
PREPARED: Friday, 03 November 2023

# 21-23 BEDFORD PLACE, LONDON; NOISE IMPACT ASSESSMENT DRAFT

CONTENTS



LIST OF ATTACHMENTS





| | | | |
|---|---|---|---|
| **Project Ref:** | AS13225 | **Title:** | 21-23 Bedford Place, London |
| **Report Ref:** | AS13225.231103.NIA | **Title:** | Noise Impact Assessment DRAFT |
| **Client Name:** | Firmdale Hotels Plc | | |
| **Project Manager:** | Alex Brooker | | |
| **Report Author:** | Alex Brooker | | |
| Clarke Saunders Acoustics<br>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 (CSA) has been commissioned to undertake a noise impact assessment of proposed new plant and to provide recommendations for noise mitigation measures, where required, in accordance with the planning requirements of London Borough of Camden (LBC).

1.2 Details of proposed new external plant have been reviewed and calculations undertaken to assess the potential noise impact of the scheme. Minimum performance specification for noise attenuation measures to demonstrate compliance with the external noise criteria have been provided.

1.3 An outline assessment of the required external building fabric performance has also been carried out, with reference to guidance on suitable internal ambient noise levels within hotel guestrooms.

## 2.0 INTRODUCTION

2.1 Planning approval is being sought for the refurbishment of 21-23 Bedford Place, a Grade II listed property comprising three linked townhouses in the Bloomsbury Conservation Area. As part of the proposals, new building services plant is required. Clarke Saunders Acoustics (CSA) has been commissioned by Firmdale Hotels PLC to undertake a noise impact assessment of the proposed new plant and to provide recommendations for noise mitigation measures, where required, in accordance with the planning requirements of London Borough of Camden (LBC).

2.2 The proposals also include the replacement of the existing non-heritage windows on the front and rear façades. An outline assessment of the required acoustic performance of the new glazing units has also been undertaken.

2.3 This report describes the noise impact assessment, including calculations, confirming the required attenuation measures for external plant to demonstrate compliance with the external noise criteria.

2.4 A glossary relevant to the terminology used in this report is presented in Appendix A.

## 3.0 DESIGN CRITERIA

### 3.1 LOCAL AUTHORITY REQUIREMENTS

3.2 The LBC *'Local Plan 2017'* refers to the *'National Planning Policy Framework'* and *'Planning Practice Guidance'* on the matter of noise impact assessment., stating the following:

*A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).*

3.3 The document also provides targeted numerical values broadly corresponding to the LOAEL and SOAEL effect levels, as shown in Table 1.

| NOISE SIGNIFICANCE RISK | GREEN LOAEL | AMBER LOAEL TO SOAEL | RED SOAEL |
|---|---|---|---|
| Camden Local Plan | 'Rating level' 10dB* below background | 'Rating level' between 9dB below and 5dB above background | 'Rating level' greater than 5dB above background |

Table 1: Excerpt from LBC Local Plan 2017

3.4 The following description is also provided with regard to acceptability of the green, amber and red designations:

- Green – where noise is considered to be at an acceptable level.
- Amber – where 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 – where noise is observed to have a significant adverse effect.

### 3.5 BS8233:2014 GUIDANCE ON SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS

3.5.1 BS8233:2014 *Guidance on sound insulation and noise reduction for buildings* sets out desirable internal noise levels to be achieved within residential dwellings, which are provided in the Table 2 below. LBC have confirmed that, while typical best practice design guidance such as BS8233:2014 would be an appropriate target, internal ambient noise conditions offered to guests is determined by the hotel operator and so would not be a planning compliance issue. Nevertheless, LBC request that a façade design sufficient to achieve appropriate internal ambient noise levels is considered at the planning stage.

| ACTIVITY | LOCATION | 07:00 TO 23:00 | 23:00 TO 07:00 |
|---|---|---|---|
| Resting | Living Room | 35dB $L_{Aeq,16hr}$ | - |
| Dining | Dining Room | 40dB $L_{Aeq,16hr}$ | - |
| Sleeping (daytime resting) | Bedroom | 35dB $L_{Aeq,16hr}$ | 30dB $L_{Aeq,8hr}$ |

Table 2– BS8233:2014 desirable internal noise targets

## 4.0 SURVEY PROCEDURE & EQUIPMENT

4.1 A survey of existing ambient and background noise levels was undertaken at three locations, two to the rear and one on the front façade, all at first floor level. The monitoring locations are shown in the attached site plan AS13225/SP1. Measurements of consecutive 5-minute $L_{Aeq}$, $L_{Amax}$, $L_{A10}$ and $L_{A90}$ sound pressure levels were taken between 16:00 hours on Friday 22nd September and 11:30 on Tuesday 26th September.

4.2 The following equipment was used during the course of the survey:

- 1 no. Rion sound level monitor type NL52;
- 2 no. NTi sound level monitor type XL2; and
- 1 no. Rion sound level calibrator type NC74.

4.3 The calibration of the sound level meters was verified before and after use. No significant calibration drift was detected.

4.4 The local noise climate to the rear (west) of the site, overlooking Montagu Street Gardens is generally determined by existing external plant associated with neighbouring properties, with contributions from road traffic on the surrounding road network. Noise levels to the east of the site are determined by road traffic noise on Bedford Place and surrounding roads.

4.5 The weather during the survey was noted on site at installation and retrieval of the meters. Conditions were observed to be dry with light winds, and were suitable to determine the minimum $L_{A90}$ during the relevant survey periods, from which the external plant noise criteria are set. The noise data is also appropriate for the specification of external building fabric performance.

4.6 Measurements were made in free-field conditions following procedures in BS 7445:1991 (ISO1996-2:1987) *Description and measurement of environmental noise Part 2- Acquisition of data pertinent to land use*.

## 5.0 SURVEY RESULTS

5.1 Figures AS13225/TH1-TH12, attached, show the $L_{Aeq}$, $L_{Amax}$, $L_{A10}$ and $L_{A90}$ sound pressure levels as time histories at the survey positions.

5.2 The measured minimum background and average noise levels from the survey are shown in Table 3.

| MONITORING LOCATION | MONITORING PERIOD | TYPICAL BACKGROUND $L_{A90,5MINS}$ | AVERAGE $L_{Aeq,T}$ |
|---|---|---|---|
| Front Façade | Daytime 07:00-23:00 Hours | 48 dB | 60 dB |
| | Night-time 23:00-07:00 Hours | 42 dB | 56 dB |
| Rear North Position | Daytime 07:00-23:00 Hours | 48 dB | 53 dB |
| | Night-time 23:00-07:00 Hours | 44 dB | 48 dB |
| Rear South Position | Daytime 07:00-23:00 Hours | 49 dB | 54 dB |
| | Night-time 23:00-07:00 Hours | 44 dB | 51 dB |

Table 3 – Typical measured background and average noise levels [dB ref. 20μPa]

5.3 On the basis of the information provided by LBC outlined in Section 3.0, the plant noise criteria required to achieve the "green" and "amber" categories are detailed in Table 4.

5.4 This project will target compliance with the "green" category, however, it is noted that exceedances of this criteria within the "amber" range may be considered acceptable "when assessed in the context of other merits of the development".

| RECEPTOR LOCATION | PERIOD | PLANT NOISE CRITERIA $L_{AEQ}$ ("GREEN") | PLANT NOISE CRITERIA $L_{AEQ}$ ("AMBER") |
|---|---|---|---|
| East (front) | 24-hour | 32 dB | 33-47 dB |
| West (rear) | 24-hour | 34 dB | 35 – 49 dB |

Table 4 – Proposed plant noise limits [dB ref. 20μPa]

# 6.0 PREDICTED NOISE IMPACT

## 6.1 PROPOSED PLANT

6.1.1 The proposed building services plant has been confirmed as the following:

**Rooftop**

- 6 no. Nuaire AVT7-R supply/extract fans

**Rear plantroom**

- 5 no. Daikin REYQ-12T VRV condensers

6.1.2 The rooftop plant will be installed within existing sunken roof areas, maximising the noise attenuation provided by the existing building mass screening. The condensing units will be located within a purpose built external plant room at basement level. These will be of solid masonry construction to fully enclose the plant with louvred sections as required to allow ventilation. The proposed plant location is shown in the indicative site plan AS13225/SP1, attached.

6.1.3 Sound data for the building services plant have been confirmed by the manufacturer as follows:

| FREQUENCY (Hz) | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K | dB(A) |
|---|---|---|---|---|---|---|---|---|---|
| Nuaire AVT7-R Inlet, $L_w$ | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Nuaire AVT7-R Outlet, $L_w$ | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Daikin REYQ12T, $L_w$ | 87 | 82 | 81 | 81 | 75 | 70 | 65 | 62 | 81 |

Table 5 – Source noise data for external plant [dB ref. 20µPa]

## 6.2 PREDICTED NOISE LEVELS

6.2.1 It is expected that all plant may run, as required to service demand, at all times. The assessment has, therefore, been based on 24-hour criteria for the relevant receptors shown in Table 4.

