Philip Acoustics Ltd.

Consultants in Noise & Vibration
Building Regulations Certification Sound Insulation Testing

REPORT TITLE: ACOUSTIC REPORT FOR PROPOSED AIR SOURCE HEAT PUMP UNITS AT 38 FROGNAL LANE, HAMPSTEAD, LONDON NW3 6PP

REPORT REF: 23082-002 Revision A

Revision	Issue Date	Commentary
-	April 2023	Initial issue acoustic report
A	March 2024	Revised report to include change of proposed noise reduction treatment / supplier

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DATE: March 2024

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SUMMARY

- This report provides an acoustic (noise & vibration) assessment for two Mitsubishi Ecodan air source heat pump units proposed to be installed to serve a residential property 38 Frognal Lane, Hampstead, London NW3 6PP.

- The assessment is conducted with reference to London Borough of Camden's planning consent acoustic requirements for mechanical services plant / equipment (including items such as ASHP units) as contained in Policy A4: *Noise and Vibration* of Section 6: *Protecting Amenity* of Camden Local Plan (adopted June 2017).

- As part of the assessment a background noise survey has been carried out over a seven-day period including sample weekdays and a full weekend. The survey establishes existing background noise levels during operational times of the proposed ASHP unit, at a position representative of outside nearest neighbouring residential properties.

- Based on results of the background noise survey and noise model calculations using the proposed ASHP units' manufacturer noise data, the overall noise level from the units exceeds (is non-compliant with) London Borough of Camden's planning consent requirement.

- The ASHP units require a minimum of 7dBA noise reduction to comply with London Borough of Camden's planning consent requirement. The noise reduction is proposed to be achieved by use of Noico Ltd acoustic louvres. Details for noise reduction treatment are provided in Section 7.1 of the report.

- The report also considers vibration from the ASHP units. Location of the units is at distance from, and not structurally linked / connected to, any neighbouring properties. Thus, it is extremely unlikely that any vibration from the units would transmit to neighbouring properties. Notwithstanding this, as good practice it is advised the ASHP units are installed mounted on vibration isolators. Specification details for typically suitable vibration isolators are provided in Section 7.2 of the report.

1. INTRODUCTION

Two Mitsubishi Ecodan outdoor air source heat pump (ASHP) units are proposed to be installed to serve a residential property 38 Frognal Lane, Hampstead, London NW3 6PP.

The Local Planning Authority (London Borough of Camden) planning application validation requirements include submission of an acoustic (noise & vibration assessment) report for proposed plant / equipment such as ASHP units and air conditioning units etc. This is for reason to protect the amenity of residents in the vicinity with regard to possible noise and vibration disturbance.

This acoustic report provides a noise and vibration assessment for the proposed ASHP units and includes:

- Qualifications & experience;
- Criteria - London Borough of Camden planning consent acoustic requirements;
- Measurement survey of existing background noise levels;
- Details of the proposed ASHP units, including location & manufacturer noise data;
- Calculation & assessment of noise from the ASHP units;
- Consideration of vibration from the ASHP units;
- Specification for noise reduction treatment and/or vibration isolation as necessary to ensure compliance with London Borough of Camden's planning consent requirements.

2. QUALIFICATIONS & EXPERIENCE

This report is prepared and issued by David Philip. David Philip graduated in 1989 from The University of Salford Department of Applied Acoustics with a BEng Honours degree in Electroacoustics. David Philip has been since 1995, and continues to be, a fully elected Member of the Institute of Acoustics (MIOA).

David Philip has been the owner / managing director of Philip Acoustics since the firm was formed in 2002. Prior to the formation of Philip Acoustics, David Philip held senior acoustic consultant positions at Sound Research Laboratories (London office) and Spectrum Acoustic Consultants.

Philip Acoustics has held full membership of the Association of Noise Consultants (ANC) since 2003 and is also a full member of the ANC Registration Scheme of approved independent organisations to undertake Building Regulations Approved Document Part E pre-completion certification sound insulation testing.

David Philip has over 30 years' experience as an Acoustic Consultant both in the UK and internationally and has considerable experience undertaking noise surveys and noise assessments for a wide range of commercial uses and also residential developments.

This experience includes a substantial quantity of noise and vibration assessments specifically associated with air conditioning units, air source heat pump units and similar plant / equipment items serving commercial / retail premises and also residential properties.

David Philip is fully familiar with London Borough of Camden's planning policy acoustic requirements, provisions of the current (and previous) editions of British Standard BS4142, as well as other acoustics related relevant standards and guidance documents.

The opinions expressed in this report are the true and professional opinions of David Philip. Neither David Philip nor Philip Acoustics is appointed on any incentive fee basis.

3. CRITERIA *(London Borough Of Camden Acoustic Requirements)*

Policy A4: *Noise and Vibration* from Section 6 – *Protecting Amenity* of the Camden Local Plan (adopted June 2017) covers in detail noise issues relating to a wide range of planning and noise pollution scenarios, including of proposed new mechanical services plant / equipment such as ASHP units.

Policy A4: *Noise and Vibration* is reproduced below:

Policy A4 Noise and vibration

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.

"Camden's Noise and Vibration Thresholds" referenced in Policy A4 as applicable for proposed new plant / equipment such as ASHP units are advised in Table C from section *Industrial and Commercial Noise Sources* of Appendix 3 to the Camden Local Plan document as reproduced below:

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}

Supporting notes to Table C and as relevant for the proposed ASHP units include:

- A Rating Level ($L_{Ar,Tr}$ dB) of 10dB below the background noise (15dB if tonal components are present) should be considered the design criterion, the Rating Level established as per the provisions of BS4142:2014;
- The periods in Table C correspond to 7am to 11pm for the day & 11pm to 7am for the night;
- For smaller equipment such as air source heat pumps where achievement of the Rating Level may not afford protection, the Council will generally also require NR35 or below. To be achieved (in terms of $L_{eq,5mins}$ dB octave band levels) 1m externally from the façade of premises located in a quiet background area.

Full title of the current edition of the referenced British Standard is BS4142:2014+A1:2019 "*Methods for rating and assessing industrial and commercial sound*". Reference throughout this report to BS4142:2014 relates to this current edition document.

Note that as an aid to clarity and to be consistent with wording / guidance of *"Camden's Noise and Vibration Thresholds"* referenced in Policy A4, this report retains use of the more familiar term "noise" throughout as opposed to the replacement term "sound" of BS4142:2014.

It is the author's experience of undertaking many surveys and assessments of noise from air source heat pumps and similar equipment in similar scenarios and contexts to that as at 38 Frognal Lane, that compliance with London Borough of Camden's policy requirements, and as the clarification points below, would mean noise from the proposed ASHP units is not generally audible / disturbing or otherwise of impact to persons inside or outside neighbouring residential dwellings.

Additional clarification points relevant to the assessment and noise criterion are provided below:

a) ASHP Units Operating Condition

The noise criterion is cautiously/robustly applied for the 2 x ASHP units operating simultaneously (cumulatively) at full (100%) duty, potentially over a full 24-hour period, i.e. including during the middle of the night.

In practice it is expected the units would operate at a reduced capacity (and thus with reduced noise output over full duty) for much of the time including during the late evening and night period.

b) Rating Noise Level

The noise criterion is applied in terms of a noise Rating Level $L_{Ar,Tr}$ dB and thus with any correction for tonal characteristics noise applied as necessary to the ASHP units' noise at the assessment position as per the BS4142:2014 assessment methodology.

c) Assessment Position

The noise criterion is applicable to outside nearest residential windows (to living areas and/or bedrooms) and also to within residential gardens used as main amenity (external amenity space). As normal convention and practice the assessment position is with reference to nearest non-associated residential properties (i.e. not the application property itself 38 Frognal Lane).

