ACAACOUSTICS

# Acoustic assessment of proposed new air conditioning condensers at Flat 2, Merlin House, London

**Report Reference: 170916-R001C**

**Date: October 2017**


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| | |
|---|---|
| **Site Address:** | Flat 2<br>Merlin House<br>London<br>NW3 7LN |
| **Client:** | Norton Mayfield Architects |
| **Report Reference:** | 170916-R001C |

| Revision: | Description: | Revision Date: | Author: | Checked: |
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| - | First issue | 05/10/2017 | James Reading MEng | Rob Cant MIOA |
| A | Second Issue – Updated equipment operating times and required mitigation | 26/10/2017 | Tommy Burn BSc(hons) AMIOA | |
| B | Third Issue – Minor alterations | 30/10/2017 | Tommy Burn BSc(hons) AMIOA | |
| C | Fourth Issue – Minor alterations | 30/10/2017 | Tommy Burn BSc(hons) AMIOA | |

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## 0. SUMMARY


- ACA Acoustics Limited have been commissioned to assess the acoustic impact of proposed new air conditioning condensers to be installed at Flat 2, Merlin House, London, NW3 7LN.

- The assessment is required to provide evidence that noise emissions from the equipment will not be detrimental to the amenity of nearby noise sensitive properties and complies with the requirements of London Borough of Camden Council. London Borough of Camden Council's requirement, applicable at this site, is that the rating level of sound from the equipment shall ideally not exceed 10dB below the existing background LA90 outside nearby noise-sensitive properties.

- Whilst on site the author identified closest non-associated, noise-sensitive properties as residential dwellings on the fourth floor of Merlin House. The nearest openable windows of these dwellings are approximately 5 meters from the proposed equipment location.

- A survey has been carried out in the vicinity to establish existing background sound levels. Representative background sound levels during the survey, were measured at LAF90 41dB overnight, and LAF90 45dB during the daytime. Based on results of the sound level survey and London Borough of Camden Council's requirement, the overall sound level limit for the equipment to outside the nearest noise-sensitive window is set at ≤ 35dBA during the daytime, and ≤ 31dBA overnight.

- The proposal includes the installation of two condensing units, one to operate during daytime periods only, and the other to operate over a potential 24-hour period.

- Calculations using manufacturer's sound level data for the new equipment confirm that the cumulative specific sound level for the new equipment operating during the night time will be LAeq 28dB outside nearest openable noise-sensitive windows, equating to a rating level of LAr 31dB, and for the unit operating overnight, LAeq 32dB outside nearest openable noise-sensitive windows, equating to a rating level of LAr 35dB. This is 10dBA below the background sound level, and achieves London Borough of Camden Council's acoustic criteria. The assessment includes benefit of noise-control treatments as set out in this report.

# 1. INTRODUCTION

Two new air conditioning condensers are to be installed at Flat 2, Merlin House, London during renovations of an existing residential property.

ACA Acoustics Limited has been commissioned to carry out an assessment of sound emissions from the proposed new mechanical equipment and, where necessary, make recommendations to reduce sound levels to ensure that the amenity of nearby noise-sensitive properties is not compromised.

This report presents results of the sound level survey and assessment.

## 2. LONDON BOROUGH OF CAMDEN COUNCIL'S ACOUSTIC REQUIREMENTS

London Borough of Camden Council's policies relating to noise are set out in Appendix 2 of the Local Plan, which provides detailed noise thresholds to determine the potential acoustic impact of new developments.

In Summary, London Borough of Camden requires an assessment to be carried out in accordance with British Standard 4142:2014 and the results compared against noise-related conditions set out in Table C of the Appendix, as shown in Table 1 below:

| Existing Noise Sensitive Receptor | Assessment Location | Design Period | LOAEL (Green) | LOAEL to SOAEL (Amber) | SOAL (Red) |
|---|---|---|---|---|---|
| Dwellings | Garden used for main amenity (free field) and outside living or dining or bedroom window (façade) | Day | Rating level 10dB below background | Rating level between 9dB below and 5dB above background | Rating level greater than 5dB above background |
| Dwellings | Outside bedroom window (façade) | Night | Rating level 10dB below background and no events exceeding 57dB LAmax | Rating level between 9dB below and 5dB above background or noise events between 57dB and 88dB LAmax | Rating level greater than 5dB above background and/or events exceeding 88dB LAmax |

*Table 1: London Borough of Camden Noise Limits*

The scope of BS 4142:2014 advises that "*this British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature … to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*". BS 4142:2014 is commonly used to assess the potential for loss of amenity due to noise from mechanical services equipment and is considered appropriate for this application.

