KP Acoustics Ltd.
info@kpacoustics.com
1 Galena Road, W6 0LT London, UK
+44 (0) 208 222 8778
www.kpacoustics.com

192 Haverstock Hill
London

Planning Compliance Report
Report 24384.PCR.01

Sasha Traders Ltd.
843 Finchley Road
London

Report 24384.PCR.01

Revision History

First Issue Date: 24/05/2022

A		D	
B		E	
C		F	

Written by:	**Checked by:**	**Approved by:**
Oliver Packman MIOA Senior Acoustic Consultant	**Daniel Green MIOA** Senior Acoustic Consultant	**Kyriakos Papanagiotou MIOA** Managing Director

Disclaimer

KP Acoustics Ltd. has used reasonable skill and care to complete this technical document, within the terms of its brief and contract with the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the stated scope. This report is confidential to the client and we accept no responsibility to third parties to whom this report, or any part thereof, is made known. KP Acoustics Ltd. accepts no responsibility for data provided by other bodies and no legal liability arising from the use by other persons of data or opinions contained in this report.

Contents

1.0 INTRODUCTION 1

2.0 SITE SURVEYS 1

2.1 Site Description 1

2.2 Environmental Noise Survey Procedure 2

2.3 Vibration Survey Procedure 4

2.4 Equipment 4

3.0 RESULTS 5

3.1 Noise Survey 5

3.2 Vibration Survey 5

4.0 NOISE ASSESSMENT GUIDANCE 6

4.1 BS4142: 2014 '*Methods for rating and assessing industrial and commercial sound*' 6

4.2 BS6472-1-2008 - Vibration Assessment 7

4.3 Planning Condition 15 – Plant Noise Emissions 8

4.4 Planning Condition 17 – Vibration 8

5.0 PLANT NOISE IMPACT ASSESSMENT 9

5.1 Plant Installations 9

5.2 Closest Noise Sensitive Receiver 9

5.3 Calculations 9

6.0 VIBRATION ASSESSMENT 10

7.0 CONCLUSION 10

List of Attachments

24384. TH1	Environmental Noise Time History
24384.Daytime.LA90	Statistical analysis for representative daytime L_{A90}
24384.Night-time.LA90	Statistical analysis for representative night-time L_{A90}
Appendix A	Glossary of Acoustics Terminology
Appendix B	Acoustic Calculations
Appendix C	Anti-Vibration Mounting Specification Reference Document

1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Sasha Traders Ltd., 843 Finchley Road, London, to undertake a noise impact assessment of plant unit installations serving the building at 192 Haverstock Hill, London, NW3 2AJ.

A 24 hour environmental noise and vibration survey has been undertaken on site in order to prepare a noise impact assessment in accordance with BS4142:2014 '*Method for rating and assessing industrial and commercial sound'* as part of the planning requirements of The London Borough of Camden.

This report presents the 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.

A 24-hour internal vibration survey was also undertaken on site in order to assess the vibration levels within the newly built residential dwellings in accordance with Planning condition 17.

2.0 SITE SURVEYS

2.1 Site Description

As shown in Figure 2.1, the site is bounded by Globe Lawn Tennis Club to the northeast, residential dwellings to the northwest, Bellsize Park Tube Station to the southeast, and Haverstock Hill to the southeast.

Figure 2.1 Site Location Plan (Image Source: Google Maps)

Initial inspection of the site revealed that the background noise profile at the monitoring location was typical of an urban cityscape environment, with the dominant source being road traffic noise from the surrounding roads. Noise at the rooftop measurement position was dominated by plant serving surrounding buildings.

2.2 Environmental Noise Survey Procedure

Continuous automated monitoring was undertaken for the duration of the noise survey between 10.34 on 13/04/2022 and 10.00 on 14/04/2022.

The environmental noise measurement position, proposed plant installation locations, and the closest noise sensitive receiver relative to the plant installations are described within Table 2.1 and shown within Figure 2.2.

