Project:	J 05300R1 Noise Impact Assessment: 17 Duchess Mews, London W1G 9DU
Consultants:	Sound Planning Ltd 25a Vicarage Hill Lower Bourne Farnham Surrey GU10 3QS
Client:	Julia Egan
Prepared by:	D. M. Thomas
Signed:	 D. M. Thomas MSc M.I.O.A Acoustic Consultant
Dated:	Thursday 29th February, 2024

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1.0 BACKGROUND

1.1 Proposal:

The redevelopment of 17 Duchess Mews, London W1G 9DU includes the introduction of an Air Source Heat Pump Unit (ASHP) that will be used for supplementary heating purposes; the system includes 1 external condenser unit which will be positioned centrally on the roof.

See APPENDIX 2 - Site Location/Plans and APPENDIX 3 – Site Photographs

1.2 The location falls under the jurisdiction of Westminster City Council and will require a noise impact assessment and noise mitigation strategy.

1.2.1 A noise assessment and acoustic report should adhere to Westminster's Unitary Development Plan (UDP) - Policies ENV 6 & 7.

1.2.2 The appropriate sections of Westminster's UDP are C46 to C50 – New Noise Planning Conditions – January 2007, revised May 2007.

1.3 Sound Planning has been retained to evaluate potential noise impact on the nearest noise sensitive receivers using appropriate methodologies and assessment criteria and design a suitable noise mitigation strategy if required.

1.3.1 Participating Acoustic Consultant

Dan Thomas is a Member of the Institute of Acoustics (M.I.O.A) having attained appropriate qualifications in acoustics and experience within the workplace.

1.3.2 Qualifications

Dan has been working within the noise and vibration industry for seventeen years and has attained the following qualifications within the field of acoustics:

- Institute of Acoustics (IOA) Diploma
- Post Graduate Diploma in Applied Acoustics and Noise Control (University of Surrey)

- Masters Degree in Applied Acoustics and Noise Control (University of Surrey)

2.0 ASSESSMENT CRITERIA

2.1 WCC - New Noise Planning Conditions[1]

2.1.1 The replacement UDP[2] Noise policies (ENV 6 & 7) are intended to protect noise sensitive properties from excessive levels and to contribute to the objectives of STRA 17 by reducing ambient noise levels where they exceed World Health Organisation (WHO) Guidelines. The previous distinction between inside and outside CAZ/CAZ Frontages/Stress Areas has therefore been replaced by a distinction between areas with noise level above WHO Guidelines (most of the City) and areas below. The conditions also provide protection from structural transmission of noise and vibration within and between properties.

2.1.2 It will often be appropriate to use more than one of these conditions for an individual proposal.

2.1.3 Noise sensitive properties are defined in the replacement UDP as: "all residential properties; educational establishments; hospitals; hotels; hostels; concert halls; theatres; broadcasting and recording studios." However, the standard conditions refer to the nearest residential window, as this is by far the most common situation. You will need to alter these references in the rare cases when another noise sensitive use is the nearest affected.

2.1.4 A preliminary noise report (acoustic and vibration report) is required with a planning application where a proposed development or change of use might affect noise sensitive properties.

2.1.5 The conditions allow applicants the option of applying subsequently (after completion of the development) for a fixed maximum noise level. For this they will need to produce a further noise report.

2.1.6 Selection of appropriate Noise Conditions is to be made on the advice of the Environmental Health Consultations Team (in Community Protection Department).

[1] Westminster City Council - Noise Requirements C46 to C50 - *New Noise Planning Conditions*.
[2] Unitary Development Plan.

2.1.7 There are five sets of noise conditions. The first two sets (C46 and C47) are for plant and internal activity respectively, with the appropriate version to be selected according to whether the proposed development is in an area in which ambient noise levels exceed WHO Guidelines. If the locality of the proposed development exceeds WHO levels at any time of day or night C46AB or C47AB is to be applied. Evidence of the 2003 Westminster Noise Study indicates that there are very few areas of Westminster can be expected to be below WHO Guideline Levels; in the few instances where this is the case, conditions C46BB or C47BB are to be applied. Part (3) in both C46 conditions and both C47 conditions provides the opportunity referred to in (5) above for applicants to apply to the City Council at a later stage for approval of a fixed maximum noise level.

2.1.8 A distinction is made within parts (1) and (2) of conditions sets C46 and C47 between developments that will or will not contain tones or be intermittent. Tonal noise is relevant where sound emitted will include prominent levels of particular frequencies. These may be intrusive high-pitched or low-pitched noise. Intermittent sounds may be regular or irregular, but tend to be percussive.

2.1.9 'Plant and machinery' includes equipment such as: air conditioning; heating and chilling plant; lifts; etc. With associated ducting and outlets. 'Internal activity' covers noise such as that from amplified and unamplified music and human voices.

2.1.10 It will often be appropriate to impose two 'hours conditions' – one for plant operation (C46CA, adapted if necessary), and one for internal activity (C12), but the hours included may often be different in these two conditions.

2.1.11 C48AA 'Vibration' should be applied in all cases in which there is any possibility of structural transmission of noise and/or vibration through the structure of the proposed development or any other property.

2.1.12 C49 conditions are entirely new. C49AA is to protect new residential developments from existing noise in the vicinity. It should be applied to all residential applications that have been determined capable of achieving internal noise levels below those specified in the condition, despite being in areas in which ambient noise levels that are above the specified noise exposure levels. Where the specified maximum internal noise levels cannot be achieved, an application for residential development would not generally be approved.

2.1.13 C49BA protects existing or proposed residential from transmission of noise or vibration within the same or an adjoining building, caused by a development or change of use.

2.1.14 C50AB 'Noise from emergency plant and generators' should be applied in all cases in which it is proposed that such equipment is installed.

2.2 WCC - New Noise Planning Conditions – Commercial Receivers

"Additionally it is recommended that reference be made to BS 8233: 2014 which contains guidance for noise limits for commercial premises that may be affected."

2.3 BS 8233: 2014 – Design Standards

Activity	Location	Design Range dB $L_{Aeq, T}$
Speech or telephone communications	Department Store, Cafeteria, canteen, kitchen	50 - 55
	Concourse Corridor, circulation space	45 - 55
Study and work requiring concentration	Library, gallery museum	40 - 50
	Staff/meeting room, training room	35 - 45
	Executive Office	35 - 40
Listening	Place of worship, counselling, meditation, relaxation	30 - 35

3.0 METHODOLOGY

3.1 The Air Source Heat Pump Unit (ASHP) for supplementary heating purposes will serve a residential property and will therefore be potentially operational at any time during a 24 hour period.

3.2 Background Noise Monitoring

3.2.1 Sound monitoring equipment was installed at 11:45 hours on Monday 12th February and collected at 12:30 hours on Wednesday 14th February, 2024 (48 hours).

3.2.2 The monitoring period is considered to include the quietest likely times when the proposed equipment will be operating.

3.2.3 The microphone/monitoring kit was positioned on the roof, in close proximity to the proposed external condenser unit position and should be deemed representative of the nearest noise sensitive receivers.

See APPENDIX 3 – Site Photographs

3.3 Measurements were undertaken in accordance with BS 7445[3] and BS 4142[4]. The A-weighted L_{eq} and L_{90} parameters were measured with the Fast (F) setting for each 15 minute measurement period during the extended assessment.

3.4 Noise levels at the nearest noise sensitive façade (residential windows) will be calculated using the manufacturers' sound pressure level (L_p) data.

3.5 Propagation corrections for distance, directivity and screening will be carried out in accordance with BS 7445 and BS 4142.

3.6 Instrumentation

3.6.1 Equipment

Equipment	Make	Model	Class	Serial Number	UKAS Calibration
SLM	Norsonic	Nor 140	1	1406175	U44210 (11/5/23)
Field Calibrator	Casella	CEL 110/1	1	077948	U44208 (11/5/23)
Environmental Tripod Kit					
Laser Measurer	Leica	Disto A5		1073750838	
Digital Camera	Samsung				

3.6.2 The Sound Level Meter (SLM) is Class 1 with real time octave measurement capability; and compliant to IEC 61672[5].

