



38 Glyn Road

Lower Brynamman, SA18 1ST

Noise Impact Assessment

5th September 2023

First Issue



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Revision History

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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA) has been written to assess the risk of adverse impact from noise 'pollution' generated by proposals for a domestic air source heat pump at 38 Glyn Road, Lower Brynamman, SA18 1ST.

The assessment has been made based on the manufacturer's laboratory test noise data, inputting this into 3D noise mapping software to predict the noise emissions outside of neighbouring windows and in neighbouring gardens.

In summary, the predicted plant noise emissions are up to:

- 36 dB L_{Aeq} outside of the worst-affected neighbouring window; and
- 36 dB L_{Aeq} in the worst-affected neighbouring garden.

As covered in **Section 5.4**, assessing against several guidelines including MCS Planning Standards, BS 8233, and WHO Guidelines, the noise emissions from the proposed ASHP should be at a low enough level to avoid anything greater than a 'low' risk of adverse impact.

However, despite this context, it is understood that the Local Planning Authority will require the noise emissions to be at most, equal to the background sound level, when assessed in accordance with BS 4142:2014+A1:2019. Therefore, to reduce emissions outside of neighbouring windows to the required level, a ventilated acoustic enclosure will need to be installed around the ASHP.

The applicant should submit a datasheet from the enclosure manufacturer which verifies that it can reduce noise emissions by a minimum of 14 dB(A).

Vibration has also been considered in **Section 6.0** – and it is expected that the provision of an enclosure with suitable mounts will ensure that the risk of adverse impact from vibration is negligible.

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1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment to accompany a planning application for the installation of an air source heat pump at 38 Glyn Road, Lower Brynamman, SA18 1ST.

1.1 Scope of Report

This document has been written to assess the risk of adverse impact from noise 'pollution' generated by the proposed ASHP ('the plant') on neighbouring residential properties once it is fully operational.

The objective is to ensure that the risk of noise impact will be controlled sufficiently. This is based upon ensuring that the noise emissions from the plant will not cause internal ambient noise levels inside nearby residential properties to exceed typical levels which are deemed to be acceptable for good living and sleeping conditions and that external noise levels in gardens won't affect the recreational use of these areas.

Therefore, the purpose of this report is to demonstrate whether the plant is able to achieve sufficiently low noise levels that avoids an adverse impact, and if not, to provide recommendations on how to do so.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in **Appendix A**.

1.2 Regulations and Guidelines

This report takes national planning policies into consideration including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in **Appendix B**), which outline the purpose and long-term vision of planning policy with respect to noise.

More specifically, the assessment has been undertaken in reference to:

- BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound';
- MCS Planning Standards (MCS 020 - For permitted development installations of wind turbines and air source heat pumps on domestic premises);
- BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'; and
- the WHO Environmental Noise Guidelines for the European Region.

2.0 Site and Development Description

The property in question is a semi-detached dwelling at no. 38 Glyn Road, Lower Brynamman, SA18 1ST – located as shown in **Figure 2.1**.

The proposals assessed herein, include the installation of a Mitsubishi PUZ-WM60VAA(-BS) Ecodan R32 Monobloc Air Source Heat Pump, located at ground level at the rear of the existing premises.

The closest neighbouring properties lie either side at no 36 and 40 Glyn Road. The noise modelling software used in the assessment inherently predicts noise emissions to *all* neighbouring windows and gardens in the area.

The property sits within a residential area where ambient/background noise levels are seen to be low, given the lack of major roads and railways or industrial use in the area.

Figure 2.1 – Site block plan (left) – Aerial view indicating ASHP location, Baseline monitoring position (right)



3.0 Relevant Guidelines

3.1 Local Authority Criteria

Based on a review of local planning policy and historic planning applications within Neath Port Talbot County Borough Council, it is seen that the following typical planning condition will be applicable to the proposed development;

"The applicant is to submit a noise impact assessment for the proposed development. The noise rating level emitted from external plant serving the approved use shall not be greater than the existing background noise level. The noise levels shall be determined at the nearest noise-sensitive premises or at another location that is deemed suitable by the Local Planning Authority. Measurements and assessments shall be made in accordance with 'BS 4142:2014 Method for rating and assessing industrial and commercial sound.'"

The typical planning condition requires that the rating level of the mechanical plant installation does not exceed the existing background noise levels. PJA assumes that similar requirements would be set for the proposals assessed herein.

3.2 BS 4142:2014

BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations (i.e., residential windows) within the context of the existing sound environment.

The method is based upon assessing the predicted noise emissions from plant/equipment against the existing background sound levels at NSRs, the latter of which is determined by a noise survey conducted at the site.

The predicted noise emissions are termed as a 'rating level', which is the 'specific sound level' from plant (the actual measurable noise level), plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

The general aim is for the 'rating level' (plant noise emissions) to not exceed the existing background sound levels outside of residential windows. BS 4142:2014 states that *"the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

3.3 MCS Planning Standards

The MCS Planning Standards ¹ set out the standard which must be complied with for domestic ASHP installations to be 'permitted development'. It includes a calculation procedure designed to confirm whether the permitted development noise limit of 42 dB $L_{Aeq,5mins}$ (at the assessment position, i.e., outside a neighbouring window) would be met. This is based upon:

- determining the sound pressure level from the ASHP at the assessment position;
- assuming that the existing background noise level is 40 dB; and
- adding the ASHP sound pressure level and the background noise level together logarithmically ²;
- comparing this total against the noise limit of ≤ 42 dB.

If the total is below the limit, the standard states: *"the air source heat pump will comply with the permitted development noise limit for this assessment position and may be permitted development (subject to compliance with other permitted development limitations/conditions and parts of this standard)"*.

3.4 BS 8233:2014

BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' suggests appropriate criteria and limits for different situations. This includes internal noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's 'Guidelines for Community Noise and Night Noise Guidelines for Europe' document.

Table 4 of BS 8233:2014 provides internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. These are summarised in **Table 4.1** below.

Table 4.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

In Annex G.1 of BS 8233:2014 it suggests that *"if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"*. Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB. Therefore, to meet internal noise targets in nearby residential dwellings, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time when measured/calculated directly outside of a residential bedroom or living room window.

1 - MCS 020 - For permitted development installations of wind turbines and air source heat pumps on domestic premises

2 - For example, an ASHP sound pressure level of 33 dB at the assessment position when added to the background noise level of 40 dB would result in a total sound pressure of 40.8 dB.

