hepworth acoustics

THE WHEATSHEAF, 27 RATHBONE PLACE, LONDON W1T 1JB

KITCHEN VENTILATION SYSTEM NOISE IMPACT ASSESSMENT

On behalf of:

Mitchells & Butlers

Report No P24-491-R01
March 2025

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KITCHEN VENTILATION SYSTEM NOISE IMPACT ASSESSMENT

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1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned to carry out a noise impact assessment of the proposed kitchen ventilation system to be installed at The Wheatsheaf public house, located at 27 Rathbone Place, London W1T 1JB. The location is shown in Figure 1. The Local Authority is Camden Borough Council.

1.2 The assessment has been commissioned in connection with the planning application for the proposed development. The aim of this report is to assess whether the proposed new kitchen ventilation system will meet suitable limits for noise, and to make recommendations for noise mitigation where required.

1.3 The site is bounded by Rathbone Place to the west. Running through an archway at the ground level of the pub is Percy Mews, which continues to the northeast. Either side of the pub are commercial premises.

1.4 The new kitchen ventilation system is proposed to be installed with the extract fan on the existing flat roof above the third floor. The supply fan will be within the second-floor kitchen, with the intake on the existing flat roof above the third floor. The proposed operating hours of the kitchen ventilation system are from 11:00 to 22:00 daily.

1.5 The nearest residence to the proposed mechanical plant is at 3 Percy Mews. Other noise-sensitive receptors are further away and will therefore be impacted less. The nearest habitable-room window to the proposed mechanical plant is 15 metres away based on our survey on site.

1.6 The proposed new mechanical plant is summarised in Table 1. Each new fan has an atmosphere-side duct attenuator ('silencer') specified.

Table 1: Proposed Mechanical Equipment

Equipment	Type	Location
Kitchen Extract Fan	SystemAir MUB 062-630	Rooftop (External)
Kitchen Supply Fan	SystemAir MUB 042-500	Second Floor Kitchen (Internal)

1.7 This assessment is based on the following drawings:

<u>Prepared by Arc Design Associates</u>

- 3091/01, Revision A
- 3091/02, Revision A

- 3091/03, Revision A
- 3091/04, Revision A
- 3091/05, Revision A

Prepared by Adapt Fabrications

- Wheat-01, Revision 4
- Wheat-02, Revision 1

1.8 The recommendations in this report have been provided with respect to acoustics only. Compliance with all other aspects of the development's performance (e.g. structure, fire, ventilation, etc.) must be checked by other professionals suitably qualified in their fields.

1.9 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 ACOUSTIC DESIGN CRITERIA

2.1 Camden Council has the following guidance in *Camden Planning Guidance: Amenity*, dated March 2018:

> *Developments proposing plant, ventilation, air extraction or conditioning equipment and flues will need to provide the system's technical specifications to the Council accompanying any acoustic report. 'BS4142 Method for rating Industrial and Commercial Sound'* [SIC] *contains guidance and standards which should also be considered within the acoustic report.*

2.2 The following additional guidance is included for industrial and commercial noise sources in *Appendix 3: Noise Thresholds* of the *Camden Local Plan 2017:*

> *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 (15 dB if tonal components are present) should be considered as the design criterion.*

2.3 The current version of British Standard 4142 is BS 4142: 2014 + A1: 2019 '*Methods for rating and assessing industrial and commercial sound'.* This standard provides methods for rating and assessing sound of an industrial and/or commercial nature. The standard will be referred to as BS 4142 for the rest of this report for brevity.

2.4 BS 4142 requires the 'rating' noise level for the operation to be compared with the background ($L_{A90,T}$) noise level in the absence of the operational noise being assessed. The time period, T, is required to be 1 hour in the daytime, i.e. between 07:00 and 23:00.

2.5 The 'rating' level is derived based on the 'specific' L_{Aeq} noise level attributable to the operation with an *'acoustic feature'* penalty added for any noise sources which give rise to tonal, impulsive, intermittent, or other characteristics readily distinctive against the residual acoustic environment.

2.6 To meet Camden Council's requirements, we have followed the guidance in BS 4142, using Camden Council's 'Rating Level' criteria stated in Paragraph 2.2 above.

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Environmental noise measurements were carried out at the site at the location marked on Figure 1, which is on the rooftop of The Wheatsheaf. This location was selected as being suitably representative of the noise environment outside the nearest residence, whilst also being secure.