6.2.2 The nearest noise sensitive receptors in the vicinity have been determined from on-site inspections and publicly available council tax information. These are shown in the attached site plan and include the Grange Beauchamp Hotel to the south, residential and hotel receptors on Bedford Place to the east and the rear windows of The Montagu on the Gardens hotel to the west. The properties to the north are all understood to be of commercial use.

6.2.3 Noise attenuation afforded by the building mass between the rooftop supply/extract fans and receptor locations has been included in the calculations. In addition, it is expected that these fans will require some additional attenuation provided by duct mounted silencers. The following indicative insertion loss specification has been included for setting out purposes. Final attenuator performance requirements will be determined when plant selections and layout are finalised to ensure compliance with the required noise criteria.

| MINIMUM SUPPLY/EXTRACT FAN SILENCER PERFORMANCE | INSERTION LOSS (DB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K |
| Supply/Extract fans | 4 | 8 | 11 | 19 | 20 | 16 | 14 | 12 |

Table 6 –Indicative insertion loss of supply/extract fan silencers

6.2.4 The louvred sections of the basement level plant compound will need to be acoustically rated to attenuate noise emissions from the plantroom. The following minimum insertion loss for the louvred sections will be required which, based on the manufacturers matched silencer performance specifications, can be achieved with a nominal 1000mm long silencer.

| MINIMUM PLANT COMPOUND LOUVRE PERFORMANCE | INSERTION LOSS (DB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K |
| Louvre | 6 | 6 | 8 | 10 | 14 | 18 | 16 | 15 |

Table 7 –Minimum required insertion loss for basement plant compound louvred sections

6.2.5 The overall predictions at the noise sensitive receptors locations are given in Table 8, set against the relevant 24-hour criterion.

| RECEPTOR | PREDICTED NOISE LEVELS | CRITERION |
|---|---|---|
| Bedford Place Receptor | $L_{Aeq}$ 25dB | 24-hour: $L_{Aeq}$ 32dB |
| The Montagu | $L_{Aeq}$ 21dB | 24-hour: $L_{Aeq}$ 34dB |
| Grange Beauchamp | $L_{Aeq}$ 34dB | |

Table 8 –Predicted noise levels at nearest noise sensitive locations [dB ref. 20µPa]

6.2.6 All other standard operational air handling and extract plant will be fitted with acoustically specified attenuators, as required, in order that the cumulative noise level does not exceed the relevant design noise criterion.

6.2.7 A summary of the calculations is shown in Appendix B.

# 7.0 INTERNAL NOISE CONDITIONS

## 7.1 EXTERNAL BUILDING FABRIC

7.1.1 The noise survey data has been used to determine the indicative façade sound reduction requirements, targeting the internal acoustic conditions identified in Section 3.5.

7.1.2 The existing windows comprise single-glazed sash units on both the front and rear facades which offer a relatively low acoustic performance due to misalignment of sashes in frames and the lack of perimeter seals. It is understood that all glazing will be replaced with new single glazed sash windows as part of the scheme.

7.1.3 It is assumed that all non-glazed elements, i.e. masonry walls/facings and the roof systems, will provide the following minimum sound insulation performances, when tested in accordance with ISO 10140:2:2021 (or equivalent standard). This is typically achievable with a standard cavity brick and block external wall construction and is expected to be met by the existing structure.

| NON-GLAZED ELEMENT | SINGLE FIGURE WEIGHTED SOUND REDUCTION |
|---|---|
| Masonry | $R_W$ 51 dB |
| Roof | $R_W$ 45 dB |

Table 9 –Non-glazed elements – assumed sound reduction indices

7.1.4 It is understood that all guestrooms will be fully mechanically ventilated with fresh air supply, extract and comfort cooling. Windows can, therefore, be closed to lower internal ambient noise levels, if desired.

7.1.5 The rear façade benefits from considerable screening from nearby noise sources and so noise levels here are relatively low for a central London location. Well-sealed, single glazed sash with standard glass are expected to be sufficient to maintain appropriate internal ambient noise levels for guestrooms on this elevation.

7.1.6 The east elevation is more exposed to traffic on Russell Square and Bedford Place and guestrooms on this side of the property would benefit from windows with a slightly higher acoustic performance. A laminated acoustic glass of nominal 6 – 7mm thickness can be expected to achieve a performance in the region of $R_w$32dB. Based on proposed room dimensions and window sized, this would be sufficient to meet the target internal noise level criteria outlined in Section 3.5.

7.1.7 It is important that the quoted minimum sound reduction specifications are met by the panels and windows, including frames, seals, etc. Glass performance alone is not an acceptable means of demonstrating compliance with the specification for window performance.

## 8.0 CONCLUSIONS

8.1 An acoustic assessment has been conducted by Clarke Saunders Acoustics for the installation of additional building services plant at 21-23 Bedford Place, London.

8.2 Results of an environmental noise survey have established the current ambient and background noise climate, which has enabled acoustic criteria to be set for the control of plant noise emissions to noise sensitive properties in accordance with the planning requirements of Camden Council.

8.3 Manufacturer's supplied data for the proposed building services plant have been used to predict the potential noise impact on the most affected receptors.

8.4 Appropriate noise mitigation measures have been identified to demonstrate feasibility of the proposed scheme. Compliance with the noise emission design criterion has been demonstrated. No further mitigation measures are required.

8.5 An outline assessment of external building fabric performance has been undertaken to provide an indicative glazing performance for replacement windows, such that appropriate internal ambient noise levels within guestrooms can be maintained. This is readily achievable by good quality single-glazed sash windows, with appropriate acoustically specified glass on facades exposed to elevated noise levels.

