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164 SHAFTESBURY AVENUE

NOISE IMPACT ASSESSMENT

CONTENTS

LIST OF ATTACHMENTS

Project Ref:	AS12374	Title:	164 Shaftesbury Avenue, London
Report Ref:	AS12374.220105.NIA	Title:	Plant Noise Impact Assessment
Client Name:	JLL		
Project Manager:	Daniel Saunders		
Report Author:	Michael Symmonds		
Clarke Saunders Acoustics Winchester SO22 5BE		This report has been prepared in response to the instructions of our client. It is not intended for and should not be relied upon by any other party or for any other purpose.	

1.0 EXECUTIVE SUMMARY

1.1 Clarke Saunders Acoustics has conducted an assessment of atmospheric noise emissions from proposed external plant associated with the refurbishment of 164 Shaftesbury Avenue, London.

1.2 Environmental noise survey data has been used to set criteria, following the requirements of Camden Council.

1.3 The external plant noise assessment demonstrates that the requirements are achieved by retaining the 1200mm high solid and imperforate parapet wall at roof level.

1.4 The acoustic impact of office worker activity on the 6th floor terrace should be acceptable, owing to the relatively small floor area and the generally sporadic use throughout the office occupancy hours.

2.0 INTRODUCTION

2.1 Clarke Saunders Acoustics (CSA) has been appointed to conduct an assessment of atmospheric noise emissions from proposed external plant, associated with the refurbishment of 164 Shaftesbury Avenue, London.

2.2 The assessment will be based on environmental noise survey data, the requirements of Camden Council and the proposed plant installations.

2.3 The potential acoustic impact of office worker activity on the 6th floor terrace will be discussed in the context of the pre-existing site use and ambient noise levels.

2.4 Please refer to Appendix A for a summary of the acoustic terminology used throughout this report.

3.0 SITE DESCRIPTION

3.1 164 Shaftesbury Avenue is situated in a predominantly commercial area of London. The surrounding area is relatively busy, with road traffic providing the predominant noise source. There is pre-existing mechanical services plant at roof level and within the rear courtyard, serving the current building and others in the vicinity, which contributes to the noise climate in this courtyard area.

3.2 There are residential windows to the south of the site on Earlham Street, facing into the courtyard.

3.3 The site is to be internally refurbished, with new building services plant installed at 7th floor roof level. A 6th floor level external terrace will be used as a breakout space during office hours. Music will not be played on the terrace.

3.4 The site, approximate positions of plant and terrace, and surrounding area are shown in AS12374/SP1.

4.0 LOCAL AUTHORITY REQUIREMENTS

4.1 Camden Council adopted the new Local Plan on 3 July 2017, which describes "noise thresholds" in Appendix 3. Noise levels from commercial and industrial developments including plant and machinery noise can be found in Table C of the document. A summary of this table is presented below.

EXISTING NOISE SENSITIVE RECEPTOR	ASSESSMENT LOCATION	DESIGN PERIOD	LOAEL (GREEN)	LOAEL TO SOAEL (AMBER)	SOAEL (RED)
Dwellings	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day (07:00 – 23:00)	'Rating level' 10 dB* below background	'Rating level' between 9 dB below and 5 dB above background	'Rating level' greater than 5 dB above background
	Outside bedroom window (façade)	Night (23:00 - 07:00)	'Rating level' 10 dB* below background and no events exceeding 57 dB L_{Amax}	'Rating level' between 9 dB below and 5 dB above background or noise events between 57 dB and 88 dB L_{Amax}	'Rating level' 5dB above background and/or events exceeding 88 dB L_{Amax}

Table 4.1 – *External plant noise requirements of Camden Council*

**10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.*

5.0 ENVIRONMENTAL NOISE SURVEY

5.1 EQUIPMENT AND PROCEDURE

5.1.1 A survey of the ambient and background noise levels was conducted at third floor level at the positions shown on the site plan AS12374/SP1. The microphones were installed outside of windows, circa 30cm from the building façade.

5.1.2 Measurements of consecutive 5-minute L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were taken between 12:00 hours on Tuesday 14^{th} December and 10:15 hours on Friday 17^{th} December 2021.

5.1.3 The following equipment was used during the survey:

- 1 no. Rion sound level meter type NL52;
- 2 no. Rion sound level meters type NL32;
- Rion sound level calibrator type NC74.

5.1.4 The calibration of the sound level meters was verified before and after use. No significant calibration drift was detected in any meter.

5.1.5 The weather during the survey was noted onsite at installation and retrieval of the meter. Conditions were mostly dry with light to moderate winds, which provided sufficient periods of appropriate weather for the measurement of environmental noise.

5.1.6 Measurements were made following procedures in BS 7445:1991 (ISO1996-2:1987) *Description and measurement of environmental noise Part 2- Acquisition of data pertinent to land use* and BS4142:2014 + A.1:2019 *Methods for rating and assessing industrial and commercial sound*.

5.2 SURVEY RESULTS

5.2.1 Figures AS12374/TH1-3 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at Position LT1.

5.2.2 Figures AS12374/TH4-6 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at Position LT2.

5.2.3 Figures AS12374/TH7-10 show the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels as time histories at Position LT3.

5.2.4 The ambient noise climate is determined by road traffic on Shaftesbury Avenue on the Shaftesbury Avenue and Mercer Street facades. In the rear courtyard, the traffic noise is less distinctive; existing mechanical services plant contribute significantly to the measured levels, particularly at night-time. It should be noted that monitoring position LT3 was representative of the receptors to the rear of Earlham Street.

5.2.5 The measured typical background (derived from the 10th percentile of the relevant L_{A90} dataset) and average noise levels from the monitoring positions are presented in the following table. A free-field correction of -3 dB has been applied to the measured noise levels, to negate the effect of noise reflections from the building façade.

POSITION	MONITORING PERIOD	TYPICAL BACKGROUND $L_{A90, 5MINS}$	AVERAGE $L_{Aeq, T}$
LT1	07:00 - 23:00 hours	55 dB	66 dB
	23:00 - 07:00 hours	47 dB	64 dB
LT2	07:00 - 23:00 hours	52 dB	62 dB
	23:00 - 07:00 hours	48 dB	60 dB
LT3	07:00 - 23:00 hours	49 dB	52 dB
	23:00 - 07:00 hours	48 dB	51 dB

Table 5.1 – *Typical measured background and average free-field noise levels* *[dB ref. 20 µPa]*

6.0 PLANT NOISE EMISSIONS CRITERIA

6.1 On the basis of the measured noise levels, the likelihood that the plant noise will not be perceptibly tonal at the receptor, and to target a LOAEL in line with Camden's standard requirements, the design criteria for new plant are as follows.