Gardens (external amenity space) of neighbouring properties are at comparable distant from the proposed ASHP units' location as compared with nearest residential buildings. Compliance with the noise criterion to outside nearest residential buildings will by default also ensure compliance to within gardens. Therefore, an assessment position to outside windows of neighbouring residential properties is used.

d) Background Noise Level

The noise criterion is applied as "worse case", cautiously/robustly based on the representative measured minimum (lower) background noise level $L_{A90,T}$ dB *(T = 15 mins),* representative of at the assessment position over 24 hours (i.e. including during the night), based on results of a seven-day noise survey including sample weekdays and a full weekend (see Section 4 of the report).

e) Very Low Background Noise Levels

In accordance with the guidance and assessment provisions of BS4142, then for scenarios of very low background noise it is generally unreasonable / unnecessary to apply a Rating Level noise limit / criterion directly relative to the background level, in terms of ensuring amenity protection such that noise from plant (including such as ASHP units) does not cause disturbance or is otherwise of adverse / detrimental impact.

This simply due to that there is a lower threshold level at which plant noise would become inaudible / not noticeable to occupiers of neighbouring properties and thus it being unreasonable and unnecessary to further reduce the plant noise below that level.

BS4142:2014 advises "*Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night*."

Where background levels are very low it is instead appropriate to apply a minimum (lower level) threshold cap plant Rating Level limit of $L_{Ar,Tr}$ 30dB at assessment positions. Previous edition of the standard BS4142:1997 advises that noise Rating Levels of below 35dB be considered very low.

Thus a minimum threshold cap plant noise limit (Rating Level) set at $L_{Ar,Tr}$ 30dB is significantly below (i.e. as 5dB betterment) to this guidance and for scenarios of very low background noise levels (i.e. regardless of the low background noise) will maintain surety of protection for from loss of amenity due to noise disturbance.

Notwithstanding the above, it is sometimes appropriate to apply a lower plant noise limit (i.e. below the threshold cap) in consideration to avoid "background noise creep". This potentially occurs in scenarios where multiple plant items serving the same or different directly adjacent premises (multiple ASHP units and/or air conditioning units etc) are in turn installed in very close / immediate proximity to one another and as then cumulatively contributing a higher overall noise level to the same receptor (noise sensitive properties). This scenario does not occur for the proposed ASHP units at 38 Frognal Lane.

Table A from section *Vibration* of Appendix 3 to the Camden Local Plan document provides vibration level thresholds. The thresholds are applicable for a wide range of vibration sources such as railways, roads, leisure & entertainment premises as well as plant/machinery (so including such as air source heat pumps), as affecting (i.e. occurring inside) various types of property including residential dwellings.

The vibration level thresholds are in terms of Vibration Dose Values (VDVs) and for dwellings with separate level thresholds applicable for the day and night period.

Proposed location for the ASHP units is at distance from, and not directly attached to (structurally linked to) any neighbouring residential properties. Camden's vibration level thresholds will be complied with by default.

Notwithstanding this, and as detailed in Section 6 plus Section 7.2 of the report, it is advised as good practice the ASHP units are installed mounted on conventional proprietary vibration isolators.

4. BACKGROUND NOISE SURVEY

To assess noise from the proposed ASHP units against London Borough Of Camden's planning consent noise requirement it is necessary to establish existing background noise levels representative of at neighbouring residential properties. Details of the background noise survey are provided in Sections 4.1 to 4.3.

4.1 Survey Instrumentation

Details of the instrumentation used for the background noise survey are provided in Appendix A. The sound level meter was calibration verified before and after the survey.

4.2 Survey Details & Procedure

Although the ASHP units would tend to operate principally during the daytime and evening periods, as they are to serve a residential property then they will potentially operate at any time over 24 hours. Therefore, the survey was conducted over at least a full 24-hour period to obtain background noise levels during the entire range of possible times of operation.

The survey was over a seven-day period from Thursday 31 August 2023 through Wednesday 06 September 2023 to include sample weekdays and also a full weekend.

Weather conditions were monitored and were suitable; dry (nil precipitation) with light / calm wind through the survey period.

Measurements of background noise were recorded continually in terms of consecutive 15-minute samples of overall equivalent free-field $L_{A90,T}$ dB values (T= 15 minutes) for the entire survey duration.

Proposed location of the ASHP units, nearest neighbouring properties and background noise survey measurement position are indicated on an aerial image, location plan and proposed site plan drawing in Appendix B.

Nearest neighbouring properties are residential dwellings:

- 40 Frognal Lane: Adjacent east of the site, comprising a main building set well back from Frognal Lane and a recently built smaller annex building directly adjacent to Frognal Lane. The smaller annex building is the physically nearest neighbouring property building to proposed location of the ASHP units;
- 12 Langland Gardens: Adjacent west of the site.

Other neighbouring properties including in either direction on Frognal Lane and to the opposite side of Frognal lane are more distant from proposed location of the ASHP units than the above properties.

The background noise survey position was selected as closest to, and directly representative for, outside nearest neighbouring properties, externally in free-field conditions at equivalent first floor windows elevation (height) facilitated by positioning the instrumentation microphone on a telescopic boom and extension cable arrangement from currently erected scaffolding at the property.

4.3 Survey Results, Observations & ASHP Units' Noise Limit

Full raw data results of the seven-day background noise survey are provided in Appendix C.

Background noise levels are low / very low, albeit normal for this location and predominantly due to underlying noise from road traffic generally in the wider area.

Background noise fluctuates during the day, then gradually reduces during the evening and into the night (lowest between circa 1am to 4am), before then increasing again in the morning as traffic increases. This diurnal noise profile is normal for this location with underlying noise from traffic in the wider area.

Summary of the representative minimum (lower) $L_{A90,T}$ background noise level and associated ASHP units' noise limit based on Camden's noise requirement (detailed in Section 3 of the report) is shown in Table 1.

ASHP Units Operating Condition	**Assessment Position & Relevant Times**	**Representative Minimum Background Noise Level** $L_{A90,15min}$	**ASHP Units' Noise Limit** ***(Rating Level)***
Both ASHP units operating full (100%) duty potentially over a 24-hour period	Outside nearest neighbouring properties *Assessment over 24 hour period*	34dB *(occurs during the night period circa 1am to 4am)*	$L_{Ar,Tr}$ ≤24dBA *(10dB below background)* $L_{Ar,Tr}$ ≤19dBA *(15dB below background, applicable if unit noise has tonal components)* ***$L_{Ar,Tr}$ ≤30dB (minimum threshold cap 30dBA applicable)***

Table 1: Measured representative minimum background noise & associated ASHP units' noise limit

5. NOISE FROM AIR SOURCE HEAT PUMP UNITS

***Informative (1)*: Proposed Air Source Heat Pump Units**

This report is based on the proposed Mitsubishi Ecodan ASHP units as detailed below.

If an alternative make and/or model of unit is selected, including as part of future possible units' replacement, it is important that noise levels for the alternative unit be checked by Philip Acoustics or another Acoustic Consultant to ensure noise emissions of the alternative unit remains compliant with the noise limit subject to noise reduction treatment as detailed in Section 7.1 of the report.

The proposed ASHP units are 2 x Mitsubishi Ecodan model CAHV-P500YA-HPB.

Manufacturer's noise data for the ASHP units is provided in Appendix D. The noise data is for the unit operating at full (100%) duty in terms of free-field overall dBA and linear octave band dB sound pressure levels at 1m distance from the unit.

For purpose of the noise assessment, it is cautiously / robustly taken as "worse case" the ASHP units are operating cumulatively at full (100%) duty, i.e. with no allowance the units may likely operate at reduced duty / capacity (with consequent lower noise output), for much of the time including during the late evening and night period.

Summary of noise output from the ASHP units (per unit) including octave band values is shown in Table 2.

