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22 TOWER STREET

COVENT GARDEN, LONDON

PLANNING COMPLIANCE REVIEW

Report 18331.PCR.01 Rev.B

For:

DWD Property Planning

Registered in England Company No. 7947892
KP Acoustics is the Trading Name of KP Acoustics Limited

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A	**11/12/2018** Assessment with Ambient Acoustics Ltd attenuation kit.	D	
B	**19/08/2019** Assessment with different plant unit proposals	E	
C		F	

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KP acoustics™

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List of Attachments

1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by DWD Property Planning, 6 New Bridge St, London EC4V 6AB, to undertake a noise impact assessment of the proposed plant unit installation serving the future office spaces at 22 Tower Street, London.

A 24 hour environmental noise survey has been carried out in order to undertake a noise impact assessment in accordance with BS4142:2014 "*Method for rating and assessing industrial and commercial sound"* as part of the requirements of The London Borough of Camden.

This report presents the overall methodology and results from the environmental survey, followed by calculations in accordance with BS4142 to provide an indication as to the likelihood of the noise emissions from the proposed plant unit installation having an adverse impact on the closest noise sensitive receiver. Mitigation measures will be outlined as appropriate.

2.0 SITE SURVEYS

2.1 Site Description

As shown in Figure 2.1, the site is bounded by residential buildings to the North, Tower Street crossing from North-West to South to the East and Tower Court from North-East to South.

Figure 2.1: Site plan showing the client's property premises

Initial inspection of the site revealed that the background noise profile at the monitoring location was comprised of traffic noise from Tower Street and surrounding roads.

2.2 Environmental Noise Survey Procedure

A noise survey was undertaken on the proposed site as shown in Figure 2.2. The meter was installed on a window on the 2nd floor of the North West façade, close to the North corner of the main building. A correction of 3dB has been applied to account for non-free field conditions. The choice of the position was based both on accessibility and on collecting representative noise data in relation to the nearest noise sensitive receiver relative to the plant unit installation.

Continuous automated monitoring was undertaken for the duration of the survey between 11:28am on 12/11/2018 and 11:08am on 13/11/2018.

Figure 2.2: Site plan showing environmental noise survey position (red dot), proposed location of condenser units on top of First Floor extension roof and top roof (purple squares) and associated noise sensitive receiver 1 and 2 (green dot), location of acoustic louvres (yellow square) of the plant room containing the AHU unit, the intake duct termination of the AHU (yellow triangle) and the associated closest noise sensitive receiver 3 (yellow dot).

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-

2:2007 Acoustics "*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*".

2.3 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.1.

Measurement instrumentation
Svantek Type 977 Class 1 Sound Level Meter
Svantek 2v12L free-field microphone
Svantek External windshield
NTi Audio, XL2-TA, Precision integrating sound level meter & analyser
B&K Type 4231 Class 1 Calibrator

Table 2.1 Measurement instrumentation

3.0 NOISE CRITERIA

3.1 London Borough of Camden criteria

The noise criteria, as per the Local Plan 2017 of London Borough of Camden, British Standard 4142:2014 "*Methods for rating and assessing industrial and commercial sound"* should be considered as the main reference document for the assessment. The resultant 'Rating Level' would be considered as follows:

Period	Assessment Location	Rating Level Acceptability Range		
		Green: noise is considered to be at an acceptable level	**Amber:** noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development	**Red:** noise is observed to have a significant adverse effect.
Daytime (7:00-23:00)	Garden used for main amenity (free field) and Outside living or dining or Bedroom window (façade)	10dB below background	9 dB below and 5dB above background	5dB above background
Night-time (23:00-7:00)	Outside bedroom window (façade)	10dB below background and no events exceeding 57dB L_{Amax}	9db below and 5dB above background or noise events between 57 dB and 88dB L_{Amax}	5dB above background and/or events exceeding 88 dB L_{Amax}

Table 3.1: Camden noise criteria for plant and machinery

3.2 BS4142: 2014 Noise Criteria

Typically, the likelihood of impact due to noise emissions of new plant is assessed as defined by BS4142:2014 *"Methods for rating and assessing industrial and commercial sound".*

This 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 noise levels in terms of a L_{Aeq} 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) due to the noise source, the "Specific Noise Level", with the existing background noise level in terms of an L_{A90} when the noise source is not operating. As part of the assessment, consideration is given to the character of the noise. The Standard provides the following advice.

Tonality

Subjectively, a correction can be allocated as a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB 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 allocated as a penalty of 3 dB for impulsivity which is just perceptible at the receiver, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

Impact Assessment

The resultant background sound level is subtracted from the Rating Level to obtain an initial estimate of the impact.

- 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. 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

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

4.0 RESULTS

4.1 Environmental Noise Survey

The results from the continuous noise monitoring survey are shown as a time history of L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} averaged over 5 minute sample periods in the attached Figure 18331.TH1. Measured ambient noise levels are shown in Table 4.1.

Descriptor	Ambient Noise Level (dB)	Representative Background Noise Level (dB)
Daytime $L_{Aeq,16hour}$ (07:00pm-23:00pm)	58	54
Night-time $L_{Aeq,8hour}$ (23:00pm-7:00am)	55	50

Table 4.1: Measured ambient and representative noise levels for daytime and night time

The representative background noise level shown in Table 4.2 is based upon the most frequently occurring measured $L_{90,5min}$ background noise level during the according daytime or night-time period. The statistical analysis is shown in attached Figures 18331.Daytime.L90 and 18331.Night-time.L90.

