Plant Noise Impact Assessment

(BS 4142:2014)

109 St James Street
Brighton, BN2 1TH

Date: 30th March 2021

Report Ref.:

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1. Introduction

Safe Acoustics has been appointed by Mr. Ali Algun to undertake an environmental noise impact assessment of a proposed kitchen extractor system (the plant) designed to service a kitchen (the premises) in relation to a planning application.

The purpose of this report is to assess noise that will be emitted by the plant in relationship to the nearest residential property. It is understood that the premises is open between 0700 hours and 2300 hours and will only use the plant during these hours.

This report presents the results of the environmental survey followed by noise impact calculations, results and recommendations (where necessary) to mitigate chances of noise disturbance.

1.1 Location and construction of Building

The premises shop front is located at 192 St. James Street, Brighton with the plant consisting of a duct running horizontally out of an existing first floor window, into a carbon filter, to a Systemair extractor fan (model MUB500) followed by a 90° elbow into a jet cowl outlet. (See **Appendix 1** for architects' diagram).

1.2 Nearby residents

The plant position is in close proximity to the bedroom window of a residential apartment (the receptor) on the second floor in the same building. 1 meter in front of this window is identified as the nearest sensitive receptor in accordance with BS4142. See **Appendix 1** for illustrating aerial plan. With extractor systems there are two primary sources of noise breakout:

a) Casing breakout from the fan enclosure

b) End breakout from the exit from the duct

The nearest residential window above the plant at the distance of approximately 1.7 meters diagonal to the proposed outlet cowl and approximately 2 meters diagonal from the proposed fan enclosure.

1.3 Proposed Plant

Ventilation and Extractor Engineers AVE Ltd. of Burgess Hill have proposed the following plant to for fill the requirements of the kitchen extractor system:

- G4 Panel (Extract pre-filter)
- Bag Filter (Extract fine filter filter)
- Site Safe Carbons (Extract Odour control)

- Ace Filtration – Model AF111 450x450mm Baffle type filters (Canopy Filters)
- Systemair – MUB 500 type acoustic box fan (Extract Fan)
- Systemair – MUB attenuator
- AVE – Canvas
- Big Feet
- Jet Cowl

The acoustic elements of this system are as follows:

1. Systemair MUB 042 500E4 Sileo Multibox
2. Systemair MUB outlet attenuator 012
   (see **Appendix 4** for manufacturers data)

The installation of the system for this proposal as designed by the architect is shown in **Appendix 1**.

2. Noise Criteria

2.1 National Planning Policy Framework (NPPF) 2019

The Tower Hamlets Local Planning Framework refers this document. NPPF stipulates the requirements for planning permission. It states the planning system should prevent:

'both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of … noise pollution'

'planning policies and decisions should aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development'

2.2 Noise Policy Statement for England (NPSE)

NPPF references NPSE. The concepts outlined are No Observed Adverse Effect Level (NOAEL), Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL). To avoid 'significant adverse impacts on health and quality of life', by creating a situation where the impact of noise lies below the SOAEL.

2.3 BS4142:2014 Methods for Rating and Assessing Industrial and Commercial Noise

NPPF also references this standard as a method of evaluating the impact of noise on residents. It lays out the method of calculating the 'specific' noise of commercial activity (measured in dBLAeq) and comparing it to the 'background noise' present without the activity (measured in dBLA90). BS4142 stipulates a number of corrections according to the character of the noise (tonal, impact etc.) to give the rating level and compares the this against the background noise. If the "rating" level exceeds the "background" by around 10 dBA or more this '*indicates a significant adverse impact*'. A difference of around 5 dBA '*indicates an adverse impact…The lower the rating level is relative 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.'