3.5 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that '*all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid*'.

The document sets out guidance as to noise levels at which there will be an unacceptable impact on the local community. WHO guidelines state:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq} .

Therefore, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime when measured or calculated within a residential garden, patio, or balcony.

4.0 Baseline Noise Survey

4.1 Methodology

PJA has attended the site to conduct a baseline noise survey across several days between Thursday the 24th and Tuesday the 29th of August 2023. The results have been used to determine a representative background sound level at a position representative of nearby residential receptors.

A fixed monitoring position was employed within the existing private garden at the rear of the premises, in a position whereby background sound levels would be representative of the windows of the closest neighbouring properties. The location of the monitoring position is also shown in **Figure 2.1 (Section 2.0)**.

The sound level meter was set to log noise levels over continuous 15-minute averaging periods with a 1-second time history rate. The monitoring equipment was left unattended for the majority of the survey with the exception for a short period around the installation and collection of the equipment.

The following noise indices were recorded (amongst others):

- **$L_{Aeq,T}$** : The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level;
- **$L_{AFmax,T}$** : The maximum A-weighted noise level during the measurement period T and the best representation of short high noise levels 'events' – i.e., emergency services sirens; and
- **$L_{A90,T}$** : The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the representative background noise level – or noise levels from continuous noise sources such as plant.

Appendix C contains further information on the methodology of the survey, including photographs taken from site and the equipment used.

4.2 Results

A graph of the measured noise levels across the monitoring period is given in **Figure 4.1**. **Table 4.1** summarises the results across the daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods.

The most relevant parameter in terms of the ‘representative background sound level’ is the $L_{A90,15min}$. **Figure 4.2** presents histograms of the $L_{A90,15min}$ values – showing minimum values of 22 dB overnight and 23 dB during the day.

Table 4.1 – Summary of measured noise levels

Period	Parameter	Maximum	Minimum	Logarithmic Average	Mean Average	Modal Average	Median Average
Daytime (07:00 – 23:00)	$L_{Aeq,15min}$ (dB)	69	26	51	42	40	41
	$L_{AFMax,15min}$ (dB)	99	39	76	62	60	61
	$L_{A90,15min}$ (dB)	46	23	34	32	31	32
Night-time (23:00 – 07:00)	$L_{Aeq,15min}$ (dB)	58	23	43	33	33	32
	$L_{AFMax,15min}$ (dB)	92	31	71	49	50	49
	$L_{A90,15min}$ (dB)	50	22	33	28	28	28

Figure 4.1 – Graph of measured noise levels

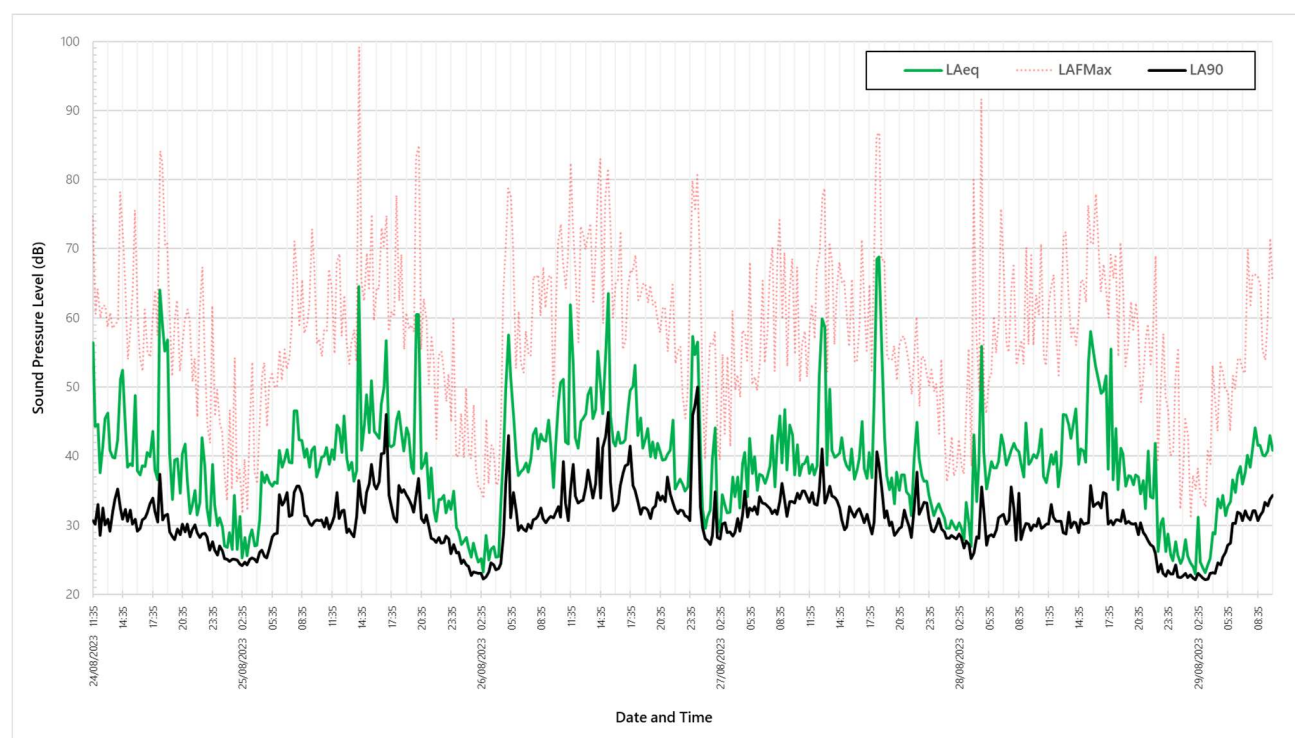
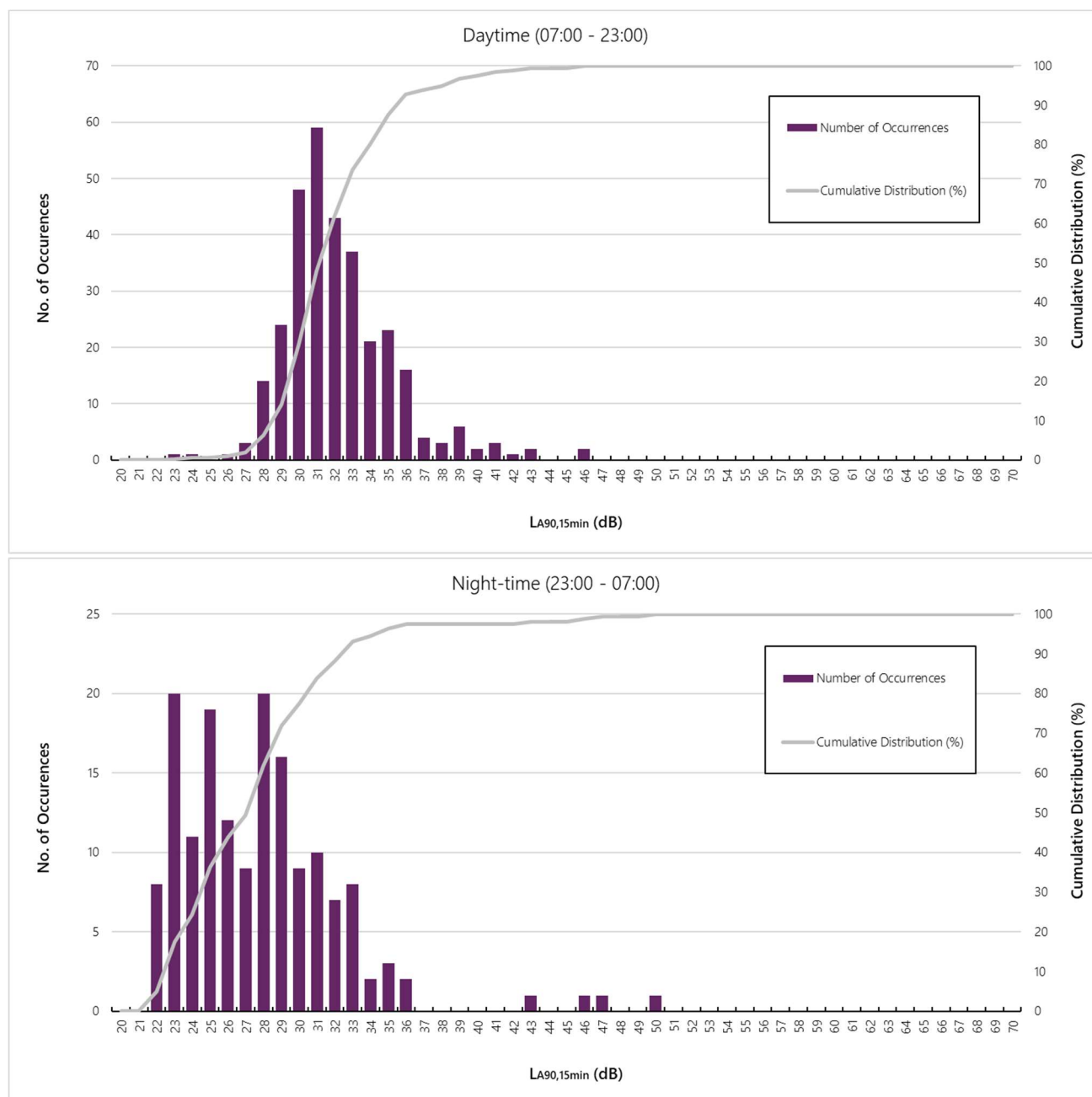