Icon	Descriptor	Location Description
	Noise Measurement Position	The microphone was installed on a tripod at 1.5m above the roof level.
	Closest Noise Sensitive Receiver	Rear façade. 4^{th} Floor window. Residential house to the west
	Proposed Plant Installation Location	Proposed plant installations are outlined in Section 5.1

Table 2.1 Measurement position and description

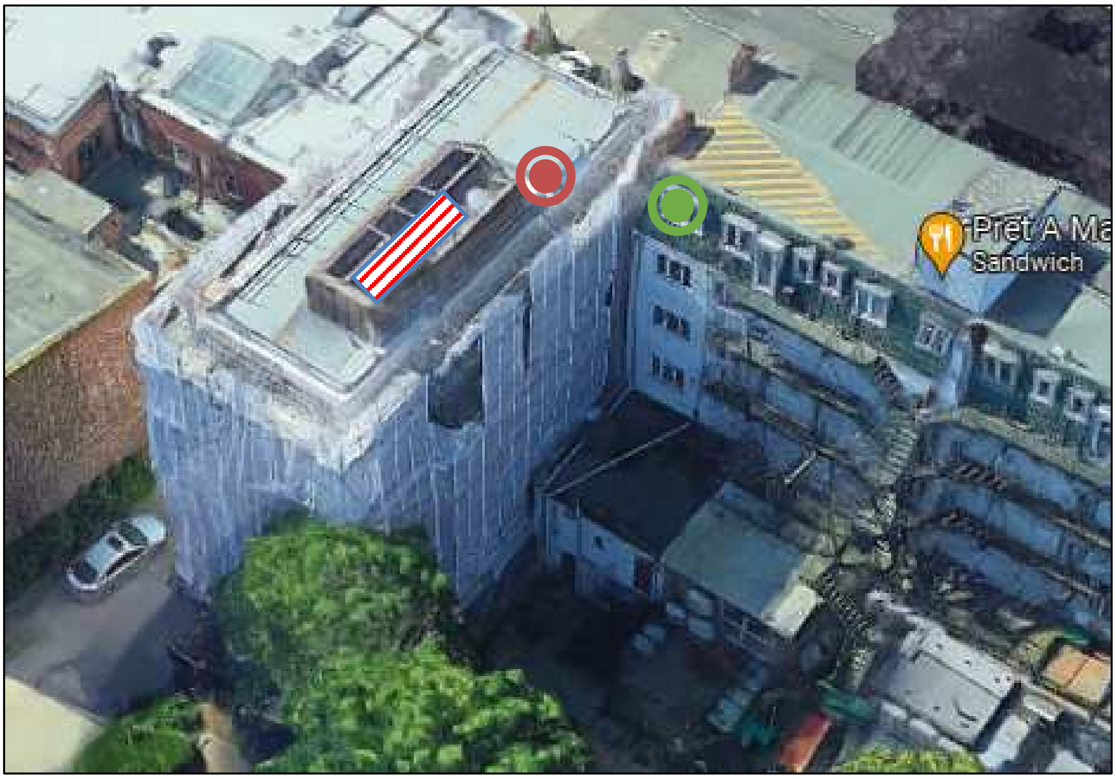

Figure 2.2 Site measurement position, identified receiver and proposed plant unit installation (Image Source: Google Maps)

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 rooftop plant installation.

Further to the 24-hour noise survey, attended noise measurements of the plant units installed were carried out between 10.26 and 10.40 on 20/05/2022. Measurements were taken within the plant enclosure and outside the plant enclosure with all plant at maximum capacity. Background measurements were also taken so that a residual noise level could be determined.

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 Vibration Survey Procedure

Continuous automated vibration monitoring was undertaken in conjunction with the noise survey between 10.34 on 13/04/2022 and 10.00 on 14/04/2022 at the position shown in Figure 2.3 below. Measurements were made of vertical (z-axis) and horizontal (x - y axes) vibration dose value levels.