POSITION	MONITORING PERIOD	CRITERIA
LT1	07:00 - 23:00 hours	$L_{Aeq} \leq 45$ dB
	23:00 - 07:00 hours	$L_{Aeq} \leq 37$ dB
LT2	07:00 - 23:00 hours	$L_{Aeq} \leq 42$ dB
	23:00 - 07:00 hours	$L_{Aeq} \leq 38$ dB
LT3	07:00 - 23:00 hours	$L_{Aeq} \leq 39$dB
	23:00 - 07:00 hours	$L_{Aeq} \leq 38$ dB

Table 6.1 – *Plant noise emissions criteria* *[dB ref. 20 μPa]*

7.0 EXTERNAL PLANT NOISE ASSESSMENT

7.1 PLANT PROPOSALS

7.1.1 The proposed cooling plant selections have been confirmed as follows:

- 2 no. Mitsubishi condensing unit type PUMY-P112 VKM5;
- 1 no. Mitsubishi condensing unit type PUMY-P125 VKM5;
- 2 no. Mitsubishi condensing unit type PUMY-P200 YKM2R2;
- 1 no. Mitsubishi condensing unit type PUMY-P250 YBM.TH;
- 1 no. Mitsubishi condensing unit type PUZ-ZM35 VKA2;
- 1 no. Mitsubishi condensing unit type PUHZ-ZRP60 YKA3;
- 1 no. Mitsubishi condensing unit type PUHZ-ZRP100 YKA3;
- 1 no. Mitsubishi condensing unit type PUHZ-ZRP250 YKA3;
- 1 no. Mitsubishi condensing unit type PURY-P350 YNW-A1;
- 1 no. Mitsubishi condensing unit type PURY-P700 YNW-A1;
- 4 no. Mitsubishi condensing unit type PURY-P850 YNW-A1;
- 2 no. Mitsubishi air source heat pump type CAHV-P500YB-HPB.

7.1.2 The condensers could be used on cooling or heating modes. As the heating modes produce higher overall levels than the cooling modes, the sound pressure levels generated by the units when operated at their maximum heating duty has been used in the daytime calculations.

7.1.3 The building services consultants have confirmed the units can be assumed to operate at their 'low noise mode' during the night-time period, where applicable.

7.1.4 The manufacturer has confirmed the following sound pressure levels produced by the condensers when operated at their maximum heating duty and their 'low noise modes', where applicable.

FREQUENCY (HZ)	63	125	250	500	1K	2K	4K	8K
PUMY-P112 VKM5	64	52	52	49	46	41	35	29
PUMY-P112 VKM5 low noise	56	48	46	44	41	36	29	30
PUMY-P125 VKM5	57	53	52	51	46	42	36	30
PUMY-P125 VKM5 low noise	61	47	46	45	41	36	36	33
PUMY-P200 YKM2R2	64	61	61	58	57	52	49	41
PUMY-P200 YKM2R2 low noise	62	56	52	50	49	44	38	32
PUMY-P250 YBM.TH	72	64	61	57	58	51	44	37
PUZ-ZM35 VKA2	58	51	45	44	40	37	32	31
PUHZ-ZRP60 YKA3	53	51	52	44	42	38	33	27
PUHZ-ZRP100 YKA3	54	54	53	49	46	41	36	29
PUHZ-ZRP250 YKA3	66	63	61	60	58	53	48	42
PURY-P350 YNW-A1	69	64	64	62	57	52	47	40
PURY-P350 YNW-A1 low noise	55	55	51	47	43	37	36	35
PURY-P700 YNW-A1	73	67	67	65	60	55	50	44
PURY-P700 YNW-A1 low noise	58	58	53	50	46	40	39	38
PURY-P850 YNW-A1	77	67	70	68	63	58	53	49
PURY-P850 YNW-A1 low noise	68	60	55	52	50	47	42	47
CAHV-P500YB-HPB	70	65	60	57	51	46	49	45

Table 7.1 – *Condensing unit source noise levels (L_p @ 1m)* *[dB ref. 20 μPa]*

7.2 NOISE PREDICTIONS

7.2.1 The pre-existing 1200mm high solid and imperforate roof parapet will be retained, enclosing the rooftop plant area.

7.2.2 Distance propagation and screening attenuation effects have been incorporated into the calculations, to predict the resultant plant noise level at the identified critical residential receptor to the rear of Earlham Street. The design criteria have been based on the background noise levels measured at Position LT3 and the requirements in Table 4.1.

PREDICTED PLANT SOUND LEVEL	DESIGN CRITERIA
L_{Aeq} 37 dB	Daytime: $L_{Aeq} \leq 39$ dB
L_{Aeq} 27 dB	Night-time: $L_{Aeq} \leq 38$ dB

Table 7.2 – *Predicted plant noise levels and criteria* *[dB ref. 20 μPa]*

7.2.3 Compliance with the plant noise emissions criteria is demonstrated.

7.2.4 Any other air handling and extract plant would be selected at the technical design stage and following assessment would be fitted with acoustically specified attenuation in order that the cumulative noise level does not exceed the design criteria.

8.0 TERRACE DISCUSSION

8.1 The pre-existing building has terraces at 5th floor level on Mercer Street, which are to be merged. There is precedent, therefore, for terrace use on this façade.

8.2 A new terrace is proposed at 6th floor level. It will be approximately 45m^2 in area, accessible via the 6th floor level office area and a stairwell to the south-east.

8.3 During a typical scenario throughout the working day, office occupants are likely to use the terrace sporadically, for short breaks or private phone calls. As such, people will typically converse at normal voice levels. A typical conversation between two people may, therefore, generate noise levels around $L_{Aeq,T}$ 55-58 dB at 1m, which would lead to levels around $L_{Aeq,T}$ 31-34 dB at the receptors, far below the typical ambient noise levels.

8.4 Whilst the maximum occupancy of the terrace is not known at this stage, it is expected that there may be typically 30-40 people on the terrace during a busy lunch hour. When a space gets busy, people raise their voices owing to the higher ambient noise levels. CSA library data shows that during this busy scenario, a group of 30-40 people may result in noise levels around $L_{Aeq,5min}$ 60-62 dB at a distance of 8 metres. When accounting for the additional distance between the centre of the terrace and the Earlham Street receptor, the resultant noise levels at 1m from the receptor facades may be around $L_{Aeq,5min}$ 54-56 dB.

8.5 In addition to the ambient noise levels generated by a group of people conversing, it is acknowledged that a single person situated near the edge of the terrace may raise their voice. Library data shows this could result in a noise level $L_{Aeq,T}$ 45 dB at the receptors.

8.6 The terrace use is expected to be similar to that of the pre-existing terraces at 5th floor; only being used during office hours with no amplified music. Owing to this existing precedent and the likely modest noise levels associated with its typical use, adverse impact as a result of terrace use is unlikely.

9.0 CONCLUSIONS

9.1 Clarke Saunders Acoustics has conducted an assessment of atmospheric noise emissions from external plant associated with the proposed refurbishment of 164 Shaftesbury Avenue, London.

9.2 The external plant noise assessment demonstrates that the requirements of Camden Council are achieved by retaining the 1200mm high solid and imperforate parapet wall. No further mitigation measures are required for external plant noise emissions.