Figure 4.2 – Histogram of measured $LA_{90,15min}$ values



5.0 Noise Assessment

5.1 Background Sound Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a 'representative' background sound level. This is commonly determined through the results of a baseline sound survey, as has been done in this case.

BS 4142:2014 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."* BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*.

As a worst-case and robust assessment, PJA has used the absolute minimum values of $L_{A90,15min}$ as the representative background sound level. In line with the Local Authority Criteria in **Section 4.1** the rating level of the installation should not exceed the levels in **Table 5.1** below.

Table 5.1 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level $L_{A90,T}$ (dB)
1m outside of neighbouring residential windows	Daytime (07:00 to 23:00)	23
	Night-time (23:00 – 07:00)	22

5.2 Proposed Plant

The proposed ASHP will be a Mitsubishi PUZ-WM60VAA(-BS) Ecodan R32 Monobloc Air Source Heat Pump, with dimensions of 1050mm wide x 1020mm high x 480mm deep.

Extracts from the manufacturers' datasheets/manual ^{3 4} are given in **Appendix E** – from which the source noise data in **Table 5.2** has been taken from. In summary a sound power level of 58 dB(A) and a sound pressure level of 45 dB(A) (at 1m in front of the unit) are quoted (under 'normal' heating conditions) – in both cooling and heating modes.

The spectral noise levels do not suggest a tonal quality – the lack of tonality being a typical trait of a domestic ASHP because the fan rotates at a relatively low speed and consequently the blade passing frequency (the main cause of tonality) is at a very low frequency, meaning the sound overall is perceived as broadband in nature. The assessment has been based on the assumption that the unit could run at full capacity at any point of the day/night.

Table 5.2 – Source noise emission data for the proposed ASHP

Make/Model	Mode	Sound Pressure Levels @ 1m ⁵								Sound Power Level dB(A)
		dB at Octave Band Centre Frequencies, Hz							dB(A)	
		63	125	250	500	1 k	2 k	4 k		
Mitsubishi PUZ-WM60VAA(-BS)	Heating	48	47	49	44	36	34	27	45	58
	Cooling	54	48	44	44	38	38	31	45	

3 - https://library.mitsubishielectric.co.uk/pdf/book/Ecodan_PUZ-WM60VAA_Monobloc_Air_Source_Heat_Pump_Product_Information_Sheet#page-1-2

4 - https://library.mitsubishielectric.co.uk/pdf/book/ATW_Databook_R32_2020

5 - Measured at 1m in front of the unit and 1.5m above ground . Measured in a semi anechoic chamber (reflective ground but no reflective vertical sources).

5.3 Predicted Noise Emissions

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines, and calculation algorithms, including those set out in ISO 9613-2:1996. A full explanation of the noise modelling is provided in **Appendix D**, along with images and noise maps/results from the model.

Figures D.2 to D.5 in Appendix D show the predicted plant noise levels ($L_{Aeq,15min}$) at ground floor (1.5m, with additional receptor points in gardens) and 1st floor (4m) heights, and in heating and cooling modes respectively.