[3] British Standard 7445-1: 2003 – *Description and measurement of environmental noise.*
[4] British Standard 4142: 2014+A1: 2019 – *Method for rating and assessing industrial and commercial sound.*
[5] International Standard IEC 61672-1: 2002. Electroacoustics – Sound level meters – Part 1: Specifications.

3.6.3 The Sound Level Meter (SLM) was field calibrated before and after the on-site noise assessment. No deviation was detected (1 kHz). UKAS accredited calibration certificates are available on request.

3.7 External Equipment

The supplementary heating system will be supported by a Daikin 5MXM9DA2V1B9 external condenser unit.

Further details in APPENDIX 6 – Equipment Sound Levels

3.8 Noise mitigation calculations will utilise sound reduction indices or transmission loss data from manufacturer's specification data sheets.

3.9 Weather conditions were generally dry with light winds meeting the requirements of BS 4142: 2014+A1:2019 and BS 7445:2003.[6]

See APPENDIX 8 – Meteorological Conditions

4.0 RESULTS

4.1 Background Noise Levels (lowest period levels during 48 hour measurement period)[7]

Day/Night	Time Period (hours)	Lowest Background Noise Level dB $L_{A90, 15mins}$
Day	07:00 - 23:00	47
Night	23:00 - 07:00	43

4.2 Existing Ambient Noise Levels

4.2.1 Daytime: > 55 dB $L_{Aeq, 16hrs}$

4.2.2 Night Time: > 45 dB $L_{Aeq, 8hrs}$

[6] Short period of rainfall on the morning of Day 2.
[7] See APPENDIX 5 – Noise Measurements for full records.

5.0 DISCUSSION

5.1 The proposed Daikin 5MXM9DA2V1B9 external unit is to be located centrally on the roof of 17 Duchess Mews.

See APPENDIX 2 - Site Location/Plans & APPENDIX 3 – Site Photographs

5.2 Nearest Noise Sensitive Window Distances

5.2.1 The nearest residential noise sensitive window belongs to the 2nd floor of 19 Duchess Mews (rear elevation) at 4.5 metres. The window is extensively screened from the proposed external condenser unit by the building.

5.2.2 The nearest residential noise sensitive window with direct line of sight belongs to the 2nd floor of 18 Duchess Mews (front elevation) at 15 metres.

5.2.3 The nearest commercial noise sensitive window belongs to the 3rd floor rear elevation of 17 Portland Place at 6 metres (direct line of sight).

See APPENDIX 2 - Site Location/Plans and APPENDIX 3 – Site Photographs

6.0 CRITERIA ASSESSMENT

6.1 A design target of 10 dB below the existing lowest background noise level should satisfy Westminster's noise target design criteria for residential noise sensitive receivers..

6.2 Target Noise Level at Nearest Noise Sensitive Window

The target noise level is the representative background level minus 10 dB:

Background Level (night)	43 dB L_{A90}
24 Hour Target Noise Level	43 - 10
	33 dB L_{Aeq}

6.3 Nearest Noise Sensitive Windows

6.3.1 Residential 2nd Floor Rear Elevation Window – 19 Duchess Mews (screened)

Daikin 5MXM90A2VB1B91 @ 1m	52 dB L_{Aeq}
Directivity Index	+3 dB (Q = 2)
Distance to NSR	4.5 metres
Direct Line of Sight	No
Screening Attenuation	-10 dB[8]
Sound Level @ NSR	52 - 20 log (4.5/1) + 3 - 10
	= 32 dB(A)

Noise Impact Evaluation

Sound Level @ NSR	32 dB(A)
Target Noise Level (see para 6.2)	33 dB(A)
Excess	-1 dB

6.3.2 Residential 2nd Floor Windows – Direct line of sight (Duchess Mews)

Daikin 5MXM90A2VB1B91 @ 1m	52 dB L_{Aeq}
Directivity Index	+3 dB (Q = 2)
Distance to NSR	15 metres
Direct Line of Sight	Yes

[8] For a solid barrier (e.g. a brick wall or a fence) that completely obscures an installer's vision of an assessment position from the top edge of the air source heat pump attenuation of -10 dB may be assumed. Source: Microgeneration Installation Standard MCS020 – P21.

Screening Attenuation	0 dB
Sound Level @ NSR (r-1)	52 - 20 log (14/1) + 3
	= 32 dB(A)

Noise Impact Evaluation

Sound Level @ NSR	32 dB(A)
Target Noise Level (see para 6.2)	33 dB(A)
Excess	-1 dB

6.3.3 Commercial 3rd Floor Windows – Direct line of sight – 17 Portland Place

Daikin 5MXM90A2VB1B91 @ 1m	52 dB L_{Aeq}
Directivity Index	+3 dB (Q = 2)
Distance to NSR	6 metres
Direct Line of Sight	Yes
Screening Attenuation	0 dB
Sound Level @ NSR (r-1)	52 - 20 log (5/1) + 3
	= 32 dB(A)

Noise Impact Evaluation

Sound Level @ NSR	41 dB(A)
Loss through partially open window	-13 dB(A)
Internal Sound Level	28 dB(A)

Internal Target Level (executive office)	35 – 40 dB L_{Aeq}
Excess	-7 dB

7.0 NOISE MITIGATION STRATEGY

7.1 Noise Evaluation

7.1.1 The noise calculations in paragraph 6.3 show that the predicted external equipment sound level meets Westminster's target noise level for the nearest residential (direct line of sight and screened) and commercial noise sensitive receivers.

7.1.2 No noise mitigation measures are required.

7.2 Vibration Isolation

7.2.1 Sound Planning would recommend mounting external condenser units on suitable isolation systems to reduce vibration transmission to the lower ground floor below; suitable systems include the Kinetics Model AC (supplied by CMS Acoustics) and Mini Split Kits (supplied by Big Foot Systems).

7.2.2 Supplier Contacts Details

CMS Acoustics	TEL: 01925 577711
Big Foot Systems	TEL: 01323 844355

8.0 CONCLUSIONS

8.1 A background noise assessment was carried out in a position representative of the nearest noise sensitive receivers to the proposed external condenser unit.

8.2 The lowest background noise level was measured at 47 dB $L_{A90,\ 15mins}$ during the daytime (07:00 – 23:00 hours) and 43 dB $L_{A90,\ 15mins}$ during the night time (23:00 – 07:00 hours).

See RESULTS section 4.0

8.3 The target noise levels at the nearest noise sensitive receiver (in accordance with Westminster's requirements) are:

Daytime	37 dB L_{Aeq} (47 - 10)
Night Time	33 dB L_{Aeq} (43 - 10)

Please refer to section 6.0 - CRITERIA ASSESSMENT

8.4 The noise impact evaluation shows that the proposed external ASHP equipment (external condenser unit) complies with Westminster's target noise levels. No noise mitigation measures are required.

Please refer to section 6.0 - CRITERIA ASSESSMENT

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APPENDIX 1

Glossary of Acoustic Terms

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2×10^{-5} pascals) and the threshold of pain is around 120 dB. The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

Noise Rating

The Noise Rating (NR) system is a set of octave band sound pressure level curves used for specifying limiting values for building services noise. The Noise Criteria (NC) and Preferred Noise Criteria (PNC) systems are similar.

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

$L_{Aeq, T}$ *The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq, T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.*

L_{AE} *Where the overall noise level over a given period is made up of individual noise events, the $L_{Aeq, T}$ can be predicted by measuring the noise of the individual noise events using the sound exposure level, L_{AE} (or SEL or L_{AX}). It is defined as the level that, if maintained constant for a period of one second, would deliver the same A-weighted sound energy as the actual noise event.*

L_{Amax} *The maximum A-weighted sound pressure level that was measured during the measurement period.*

L_{A10} *The level exceeded for 10% of the time is often used to describe road traffic noise.*

L_{A90} *The level exceeded for 90% of the time is normally used to describe background noise.*

Sound Transmission Descriptors

D_{nT} Standardised level difference

$D_{nT, w}$ Weighted standardised level difference

L_1 The average sound pressure level in the source room

L_2 The average sound pressure level in the receiving room

T Reverberation time (receiving room)

T_0 Reference reverberation time = 0.5s

C_{tr} Adaption spectrum which takes account for low to medium speed road/rail/air traffic; disco music; and factory noise (medium to low frequency noise).

C Adaptation spectrum which takes account of domestic activities including speech, music, radio and television.