Alex Brooker MIOA
CLARKE SAUNDERS ACOUSTICS

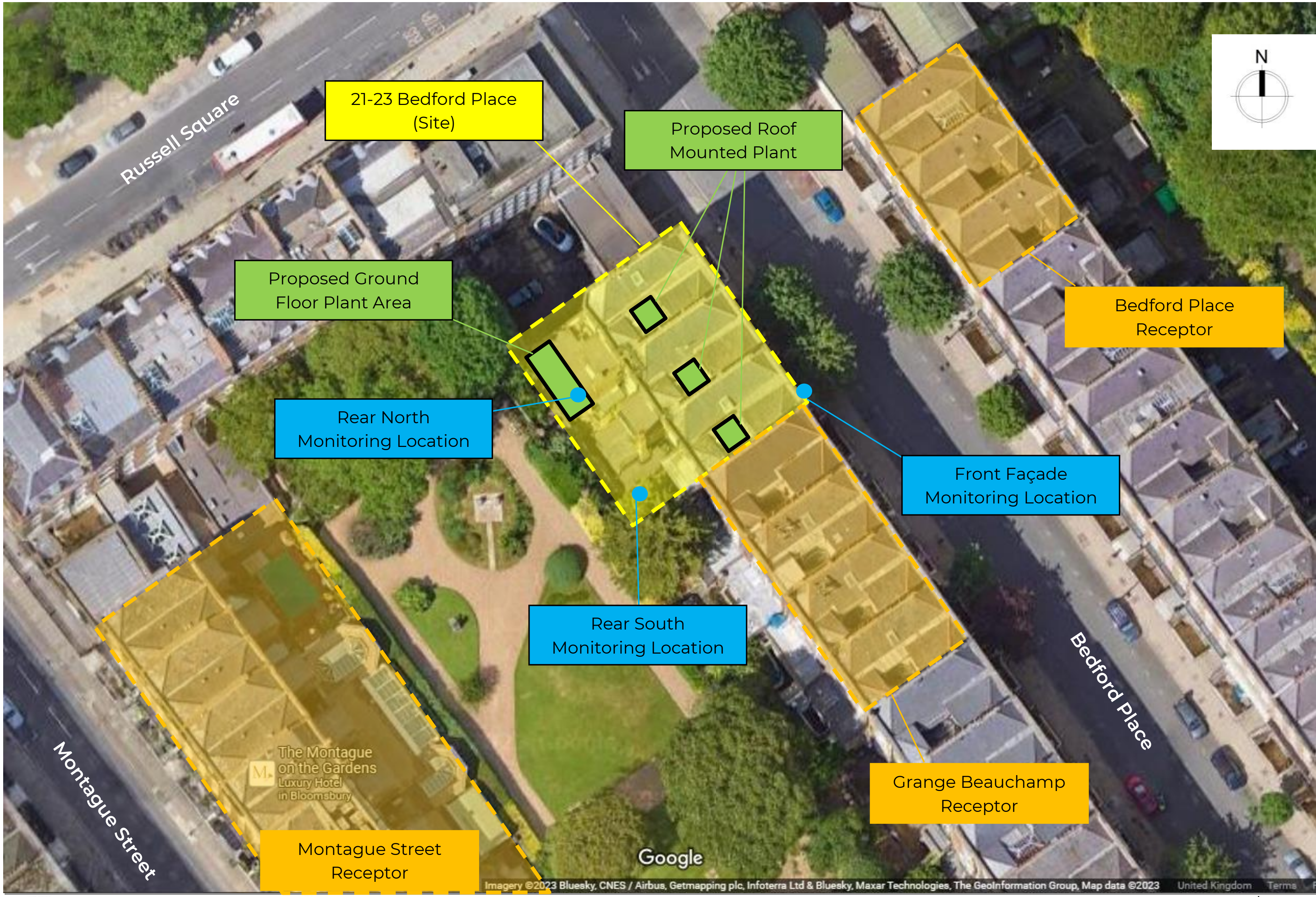
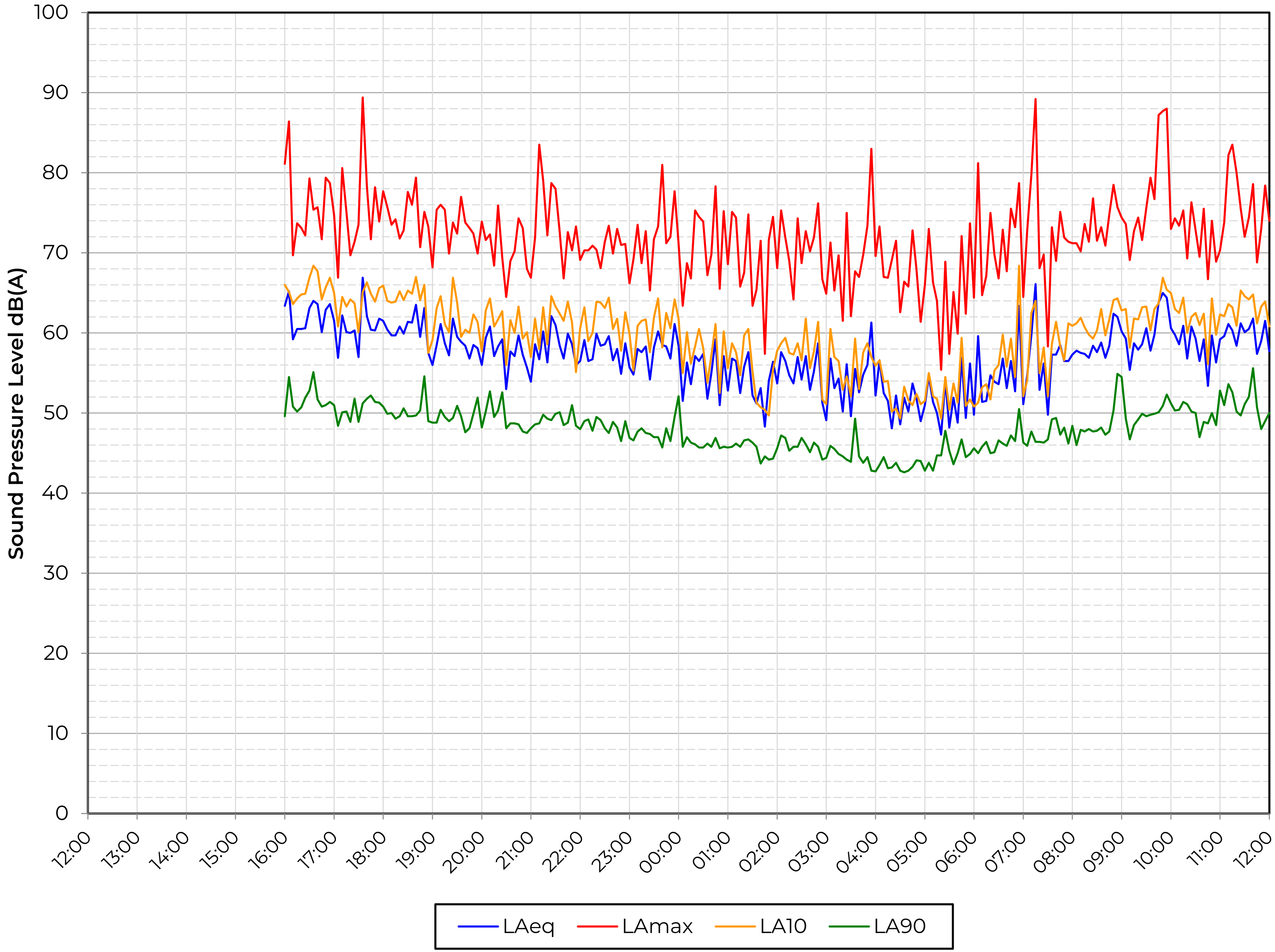



Figure AS13225/SP1

21-23 Bedford Place

## Position Front Façade




Fri 22 Sep to Sat 23 Sep

Figure AS13225/TH1

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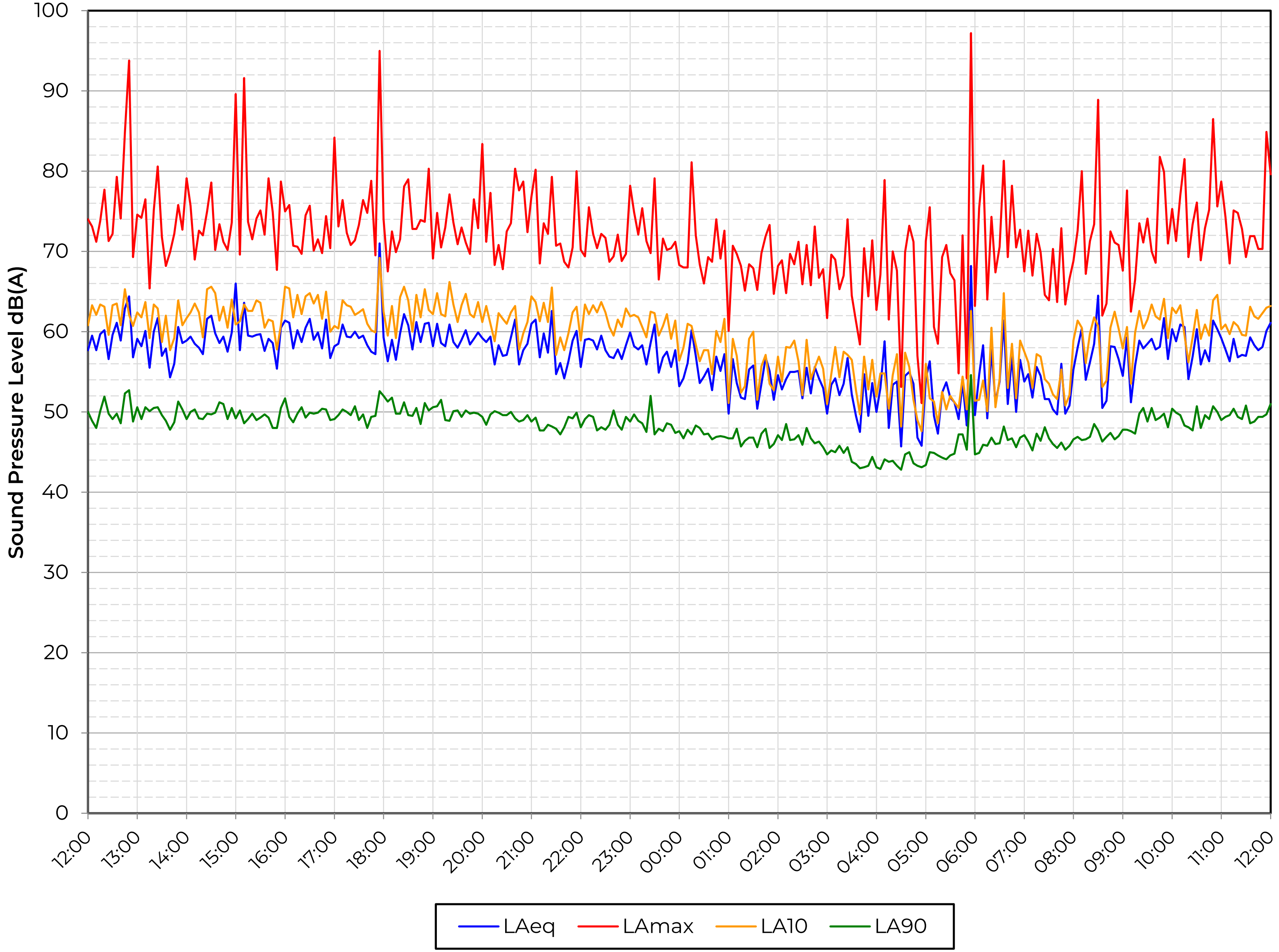
21-23 Bedford Place