5.0 DISCUSSION

5.1 Proposed Plant unit installations

It is understood that three different plant unit installations would be built on site:

- Installation 1: 1 No. Mitsubishi PURY P1100YSNW-A, 1 No. Mitsubishi PURY P400YNW-A and a MVHR for toilets on top of a proposed first floor roof extension to the north of the main building as shown in Figures 2.2 and 5.1. in order to cater for a realistic scenario assessment, it is assumed that 50% of the units would operate at the same time for 1h. it is also assumed that the units would operate on a standard mode during daytime and low noise mode during night-time

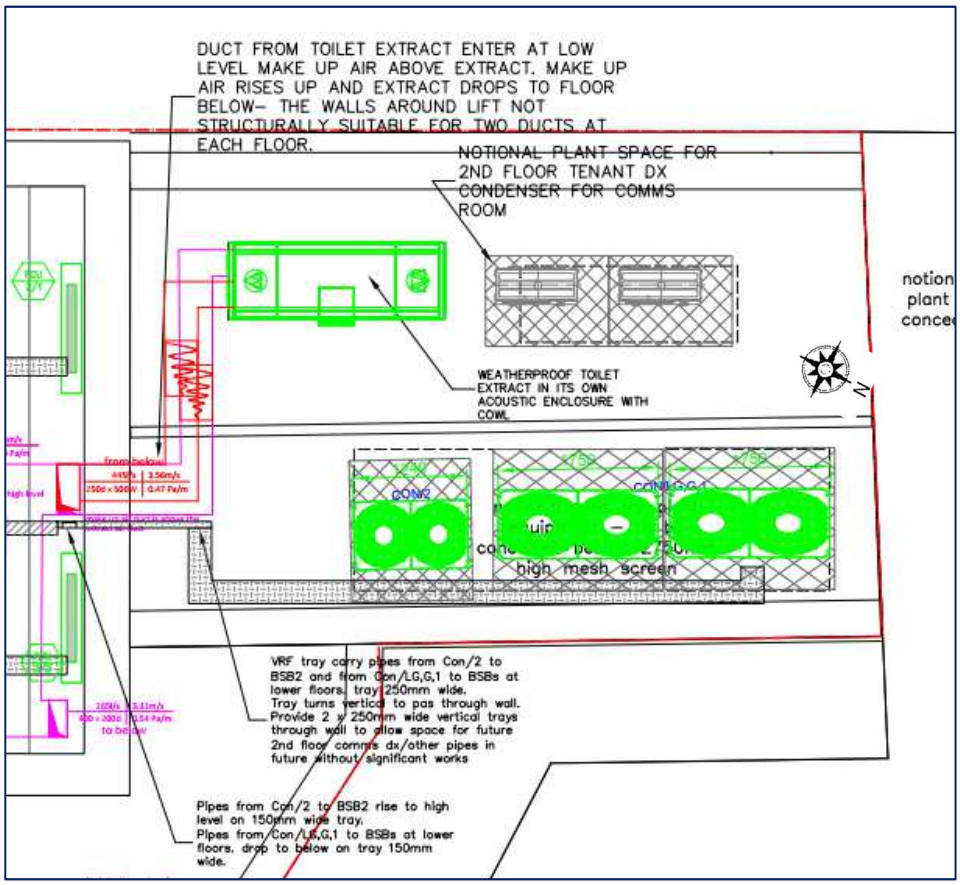

Figure 5.1: Proposed Installation 1 layout

- Installation 2: 1 No. Mitsubishi PURY P450YNW-A and 1 No. Mitsubishi PURY P400YNW-A on top of top roof of the main building as shown in Figures 2.2 and 5.2

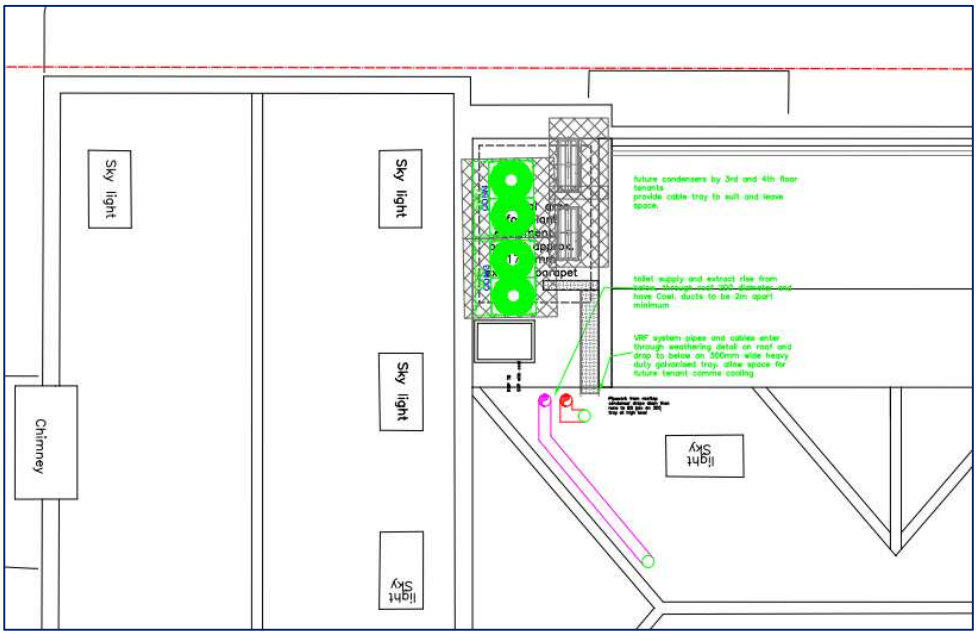

Figure 5.2: Proposed Installation 2 layout

- Installation 3: An Air handling unit (AHU01) inside a plant room at ground floor to the rear of the property. The plant room would entail an acoustic louvred wall to allow exhaust air to exit and a duct on the plant room roof for intake air as shown in Figures 2.2 and 5.3. it is assumed that the unit would not operate during night-time.