BS4142 also gives clarification between daytime and night time hours and the background noise measurement lengths accordingly:

Day: 1 Hour (7am to 11pm)
Night: 15 Minutes (11pm to 7am)

2.4 ISO 1996 – Part 2:2017 Description, measurement and assessment of environmental noise- Part 2: Determination of sound pressure levels

Part 2 of ISO 1996 describes the determination and assessment of environmental noise levels through either direct measurement, by extrapolation of measurement results, or by means of calculation.

3. Environmental Noise Survey

3.1 Methodology

Mr Steven Dover from Brighton and Hove Planning was contacted by the architect, Derya Yilmaz, in relation to using background noise measurements from a previous report (reference IMP5837-1) on a rejected proposal for extractor plant at the same premises dated November 2020 and carried out by I Broom of Impact Acoustics of Bournemouth. As a result, no fresh measurements were taken. All measurements in the previous report were in accordance with BS4142.

This report focuses on the acoustic design criteria of a new proposal which has been submitted and accepted pending this acoustic report.

Specific sound levels have been calculated from manufacturers product data in accordance with BS1996 to give the specific noise values present at the receptor.

3.2 Calculations

Using the background sound levels from the previous report and data from fan the manufacturers website, Systemair (see **Appendix 4**) to calculate the specific sound level from the plant present at the receptor resulting from both outlet breakout and casing breakout. Results were established in accordance with BS4142 and BS1996. See **Appendix 3** for formula. 4. Results

4. Results

4.1 Fixed measurement results

Measurement	Value (dBA)
Residual sound level ($LAeq_{,15mins}$) 0700-2300	49
Background sound level ($LA_{90,1hour}$)	38

Table 4.1: Table of Measurements
All measurements rounded to nearest integer in accordance with BS4142

Table 4.1 shows a summary of the measured residual, background at the fixed microphone location during the operation hours with an hour added before and after to allow for opening up and closing down the shop and ambient sound levels recorded with the plant in operation See **Appendix 2** for a graph representing the time distribution of these measurements from the previous report (see **Appendix 1** for chart).

4.2 Calculated Fan Noise Breakout

The specific sound pressure levels resulting from noise breakout of the extractor system present at the receptor were calculated in accordance to BS1996 with reference to manufacturer data and Fläkt Woods Practical Guide to Noise Control (2005). **Table 4.2** displays those for casing breakout and **Table 4.3** those for noise from the outlet. As there were no distinct tonal qualities in the fan noise and no impact type characteristics, no additional penalty was added to the specific sound.

Octave band (Hz)	63	125	250	500	1000	2000	4000	8000	Lw dBA	SPL dBA
Fan Sound Power Level*	51	68	68	74	79	79	77	68	84	
Attenuator (MUB)*	-3	-8	-13	-25	-23	-14	-8	-4		
Duct attenuation**	0	0	0	0	0	0	0	0		
Elbow attenuation**	0	0	-1	-8	-6	-3	-3	-3		
End Reflection**	-15	-10	-5	-2	0	0	0	0		
Directivity***	3	3	3	3	3	3	3	3		
Barrier attenuation***	0	0	0	0	0	0	0	0		
Discharge level	36	53	52	42	53	65	69	64	72	
Distance attenuation***	-17	-17	-17	-17	-17	-17	-17	-17		
Specific rating	19	36	35	25	36	48	52	47		55

Table 4.2 Noise Breakout from Duct Outlet
*From manufacturer Data (see **Appendix 4**)
**Taken from Fläkt Woods Guide to Noise Control,
***According to BS1996. All values given in decibels (dB).

Octave band (Hz)	63	125	250	500	1000	2000	4000	8000	Lw dBA	SPL dBA
Fan Sound Power Level*	30	47	50	45	50	54	54	32	59	
Directivity***	3	3	3	3	3	3	3	3		
Discharge level	33	50	53	48	53	57	57	35	62	
Distance attenuation***	-16	-16	-16	-16	-16	-16	-16	-16		
Specific noise	17	34	37	32	37	41	41	19		46

Table 4.3 Noise Breakout from Fan Casing

*From manufacturer Data (casing breakout level) (see **Appendix 4**), ***According to BS1996. All values given in decibels (dB).

