

138-144 Friar Street Reading

Noise Impact Assessment Report
Report 24329.NIA.01 Rev A

Thackeray Estates Reading Investments Limited

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1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Thackeray Estates Reading Investments Limited to assess the suitability of the site at 138-144 Friar Street, Reading, RG1 1DP for a hotel development in accordance with the provisions of the National Planning Policy Framework and the Noise Policy Statement for England (NPSE).

This report presents the results of the environmental survey undertaken in order to measure prevailing background noise levels and outlines any necessary mitigation measures.

2.0 SITE SURVEYS

2.1 Site Description

The site is bounded by Friar Street to the north, residential and commercial buildings to the west and east, and a small parking area to the south. At the time of the survey, the background noise climate was dominated by road traffic noise from Friar Street.

2.2 Environmental Noise Survey Procedure

A noise survey was undertaken on the proposed site as shown in Figure 2.1. The location was chosen in order to collect data representative of the worst-case levels expected on the site due to all nearby sources.

Continuous automated monitoring was undertaken for the duration of the survey between 13:25 on 19/05/2022 and 11:35 on 23/05/2022.

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*'.

2.3 Measurement Positions

Measurement positions are as described within Table 2.1 and shown within Figure 2.1.

Icon	Descriptor	Location Description
	Noise Measurement Position 1	The microphone was installed on a window on the second floor of the north façade. A correction of 3dB has been applied to account for non-free field conditions.
	Noise Measurement Position 2	The microphone was installed on a tripod (1.2m from the ground) on the first-floor roof terrace at the south façade.

Table 2.1 Measurement positions and descriptions



Figure 2.1 Site measurement positions (Image Source: Google Maps)

2.4 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.2.

Measurement instrumentation		Serial no.	Date	Cert no.
B&K 01	Brüel & Kjær 2250 Class 1 Sound Level Meter	2644992	11/01/2022	2022-0145
	Free-field microphone	2378044		
	Preamplifier	06995		
	Brüel & Kjær windshield	-		
B&K 02	Brüel & Kjær 2250 Class 1 Sound Level Meter	2506557	06/01/2022	2022-0118
	Free-field microphone	2786879		
	Preamplifier	17002		
	Brüel & Kjær windshield	-		
Larson Davis CAL200 Class 1 Calibrator		17148	18/03/2022	UCRT22/13 97

Table 2.2 Measurement instrumentation

3.0 RESULTS

3.1 Noise Survey

The $L_{Aeq}: 5min$, $L_{Amax}: 5min$, $L_{A10}: 5min$ and $L_{A90}: 5min$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as time histories in Figures 24329.TH1-2 for noise monitoring positions 1 and 2 respectively. Measured noise levels are representative of noise exposure levels expected to be experienced by all facades of the proposed development, and are shown in Table 3.1.

Time Period	Noise Measurement Position 1 (Measured Noise level – dBA)	Noise Measurement Position 2 (Measured Noise level – dBA)
Daytime $L_{Aeq,16hour}$	67	52
Night-time $L_{Aeq,8hour}$	64	50

Table 3.1 Site average noise levels for daytime and night time

4.0 NOISE ASSESSMENT GUIDANCE

4.1 Noise Policy Statement For England 2021

The National Planning Policy Framework (NPPF) has superseded and replaces Planning Policy Guidance Note 24 (PPG24), which previously covered issues relating to noise and planning in England. Paragraph 174 of NPPF 2021 states that planning policies and decisions should aim to:

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans

In addition, Paragraph 185 of the NPPF states that *‘Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should’:*

- Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life

- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

The Noise Policy Statement for England (NPSE) was developed by DEFRA and published in March 2010 with the aim to 'Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development.'

Noise Policy Statement England (NPSE) noise policy aims are as follows:

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 Noise Policy Statement England (NPSE) outlines observed effect levels relating to the above, as follows:

- 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.

As stated in The Noise Policy Statement England (NPSE), it is not currently possible to have a single objective based measure that defines SOAEL that is applicable to all sources of noise in all situations. Specific noise levels are not stated within the guidance for this reason, and allow flexibility in the policy until further guidance is available.

4.2 Planning Practice Guidance – Noise (PPG-N)

Planning Practice Guidance – Noise (PPG) was introduced by the Ministry of Housing, Communities & Local Government in March 2014 and revised in July 2019. It is an online digital resource that “advises on how planning can manage potential noise impacts in new development”. It gives guidance on establishing whether noise will likely cause a concern, factors of influence on noise impact and methods by which planning can address adverse effects of noise sources.

A noise exposure hierarchy table is provided within the guidance that follows the same observed effect descriptors given within the NPSE guidance, i.e. NOEL, NOAEL and LOAEL and SOAEL.

For a NOAEL descriptor: “A noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life”

4.3 ProPG: Planning and Noise

As outlined above, the National Planning Policy Framework encourages improved standards of design, although it provides no specific noise levels which should be achieved on site for varying standards of acoustic acceptability, or a prescriptive method for the assessment of noise.

ProPG: Planning and Noise was published in May 2017 in order to encourage better acoustic design for new residential schemes in order to protect future residents from the harmful effects of noise. This guidance can be seen as the missing link between the current NPPF and its predecessor, PPG24 (Planning Policy Guidance 24: Planning and Noise), which provided a prescriptive method for assessing sites for residential development, but without the nuance of ‘good acoustic design’ as outlined in ProPG.