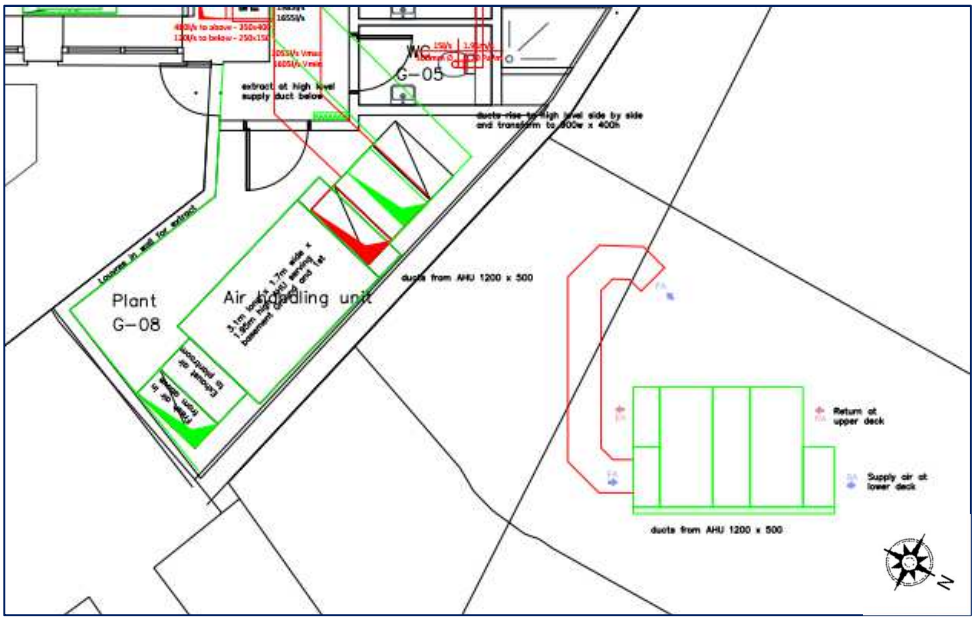

Figure 5.3: Proposed Installation 2 layout

The manufacturer's noise data of each proposed plant unit is presented in Table 5.1.

Unit	Octave Frequency Band (Hz)							
	63	125	250	500	1k	2k	4k	8k
Mitsubishi PURY P1100YSNW-A Standard mode SPL at 1m (dB)	82	72	72	68	62	59	55	51
Mitsubishi PURY P400YNW-A Standard mode SPL at 1m (dB)	74	64	66	64	59	55	49	45
Mitsubishi PURY P450YNW-A Standard mode SPL at 1m (dB)	81	65	64	62	55	52	50	46
Swegon MVHR for toilets Exhaust SWL (dB)	76	72	69	69	70	68	64	61
Swegon MVHR for toilets Intake SWL (dB)	68	61	56	53	44	41	38	38
Swegon AHU01 Exhaust SWL (dB)	83	78	80	82	79	78	76	76
Swegon AHU01 Intake SWL (dB)	82	77	79	81	78	77	75	75

Table 5.1: Manufacturer's Noise Data

5.2 Receivers

The relevant closest noise sensitive receivers relevant to each of the described installations are shown in Figure 2.2 and are described as follows:

- Receiver 1. Residential window at 6m to the rear of installation 1
- Receiver 2. Top window office building at 4-10 Tower Street at 10mm from installation 2. The line of sight from this receiver to Installation 2 would be screened by the plant room building envelope.
- Receiver 3. Residential window at 2nd floor, 5m from the proposed AHU intake duct termination described in the aforementioned Installation 2. The line of sight from this receiver to the louvered wall of the plant room would be screened by the plant room building envelope.

5.3 Calculations

Specific Noise levels of each plant unit installation have been calculated at 1m from its according receiver using the noise levels shown in Table 5.1 and corrections due to different acoustic propagation features such as distance, directivity, screening elements, etc.

The specific noise levels were calculated for both Daytime and Night-time periods and are presented in Table 5.2 – 5.4. Detailed calculations are shown in 18331.Appendix B Rev A.

Daytime and night-time specific noise levels of each installation has been assessed following BS4142:2014 guideline as shown in Table 5.2 – 5.4 with a subsequent conclusion taking into consideration the above context.

BS4142 Assessment 1		
Source:	Installation 1	
Operating Period:	Daytime	
Reference time interval (*T*):	1 h	
Receiver:	Receiver 1. Residential window at 5-6m to the rear of the plant unit installation	
Element	**Level (dB)**	**Comment**
Background $L_{A90,T}$	54	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. Derived using the most common occurring levels $L_{A90,5\ min}$ during the environmental noise survey undertaken on site.
Specific $L_{Aeq,\ T}$	48	Equivalent continuous A-weighted sound pressure level produced by the specific sound source. In this case, noise levels of proposed plant units taken from manufacturer data. The level also takes into consideration reflection, attenuation due to distance and any screening.
Acoustic Feature Correction	+0	No particular sound feature is expected from new equipment.
Correction for 75% on-time over 1h reference time interval	-1	As per normal operations of condenser units, it is expected that they would not run more than 45min over 1h period.
Rating Level	48	Rating Level = Specific $L_{Aeq,\ T}$ + Acoustic Feature Correction + On-time correction
Excess of rating over background sound level	-6	
Assessment Indication		
Assessment indicates very low adverse impact on the receiver provided that attenuation kits described in section 6 for Mitsubishi units or acoustic enclosures with similar attenuation are installed. The units would be serving an office building, so it is unlikely that they would be operating further than 19:00pm and not before 7:00am. As per Camden's Council criteria shown in Table 3.1, noise is considered to be at an acceptable level based on the context.		