9.3 The acoustic impact of the 6th floor terrace should be acceptable, owing to the relatively small floor area and the generally sporadic use throughout the office occupancy hours.

M Symmonds

Michael Symmonds MIOA
CLARKE SAUNDERS ACOUSTICS

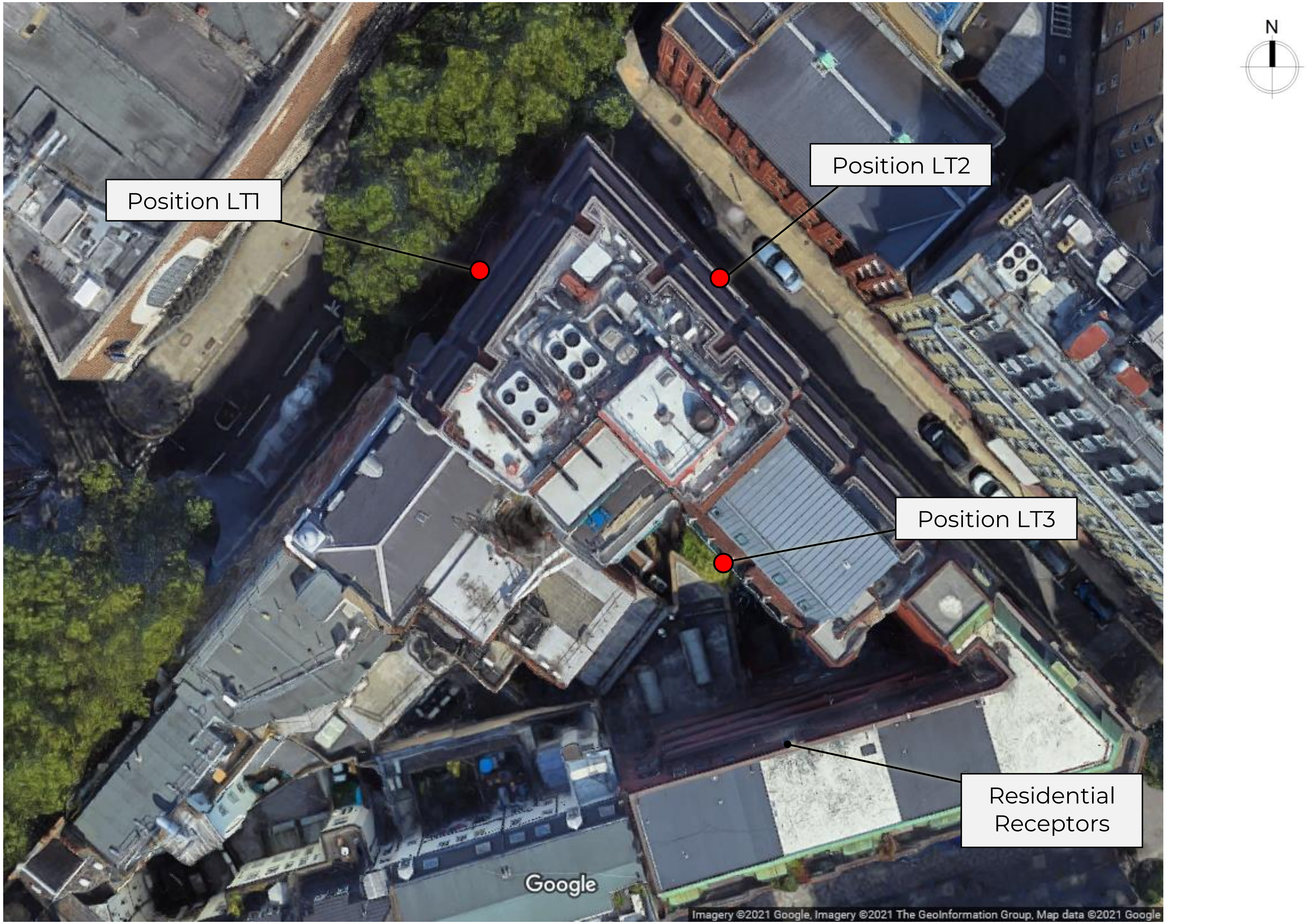

Figure AS12374/SP1

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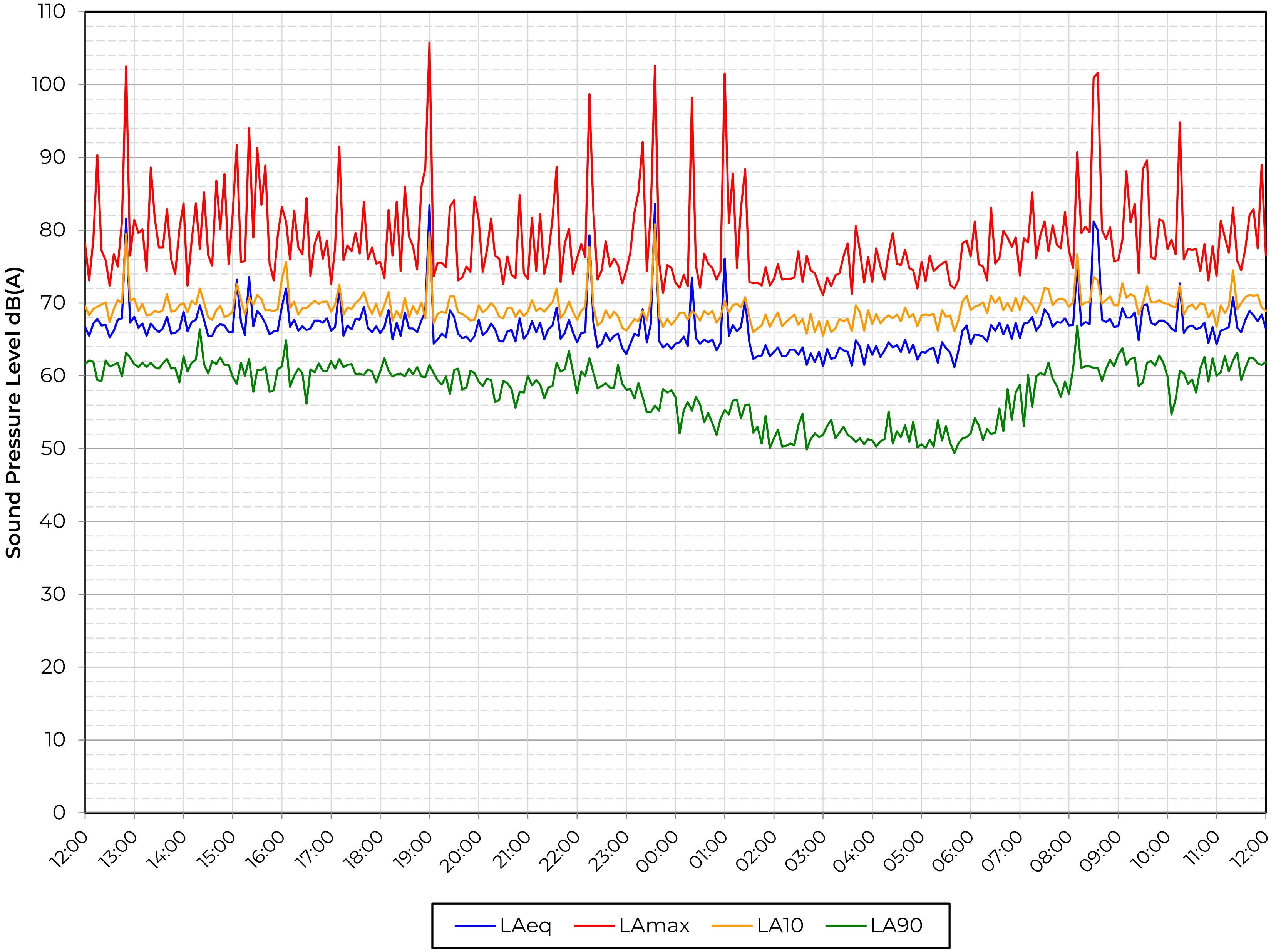
164 Shaftesbury Avenue, London