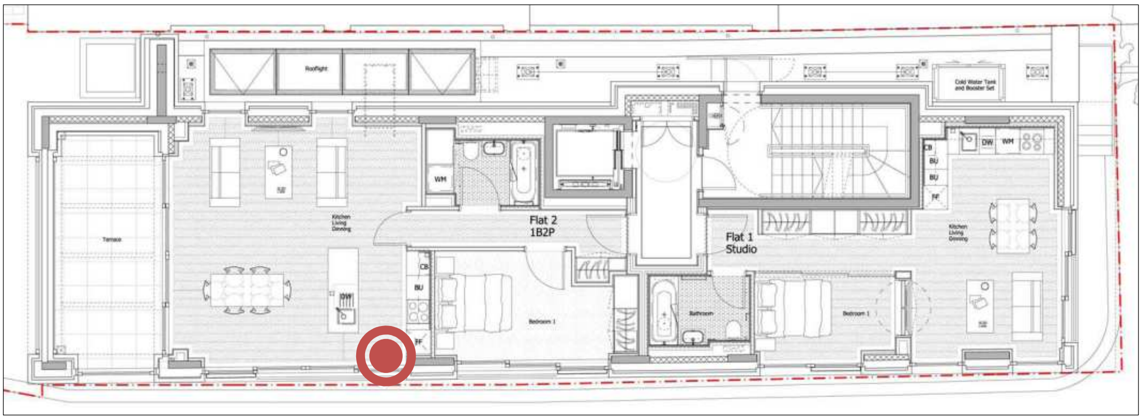

Figure 2.3 Site vibration measurement position (Image Source: Squire & Partners)

This survey addressed underground traffic vibration from the nearby underground railway line. The character of the vibration would be considered to be intermittent.

The vibration monitoring position was chosen in order to capture worst case expected levels of vibration as stated within BS6472-1:2008 *''Guide to evaluation of human exposure to vibration in buildings''.*

2.4 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.3.

Measurement instrumentation		Serial no.	Date	Cert no.
Noise Kit 2	Svantek Type 977C Sound Level Meter	97502	18/02/2021	Factory Calibrated
	Microtech type MK255	20569		
	Preamp Svantek SV12L	106973		
	Svantek External Microphone Shroud	-	-	-
Noise & Vibration Kit 2	Svantek Type 958A Class 1 Sound & Vibration Level Meter	36655	25/01/2022	1501654-5a
	Accelerometer PCB 356B18	LW176243		
Larson Davis CAL200 Class 1 Calibrator		17148	18/03/2022	UCRT22/1397

Table 2.3 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 a time history in Figure 24384.TH1.

Representative background noise levels are shown in Table 3.1 for daytime and night-time.

It should be noted that the representative background noise level has been derived from the most commonly occurring $L_{A90,5\ min}$ levels measured during the environmental noise survey undertaken on site, as shown in 24384.Daytime.LA90 and 24384.Night-time.LA90 attached.

Time Period	Representative background noise level L_{A90} dB(A)
Daytime (07:00-23:00)	52
Night-time (23:00-07:00)	47

Table 3.1 Representative background noise levels

3.2 Vibration Survey

The results of the vibration measurements captured during the automated survey period are shown as a time history in Figure 24384.VH1 as VDV levels over the full survey period. It should be noted that vibration was not subjectively felt on site during the equipment installation and collection periods.

4.0 NOISE ASSESSMENT GUIDANCE

4.1 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.

4.2 BS6472-1-2008 - Vibration Assessment

BS 6472 provides guidance on predicting human response to vibration in buildings over the frequency range 0.5 Hz to 80 Hz. The vibration dose value is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

Table 4.1 shows the different likelihoods of adverse comment from nearby vibration sources on residential occupants.

Place and time	Low probability of adverse comment $m.s^{-1.75}$	Adverse comment possible $m.s^{-1.75}$	Adverse comment probable $m.s^{-1.75}$
Residential buildings 16h day	0.2-0.4	0.4-0.8	0.8-1.6
Residential buildings 8h night	0.1-0.2	0.2-0.4	0.4-0.8

Table 4.1 Likelihood of comment on vibration perceived within residential dwellings

4.3 Planning Condition 15 – Plant Noise Emissions

Planning condition 15 of the decision notice issued by The London Borough of Camden relates to noise emissions of new plant and is as follows:

"Prior to the first occupation of any of the new residential units, details shall be submitted to and approved in writing by the Council, of the external noise level emitted from plant/ machinery/ equipment and mitigation measures as appropriate. The measures shall ensure that the external noise level emitted from plant, machinery/ equipment will be lower than the lowest existing background noise level by at least 10dBA as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with all machinery operating together at maximum capacity. A post installation noise assessment shall be carried out where required to confirm compliance with the noise criteria and additional steps to mitigate noise shall be taken, as necessary. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained."