ProPG allows the assessor to take a holistic approach to consider the site’s suitability, taking into consideration numerous design factors which previously may not have been considered alongside the noise level measured on site, for example the orientation of the building in relation to the main source of noise incident upon it.

It should be noted this document is not an official government code of practice, and neither replaces nor provides an authoritative interpretation of the law or government policy, and therefore should be seen as a good practice document only.

4.4 BS8233:2014

BS8233:2014 ‘*Sound insulation and noise reduction for buildings*’ describes recommended internal noise levels for residential spaces, which can be used to establish suitable noise criteria for hotel guest rooms. The recommended internal noise levels are shown in Table 4.1.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Rooms	35 dB(A)	-
Dining	Dining Room/area	40 dB(A)	-
Sleeping (daytime resting)	Bedrooms	35 dB(A)	30 dB(A)

Table 4.1 BS8233 recommended internal background noise levels

It should be noted that the recommended internal noise levels outlined above are not applicable under “purge ventilation” conditions as defined by Approved Document F of the Building Regulations, as this should only occur occasionally (E.G. to remove odour from painting or burnt food). However, the levels above should be achieved whilst providing sufficient background ventilation, either via passive or mechanical methods.

The external building fabric would need to be carefully designed to achieve these recommended internal levels.

4.5 WHO Guidelines for Community Noise (1999)

WHO Guidelines for Community Noise (1999) recommends that internal noise levels for individual events should not exceed 45dB L_{Amax} more than 10-15 times per night.

It should be noted that this impact is increasingly being regarded as ‘LOAEL’ for this number of exceedances, as described in Section 4.1.

The external building fabric would need to be carefully designed to ensure that the above guidance is achieved.

4.6 Client Requirements – BS8233 Annex H: Examples of design criteria adopted by hotel groups

In addition to current legislation, the client has specified that the acoustic performance of the hotel should be consistent with all recommendations for hotels outlined in Annex H of BS8233.

The recommend indoor ambient noise level ranges for hotels bedrooms given in Annex H of BS8233 are shown in Table 4.2 below. The external building fabric would need to be carefully designed to ensure that the indoor ambient noise levels adhere to the ranges given in Annex H of BS8233.

Period	Noise Level
Daytime (07:00 – 23:00 hours)	30 – 40dB $L_{Aeq,1hour}$
Night-time (23:00 – 07:00 hours)	25 – 35dB $L_{Aeq,1hour}$
	45 – 55dB L_{Amax}

Table 4.2 Indoor Ambient Noise Levels Ranges for Hotel Bedrooms from BS8233:2014

5.0 EXTERNAL BUILDING FABRIC SPECIFICATION

Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed and non-glazed elements in order to achieve the recommended internal noise levels shown in Table 4.1, taking into account average and maximum noise levels monitored during the environmental noise survey.

Typical smaller-sized bedrooms with a high ratio of glazing to masonry have been used for all calculations in order to specify glazing for a worst-case scenario.

As a more robust assessment, L_{Amax} spectrum values of night-time peaks have also been considered and incorporated into the glazing calculation in order to cater for the interior limit of 45 dB L_{Amax} for individual events, as recommended in WHO Guidelines.

Please note that the glazed and non-glazed element calculations would need to be finalised once all design proposals are finalised.

5.1 Non-Glazed Elements

It is currently understood that the non-glazed building façade is comprised of the elements as shown within Table 5.1 based on the construction detail provided. The anticipated sound reduction index has been calculated, and would be expected to provide the minimum figures shown in Table 5.1 when tested in accordance with BS EN ISO, 140-3:1995.

Element	Octave band centre frequency SRI, dB					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Brickwork Cavity Wall	41	43	48	50	55	55

Table 5.1 Assumed sound reduction performance for non-glazed elements

5.2 Glazed Elements

Minimum octave band sound reduction index (SRI) values required for all glazed elements to be installed are shown in Table 5.2. The performance is specified for the whole window unit, including the frame and other design features such as the inclusion of trickle vents. Sole glass performance data would not demonstrate compliance with this specification.

Glazing performance calculations have been based both on average measured night-time noise levels as well as verified against the L_{Amax} spectrum of individual events in order to comply with a maximum internal noise level of 45dB(A) in bedrooms as recommended by World Health Organisation Guidelines. The combined most robust results of these calculations are shown in Table 5.2.

Glazing Type	Octave band centre frequency SRI, dB						$R_w(C;C_{tr})$, dB
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	
Glazing Type 1 █	29	27	35	37	36	45	36 (-1;-3)
Glazing Type 2 █	22	20	26	36	39	31	31 (-1;-4)

Table 5.2 Required glazing performance

The glazing types mentioned above are shown in Figure 5.1 below.

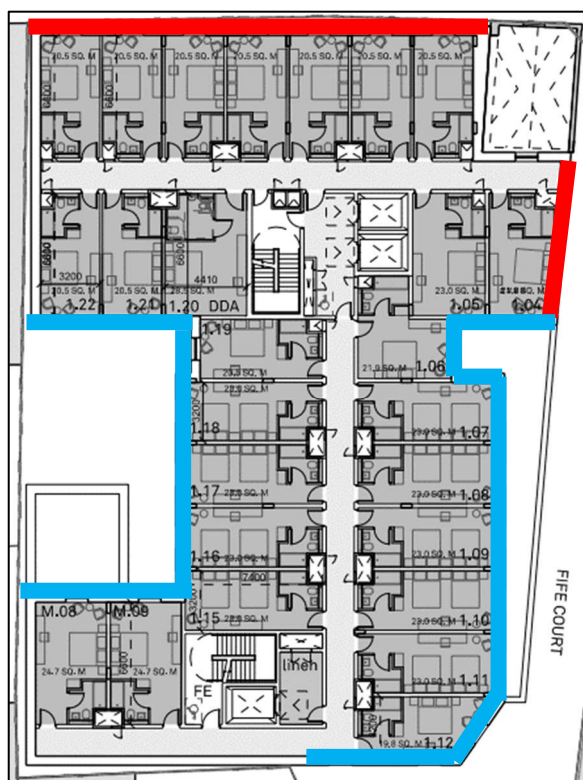


Figure 5.1 Glazing types (Drawing Source: Falconer Chester Hall)

The nominated glazing supplier should verify that their proposed window system meets the attenuation figures shown at each centre frequency band as shown in Table 5.2.