These calculations give a combined decibel value of **55.5dBA** noise resulting from the fan assembly present at the receptor.

4. Assessment of Results

BS4142 sates that if a specific sound rating does not exceed the background sound level it is likely to have "*low impact*". This is the desired rating to achieve NPPF status of NOAEL.

The background sound level is given by the previous report is given as **38dBLA$_{90}$**. This is the target value for the combined breakout noise from the extractor system to fall below.

From the results it can be seen that the combined specific sound rating of the plant is **55.5dBA**.

This indicates mitigation measures must be added to the system to achieve the desired level. As a result this report will offer robust measures to achieve this in the following section.

5. Recommendations

All the following recommendations should be certified by the ventilation system designer to find the best practical solutions.

5.1 Additional inline silencers as part of the duct system

It is recommended that 2 additional silencers are inserted along the duct between the fan casing and the outlet cowl. The suggested units are the Acoustica CP01-M10-120. These would have to be lined with Melinex to offer protection from contaminants in the extracted fumes. This design of silencers will add no additional resistance to the air flow in the system. Manufacturers data has been included in **Appendix 4**. Similar silencers can be used in its place at the digression of the ventilation contractor so long as it displays at least the same attenuation properties.

5.2 Acoustic enclosure around the fan casing

In addition to the output attenuator specified by AVE Ltd., an additional custom made acoustic enclosure should be built around the fan casing to provide additional attenuation of the casing breakout noise. The construction should be of weatherproof panels consisting of 70kg/m^2 mineral fibre wool (e.g. Rockwool) absorber encased in 1mm (minimum) steel (lacquered for weather protection) which is perforated internally with a minimum of 20% perforation area to allow ingress of sound from the fan to the absorber. The construction should be acoustically sealed around all joints. An example of this panel construction is Acoustimodule-80 panel. Although a custom enclosure will need to be made, the composition and acoustic data of this product is a good guideline to what can be achieved and has been used in calculations. See **Appendix 4** for manufacturers data sheet.

5.3 Calculations of fan breakout noise to encompass recommendations

Octave band (Hz)	63	125	250	500	1000	2000	4000	8000	Lw dBA	SPL dBA
Fan Sound Power Level	51	68	68	74	79	79	77	68	84	
Attenuator (MUB)*	-3	-8	-13	-25	-23	-14	-8	-4		
Silencer 1 (Acoustica)*	-6	-9	-14	-23	-32	-32	-18	-15		
Silencer 2 (Acoustica)**	-3	-4.5	-7	-11.5	-16	-16	-9	-7.5		
Duct attenuation	0	0	0	0	0	0	0	0		
Elbow attenuation	0	0	-1	-8	-6	-3	-3	-3		
End Reflection	-15	-10	-5	-2	0	0	0	0		
Directivity	3	3	3	3	3	3	3	3		
Barrier attenuation	0	0	0	0	0	0	0	0		
Discharge level at outlet	27	39.5	31	7.5	5	17	42	41.5	46	
Distance attenuation	-17	-17	-17	-17	-17	-17	-17	-17		
Specific noise rating	10	22	14	-10	-12	0	25	24		**29**

Table 5.1 Noise Breakout from Duct Outlet after Recommendations

*From manufacturers data (see **Appendix 4**).** Rule of thumb from manufacturer that a second attenuator of equal specification will achieve around half the original attenuation

Table 5.1 and **5.2** show the revised specific sound calculations to encompass the recommendations. These calculations give a combined (casing breakout and outlet) decibel value of (29+24dBA) **30dBA** noise resulting from the fan assembly present at the receptor. This is 8dB lower than the background sound level given in the previous report and therefore rated as "*low impact*" according to BS4142 and NOAEL according NNPF. This 8dB excess of the requirement allows for factors that may lead to deviation from the manufacturer data and therefore constitutes a robust solution.