## Position Front Façade




Sat 23 Sep to Sun 24 Sep

Figure AS13225/TH2

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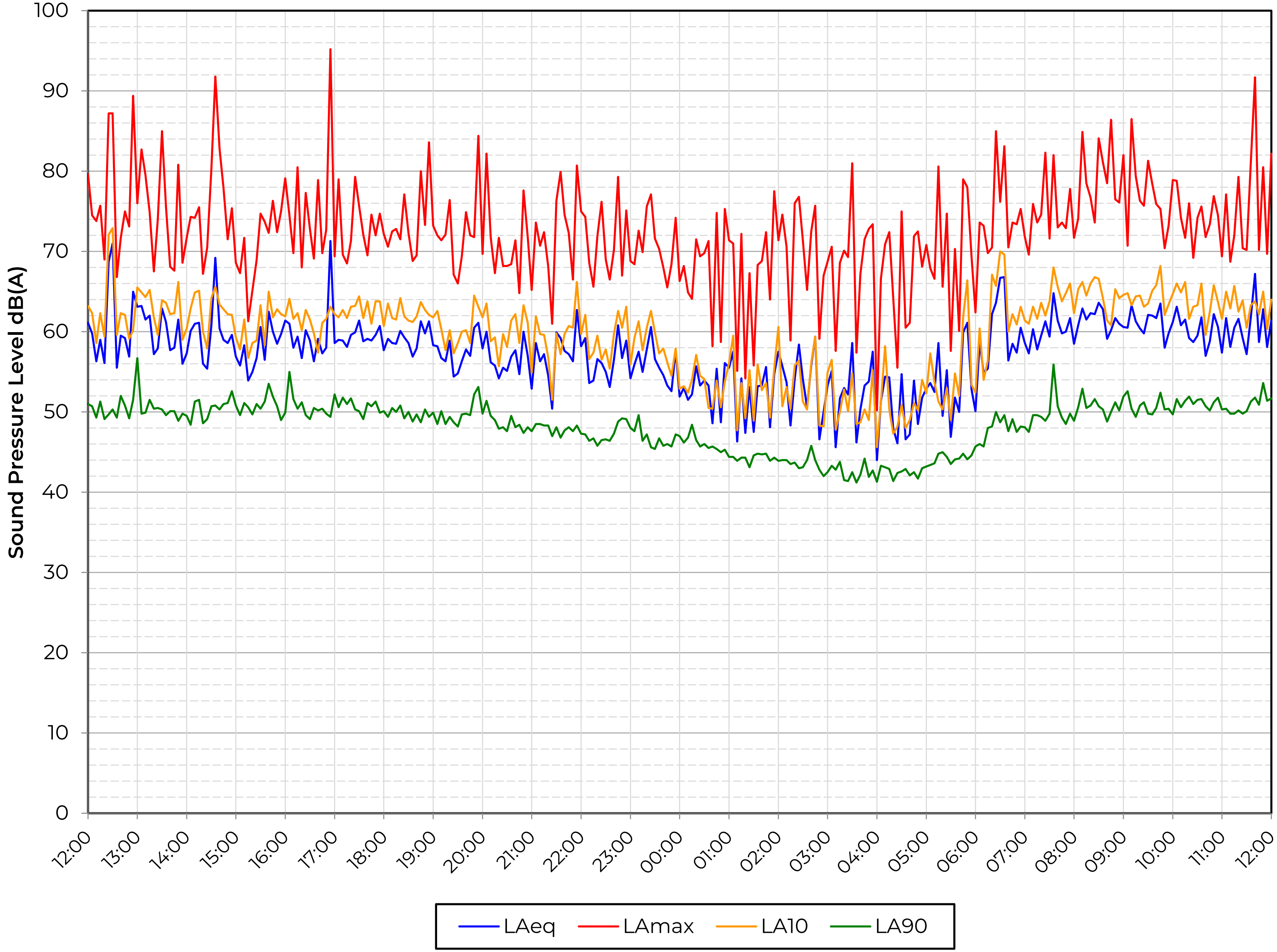
21-23 Bedford Place