3.2 Automatic data-logging noise measurements were taken for 48 hours, starting at 09:30 on Wednesday 5th March 2025.

3.3 The weather conditions throughout the noise survey were mild, dry, and clear, with wind speeds below 5 m/s. Wind was from the southwest. These were considered suitable conditions for the noise survey.

3.4 The noise measurements were taken in 'free-field' conditions with the microphone at approximately 1.5 metres above third-floor roof level. Measurements were taken in 15-minute samples for the duration of the survey. All existing mechanical plant associated with the premises was switched off for the duration of the survey, with the exception of the small, domestic-scale extract fans for the first-floor WCs, which were not audible on the rooftop.

3.5 The results of the noise survey are detailed in Appendix II and summarised in Table 2 below, for the plant's proposed operating hours (i.e. 11:00 to 22:00 each day).

Table 2: Noise survey summary for the hours of 11:00 to 22:00 (dB)

$L_{AMax,fast}$	$L_{Aeq,15mins}$	$L_{A90,15mins}$	
Range	**Log Average**	**Lowest**	**Mean**
57 – 91	57	52	54

3.6 The dominant noise sources were ventilation plant serving nearby commercial premises, and distant road traffic. Noise from aircraft was occasionally audible in lulls between traffic.

3.7 The noise monitoring was carried out using a NTi XL2 Class 1 Sound Analyser (serial no. A2A-20294-E0) fitted with a windshield.

3.8 The calibration level of the meter was checked before and after the survey with a Brüel & Kjær Type 4231 sound calibrator (serial no. 2412667). No significant calibration deviation occurred.

4.0 ASSESSMENT

Equipment Noise Data

4.1 The manufacturer's sound power level data (in octave bands) of the proposed new equipment when operating at full speed are shown in Table 3.

Table 3: Equipment Octave Band Sound Power Level Data, dB L_w

Equipment	Type	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Kitchen Extract	SystemAir MUB 062-630 inlet	82	96	88	85	83	78	75	68
	SystemAir MUB 062-630 outlet	83	97	89	86	85	80	77	70
	SystemAir MUB 062-630 case	62	80	60	53	53	50	42	33
Kitchen Supply	SystemAir MUB 042-500 inlet	72	81	77	76	78	75	72	65
	SystemAir MUB 042-500 outlet	74	83	78	78	79	77	73	67
	SystemAir MUB 042-500 case	52	63	53	46	48	49	40	30

4.2 If substitutions to the above equipment selections need to be made, for example due to supplier shortages or delays, we recommend that any alternative selection has equal or lower sound power levels than the equivalent item in Table 3.

4.3 It should be noted that the data in Table 3 is in the form of 'unweighted sound power levels'. This data has been used as a basis for calculating the 'A-weighted' sound pressure levels outside the nearest noise-sensitive premises.

4.4 There will be distance attenuation from the new mechanical plant to the nearest noise-sensitive premises. The formula used for attenuation of sound over distance in this context is as follows:

$$L_p = L_w - 20 \log r - 8$$

Where:

L_p = sound pressure level (dB)

L_w = sound power level (dB)

r = distance (metres)

4.5 Based on our experience of this type of equipment and the manufacturer's noise data, we do not expect it to feature tonal or impulsive characteristics readily distinctive against the residual acoustic

environment. The plant will not operate intermittently. Based on this, no penalty is applicable to obtain the rating level according to BS 4142.

Noise Control Measures for Equipment

4.6 We understand that the duct attenuators ('silencers') specified for the atmosphere-side of both kitchen ventilation fans have the insertion loss values shown in Table 4.

Table 4: Kitchen Fan Attenuators Insertion Loss Values (dB)

Attenuator Description	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
SystemAir LDK 70	-5	-5	-7	-19	-24	-23	-15	-10

4.7 We recommend that all external ventilation ductwork uses minimum 22g steel sheet, which we understand has been specified for the proposed design.

4.8 Our noise calculations assume that the noise control measures described above are fully installed.

4.9 There will be barrier attenuation provided by the roof edge, which blocks line-of-sight from the kitchen ventilation fans to the nearest habitable room windows. This is calculated to reduce noise at the nearest residence by the values shown in Table 5 for the kitchen fans. The barrier calculation is in Appendix IV.