Description	Overall dBA	Octave Band Centre Frequency (Hz) (Linear dB)							
		63	125	250	500	1k	2k	4k	8k
Mitsubishi Ecodan model CAHV-P500YA-HPB *Unit operating full 100% duty*	59	70	65	60	57	52	46	48	45

Table 2: ASHP unit noise data (per unit); free-field sound pressure levels at 1m

Manufacturer noise data indicates the Mitsubishi Ecodan model CAHV-P500YA-HPB unit generates a broadband type noise without strong, identifiable or clearly perceptible tonal elements. This correlates with experience of the author in measuring noise levels from installed same and similar model ASHP units used in domestic settings.

To calculate the noise contribution from the ASHP units to outside nearest neighbouring residential properties (assessment position) a spreadsheet noise calculation model has been used.

The model takes account of the distance between the units and assessment position, acoustic directivity, acoustic reflections (i.e. non free-field conditions) and natural / default line of sight acoustic screening (i.e. fences and intervening structures / buildings etc).

Noise assessment position and noise model calculation details are provided in Appendix E.

The overall calculated noise Rating Level from the proposed ASHP units to outside nearest neighbouring properties compared with the noise limit is shown in Table 3.

Noise from the ASHP units to outside other neighbouring properties in the vicinity that are more distant from proposed location of the units will be lower.

ASHP Units Operating Condition	**Assessment Position**	**ASHP Units Overall Noise Level** *(Rating Level)*	**Noise Limit** ***(Rating Level)***	**Comment**
Both ASHP units operating full (100%) duty potentially over a 24-hour period	**A)** Neighbouring property 40 Frognal Lane *(annex building)*	$L_{Ar,Tr}$ 37dB	$L_{Ar,Tr}$ ≤ 30dB	Noise from proposed ASHP units to the assessment position (nearest neighbouring properties) exceeds criterion limit by up to 7dBA; noise reduction treatment required.
	B) Neighbouring property 40 Frognal Lane *(main building)*	$L_{Ar,Tr}$ 32dB		
	C) Neighbouring property 12 Langland Gardens	$L_{Ar,Tr}$ 36dB		

Table 3: Assessment of noise from ASHP units to nearest neighbouring properties

The assessment as Table 3 shows noise from the ASHP units exceeds the noise limit criterion set with reference to London Borough of Camden's policy requirements.

The proposed ASHP units require up to 7dBA noise reduction to comply. Details for the proposed noise reduction treatment are provided in Section 7.1 of the report.

In addition to the assessment as detailed above and in Table 3, noise from proposed ASHP units to nearest neighbouring properties is also assessed against London Borough of Camden's NR value noise limit requirement (NR35) as detailed in Table 4 on the following page.

Description	NR Value	Octave Band Centre Frequency (Hz) ($L_{eq,5mins}$ dB)							
		63	125	250	500	1k	2k	4k	8k
London Borough of Camden NR value limit	≤NR35	≤63	≤52	≤45	≤39	≤35	≤32	≤30	≤29
Assessment Position A) Neighbouring property 40 Frognal Lane *(annex building)*									
Noise from ASHP units to assessment position	NR30	50	44	37	34	29	23	25	22
Excess of ASHP unit noise on NR limit	-	-	-	-	-	-	-	-	-
Assessment Position B) Neighbouring property 40 Frognal Lane *(main building)*									
Noise from ASHP units to assessment position	NR26	46	40	33	29	24	18	20	17
Excess of ASHP unit noise on NR limit	-	-	-	-	-	-	-	-	-
Assessment Position C) Neighbouring property 12 Langland Gardens									
Noise from ASHP units to assessment position	NR30	47	42	37	34	29	23	25	22
Excess of ASHP unit noise on NR limit	-	-	-	-	-	-	-	-	-

Table 4: Assessment of noise from ASHP units to nearest neighbouring properties *(NR value assessment)*

Table 4 indicates noise from the ASHP units comply with (do not exceed) the NR35 noise limit criterion as per London Borough of Camden's requirements.

This is notwithstanding that noise from the ASHP units exceeds the criterion (limit) set relative to background noise levels and with reference to BS4142:2014 as detailed in Table 3 on the previous page.

This is because in this instance background noise levels are very low, which correspondingly results in a more onerous criterion limit for an assessment relative to background noise levels, as compared with the fixed NR35 value noise limit criterion.

6. VIBRATION FROM AIR SOURCE HEAT PUMP UNITS

Location for the proposed ASHP units is at distance from and separate from (i.e. not structurally attached or otherwise physically connected / fixed to) any neighbouring properties.

It is not expected there would be any vibration transmission from the ASHP units to neighbouring properties and it is not necessary to specify vibration isolator mountings to the ASHP units specifically to protect neighbouring properties from potential vibration.

Notwithstanding this, as good practice and to anyhow mitigate possible residual vibration from the ASHP units to the property 38 Frognal Lane itself, it is advised the units are installed mounted on conventional proprietary vibration isolators.

Specification details for typically suitable vibration isolators are provided in Section 7.2 of the report.

7. SPECIFICATIONS FOR NOISE & VIBRATION TREATMENTS

7.1 Noise

***Informative (2)*: Other Considerations Associated With Noise Reduction Treatment**

Philip Acoustics can only advise on noise & vibration (acoustic) issues and therefore professional advice from others may need to be sought to confirm aspects of the noise reduction treatment with regard to non-acoustic issues such as airflow ventilation to the units, maintenance access, physical size constraints and any visual requirements.

The proposed ASHP units require minimum 7dBA noise reduction to comply with Camden's noise policy requirement.

It is proposed to use Noico Ltd acoustic louvres to form an acoustic enclosure around the ASHP units.

The louvres would be of metal construction with blade depth of 150mm (i.e. standard 150mm depth type acoustic louvres).

A copy of the Noico Ltd acoustic louvres datasheet, including with supplier acoustic calculation demonstrating compliance with the required ≥7dBA noise reduction as applicable for the proposed Mitsubishi Ecodan model CAHV-P500YA-HPB ASHP units at 38 Frognal Lane is provided in Appendix F.

7.2 Vibration Isolators

As detailed in Section 6, it is advised as good practice the ASHP units are installed mounted on conventional proprietary vibration isolator mountings.

Appropriate proprietary vibration isolators for the units are rubber or neoprene turret type mountings, fitted to under each mounting foot / bracket of the units.

The vibration isolators should each have a static deflection nominally ≥3mm under weight of the units.

Details of three example suppliers and their typically suitable vibration isolators are provided below.

The stated gross weight for the Mitsubishi Ecodan model CAHV-P500YA-HPB is for the ASHP unit itself (net weight 526kg) plus with a +10% allowance (rounded up) for circulating water and refrigerant charge.

The indicated typically suitable vibration isolators are sized based on the ASHP units each having a total of 8 x mounting feet / brackets (i.e. using 8 x vibration isolators), and with equal weight distribution, i.e. nominally the same weight / loading for each mounting.

The suppliers are not listed in any order of preference, a copy of each of the supplier's data sheets for the suitable isolators is provided in Appendix G. Other suppliers will also be able to offer suitable equivalent vibration isolators.

Example Supplier 1:

EMTEC: www.emtecproducts.co.uk Isolator type: Neoprene Mountings Series R/RD

Mitsubishi CAHV-P500YA-HPB (gross weight ≈580kg) = Isolator R-2 Black (max load per isolator 77kg)

Example Supplier 2:

Christie & Grey: www.christiegrey.co.uk Isolator type: Rubber Turret Mountings RM

Mitsubishi CAHV-P500YA-HPB (gross weight ≈580kg) = Isolator RM 19.100.R.F Red (max load per isolator 80kg)

Example Supplier 3:

Vibracoustics: www.vibracoustics.com Isolator type: Vi-Turret Mountings

Mitsubishi CAHV-P500YA-HPB (gross weight ≈580kg) = Isolator VS42000 Red (max load per isolator 100kg)

APPENDIX A

Noise Survey Instrumentation

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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Date: March 2024

NOISE SURVEY INSTRUMENTATION

Instrumentation Used:

- Rion sound level meter type NL-31 Class 1, Rion preamplifier type NH-21, Rion microphone type UC-53A, Rion microphone windshield type WS-10, Rion microphone extension cable type EC-04A and boom arrangement;
- Bruel & Kjaer calibrator type 4231 serial number 2642929.
- Speedtech Instruments Skymaster model SM-28 serial number 19370 (weather conditions data).

