to attract attention. The value for any tonal noise can be an addition of up to 6dB and for impulsive noise of up to 9dB.

BS 4142 goes onto state that:

'The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.'

BS4142 has been referenced in setting noise limits for any fixed plant proposed as part of the proposed development.

APPENDIX D

SURVEY RESULTS
(TABULAR)

EC 15205 - UOL IALS Project

Fowler Martin

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
14:00	54	70	52
14:15	55	73	52
14:30	54	62	52
14:45	56	67	52
15:00	62	79	52
15:15	55	71	51
15:30	55	69	51
15:45	53	65	51
16:00	53	70	51
16:15	54	68	51
16:30	52	60	51
16:45	53	63	51
17:00	55	69	51
17:15	53	68	51
17:30	53	63	51
17:45	54	70	51
18:00	53	66	50
18:15	53	62	51
18:30	53	61	51
18:45	53	69	50
19:00	52	61	50
19:15	56	74	50
19:30	55	73	50
19:45	53	68	50
20:00	54	70	50
20:15	51	60	49
20:30	52	62	50
20:45	53	71	49
21:00	52	72	49
21:15	51	58	49
21:30	52	63	49
21:45	51	59	49
22:00	52	69	48
22:15	51	65	48
22:30	51	60	48
22:45	50	59	48
23:00	50	57	48
23:15	50	60	47
23:30	50	60	47
23:45	49	59	46
00:00	52	68	46
00:15	49	58	46
00:30	49	62	45
00:45	49	63	46
01:00	49	69	46
01:15	49	67	45
01:30	49	64	46
01:45	48	57	45

Time	L_{Aeq}	L_{AMax}	L_{A90}
02:00	48	54	45
02:15	48	60	45
02:30	48	64	45
02:45	47	55	44
03:00	47	55	44
03:15	49	66	44
03:30	48	58	45
03:45	47	54	44
04:00	48	55	45
04:15	48	63	44
04:30	49	62	45
04:45	49	64	46
05:00	50	64	47
05:15	50	63	47
05:30	50	62	47
05:45	53	76	47
06:00	51	58	48
06:15	52	60	49
06:30	52	61	49
06:45	52	60	49
07:00	52	65	49
07:15	53	59	50
07:30	53	66	50
07:45	53	75	50
08:00	52	58	50
08:15	54	67	51
08:30	54	65	52
08:45	54	66	52
09:00	54	63	52
09:15	58	66	52
09:30	56	78	52
09:45	54	71	52
10:00	54	70	51
10:15	54	68	52
10:30	54	64	52
10:45	54	69	52
11:00	53	64	52
11:15	54	64	52
11:30	54	69	52
11:45	55	71	51
12:00	54	69	51
12:15	55	70	51
12:30	53	62	51
12:45	53	61	51
13:00	54	72	51
13:15	55	69	52
13:30	57	73	51
13:45	54	67	51