A receptor point is also placed at 1m in front of the unit / 1.5m above the ground level of the unit to verify that the noise emissions are in line with the manufacturer quoted levels (albeit slightly higher because of the surrounding conditions with vertical reflective surfaces when installed in-situ).

In summary, the predicted plant noise emissions are up to:

- 36 dB L_{Aeq} outside of the worst-affected neighbouring window; and
- 36 dB L_{Aeq} in the worst-affected neighbouring garden.

5.4 Analysis

If assessing in accordance with the MCS Planning Standards, the addition of the predicted ASHP noise emissions at the worst affected window (36 dB), and the assumed background level of 40 dB, would result in a total level of 41.5 dB, within the 42 dB limit.

If assessing based on BS 8233:2014 and WHO guidelines, to exceed internal noise level targets (of 30 dB L_{Aeq}) within a bedroom, based on an estimated sound reduction across an open window of 10 - 15 dB, specific noise levels would have to exceed 40 - 45 dB $L_{Aeq,8hr}$ at night when measured outside of the window. The worst-case specific noise level, in this case, is 36 dB L_{Aeq} – and hence these internal noise targets would easily be achieved (21 – 26 dB L_{Aeq}).

A level of 36 dB within gardens is also comfortably within WHO/BS 8233 targets (<50 dB). Note that this level is derived at the nearest corner of the amenity area at 40 Glyn Road to the proposed ASHP. Noise levels further away in the receptor garden will be significantly lower.

Nonetheless, the Local Authority Criteria (as outlined in **Section 4.1**) require that the rating level of the plant is at most, equal to the background sound level. Therefore, a specific noise level of 36 dB outside of a window, would be up to 14 dB above the background noise level. As such, mitigation will be required in order to comply with the local authority rating level requirements.

5.5 Mitigation

Some form of mitigation will be required for plant noise emissions to be reduced to a level that is compliant with the criteria stipulated by the Local Planning Authority, i.e., no greater than the existing background noise levels.

At least a 14 dB reduction will be required to meet this limit.

It is unlikely that noise would be sufficiently mitigated by either a) moving the unit to a different location, b) changing to a quieter alternative, or c) installing a barrier/fence around the unit to create an open topped enclosure.

The required level of reduction *can* be achieved by installing a full ventilated acoustic enclosure. Such an enclosure is usually metal clad with an inner layer of acoustically absorbent insulation – with a staggered air path (louvres placed to the side of the fan opening, rather than directly in front).

These enclosures typically achieve noise reductions of anywhere between 12 and 26 dB(A).

A suitable enclosure could be sourced from Environ, who produce domestic acoustic enclosures for condensers that are able to achieve a sound transmission loss of 22 dB(A). More information on this enclosure (and alternatives) is given in **Appendix E.2**, including the manufacturer's claimed transmission losses. This enclosure would be sufficient to meet the noise limit in this case.

The applicant should submit a datasheet from the enclosure manufacturer which verifies that it can reduce noise emissions by a minimum of 14 dB(A).

6.0 Vibration Assessment

The external unit should be installed using anti-vibration fixings and rubber washings on screws/bolts, to dampen vibration transmitting through the fixings and radiating through the structure. This is particularly important when a unit is fixed to the external wall.

Such mounts would usually be made of a resilient material such as rubber and are usually supplied by the manufacturer (as standard) and then applied to any connection with the structure, including floors, walls, and soffits.

An acoustic enclosure will also inherently include anti-vibration measures.

However, in the unlikely event that the applicant receives a formal complaint from the neighbouring property, the applicant is committed to investigating the source of the problem and re-installing the offending unit on an upgraded anti-vibration mount if necessary.

This further action is unlikely to be required as the risk of vibration is considered to be very low. Domestic ASHPs are regularly installed into similar properties with minimal risk of vibration impact.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e., 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.

A.2 – Subjective Changes in Noise Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies and Guidelines

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by ... preventing new and existing development from contributing to, being put at unacceptable risk from ... noise pollution"*.

B.2 – Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."* It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- **NOEL – No Observed Effect Level** - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- **LOAEL – Lowest Observed Adverse Effect Level** - This is the level above which *adverse* effects on health and quality of life can be detected.
- **SOAEL – Significant Observed Adverse Effect Level** - This is the level above which *significant adverse* effects on health and quality of life occur.

Under the first aim of the NPSE (*"avoid significant adverse impacts on health and quality of life"*), an impact in line with SOAEL should be avoided. Under the second aim (*"mitigate and minimise adverse impacts on health and quality of life"*), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions from the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e., changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level ¹			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g., turning up the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent
¹ This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.			

Appendix C – Noise Survey Methodology

C.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meter was calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meter has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of as BS EN 60942:2003 Class 1 device.

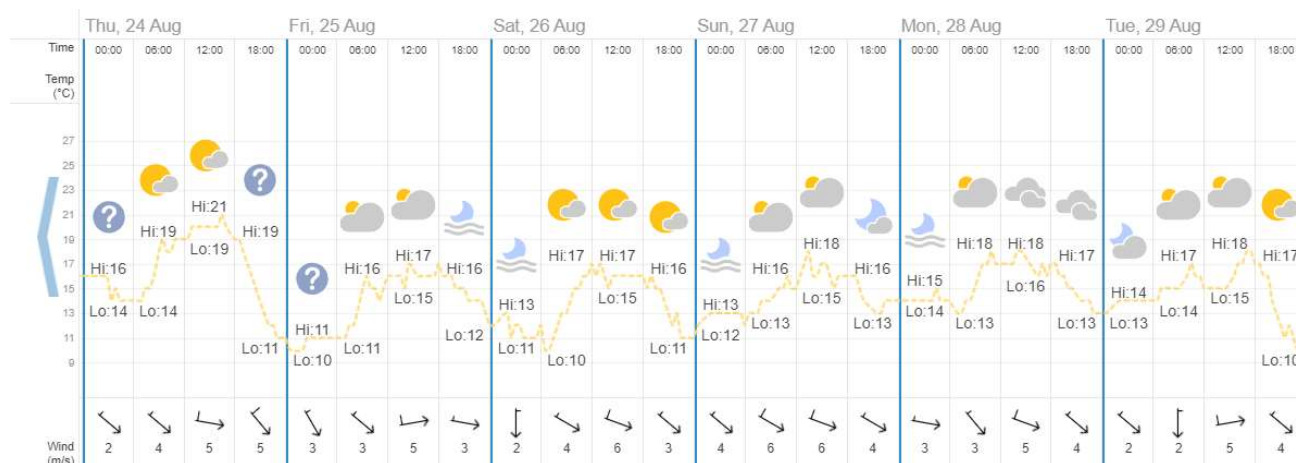
Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
SVAN 949 Class 1 Sound Level Meter	9720	Nov-21	Nov-23
SV22 Class 1 Microphone	4012386	Nov-21	Nov-23
Cirrus CRL511E Class 1 Acoustic Calibrator	035235	Nov-22	Nov-23