4.4 Planning Condition 17 – Vibration

Planning condition 17 of the decision notice issued by The London Borough of Camden relates to vibration levels within dwellings and is as follows:

Prior to the first occupation of any of the new residential units, details shall be submitted to and approved in writing by the Council, of building vibration levels and, together with appropriate mitigation measures where necessary. Details shall demonstrate that vibration will meet a level that has low probability of adverse comment and the assessment method shall be as specified in BS 6472:2008. No part of the development shall be occupied until the approved details have been implemented. Approved details shall thereafter be permanently retained.

5.0 PLANT NOISE IMPACT ASSESSMENT

5.1 Plant Installations

The plant installation is comprised of the following units:

- 5No. Daikin VRV IV Condensing Units

The installation location for the condensing units is at the rooftop level within a louvred plant area, as shown in Figure 2.2 above.

The measured residual noise emission levels for the units are shown in Table 5.1.

Units	Location	Octave Frequency Band (Hz)								Overall (dBA)
		63	125	250	500	1k	2k	4k	8k	
Daikin VRV IV Condensing Units	Within Plant Enclosure	68	64	58	58	56	50	44	37	56

Table 5.1 Plant Units Noise Emission Levels as provided by the manufacturer

5.2 Closest Noise Sensitive Receiver

The closest noise sensitive receiver to the proposed installation location has been identified as being a residential window of the property to the west, located approximately 9 metres from the plant installation location, as shown in Figure 2.2.

5.3 Calculations

The 'Rating Level' of each plant unit installation has been calculated at 1m from the closest receiver using the noise levels shown in Table 5.1, and corrected due to different acoustic propagation features such as distance, reflective surfaces, screening elements, etc.

No acoustic feature corrections as per BS4142 have been applied for as the source is not considered to have characteristic noise features.

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

Receiver	Criterion	Noise Level at 1m From the Closest Noise Sensitive Window
Rear Window 196-198 Haverstock Hill, London	37dB(A)	35dB(A)

Table 5.2 Predicted noise level and criterion at nearest noise sensitive location

As shown in Appendix B and Table 5.2, transmission of noise to the nearest sensitive windows due to the effects of the Air Conditioning unit installation satisfies the emissions criterion of The London Borough of Camden.

6.0 VIBRATION ASSESSMENT

The measured results of the 24 hour survey have been aggregated to produce the VDV over the 16 hour daytime and 8 hour night time period. Table 7.1 compares the measured levels on site against VDV ranges outlined in Table 4.4 and BS6472-1 2008 '*Guide to evaluation of human exposure to vibration in buildings*'.

Axis	Vibration Measurement	Measured VDV Level $m/s^{1.75}$	Likelihood of Comment
x	$VDV_{d,day}$	0.006	Adverse comment is not expected
	$VDV_{d,night}$	0.003	Adverse comment is not expected
y	$VDV_{d,day}$	0.046	Adverse comment is not expected
	$VDV_{d,night}$	0.027	Adverse comment is not expected
z	$VDV_{b,day}$	0.013	Adverse comment is not expected
	$VDV_{b,night}$	0.010	Adverse comment is not expected

Table 7.1 Daytime and night-time VDV levels and likelihood of comment in accordance with BS6472

As shown in Table 7.1, the most dominant axis of vibration is the y-axis with a $VDV_{d,day}$ of $0.046m/s^{1.75}$ and $VDV_{d,night}$ $0.027m/s^{1.75}$, which correlates with adverse comment not being expected from future occupiers within the development.

7.0 CONCLUSION

An environmental noise survey has been undertaken at 192 Haverstock Hill, London, NW3 2AJ, by KP Acoustics Ltd between 10.34 on 13/04/2022 and Time on 14/04/2022, with additional measurements on 20/05/2022. The results of the survey have enabled a representative background noise level to be set.

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 Planning Condition 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 residential receivers and meet the requirements of Planning Condition 15.

Measurement of underground train activity indicates that vibration levels are below the threshold of human perception in the z-axis, in accordance with BS6472: 2008, and therefore the requirements of Planning Condition 17 are met.