The assessment method of BS 4142:2014 corrects the specific sound level from the source under investigation to account for characteristics that could make the sound more intrusive to obtain a rating level. This rating level is compared against the prevailing background sound level outside the noise-sensitive property. Section 11 of BS 4142:2014 provides a commentary of the assessment result and advises that:

a) The greater the difference between the rating level and the background sound level, the greater the magnitude of the impact;
b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context;
d) The lower the rating level is to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Assessment result criteria shown within Appendix A of Camden's Local Plan are significantly more stringent than those set out in the British Standard and can therefore be taken to ensure a robust assessment. Compliance with the "Green" criteria or lower half of the "Amber" range will generally ensure no loss of amenity to nearby residents, albeit, the context of the development must also be considered on a project-by-project basis which can alter the initial assessment result. This is discussed in more detail in Section 4 below.

## 3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

A planning application is being prepared, to include the installation of two new air conditioning condensers at Flat 2, Merlin House, London. The proposed equipment will serve a residential dwelling, with one unit serving the kitchen and livingroom over daytime hours, and another serving bedrooms over a 24-hour period.

The proposed location of the new units is on the sixth-floor balcony of Merlin house. As Flat 2 extends over both the fifth and sixth floors, the closest non-associated noise-sensitive windows are taken to be on the fourth floor of Merlin House. These positions are marked in Figure 1 below.


*Figure 1: Site layout* *[image available at: www.rightmove.co.uk/property-for-sale/property-54429224.html]*

## 4. SOUND LEVEL SURVEY

To assess sound levels from the condensers it is necessary to establish background sound levels in the vicinity. Details of the sound level survey carried out by ACA Acoustics Limited are provided below.

The sound level survey measurement position was selected on the balcony of Flat 2, Merlin House. This position was deemed equivalent to the nearest noise-sensitive window on the fourth floor of the building. An unattended survey was carried out over a 24-hour period between 3rd and 4th October 2017. During the survey the weather was predominantly dry and calm.

The following equipment was used during the survey; the sound level meter was calibrated before and checked after the survey measurements with no change noted:

| Equipment | Serial Number | Calibration Certificate |
|---|---|---|
| Rion sound level meter type NL-31 Class 1 complete with weatherproof and lockable outdoor environmental kit | 00431030 | 1512668 |
| NTi Audio calibrator type CAL200 94/114dB. Compliant to IEC 60942-1:2003 (Calibrated to a reference traceable to NIST) | 11441 | 160915 |

*Table 2: Equipment used*

Results of the survey are provided in graphical form in Figure 2 on the following page.

In accordance with BS 4142:214, the prevailing background sound level is not necessarily taken to be the lowest recorded values, but rather the level that best represents the typical background sound level during a defined period. Commentary to Section 8 of the Standard discusses this further, noting that '*the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes.*' This acknowledges that continuous sound levels are likely to be of less significance, compared with short-term, transient events, which may result in greater levels of awakening and sleep disturbance. In this instance, the source sound is mechanical equipment which would not result in short-term high-noise events but rather a continuous low 'hum'. Therefore, in accordance with the Standard, levels to the start and end of the night time period are likely to be the most significant.

A statistical analysis of the measured sound levels has been carried out, generally following suggested guidance contained in Section 8 of the Standard. Distribution of the measured LA90 sound levels over a 24-hour period are shown in Figure 3, and the measured sound levels during the daytime are shown in Figure 4.