C.2 – Meteorological Conditions

During the survey, weather conditions were generally dry and warm with wind speeds less than 6 ms^{-1} (the microphone was fitted with a weather protection kit/windshield). These weather conditions are suitable for the measurement of environmental noise in accordance with BS 7445 'Description and Measurement of Environmental Noise'. The weather data below has been sourced from <https://www.timeanddate.com/weather/@2648385/historic>

Figure C.1 – Meteorological conditions during the survey



C.3 – Photos

Figure C.2 – Photographs of the monitoring position



Appendix D – Calculations

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines, and calculation algorithms, including those set out in ISO 9613-2:1996.

All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Where OpenStreetMap contains little or inaccurate information, the objects have been drawn manually. The scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting L_{Aeq} noise emissions from the proposed plant.

The noise model has assumed:

- downwind propagation, i.e., a wind direction that assists the propagation of sound from source to receptor, as a worst-case;
- a maximum reflection factor of three where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- a ground absorption factor of 0 to represent hard, reflective ground as a worst-case.
- receptor heights on the façade at ground floor (1.5m) and 1st floor (4m) window heights, placed at 1m outside of elevations which contain windows.
- a receptor is also placed 1m in front of the unit at a height of 1.5m above ground (to replicate the measurement position from the manufacturers testing).
- atmospheric sound absorption based upon a temperature of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996

The images on the following pages contain the results of the mapping.

Figure D.1 – 3D view of the model setup

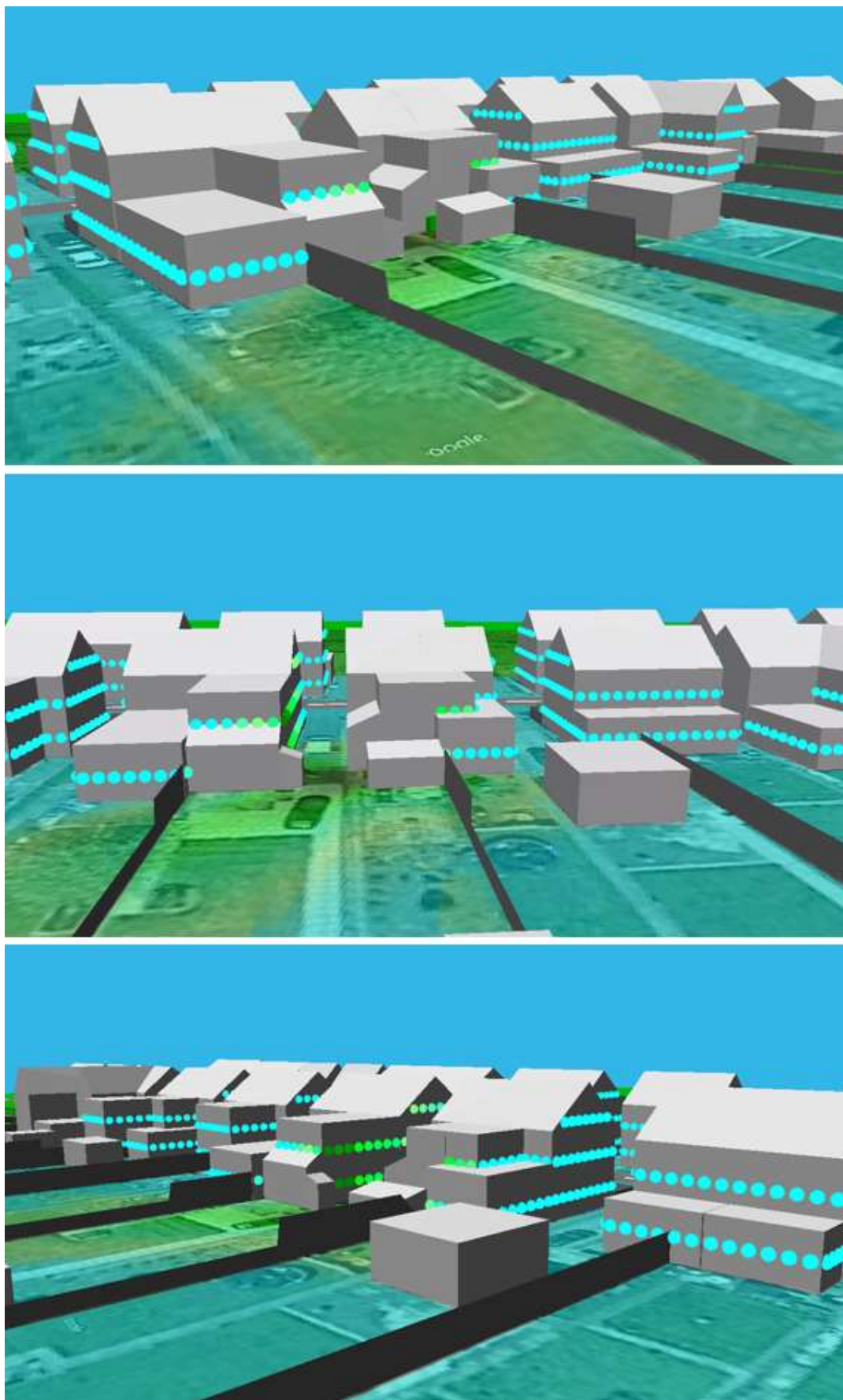


Figure D.2 – Predicted specific noise levels (dB LAeq) – heating mode – Ground floor facades (1.5m), Receptor gardens (1.5m)