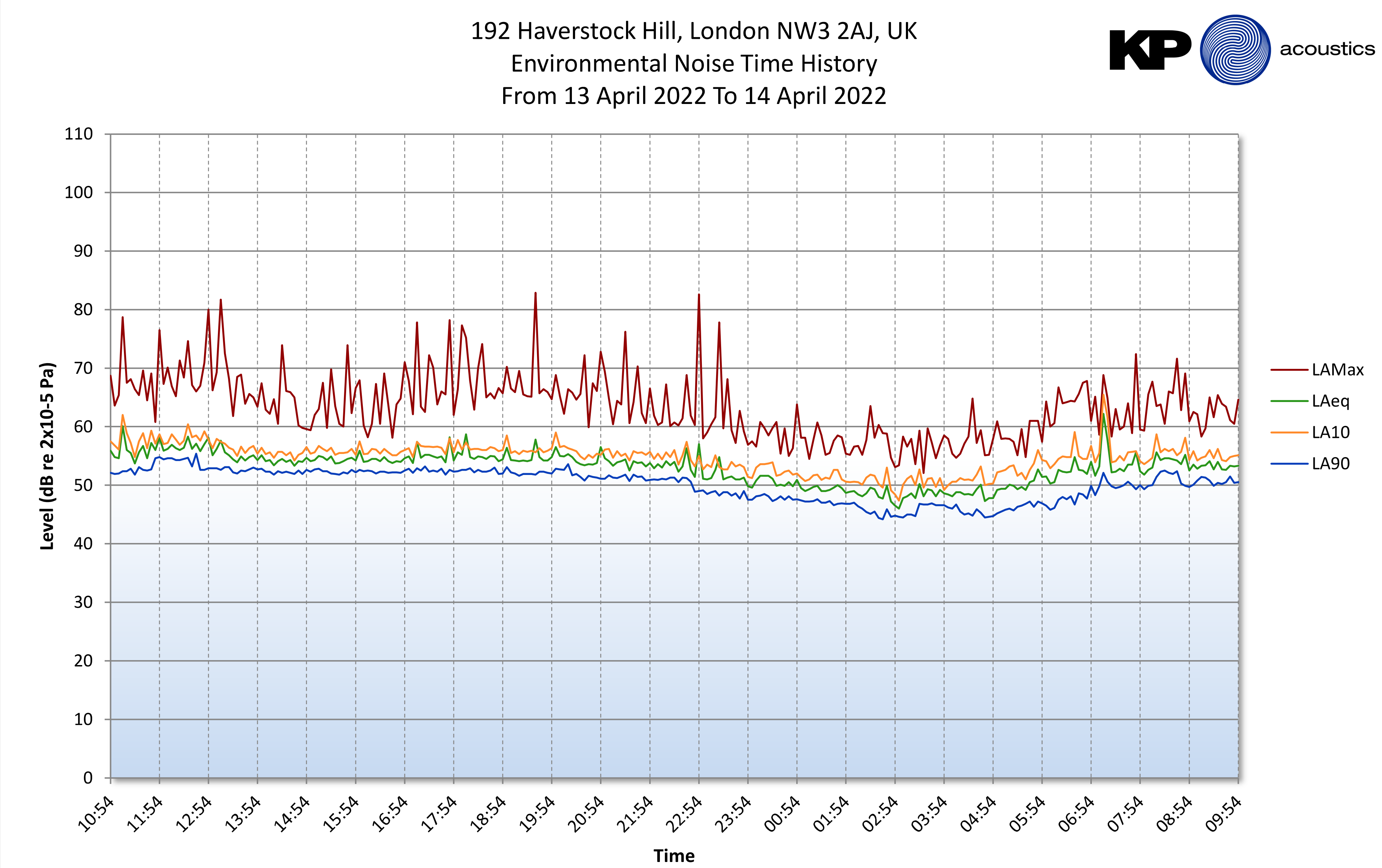

Figure 24384.TH1

192 Haverstock Hill, London NW3 2AJ, UK
Representative Daytime Background Noise Level
From 13 April 2022 To 14 April 2022