Octave band (Hz)	63	125	250	500	1000	2000	4000	8000	Lw dBA	SPL dBA
Fan Sound Power Level*	30	47	50	45	50	54	54	32	59	
Enclosure**	0	-13	-20	-32	-44	-50	-57	-59		61dB IL
Directivity	3	3	3	3	3	3	3	3		
Discharge level at outlet	33	37	33	16	9	7	0	0	40	
Distance attenuation	-16	-16	-16	-16	-16	-16	-16	-16		
Specific noise rating	17	21	17	0	0	0	0	0		**24**

Table 5.2 Noise Breakout from Fan Casing

*From Systemair manufacturer data (casing breakout level) (see **Appendix 4**)

** From Acousticmodule 80 manufacturers data as example of attenuation from recommended enclosure design (see **Appendix 4**)

5.4 General Comments on Recommendations

These recommendations are a minimum that need to be implemented. Caution must be exercised in doing so not to locate the outlet within 2 meters of any other residential window. Although effort has been taken to consider factors such as air flow and practicality, changes to the extractor system must be authorised by the ventilation engineer. Due to the close proximity of residential windows it is recommended that duct pipe with thicker than usual walls should be used to eliminate chance of noise breakout, e.g. 1.2mm rather than 0.8. See **Appendix 1** for example implementation of the suggestions in this report.

7. Conclusions

Safe Acoustics has been appointed by Mr. Ali Algun to undertake an environmental noise survey of a proposed kitchen extractor assembly designed to service a kitchen on the first floor of the premises.

A noise survey has previously been undertaken to establish background sound levels, the results of which, along with calculations extrapolated from manufacturers data of the plant (in accordance with BS1996), have been used to form the basis of the noise assessment which has been undertaken in accordance with BS4142:2014 and referenced against National Planning Policy Framework.

Based upon the results of the noise survey, specific sound rating from plant should be no more than 38dBA during the operation period 0800-2300.

The results of the assessment have identified that the proposed plant does not meet the acoustic planning obligations and therefore mitigation measures to reduce noise breakout will be necessary. Recommendations of relocation of the plant design, an acoustic enclosure around the fan casing assembly and additional silencers to be placed in-line with outlet duct between the fan and the cowl have been made with minimum specifications provided.

The implementation of these recommendations will bring the anticipated noise levels from the proposed plant in line with these local authority planning requirements with a robust 3dB margin for error.

Appendix 1: Photos

Figure A1.1 Site Plan (109 St James Street, Brighton)
The building containing the premises and the receptor is outlined in red

Figure A1.2 Background Sound Assessment Point
Photo from report I Broom of Impact Acoustics, November 2020