Frequency Analysis

Octave Band	*A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000 Hz…*
One Third Octave	*The logarithmic frequency interval between a lower frequency f_2, when f_2/f_1 equals $2^{1/3}$ apart. Frequencies include: 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000Hz.*

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law.

In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB. Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

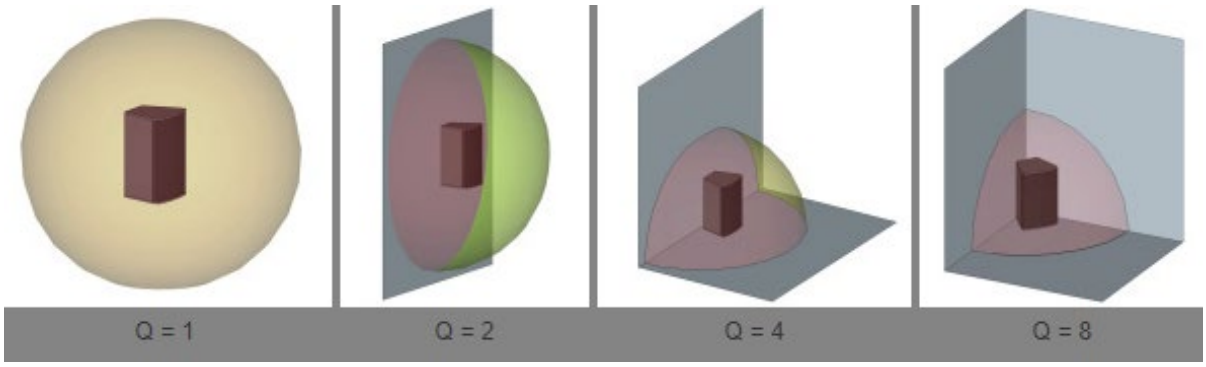
Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradient are variable and difficult to predict.

Directivity Index



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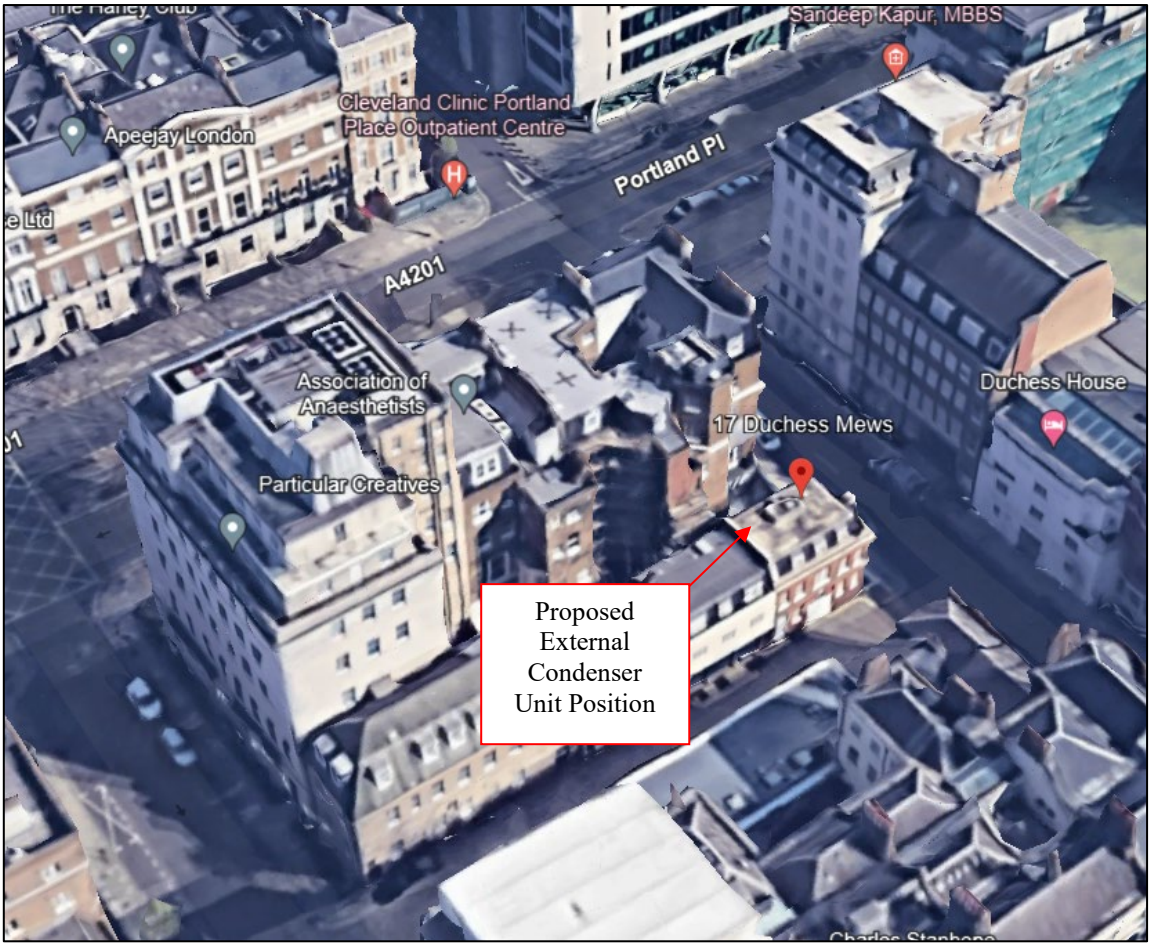
APPENDIX 2

Site Location/Plans

Google Earth 3D View



17 Duchess Mews, London W1G 9DU

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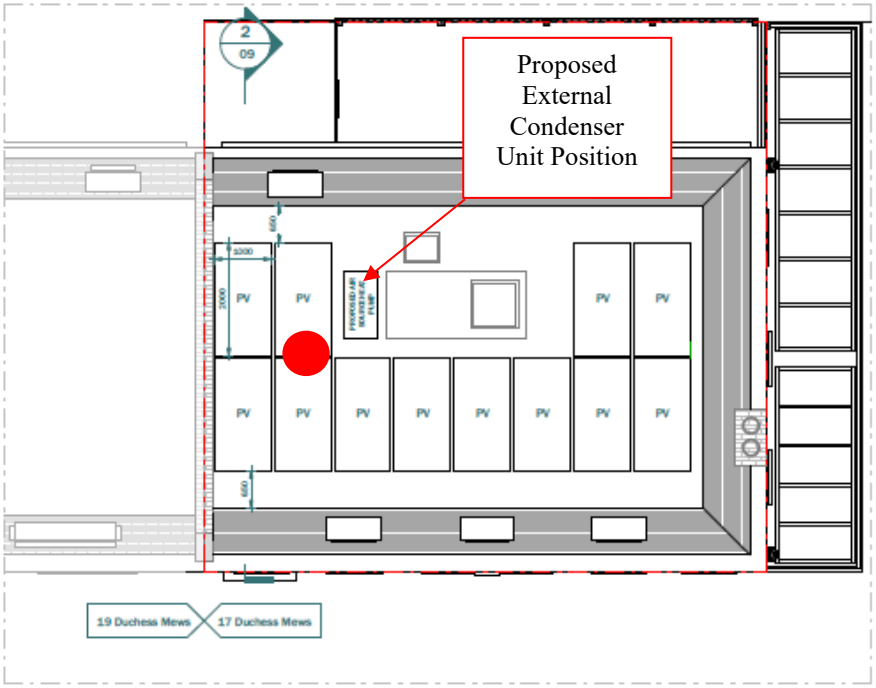
Site Location/Plans