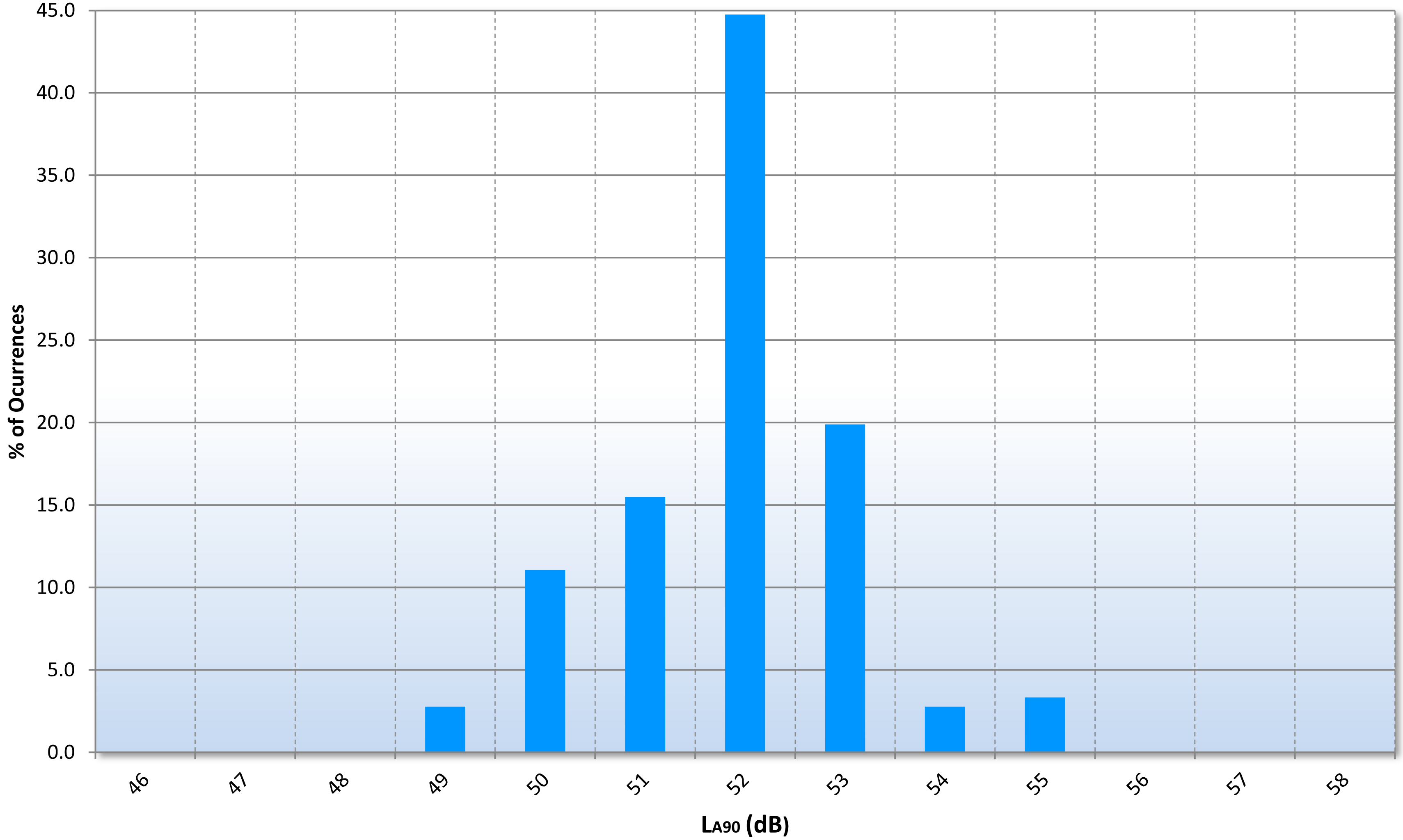

Figure 24384.L90

192 Haverstock Hill, London NW3 2AJ, UK
Representative Night-time Background Noise Level
From 13 April 2022 To 14 April 2022

