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355 Euston Road
Fitzroy House, London, NW1 3AL

Noise and Vibration Impact Assessment Report
Report 29004.NIA.01

Opera
24/25 The Shard
32 London Bridge Street
London, SE1 9SG

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1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Opera, 24/25 The Shard, 32 London Bridge Street, London, SE1 9SG to undertaken noise and vibration measurements on site at 355 Euston Road, Fitzroy House, London in order to determine the internal and external noise levels, as well as the background vibration levels within the development.

The development consists of six stories of office space which are proposed to be refurbished.

This report presents the results of internal noise surveys undertaken in order to measure the current internal noise climate, which will be assessed against current BS8233:2014 guidance. This report also presents the results of the external environmental surveys undertaken in order to measure the prevailing background noise levels and the results of the vibration survey undertaken in order to measure the prevailing background vibration levels due to the nearby Euston Road and underground rail. The vibration levels are assessed against BS6472-1-2008 guidelines for indicative purposes only.

2.0 SITE SURVEYS

2.1 Site Description

The site is bounded by Euston Road and commercial businesses to the north, Conway Street and commercial buildings to the west, Warren Street and commercial businesses to the south, and Fitzroy Street and commercial businesses and to the east. Entrance to the site is located on Euston Road. At the time of the survey, the background noise climate was dominated by road traffic noise from the surrounding roads.

2.2 Internal Noise Survey Procedure

Noise surveys were undertaken within the first-floor internal areas of the building at the northeast and southeast elevations in order to assess worst-case levels with the current external building fabric configuration.

Continuous automated monitoring was undertaken for the duration of the survey between 11:51 on 10/09/2024 and 12:25 on 11/09/2024.

Microphones installed internally were positioned within the diffuse field of the room, ensuring the microphone was at least 1.5m from any reflective surface. Noise measurement positions are detailed in Table 2.1 and shown in Figure 2.1.

2.3 Environmental Noise Survey Procedure

External noise surveys were 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, including those from nearby commercial premises and the surrounding roads.

Continuous automated monitoring was undertaken for the duration of the survey between 11:15 on 10/09/2024 and 12:15 on 11/09/2024.

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*'.

2.4 Vibration Survey Procedure

Continuous automated vibration monitoring was undertaken in conjunction with the noise survey between 16:23 on 11/09/2024 and 16:20 on 12/09/2024 at the position shown in Figure 2.1. Measurements were made of vertical (z-axis) and horizontal (x - y axes) vibration dose value levels.

This survey addressed road and underground rail traffic vibration from the nearby Euston Road and underground rail below. The character of the vibration would be considered to be continuous from the road and intermittent from the rail traffic.

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''*.

2.5 Measurement Positions

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

Icon	Descriptor	Location Description
1	Internal Noise Measurement Position 1	Located on the first floor of the building within a room on the northeast façade. The microphone was installed on a tripod at a distance of 1.5m from the window on the external façade and positioned at 1.5m above ground floor
2	Internal Noise Measurement Position 2	Located on the first floor of the building within a room on the southwest façade overlooking Conway Street and Warren Street. The microphone was installed on a tripod at a distance of 1.5m from the window on the external façade and positioned at 1.5m above ground floor

Icon	Descriptor	Location Description
3	External Noise Measurement Position 3	The microphone was installed on a tripod on the roof at 355 Euston Road facing Euston Road, as shown in Figure 2.2. The microphone was positioned within free-field conditions at least approx. 1.5 metres from the nearest surface.
4	External Noise Measurement Position 4	The microphone was installed on the tripod on the roof of 355 Euston Road facing Warren Street, as shown in Figure 2.2. The microphone was positioned within free-field conditions at least approx. 1.5 metres from the nearest surface.
5	Vibration Measurement Position 1	The accelerometer was installed at a distance of 1m from the façade adjoining the nearby Euston Road on a steel cube and attached with a magnetic plate.