Proposed Roof Plan

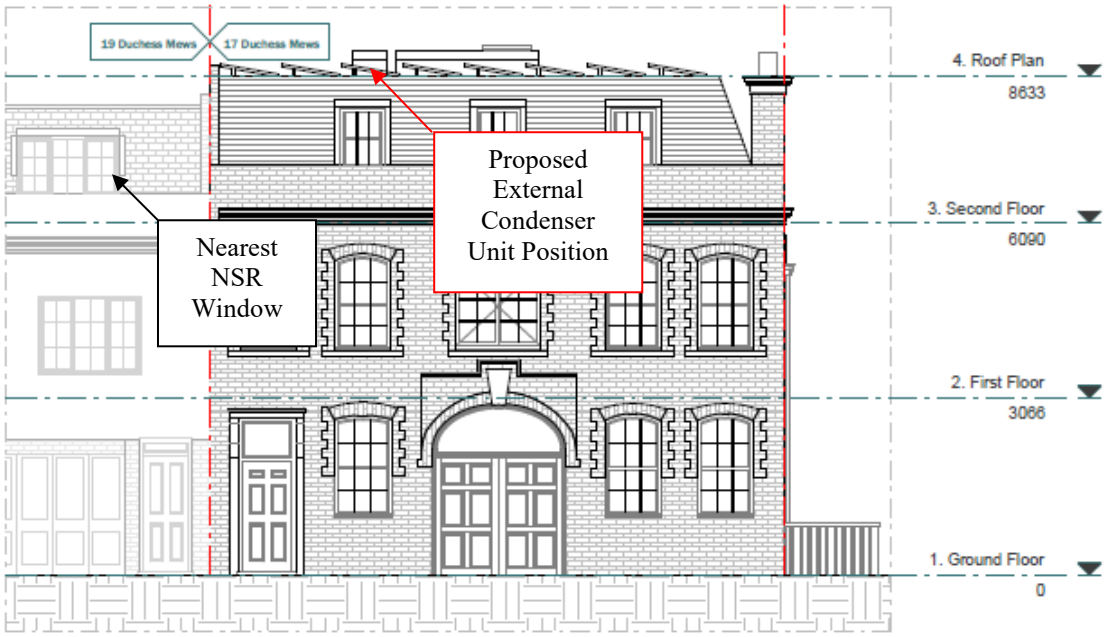


Key:

Background Monitoring Position

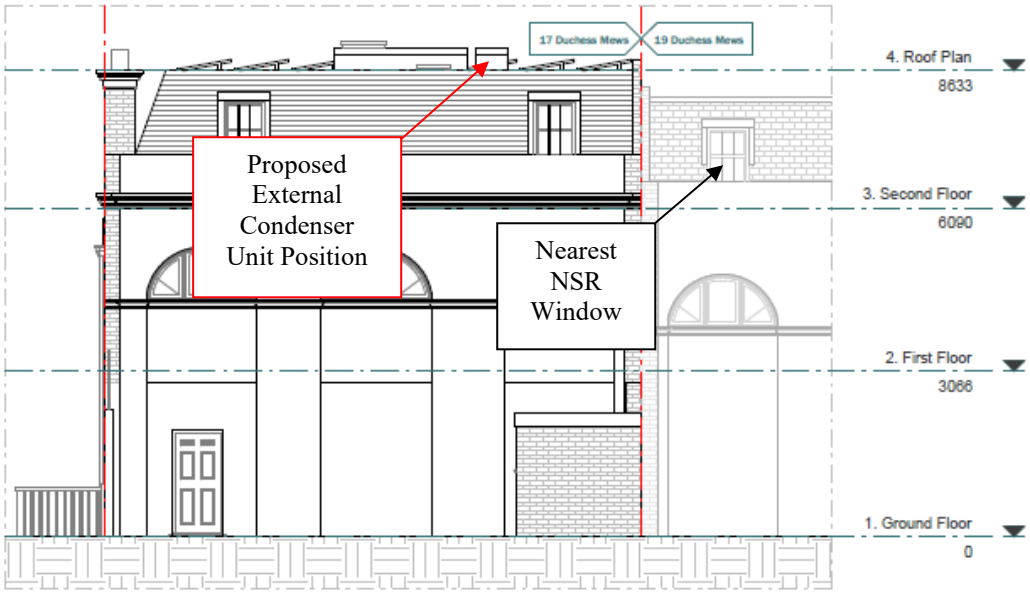
Site Location/Plans

Proposed Front Elevation



Site Location/Plans

Proposed Rear Elevation



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Site Location/Plans

Google Earth Plan

Distance to Residential NSR Window (direct line of sight)

Site Location/Plans

Google Earth Plan

Distance to Commercial Office NSR Window (direct line of sight)

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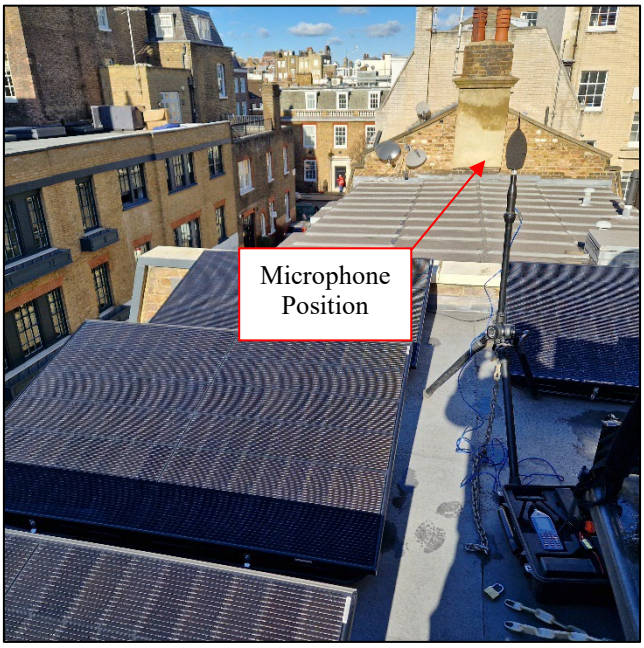
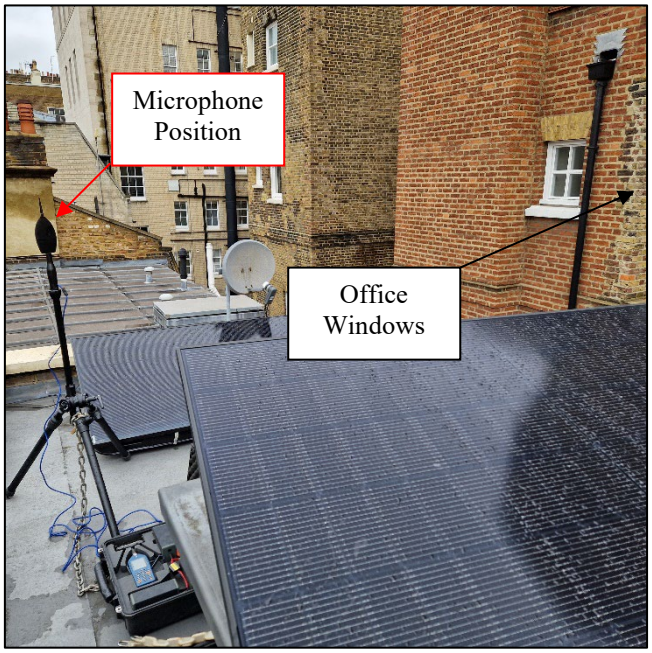
APPENDIX 3

Site Photographs:



Background Measurements - Microphone Position



Background Measurements - Microphone Position

Site Photographs:

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APPENDIX 4

Noise Standard: C46 – Plant and Machinery; noise and hours

C46AB: *Noise from plant & machinery for areas above WHO Guideline levels, where the existing external ambient noise level exceeds WHO Guideline levels of either $L_{Aeq,\ 16hrs}$ 55dB daytime (07.00-23.00 hrs) or $L_{Aeq,\ 8hrs}$ 45dB night-time (23.00-07.00hrs)*

Where noise emitted from the proposed plant and machinery will not contain tones or will not be intermittent, the 'A' weighted sound pressure level from the plant and machinery (including non-emergency auxiliary plant and generators) hereby permitted, when operating at its noisiest, shall not at any time exceed a value of 10dB below the minimum external background noise, at a point 1 metre outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council. The background level should be expressed in terms of the lowest $L_{A90,\ 15\ mins}$ during the proposed hours of operation. The plant-specific noise level should be expressed as $L_{AeqTm,}$ and shall be representative of the plant operating at its maximum.

Where noise emitted from the proposed plant and machinery will contain tones or will be intermittent, the 'A' weighted sound pressure level from the plant and machinery (including non-emergency auxiliary plant and generators) hereby permitted, when operating at its noisiest, shall not at any time exceed a value of 15dB below the minimum external background noise, at a point 1 metre outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council. The background level should be expressed in terms of the lowest $L_{A90,\ 15\ mins}$ during the proposed hours of operation. The plant-specific noise level should be expressed as $L_{AeqTm,}$ and shall be representative of the plant operating at its maximum.