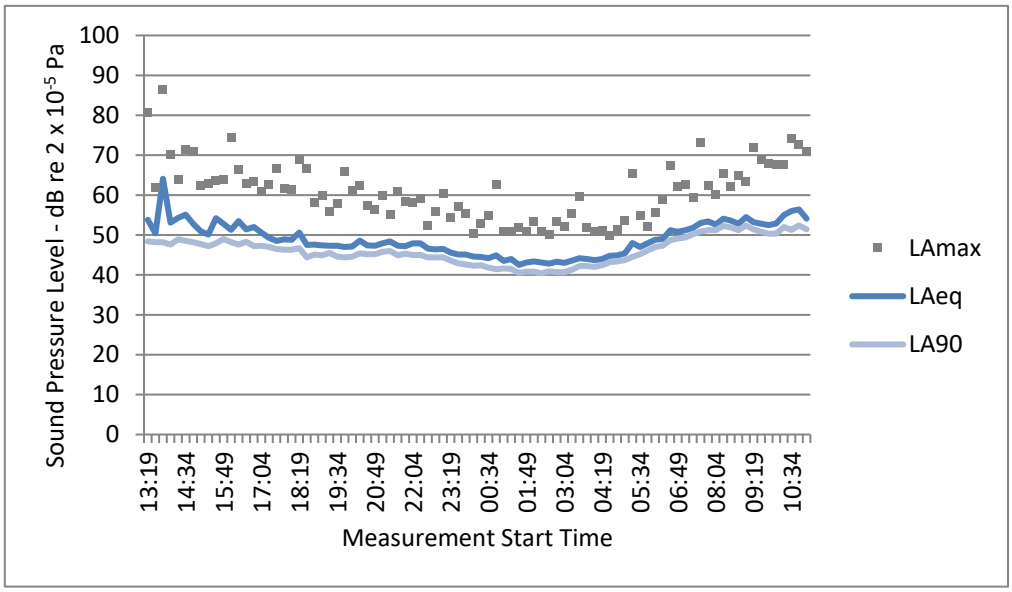


*Figure 2: Survey Measurement Results*

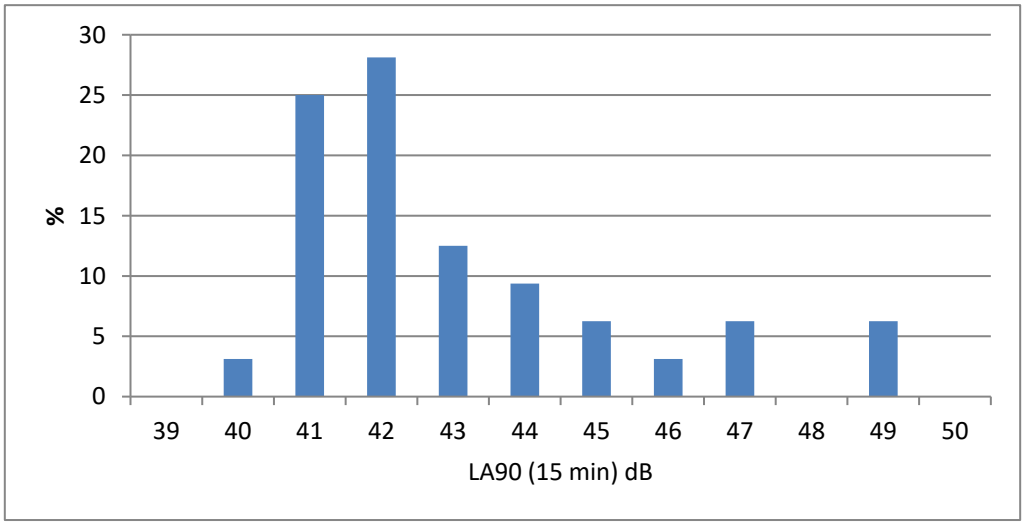


*Figure 3: Statistical Analysis to Determine the Background Sound Level over the night time period*