Instrumentation Calibration Certification:

Description	Type Number	Manufacturer	Date of Calibration Expiration	Calibration Certificate Number
Class 1 Sound Level Meter *s/n 00773045*	NL-31	Rion	05/08/2024	TCRT22/1493
Microphone *s/n 313002*	UC-53A			
Preamplifier *s/n 25056*	NH-21			
Calibrator *s/n 2642929*	4231	Bruel & Kjaer	18/02/2024	TCRT22/1131

Instrumentation On-Site Calibration Check:

Description	Calibrator Reference Level	Measured Level	Comment
Before survey measurements	94.0dB	94.1dB	Pass
After survey measurements		94.1dB	Pass *(nil significant drift)*

APPENDIX B

Aerial Image, Site Location Plan & Proposed ASHP Units Location Drawing

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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Date: March 2024

AERIAL IMAGE

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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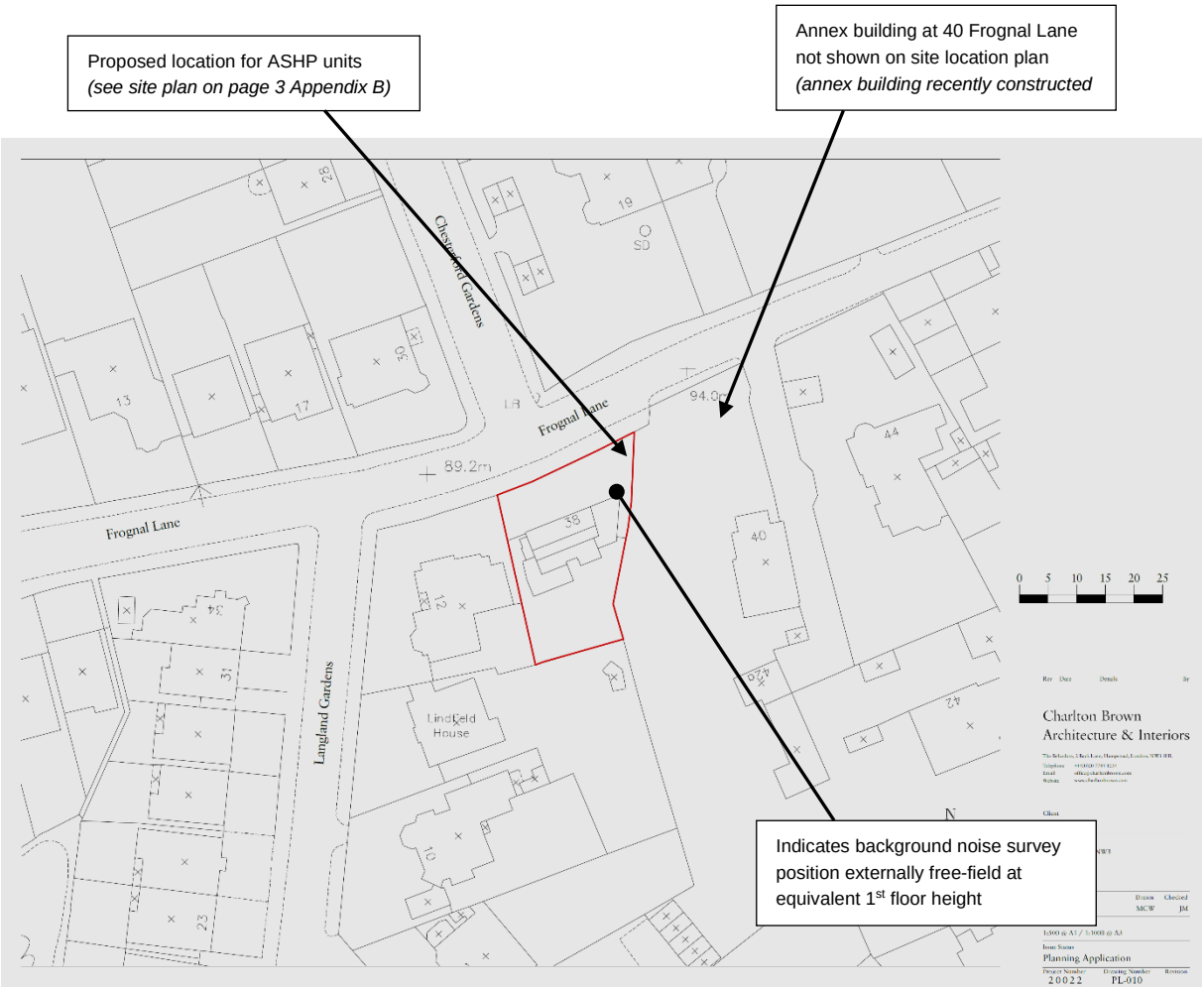
Date: March 2024

SITE LOCATION PLAN



Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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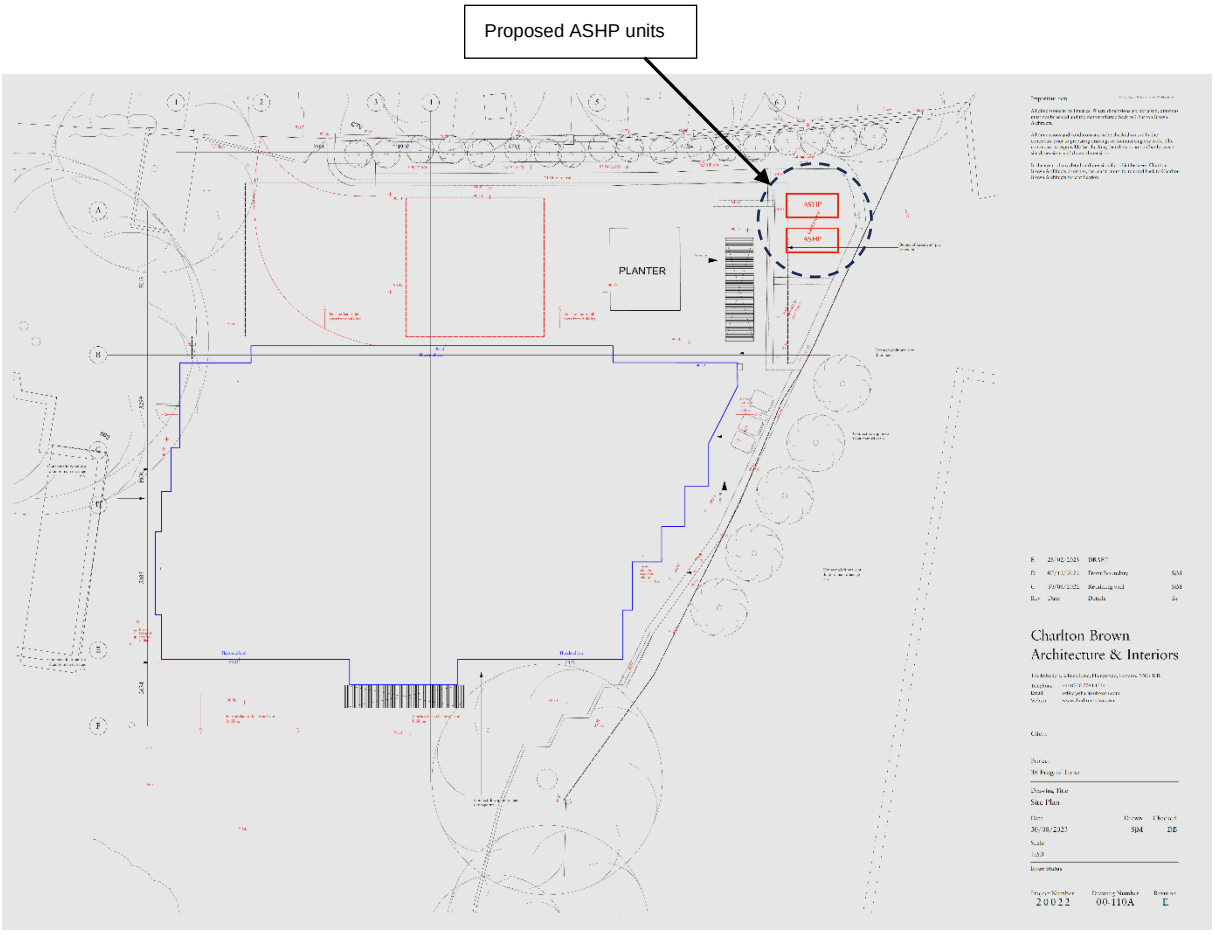
SITE PLAN INDICATING PROPOSED ASHP UNITS LOCATION