Table 5.2 BS4142 Noise impact assessment of proposed installation 1 upon the closest noise residential receiver 1 at Daytime

BS4142 Assessment 2		
Source:	Installation 2	
Operating Period:	Daytime	
Reference time interval (*T*):	1 h	
Receiver:	Receiver 2. Top window, office building at 4-10 Tower Street	
Element	**Level (dB)**	**Comment**
Background $L_{A90,T}$	54	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. Derived using the most common occurring levels $L_{A90,5\ min}$ during the environmental noise survey undertaken on site.
Specific $L_{Aeq,\ T}$	45	Equivalent continuous A-weighted sound pressure level produced by the specific sound source. In this case, noise levels of proposed plant units taken from manufacturer data. The level also takes into consideration reflection, attenuation due to distance and any screening.
Acoustic Feature Correction	+0	No particular sound feature is expected from new equipment.
Correction for 75% on-time over 1h reference time interval	-1	As per normal operations of condenser units, it is expected that they would not run more than 45min over 1h period.
Rating Level	44	Rating Level = Specific $L_{Aeq,\ T}$ + Acoustic Feature Correction + On-time correction
Excess of rating over background sound level	-10	
Assessment Indication		
Assessment indicates low adverse impact on the receiver. As per Camden's Council criteria shown in Table 3.1, noise is considered to be at an acceptable level.		

Table 5.3 BS4142 Noise impact assessment of proposed installation 2 upon the closest noise residential receiver 2 at Daytime

BS4142 Assessment 3		
Source:	Installation 3	
Operating Period:	Daytime	
Reference time interval (*T*):	1 h	
Receiver:	Receiver 3. Residential window above the plant unit, at 5m from the intake duct termination on the plant room roof.	
Element	**Level (dB)**	**Comment**
Background $L_{A90,T}$	54	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. Derived using the most common occurring levels $L_{A90,5\ min}$ during the environmental noise survey undertaken on site.
Specific $L_{Aeq,\ T}$	47	Equivalent continuous A-weighted sound pressure level produced by the specific sound source. In this case, noise levels of proposed plant units taken from manufacturer data. The level also takes into consideration reflection, attenuation due to distance and any screening.
Acoustic Feature Correction	+0	No particular sound feature is expected from new equipment.
Rating Level	47	Rating Level = Specific $L_{Aeq,\ T}$ + Acoustic Feature Correction
Excess of rating over background sound level	-7	
Assessment Indication		
Assessment indicates low adverse impact on the receiver provided that a silencer is installed on the intake of the AHU with, at least, the insertion loss figures shown in Section 6. As per Camden's Council criteria shown in Table 3.1, rating noise would be considered to be at an acceptable level. This unit would operate only during office hours.		

Table 5.3 BS4142 Noise impact assessment of proposed installation 3 upon the closest noise residential receiver 3 at Daytime

BS4142 Assessment 4		
Source:	Installation 1.	
Operating Period:	Night-time	
Reference time interval (*T*):	15 min	
Receiver:	Receiver 1. Residential window at 5-6m to the rear of the plant unit installation	
Element	**Level (dB)**	**Comment**
Background $L_{A90,T}$	50	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. Derived using the most common occurring levels $L_{A90,5\ min}$ during the environmental noise survey undertaken on site.
Specific $L_{Aeq,\ T}$	33	Equivalent continuous A-weighted sound pressure level produced by the specific sound source. In this case, noise levels of proposed plant units taken from manufacturer data. The level also takes into consideration reflection, attenuation due to distance and any screening.
Acoustic Feature Correction	+0	No particular sound feature is expected from new equipment.
Rating Level	33	Rating Level = Specific $L_{Aeq,\ T}$ + Acoustic Feature Correction
Excess of rating over background sound level	-17	
Assessment Indication		
Assessment indicates no adverse impact on the receiver provided that low noise mode is activated during night-time period. As per Camden's Council criteria shown in Table 3.1, noise is considered to be at an acceptable level.		

Table 5.4 BS4142 Noise impact assessment of proposed installation 1 upon the closest noise residential receiver 1 at Night-time

BS4142 Assessment 5		
Source:	Installation 2	
Operating Period:	Night-time	
Reference time interval (*T*):	15 min	
Receiver:	Receiver 2. Top window, office building at 4-10 Tower Street	
Element	**Level (dB)**	**Comment**
Background $L_{A90,T}$	50	Sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. Derived using the most common occurring levels $L_{A90,5\ min}$ during the environmental noise survey undertaken on site.
Specific $L_{Aeq,\ T}$	34	Equivalent continuous A-weighted sound pressure level produced by the specific sound source. In this case, noise levels of proposed plant units taken from manufacturer data. The level also takes into consideration reflection, attenuation due to distance and any screening.
Acoustic Feature Correction	+0	No particular sound feature is expected from new equipment.
Rating Level	34	Rating Level = Specific $L_{Aeq,\ T}$ + Acoustic Feature Correction
Excess of rating over background sound level	-16	
Assessment Indication		
Assessment indicates no adverse impact on the receiver provided that low noise mode is activated during night-time period. As per Camden's Council criteria shown in Table 3.1, noise is considered to be at an acceptable level.		