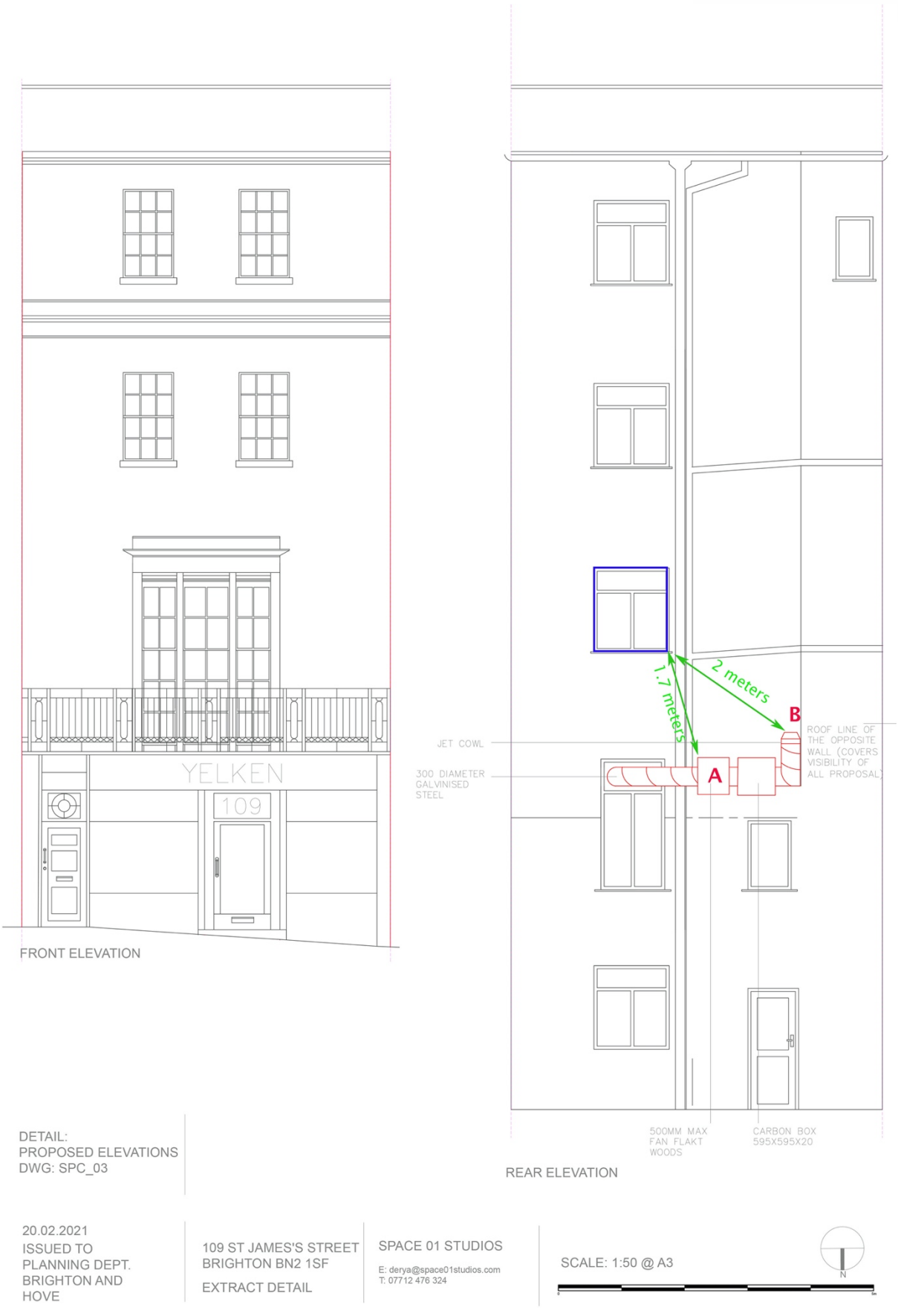

Figure A.3 Architects Elevation Diagram of Premises, Proposed Plant and Receptor
/=proposed plant, /=distance from noise sources to receptor, /=receptor, A+B=Noise sources