C46BB: *Noise from plant & machinery for areas <u>below</u> WHO Guideline levels, where the existing external ambient noise level <u>does not exceed</u> WHO Guideline levels of either $L_{Aeq,\ 16hrs}$ 55dB daytime (07.00-23.00 hrs) or $L_{Aeq,\ 8hrs}$ 45dB night-time (23.00-07.00hrs)*

Where noise emitted from the proposed plant and machinery will not contain tones or will not be intermittent, the 'A' weighted sound pressure level from the plant and machinery (including non-emergency auxiliary plant and generators) hereby permitted, when operating at its noisiest, shall not at any time exceed a value of 5dB below the minimum external background noise, at a point 1 metre outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council. The background level should be expressed in terms of the lowest $L_{A90,\ 15\ mins}$ during the proposed hours of operation. The plant-specific noise level should be expressed as $L_{AeqTm,}$ and shall be representative of the plant operating at its maximum.

Where noise emitted from the proposed plant and machinery will contain tones or will be intermittent, the 'A' weighted sound pressure level from the plant and machinery (including non-emergency auxiliary plant and generators) hereby permitted, when operating at its noisiest, shall not at any time exceed a value of 10dB below the minimum external background noise, at a point 1 metre outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council. The background level should be expressed in terms of the lowest $L_{A90,\ 15\ mins}$ during the proposed hours of operation. The plant-specific noise level should be expressed as $L_{AeqTm,}$ and shall be representative of the plant operating at its maximum.

Following installation of the plant and equipment, you may apply in writing to the City Council for a fixed maximum noise level to be approved. This is to be done by submitting a further noise report confirming previous details and subsequent measurement data of the installed plant, including a proposed fixed noise level for approval by the City Council. Your submission of a noise report must include: (See 3.1.3).

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APPENDIX 5

Noise Measurements

Table

Date (d/m/y)	Time (hrs:mins)	L_{Aeq} (dB)	L_{AFmax} (dB)	L_{AFmin} (dB)	L_{AF50} (dB)	L_{AF90} (dB)
12/2/24	11:45	54.3	74.3	48.6	53.6	50.9
12/2/24	12:00	55.2	66.4	49.7	54	52
12/2/24	12:15	55.3	73.9	47.8	54.1	51.5
12/2/24	12:30	54.5	72.8	49	53.5	51.1
12/2/24	12:45	56.1	71	49	54.3	51.6
12/2/24	13:00	54.3	65.8	48.1	53.3	51.1
12/2/24	13:15	54.8	73.7	47.2	53.4	50.6
12/2/24	13:30	54.8	72.3	47.8	53.3	50.9
12/2/24	13:45	54.7	66.7	47.8	53.7	50.7
12/2/24	14:00	54.9	74	47.9	53.1	50.3
12/2/24	14:15	55.2	71.6	48.3	53.7	51.3
12/2/24	14:30	54.5	69.8	48	53.1	50.7
12/2/24	14:45	54.3	65.6	48.2	53.3	50.5
12/2/24	15:00	54	62.7	48.5	53.5	51
12/2/24	15:15	57.5	76.6	48.3	53.8	50.8
12/2/24	15:30	54.8	66.6	48.3	54	51.2
12/2/24	15:45	55.6	73.5	47.8	53.2	50.3
12/2/24	16:00	54.1	62.9	46.6	53.4	50.6
12/2/24	16:15	54.8	66	47.3	53.3	50.6
12/2/24	16:30	54.5	66.6	47.4	53.5	50.4
12/2/24	16:45	54.4	71	47.2	53.3	50.3
12/2/24	17:00	54.7	74.9	49.3	53.6	51.1
12/2/24	17:15	54.9	67.7	48.5	54	51.5
12/2/24	17:30	55.8	68.4	48.3	54	51.4
12/2/24	17:45	54.6	64.2	49.3	53.6	51.1
12/2/24	18:00	54.2	62.9	48.1	53.3	50.7
12/2/24	18:15	55.5	69.8	48.6	53.7	51.2
12/2/24	18:30	56	75.6	48.4	53.8	51.1
12/2/24	18:45	54.4	66.6	47.9	53	50
12/2/24	19:00	54.2	63.3	48	53	50.5
12/2/24	19:15	58.4	80.5	48.1	54.1	50.7
12/2/24	19:30	54.2	66.8	47.8	52.9	50.1
12/2/24	19:45	56.5	79.4	47.3	52.7	50.2
12/2/24	20:00	53.4	68.1	46.9	52.1	49.2
12/2/24	20:15	53.6	68.2	47.4	52	49.7
12/2/24	20:30	53.9	65.2	47.5	52.3	50
12/2/24	20:45	53.3	65.2	47.7	52	49.5
12/2/24	21:00	53.1	63.6	45.1	51.9	48.2
12/2/24	21:15	53	69.2	44.8	51.5	47.6
12/2/24	21:30	52.9	70.7	44.9	51.3	47.8
12/2/24	21:45	53.3	66.2	44.6	51.6	48
12/2/24	22:00	52.4	60.6	45.5	51.5	48.2

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12/2/24	22:15	52.4	64	44.6	51.3	48
12/2/24	22:30	52	66.3	44.9	50.9	47.3
12/2/24	22:45	52.1	59.6	45	50.9	47.7
12/2/24	23:00	52.9	70.9	44.3	51.2	47.3
12/2/24	23:15	51.6	66.6	44.5	50.5	46.7
12/2/24	23:30	51.2	62.1	43.8	49.8	46
12/2/24	23:45	51.2	66.3	42.9	49.5	45.5
13/2/24	00:00	51.9	63	44.8	50.6	47.6
13/2/24	00:15	50.8	64.3	42.7	49.2	45.5
13/2/24	00:30	49.5	59	42.9	47.7	44.2
13/2/24	00:45	53.2	73	42.6	47.9	44.5
13/2/24	01:00	51.6	75	42.2	48	44
13/2/24	01:15	50	69.5	42.3	46.7	43.7
13/2/24	01:30	49.5	60.2	42.1	47.7	43.7
13/2/24	01:45	48.7	63.7	42.3	46.3	43.5
13/2/24	02:00	49	60.5	42.2	47.6	43.9
13/2/24	02:15	48.3	58.6	42.2	46.2	43.1
13/2/24	02:30	49.8	65.7	42.3	46.2	43.3
13/2/24	02:45	48.8	61.7	42	45.6	42.9
13/2/24	03:00	57.1	83.3	42	46.8	43.1
13/2/24	03:15	48.1	58.7	42.1	45.5	43
13/2/24	03:30	47.7	57.6	41.4	45.8	42.8
13/2/24	03:45	49.2	64.4	41.9	46.2	43.2
13/2/24	04:00	49.7	64.2	41.8	47.4	43.1
13/2/24	04:15	48.2	58.5	41.8	45.9	42.9
13/2/24	04:30	49	64.1	41.8	46.7	43.2
13/2/24	04:45	48.8	62.3	42.4	46.6	44.2
13/2/24	05:00	49.7	62.6	42.9	47.8	44.5
13/2/24	05:15	49.5	59.9	42.7	47.7	44.7
13/2/24	05:30	50.5	62.9	43	48.6	45.4
13/2/24	05:45	51.7	61.9	43.1	50.1	46
13/2/24	06:00	52.4	66.5	44.3	50.9	47.8
13/2/24	06:15	52.8	63.3	47.6	51.6	49.3
13/2/24	06:30	54.1	69.8	47.7	52.9	49.7
13/2/24	06:45	53.9	63.5	47.7	52.6	49.8
13/2/24	07:00	55.8	77	48.1	53.6	50.3
13/2/24	07:15	57	72.1	48.5	54.1	51
13/2/24	07:30	55	67.5	48.5	53.9	50.8
13/2/24	07:45	56	71	49	55	52.5
13/2/24	08:00	55.3	66.7	48.9	54.3	51.2
13/2/24	08:15	55.4	68.3	49.7	54.4	52
13/2/24	08:30	55.3	65.9	49.8	54.2	51.9
13/2/24	08:45	55.7	76.7	49.4	54.6	51.8
13/2/24	09:00	56.4	77.1	50	55.1	52.7
13/2/24	09:15	56.4	65.8	49.4	55.4	52.8
13/2/24	09:30	55.5	65	49.5	54.7	52.2
13/2/24	09:45	56.4	64.7	50.7	55.5	53.1
13/2/24	10:00	55.9	71.2	50.6	54.9	53
13/2/24	10:15	56.4	69.5	50.8	55.7	52.8
13/2/24	10:30	56.9	73.8	49.5	55.6	52.6
13/2/24	10:45	56.7	65.7	50.5	55.8	53.2
13/2/24	11:00	57.4	75.5	51.1	56.5	54
13/2/24	11:15	56.3	65.9	49.6	55.5	53.2
13/2/24	11:30	56.1	70.6	50.6	55	52.9