Table 5.4 BS4142 Noise impact assessment of proposed installation 2 upon the closest noise residential receiver 2 at Night-time

Please note that BS4142 assessment for night-time noise emissions has been assessed with Mitsubishi units as the only operating units. The rest of units would not need to be operating during night. Only Mitsubishi units might need to work in low mode to keep circuit maintenance operations.

6.0 NOISE CONTROL MEASURES

In order to achieve the rating levels shown in each of the aforementioned assessments, the following noise control strategy should be adopted.

6.1 Noise Control Strategy for Installation 1

Mitsubishi Full Attenuation Kit, provided by Ambient Acoustics Ltd, should be installed on each Mitsubishi unit of Installation 1 or an acoustic enclosure that is able to provide the same minimum insertion loss figures.

The insertion loss figures that attenuation kit or acoustic enclosure should provide, as per manufacturer's data, are shown in Table 6.1. A representative

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Attenuation kit or louvered enclosure	3	4	6	7	10	10	8	7

Table 6.1 Insertion loss figures to be provided by the attenuation kit for Mitsubishi units

Figure 6.1 Picture showing the proposed attenuation kit Source: ambientacoustics.co.uk

6.2 Noise Control Strategy for Installation 3

It is recommended that the acoustic louvres to be installed on the external wall of the plant room and the silencer for the intake of the AHU01 unit provide the following insertion loss figures:

Unit	Insertion Loss Levels (dB) in each Octave Frequency Band							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Acoustic louvres of plant room wall	4	3	4	6	11	13	12	10
Silencer for AHU01 intake	3	5	8	15	15	13	10	5

Table 6.2: Minimum insertion loss to be provided by the Acoustic louvres on the plant room external wall and silencer on the intake.

7.0 CONCLUSION

An environmental noise survey has been undertaken at 22 Tower Street, London by KP Acoustics Ltd between 11:28am on 12 November 2018 and 11:08am on 13 November 2018. The results of the survey have enabled the representative background noise level to be set.

In accordance with British Standard BS4142:2014, manufacturer's noise data of proposed plant units has been used to obtain Specific and Rated Noise Level at the nearest noise sensitive receiver for compliance with current requirements.

The rated noise level was compared with the measured background noise level to assess the likelihood of impact considering the environmental noise context of the area as per the requirements of the London Borough of Camden. It has been concluded that noise emissions from the proposed plant units would have low impact on the nearest residential receivers during office hours provided that the noise control strategy presented in Section 6 is followed.