EC 15205 - UOL IALS Project

Fowler Martin

Tabulated Noise data

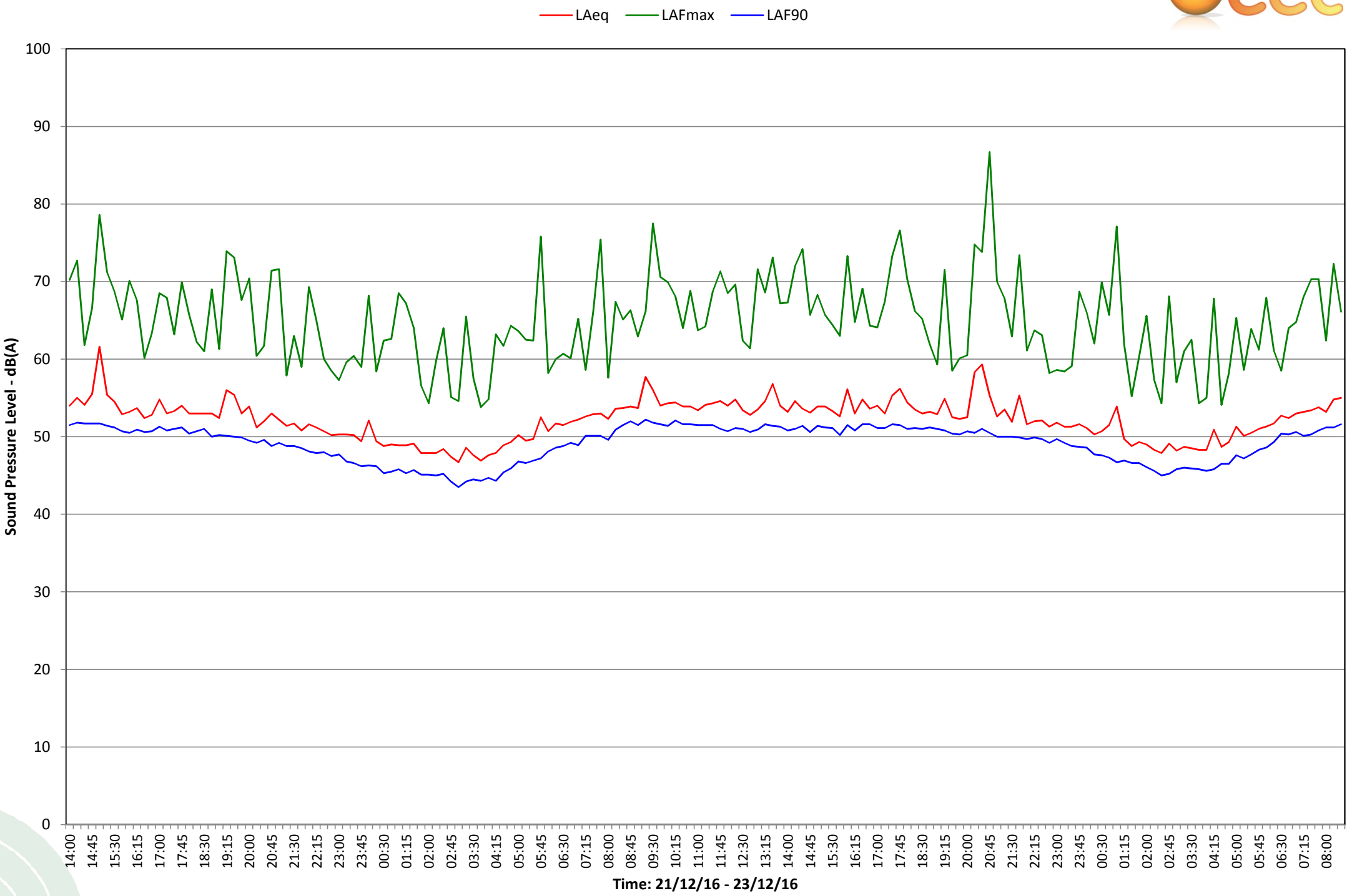
Time	L_{Aeq}	L_{AMax}	L_{A90}
14:00	53	67	51
14:15	55	72	51
14:30	54	74	51
14:45	53	66	51
15:00	54	68	51
15:15	54	66	51
15:30	53	64	51
15:45	53	63	50
16:00	56	73	52
16:15	53	65	51
16:30	55	69	52
16:45	54	64	52
17:00	54	64	51
17:15	53	67	51
17:30	55	73	52
17:45	56	77	52
18:00	54	70	51
18:15	54	66	51
18:30	53	65	51
18:45	53	62	51
19:00	53	59	51
19:15	55	72	51
19:30	53	59	50
19:45	52	60	50
20:00	53	61	51
20:15	58	75	51
20:30	59	74	51
20:45	55	87	51
21:00	53	70	50
21:15	54	68	50
21:30	52	63	50
21:45	55	73	50
22:00	52	61	50
22:15	52	64	50
22:30	52	63	50
22:45	51	58	49
23:00	52	59	50
23:15	51	58	49
23:30	51	59	49
23:45	52	69	49
00:00	51	66	49
00:15	50	62	48
00:30	51	70	48
00:45	52	66	47
01:00	54	77	47
01:15	50	62	47
01:30	49	55	47
01:45	49	60	47