## Position Front Façade

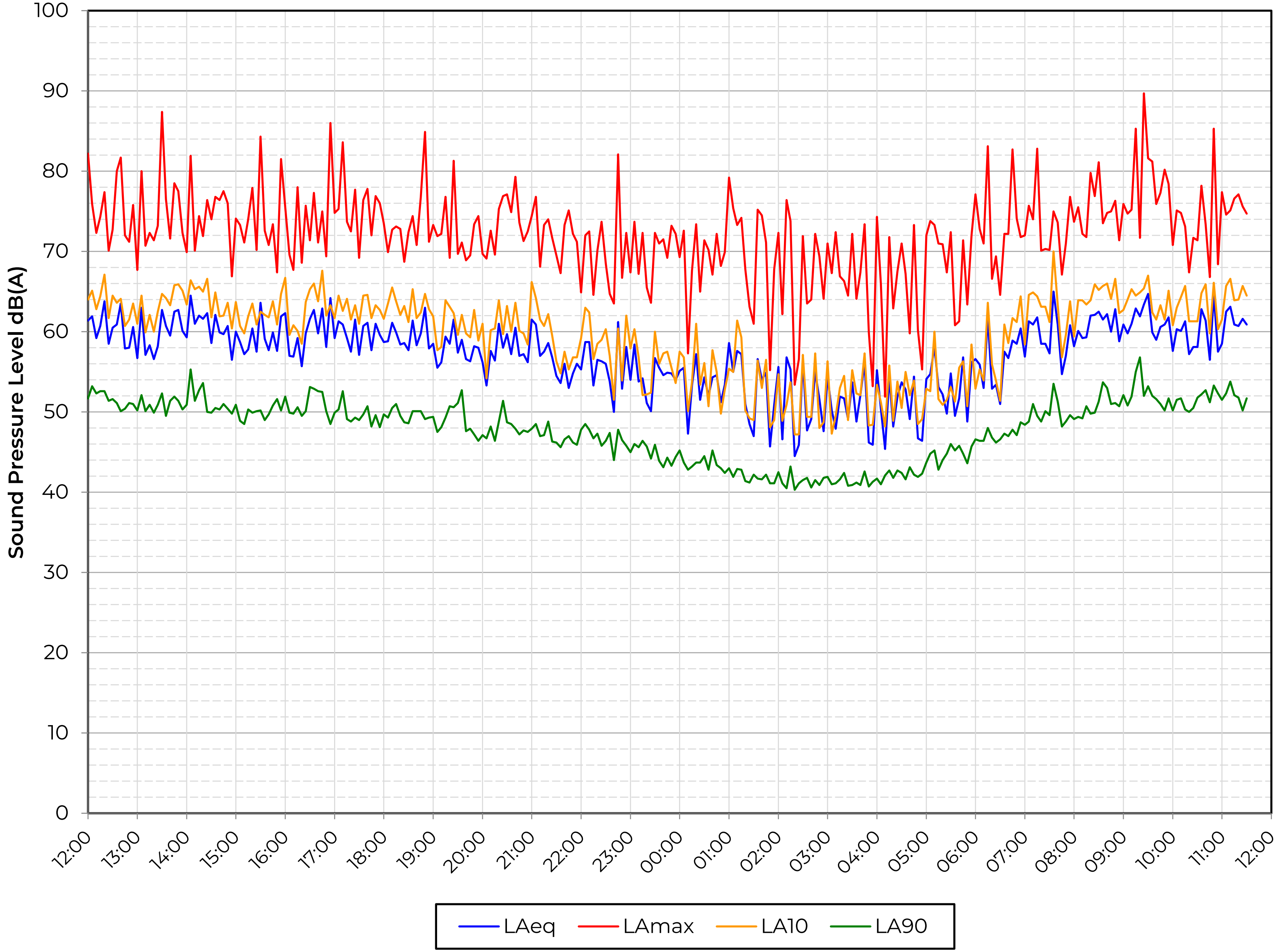



Sun 24 Sep to Mon 25 Sep

Figure AS13225/TH3

21-23 Bedford Place

## Position Front Façade




Mon 25 Sep to Tue 26 Sep

Figure AS13225/TH4

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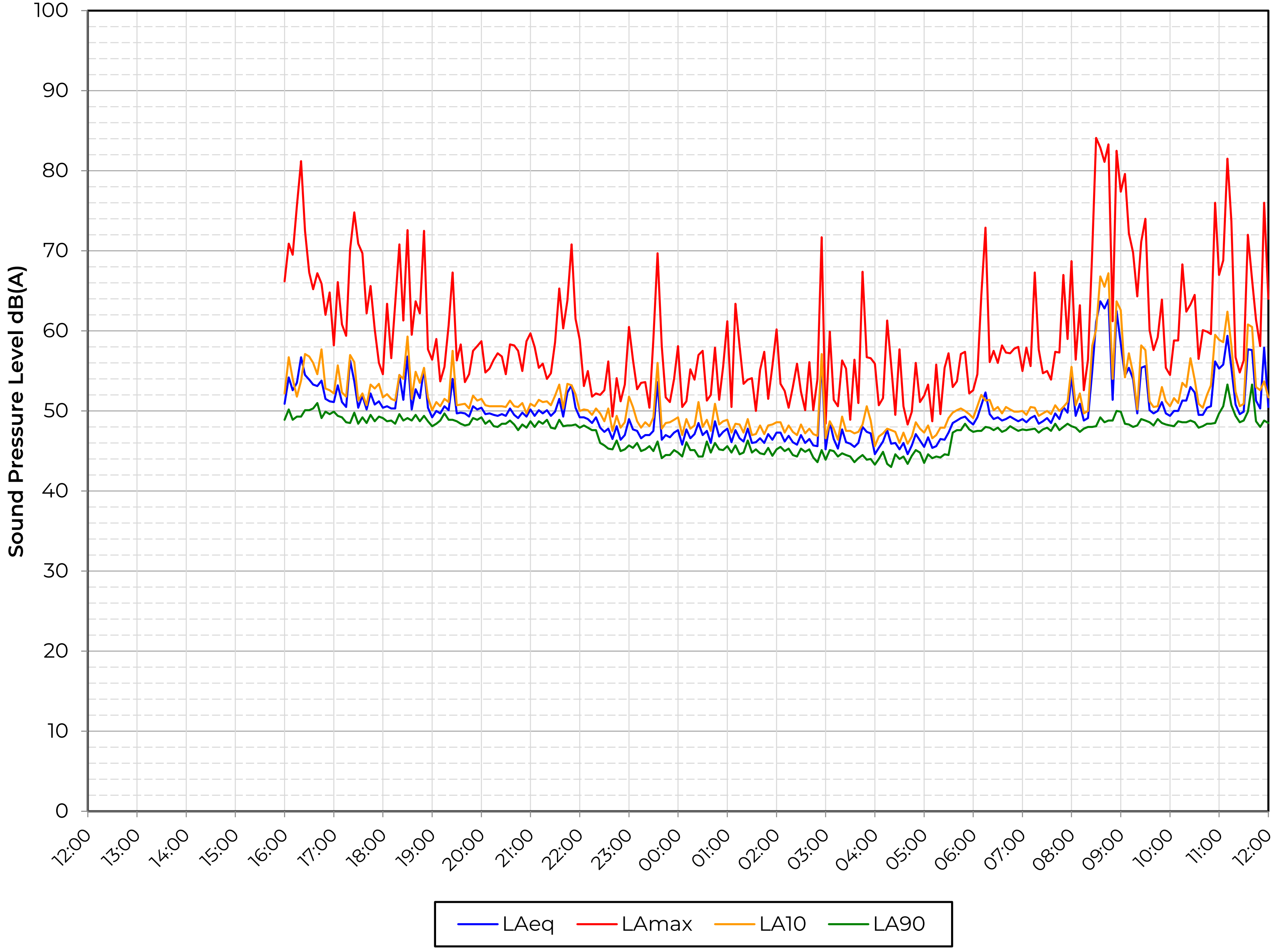
21-23 Bedford Place