22 Tower Street, London
Environmental Noise Time History
From 12 November 2018 To 13 November 2018

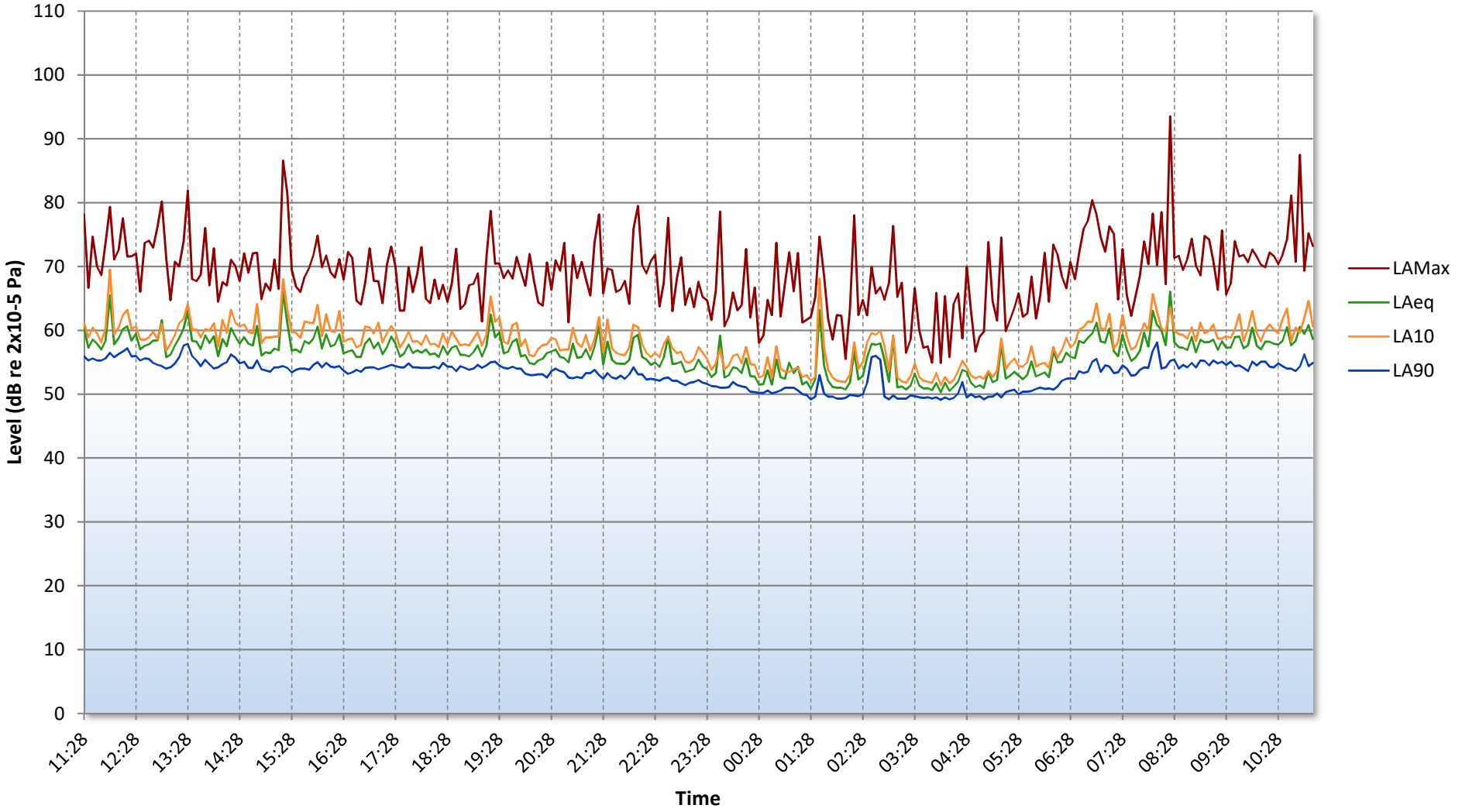

Figure 18331.TH1

22 Tower Street, London
Representative Daytime Background Noise Level
From 12 November 2018 To 13 November 2018

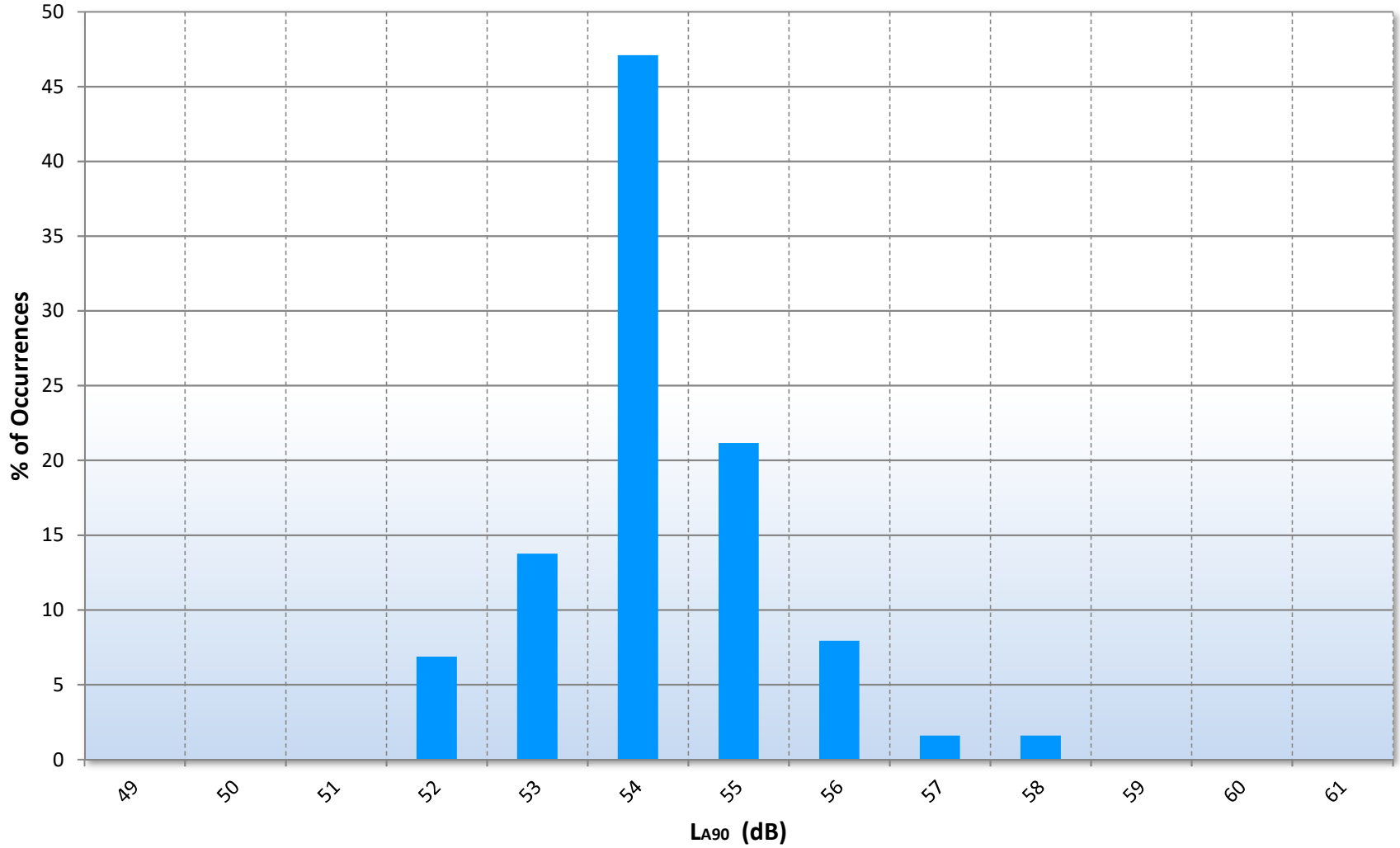

Figure 18331.Daytime.L90

22 Tower Street, London
Representative Night-time Background Noise Level
From 12 November 2018 To 13 November 2018

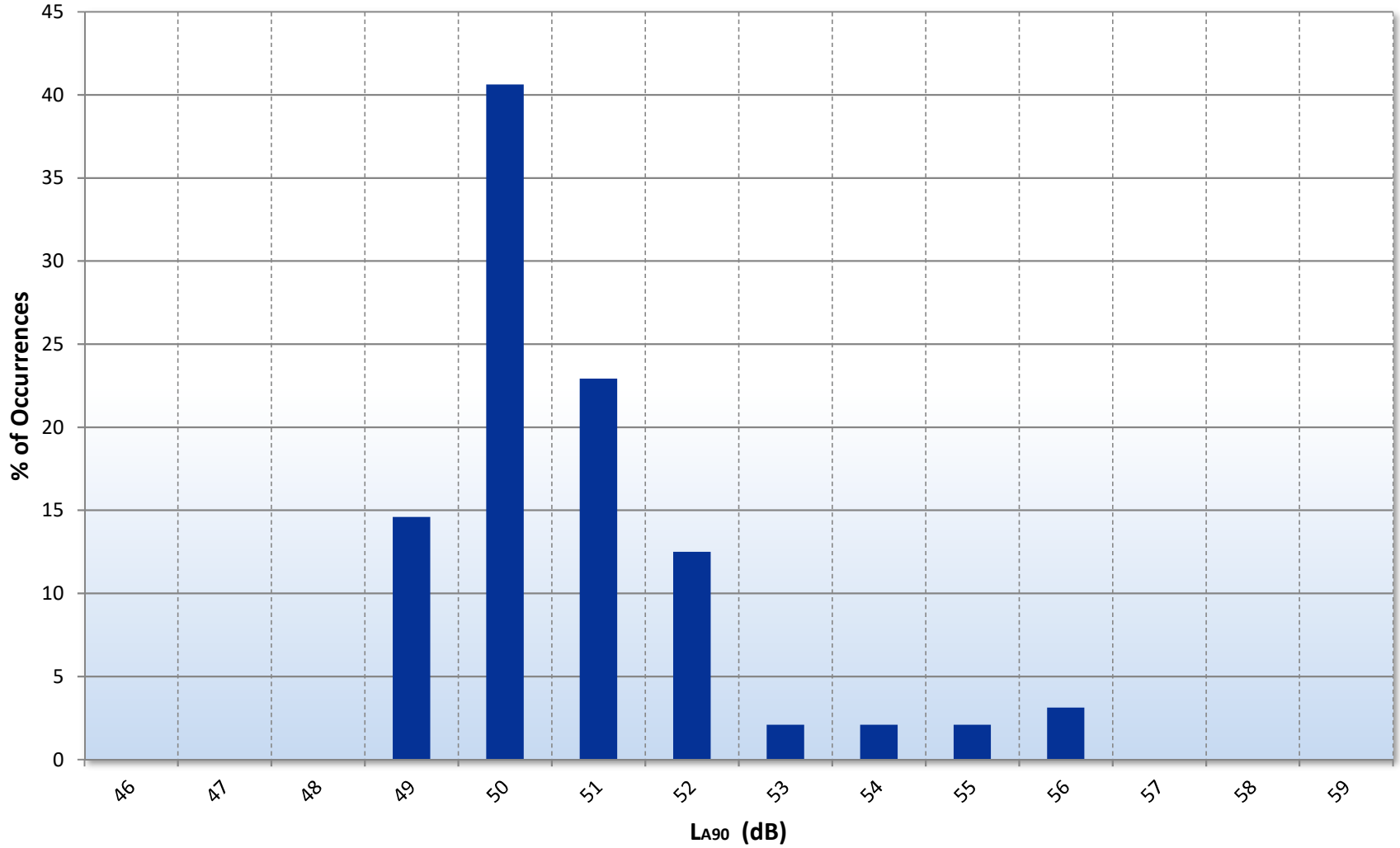

Figure 18331.Night-time.L90

APPENDIX A

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*.

APPENDIX A

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 Rev B

22 Tower Street, Covent Garden, London

DAYTIME PLANT NOISE EMISSIONS CALCULATIONS

Source: Installation 1	Frequency, Hz								
Receiver: Receiver 1	***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
Units serving office spaces									
Mitsubishi PURY P1100YSNW-A	82	72	72	68	62	59	55	51	69
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (6m)	-16	-16	-16	-16	-16	-16	-16	-16	
Correction due to acoustic enclosure	-3	-4	-6	-7	-10	-10	-8	-7	
SPL at receiver due to PURY1100 units noise emssions	66	55	53	48	39	36	34	31	50