Example glazing types that would be expected achieve the above spectral values are shown in Table 5.3.

Glazing Type	Example glazing type
Glazing Type 1 	8/12/10mm
Glazing Type 2 	4/12/4mm

Table 5.3 Example glazing types

All major building elements should be tested in accordance with BS EN ISO 140-3:1995.

Independent testing at a UKAS accredited laboratory will be required in order to confirm the performance of the chosen system for an 'actual' configuration.

5.3 Ventilation Strategy

It is currently understood that the proposed ventilation strategy is to utilise a continuous mechanical supply and extract system in order to ventilate the building.

In the case of mechanical ventilation, systems should be designed to meet the internal noise levels as defined in CIBSE Guide A (2015), as shown in Table 5.4.

Room Type	LAeq, dB	NR
Bedrooms	30	25
Living Rooms	35	30
Kitchen	45-50	40-45

Table 5.4 CIBSE Guide A 2015 guidance levels for mechanical building services

In all cases, purge ventilation would be provided by openable windows. As outlined in Section 4.4, the internal noise level requirement would not be applicable during purge conditions as this would only occur occasionally.

6.0 PLANT NOISE IMPACT ASSESSMENT

6.1 Local Authority Guidance

Reading Borough Council have provided the following guidance concerning a noise assessment for new plant unit installations:

Noise assessments should be prepared by suitably qualified acousticians. They should usually outline the existing noise environment, the potential noise sources from the development, or the noise sources likely to affect the development, together with any mitigation measures. Advice should be sought from the council's Public Protection Service for individual requirements. (BS4142).

The assessment should include information about: the sound power level and the likely resultant noise level of equipment at the site boundary for all noise-producing machinery such as extract ventilation systems, refrigeration equipment etc. that is likely to be installed; where any noise-generating plant or equipment will be located and installed so as to reduce noise impacts on neighbouring properties; delivery times and opening hours for commercial premises within noise sensitive areas; details of waste collection for example pubs/clubs where glass collection could be noisy.

6.2 BS4142: 2014 'Methods for rating and assessing industrial and commercial sound'

British Standard BS4142:2014 'Methods for rating and assessing industrial and commercial sound' describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes
- Sound from fixed installations which comprise mechanical and electrical plant and equipment
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

This Standard compares the Rating Level due to the noise source/s under assessment for a one-hour period during the daytime (07:00 – 23:00 hours) and a fifteen-minute period during the night-time (23:00 – 07:00 hours) with the existing background noise level in terms of an L_{A90} when the noise source is not operating.

It should be noted that the Rating Level is the Specific Sound Level in question ($L_{Aeq, Tr}$), including any relevant acoustic feature corrections, as follows:

- **Tonality** – *‘For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible’*
- **Impulsivity** – *‘A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible’*
- **Intermittency** – *‘If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied’*
- **Other sound characteristics** – *‘Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied’*

Once the Rating Level has been obtained, the representative background sound level is subtracted from the Rating Level to obtain an initial estimate of the impact, as follows:

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

NOTE: Adverse impacts may include but not be limited to annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

6.3 Background Noise Levels and Noise Criteria

Representative background noise levels measured on site at noise measurement position 2 are shown in Table 6.1 for daytime and night-time.

Time Period	Representative background noise level L_{A90} dB(A)
Daytime (07:00-23:00)	49
Night-time (23:00-07:00)	46

Table 6.1 Representative background noise levels

In order to ensure that noise emissions from any proposed plant would have no adverse impact upon the neighbouring properties or proposed hotel windows, we would propose that it does not exceed a level of 5dB below the representative background noise level at 1m from the closest noise sensitive windows. As noted in section 6.2, *‘where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context’*. In this case, a level of 5dB below the representative background noise level would ensure that the existing background noise of the area broadly masks any noise from the plant at the closest receivers.

As the proposed plant could be used at any time of the day or night, the criterion has been set as shown in Table 6.2 in order to comply with the above requirements.

Time period	Noise Criterion at Nearest Receivers
Night-time (23:00 to 07:00)	41 dB(A)

Table 6.2 Proposed noise emissions criterion

6.4 Proposed Plant Installation

It is understood that the provisional plant selections are as follows:

- 8 No. Mitsubishi PURY-P200YLM-A1
- 2 No. Mitsubishi PURY-P250YLM-A1
- 1 No. Mitsubishi PURY-P300YLM-A1
- 2 No. Mitsubishi PURY-EM200YNW-A1
- 2 No. Mitsubishi PURY-EM250YNW-A1

- 2 No. Mitsubishi PURY-EM300YNW-A1
- 1 No. Mitsubishi MUZ-AP35VG
- 1 No. Mitsubishi MUZ-AP60VG
- Kitchen Extraction Fan
- Kitchen Supply Fan

Further to discussions with the project mechanical and electrical consultant, it should be noted that the plant selections presented above are based on typical selections and estimated load assessments, and are therefore not the finalised units. Once the final plant selections are made, this report would be updated accordingly.