Table 2.1 Measurement positions and descriptions

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

2.6 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.
Noise Kit 26	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21130-E0	23/07/2024	TCRT24/1572
	Free-field microphone NTI Acoustics MC230A	A25902		
	Preamp NTI Acoustics MA220	5522		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise Kit 27	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21174-E0	23/07/2024	TCRT24/1570
	Free-field microphone NTI Acoustics MC230A	A23366		
	Preamp NTI Acoustics MA220	11034		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise Kit 28	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21140-E0	23/05/2023	UK-23-063
	Free-field microphone NTI Acoustics MC230A	A23592		
	Preamp NTI Acoustics MA220	10981		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise Kit 29	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21175-E0	22/07/2024	TCRT24/1568
	Free-field microphone NTI Acoustics MC230A	A23073		
	Preamp NTI Acoustics MA220	11033		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise & Vibration Kit 1	Svantek Type 958A Class 1 Sound & Vibration Level Meter	34580	18/03/2024	1507821-2S
	Accelerometer PCB 356B18	LW254496		
Larson Davis CAL200 Class 1 Calibrator		17148	21/02/2024	UCRT24/1285

Table 2.2 Measurement instrumentation

3.0 RESULTS

3.1 Internal Noise Surveys

The $L_{Aeq:\ 15min}$ and $L_{Amax:\ 15min}$ acoustic parameters were measured throughout the duration of the internal noise surveys. Measured levels are shown as time histories in Figures 29004.TH1-2 for internal monitoring positions 1 and 2 respectively.

Measured noise levels are representative of noise exposure levels expected to be experienced in all spaces on all façades of the development, and are shown in Table 3.1.

Time Period	Internal Noise Measurement Position 1 (Measured Noise level – dBA)	Internal Noise Measurement Position 2 (Measured Noise level – dBA)
Daytime $L_{Aeq,16hour}$	42	28
Night-time $L_{Aeq,8hour}$	39	25

Table 3.1 Current internal average noise levels for daytime and night time

3.2 External Noise Surveys

The $L_{Aeq:\ 15min}$, $L_{Amax:\ 15min}$, $L_{A10:\ 15min}$ and $L_{A90:\ 15min}$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as time histories in Figures 29004.TH3-4.

Measured noise levels are representative of noise exposure levels expected to be experienced by all facades, and are shown in Table 3.2.

Time Period	External Noise Measurement Position 3 (Measured Noise level – dBA)	External Noise Measurement Position 4 (Measured Noise level – dBA)
Daytime $L_{Aeq,16hour}$	64	61
Night-time $L_{Aeq,8hour}$	61	58

Table 3.2 Site average noise levels for daytime and night time

3.3 Vibration Survey

The results of the vibration measurements captured during the automated survey period are shown as a time history in Figure 29004.VTH1 as VDV levels over the full survey period. It should be noted that vibration was slightly subjectively felt, and the noise due to underground rail was heard on site (ground floor) during the equipment installation and collection periods.

4.0 NOISE ASSESSMENT GUIDANCE

4.1 BS8233:2014

BS8233:2014 *'Sound insulation and noise reduction for buildings'* describes recommended internal noise levels for various types of spaces that have different functions, including office spaces. These levels are shown in Table 4.1.

Objective	Typical situations	Design range $L_{Aeq,T}$ dB
Typical noise levels for acoustic privacy in shared spaces	Restaurant	40 – 55
	Open plan office	45 – 50
	Night club, public house	40 – 45
	Ballroom, banqueting hall	35 – 40
	Living room	35 – 40
NOTE See Noise control in building services [28] and BS EN ISO 3382.		

Table 4.1 BS8233 recommended internal background noise levels in spaces when they are unoccupied and privacy is also important

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 4.2 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 4.2 Likelihood of comment on vibration perceived within residential dwellings

It should be noted that for offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose value ranges for a 16h day. Table 4.3 shows the different likelihoods of adverse comment from nearby vibration sources on office 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	0.4-0.8	0.8-1.6	1.6-3.2

Table 4.3 Likelihood of comment on vibration perceived within offices

It should also be noted that the vibration levels outlined in Table 4.3 are at the point of entry into the human body, and not the point of entry of vibration into the structure itself. In the cases where the proposed structure is not yet built and vibration measurements cannot be taken inside the building, losses should be accounted for due to the transfer function between the ground and building structure and its foundations. As ground conditions, foundation types, building construction, and floor construction and loading are all variables in terms of transfer function and losses, this report will assume piled foundations in rock and a negligible loss as a worst-case scenario.

In addition to potential losses as vibration passes from unloaded ground into the structure, amplification of vibration can occur as the vibration propagates across a suspended floor, such as in upper floors of the proposed building. As this is fully dependent on the input frequency of vibration and the natural frequency of the receiving structure, VDV levels would only be considered on the ground floor of the proposed development within this assessment.