Time	L_{Aeq}	L_{AMax}	L_{A90}
02:00	49	66	46
02:15	48	57	46
02:30	48	54	45
02:45	49	68	45
03:00	48	57	46
03:15	49	61	46
03:30	49	63	46
03:45	48	54	46
04:00	48	55	46
04:15	51	68	46
04:30	49	54	47
04:45	49	58	47
05:00	51	65	48
05:15	50	59	47
05:30	51	64	48
05:45	51	61	48
06:00	51	68	49
06:15	52	61	49
06:30	53	59	50
06:45	52	64	50
07:00	53	65	51
07:15	53	68	50
07:30	53	70	50
07:45	54	70	51
08:00	53	62	51
08:15	55	72	51
08:30	55	66	52

APPENDIX E

SURVEY RESULTS
(GRAPHICAL)

Noise Level Time History at UOL IALS Project



APPENDIX F

PUBLISHED PLANT NOISE DATA

PWL

PURY-(E)P・YNW(NEXTSTAGE-R2)

Cooling

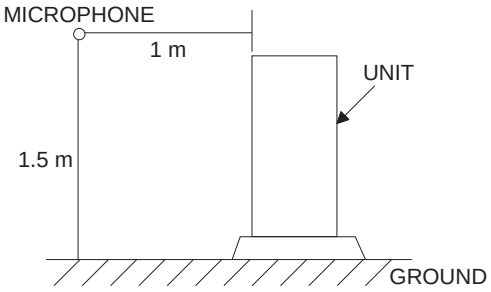
Model	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	PWL dB(A)
(E)P200	77.5	76.0	74.5	73.0	71.5	68.0	64.0	59.0	76.0
(E)P250	80.5	78.5	77.0	75.0	73.0	70.5	69.0	61.5	78.5
(E)P300	79.0	78.5	77.5	76.5	76.0	72.5	66.0	59.0	80.0
(E)P350	77.5	77.5	77.5	77.5	77.5	73.5	67.0	58.0	81.0
(E)P400	79.5	79.5	79.5	79.0	79.5	76.0	68.5	62.5	83.0
(E)P450	79.5	79.5	79.5	79.0	79.5	76.0	69.0	62.5	83.0
(E)P500	77.5	77.5	77.5	77.0	77.0	76.0	71.5	62.5	82.0
(E)P550	79.5	79.5	79.0	79.0	79.0	77.5	72.0	64.5	83.5
(E)P400S	80.5	79.0	77.5	76.0	74.5	71.0	67.0	62.0	79.0
(E)P450S	82.0	80.5	79.0	77.0	75.5	72.5	70.5	63.5	80.5
(E)P500S	83.5	81.5	80.0	78.0	76.0	73.5	72.0	64.5	81.5
(E)P550S	83.0	81.5	80.5	79.0	78.0	75.0	71.5	63.5	82.5
(E)P600S	82.0	81.5	80.5	79.5	79.0	75.5	69.0	62.0	83.0
(E)P650S	81.5	81.0	80.5	80.0	79.5	76.0	69.5	61.5	83.5
(E)P700S	80.5	80.5	80.5	80.5	80.5	76.5	70.0	61.0	84.0
(E)P750S	82.0	82.0	82.0	81.5	82.0	78.0	71.0	64.5	85.5
(E)P800S	82.5	82.5	82.5	82.0	82.5	79.0	71.5	65.5	86.0
(E)P850S	82.5	82.5	82.5	82.0	82.5	79.0	71.5	65.5	86.0
(E)P900S	82.5	82.5	82.5	82.0	82.5	79.0	72.0	65.5	86.0
(E)P950S	81.5	81.5	81.5	81.5	81.5	79.0	73.0	65.5	85.5
(E)P1000S	80.5	80.5	80.5	80.0	80.0	79.0	74.5	65.5	85.0
(E)P1050S	82.0	82.0	81.5	81.5	81.0	80.0	75.0	67.0	86.0
(E)P1100S	82.5	82.5	82.0	82.0	82.0	80.5	75.0	67.5	86.5