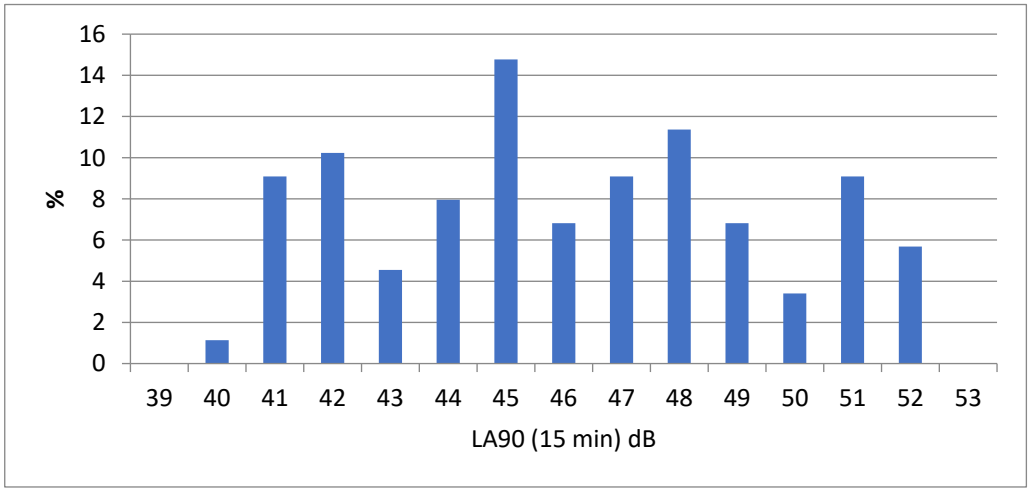


*Figure 4: Statistical Analysis to Determine the Background Sound Level over the 24-hour period*

The values recorded by ACA Acoustics Limited are used as basis for acoustic design such that sound levels from the proposed new equipment are ≤31dBA outside the closest noise sensitive windows during night time hours, and ≤35dBA outside the closest noise sensitive windows during day time hours; these are at least 10dBA below the representative night time background sound level.

Confirmation of the background sound level used in the assessment is shown in Table 3 below.

| Survey Date | Existing Measured Background LA90, 15 min |
|---|---|
| 3rd to 4th October 2017 24-hours | 41dB |
| 3rd to 4th October 2017 07:00 – 23:00 | 45dB |

*Table 3: Summary background sound level survey results*

## 5. ACOUSTIC ASSESSMENT

The development includes the installation of two new air conditioning condensers. Confirmation of the equipment models used in the assessment is provided in Table 4 below.

| Description | Equipment Model | Proposed operating times |
|---|---|---|
| Condenser Unit 1 | Hitachi RAS-4HVNC1E | 24-hours |
| Condenser Unit 2 | Hitachi RAS-5HVNC1E | 07:00 – 23:00 |

*Table 4: Proposed new mechanical equipment*

Sound emissions from the mechanical equipment can be determined from manufacturer's published octave band sound power data. Note that alterations in equipment selections may be possible, so long as sound power levels for the new item does not exceed levels used in the calculation model as shown in Appendix A.

A computer model has been used to calculate the noise contribution from the proposed plant to outside nearest noise-sensitive window. The model uses the assessment method set out in ISO 9613-2:1996.

The cumulative calculated specific sound level from the equipment to outside the closest noise sensitive window is shown in Table 5. Summary print-outs from the calculation models are included in Appendix A.

| Receptor Location | Calculated Equipment Sound Levels |
|---|---|
| Closest noise-sensitive windows during night time hours | 28dBA |
| Closest noise-sensitive windows during day time hours | 32dBA |

*Table 5: Calculated cumulative equipment sound levels at 1m outside noise-sensitive windows*

Assessments of the calculated specific sound levels in accordance with BS 4142:2014 are provided in Tables 6 and 7 below.

| Description | | Relevant Clause | Commentary |
|---|---|---|---|
| Calculated specific sound level to closest noise-sensitive windows | LAeq 28dB | 7.1<br>7.3.6 | Refer calculation sheets in Appendix A. |
| Background sound level | LA90 41dB | 8.1.3<br>8.3 | Representative night time background sound level. |
| Acoustic feature correction | +3dB | 9.2 | Calculations do not indicate any tonal element and the specific sound level is 13dBA below the prevailing background sound level, therefore in accordance with the Appendices to the Standard, no correction for specific character is applicable. However, the condensers are likely to operate intermittently, therefore, in accordance with Section 9.2 a correction of +3dB is applied. |
| Rating level | LAr 31dB | | |
| **Excess of rating level over background sound level** | **-10dB** | **11** | **Assessment indicates negligible likelihood of adverse impact** |