The proposed installation location for the plant units will be on the rooftop of the development, as shown in Figure 6.1.

The noise emission levels as provided by the manufacturer for the units are shown in Table 6.3.

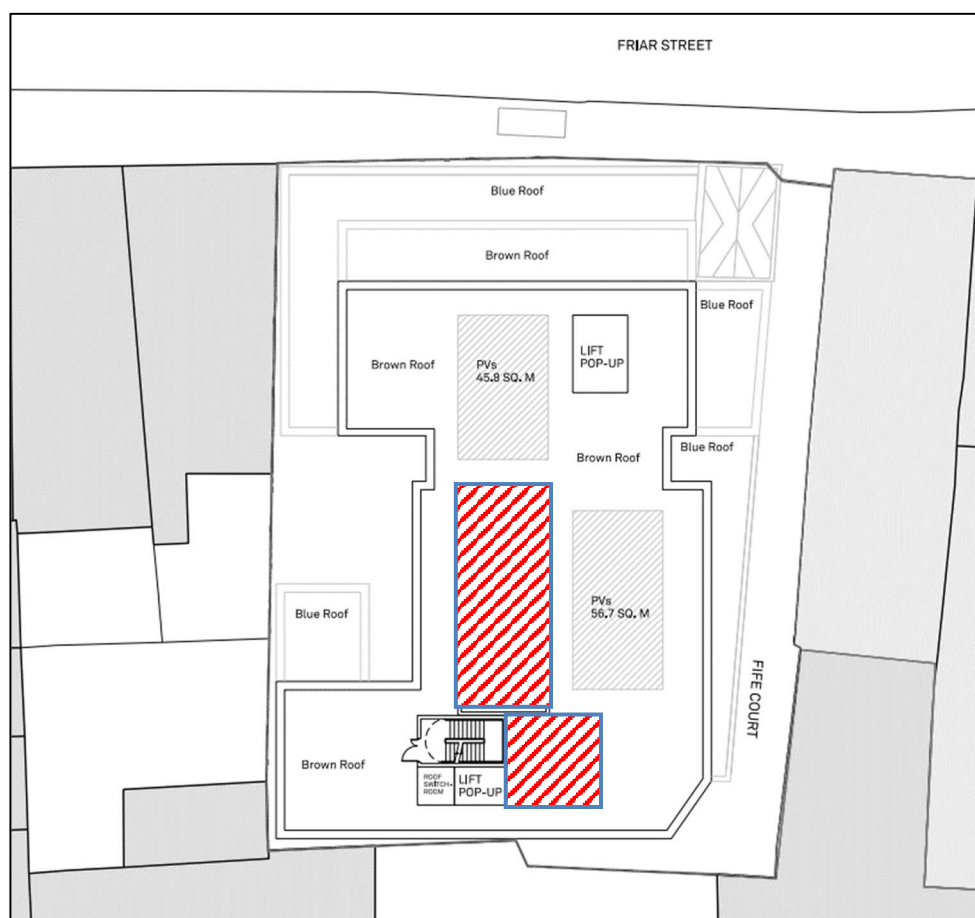


Figure 6.1 Proposed plant installation location, rooftop (Drawing Source: Troup Bywaters and Anders)

Unit	Descriptor	Octave Frequency Band (Hz)								Overall (dBA)
		63	125	250	500	1k	2k	4k	8k	
PURY-P200YLM-A1	SPL@1m (dB)	75	65	62	58	51	45	39	33	59
PURY-P250YLM-A1	SPL@1m (dB)	76	66	63	59	52	46	42	34	60
PURY-P300YLM-A1	SPL@1m (dB)	74	69	65	62	56	48	41	37	63
PURY-EM200YNW-A1	SPL@1m (dB)	77	61	61	58	51	47	44	42	59
PURY-EM250YNW-A1	SPL@1m (dB)	78	63	62	59	52	49	49	43	61
PURY-EM300YNW-A1	SPL@1m (dB)	76	63	63	60	54	50	45	49	61
MUZ-AP35VG	SPL@1m (dB)	49	50	51	47	44	43	37	33	50
MUZ-AP60VG	SPL@1m (dB)	64	60	58	55	52	48	42	36	57

Table 6.3 Plant Units Noise Emission Levels as provided by the manufacturer

6.5 Closest Noise Sensitive Receiver

The closest noise sensitive receiver to the proposed installation location has been identified as being a proposed seventh (mezzanine) floor window of the development, located approximately 6 metres from the proposed plant installation location, as shown in Figures 6.2 and 6.3 below.

In addition to the closest noise sensitive receiver, the worst-affected noise sensitive receiver has also been considered for plant noise emissions, which has been identified as being a eighth-floor front window of Novotel Reading, located approximately 40 metres from the proposed plant installation location, as shown in Figure 6.2 below.

It should be noted the proposed plant unit would be out of line of site of the receiving window at the development due to screening from the building envelope.