## Position Rear North

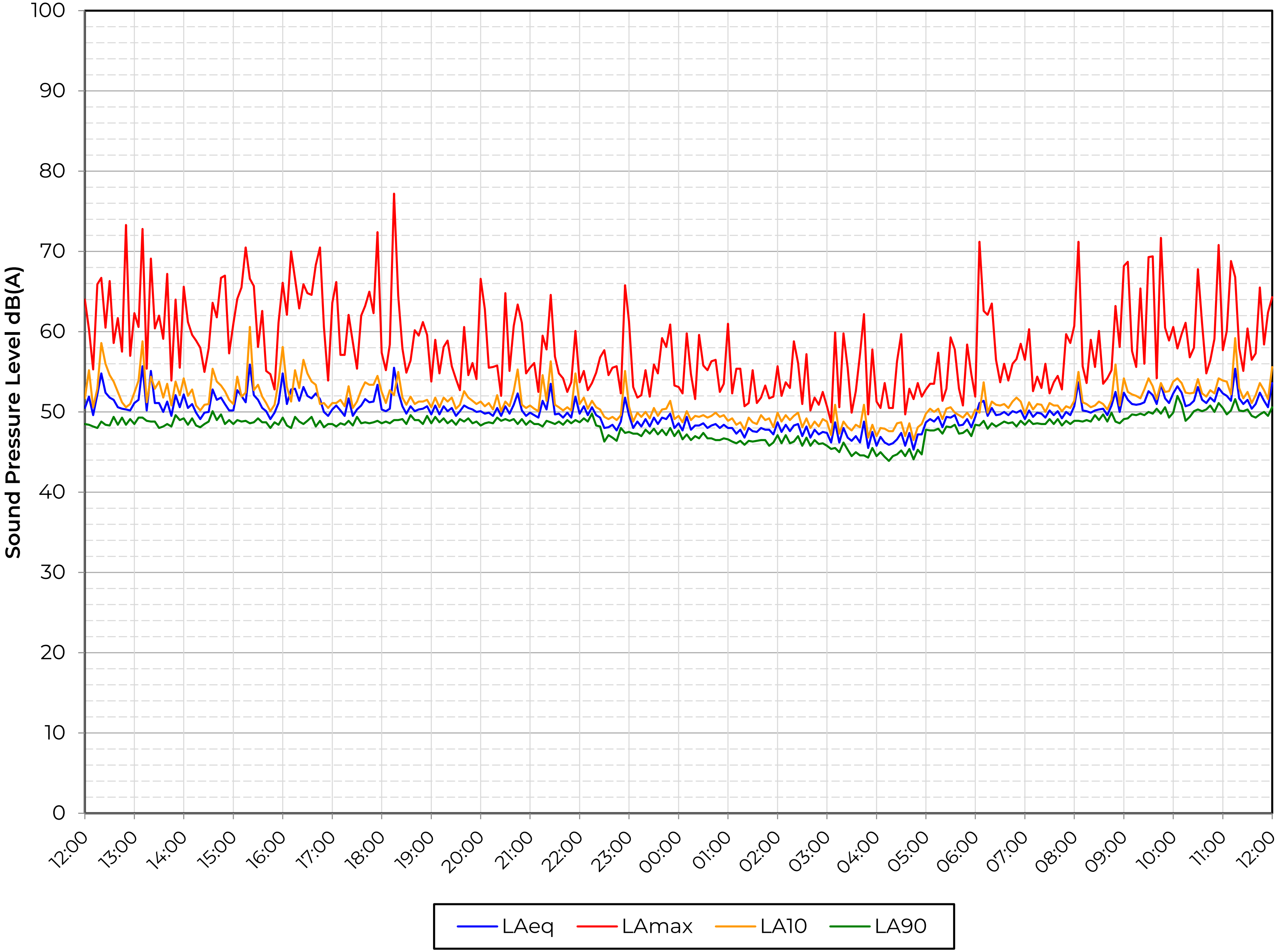



Fri 22 Sep to Sat 23 Sep

Figure AS13225/TH5

21-23 Bedford Place

## Position Rear North

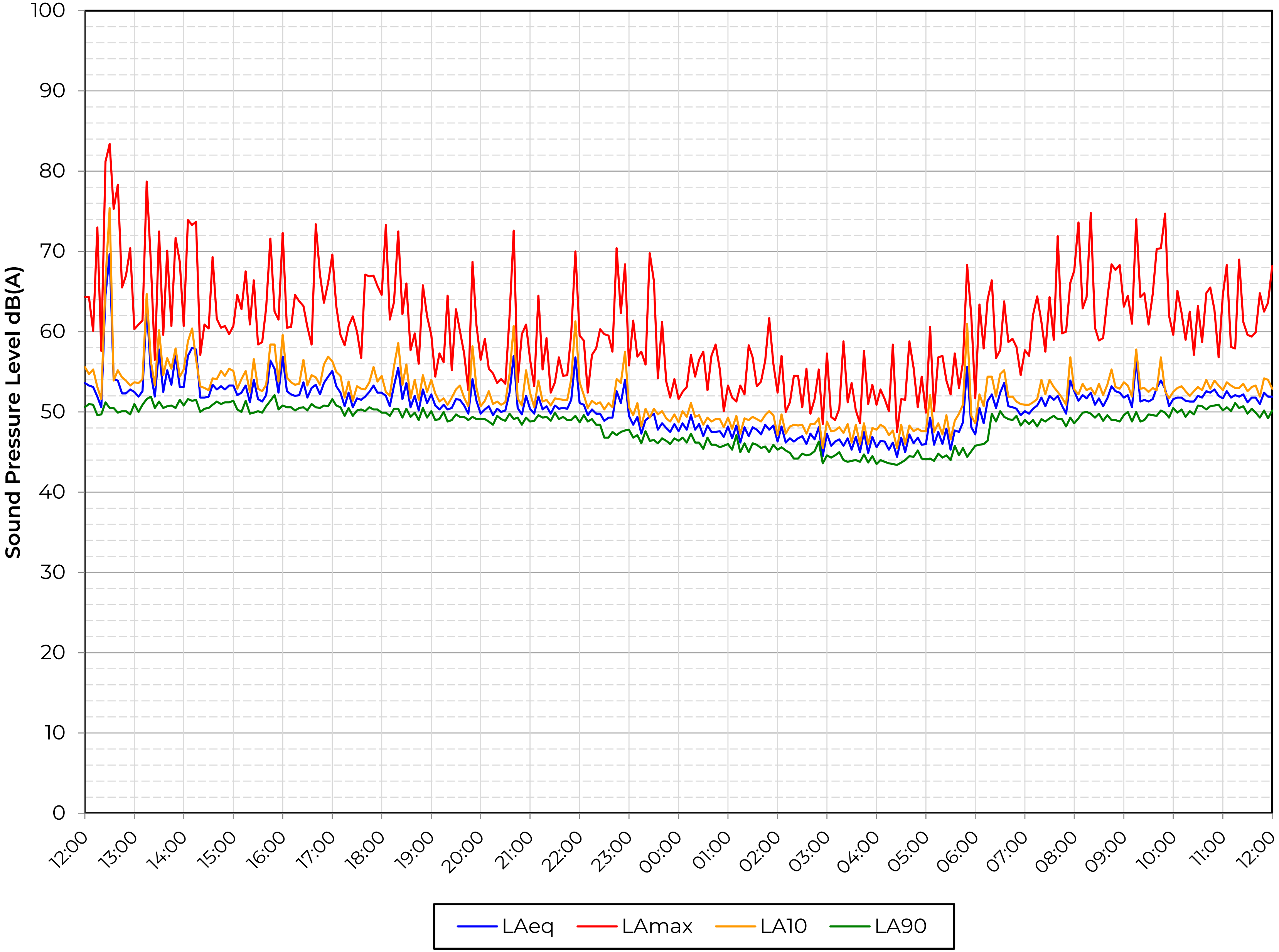



Sat 23 Sep to Sun 24 Sep

Figure AS13225/TH6

21-23 Bedford Place

**Position Rear North**




Sun 24 Sep to Mon 25 Sep

Figure AS13225/TH7

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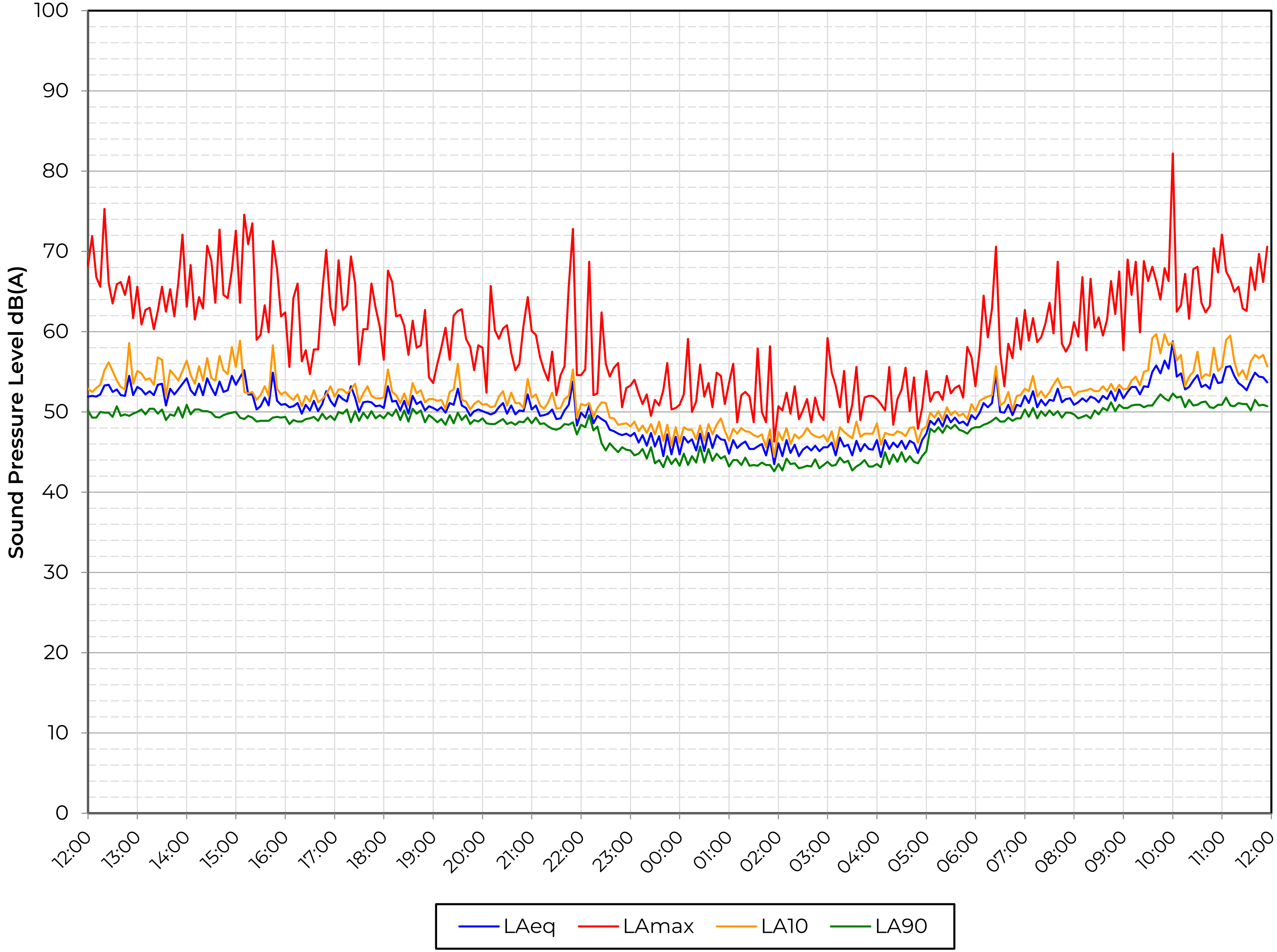
21-23 Bedford Place

**Position Rear North**




Mon 25 Sep to Tue 26 Sep

Figure AS13225/TH8

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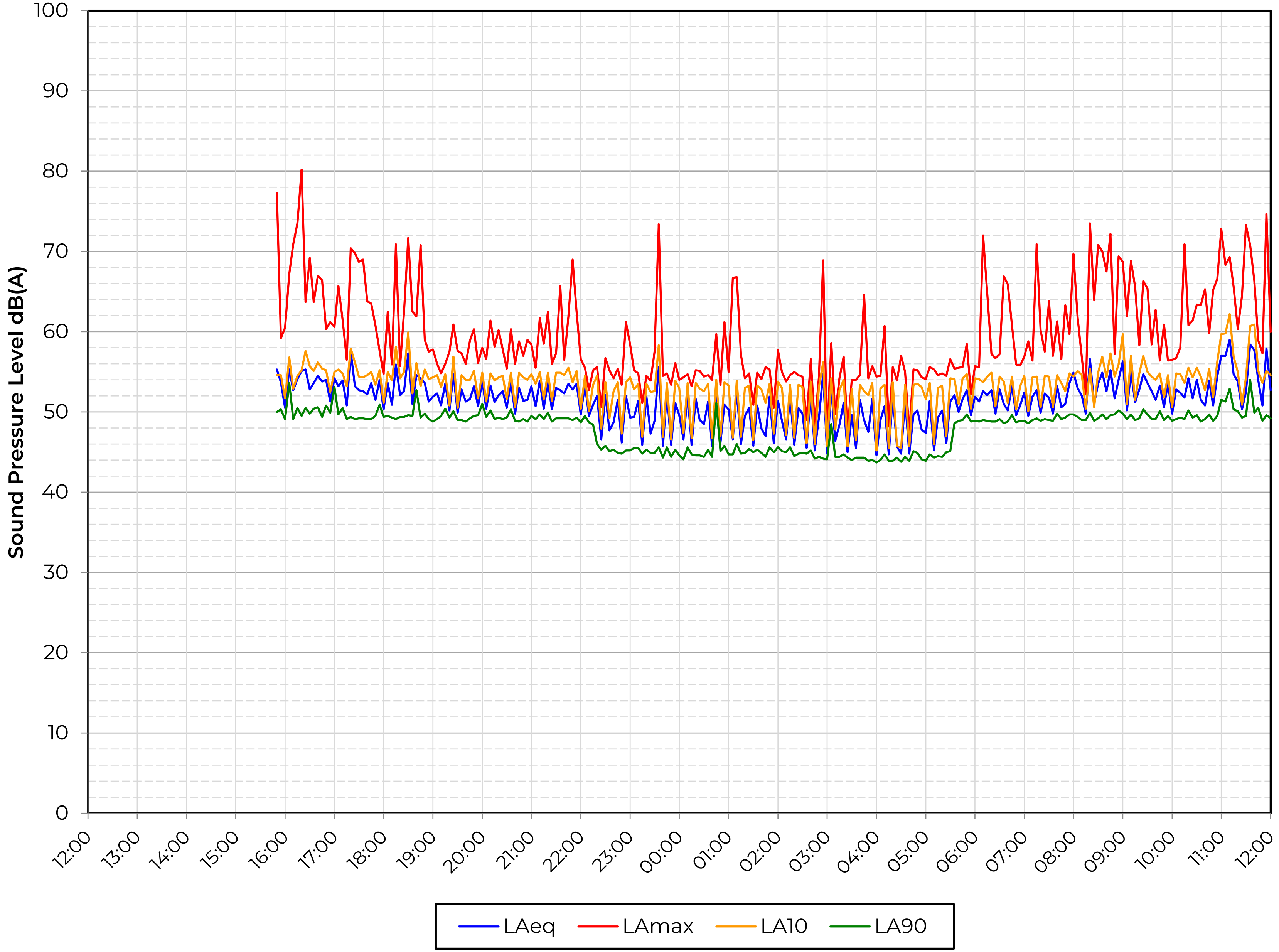
21-23 Bedford Place