*Table 6: BS 4142:2014 Assessment for night-time plant operating*

| Description | | Relevant Clause | Commentary |
|---|---|---|---|
| Calculated specific sound level to closest noise-sensitive windows | LAeq 32dB | 7.1<br>7.3.6 | Refer calculation sheets in Appendix A. |
| Background sound level | LA90 45dB | 8.1.3<br>8.3 | Representative daytime background sound level. |

| | | | |
|---|---|---|---|
| Acoustic feature correction | +3dB | 9.2 | Calculations do not indicate any tonal element and the specific sound level is 13dBA below the prevailing background sound level, therefore in accordance with the Appendices to the Standard, no correction for specific character is applicable. However, the condensers are likely to operate intermittently, therefore, in accordance with Section 9.2 a correction of +3dB is applied. |
| Rating level | LAr 35dB | | |
| **Excess of rating level over background sound level** | **-10dB** | **11** | **Assessment indicates negligible likelihood of adverse impact** |

*Table 7: BS 4142:2014 Assessment for all plant operating during daytime hours*

Table 6 and 7 show that the overall rating level of the proposed new plant will be at least 10BA below the background LA90 sound level outside the closest noise-sensitive properties. During the earlier evening and daytime period, the background sound level is expected to be higher than the level used in the assessment and thus calculated levels would be even further below the prevailing background level at these times.

BS 4142:2014 requires an assessment to consider the context of the development, rather than simply adhering to numerical figures. Considering the specific numerical value, allowing for a reduction of 15dBA through partially open windows, as described in BS 8233:2014, this equates to a specific level inside the closest residential properties of 16dBA; significantly below the guideline sound level to bedrooms of LAeq 30dB set out in BS 8233:2014.

The author considers that the context of the assessment does not alter the initial estimate of the impact, and that sound levels from the new mechanical equipment should not be detrimental to the amenity of any residential occupiers in the vicinity. The calculation model includes benefit of noise control treatments to the equipment; discussion of suitable noise mitigation measures is provided in Section 6 of this report.

## 6. NOISE AND VIBRATION CONTROL TREATMENTS

*Note that consideration of non-acoustic aspects including, but not limited to structural calculations, airflow and pressure drop, and construction material are outside the scope of ACA Acoustics Limited and should be considered by others accordingly. Alternative methods of attenuation to those detailed below may be acceptable, for example relocation of noisy equipment to other, less sensitive, areas of the development. Full details of any alternative scheme, including working drawings and expected attenuation should be submitted and approved prior to manufacture.*

As discussed in Section 5 above, the calculated model includes benefit of noise control treatments to the new equipment.

It is advised that absorptive acoustic panel is installed to the soffit of the overhang above the units. Suitable panels would be typically 50mm thick, faced with perforated steel or similar with a mineral wool core, such as model CP50/UF, supplied by Allaway Acoustics Limited or equal and approved. The panel should line the soffit of the overhead parapet such that there are no gaps, and should have a width of nominally 2 times the widths of the units and extend beyond the units by at least 1 meter, or to the edge of the soffit where this is <1m.

Line of sight to the units from above will be blocked from upper floor residential windows by the balconies of those floors.

## 7. CONCLUSION

New air conditioning condenser units associated with a residential dwelling are to be installed at Flat 2, Merlin House, London.

ACA Acoustics have undertaken a background sound level survey in the vicinity and calculated sound emissions from the proposed new equipment using manufacturer's published data.

The calculated cumulative rating levels with new equipment operating are at least 10dBA below the prevailing background sound level to outside the closest noise-sensitive properties. At this level, the new equipment fully complies with London Borough of Camden's requirements and will not be detrimental to the amenity of nearby residents.

The assessment includes benefit of noise control treatments set out in this report and no further mitigation measures would be required.