Table 5: Roof Barrier Attenuation Noise Loss Values (dB)

Description	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Barrier attenuation	-11	-13	-16	-19	-22	-25	-28	-31

Noise Calculations

4.10 With the above measures, the noise level of the equipment (expressed as the sound rating level, as per BS 4142) is calculated to be 42 dB $L_{Ar,1hr}$ outside the nearest noise-sensitive premises. This assumes the fans are operating at full speed, to consider a worst-case scenario. The detailed calculations are shown in Appendix III, and are summarised in Table 6.

4.11 Table 6 compares the plant rating level with the lowest measured background noise level during the plant's operating hours, for a cautious approach.

Table 6: Initial BS 4142 Assessment

Description	dB(A)
Resultant kitchen supply fan rating level (dB $L_{Ar,1hr}$)	25
Resultant kitchen extract fan rating level (dB $L_{Ar,1hr}$)	42
Total rating level outside nearest residence (dB $L_{Ar,1hr}$)	42
Lowest measured background sound level (dB $L_{A90,1hr}$)	52
Comparison (dB $L_{Ar} - L_{A90}$)	-10

4.12 As shown in Table 6, the noise level with the recommended noise mitigation measures is predicted to be 10 dB(A) below the background noise level outside the nearest noise-sensitive premises. Since the equipment has no tonal components, this complies with Camden Council's Noise Threshold stated in Section 2.

4.13 On this basis, the noise impact is predicted to be within suitable limits. No further noise mitigation measures are necessary, beyond the above-mentioned duct attenuators already specified.

4.14 Nonetheless, we also suggest installing timers on the kitchen fans to ensure these are switched off overnight.

4.15 For general good practice, we also recommend that the equipment is inspected periodically to confirm whether maintenance is needed. This should include checks that the fan is running smoothly, without any unusual noise or excessive vibration, with the necessary maintenance carried out as needed.

5.0 SUMMARY AND CONCLUSION

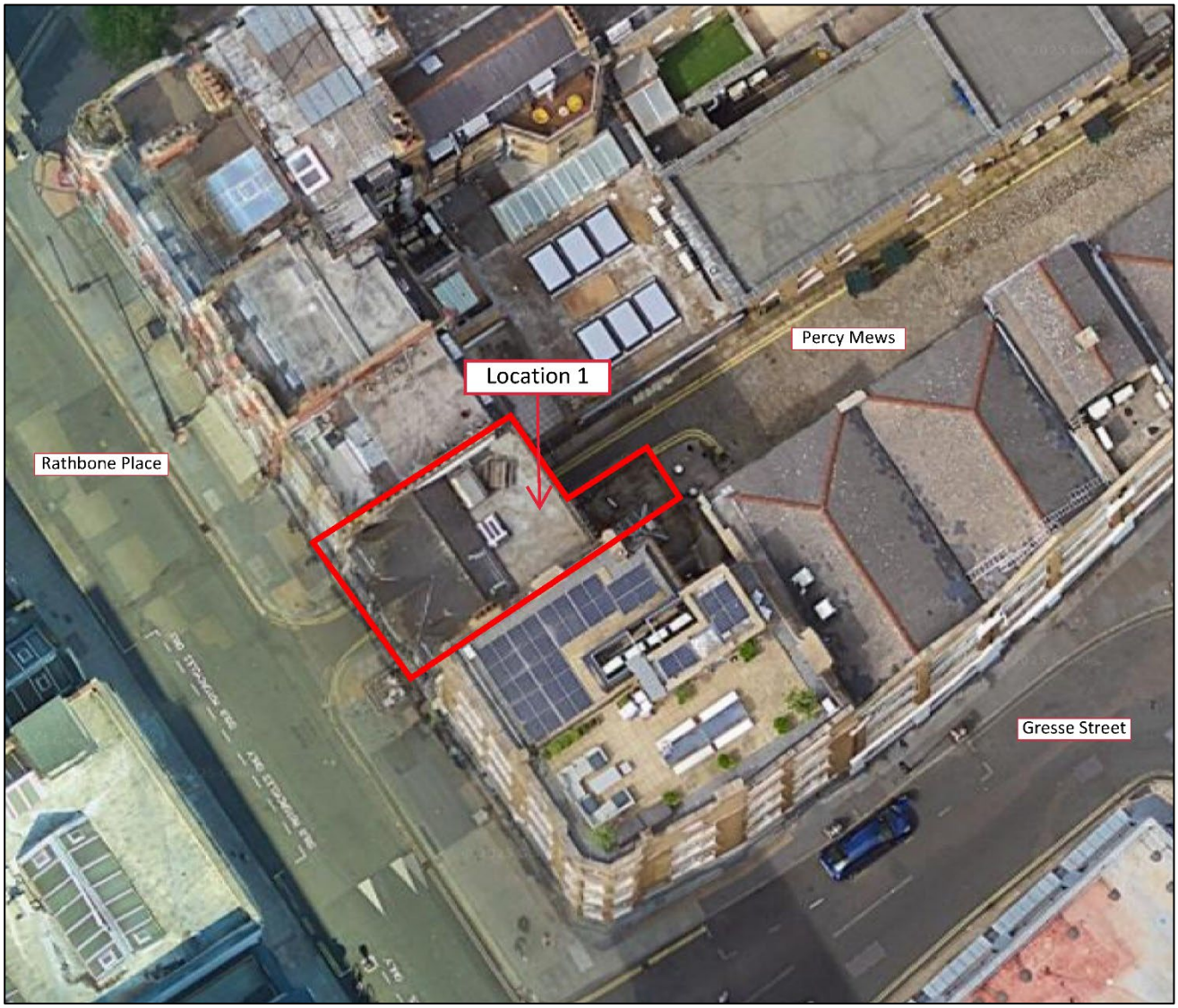
5.1 Mitchells & Butlers appointed Hepworth Acoustics to assess the impact of noise on the neighbouring residential properties from the proposed new kitchen ventilation system to be installed on the roof of The Wheatsheaf, 27 Rathbone Place, London.