5.0 DISCUSSION

5.1 Noise Assessment

Internally measured noise levels inside the ground floor spaces ranged from $L_{Aeq,16hour}$ 28dB – 42dB. As shown in Table 3.1, internally measured noise levels would be generally commensurate with the design criteria of BS8233:2014 (as shown in Table 4.1) for office spaces.

It should be noted that the internal noise level of $L_{Aeq,16hour}$ 28dB is significantly lower than the lower end of the range for offices. Very low background noise levels in offices could result in reduced acoustic privacy. Low internal noise levels can also make office activities appear louder and potentially distracting. A more acoustically private and comfortable environment could be achieved by balancing the ventilation and services to mask noises of office activities, which should be done at the M&E stage and should conform to the targets above.

If the surrounding area were to remain unchanged, the existing external building fabric would be sufficient in controlling noise break-in from external noise sources and would provide a suitable office environment.

5.2 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 nighttime period. BS6472-1-2008 guidelines state that for office spaces the VDV value is calculated over the daytime period only. Table 5.1 compares the measured levels on site against VDV ranges for office spaces 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 $ms^{-1.75}$	Likelihood of Comment
x	$VDV_{d,day}$	0.14	Adverse comment is not expected
y	$VDV_{d,day}$	0.02	Adverse comment is not expected
z	$VDV_{b,day}$	0.03	Adverse comment is not expected

Table 8.1 Daytime and night-time VDV levels and likelihood of comment in accordance with BS6472

As shown in Table 8.1, the most dominant axis of vibration is the x-axis with a $VDV_{d,day}$ of $0.14ms^{-1.75}$ which correlates with adverse comment not being expected from future occupiers within the office development.

6.0 CONCLUSION

Internal noise surveys, environmental noise surveys and an internal vibration survey have been undertaken at 355 Euston Road, Fitzroy House, London, NW1 3AL allowing the assessment of daytime and night-time levels likely to be experienced by the proposed development.

Noise levels measured internally demonstrate that the existing external building fabric would be sufficient in providing a suitable office environment following the BS8233:2014 guidelines for office spaces.

Measurement of road and rail from underground train activity indicates that vibration levels correlate to a VDV level where adverse comment is not expected, in accordance with BS6472: 2008 guidelines for office spaces.