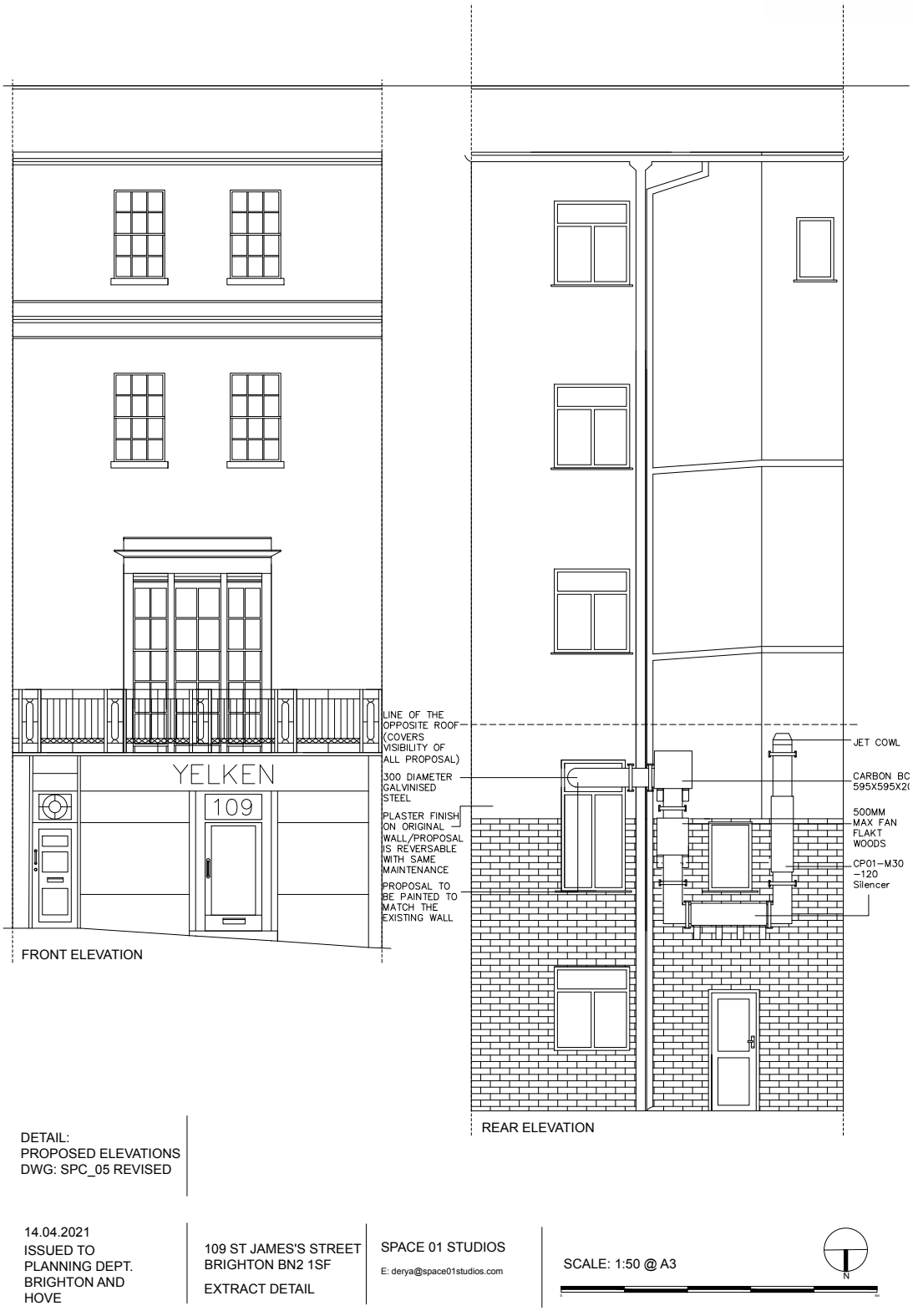

Figure A.4 Architects Elevation Diagram of implementation of report recommendations