5.2 A noise survey has been undertaken at the site and the background noise levels have been determined in accordance with the guidance in BS 4142: 2014 + A1: 2019, as stipulated by Camden Borough Council.

5.3 Using the noise data for the proposed equipment and the specified noise control measures, the rating level for the kitchen ventilation system noise emissions at the nearest noise-sensitive premises has been predicted.

5.4 By following the recommendations in this report, the rating level of noise emitted from the proposed new kitchen ventilation plant is calculated to be at least 10 dB(A) below the background levels determined outside the nearest noise-sensitive receptor. This is compliant with the noise requirements of the Local Authority.

Figure 1 – Site Layout



NB: Development site outlined in red

Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

$L_{Aeq,T}$ This is the A–weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period, T. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A–weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_W This is the sound power level of a sound source, in decibels, which is 10 times the logarithm to the base 10 of the ratio of sound power radiated by the source to a reference power. The reference power is 1 picowatt (1×10^{-12} watt). The sound power level is the fundamental measure of the total sound energy radiated by a source per unit time.

$L_{A90,T}$ This is the A–weighted noise level exceeded for 90% of the time period, T. L_{A90} is used as a measure of background noise.

$L_{Ar,T}$ This is the BS 4142 rating level for the time period, T.

Appendix II: Noise Survey Results

Equipment: NTi XL2 Class 1 Sound Analyser (serial no. A2A-20294-E0) with tripod and windshield.

Weather: Dry, wind speed below 5 m/s

All levels in dB(A)

Date	Start Time	$L_{Aeq,15mins}$	$L_{Amax,f}$	$L_{A90,15mins}$
05/03/2025	09:30:00	51	61	48
05/03/2025	09:45:00	53	82	48
05/03/2025	10:00:00	51	63	49
05/03/2025	10:15:00	60	84	49
05/03/2025	10:30:00	55	63	54
05/03/2025	10:45:00	54	60	53
05/03/2025	11:00:00	54	65	54
05/03/2025	11:15:00	55	63	54
05/03/2025	11:30:00	56	66	54
05/03/2025	11:45:00	57	63	54
05/03/2025	12:00:00	55	65	54
05/03/2025	12:15:00	55	60	54
05/03/2025	12:30:00	55	67	54
05/03/2025	12:45:00	56	66	54
05/03/2025	13:00:00	55	63	54
05/03/2025	13:15:00	55	68	54
05/03/2025	13:30:00	54	64	53
05/03/2025	13:45:00	55	69	54
05/03/2025	14:00:00	57	73	54
05/03/2025	14:15:00	56	70	53
05/03/2025	14:30:00	54	67	53
05/03/2025	14:45:00	55	67	53
05/03/2025	15:00:00	55	64	53
05/03/2025	15:15:00	55	66	53
05/03/2025	15:30:00	57	62	54
05/03/2025	15:45:00	56	62	54
05/03/2025	16:00:00	56	64	54
05/03/2025	16:15:00	54	66	53
05/03/2025	16:30:00	54	65	53
05/03/2025	16:45:00	54	61	53
05/03/2025	17:00:00	54	57	53
05/03/2025	17:15:00	54	67	53
05/03/2025	17:30:00	55	71	53
05/03/2025	17:45:00	55	66	54