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

355 Euston Road, Fitzroy House, London - Position 1
Environmental Time History
10/09/2024 to 11/09/2024

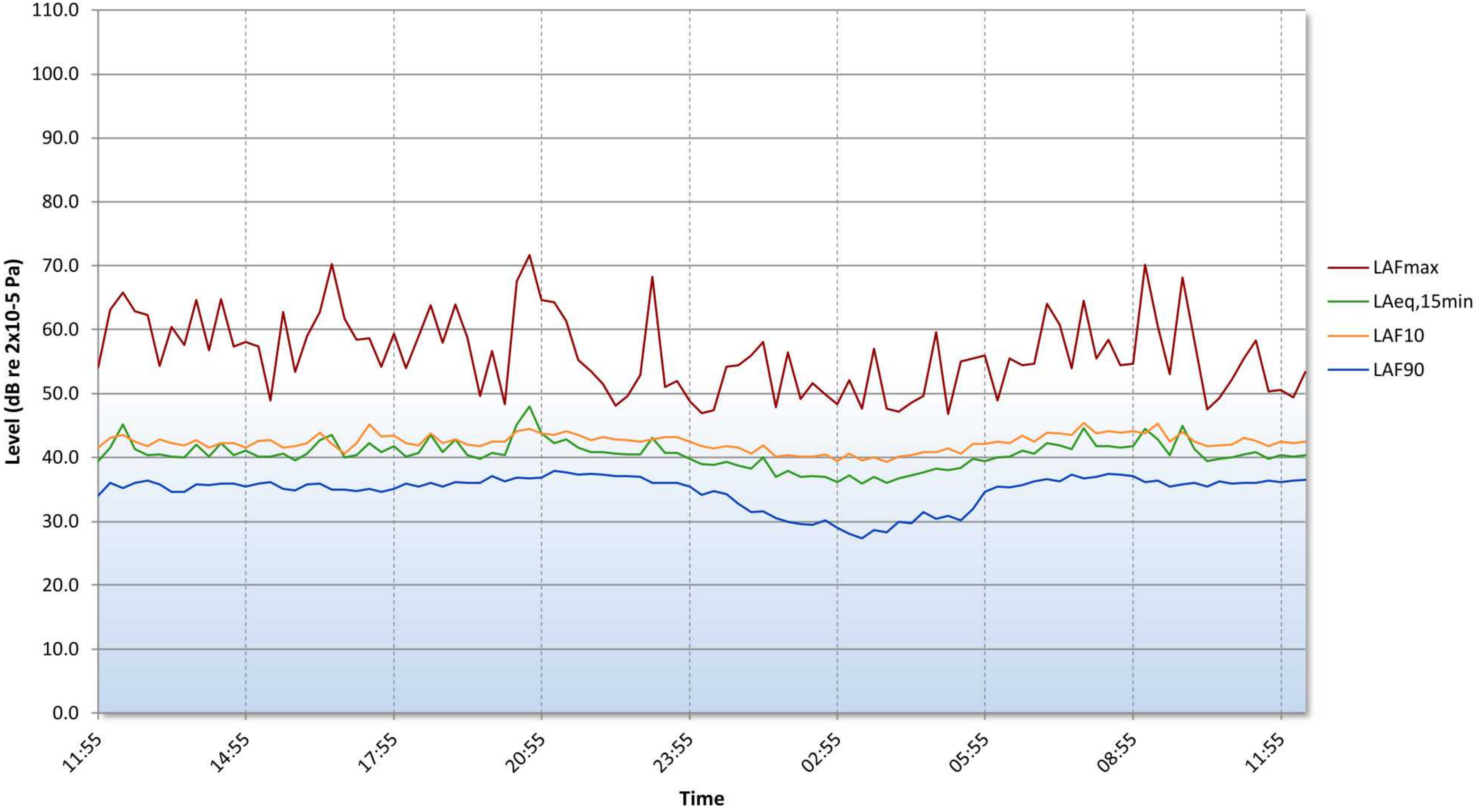

Figure 29004.TH1

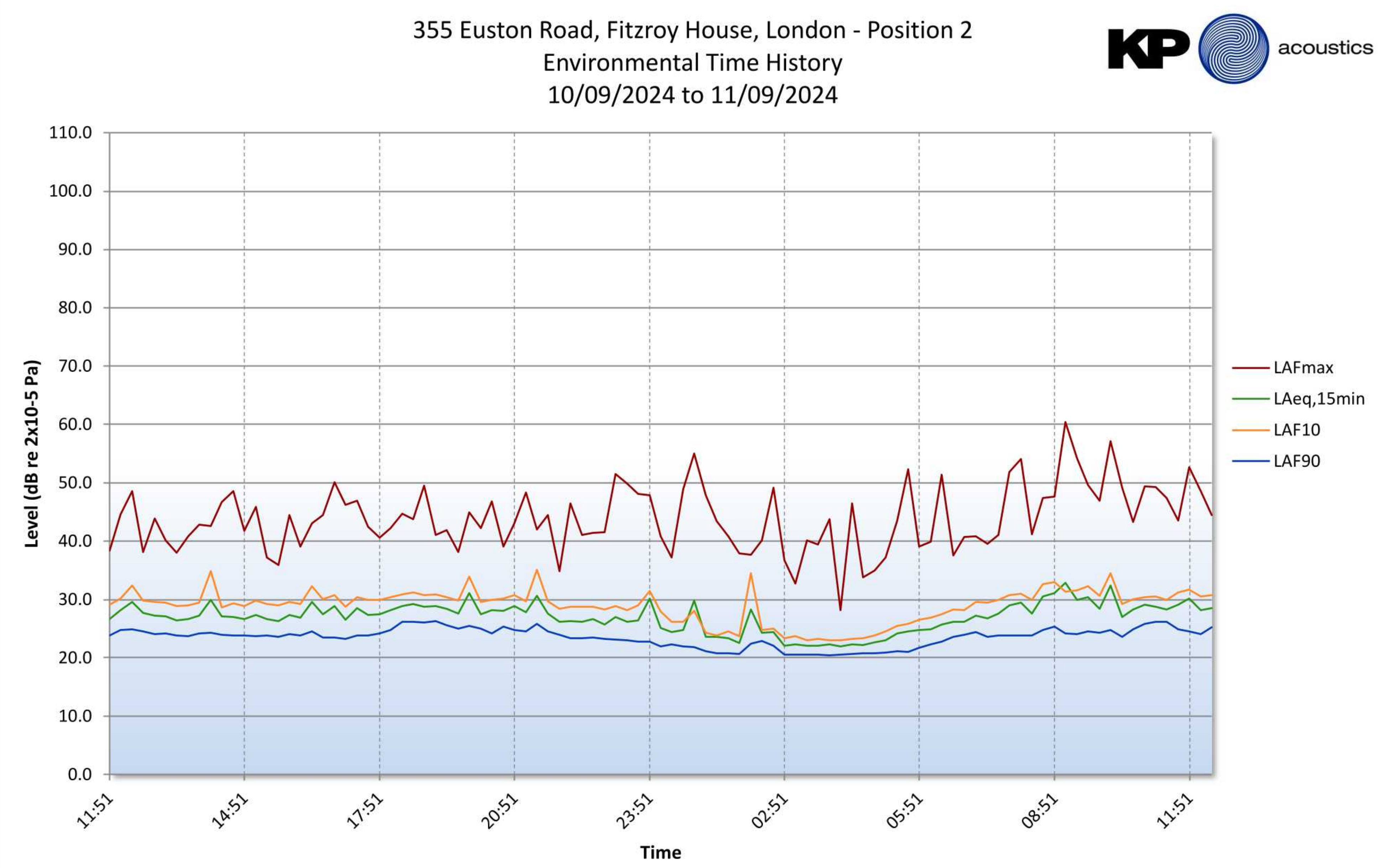

Figure 29004.TH2

355 Euston Road, Fitzroy House, London - Position 3