Heating

Model	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	PWL dB(A)
(E)P200	79.5	78.0	76.5	74.5	73.0	69.0	69.5	61.5	78.0
(E)P250	81.0	79.5	78.0	76.5	75.0	71.0	72.0	63.0	80.0
(E)P300	83.0	83.0	83.0	82.5	82.5	79.0	75.0	68.0	86.5
(E)P350	78.5	78.5	78.5	78.5	78.5	76.0	73.5	67.5	83.0
(E)P400	88.0	87.0	85.5	84.5	83.5	81.0	76.0	68.0	88.0
(E)P450	88.5	87.5	86.5	85.5	84.0	82.0	78.0	69.5	89.0
(E)P500	81.0	80.0	79.5	79.0	78.5	78.0	75.0	67.5	84.0
(E)P550	88.5	87.5	86.5	85.0	84.0	82.0	78.0	73.0	89.0
(E)P400S	82.5	81.0	79.5	77.5	76.0	72.0	72.5	64.5	81.0
(E)P450S	84.0	82.0	80.5	79.0	77.5	73.5	74.5	65.5	82.5
(E)P500S	84.0	82.5	81.0	79.5	78.0	74.0	75.0	66.0	83.0
(E)P550S	85.0	84.5	84.0	83.5	83.5	79.5	77.0	69.0	87.5
(E)P600S	86.0	86.0	86.0	85.5	85.5	82.0	78.0	71.0	89.5
(E)P650S	84.5	84.5	84.5	84.5	84.5	81.0	78.0	71.0	88.5
(E)P700S	81.5	81.5	81.5	81.5	81.5	79.0	76.5	70.5	86.0
(E)P750S	89.0	88.0	87.0	86.0	85.0	82.5	78.5	71.0	89.5
(E)P800S	91.0	90.0	88.5	87.5	86.5	84.0	79.0	71.0	91.0
(E)P850S	91.5	90.0	89.0	88.0	86.5	84.5	80.0	72.0	91.5
(E)P900S	91.5	90.5	89.5	88.5	87.0	85.0	81.0	72.5	92.0
(E)P950S	89.5	88.5	87.5	86.5	85.5	84.0	80.0	72.0	90.5
(E)P1000S	84.0	83.0	82.5	82.0	81.5	81.0	78.0	70.5	87.0
(E)P1050S	91.0	90.0	89.0	88.0	87.0	85.5	81.5	76.0	92.0
(E)P1100S	91.5	90.5	89.5	88.0	87.0	85.0	81.0	76.0	92.0

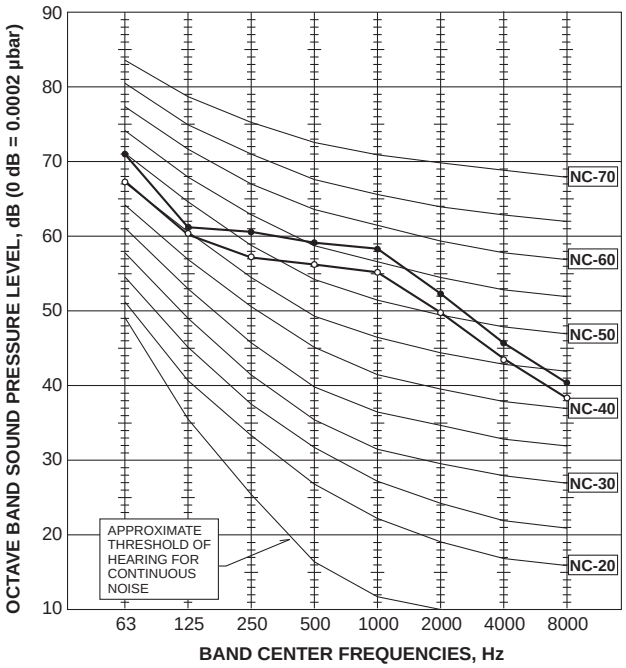
Service Ref.				PUHZ-ZRP200YKA.UK		PUHZ-ZRP250YKA.UK	
Mode				Cooling	Heating	Cooling	Heating
OUTDOOR UNIT	Power supply (phase, cycle, voltage)			3 phase 50Hz, 400V			
		Max. current	A	19		21	
	External finish			Munsell 3Y 7.8/1.1			
	Refrigerant control			Linear Expansion Valve			
	Compressor			Hermetic			
		Model		ANB52FRNMT			
		Motor output	kW	4.7		5.5	
		Starter type		Inverter			
		Protection devices		HP switch Comp. surface thermo			
	Crankcase heater		W	—			
	Heat exchanger			Plate fin coil			
	Fan	Fan (drive) × No.		Propeller fan × 2			
		Fan motor output	kW	0.200 + 0.200			
		Airflow	m³/min(CFM)	140 (4,940)			
	Defrost method			Reverse cycle			
	Noise level	Cooling	dB	59			
		Heating	dB	62			
	Dimensions	W	mm (in)	1,050 (41-5/16)			
		D	mm (in)	330 + 40 (13+1-9/16)			
		H	mm (in)	1,338 (52-11/16)			
	Weight		kg (lb)	135 (298)			
	Refrigerant			R410A			
		Charge	kg (lb)	7.1 (15.7)		7.7 (17.0)	
		Oil (Model)	L	2.30 (FVC68D)			
REFRIGERANT PIPING	Pipe size O.D.	Liquid	mm (in)	9.52 (3/8)		12.7 (1/2)	
		Gas	mm (in)	25.4 (1)		25.4 (1)	
	Connection method	Indoor side		Flared			
		Outdoor side		Flared & Brazing			
	Between the indoor & outdoor unit	Height difference		Maximum 30 m			
		Piping length		Maximum 100 m			