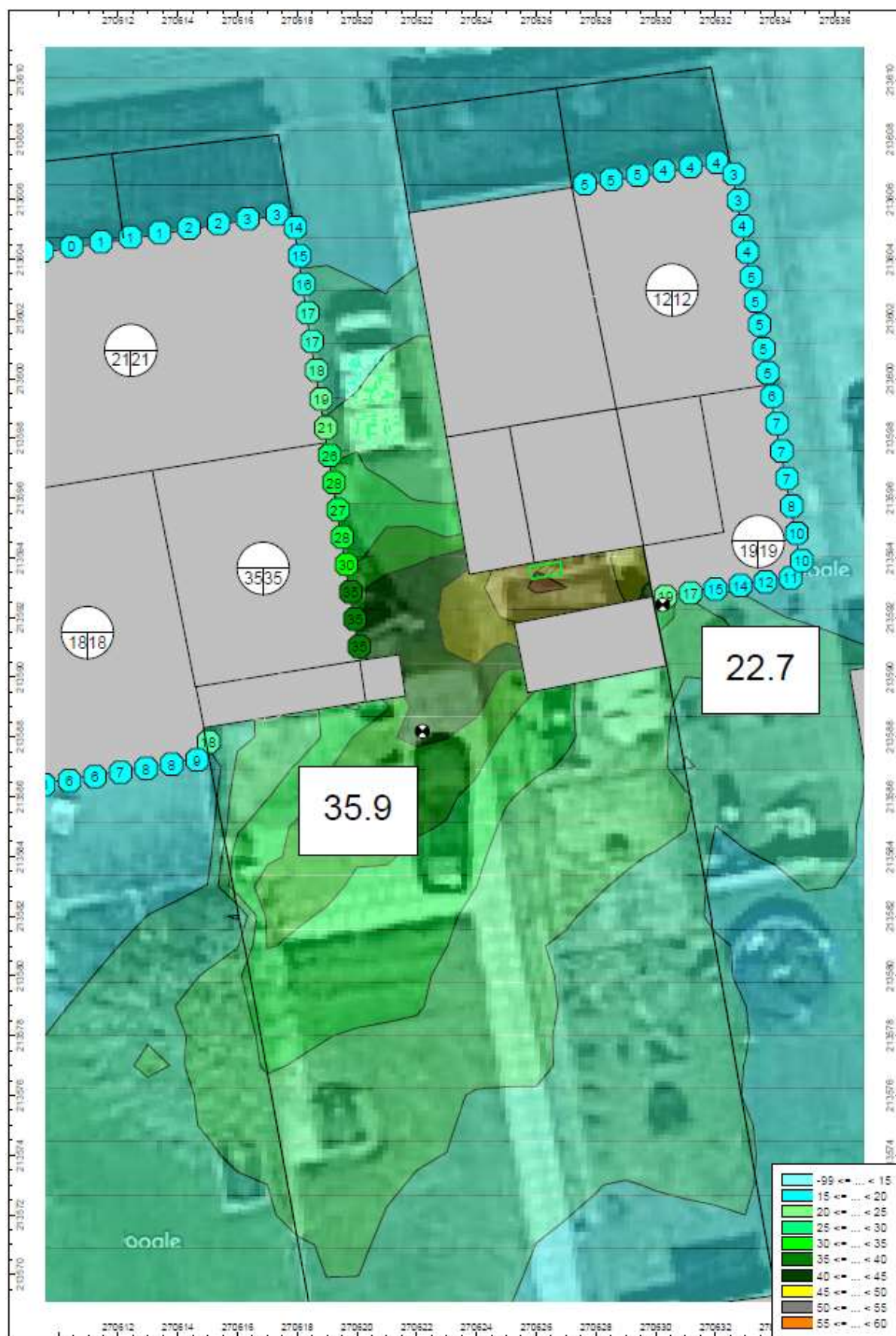


Figure D.3 – Predicted specific noise levels (dB LAeq) – heating mode – First floor facades (4m)



Figure D.4 – Predicted specific noise levels (dB LAeq) – cooling mode – Ground floor facades (1.5m), Receptor gardens (1.5m)