Mitsubishi PURY P400YNW-A	74	64	66	64	59	55	49	45	65
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (6m)	-16	-16	-16	-16	-16	-16	-16	-16	
Correction due to acoustic enclosure	-3	-4	-6	-7	-10	-10	-8	-7	
SPL at receiver due to PURY400 units noise emssions	58	47	47	44	36	32	28	25	45
Toilet MVHR									
Swegon.to Outdoor air duct SWL	68	61	56	53	44	41	38	38	
SWL to SPL conversion correction	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (7m)	-17	-17	-17	-17	-17	-17	-17	-17	
Correction for directivity	-1	-2	-2	-3	-3	-3	-3	-3	
SPL at receiver due to Outdoor air duct noise emssions	42	34	29	25	16	13	10	10	43
Swegon.to Exhaust air duct SWL	76	72	69	69	70	68	64	61	
SWL to SPL conversion correction	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (7m)	-17	-17	-17	-17	-17	-17	-17	-17	
Correction for directivity	-1	-2	-2	-3	-3	-3	-3	-3	
Correction for silencer	-1	-2	-4	-11	-15	-15	-12	-8	
SPL at receiver due to Extract air duct noise emssions	49	43	38	30	27	25	24	25	50
Correction for No. units operating at the same time (50%)	-3	-3	-3	-3	-3	-3	-3	-3	
Specific Noise Level at receiver due to All Units, dB	**64**	**53**	**51**	**47**	**38**	**35**	**32**	**30**	**48**