Position 1



Tue 14 Dec to Wed 15 Dec

Figure AS12374/TH1

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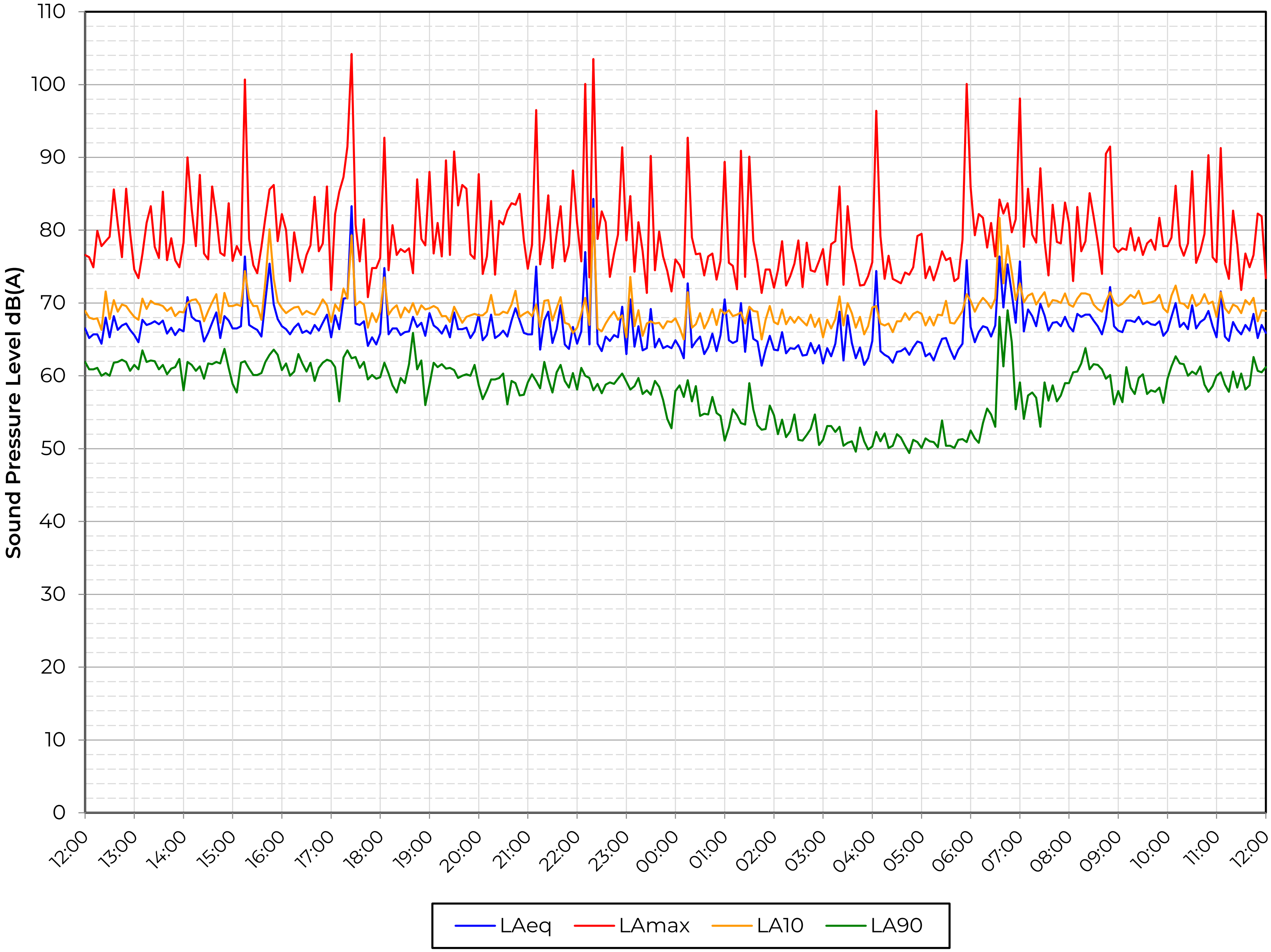
164 Shaftesbury Avenue, London