Appendix 2: Sound Measurements

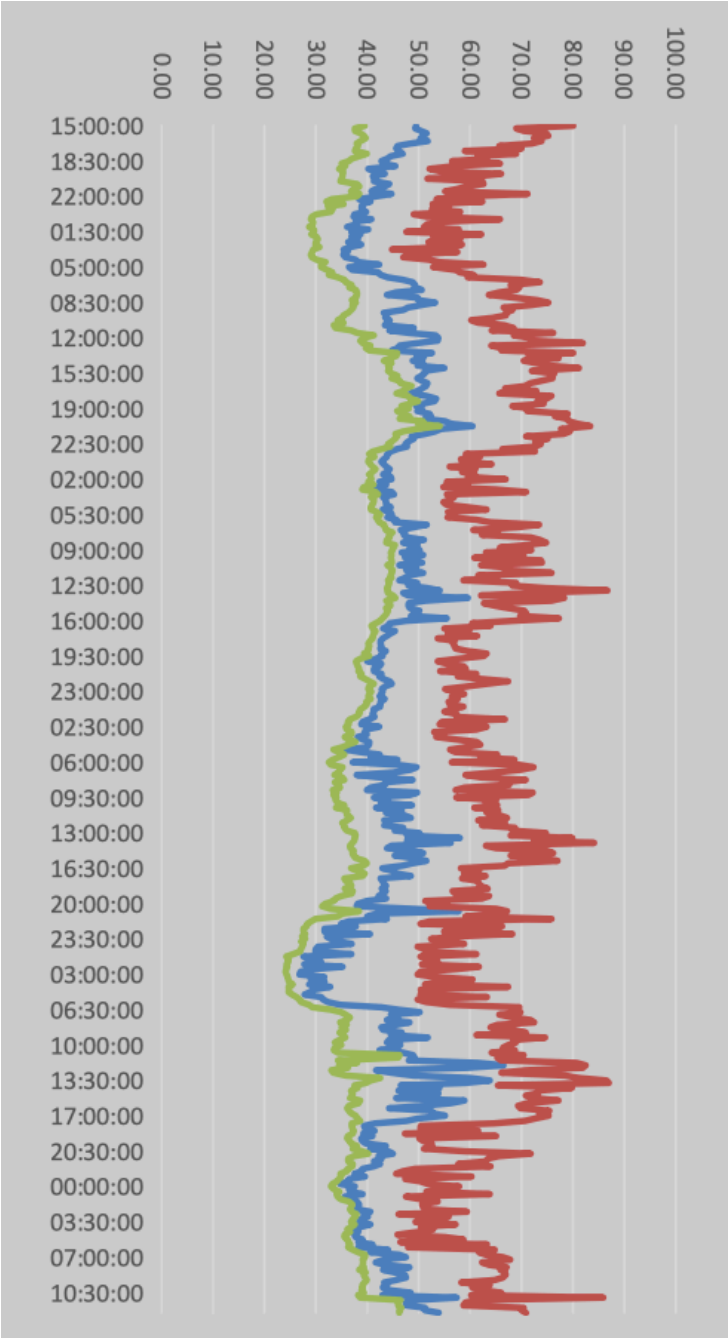

Figure A2.1 Graph showing the 24H recorded residual sound (LAeq), LAmax and background (LA90) measurements against time

Data collected by I Broom of Impact Acoustics on 19th-23rd November 2020

Appendix 3 Explanation of Acoustic Terms

Term	Abbreviation	Description
Decibel	dB	a relative unit of measurement widely used in acoustics, electronics and communications. The dB is a logarithmic unit used to describe a ratio between the measured level and a reference or threshold level of 0dB. A 3dB increase represents a doubling of sound pressure level and is generally taken as the smallest increase easily perceivable by the human ear. In sound pressure level, dB reference $2x10^{-5}$ Pascal.
Hertz	Hz	the unit of frequency or pitch of a sound. One hertz equals one cycle per second. 1 kHz = 1000 Hz, 2 kHz = 2000 Hz, etc. The optimum range of human hearing is generally taken as 20Hz-20kHz, 20Hz being very low bass and 20kHz being very high treble.
A weighting	dBA	a filter that covers the full audio range, 20 Hz to 20 kHz, and the shape is similar to the response of the human ear at the lower levels. It is less sensitive to low frequency sound.
C weighting	dBC	a standard frequency weighting filter for sound level meters, commonly used for higher level measurement. It is more sensitive to low frequency sounds and will show a higher value than dBA in low frequency environments.
Z weighting	dBZ	Unweighted sound pressure level
Equivalent continuous sound level	$Leq_{,mins}$	is the sound level in decibels equivalent to the total sound energy measured over the period of time stated after the comma.
90^{th} percentile of continuous sound level	LA_{90}	the noise level exceeded for 90% of the measurement period, A-weighted and calculated by statistical analysis. The 90^{th} percentile of LAeq.
Octave	oct	a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1000 Hertz octave band contains noise energy at all frequencies from 707 to 1414 Hertz.
Residual sound		an average sound level taken with the plant off ($LAeq15_{15mins}$ averaged over a the period of operation) as defined by BS4142
Background sound		the 90^{th} percentile of the residual noise (LA90) as defined by BS4142
Ambient sound		the sound of the plant working with residual noise included ($LAeq_{1hour}$ for daytime hours between 0700-2300hrs, $LAeq_{15mins}$ for night time hours between 2300-0700) as defined by BS4142
Specific sound		the ambient sound with the residual sound logarithmically subtracted as defined by BS4142