APPENDIX C

Background Noise Survey Results

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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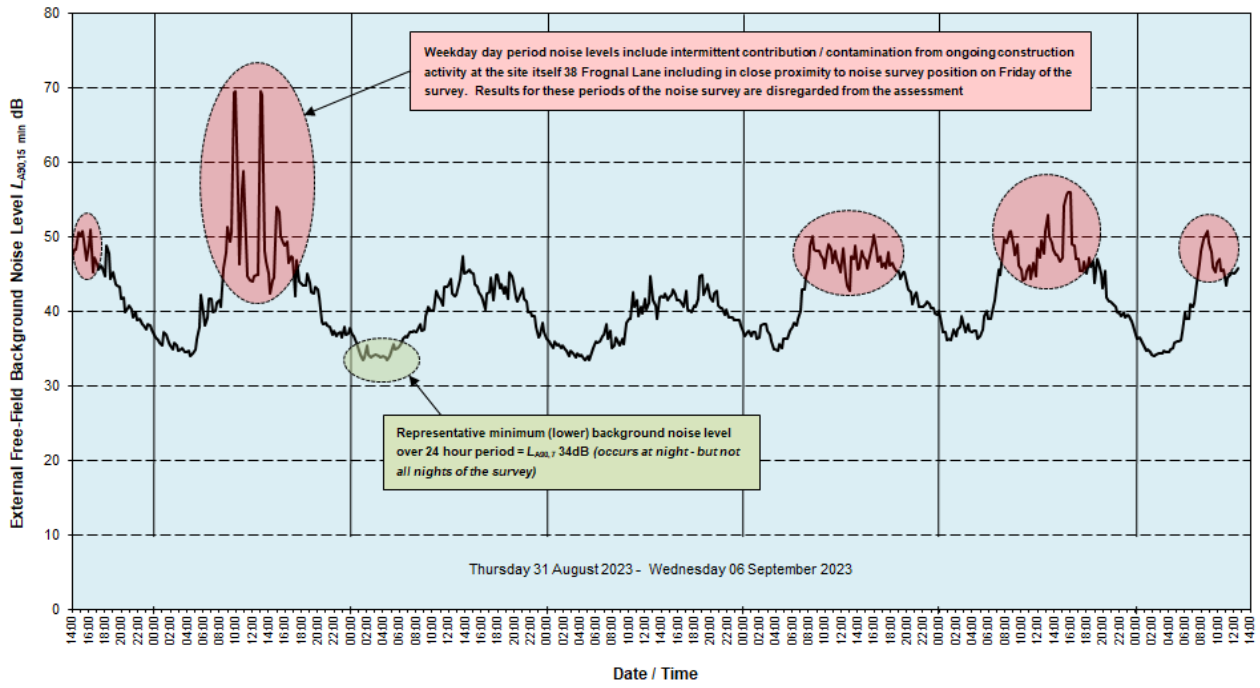
Date: March 2024

BACKGROUND NOISE SURVEY RESULTS

Raw Data Results Of Background Noise Survey Thursday 31 August 2023 - Wednesday 06 September 2023:



APPENDIX D

Manufacturer Noise Data For Proposed ASHP Units

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

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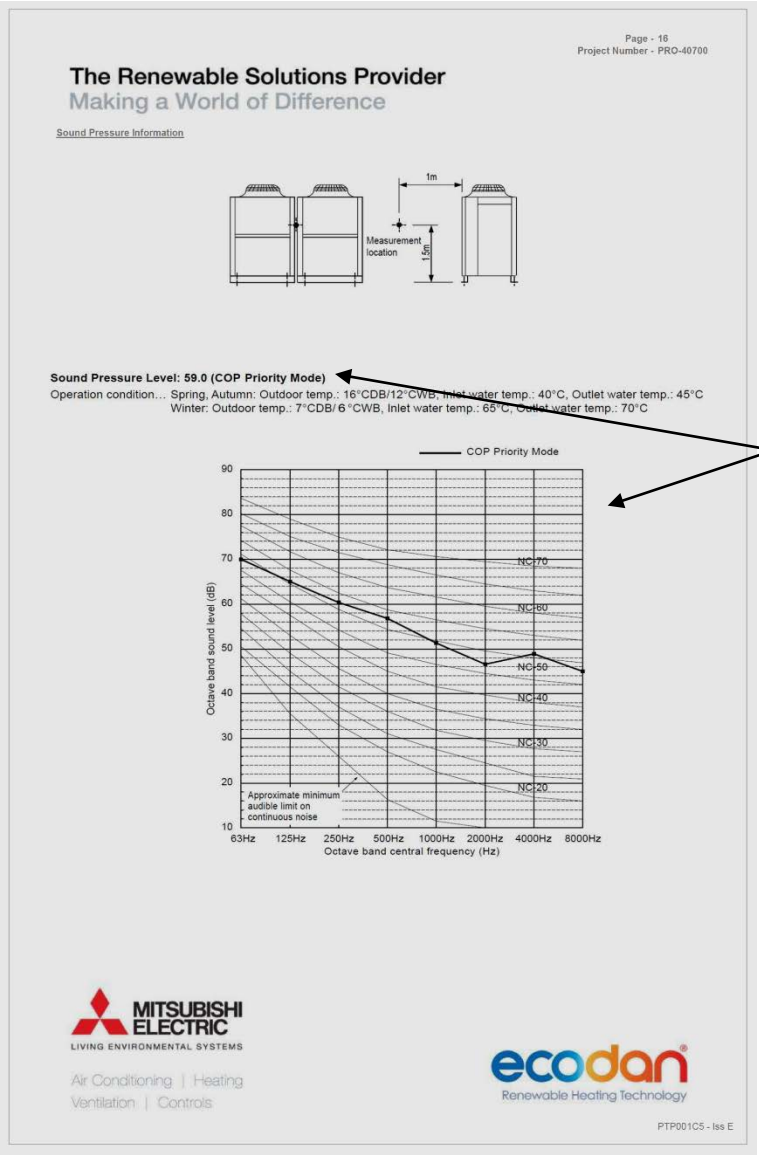
Date: March 2024

MANUFACTURER NOISE DATA FOR PROPOSED ASHP UNITS

Mitsubishi Ecodan CAHV-P500YA-HPB



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Sound Pressure Information

Sound Pressure Level: 59.0 (COP Priority Mode)
Operation condition... Spring, Autumn: Outdoor temp.: 16°CDB/12°CWB, Inlet water temp.: 40°C, Outlet water temp.: 45°C
Winter: Outdoor temp.: 7°CDB/ 6 °CWB, Inlet water temp.: 65°C, Outlet water temp.: 70°C

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Renewable Heating Technology

PTP001C5 - Iss E

Manufacturer noise data is in terms of free-field overall dBA & octave band linear dB sound pressure levels at 1m *(unit operating full 100% duty)*

APPENDIX E

Noise Assessment Positions & Noise Model Calculation

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix E *(page 1 of 4)*

Date: March 2024

NOISE ASSESSMENT POSITIONS

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix E *(page 2 of 4)*

Date: March 2024

NOISE MODEL CALCULATION

Assessment Position A: Neighbouring property 40 Frognal Lane *(annex building)*

Noise Condition: 2 x Mitsubishi Ecodan ASHP units model CAHV-P500YA-HPB operating full duty