13/2/24	11:45	59.6	79.6	50.8	56.1	53.3
13/2/24	12:00	59.8	76.2	51	56.9	53.9
13/2/24	12:15	61.6	75.5	51.7	56.6	54.1
13/2/24	12:30	57.1	65.2	51.2	56.7	53.4
13/2/24	12:45	57.9	76.1	51.3	56.4	53.6
13/2/24	13:00	57.2	68.1	50.6	56.3	53.5
13/2/24	13:15	61.9	80.3	51	56.4	53.8
13/2/24	13:30	56.5	74.5	50.2	55.4	52.5
13/2/24	13:45	55.7	66.1	50.6	55.2	53.1
13/2/24	14:00	56.3	70.1	50.9	55.2	52.8
13/2/24	14:15	56.6	67.4	50.3	55.5	53
13/2/24	14:30	56.1	67.9	50.7	55.3	52.9
13/2/24	14:45	56.5	72.7	51.3	55.7	53.6
13/2/24	15:00	57.1	72.3	51.5	55.6	53.4
13/2/24	15:15	56.2	70.4	49.8	55.3	53
13/2/24	15:30	56.1	71.9	50.6	55.1	52.7
13/2/24	15:45	55.9	62.3	50.1	55.3	53
13/2/24	16:00	56.1	66.6	50	55.3	52.9
13/2/24	16:15	56.2	67.6	49	55.4	52.4
13/2/24	16:30	55.9	69	49.1	54.9	52.2
13/2/24	16:45	55.4	65.8	49.2	54.6	51.8
13/2/24	17:00	55.5	65.6	49.4	54.8	52.3
13/2/24	17:15	55	65.1	49.8	53.9	51.7
13/2/24	17:30	55.6	65.9	48.1	54.9	51.7
13/2/24	17:45	55.4	73.8	48.5	53.8	51.3
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13/2/24	21:15	54.4	69.8	45.6	52.4	48.5
13/2/24	21:30	53.1	64.8	45.2	51.8	48.5
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13/2/24	23:00	52.4	61.3	44.7	51.3	47.1
13/2/24	23:15	52.7	65.9	44.2	51.3	47.3
13/2/24	23:30	55.1	76.2	43.9	51.4	46.2
13/2/24	23:45	52.6	69.6	44.2	50.4	46.7
14/2/24	00:00	51.6	62.3	44.3	50	45.8
14/2/24	00:15	52	66.2	43.9	49.6	46.1
14/2/24	00:30	52.1	66.5	43.7	50.2	45.8
14/2/24	00:45	50.5	60.4	43.4	48.8	44.9
14/2/24	01:00	51.7	65.2	43.2	50.1	45.7

14/2/24	01:15	50.5	61.3	43.2	48.6	45
14/2/24	01:30	50.3	64.6	43	47.7	44.4
14/2/24	01:45	50.7	73.3	42.8	47.4	44.1
14/2/24	02:00	50.4	61.5	43.1	48.5	44.7
14/2/24	02:15	49.7	60.7	42.7	47.1	44.2
14/2/24	02:30	50	60.9	42.7	47.8	44.1
14/2/24	02:45	51.3	67.3	42.7	47.8	44.3
14/2/24	03:00	48.5	59.5	42.5	45.9	43.8
14/2/24	03:15	48.9	62.8	42.5	46.3	43.7
14/2/24	03:30	48.9	60.8	42.4	46.2	43.8
14/2/24	03:45	49.2	63.2	42.8	47	43.9
14/2/24	04:00	48.7	58.8	42.7	46.3	43.8
14/2/24	04:15	49.2	62.4	43.3	47	44.3
14/2/24	04:30	48.8	61.1	43.2	47	44.5
14/2/24	04:45	48.8	63.3	43.5	46.5	44.5
14/2/24	05:00	49.8	63.4	43.3	47.6	44.7
14/2/24	05:15	50.6	60.9	43.8	49.1	45.5
14/2/24	05:30	51.4	61.2	44	49.2	45.6
14/2/24	05:45	52.7	66.3	44.9	50.9	47.7
14/2/24	06:00	51.7	63.5	44.8	50.1	47.8
14/2/24	06:15	53.6	65.5	47	52.6	49
14/2/24	06:30	53.7	65.7	47.3	51.8	48.9
14/2/24	06:45	54.6	71.2	47.5	53.2	49.7
14/2/24	07:00	55.2	66.4	47.4	53.7	50.3
14/2/24	07:15	55.7	64.6	47.6	54.8	50.6
14/2/24	07:30	55.7	63.9	48.4	55	52.1
14/2/24	07:45	56.5	66.8	48.5	56	52.1
14/2/24	08:00	55.8	69.2	48.4	55.1	51.4
14/2/24	08:15	56.4	68.9	48.5	55.1	51.9
14/2/24	08:30	58.9	81.3	50.8	55.7	53.2
14/2/24	08:45	57	74.4	49.3	56.1	53.5
14/2/24	09:00	58.5	77.1	49.4	55.8	52.3
14/2/24	09:15	57	68.7	49.9	55.4	52.6
14/2/24	09:30	56.4	76.5	50.2	55.3	52.7
14/2/24	09:45	55.3	63.5	49.6	54.7	52.2
14/2/24	10:00	56.5	67.2	50.5	55.6	53.2
14/2/24	10:15	58.3	72.1	50.4	57	53.8
14/2/24	10:30	59.1	77.2	49.4	55.6	53
14/2/24	10:45	56.3	65	50.3	55.5	52.8
14/2/24	11:00	56.4	66.2	50.6	55.6	53.1
14/2/24	11:15	55.8	63.7	49.8	54.9	52.7
14/2/24	11:30	55.5	65.4	48.8	54.5	52.1
14/2/24	11:45	56.3	68.7	49.2	54.8	52.4
14/2/24	12:00	56	69.4	50	55.2	52.6
14/2/24	12:15	58.2	80.9	50.8	56.1	53.3

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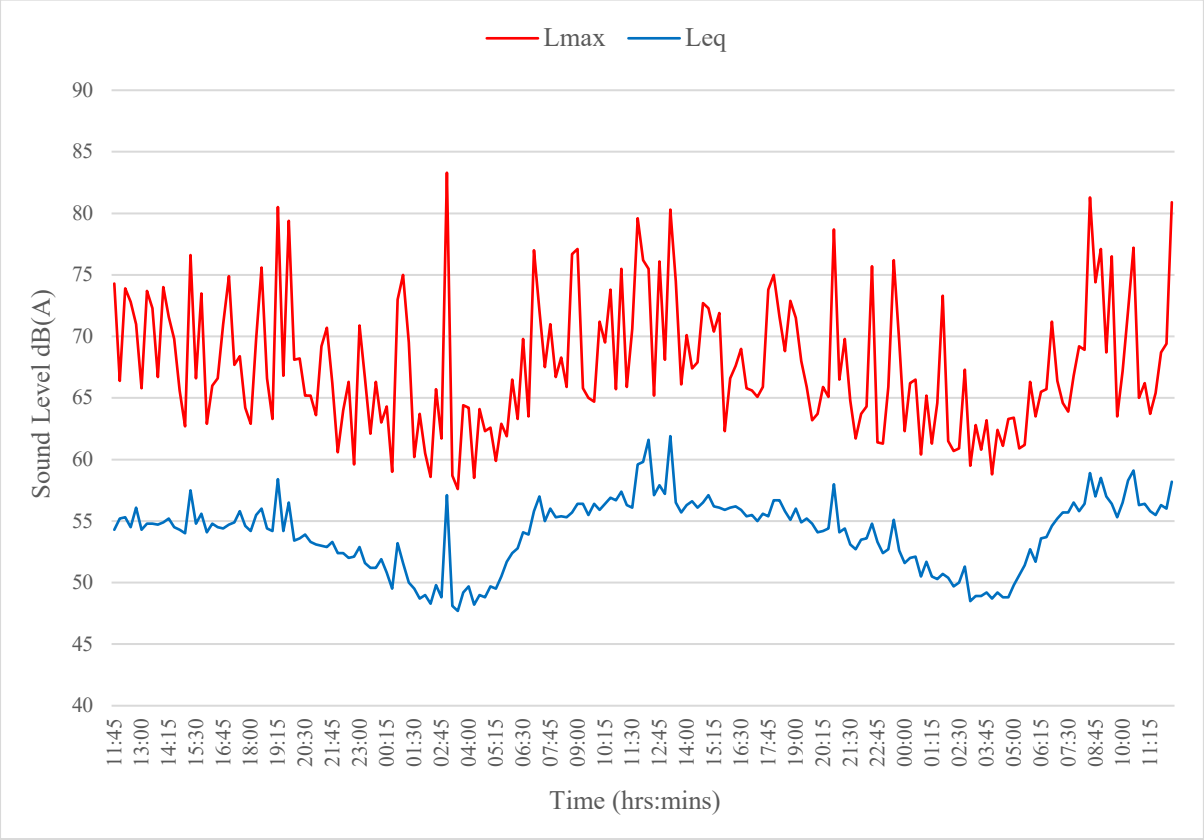
Noise Measurements