Source: Installation 3	Frequency, Hz								
Receiver: Receiver 3	***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
AHU exhaust air duct									
Swegon Air Handling Unit. Exhaust SWL	83	78	80	82	79	78	76	76	
Correction for reverberant field inside plant room	-2	-4	-4	-5	-5	-5	-5	-5	
SPL inside plantroom	81	74	76	77	74	73	71	71	
SWL of exhaust louvered area (SPL+10*log(louvered Area)-6)	84	77	79	80	77	76	74	74	
Correction for SWl to SPL conversion	-11	-11	-11	-11	-11	-11	-11	-11	
Correction for acoustic louvres insertion loss	-4	-3	-4	-6	-11	-13	-12	-10	
Correction due to building envelope	-2	-5	-5	-5	-6	-7	-8	-10	
Correction due to reflective surfaces	3	3	3	3	3	3	3	3	
Correction for directivity (140°)	1	-4	-11	-11	-11	-11	-11	-11	
Correction for distance (7m)	-17	-17	-17	-17	-17	-17	-17	-17	
SPL at receiver due to AHU exhaust	53	41	35	33	24	20	18	18	34
AHU intake air duct									
Swegon Air Handling Unit. Intake SWL	82	77	79	81	78	77	75	75	
Correction for SWL to SPL conversion	-11	-11	-11	-11	-11	-11	-11	-11	
Correction due to duct end reflections	-6	-3	-1	0	0	0	0	0	
Correction for duct length	-3	-2	-1	-1	0	0	0	0	
Correction due to directivity	0	0	-3	-3	-5	-5	-5	-5	
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (5m)	-14	-14	-14	-14	-14	-14	-14	-14	
Correction due to silencer	-3	-5	-8	-15	-15	-13	-10	-5	
SPL at receiver due to AHU intake	48	45	45	41	36	37	38	43	46
Specific Noise Level at receiver due to All Units, dB	**54**	**46**	**45**	**42**	**36**	**37**	**38**	**43**	**47**

Source: Installation 2	Frequency, Hz								
Receiver: Receiver 2	***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
Units serving office spaces									
Mitsubishi PURY P450YNW-A	81	65	64	62	55	52	50	46	63
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (10m)	-20	-20	-20	-20	-20	-20	-20	-20	
Correction due to building envelope	-5	-5	-5	-5	-5	-5	-5	-5	
SPL at receiver due to PURY1100 units noise emssions	59	43	42	40	33	30	28	24	41
Mitsubishi PURY P400YNW-A	74	64	66	64	59	55	49	45	65
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (10m)	-20	-20	-20	-20	-20	-20	-20	-20	
Correction due to building envelope	-5	-5	-5	-5	-5	-5	-5	-5	
SPL at receiver due to PURY400 units noise emssions	52	42	44	42	37	33	27	23	43
Specific Noise Level at receiver due to All Units, dB	**60**	**45**	**46**	**44**	**39**	**34**	**30**	**26**	**45**

NIGHT-TIME PLANT NOISE EMISSIONS CALCULATIONS

Source: Installation 1	Frequency, Hz								
Receiver: Receiver 1	***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
Units serving office spaces									
Mitsubishi PURY P1100YSNW-A. Low Noise Mode	69	62	60	51	49	46	44	37	56
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (6m)	-16	-16	-16	-16	-16	-16	-16	-16	
Correction due to acoustic enclosure	-3	-4	-6	-7	-10	-10	-8	-7	
SPL at receiver due to PURY units noise emssions	53	45	41	31	26	23	23	17	37
Mitsubishi PURY P400YNW-A. Low Noise Mode	64	57	51	48	47	43	38	44	52
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (6m)	-16	-16	-16	-16	-16	-16	-16	-16	
Correction due to acoustic enclosure	-3	-4	-6	-7	-10	-10	-8	-7	
SPL at receiver due to PURY units noise emssions	48	40	32	28	24	20	17	24	32
Specific Noise Level at receiver due to All Units, dB	**55**	**47**	**42**	**33**	**28**	**25**	**24**	**25**	**38**

Source: Installation 2	Frequency, Hz								
Receiver: Receiver 2	***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
Units serving office spaces									
Mitsubishi PURY P450YNW-A. Low Noise Mode	65	57	52	50	48	44	40	44	53
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (10m)	-20	-20	-20	-20	-20	-20	-20	-20	
Correction due to building envelope	-5	-5	-5	-5	-5	-5	-5	-5	
SPL at receiver due to PURY1100 units noise emssions	43	35	30	28	26	22	18	22	31
Mitsubishi PURY P400YNW-A. Low Noise Mode	64	57	51	48	47	43	38	44	52
Correction for reflective surfaces	3	3	3	3	3	3	3	3	
Correction due to distance to receiver (10m)	-20	-20	-20	-20	-20	-20	-20	-20	
Correction due to building envelope	-5	-5	-5	-5	-5	-5	-5	-5	
SPL at receiver due to PURY400 units noise emssions	42	35	29	26	25	21	16	22	30
Specific Noise Level at receiver due to All Units, dB	**45**	**38**	**33**	**30**	**28**	**24**	**20**	**25**	**34**