Position 1



Wed 15 Dec to Thu 16 Dec

Figure AS12374/TH2

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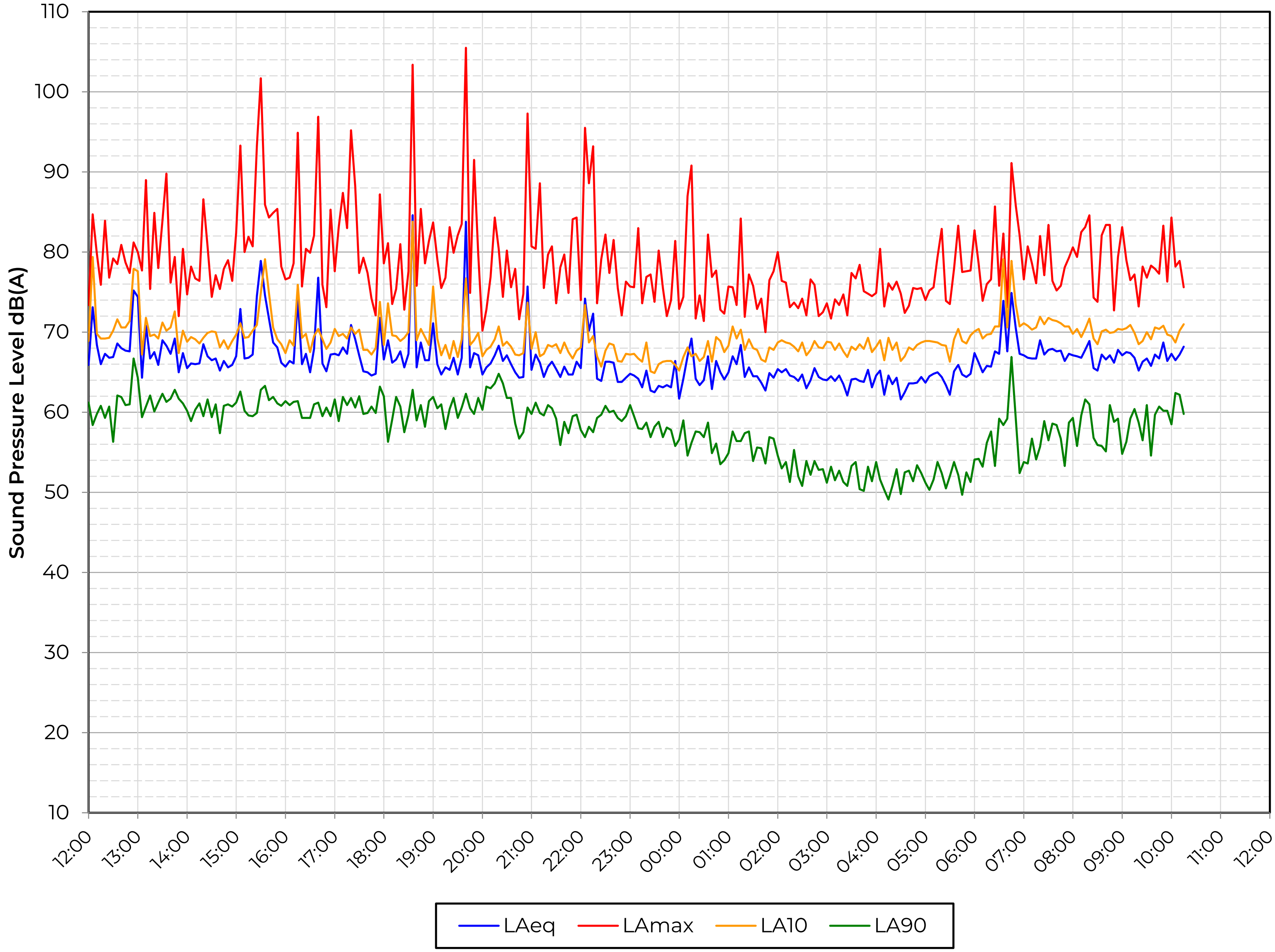
164 Shaftesbury Avenue, London

Position 1



Thu 16 Dec to Fri 17 Dec

Figure AS12374/TH3

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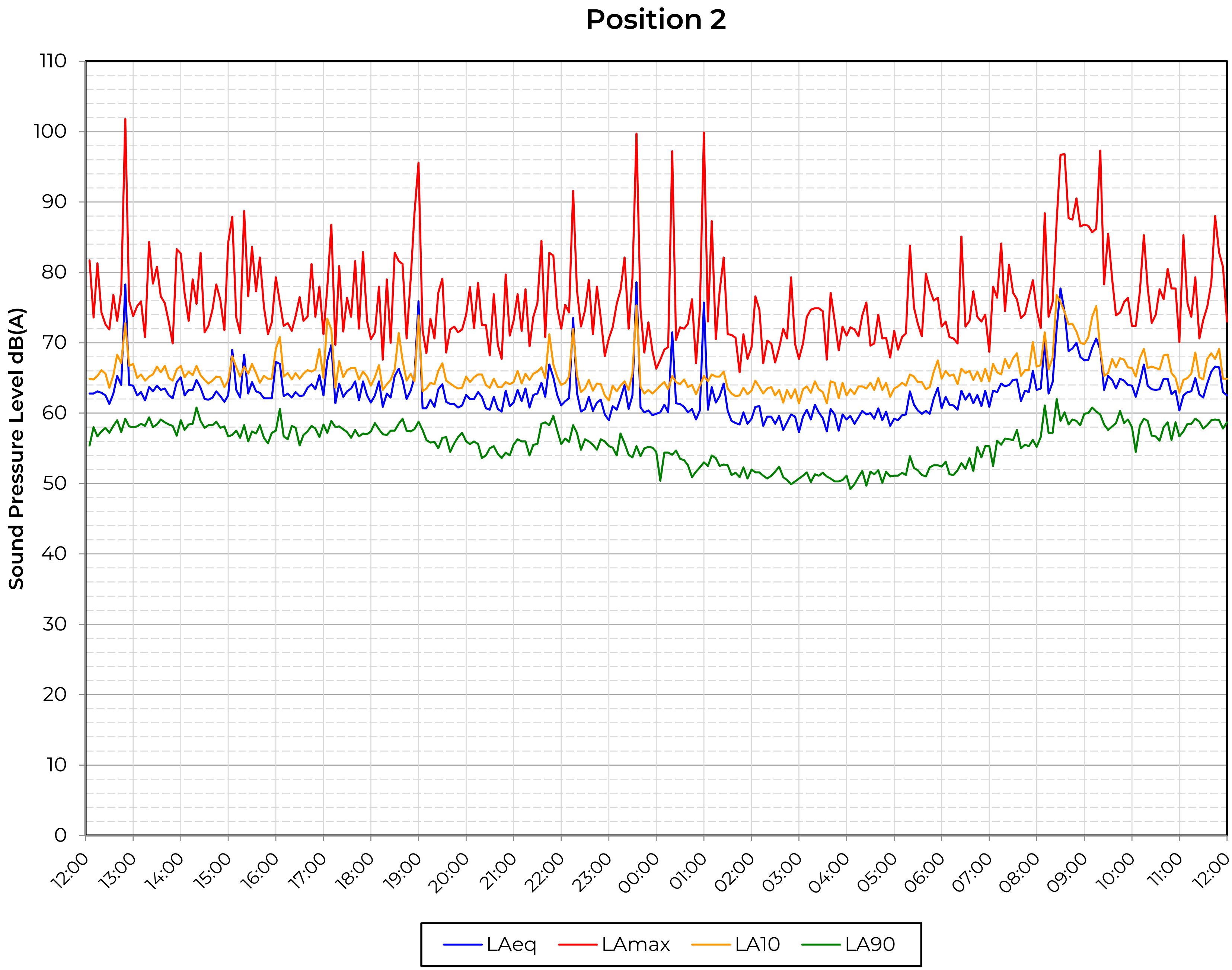
164 Shaftesbury Avenue, London