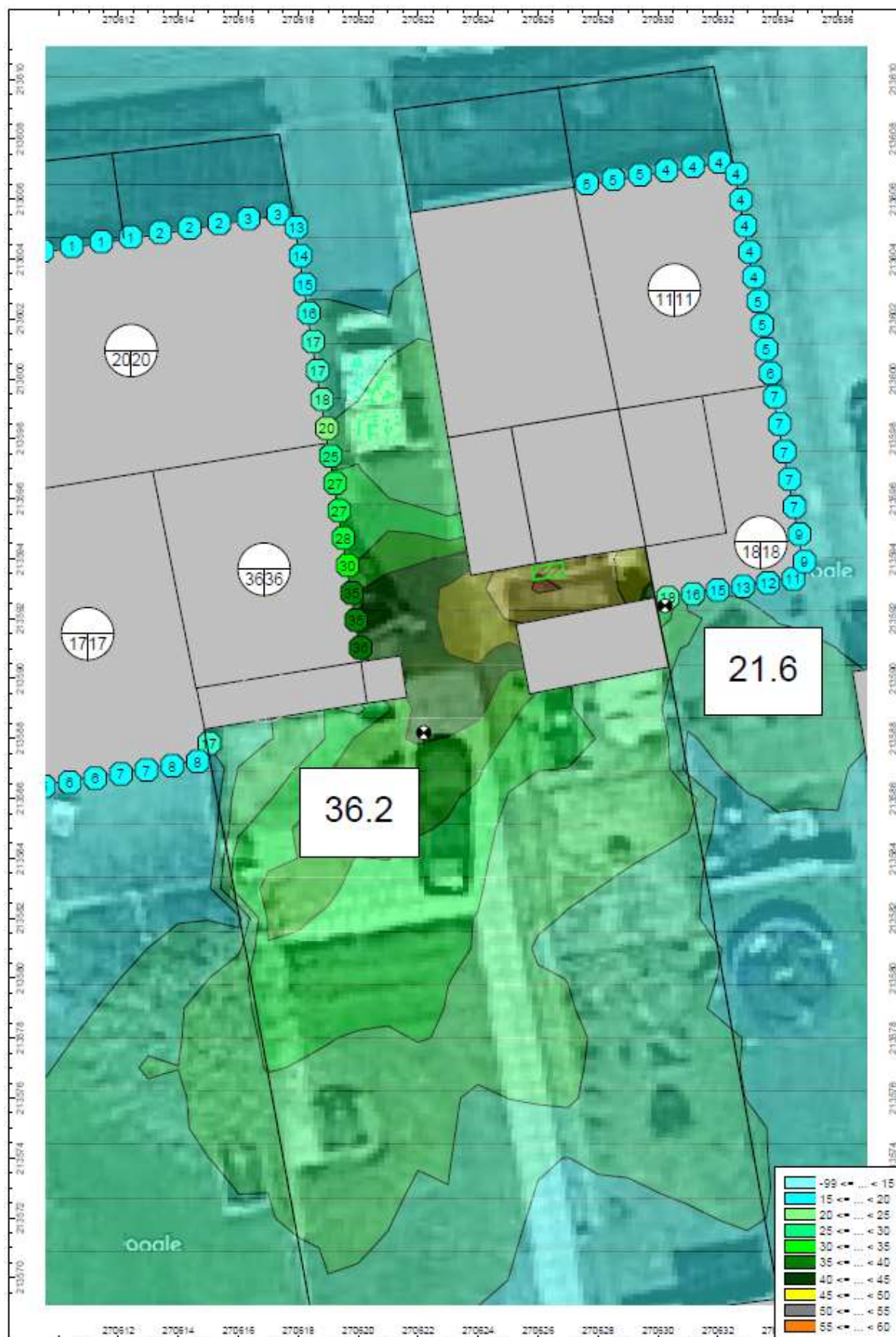


Figure D.5 – Predicted specific noise levels (dB L_{Aeq}) – cooling mode – First floor facades (4m)



Appendix E – Manufacturer Data

E.1 – ASHP

Heating

Product Information

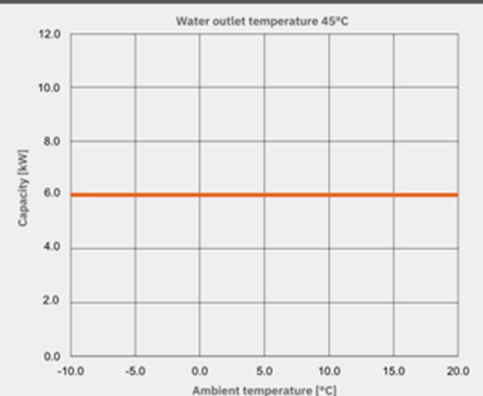
PUZ-WM60VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT	PUZ-WM60VAA(-BS)	
HEAT PUMP SPACE HEATER - 55°C	ErP Rating η_{hp} SCOP (MCS)	A++ 142% 3.57
HEAT PUMP SPACE HEATER - 35°C	ErP Rating η_{hp} SCOP (MCS)	A+++ 190% 4.81
HEAT PUMP COMBINATION HEATER - Large Profile ¹	ErP Rating η_{hp}	A+ 145%
HEATING ² (A-7/W35)	Capacity (kW) Power Input (kW) COP	6.0 1.88 3.20
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35
SOUND DATA ³	Pressure Level at 1m (dBA) Power Level (dB(A)) ⁴	45 58
WATER DATA	Pipework Size (mm) Flow Rate (l/min) Water Pressure Drop (kPa)	22 17 8.0
DIMENSIONS (mm)	Width Depth Height	1050 480 1020
WEIGHT (kg)		98
ELECTRICAL DATA	Electrical Supply Phase Nominal Running Current [MAX] (A) ⁵ Fuse Rating - MCB Sizes (A) ⁶	220-240V, 50Hz Single 5.68 [13] 16
REFRIGERANT CHARGE (kg) / CO ₂ EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

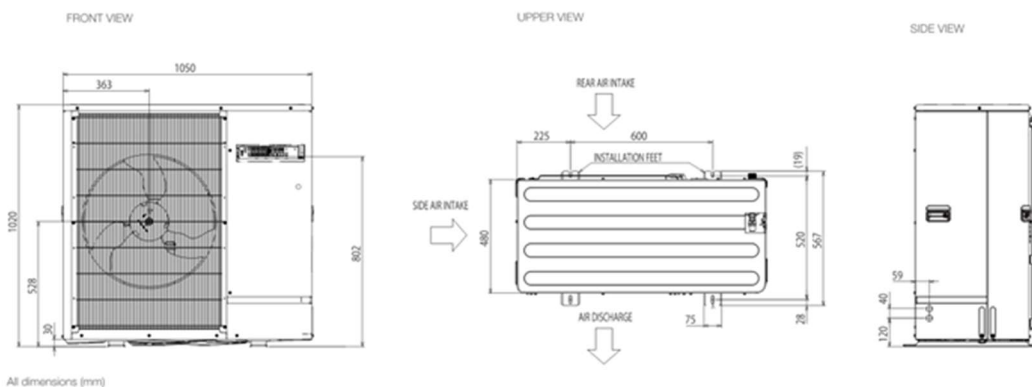
Notes:

- ¹⁾ Combination with E*PT20X Cylinder
²⁾ Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
³⁾ Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.
⁴⁾ Sound power level tested to BS EN12102.
⁵⁾ Under normal heating conditions at outdoor temp: 7°C, outlet water temp: 35°C.
⁶⁾ MCB Sizes BS EN60898-2 & BS EN60947-2.
 η_{hp} is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

NOMINAL HEATING CAPACITY



PUZ-WM60VAA(-BS) DIMENSIONS



All dimensions (mm)



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Note: Refer to "Installation Manual" and "Instruction Book" for further "Technical Information". The fuse rating is for guidance only and please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R32 (GWP:675), R407C (GWP:1774), R134a (GWP:1430), R133a (GWP:831), R454B (GWP:466), R1234ze (GWP:7) or R1234yf (GWP:4). These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No 605/2011 from IPCC 3rd edition, these are as follows: R410A (GWP:1975), R32 (GWP:555), R407C (GWP:1655) or R134a (GWP:1300).