Graph



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APPENDIX 6

Equipment - Sound Levels

Daikin 5MXM90A2V1B9[9]

DAIKIN • Outdoor Unit • 5MXM-M

1 Features

- Seasonal efficiency values up to A+++
- Seasonal efficiency values up to A+++ in cooling and A++ in heating thanks to its up-to-date technology and built-in intelligence
- Up to 5 indoor units can be connected to 1 multi outdoor unit; all indoor units are individually controllable and do not need to be installed in the same room or at the same time. They operate simultaneously within the same heating or cooling mode.
- Choosing for an R-32 product, reduces the environmental impact with 68% compared to R-410A and leads directly to lower energy consumption thanks to its high energy efficiency
- Different types of indoor units can be connected: e.g. wall mounted, ceiling mounted cassette corner, concealed ceiling unit
- Outdoor units are fitted with a swing compressor, renowned for its low noise and high energy efficiency

1

[9] Source: Daikin Technical Data Sheet.

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Equipment - Sound Levels

Daikin 5MXM90A2V1B9[10]

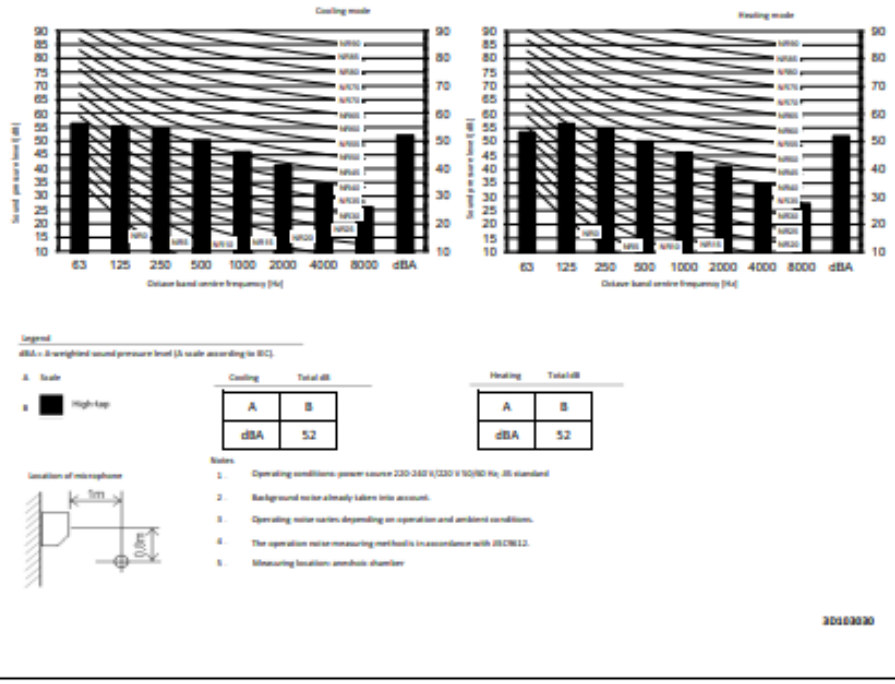
DAIKIN • Outdoor Unit • 5MXM-M

10 Sound data

10 - 1 Sound Pressure Spectrum

10

5MXM-M



[10] Source: Daikin Technical Data Sheet.

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APPENDIX 8

Vibration Isolation

CMS – Kinetics Model AC[11]

KINETICS™
Fiberglass
Isolators
Model AC

Description

Model AC Fiberglass Isolators consist of a molded inorganic fiberglass isolation pad bonded to a steel load transfer plate and to a formed steel bolt-down bracket and include an equipment anchor bolt with a neoprene grommet to prevent metal-to-metal contact. Fiberglass pads are fine (0.00027"/6.8 microns diameter) bonded annealed glass fibers which are stabilized by pre-compressing the material during manufacture and then coated with a flexible moisture-impervious elastomeric membrane. Fiberglass is unique in that the natural frequency is constant over a wide operating load range and the stiffness increases proportionately with load applied. Model AC Fiberglass Isolators are available in sizes with capacities from 40 to 900 lbs. (18 kg-409 kg) and deflections of 0.18" to 0.70" (4mm-18mm). Kinetics Model AC Isolators are recommended for the isolation of vibration produced by utility ventilating fans, vane axial fans, high speed motors, roof-mounted exhaust fans, and similar mechanical equipment.

Features

- Inorganic fiberglass media
- Flexible elastomeric coating
- Constant natural frequency over a wide load range
- Predictable dynamic response
- High energy dissipation
- Controlled viscous damping
- Load capacities 40 lbs. to 900 lbs. (18kg-409kg)
- Rated static deflection 0.18" to 0.70" (4mm-18mm)
- Steel load transfer plate
- Steel bolt and hold-down support bracket

Application

Kinetics Model AC Fiberglass Isolators can be used for any application requiring isolation of audible frequency vibration, or noise, or for vibration isolation of mechanical equipment with lowest operating speeds of 1750 RPM when mounted on a grade-supported slab or pier.

Model AC isolators are typically used when the predictable dynamic response and permanent load support characteristics of fiberglass are desired in conjunction with a bolt-down and vertical lift control feature.

Typical uses of Model AC isolators include the support and isolation of utility ventilating fans, vane axial fans, motors, roof-mounted exhaust fans, and similar mechanical equipment.

Special application of Model AC isolators have included use as both an isolator and wind lift hold-down support for isolated precast concrete roof systems used to reduce transmitted noise from fly-over aircraft.

Use Model AC mounts when Kinetics fiberglass isolators are recommended and it is desirable to bolt equipment to supporting structures.

[11] Supplied by CMS Acoustics (UK).

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Vibration Isolation

CMS – Kinetics Model AC

Specifications

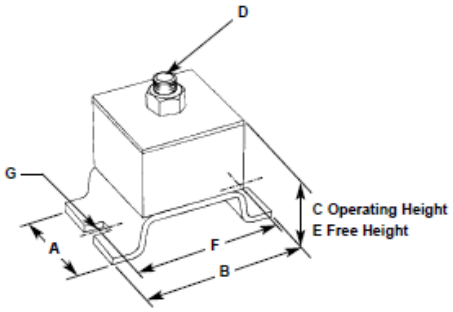
Vibration isolators shall be precompressed molded fiberglass pads individually coated with flexible, moisture-impervious elastomeric membrane. Vibration isolation pads shall be molded from glass fibers with fiber diameters not exceeding 0.00027" (6.8 microns) and with a modulus of elasticity of 10.5 million PSI (750,00 kg per sq. cm).

Natural frequency of fiberglass vibration isolators shall be essentially constant for the operating load range of the supported equipment.