# APPENDIX A

Acoustic Calculations

Calculation Sheet

# CU1 to Daytime nearest residential window

| | | Octave Band Centre Frequency (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| ***Noise Source*** | | | | | | | | | | |
| Noise Source - CU1 | | | | | | | | | | |
| **Sound Power Levels** | | **69.0** | **72.0** | **66.0** | **66.0** | **64.0** | **57.0** | **51.0** | **52.0** | |
| ***Noise Control Treatments*** | | | | | | | | | | |
| Treatment - None | | | | | | | | | | |
| **Attenuated Lw** | | **69.0** | **72.0** | **66.0** | **66.0** | **64.0** | **57.0** | **51.0** | **52.0** | **Row A** |
| ***ISO 9613 Calculation - Reflections*** | | | | | | | | | | |
| Type of Reflecting Surface - Walls with windows, recesses or bays<br>Q Factor - Junction | | | | | | | | | | |
| Source Height (m) | 18.5 | | | | | | | | | |
| Reflecting Height (m) | 13.0 | | | | | | | | | |
| Barrier - No Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 0.0 | | | | | | | | | |
| Barrier Height (m) | 0.0 | | | | | | | | | |
| Screening at (m) | 13.0 | | | | | | | | | |
| **Reflected Lp** | | **0.0** | **12.8** | **6.7** | **6.7** | **4.6** | **-2.8** | **-10.2** | **-14.3** | |
| ***ISO 9613 Calculation*** | | | | | | | | | | |
| Horiz. Distance (m) | 2.8 | | | | | | | | | |
| Source Height (m) | 18.0 | | | | | | | | | |
| Receiver Height (m) | 12.8 | | | | | | | | | |
| Barrier - Single Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 1.9 | | | | | | | | | |
| Barrier Height (m) | 18.0 | | | | | | | | | |
| Screening at (m) | 14.5 | | | | | | | | | |
| Q Factor - Plane | | | | | | | | | | |
| **Direct Lp** | | **36.7** | **37.7** | **29.2** | **26.5** | **21.7** | **13.5** | **7.4** | **7.9** | |
| ***Cumulative Lp at Receiver*** | | | | | | | | | | |
| ***External Receiver*** | | | | | | | | | | |
| External Receiver - Daytime nearest residential window | | | | | | | | | | |
| **Sound Pressure, Lp:** | | **36.7** | **37.7** | **29.2** | **26.6** | **21.7** | **13.6** | **7.5** | **7.9** | |



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Calculation Sheet

# CU2 to Daytime nearest residential window

| | | Octave Band Centre Frequency (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| ***Noise Source*** | | | | | | | | | | |
| Noise Source - CU2 | | | | | | | | | | |
| **Sound Power Levels** | | **75.0** | **72.0** | **67.0** | **63.0** | **63.0** | **61.0** | **56.0** | **57.0** | |
| ***Noise Control Treatments*** | | | | | | | | | | |
| Treatment - None | | | | | | | | | | |
| **Attenuated Lw** | | **75.0** | **72.0** | **67.0** | **63.0** | **63.0** | **61.0** | **56.0** | **57.0** | **Row A** |
| ***ISO 9613 Calculation - Reflections*** | | | | | | | | | | |
| Type of Reflecting Surface - Walls with windows, recesses or bays<br>Q Factor - Junction | | | | | | | | | | |
| Source Height (m) | 19.5 | | | | | | | | | |
| Reflecting Height (m) | 6.0 | | | | | | | | | |
| Barrier - No Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 0.0 | | | | | | | | | |
| Barrier Height (m) | 0.0 | | | | | | | | | |
| Screening at (m) | 6.0 | | | | | | | | | |
| **Reflected Lp** | | **0.0** | **11.6** | **6.6** | **2.5** | **2.4** | **0.0** | **-6.5** | **-10.9** | |
| ***ISO 9613 Calculation*** | | | | | | | | | | |
| Horiz. Distance (m) | 2.8 | | | | | | | | | |
| Source Height (m) | 19.5 | | | | | | | | | |
| Receiver Height (m) | 12.7 | | | | | | | | | |
| Barrier - Single Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 1.9 | | | | | | | | | |
| Barrier Height (m) | 18.0 | | | | | | | | | |
| Screening at (m) | 14.9 | | | | | | | | | |
| Q Factor - Plane | | | | | | | | | | |
| **Direct Lp** | | **43.0** | **38.7** | **31.9** | **25.6** | **23.0** | **18.2** | **10.4** | **10.8** | |
| ***Cumulative Lp at Receiver*** | | | | | | | | | | |
| ***External Receiver*** | | | | | | | | | | |
| External Receiver - Daytime nearest residential window | | | | | | | | | | |
| **Sound Pressure, Lp:** | | **43.0** | **38.7** | **31.9** | **25.6** | **23.1** | **18.3** | **10.5** | **10.8** | |