5-4. NOISE CRITERION CURVES



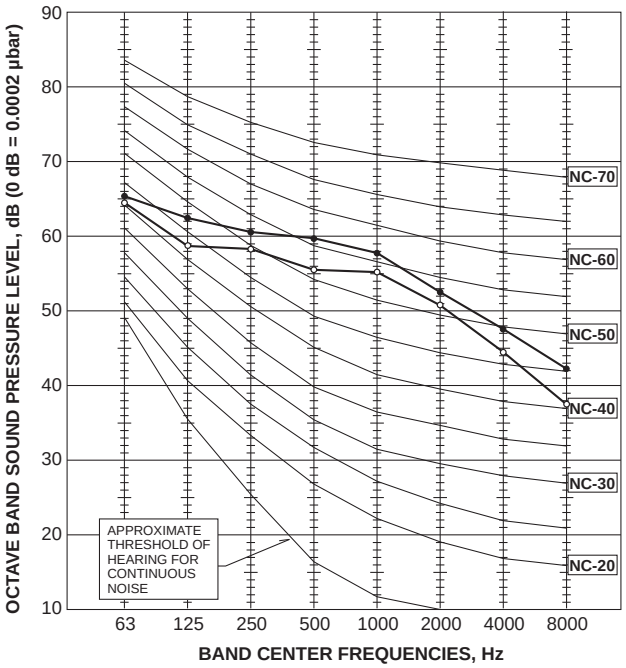
PUHZ-ZRP200YKA3.UK

MODE	SPL(dB)	LINE
COOLING	59	
HEATING	62	



PUHZ-ZRP250YKA3.UK

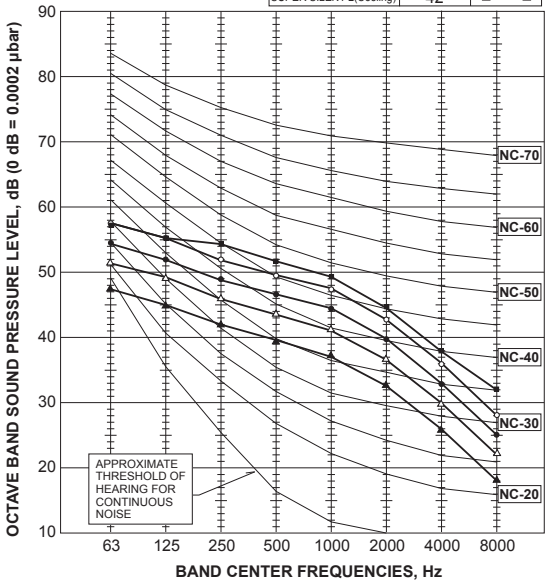
MODE	SPL(dB)	LINE
COOLING	59	
HEATING	62	