Vibration isolators shall be bonded to a steel load transfer plate and a formed steel bolt-down bracket and shall also include an equipment mounting bolt with a neoprene grommet to prevent metal-to-metal contact.

Vibration isolators shall be selected by the manufacturer for each specific application to comply with deflection requirements as shown on the Vibration Isolation Schedule or as indicated on the project documents.

Vibration isolators shall be model AC, as manufactured by Kinetics Noise Control, Inc.



Isolator Type	Capacity Range	Maximum Deflection	Dimensions A	B	C*	D	E	F	G
AC-221L	40-200 lbs.	0.27"	2.50"	4.75"	1.98"	0.38"	2.25"	3.75"	0.44"
AC-221Q	100-400 lbs.	0.18"	2.50"	4.75"	2.07"	0.38"	2.25"	3.75"	0.44"
AC-331L	90-450 lbs.	0.35"	3.00"	4.75"	1.90"	0.38"	2.25"	3.75"	0.44"
AC-331Q	225-900 lbs.	0.27"	3.00"	4.75"	1.98"	0.38"	2.25"	3.75"	0.44"
AC-222G	20-100 lbs.	0.69"	2.50"	4.75"	2.56"	0.38"	3.25"	3.75"	0.44"
AC-222L	40-200 lbs.	0.54"	2.50"	4.75"	2.71"	0.38"	3.25"	3.75"	0.44"
AC-222Q	100-400 lbs.	0.36"	2.50"	4.75"	2.89"	0.38"	3.25"	3.75"	0.44"
AC-332-L	90-450 lbs.	0.70"	3.00"	4.75"	2.55"	0.38"	3.25"	3.75"	0.44"
AC-332Q	225-900 lbs.	0.54"	3.00"	4.75"	2.71"	0.38"	3.25"	3.75"	0.44"
AC-221L	18-91 kg	6 mm	63 mm	121 mm	50 mm	9.6 mm	57 mm	95 mm	11 mm
AC-221Q	46-182 kg	4 mm	63 mm	121 mm	52 mm	9.6 mm	57 mm	95 mm	11 mm
AC-331L	41-205 kg	9 mm	75 mm	121 mm	48 mm	9.6 mm	57 mm	95 mm	11 mm
AC-331Q	102-409 kg	6 mm	75 mm	121 mm	50 mm	9.6 mm	57 mm	95 mm	11 mm
AC-222G	9-46 kg	17 mm	63 mm	121 mm	65 mm	9.6 mm	83 mm	95 mm	11 mm
AC-222L	18-91 kg	14 mm	63 mm	121 mm	69 mm	9.6 mm	83 mm	95 mm	11 mm
AC-222Q	46-182 kg	9 mm	63 mm	121 mm	73 mm	9.6 mm	83 mm	95 mm	11 mm
AC-332-L	41-205 kg	18 mm	75 mm	121 mm	65 mm	9.6 mm	83 mm	95 mm	11 mm
AC-332Q	102-409 kg	14 mm	75 mm	121 mm	69 mm	9.6 mm	83 mm	95 mm	11 mm

*Operating height varies with applied load.

KINETICS Noise Control

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Fax: 614-889-0540

Canada
1720 Meyerside Drive
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L5T 1A3
Phone: 905-670-4922
Fax: 905-670-1698

www.kineticsnoise.com
sales@kineticsnoise.com

AC 2/04

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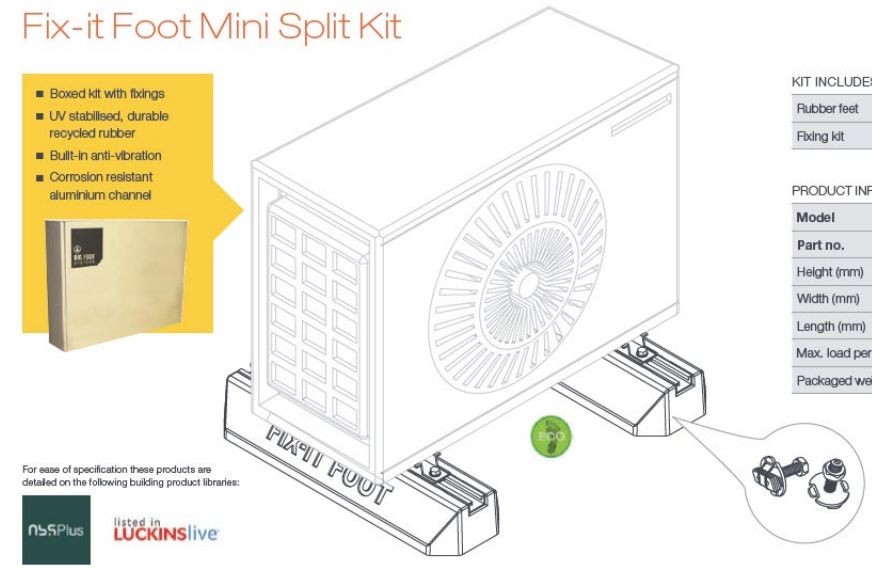
Vibration Isolation

Big Foot Systems[12]

Mini Split Kit



KIT INCLUDES	
Rubber feet	x 2
Fixing kit	x 2

FOOT FLEECES
Recommended for use on PVC membrane roof surfaces to prevent polymer migration

PRODUCT INFORMATION

Model	600mm	1000mm
Part no.	B9284	B9530
Height (mm)	95	95
Width (mm)	180	180
Length (mm)	600	1000
Max. load per kit (kg)	448	590
Packaged weight (kg)	11	19

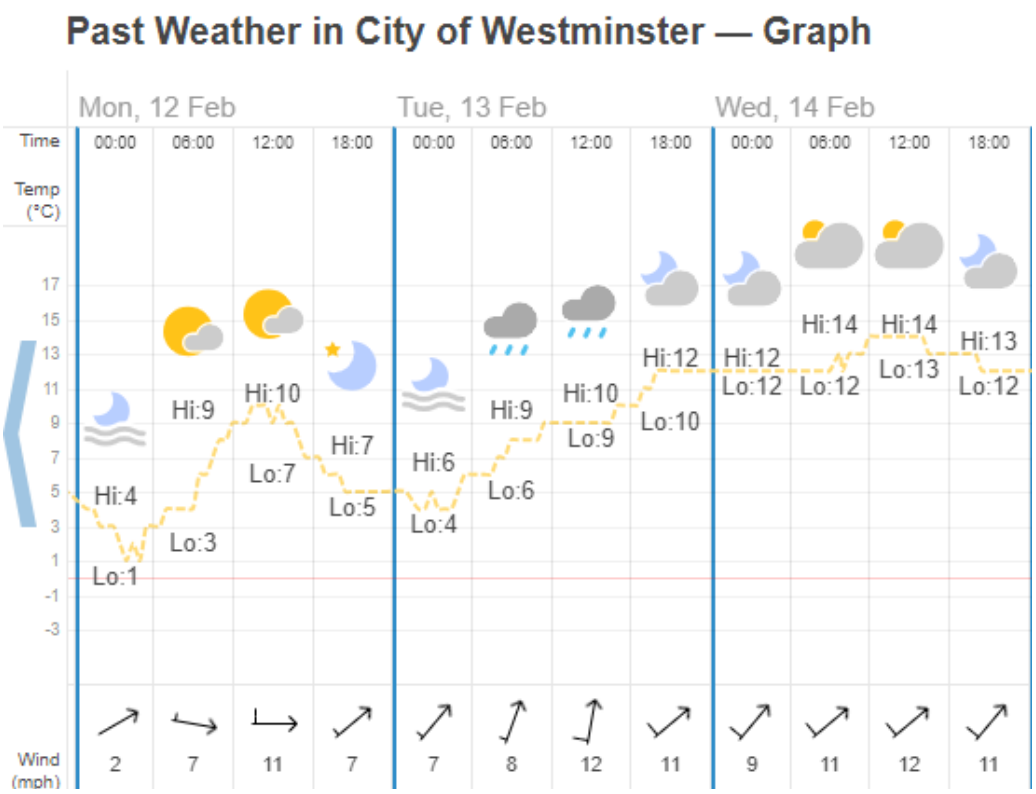



[12] Big Foot Systems – TEL 01323 844355.

soundplanning

APPENDIX 8

Meteorological Conditions[13]



[13] Source: www.wunderground.com