## Position Rear South




Fri 22 Sep to Sat 23 Sep

Figure AS13225/TH9

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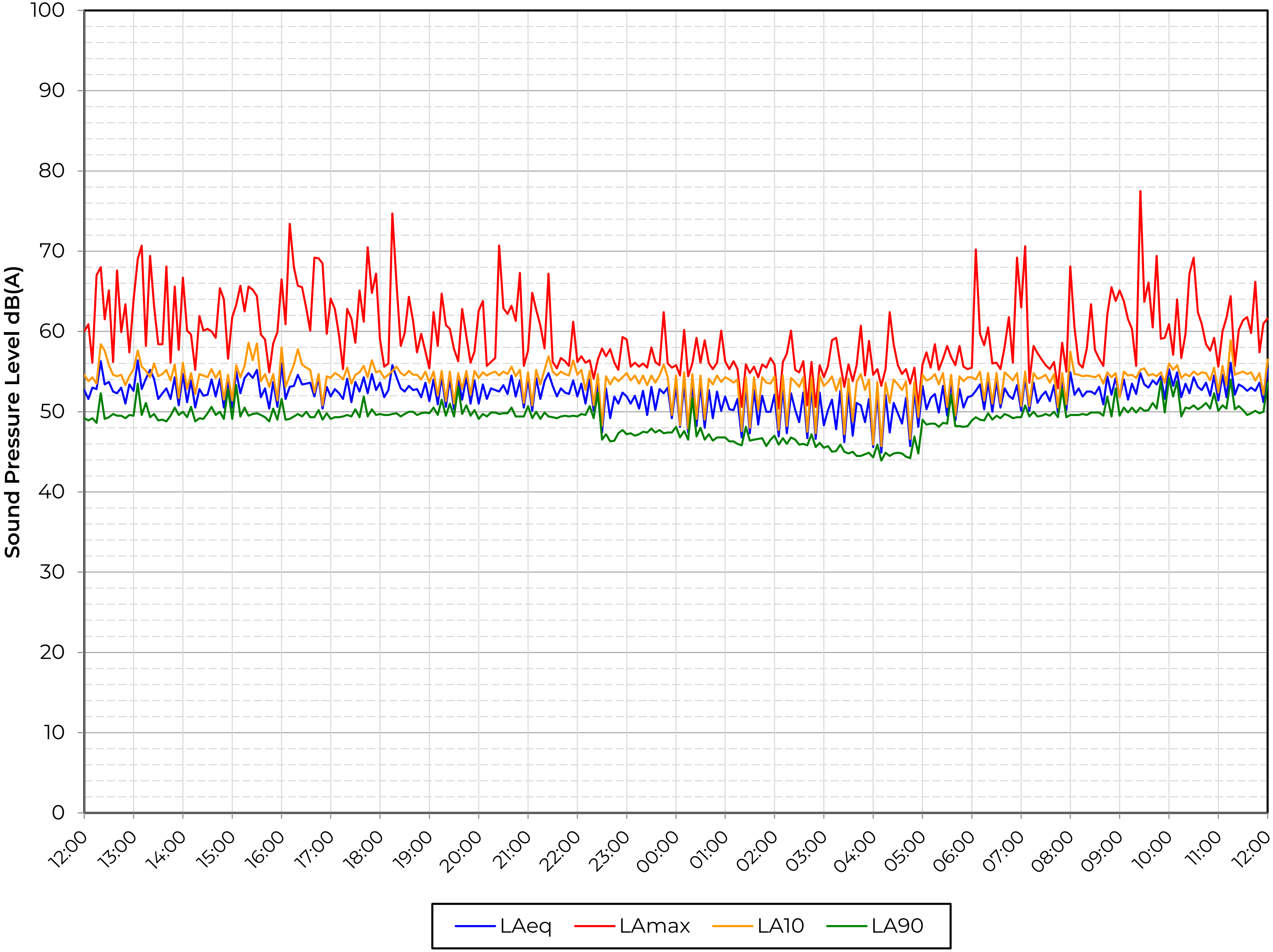
21-23 Bedford Place

## Position Rear South




Sat 23 Sep to Sun 24 Sep

Figure AS13225/TH10

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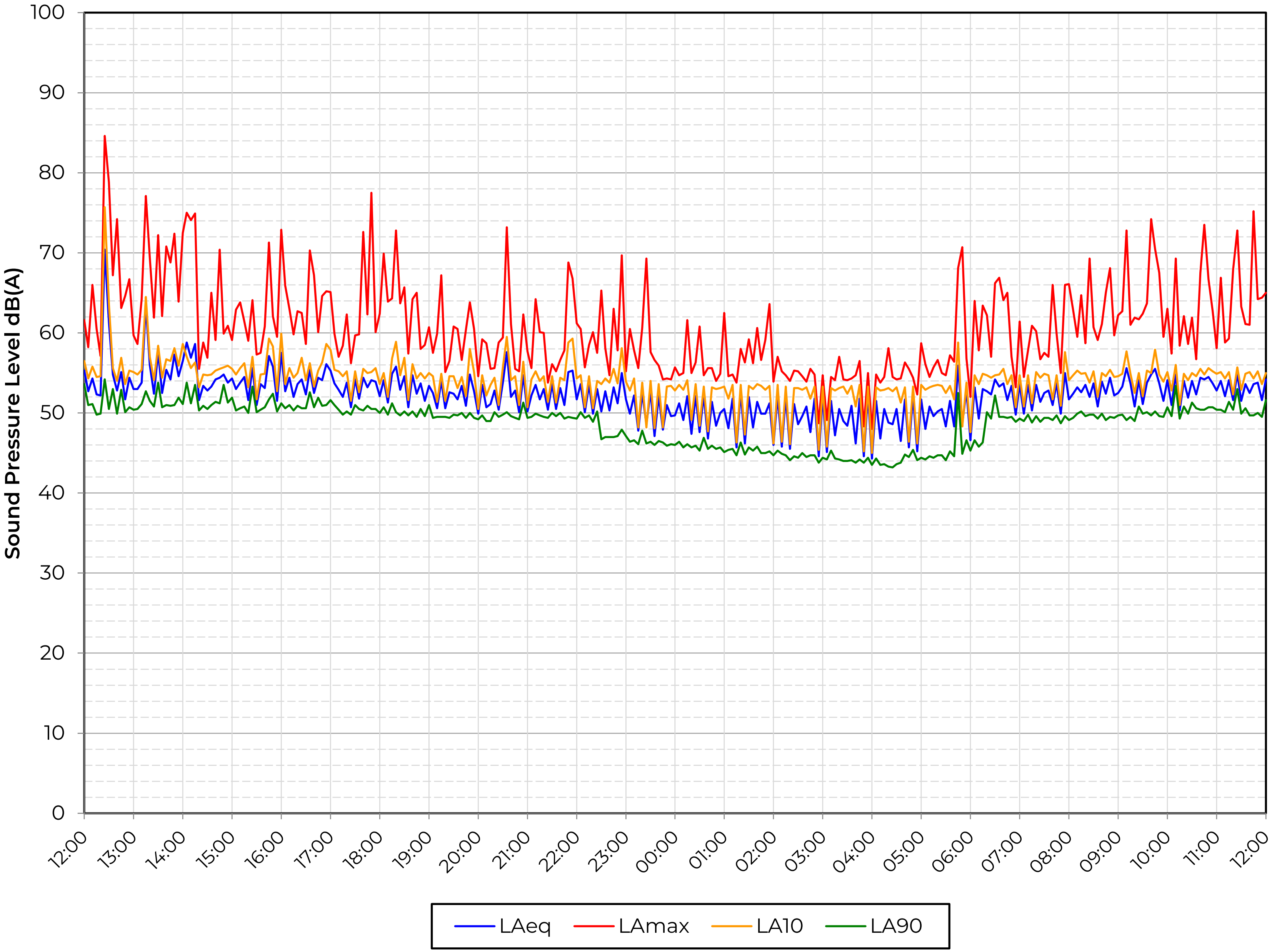
21-23 Bedford Place