05/03/2025	18:00:00	55	63	53
05/03/2025	18:15:00	55	62	54
05/03/2025	18:30:00	54	62	53
05/03/2025	18:45:00	54	60	53
05/03/2025	19:00:00	54	69	53
05/03/2025	19:15:00	54	67	53
05/03/2025	19:30:00	54	66	53
05/03/2025	19:45:00	54	65	53
05/03/2025	20:00:00	54	58	53
05/03/2025	20:15:00	54	59	53
05/03/2025	20:30:00	54	58	53
05/03/2025	20:45:00	54	59	53
05/03/2025	21:00:00	54	62	53
05/03/2025	21:15:00	54	62	53
05/03/2025	21:30:00	54	62	53
05/03/2025	21:45:00	50	60	48
05/03/2025	22:00:00	49	60	48
05/03/2025	22:15:00	49	59	48
05/03/2025	22:30:00	50	70	48
05/03/2025	22:45:00	49	58	48
05/03/2025	23:00:00	49	60	47
05/03/2025	23:15:00	48	60	47
05/03/2025	23:30:00	48	60	47
05/03/2025	23:45:00	49	61	47
06/03/2025	00:00:00	49	57	47
06/03/2025	00:15:00	47	60	46
06/03/2025	00:30:00	45	62	42
06/03/2025	00:45:00	45	64	42
06/03/2025	01:00:00	43	58	42
06/03/2025	01:15:00	43	54	41
06/03/2025	01:30:00	43	56	41
06/03/2025	01:45:00	44	59	41
06/03/2025	02:00:00	43	55	41
06/03/2025	02:15:00	43	50	41
06/03/2025	02:30:00	43	54	41
06/03/2025	02:45:00	42	50	41
06/03/2025	03:00:00	46	67	42
06/03/2025	03:15:00	43	60	41
06/03/2025	03:30:00	42	55	41
06/03/2025	03:45:00	42	52	41
06/03/2025	04:00:00	42	59	41
06/03/2025	04:15:00	42	53	41
06/03/2025	04:30:00	43	51	41
06/03/2025	04:45:00	42	54	40

06/03/2025	05:00:00	43	52	41
06/03/2025	05:15:00	42	53	41
06/03/2025	05:30:00	44	58	42
06/03/2025	05:45:00	43	53	41
06/03/2025	06:00:00	45	62	43
06/03/2025	06:15:00	49	68	44
06/03/2025	06:30:00	48	64	44
06/03/2025	06:45:00	48	66	45
06/03/2025	07:00:00	47	61	45
06/03/2025	07:15:00	50	64	46
06/03/2025	07:30:00	56	81	46
06/03/2025	07:45:00	51	67	47
06/03/2025	08:00:00	51	70	47
06/03/2025	08:15:00	52	72	46
06/03/2025	08:30:00	49	60	46
06/03/2025	08:45:00	50	65	46
06/03/2025	09:00:00	51	64	47
06/03/2025	09:15:00	48	58	46
06/03/2025	09:30:00	49	67	46
06/03/2025	09:45:00	48	62	46
06/03/2025	10:00:00	55	79	46
06/03/2025	10:15:00	51	61	46
06/03/2025	10:30:00	56	68	53
06/03/2025	10:45:00	57	77	53
06/03/2025	11:00:00	67	81	53
06/03/2025	11:15:00	54	63	53
06/03/2025	11:30:00	57	82	53
06/03/2025	11:45:00	60	80	54
06/03/2025	12:00:00	62	79	53
06/03/2025	12:15:00	59	78	53
06/03/2025	12:30:00	54	61	53
06/03/2025	12:45:00	59	79	53
06/03/2025	13:00:00	63	80	53
06/03/2025	13:15:00	62	81	53
06/03/2025	13:30:00	68	91	53
06/03/2025	13:45:00	64	86	53
06/03/2025	14:00:00	64	84	54
06/03/2025	14:15:00	63	86	53
06/03/2025	14:30:00	61	85	53
06/03/2025	14:45:00	61	78	53
06/03/2025	15:00:00	62	78	53
06/03/2025	15:15:00	61	80	54
06/03/2025	15:30:00	60	78	54
06/03/2025	15:45:00	65	88	54