Environmental Time History
10/09/2024 to 11/09/2024

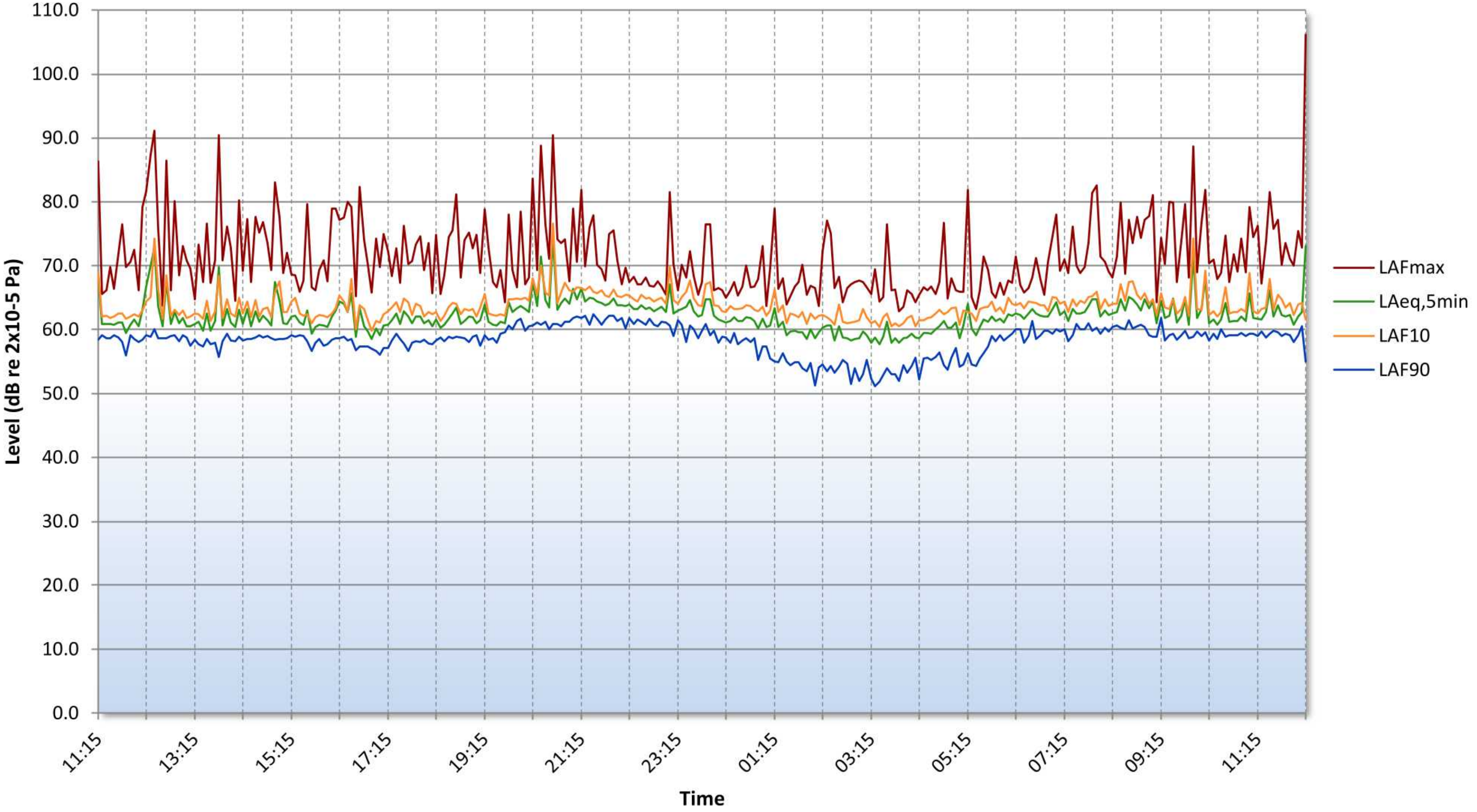

Figure 29004.TH3