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Calculation Sheet

# CU1 to Nighttime nearest residential window

| | | Octave Band Centre Frequency (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| ***Noise Source*** | | | | | | | | | | |
| Noise Source - CU1 | | | | | | | | | | |
| **Sound Power Levels** | | **69.0** | **72.0** | **66.0** | **66.0** | **64.0** | **57.0** | **51.0** | **52.0** | |
| ***Noise Control Treatments*** | | | | | | | | | | |
| Treatment - None | | | | | | | | | | |
| **Attenuated Lw** | | **69.0** | **72.0** | **66.0** | **66.0** | **64.0** | **57.0** | **51.0** | **52.0** | **Row A** |
| ***ISO 9613 Calculation - Reflections*** | | | | | | | | | | |
| Type of Reflecting Surface - Walls with windows, recesses or bays<br>Q Factor - Junction | | | | | | | | | | |
| Source Height (m) | 18.5 | | | | | | | | | |
| Reflecting Height (m) | 13.0 | | | | | | | | | |
| Barrier - No Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 0.0 | | | | | | | | | |
| Barrier Height (m) | 0.0 | | | | | | | | | |
| Screening at (m) | 13.0 | | | | | | | | | |
| **Reflected Lp** | | **0.0** | **12.8** | **6.7** | **6.7** | **4.6** | **-2.8** | **-10.2** | **-14.3** | |
| ***ISO 9613 Calculation*** | | | | | | | | | | |
| Horiz. Distance (m) | 2.8 | | | | | | | | | |
| Source Height (m) | 18.0 | | | | | | | | | |
| Receiver Height (m) | 12.8 | | | | | | | | | |
| Barrier - Single Barrier | | | | | | | | | | |
| Distance to Barrier (m) | 1.9 | | | | | | | | | |
| Barrier Height (m) | 18.0 | | | | | | | | | |
| Screening at (m) | 14.5 | | | | | | | | | |
| Q Factor - Plane | | | | | | | | | | |
| **Direct Lp** | | **36.7** | **37.7** | **29.2** | **26.5** | **21.7** | **13.5** | **7.4** | **7.9** | |
| ***Cumulative Lp at Receiver*** | | | | | | | | | | |
| ***External Receiver*** | | | | | | | | | | |
| External Receiver - Nighttime nearest residential window | | | | | | | | | | |
| **Sound Pressure, Lp:** | | **36.7** | **37.7** | **29.2** | **26.6** | **21.7** | **13.6** | **7.5** | **7.9** | |



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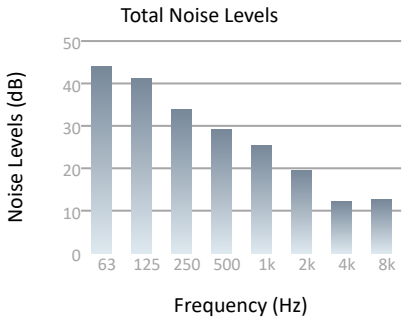
# Flat 2, Merlin House, London

| | |
|---|---|
| **Project Name** | Flat 2, Merlin House, London |
| **Project Reference** | 170916 |
| **Reference** | Daytime nearest residential window |
| **Description** | 4th Floor front window, Merlin House |
| **Noise Limit** | 34 |
| **dBA** | 32.1 |




## Noise Sources

| Reference | Quantity | Noise Levels (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| CU1 | 1 | 36.7 | 37.7 | 29.2 | 26.6 | 21.7 | 13.6 | 7.5 | 7.9 |
| CU2 | 1 | 43 | 38.7 | 31.9 | 25.6 | 23.1 | 18.3 | 10.5 | 10.8 |



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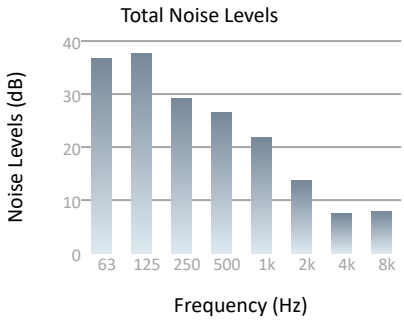
| | |
|---|---|
| **Project Name** | Flat 2, Merlin House, London |
| **Project Reference** | 170916 |
| **Reference** | Nighttime nearest residential window |
| **Description** | 4th Floor front window, Merlin House |
| **Noise Limit** | 31 |
| **dBA** | 28.3 |




## Noise Sources

| Reference | Quantity | Noise Levels (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| CU1 | 1 | 36.7 | 37.7 | 29.2 | 26.6 | 21.7 | 13.6 | 7.5 | 7.9 |



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