## Position Rear South



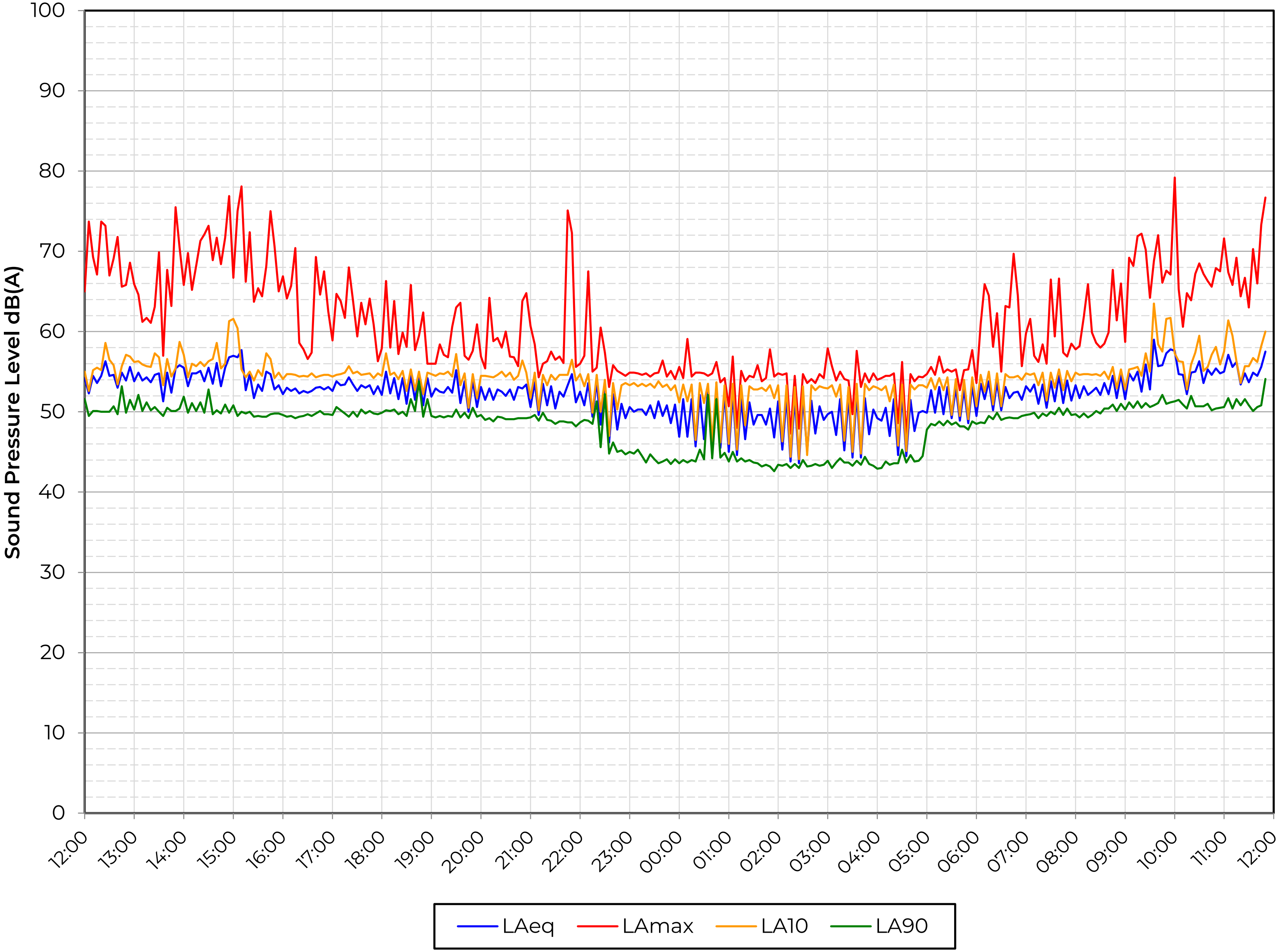

Sun 24 Sep to Mon 25 Sep

Figure AS13225/TH11

clarke saunders acoustics

21-23 Bedford Place

## Position Rear South




Mon 25 Sep to Tue 26 Sep

Figure AS13225/TH12

## 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.

## 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 |
|---|---|---|---|---|---|---|---|---|

## 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 |

## 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.

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# APPENDIX B
## AS13225 21-23 Bedford Place
## PLANT SOUND CALCULATIONS

| **Plant sound to Bedford Place Apartmer** | | **63 Hz** | **125 Hz** | **250 Hz** | **500 Hz** | **1 kHz** | **2 kHz** | **4 kHz** | **8 kHz** | **dB(A)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -8 | -8 | -8 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 30m | -30 | -30 | -30 | -30 | -30 | -30 | -30 | -30 | |
| | **Subtotal** | **31** | **28** | **26** | **15** | **9** | **9** | **7** | **2** | **20** |
| 22 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -8 | -8 | -8 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 30m | -30 | -30 | -30 | -30 | -30 | -30 | -30 | -30 | |
| | **Subtotal** | **31** | **28** | **26** | **15** | **9** | **9** | **7** | **2** | **20** |
| 23 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| | | | | | | | | | | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -8 | -8 | -8 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 30m | -30 | -30 | -30 | -30 | -30 | -30 | -30 | -30 | |
| | **Subtotal** | **31** | **28** | **26** | **15** | **9** | **9** | **7** | **2** | **20** |
| **Specific sound level at receptor** | **$L_{eq\ 1hr}$** | **36** | **32** | **30** | **20** | **14** | **14** | **12** | **7** | **25** |

| Plant sound to Montague | | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz | dB(A) |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -7 | -7 | -7 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 50m | -34 | -34 | -34 | -34 | -34 | -34 | -34 | -34 | |
| | **Subtotal** | **27** | **23** | **21** | **11** | **5** | **6** | **3** | **0** | **16** |
| 22 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -7 | -7 | -7 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 50m | -34 | -34 | -34 | -34 | -34 | -34 | -34 | -34 | |
| | **Subtotal** | **27** | **23** | **21** | **11** | **5** | **6** | **3** | **0** | **16** |
| 23 Bedford Place Roof | | | | | | | | | | |
| AVT7-R Inlet | Lw | 80 | 77 | 75 | 75 | 69 | 66 | 63 | 58 | 76 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| AVT7-R Outlet | Lw | 80 | 78 | 79 | 81 | 79 | 75 | 70 | 63 | 83 |
| Lw to Lp @ 1m | Q = 2 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | -8 | |
| End Reflection | | -5 | -2 | -1 | 0 | 0 | 0 | 0 | 0 | |
| Attenuation Loss | | -4 | -8 | -11 | -19 | -20 | -16 | -14 | -12 | |
| Cumulative | Lw | 66 | 62 | 61 | 55 | 51 | 52 | 49 | 44 | **59** |
| Directivity | | 0 | 0 | -1 | -5 | -8 | -7 | -7 | -7 | |
| Screening Loss | | -5 | -5 | -5 | -5 | -5 | -5 | -5 | -5 | |
| Distance Loss | 50m | -34 | -34 | -34 | -34 | -34 | -34 | -34 | -34 | |
| | **Subtotal** | **27** | **23** | **21** | **11** | **5** | **6** | **3** | **0** | **16** |
| **Specific sound level at receptor** | $L_{eq\ 1hr}$ | **31** | **28** | **26** | **16** | **10** | **10** | **8** | **5** | **21** |

| Plant sound to Grange Beauchamp Hot | | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz | dB(A) |
|---|---|---|---|---|---|---|---|---|---|---|
| GF Plant Area | | | | | | | | | | |
| Daikin REYQ12T | Lw | 87 | 82 | 81 | 81 | 75 | 70 | 65 | 62 | 81 |
| Number of | 5no | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | |
| SPL in plantroom | | 86 | 78 | 76 | 76 | 70 | 64 | 72 | 69 | **78** |
| Louvre attenuation | SL-150 | -6 | -6 | -8 | -10 | -14 | -18 | -16 | -15 | |
| Radiation corrections | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Sound Power outside louvre | | 84 | 76 | 72 | 70 | 60 | 50 | 60 | 58 | |
| Directivity corrections | | -10 | -9 | -9 | -9 | -9 | -9 | -9 | -9 | |
| Rathe Decay | | -27 | -27 | -27 | -27 | -27 | -27 | -27 | -27 | |
| | **Subtotal** | **47** | **40** | **36** | **34** | **24** | **14** | **24** | **22** | **34** |
| **Specific sound level at receptor** | $L_{eq\ 1hr}$ | **47** | **40** | **36** | **34** | **24** | **14** | **24** | **22** | **34** |