Effective as of August 2020



Green Gateway greengateway.mitsubishielectric.co.uk

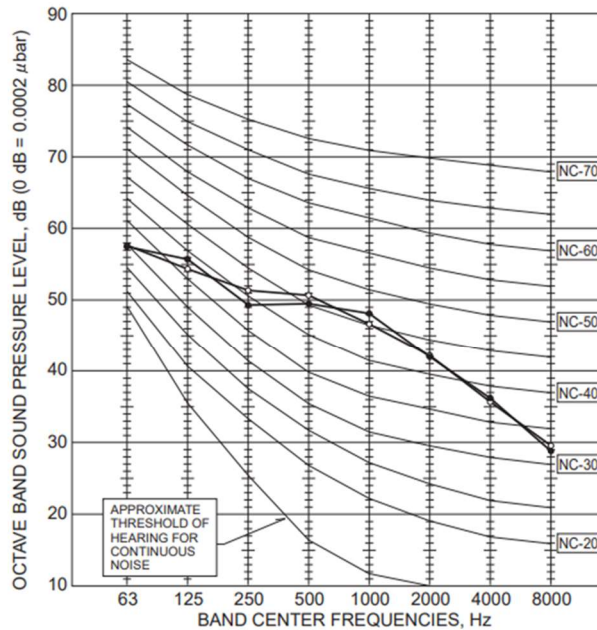
6 Noise criterion curves

Outdoor uni

(1) Packaged-type units

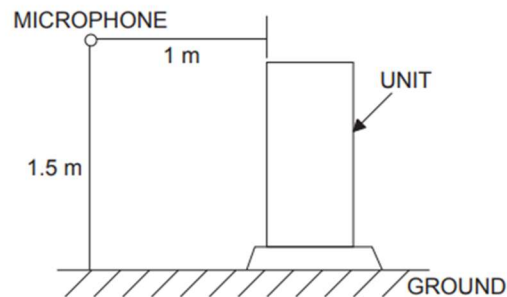
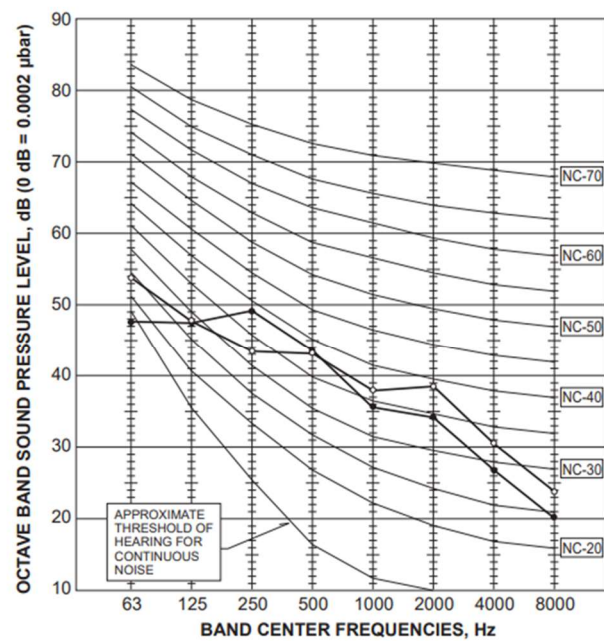
■ PUZ-WM50VHA(-BS)

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



■ PUZ-WM60VAA(-BS) PUZ-WM85VAA(-BS) PUZ-WM85YAA(-BS)

MODE	SPL(dB)	LINE
COOLING	45	○—○
HEATING	45	●—●



<Notes>

- 1) Sound data is taken when the system is running stably.
- 2) Relatively large noise could be heard transiently in the case 4-way valve, or LEV operates.

E.2 – Acoustic Enclosure

A specialist acoustic enclosure is usually metal clad with an inner layer of acoustically absorbent insulation – with a staggered air path (louvres placed to the side of the fan opening, rather than directly in front). These enclosures are typically capable of achieving noise reductions of anywhere between 15 and 26 dB(A).

A suitable enclosure could be sourced from Environ ⁶, who produce domestic acoustic enclosures for condensers that are able to achieve a sound transmission loss of 22 dB(A) (albeit typically closer to 18 – 22 dB(A), depending on the frequency spectrum of the noise source). The manufacturer claimed transmission losses from Environ (based upon an environlite ELV1.1.25AC product or similar) are shown in **Table E.1** below and in **Figure E.2** overleaf. The enclosures look like those in **Figure E.1**.

Table E.1 – Transmission loss of an *Environ* acoustic enclosure

	Transmission Loss						
	dB at Octave Band Centre Frequencies, Hz						
	63	125	250	500	1 k	2 k	4 k
environlite ELV1.1.25AC acoustic enclosure	11	13	19	28	34	36	36

Figure E.1 – *Environ* acoustic enclosure



Other manufacturers ^{7 8 9 10 11} are available who may be able to supply enclosures that achieve a similar loss (Environ data has been presented as it is more publicly available, and the design of these enclosures included a staggered/dog leg type air path through the sides of the enclosure which theoretically make them perform better than other enclosures where the air intake is in front out the fan outlet).

6 - <https://www.environ.co.uk/domestic/>

7 - <https://www.soundplanning.co.uk/acoustic-enclosures/>

8 - <https://www.bas-ltd.co.uk/>

9 - <https://www.acoustic-enclosures.uk/product/air-conditioning-and-heat-pump-enclosures>

10 - <https://acousticenclosuresltd.co.uk/>

11 - <https://www.environgroup.uk/>

Figure E.2 – *Environ* acoustic enclosure – acoustic data



Environ Technologies Ltd

Regus House, 1010 Cambourne Business Park
Cambourne, Cambridgeshire, UK, CB23 6DP
Tel: +44 (0)870 383 3344
Fax: +44 (0)1223 598001
www.environ.co.uk

ENVIRON SYSTEM ACOUSTICAL DATA

Noise Measurement Information:

Test: Environ Lite Acoustic Enclosure

Test Standard:

BS EN ISO 140-3 Acoustics - Measurement of Sound Insulation in Buildings and of Building Elements - Part 1:
Airborne Sound Insulation

Sound Level Measuring Equipment:

Norsonic 830 RTA Precision Sound Analyser Type 1
CEL 284/2 Acoustic Calibrator Type 1
JBL Loudspeaker driven by CEL Loudspeaker driven by 830 White Noise Source

Transmission Loss Data:

Transmission Loss — Environ ELV1.1.25AC Acoustic Enclosure							
Octave Frequency in Hertz (dB ref 2×10^{-5} Pascal's)							
63	125	250	500	1K	2K	4K	8K
11	13	19	28	34	36	36	37
Summary							
Transmission Loss Equates to an Overall Reduction of 22 dB(A)							

Support Information:

Monitoring was carried out using the BS3740 technique, insofar as measurements were taken in each quadrant and the results averaged. Internal Test Room: W 6m x D 16m x H 5m. Background noise in the semi-reverberant test room was such as not to interfere with the practical measurements

IMPORTANT NOTE: acoustic performance based on accuracy of equipment noise & ventilation data

Environ acoustic enclosure designs are protected under patent



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