Noise Mitigation: None applied

		Lin dB at Octave Band Centre Frequency Hz							
Plant & Description	**Overall dBA**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ASHP UNITS: 2 X Mitsubishi Ecodan model CAHV-P500YA-HPB									
Noise Data: *sound pressure level at 1m (free-field); Lp dB per unit operating full 100% duty (manufacturer data)*	59	70	65	60	57	52	46	48	45
Quantity; *3dB unit quantity correction applicable for 2 x units*		3	3	3	3	3	3	3	3
Noise Mitigation; *none applied*		0	0	0	0	0	0	0	0
Distance; *free-field correction for ≈12m from units to assessment position*		-22	-22	-22	-22	-22	-22	-22	-22
Screening; *complete line of sight screening correction applicable (elevation difference & boundary fence), limit to -10dB*		-7	-9	-10	-10	-10	-10	-10	-10
Directivity; *nil propagation directivity correction applicable (units radiate noise equally all directions)*		0	0	0	0	0	0	0	0
Non Free-Field / Reflections; *+6dB correction applied for units adjacent to boundary walls / fences*		6	6	6	6	6	6	6	6
ASHP units contribution at assessment position	37	50	44	37	34	29	23	25	22
Cumulative Contribution All Plant At Assessment Position	**37**	**50**	**44**	**37**	**34**	**29**	**23**	**25**	**22**

The overall cumulative sound pressure (Specific Noise) level at the assessment position both ASHP units operating = 37dBA.

Manufacturer noise data indicates the ASHP unit Mitsubishi Ecodan model CAHV-P500YA-HPB generate a broadband characteristic noise without strong, identifiable or clearly perceptible tonal elements. This correlates with experience of the author in measuring noise levels from installed same and similar type/size/make ASHP units used in domestic settings.

As per BS4142:2014 assessment methodology, overall ASHP units noise to the assessment position is a Rating Level $L_{Ar,Tr}$ 37dB.

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix E *(page 3 of 4)*

Date: March 2024

NOISE MODEL CALCULATION

Assessment Position B: Neighbouring property 40 Frognal Lane *(main building)*

Noise Condition: 2 x Mitsubishi Ecodan ASHP units model CAHV-P500YA-HPB operating full duty

Noise Mitigation: None applied

		Lin dB at Octave Band Centre Frequency Hz							
Plant & Description	**Overall dBA**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ASHP UNITS: 2 X Mitsubishi Ecodan model CAHV-P500YA-HPB									
Noise Data: *sound pressure level at 1m (free-field); Lp dB per unit operating full 100% duty (manufacturer data)*	59	70	65	60	57	52	46	48	45
Quantity; *3dB unit quantity correction applicable for 2 x units*		3	3	3	3	3	3	3	3
Noise Mitigation; *none applied*		0	0	0	0	0	0	0	0
Distance; *free-field correction for ≈22m from units to assessment position*		-27	-27	-27	-27	-27	-27	-27	-27
Screening; *complete line of sight screening correction applicable (elevation difference & boundary fence), limit to -10dB*		-6	-7	-9	-10	-10	-10	-10	-10
Directivity; *nil propagation directivity correction applicable (units radiate noise equally all directions)*		0	0	0	0	0	0	0	0
Non Free-Field / Reflections; *+6dB correction applied for units adjacent to boundary walls / fences*		6	6	6	6	6	6	6	6
ASHP units contribution at assessment position	32	46	40	33	29	24	18	20	17
Cumulative Contribution All Plant At Assessment Position	**32**	**46**	**40**	**33**	**29**	**24**	**18**	**20**	**17**

The overall cumulative sound pressure (Specific Noise) level at the assessment position both ASHP units operating = 32dBA.

Manufacturer noise data indicates the ASHP unit Mitsubishi Ecodan model CAHV-P500YA-HPB generate a broadband characteristic noise without strong, identifiable or clearly perceptible tonal elements. This correlates with experience of the author in measuring noise levels from installed same and similar type/size/make ASHP units used in domestic settings.

As per BS4142:2014 assessment methodology, overall ASHP units noise to the assessment position is a Rating Level $L_{Ar,Tr}$ 32dB.

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix E *(page 4 of 4)*

Date: March 2024

NOISE MODEL CALCULATION

Assessment Position C: Neighbouring property 12 Langland Gardens

Noise Condition: 2 x Mitsubishi Ecodan ASHP units model CAHV-P500YA-HPB operating full duty

Noise Mitigation: None applied

		Lin dB at Octave Band Centre Frequency Hz							
Plant & Description	**Overall dBA**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ASHP UNITS: 2 X Mitsubishi Ecodan model CAHV-P500YA-HPB									
Noise Data: *sound pressure level at 1m (free-field); Lp dB per unit operating full 100% duty (manufacturer data)*	59	70	65	60	57	52	46	48	45
Quantity; *3dB unit quantity correction applicable for 2 x units*		3	3	3	3	3	3	3	3
Noise Mitigation; *none applied*		0	0	0	0	0	0	0	0
Distance; *free-field correction for ≈28m from units to assessment position*		-29	-29	-29	-29	-29	-29	-29	-29
Screening; *slight / partial line of sight screening correction applicable (edge of building), limit to -3dB*		-3	-3	-3	-3	-3	-3	-3	-3
Directivity; *nil propagation directivity correction applicable (units radiate noise equally all directions)*		0	0	0	0	0	0	0	0
Non Free-Field / Reflections; *+6dB correction applied for units adjacent to boundary walls / fences*		6	6	6	6	6	6	6	6
ASHP units contribution at assessment position	36	47	42	37	34	29	23	25	22
Cumulative Contribution All Plant At Assessment Position	**36**	**47**	**42**	**37**	**34**	**29**	**23**	**25**	**22**

The overall cumulative sound pressure (Specific Noise) level at the assessment position both ASHP units operating = 36dBA.

Manufacturer noise data indicates the ASHP unit Mitsubishi Ecodan model CAHV-P500YA-HPB generate a broadband characteristic noise without strong, identifiable or clearly perceptible tonal elements. This correlates with experience of the author in measuring noise levels from installed same and similar type/size/make ASHP units used in domestic settings.

As per BS4142:2014 assessment methodology, overall ASHP units noise to the assessment position is a Rating Level $L_{Ar,Tr}$ 36dB.

APPENDIX F

Details For Noise Reduction Treatment

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix F *(page 1 of 1)*

Date: March 2024

DETAILS FOR NOISE REDUCTION TREATMENT ***(including supplier acoustic calculation)***

Noico Ltd Acoustic Louvres Noise Reduction Treatment For Mitsubishi Ecodan model CAHV-P500YA-HPB ASHP Units

NOICO LTD
NOISE CONTROL ENGINEERS

Tel: 01256 766207
www.noico.co.uk

Acoustic Louvres

Sound Transmission Loss (dB)

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
150mm deep	2	3	4	8	13	11	9	8
270mm deep	4	7	10	12	15	16	13	12
540mm deep	5	8	14	27	38	40	33	31

Pressure Drop: Pascal's (N/m²)

Face Velocity (m/s)	0.5	1.0	1.5	2.0	2.5
150mm deep	2	8	18	31	48
270mm deep	2	8	18	32	50
540mm deep	3	12	26	46	72

Construction & Finish
All metal construction from either pre-galvanised steel, aluminium or stainless steel.
Standard depths are 150mm, 270mm and 540mm deep.

Perforated metal forms the underside of the louvre blades to retain the absorptive mineral fibre which is packed under 10% compression.