Tue 14 Dec to Wed 15 Dec

Figure AS12374/TH4

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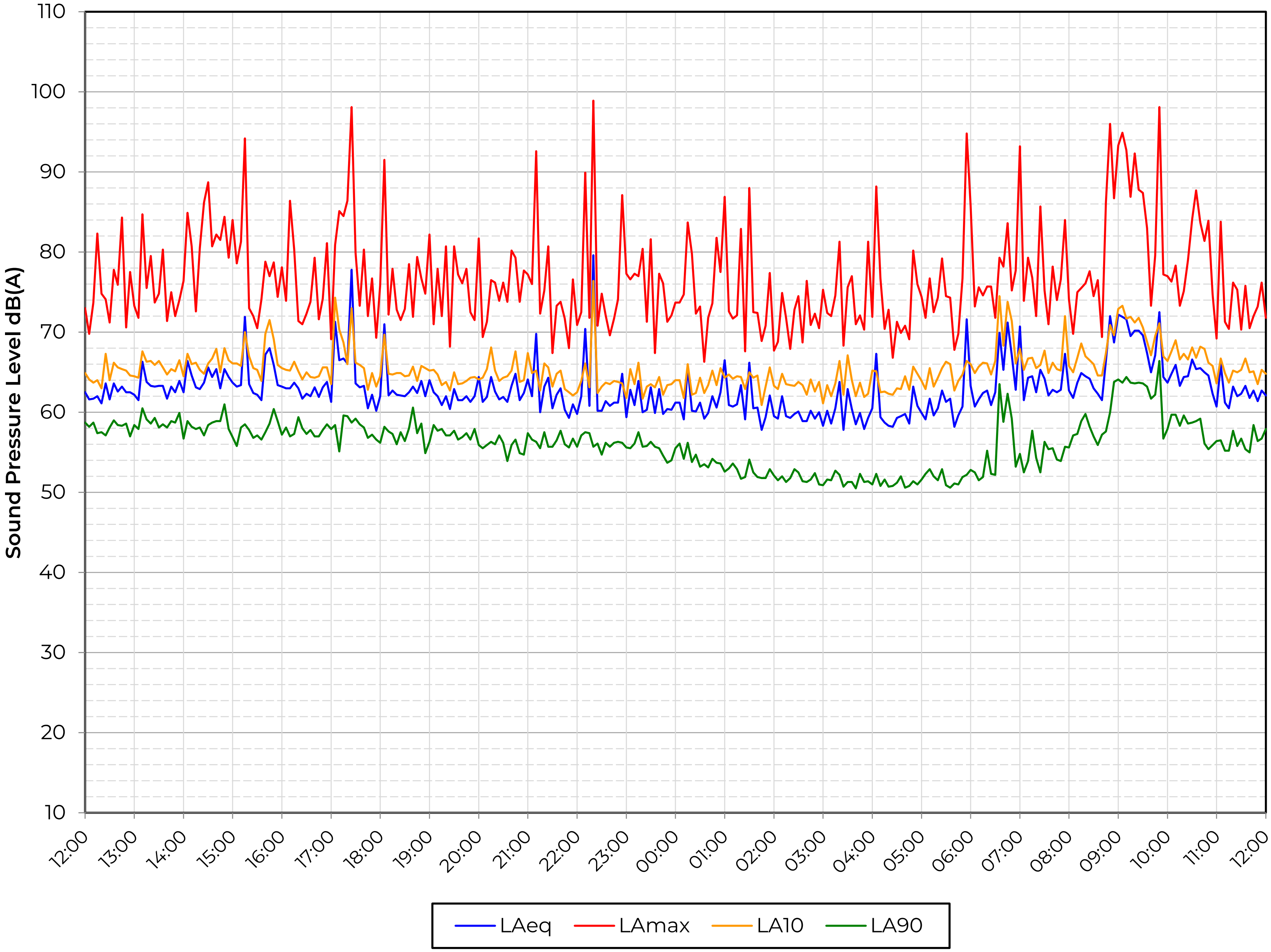
164 Shaftesbury Avenue, London