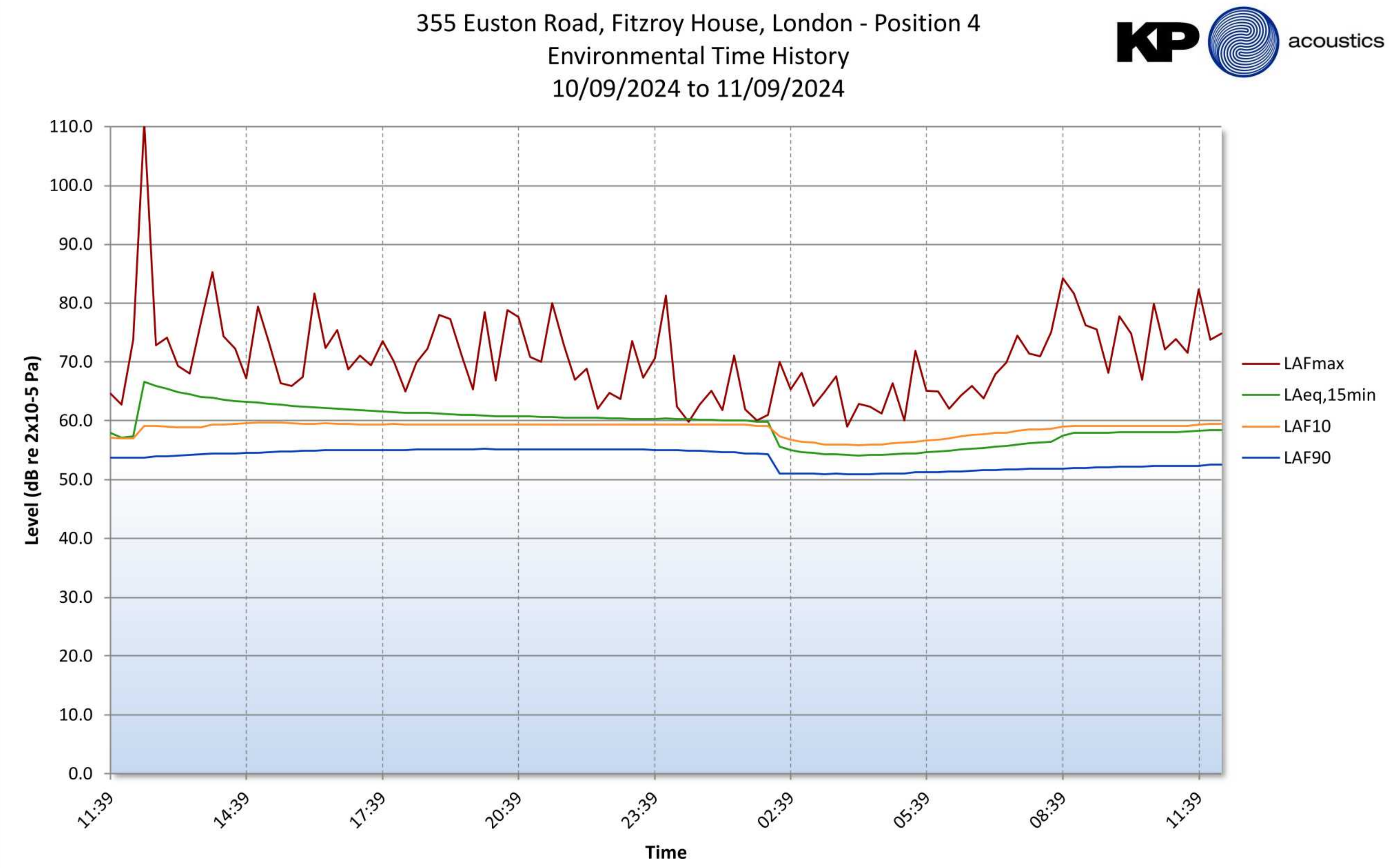

Figure 29004.TH4

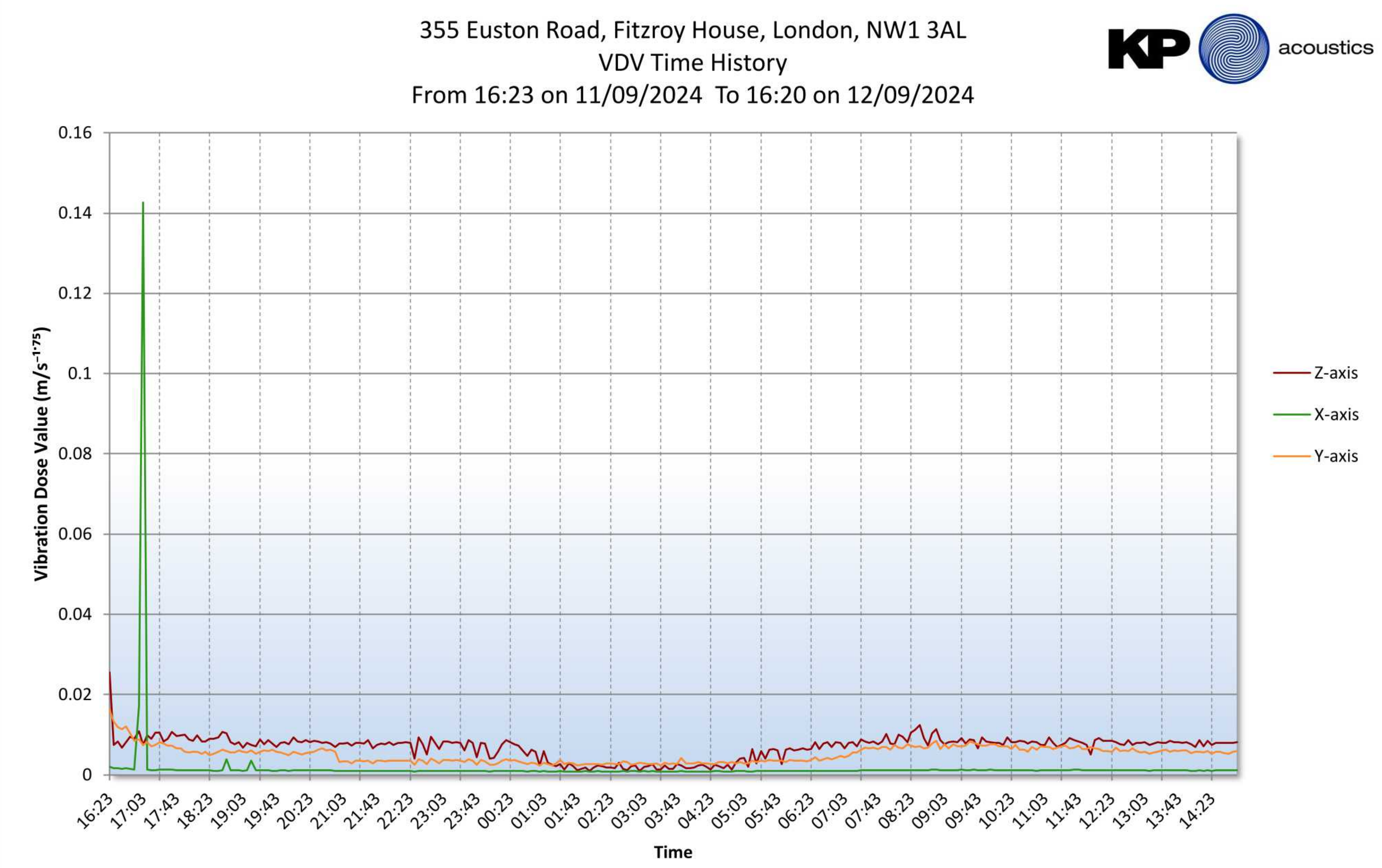

Figure: 29004.TH5

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.