Figure 6.2 Closest noise sensitive receivers relative to plant installation (Image Source: Google Maps)

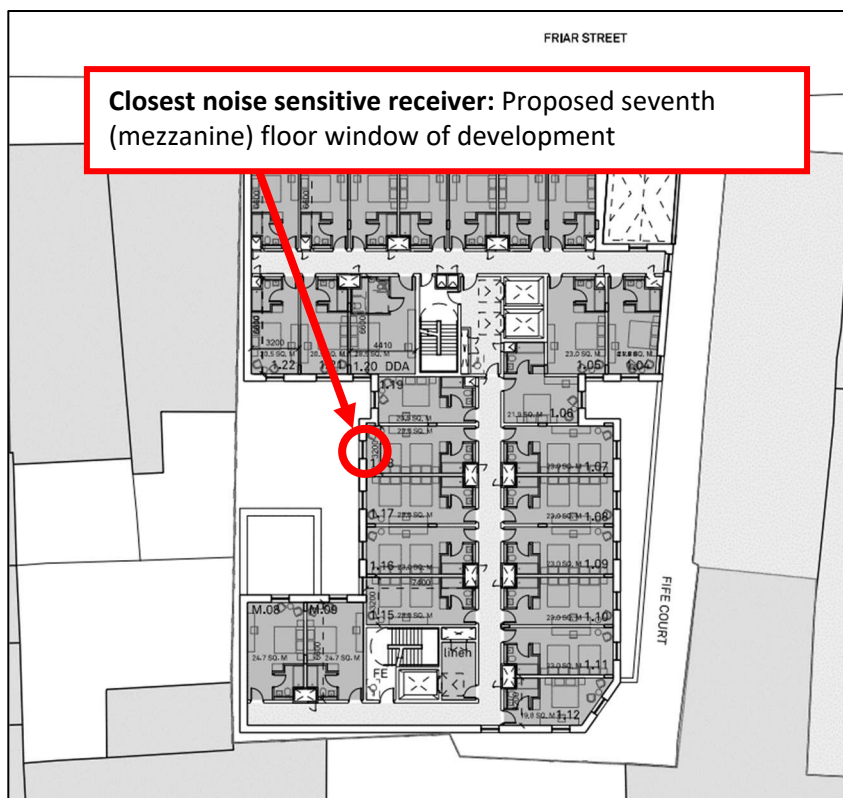


Figure 6.3 Closest noise sensitive receiver relative to plant installation (Drawing Source: Troup Bywaters and Anders)

6.6 Calculations

The 'Rating Level' of each plant unit installation has been calculated at 1m from the closest receivers using the noise levels shown in Table 6.3, and corrected due to different acoustic propagation features such as distance, reflective surfaces, screening elements, etc.

Acoustic feature corrections as per BS4142 have been applied for tonality, as the plant installation location would be considered to be tonal at the nearest noise sensitive receivers.

Detailed calculations for each plant unit installation are shown in Appendix B.

Receiver	Criterion	Noise Level at 1m From the Closest Noise Sensitive Window
Proposed seventh (mezzanine) floor window of development	39dB(A)	36dB(A)
Eighth-floor front window of Novotel Reading	39dB(A)	39dB(A)

Table 6.4 Predicted noise level and criterion at nearest noise sensitive location

As shown in Appendix B and Table 6.4, transmission of noise to the nearest sensitive windows due to the effects of the plant unit installation satisfies the emissions criterion of Reading Borough Council, providing that the mitigation measures outlined in Section 7 are implemented.

7.0 NOISE CONTROL MEASURES

In order to achieve the specific sound level and subsequent rating level shown in the assessment above, the following noise control strategy should be adopted.

7.1 Rooftop Plant Installation

In order to control the noise emissions from the rooftop plant installation, we would recommend that a plant enclosure is installed which should provide the minimum insertion loss levels shown in Table 7.1.

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Louvres of acoustic enclosure	4	4	6	8	11	11	11	10

Table 7.1 Insertion loss figures to be provided by acoustic enclosure

We would recommend the following suppliers of the aforementioned enclosure:

- Environmental Equipment Corporation
- Noico Ltd
- Waterloo Acoustics
- Allaway Acoustics
- Wakefield Acoustics
- Caice
- Environ

7.2 Anti-Vibration Mounting Strategy

In the case of all plant units, appropriate anti-vibration mounts should be installed in order to ensure that vibrations do not give rise to structure-borne noise. Appendix C outlines detailed advice in order to ensure that the system installer selects the appropriate anti-vibration mount for the installation.

It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail.

8.0 CONCLUSION

An environmental noise survey has been undertaken at 138-144 Friar Street, Reading, RG1 1DP allowing the assessment of daytime and night-time levels likely to be experienced by the proposed development.

Measured noise levels allowed a robust glazing specification to be proposed which would provide internal noise levels for all hotel guest room environments of the development commensurate to the design range of BS8233.

No further mitigation measures should be required in order to protect the proposed habitable spaces from external noise intrusion.

Manufacturer's noise data of proposed plant units has been used to obtain Specific and Rated Noise Level at the nearest noise sensitive receiver in accordance with British Standard BS4142:2014 for compliance with Reading Borough Council requirements.

The rating level was compared with the representative background noise level to assess the likelihood of impact considering the environmental noise context of the area as per the requirements of BS4142:2014.

It has been concluded that noise emissions from the proposed plant units would not have an adverse impact on the nearest noise sensitive receivers, identified as being the eighth-floor front window of Novotel Reading or the proposed seventh (mezzanine) floor window of development, provided that the noise control strategy presented in Section 7 is followed.