06/03/2025	16:00:00	55	67	53
06/03/2025	16:15:00	54	62	53
06/03/2025	16:30:00	54	60	53
06/03/2025	16:45:00	54	59	53
06/03/2025	17:00:00	55	71	53
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06/03/2025	17:30:00	54	63	53
06/03/2025	17:45:00	56	65	54
06/03/2025	18:00:00	57	68	55
06/03/2025	18:15:00	58	67	56
06/03/2025	18:30:00	58	66	56
06/03/2025	18:45:00	57	68	56
06/03/2025	19:00:00	58	63	56
06/03/2025	19:15:00	58	68	56
06/03/2025	19:30:00	57	66	55
06/03/2025	19:45:00	56	64	55
06/03/2025	20:00:00	58	71	55
06/03/2025	20:15:00	57	66	55
06/03/2025	20:30:00	57	66	55
06/03/2025	20:45:00	57	67	56
06/03/2025	21:00:00	57	68	56
06/03/2025	21:15:00	57	67	55
06/03/2025	21:30:00	57	70	55
06/03/2025	21:45:00	56	68	54
06/03/2025	22:00:00	53	67	51
06/03/2025	22:15:00	53	63	51
06/03/2025	22:30:00	57	75	51
06/03/2025	22:45:00	52	65	49
06/03/2025	23:00:00	49	68	46
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07/03/2025	00:30:00	43	62	42
07/03/2025	00:45:00	43	59	42
07/03/2025	01:00:00	46	70	41
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07/03/2025	01:30:00	42	52	41
07/03/2025	01:45:00	42	52	41
07/03/2025	02:00:00	42	55	41
07/03/2025	02:15:00	47	72	41
07/03/2025	02:30:00	44	64	41
07/03/2025	02:45:00	44	65	41

07/03/2025	03:00:00	48	73	41
07/03/2025	03:15:00	44	68	40
07/03/2025	03:30:00	42	55	40
07/03/2025	03:45:00	43	60	40
07/03/2025	04:00:00	42	53	40
07/03/2025	04:15:00	43	60	40
07/03/2025	04:30:00	42	51	41
07/03/2025	04:45:00	43	58	41
07/03/2025	05:00:00	42	55	41
07/03/2025	05:15:00	44	60	41
07/03/2025	05:30:00	44	58	41
07/03/2025	05:45:00	46	59	42
07/03/2025	06:00:00	47	68	42
07/03/2025	06:15:00	46	66	42
07/03/2025	06:30:00	47	66	42
07/03/2025	06:45:00	46	64	42
07/03/2025	07:00:00	48	63	44
07/03/2025	07:15:00	47	70	44
07/03/2025	07:30:00	51	76	44
07/03/2025	07:45:00	46	58	44
07/03/2025	08:00:00	48	76	44
07/03/2025	08:15:00	48	60	45
07/03/2025	08:30:00	48	61	45
07/03/2025	08:45:00	50	67	45
07/03/2025	09:00:00	49	67	45
07/03/2025	09:15:00	51	69	46