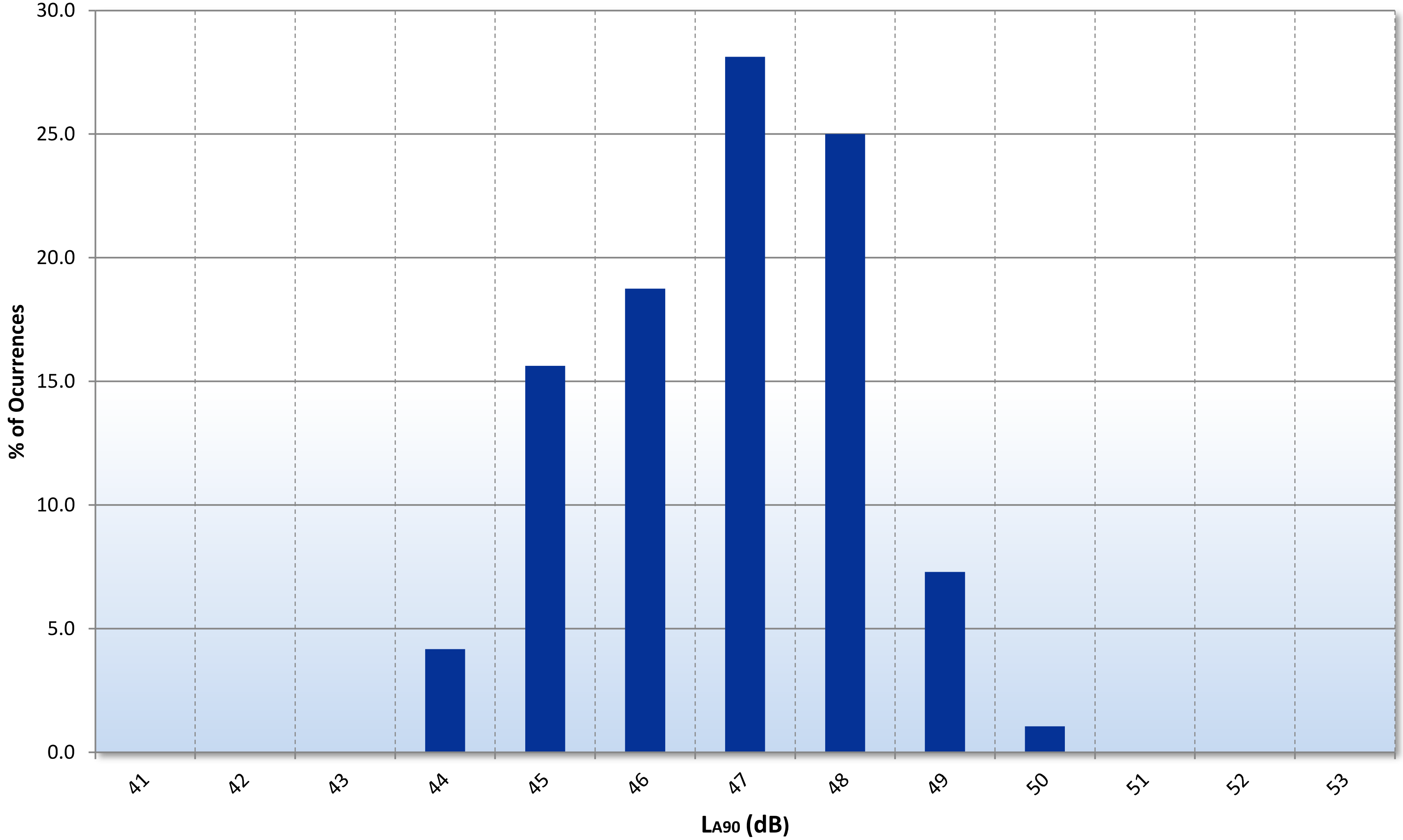

Figure 24384.L90

192 Haverstock Hill
VDV Time History
From 10.34 on 13/04/2022 to 10.00 on 14/04/2022

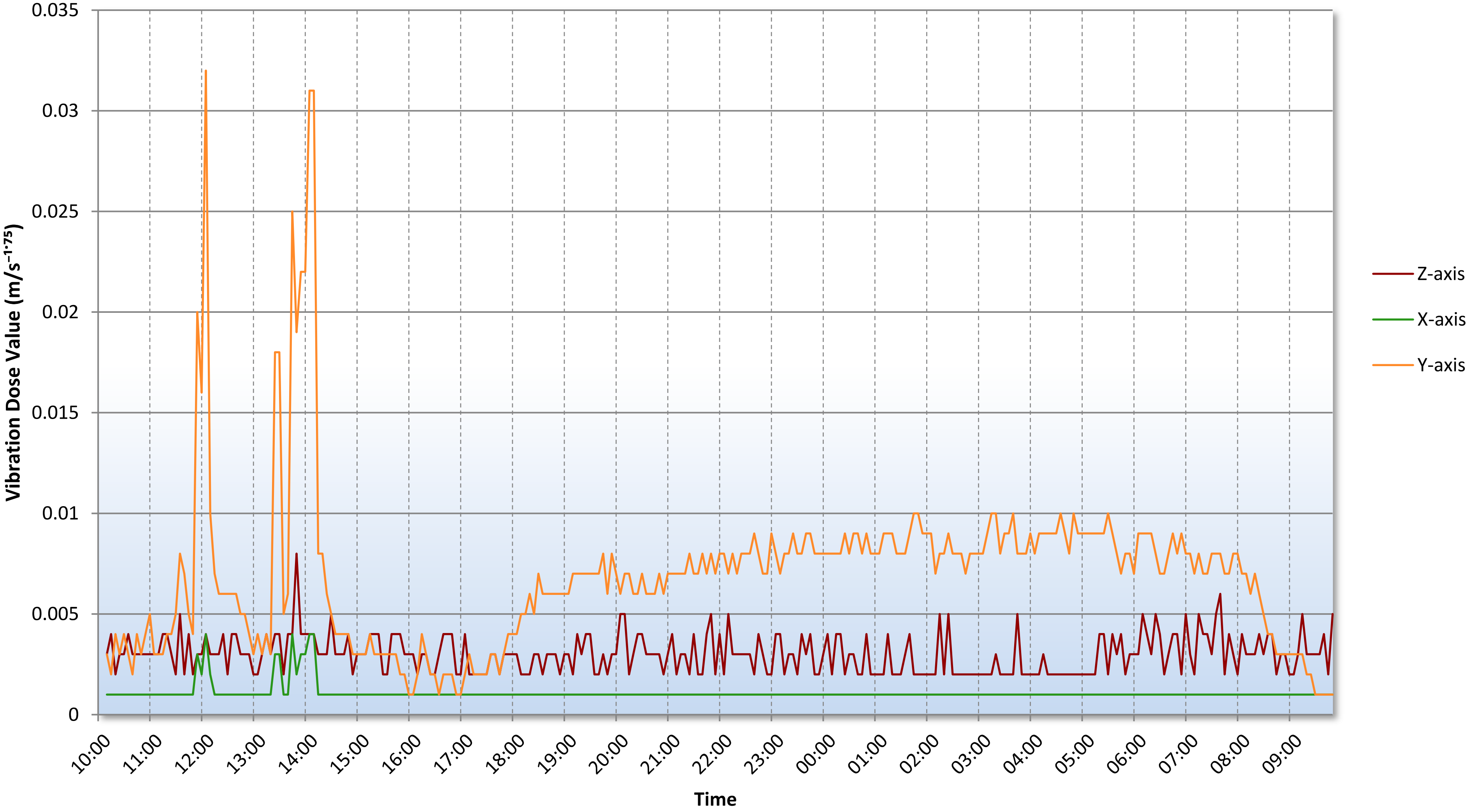

Figure 24384.VDV TH1

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

192 Haverstock Hill, London

PLANT NOISE EMISSIONS CALCULATIONS

Source: 192 Haverstock Hill, London **Receiver: 196-168 Rear Window Haverstock Hill, London**	***Frequency, Hz***								***dB(A)***
	63	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	
Daikin VRV IV Condensing Units, Outside enclosure (SPL @1m)	68	64	58	58	56	50	44	37	60
Minimum attenuation provided by distance (10m), dB	-20	-20	-20	-20	-20	-20	-20	-20	
Minimum attenuation predicted by installed plant screen, dB	-5	-5	-5	-5	-5	-5	-5	-5	
Sound Pressure Level at Receiver due to Plant Units, dB	**43**	**39**	**33**	**33**	**31**	**25**	**19**	**12**	**35**

Design Criterion	**37**

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/m^3) 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.