138-144 Friar Street, Reading - Front Facade
Environmental Noise Time History
19th May 2022 to 23rd May 2022

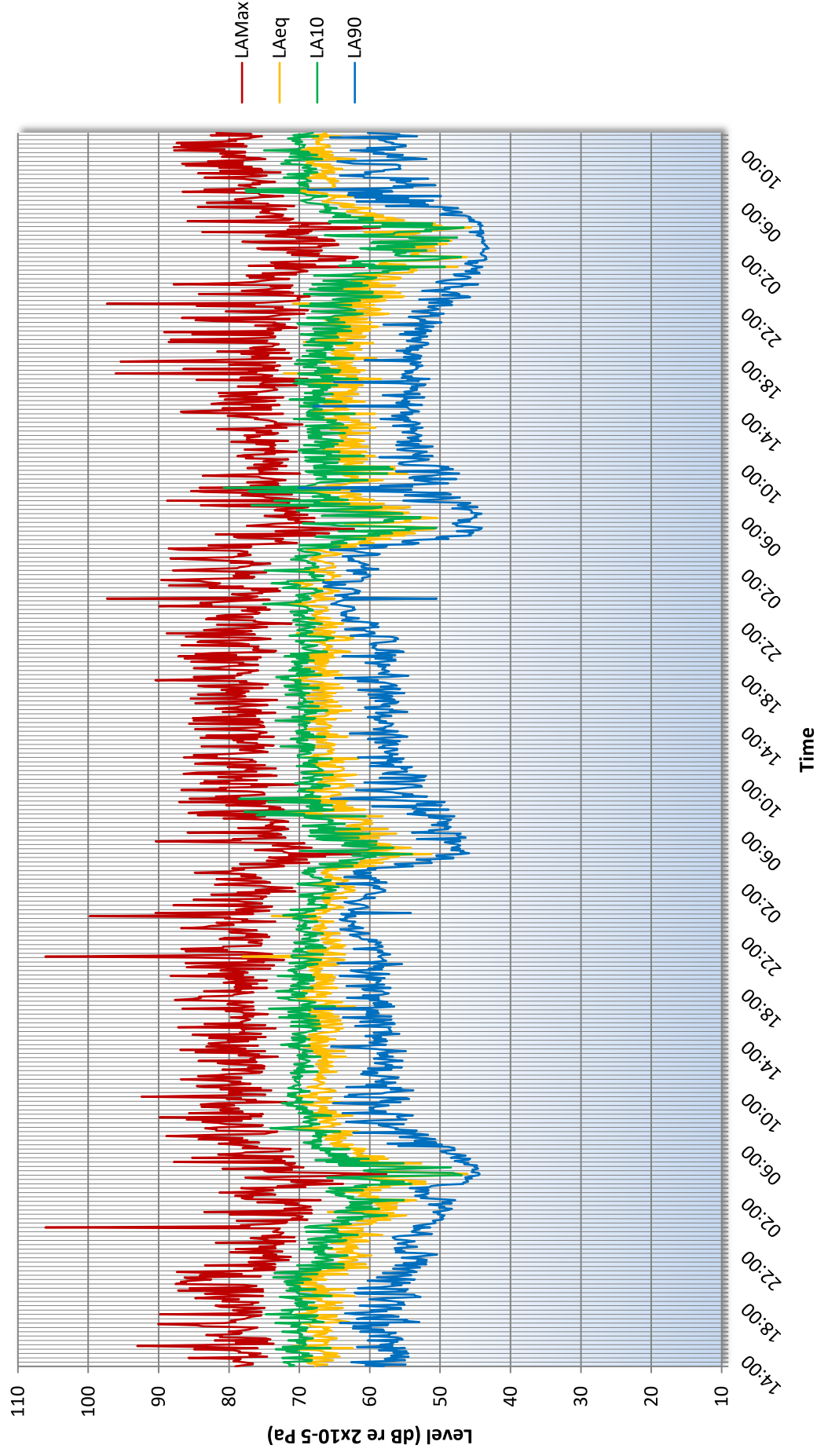
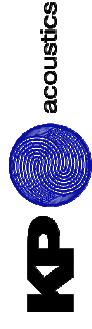


Figure 24329.TH1

138-144 Friar Street, Reading - Rear Facade
Environmental Noise Time History
19th May 2022 to 23rd May 2022