4-6. NOISE CRITERION CURVES

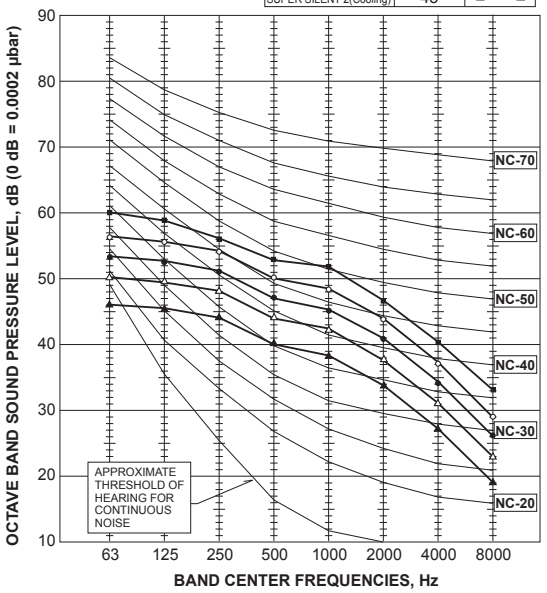
PUMY-SP112VKM.TH(-BS)
PUMY-SP112VKMR1.TH(-BS)
PUMY-SP112YKM.TH(-BS)
PUMY-SP112YKMR1.TH(-BS)

MODE	SPL(dB)	LINE
HEATING	54	
COOLING	52	
SILENT(Cooling)	49	
SUPER SILENT 1(Cooling)	46	
SUPER SILENT 2(Cooling)	42	



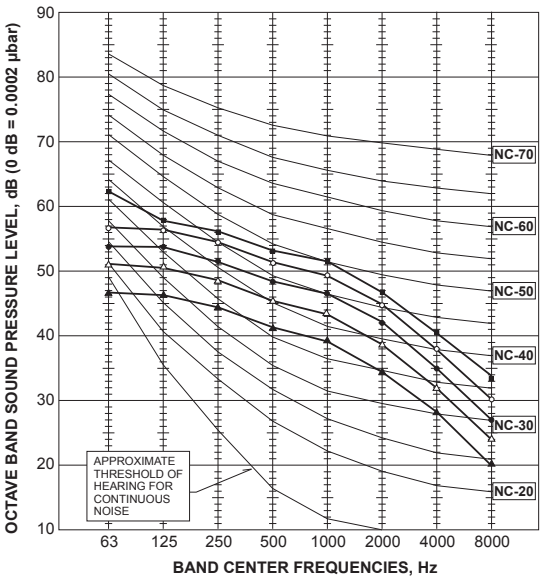
PUMY-SP125VKM.TH(-BS)
PUMY-SP125VKMR1.TH(-BS)
PUMY-SP125YKM.TH(-BS)
PUMY-SP125YKMR1.TH(-BS)

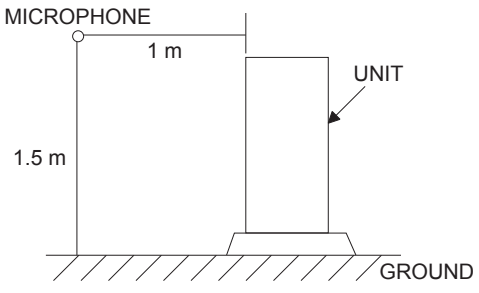
MODE	SPL(dB)	LINE
HEATING	56	
COOLING	53	
SILENT(Cooling)	50	
SUPER SILENT 1(Cooling)	47	
SUPER SILENT 2(Cooling)	43	



PUMY-SP140VKM.TH(-BS)
PUMY-SP140VKMR1.TH(-BS)
PUMY-SP140YKM.TH(-BS)
PUMY-SP140YKMR1.TH(-BS)

MODE	SPL(dB)	LINE
HEATING	56	
COOLING	54	
SILENT(Cooling)	51	
SUPER SILENT 1(Cooling)	48	
SUPER SILENT 2(Cooling)	44	