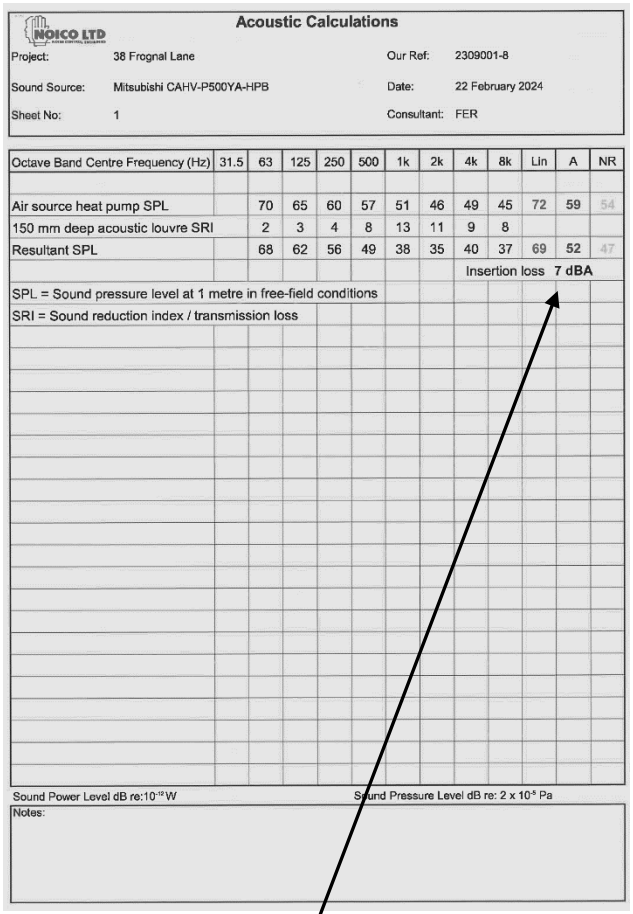
There are a range of finishes available:
- Un-painted
- Plastisol coated steel (to standard colour range)
- Polyester powder paint finish (to a standard RAL or BS colour)

Birdscreen and insect mesh are an optional feature mechanically fixed to the rear of the louvre.

150 & 270mm deep Single Bank

540mm deep Double Bank

Noico Ltd. Landmark House, Station Road, Hook, Hampshire RG27 9HA
Tel: 01256 766207 email: sales@noico.co.uk



NOICO LTD

Acoustic Calculations

Project: 38 Frognal Lane — Our Ref: 2309001-8
Sound Source: Mitsubishi CAHV-P500YA-HPB — Date: 22 February 2024
Sheet No: 1 — Consultant: FER

Octave Band Centre Frequency (Hz)	31.5	63	125	250	500	1k	2k	4k	8k	Lin	A	NR
Air source heat pump SPL		70	65	60	57	51	46	49	45	72	59	54
150 mm deep acoustic louvre SRI		2	3	4	8	13	11	9	8			
Resultant SPL		68	62	56	49	38	35	40	37	69	52	47

Insertion loss 7 dBA

SPL = Sound pressure level at 1 metre in free-field conditions
SRI = Sound reduction index / transmission loss

Sound Power Level dB re:10^{-12} W — Sound Pressure Level dB re: 2 x 10^{-5} Pa

Notes:

Proposed noise reduction treatment to the ASHP units provides the required level of noise reduction ≥7dBA

APPENDIX G

Details For Example Vibration Isolators

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix G *(page 1 of 3)*

Date: March 2024

DETAILS FOR EXAMPLE VIBRATION ISOLATORS

Supplier: EMTEC

Bulletin No. R12/93 (UK)

VMC
KORFUND

Neoprene Mountings
Series R/RD

EXCLUSIVE— COLOR CODED

Available in 4 sizes – 5 durometers
Load Range – 10 lbs. to 4,000 lbs.
Deflections to ¼" with type R
to ½" with type RD
Corrosion Proof
Molded in colored oil-resistant neoprene
5 colors for error free identification

Effective Isolation for Floor Mounted Equipment

Series R & RD Neoprene Mountings are molded in colored oil-resistant neoprene. This unique color coding provides instant identification of loading capacity — simplifies stocking — prevents installation errors.

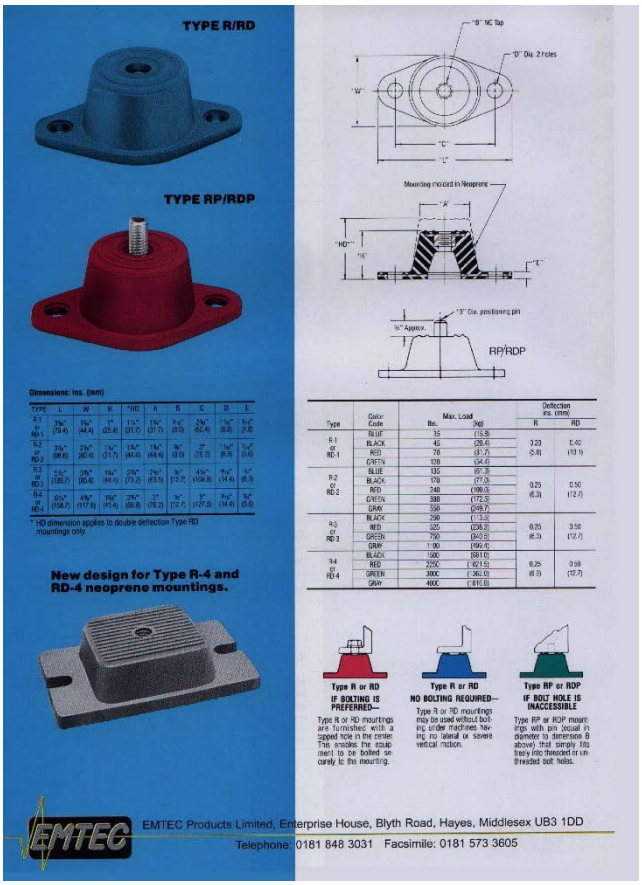
The VMC molding process embeds all metal parts in neoprene, preventing corrosion. Mountings can also be molded in other elastomers to meet special requirements.

Typical Applications
Air Handling Units Business Machines
Compressors Fans Instrument Panels
Machine Tools Pumps
Motor Generators Transformers

To Specify:

Neoprene mountings shall consist of a steel top plate and base plate completely embedded in coloured oil-resistant neoprene stock for easy identification of capacity. The mountings shall be Type R or RD, depending upon the required deflection of 1/4" to 1/2", as manufactured by VMC and as supplied by EMTEC Products Limited

EMTEC Products Limited, Enterprise House, Blyth Road, Hayes, Middlesex UB3 1DD
Telephone: 0181 848 3031 Facsimile: 0181 573 3605



TYPE R/RD

TYPE RP/RDP

Dimensions: ins. (mm)

TYPE	L	W	H	*HD	A	B	C	D	E
R-1 or RD-1	3⅛" (79.4)	1¾" (44.4)	1" (25.4)	1¼" (31.7)	1¼" (31.7)	⅜" (9.5)	2⅝" (66.4)	1⅜" (34.9)	¼" (6.4)
R-2 or RD-2	3⅝" (98.6)	2⅜" (60.4)	1⅝" (41.7)	1¾" (44.4)	1¾" (44.4)	⅜" (9.5)	3" (76.2)	1⅝" (41.3)	¼" (6.4)
R-3 or RD-3	4⅝" (120.7)	3⅝" (92.8)	1¾" (44.4)	2⅜" (73.2)	2⅜" (73.2)	⅝" (15.9)	4⅛" (104.8)	1⅝" (41.3)	¼" (6.4)
R-4 or RD-4	6¼" (158.7)	4⅝" (117.8)	1⅝" (41.4)	2⅜" (60.8)	2⅜" (76.2)	½" (12.7)	5" (127.0)	1⅝" (41.3)	¼" (6.4)

* HD dimension applies to double deflection Type RD mountings only.

New design for Type R-4 and RD-4 neoprene mountings.