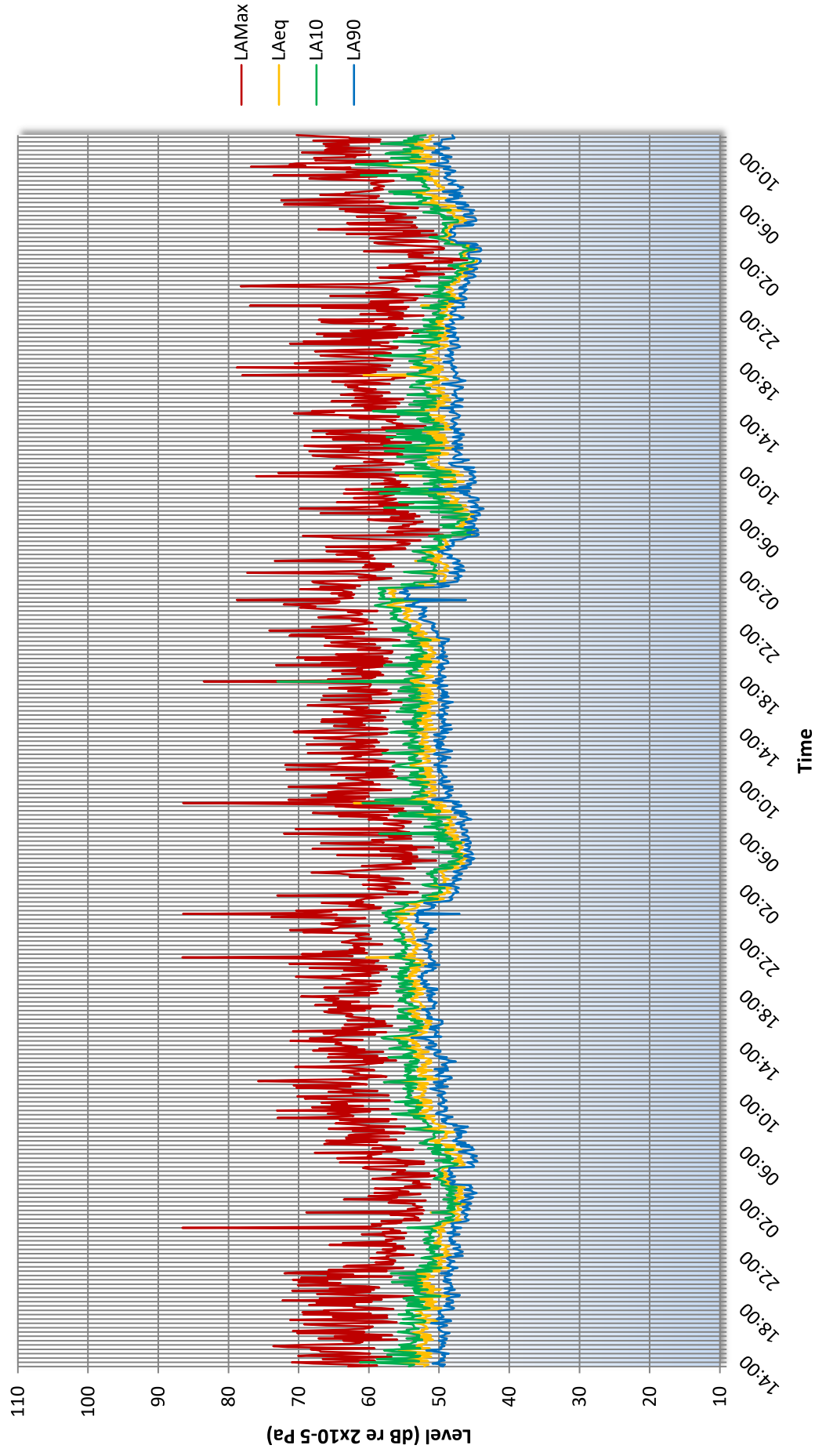


Figure 24329.TH2

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq} . The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

APPENDIX B

138-144 Friar Street, Reading

PLANT NOISE EMISSIONS CALCULATIONS

Source: Rooftop Plant Installation	Frequency, Hz								dB(A)
Receiver: Proposed seventh (mezzanine) floor window of development	63	125	250	500	1k	2k	4k	8k	
Mitsubishi PURY-P200YLM-A1 (SPL@1m, dB)	75	65	62	58	51	45	39	33	59
Correction for number of units (8),dB	9	9	9	9	9	9	9	9	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	52	40	32	23	10	1	-8	-16	30
Mitsubishi PURY-P250YLM-A1 (SPL@1m, dB)	76	66	63	59	52	46	42	34	60
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	47	34	27	18	5	-4	-11	-21	25
Mitsubishi PURY-P300YLM-A1 (SPL@1m, dB)	74	69	65	62	56	48	41	37	63
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	42	34	26	18	6	-5	-15	-21	23
Mitsubishi PURY-EM200YNW-A1 (SPL@1m, dB)	77	61	61	58	51	47	44	42	59
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	48	29	25	17	4	-3	-9	-13	24
Mitsubishi PURY-EM250YNW-A1 (SPL@1m, dB)	78	63	62	59	52	49	49	43	61
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	49	31	26	18	5	-1	-4	-12	25
Mitsubishi PURY-EM300YNW-A1 (SPL@1m, dB)	76	63	63	60	54	50	45	49	61
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	47	31	27	19	7	0	-8	-6	24
Mitsubishi MUZ-AP35VG (SPL@1m, dB)	49	50	51	47	44	43	37	33	50
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	17	15	12	3	-6	-10	-19	-25	6
Mitsubishi MUZ-AP60VG (SPL@1m, dB)	64	60	58	55	52	48	42	36	57
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation due to building envelope, dB	-15	-18	-21	-24	-27	-30	-33	-36	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	32	25	19	11	2	-5	-14	-22	15
Total Specific Level of all Plant Unit Installations at Receiver	57	43	35	27	14	6	0	-4	34

BS4142 Acoustic Feature Corrections									
Tonality	2	2	2	2	2	2	2	2	
Impulsivity	0	0	0	0	0	0	0	0	
Intermittency	0	0	0	0	0	0	0	0	
Sound Pressure Level at Receiver due to Plant Units, dB	59	45	37	29	16	8	2	-2	36