Appendix III: Mechanical Plant Noise Calculations

Description	63	125	250	500	1k	2k	4k	8k	dB(A)	Comments
Kitchen extract - outlet										
Extract outlet Lw	83	97	89	86	85	80	77	70		Manufacturer's data
Exhaust silencer	-5	-5	-7	-19	-24	-23	-15	-10		SystemAir LDK 70
Duct losses	-4	-4	-3	-2	-1	0	0	0		
Louvre area	2	2	2	2	2	2	2	2		
End reflections	-4	-1	0	0	0	0	0	0		Woods Practical Guide to Noise Control, Fig 5.7
Louvre directivity	1	1	1	0.5	-0.5	-2	-15	-15		SRL Noise Control in Building Services, Fig 11.2
Barrier attenuation	-6	-7	-8	-10	-12	-15	-17	-20		
Distance attenuation	-32	-32	-32	-32	-32	-32	-32	-32		15
Resulting SPL from duct outlet	36	52	43	26	18	11	0	-5	38	
Kitchen extract - case breakout										
AHU case breakout Lw	62	80	60	53	53	50	42	33		Manufacturer's data
Barrier attenuation										Duct lagging
Distance attenuation	-32	-32	-32	-32	-32	-32	-32	-32		15
Resulting SPL from case breakout	30	48	28	21	21	18	10	1	33	
Kitchen extract - duct breakout										
AHU inlet Lw	82	96	88	85	83	78	75	68		Manufacturer's data
SRI of duct	3	11	14	20	23	26	27	35		22g steel sheet - adopted from Woods Practical Guide to Noise Control - Appendix B
Duct surface area (m^2)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4		4m length of duct
Cross sectional area of duct (m^2)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36		
Lw of duct break-out	79	91	80	71	66	58	54	39		Woods Practical Guide to Noise Control eqn. 5.11, subject to upper limit of in-duct Lw - 3dB
Barrier attenuation	-6	-7	-8	-10	-12	-15	-17	-20		Duct lagging
Distance attenuation	-32	-32	-32	-32	-32	-32	-32	-32		15
Resulting	42	53	41	30	22	12	5	-13	38	
Kitchen supply - inlet										
AHU Inlet Lw	72	81	77	76	78	75	72	65		Manufacturer's data
Fresh air inlet silencer	-5	-5	-7	-19	-24	-23	-15	-10		SystemAir LDK 70
Duct losses	-4	-4	-3	-2	-1	0	0	0		
Louvre area	2	2	2	2	2	2	2	2		
End reflections	-4	-1	0	0	0	0	0	0		Woods Practical Guide to Noise Control, Fig 5.7
Louvre directivity	1	1	1	0.5	-0.5	-2	-15	-15		SRL Noise Control in Building Services, Fig 11.2
Barrier attenuation	-6	-7	-8	-10	-12	-15	-17	-20		
Distance attenuation	-32	-32	-32	-32	-32	-32	-32	-32		15
Resulting SPL from duct inlet	25	36	31	16	11	6	-5	-10	25	
Total of fans	43	56	45	32	26	20	12	3	42	Outside nearest residential window
Background noise	61	59	54	49	46	38	28	24	52	At residence.
Difference	-18	-3	-9	-17	-20	-18	-16	-21		

Appendix IV: Noise Barrier Calculations

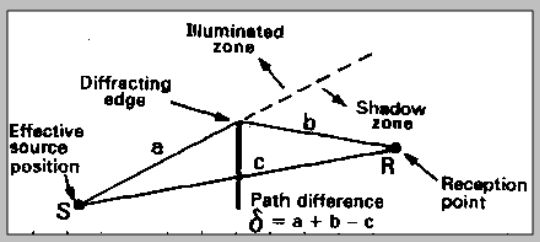
Barrier Attenuation	h (Source)	h(Receiver)	h(Barrier)	d(S-B)	d(B-R)	d(S-B-R)	d(SBR)	d(SR)
	14.0	4.5	13.0	3.0	12.0	15.0	17.87	17.76

a	b	c	Path Diff	Log
3.16	14.71	17.76	0.112438	-9.49E-01

Frequency (Hz)	500	h(S)-H(R)	S)-H(R)/SE	Theta	h(min shadow)	Zone
Speed (c)	344	9.5	0.633333	0.564569	12.1	Shadow

		Freq Hz	Barrier Correction dB
CRTN			-9.6
CRN	Reflective Barrier		-9.0
	Absorptive Barrier		-10.4
BS5228	Approximation		-10.0
ISO9613	At Frequency (Hz)		-7.9
Fresnel			-9.8
Octave Band		63	-5.8
		125	-6.7
		250	-8.0
		500	-9.8
		1000	-12.1
		2000	-14.6
		4000	-17.4
		8000	-20.3

BS5228



Minimum mass kg/m^2	2.8

	BS5228							
	63	125	250	500	1k	2k	4k	8k
Fresnel	-6	-7	-8	-10	-12	-15	-17	-20