Position 2

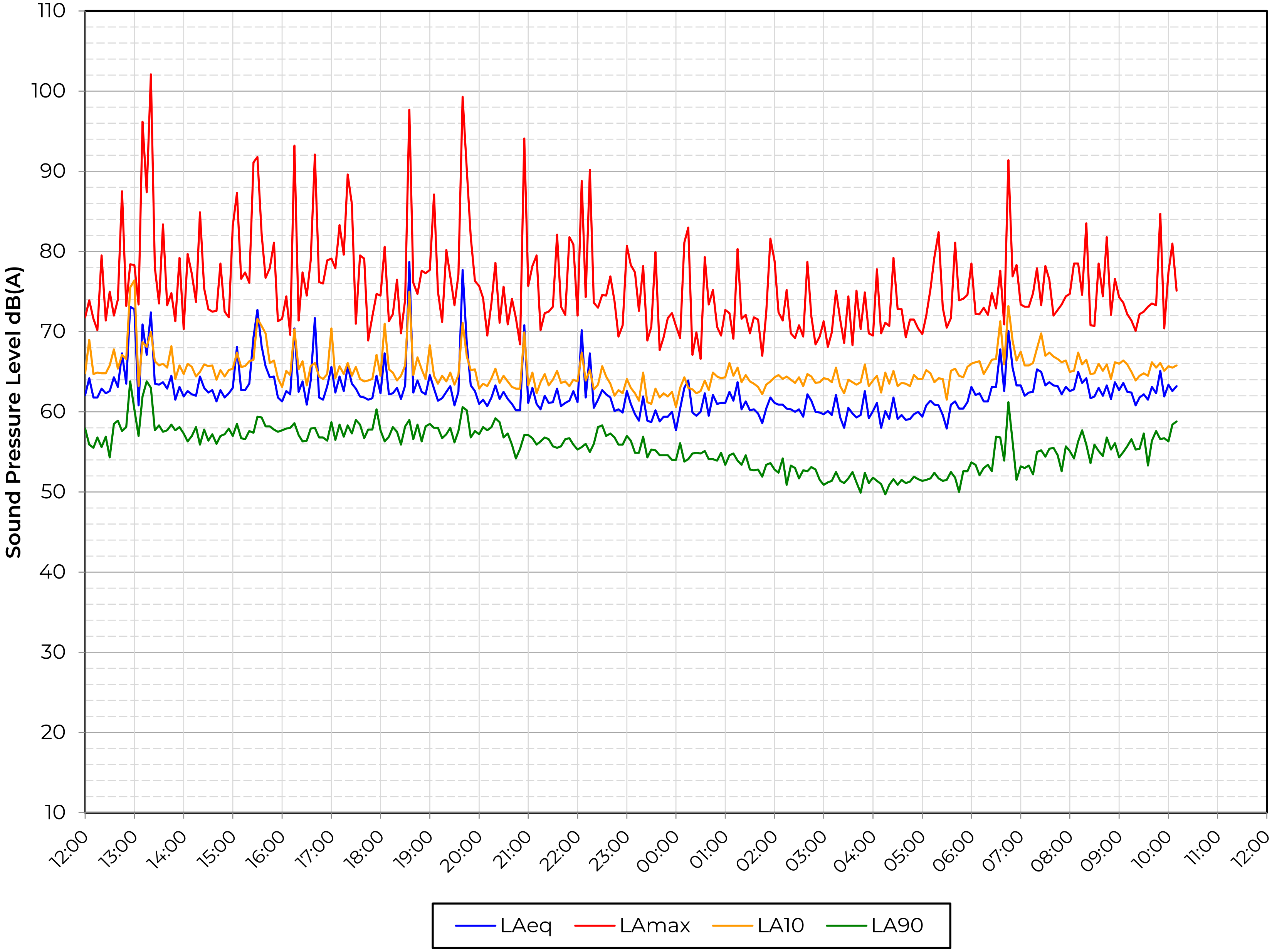


Wed 15 Dec to Thu 16 Dec

Figure AS12374/TH5

164 Shaftesbury Avenue, London

Position 2



Thu 16 Dec to Fri 17 Dec

Figure AS12374/TH6

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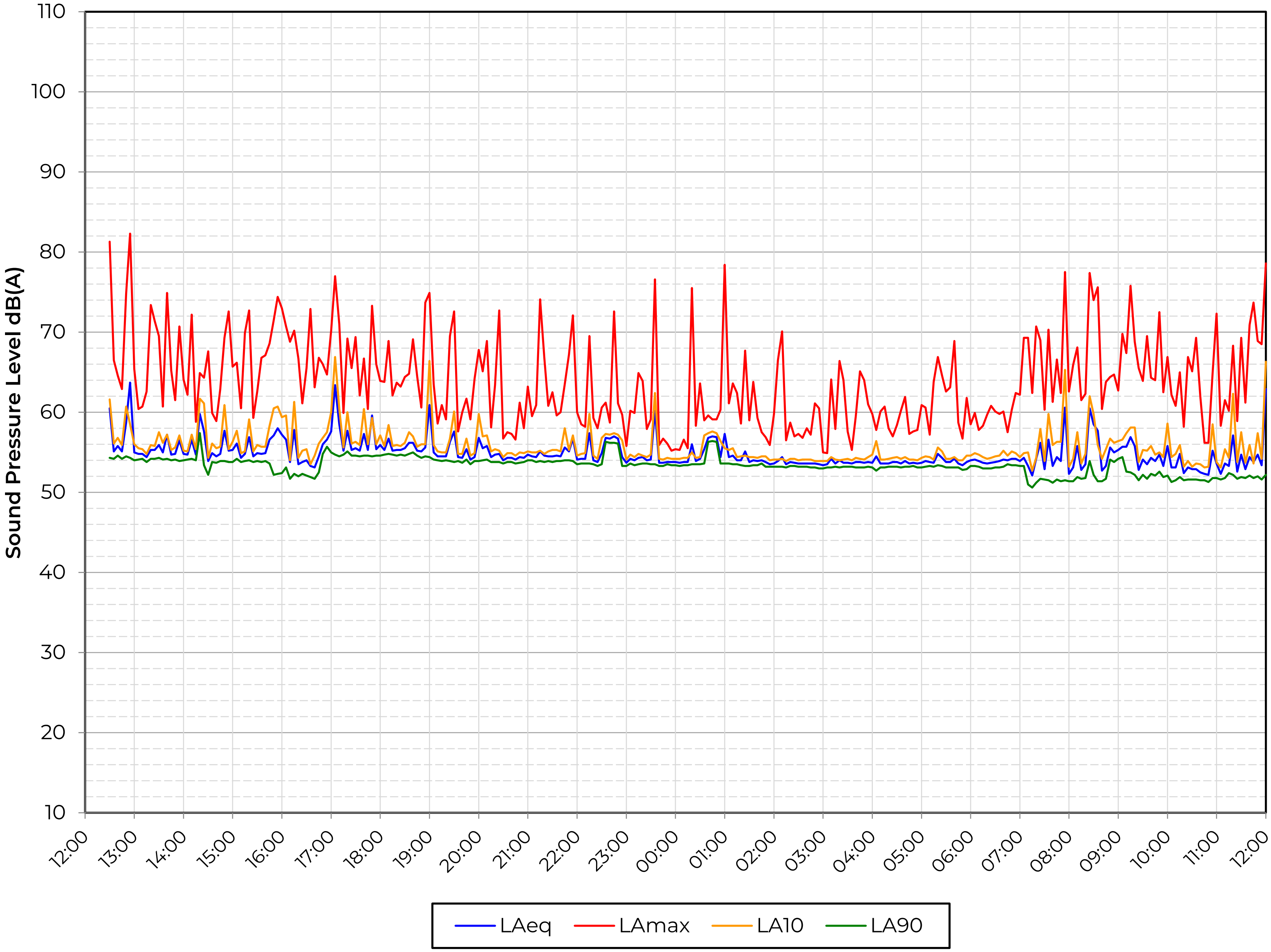
164 Shaftesbury Avenue, London

Position 3



Tue 14 Dec to Wed 15 Dec

Figure AS12374/TH7

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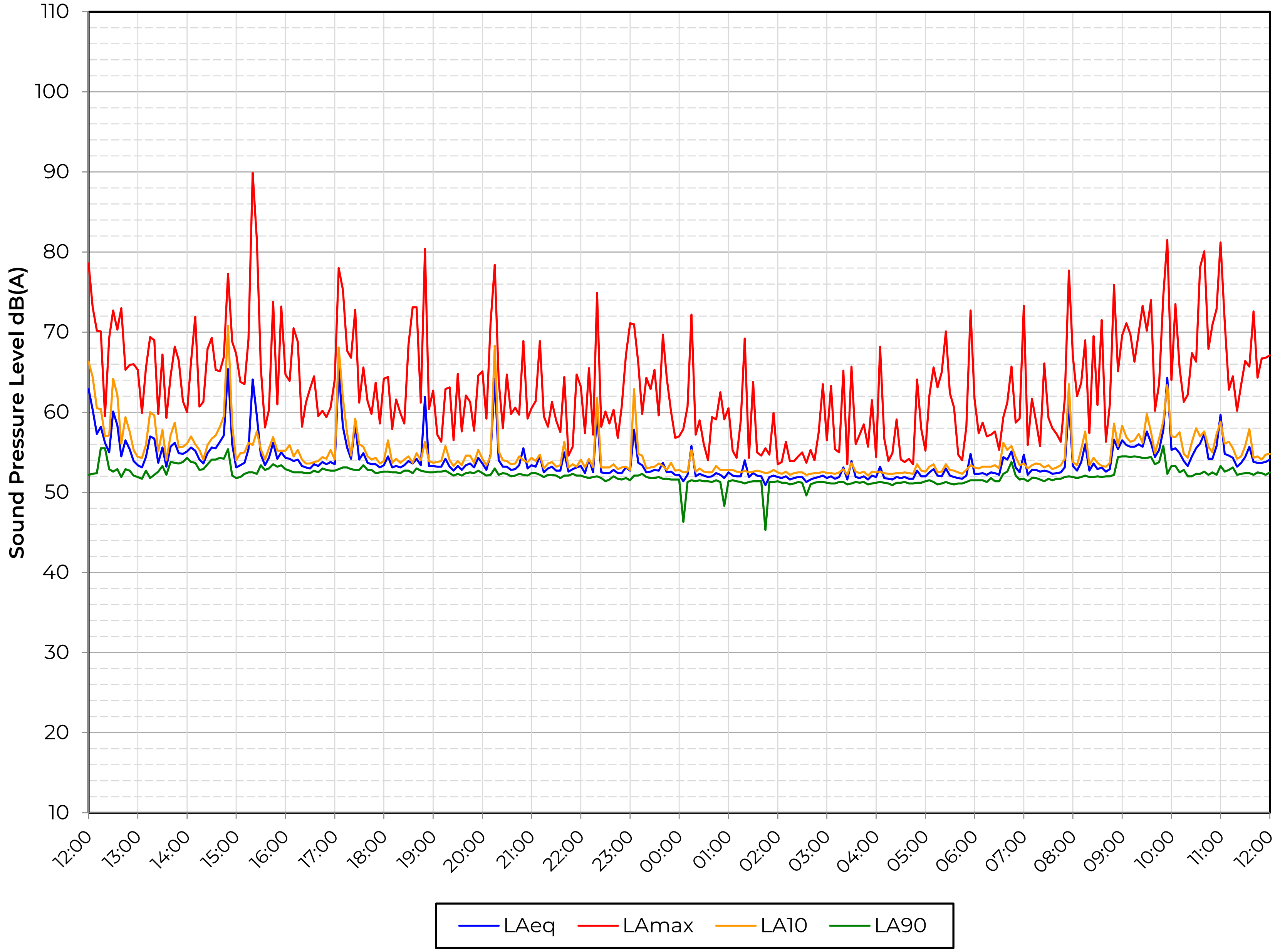
164 Shaftesbury Avenue, London