Source: Rooftop Plant Installation	Frequency, Hz								dB(A)
Receiver: Eighth-floor front window of Novotel Reading	63	125	250	500	1k	2k	4k	8k	
Mitsubishi PURY-P200YLM-A1 (SPL@1m, dB)	75	65	62	58	51	45	39	33	59
Correction for number of units (8),dB	9	9	9	9	9	9	9	9	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	51	41	36	30	20	14	8	3	33
Mitsubishi PURY-P250YLM-A1 (SPL@1m, dB)	76	66	63	59	52	46	42	34	60
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	46	36	31	25	15	9	5	-2	28
Mitsubishi PURY-P300YLM-A1 (SPL@1m, dB)	74	69	65	62	56	48	41	37	63
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	41	36	30	25	16	8	1	-2	27
Mitsubishi PURY-EM200YNW-A1 (SPL@1m, dB)	77	61	61	58	51	47	44	42	59
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	47	31	29	24	14	10	7	6	26
Mitsubishi PURY-EM250YNW-A1 (SPL@1m, dB)	78	63	62	59	52	49	49	43	61
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	48	33	30	25	15	12	12	7	28
Mitsubishi PURY-EM300YNW-A1 (SPL@1m, dB)	76	63	63	60	54	50	45	49	61
Correction for number of units (2),dB	3	3	3	3	3	3	3	3	
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	46	33	31	26	17	13	8	13	28
Mitsubishi MUZ-AP35VG (SPL@1m, dB)	49	50	51	47	44	43	37	33	50
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	16	17	16	10	4	3	-3	-6	12
Mitsubishi MUZ-AP60VG (SPL@1m, dB)	64	60	58	55	52	48	42	36	57
Correction due to surface reflections (1), dB	3	3	3	3	3	3	3	3	
Minimum attenuation provided by distance (40m), dB	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32.04	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-4	-4	-6	-8	-11	-11	-11	-10	
Total	31	27	23	18	12	8	2	-3	20
Total Specific Level of all Plant Unit Installations at Receiver	55	44	40	34	25	20	16	15	37
BS4142 Acoustic Feature Corrections									
Tonality	2	2	2	2	2	2	2	2	
Impulsivity	0	0	0	0	0	0	0	0	
Intermittency	0	0	0	0	0	0	0	0	
Sound Pressure Level at Receiver due to Plant Units, dB	57	46	42	36	27	22	18	17	39

ANTI-VIBRATION MOUNTING SPECIFICATION REFERENCE DOCUMENT

1.0 General

- 1.1 All mountings shall provide the static deflection, under the equipment weight, shown in the schedules. Mounting selection should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under the equipment, under operating conditions.
- 1.2 It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention should be paid to mountings which will be exposed to atmospheric conditions to prevent corrosion.
- 1.3 All mountings shall be colour coded, or otherwise marked, to indicate their load capacity, to facilitate identification during installation.

Where use of resilient supports allows omission of pipe flexible connections for vibration/noise isolation, it shall be the Mechanical Service Consultant's or Contractor's responsibility to decide whether such devices are required to compensate for misalignment or thermal strain.

2.1 Type A Mounting (Caged Spring Type)

- 2.1.1 Each mounting shall consist of cast or fabricated telescopic top and bottom housings enclosing one or more helical steel springs as the principle isolation elements, and shall incorporate a built-in levelling device. The housing should be designed to permit visual inspection of the springs after installation, i.e. the spring must not be totally enclosed.
- 2.1.2 The springs shall have an outside diameter of not less than 75% of the operating height, and be selected to have at least 50% overload capacity before becoming coil-bound.
- 2.1.3 The bottom plate of each mounting shall have bonded to it a rubber/neoprene pad designed to attenuate any high frequency energy transmitted by the springs.
- 2.1.4 Mountings incorporating snubbers or restraining devices shall be designed so that the snubbing, damping or restraining mechanism is capable of being adjusted to have no significant effect during the normal running of the isolated machine.
- 2.1.5 All nuts, bolts or other elements used for adjustment of a mounting shall incorporate locking mechanisms to prevent the isolator going out of adjustment as a result of vibration or accidental or unauthorised tampering.

2.2 Type B Mounting (Open Spring Type)

- 2.2.1 Each mounting shall consist of one or more helical steel springs as the principal isolation elements, and shall incorporate a built-in levelling device.
- 2.2.2 The springs shall be fixed or otherwise securely located to cast or fabricated top and bottom plates, shall have an outside diameter of not less than 75% of the operating height, and shall be selected to have at least 50% overload capacity before becoming coil-bound.
- 2.2.3 The bottom plate shall have bonded to it a rubber/ neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

2.3 Type C Mounting (Rubber/Neoprene Type)

Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant rubber/neoprene. Each mounting shall be capable of being fitted with a levelling device, and should have bolt holes in the base plate and a threaded metal insert in the top plate so that they can be bolted to the floor and equipment where required.

3.0 Plant Bases

3.1 Type A Bases (A.V. Rails)

An A.V. Rail shall comprise a steel beam with two or more height-saving brackets. The steel sections must be sufficiently rigid to prevent undue strain in the equipment and if necessary should be checked by the Structural Engineer.

3.2 Type B Bases (Steel Plant Bases)

Steel plant bases shall comprise an all-welded steel framework of sufficient rigidity to provide adequate support for the equipment, and fitted with isolator height saving brackets. The frame depth shall be approximately 1/10 of the longest dimension of the equipment with a minimum of 150 mm. This form of base may be used as a composite A.V. rail system.

3.3 Type C Bases (Concrete Inertia Base: for use with steel springs)

These shall consist of an all-welded steel pouring frame-work with height saving brackets, and a frame depth of approximately 1/12 of the longest dimension of the equipment, with a minimum of 100 mm. The bottom of the pouring frame should be blanked off, and concrete (2300 kg/m³) poured in over steel reinforcing rods positioned 35 mm above the bottom. The inertia base should be sufficiently large to provide support for all parts of the equipment, including any components which over-hang the equipment base, such as suction and discharge elbows on centrifugal pumps.