Type	Color Code	Max. Load lbs. (kg)	Deflection ins. (mm) R	Deflection ins. (mm) RD
R-1 or RD-1	BLUE	35 (15.9)	0.23 (5.8)	0.40 (10.1)
	BLACK	45 (20.4)		
	RED	70 (31.7)		
	GREEN	120 (54.4)		
R-2 or RD-2	BLUE	135 (61.3)	0.25 (6.3)	0.50 (12.7)
	BLACK	170 (77.2)		
	RED	240 (108.9)		
	GREEN	380 (172.5)		
	GRAY	550 (249.7)		
R-3 or RD-3	BLACK	290 (131.5)	0.25 (6.3)	0.50 (12.7)
	RED	525 (238.2)		
	GREEN	750 (340.3)		
	GRAY	1 100 (499.4)		
R-4 or RD-4	BLACK	1500 (681.0)	0.25 (6.3)	0.50 (12.7)
	RED	2250 (1021.5)		
	GREEN	3000 (1362.0)		
	GRAY	4000 (1816.0)		

Type R or RD
IF BOLTING IS PREFERRED—
Type R or RD mountings are furnished with a tapped hole in the center. This enables the equipment to be bolted securely to the mounting.

Type R or RD
NO BOLTING REQUIRED—
Type R or RD mountings may be used without bolting under machines having no lateral or severe vertical motion.

Type RP or RDP
IF BOLT HOLE IS INACCESSIBLE
Type RP or RDP mountings with pin (equal in diameter to dimension B above) that simply fits freely into threaded or unthreaded bolt holes.

EMTEC Products Limited, Enterprise House, Blyth Road, Hayes, Middlesex UB3 1DD
Telephone: 0181 848 3031 Facsimile: 0181 573 3605

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix G *(page 2 of 3)*

Date: March 2024

DETAILS FOR EXAMPLE VIBRATION ISOLATORS

Supplier: Christie & Grey

Rubber Turret Mountings

Type RM

Type RM Rubber Turret mountings are designed to provide superior attenuation of medium to high frequency vibration and noise emanating from a wide range of motor driven machines particularly axial and centrifugal fans.

High resilience rubber with low dynamic to static stiffness ratio ensures maximum efficiency, good creep performance and long service life.

DESIGN FEATURES

- Moulded in first grade natural rubber with integral steel base and upper fixing boss.
- Manufactured in three sizes, each available in three rubber compounds identified by a colour spot.
- Static deflections of up to 8 mm with loads from 5 kg to 400 kg.
- Upper fixing screw supplied as standard with optional height adjustors also available.

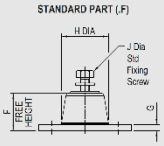
TYPICAL APPLICATIONS

- Axial and Centrifugal Fans.
- Air Handling Units.
- Refrigeration Plant.
- Pumps.
- Rotary and Multi Cylinder Compressors.
- Floating Floors.
- Isolation of Sensitive Equipment.
- Test Rigs and Special Purpose Machines.

CHRISTIE & GREY Vibration & Shock Control

PL0091 - JUNE 2005 - Rev. C

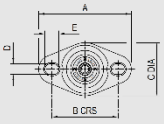
STANDARD PART (.F)



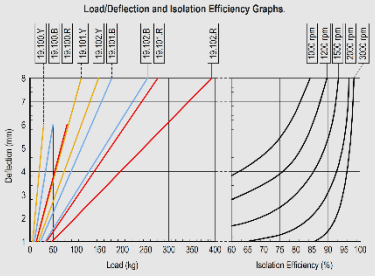
TYPE RM RUBBER TURRET MOUNTINGS

PART No.	COLOUR CODE	RATED LOAD (kg)	DEFLECTION AT RATED LOAD (mm)	DIMENSIONS (mm) A	B	C	D	E	F	G	H	J	K	L	M	WT (kg) MAX
19.100.Y.F	YELLOW	25	6	82	57	45	9	12	32	5	41	M8 x 20	42	13	18	0.17
19.100.B.F	BLUE	50														
19.100.R.F	RED	80														
19.101.Y.F	YELLOW	100	6	95	71	60	9	14	45	6	56	M10 x 25	56	18	28	0.25
19.101.B.F	BLUE	180														
19.101.R.F	RED	280														
19.102.Y.F	YELLOW	150	8	130	115	86	11	22	70	6	82	M12 x 30	83	27	38	0.73
19.102.B.F	BLUE	280														
19.102.R.F	RED	400														

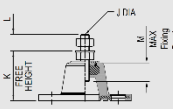
- Above part number includes standard upper fixing screw size J, for height adjustable variant replace **.F** with **.HA**.
- Maximum height adjustment available is 10 mm with **.HA** variant.



Load/Deflection and Isolation Efficiency Graphs.



HEIGHT ADJUSTABLE VARIANT (.HA)



Isolation efficiency is based on dynamic rather than static stiffness for accurate calculation of system performance.

Application Notes:
Rubber Turret mountings should not be used on machines exhibiting high out of balance forces or mobile applications without locking devices or independent restraints.

For full installation instructions please refer to our data sheet DS010.

For more detailed information and technical assistance please contact our Technical Department.

In the interests of continual development, the Company reserves the right to make modifications to these details without notice.

CHRISTIE & GREY
Christie & Grey Limited
Morley Road, Tonbridge, Kent TN9 1RA, England
Telephone : +44 (0) 1732 371100 • Fax: +44 (0) 1732 359666
E-mail : sales@christiegrey.com • web site: www.christiegrey.com

PL0092 - JUNE 2005 - Rev. C

Site: 38 Frognal Lane, Hampstead, London NW3 6PP

Report: 23082-002 Revision A Appendix G *(page 3 of 3)*

Date: March 2024

DETAILS FOR EXAMPLE VIBRATION ISOLATORS

Supplier: Vibracoustics

Vibracoustics™

Products & Services for Vibration, Noise & Shock Control

PRODUCT GROUP 42

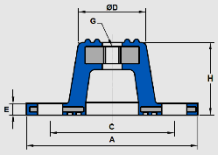
VI-TURRET MOUNTINGS

Description:

Vibracoustics Ltd Vi-Turret Mountings are designed principally for the mounting of HVAC systems, with relatively high levels of deflection ideal for the effective attenuation of noise and vibration from rotating equipment with speeds of 1000rpm (16Hz) and above.

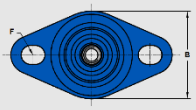
Efficient construction with fully rubber encapsulated metal components for environmental protection, threaded top and stable base fixings with non-skid mounting faces.

Available in a range of sizes and rubber hardness for load capacities 35Kg to 500Kg. Other non-standard sizes available, contact Vibracoustics Ltd technical department for more information.



Typical Applications Include:

- Fans.
- Pumps.
- HVAC.
- Generators.
- Electric motors.
- Compressors.
- General equipment.



Part No.	Dimensions (mm)								Max Load (Kg)	Max Static Deflection (mm)
	H	A	B	C	D	G	F	E		
VS42000 YELLOW	32	80	45	57	41	M8	9x12	5	35	8
VS42000 BLUE	32	80	45	57	41	M8	9x12	5	65	8
VS42000 RED	32	80	45	57	41	M8	9x12	5	100	8
VS42001 YELLOW	45	95	60	71	56	M10	9x14	5	130	10
VS42001 BLUE	45	95	60	71	56	M10	9x14	5	225	10
VS42001 RED	45	95	60	71	56	M10	9x14	5	350	10
VS42002 YELLOW	70	150	86	115	82	M12	11x22	6	185	10
VS42002 BLUE	70	150	86	115	82	M12	11x22	6	320	10
VS42002 RED	70	150	86	115	82	M12	11x22	6	500	10

Vibracoustics is continually seeking to improve products and reserves the right to change designs and specifications without prior notice or alteration of literature.
For applications and technical assistance please contact Vibracoustics, see index Ref 00-A-01
E-mail: mail@vibracoustics.com Website: www.vibracoustics.com Cat Ref: 42-A-01 Iss:21B