Position 3



Wed 15 Dec to Thu 16 Dec

Figure AS12374/TH8

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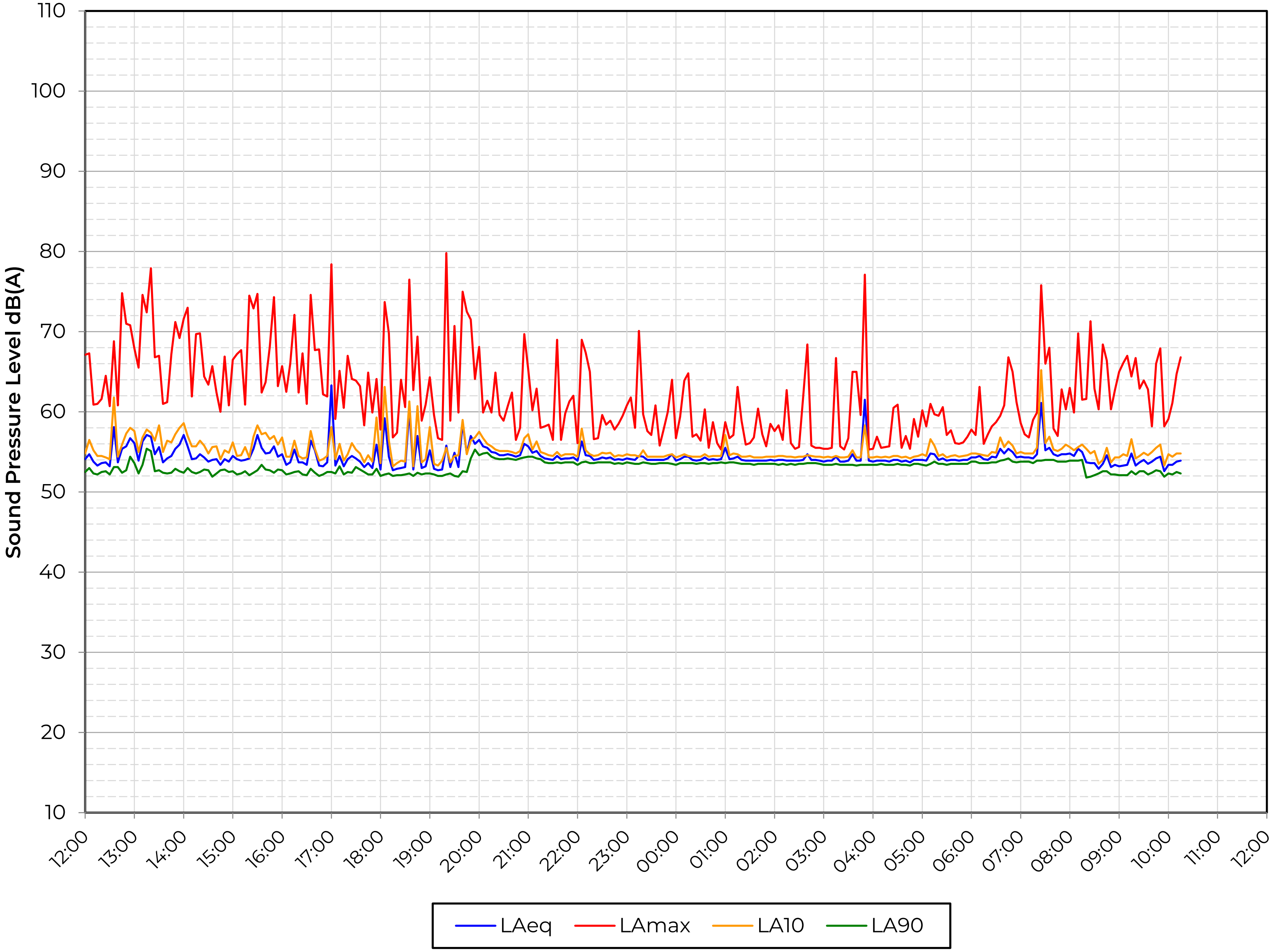
164 Shaftesbury Avenue, London

Position 3



Thu 16 Dec to Fri 17 Dec

Figure AS12374/TH9

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.

Noise Sound that is unwanted by or disturbing to the perceiver.

Frequency The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.

dB(A): Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.

L_{eq} : A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc).

The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction.

Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.

L_{10} & L_{90} : Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise.

It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.

L_{max} : The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.

R *Sound Reduction Index.* Effectively the *Level Difference* of a building element when measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010 and corrected for its size and the reverberant characteristics of the receive room.

D The sound insulation performance of a construction is described in terms of the difference in sound level on either side of the construction in the presence of a sound source on one side and the reverberant characteristics of the adjoining

	'receive' space. *D* is the arithmetic *Level Difference* in decibels between the source and receive sound levels when filtered into frequency bands.
D_{nT}	*Weighted Standardised Level Difference.* As defined in BS EN ISO 717-1, representing the *Weighted Level Difference*, when standardised for reference receiving room reverberant characteristics.
R_w D_w $D_{nT,w}$	Value of parameter, determined as above, but weighted in accordance with the procedures laid down in BS EN ISO 717-1 to provide a single-figure value.
$L'_{nT,w}$	*Weighted Standardised Impact Sound Pressure Level* as defined in BS EN ISO 717-2, representing the level of sound pressure when measured within a space where the floor above is under excitation from a calibrated tapping machine, standardised for the receiving room reverberant characteristics.
ΔL_w	Change in impact sound pressure level when a floor is fitted with a 'soft' or resilient covering, as measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-3:2010.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz.

The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

INTERPRETATION

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.