SUMMARY FAN DATA SHEET

Nuaire Limited, Western Industrial Estate, Caerphilly, CF83 1NA, United Kingdom. email:info@nuaire.co.uk
UK Commercial Enquiries T:029 2085 8200 UK Residential Enquiries T:029 2085 8500 International Enquiries T:+44.29 2085 8497

Whilst the information given on this data sheet is fan specific, it is in summary and reference to the product selection catalogue and installation & maintenance documents is recommended.
This data sheet produced on 20 Aug 2018 08:18 using software version 3.5.04.1655 - 5-Jul-2017

Technical Data

New XBOXER - With Basic Control
Heat Recovery Fan

Fan Code:	**XBC55-H-LBC**
Installation Manual Links:	671605
Required Duty:	0.276 m³/s @ 250 Pa
Addition for Ancillaries:	+82 Pa
Actual Duty:	0.363 m³/s @ 434 Pa
Actual Duty inc Ancil's:	0.331 m³/s @ 476 Pa
Actual at Required Flow:	0.276 m³/s @ 543 Pa
Velocity at Actual Duty:	1.858 m/s

When Speed Controlled to Required Duty (83.4%):

Velocity at Required Duty:	1.551 m/s
Motor Input Power:	**0.519 kW**
Specific Fan Power:	**1.9 W/(l/s)**
Motor Input Power:	0.893 kW
Specific Fan Power:	2.7 W/(l/s)
Nominal Fan Speed:	2,400 RPM
Electrical Supply:	230 V 1 Phase 50 Hz
Motor Rating:	1.1 kW
Motor Current:	flc: 5.1 A
Motor Current:	sc: 5.1 A
Max. Operating Temp.:	45°C
Weight:	364 kg

CIBSE BUILDING PERFORMANCE AWARDS 2014 — Winner

XBOXER XBC Heat Recovery Range
Energy Saving Product of the Year

Sound Data

Sound Power Levels re 1 pWatts (Hz):

	63	125	250	500	1k	2k	4k	8k	dBA
Breakout	68	61	57	43	41	39	36	24	31
Induct Intake	77	70	71	59	60	57	49	37	
Induct Supply	81	76	80	67	68	66	62	57	
Induct Discharge	82	77	80	67	68	67	62	59	
Induct Extract	78	71	71	59	60	58	49	39	

The above spectrums running speed controlled to required duty (83.5%). When running at full speed:

Breakout	72	65	61	47	45	43	40	28	35
Induct Intake	81	74	75	63	64	61	53	41	
Induct Supply	85	80	84	71	72	70	66	61	
Induct Discharge	86	81	84	71	72	71	66	63	
Induct Extract	82	75	75	63	64	62	53	43	

dBA is spherical at 3 metres. For hemi-spherical add 3 dBA.

Please note that the noise data stated on this data sheet for the unit and/or silencer is tested in accordance with UK, European and International industry laboratory standards. However onsite conditions may vary and we would recommend that this information is verified by an acoustic specialist in order to ensure its suitability for the intended application.

Specification

Nuaire XBOXER supply & extract unit with heat recovery. The unit incorporates a high efficiency counterflow plate heat exchanger (up to 90% efficiency) with segmented 100% bypass facility (patent app. for) automatic control and actuator. Performance optimised backward curved impellers and IP54 EC motors provide low specific fan powers and stepless, speed control without tonal noise generation and are suitable for 2- 10V adjustment (by others). Asymmetric, high mass double skinned wall construction (patented) with integral acoustic barrier mat (not XBC10) ensures low breakout noise levels. Unit is fitted with high capacity pleated G4 (XBC10 is G3) panel filters (spare filters are included). Low casing height for ceiling / underfloor / slab mounted applications. Flexibility in unit ductwork connections - Supply / Discharge connections on unit centreline; Intake / Extract connections are configurable on site to either side of unit. A side mounted terminal box is provided for connection to the fans (230 V 50 Hz LNE and 2 - 10 V) and bypass actuator. Unit supplied as configuration A (refer to technical documentation). 2 year warranty. .Fitted with LPHW heater battery (valve and actuator by other.)

Performance Curve