Sound Pressure Level (dB)	Example of Equivalent Sound
130	artillery fire at close proximity (threshold of pain)
120	amplified rock music; near jet engine
110	loud orchestral music, in audience
100	electric saw
90	bus or truck interior
80	automobile interior
70	average street noise; loud telephone bell
60	normal conversation; business office
50	restaurant; private office
40	quiet room in home
30	quiet lecture hall; bedroom
20	radio, television, or recording studio
10	soundproof room
0	absolute silence (threshold of hearing)

Appendix 4: Manufacturers Data

Attenuator Schedule

Ref.	Description	Type and Model Code	Dimensions (mm)			Insertion Loss (dB)								Vol (m^3/s)	PL (Pa)	Qty	Features
			W	H	L	63	125	250	500	1k	2k	4k	8k				
8936	MUB042 INTAKE 012 Atmosphere side	Rectangular LG01V/3B/L/SN	546	546	1250	3	6	11	20	19	11	7	4	1.75	56	1	20mm profile flanges. Non-standard element configuration.
7945	MUB042 INTAKE 012 M Atmosphere side	Rectangular LG01V/3B/L/SMN	546	546	1250	3	6	10	17	15	8	5	3	1.75	56	1	20mm profile flanges. Melinex wrapped infill. Non-standard element configuration.
ATT/9	MUB042 INTAKE 015 Atmosphere side	Rectangular LG02V/3B/L/SN	546	546	1600	3	8	14	26	24	15	9	4	1.75	60	1	Unit delivered in 2 sections, split in length. 20mm profile flanges. Non-standard element configuration.
ATT/10	MUB042 OUTLET 060 Atmosphere side	Rectangular LG01V/3B/L/S	546	546	650	2	4	7	14	14	8	6	3	1.75	53	1	20mm profile flanges.
ATT/11	MUB042 OUTLET 090 Atmosphere side	Rectangular LG01V/3B/L/S	546	546	950	3	6	10	19	19	11	7	4	1.75	56	1	20mm profile flanges.
ATT/12	MUB042 OUTLET 012 Atmosphere side	Rectangular LG01V/3B/L/S	546	546	1250	3	8	13	25	23	14	8	4	1.75	59	1	20mm profile flanges.
ATT/13	MUB062 INTAKE 090 Atmosphere side	Rectangular LG01V/2B/L/SN	676	676	950	2	4	7	12	10	6	4	2	3.50	70	1	20mm profile flanges. Non-standard element configuration. Medium pressure rating (+1000/-750Pa).
8937	MUB062 INTAKE 012 Atmosphere side	Rectangular LG01V/2B/L/SN	676	676	1250	3	6	10	16	14	8	4	2	3.50	73	1	20mm profile flanges. Non-standard element configuration. Medium pressure rating (+1000/-750Pa).
7946	MUB062 INTAKE 012 M Atmosphere side	Rectangular LG01V/2B/L/SMN	676	676	1250	3	6	10	14	11	6	3	2	3.50	73	1	20mm profile flanges. Melinex wrapped infill. Non-standard element configuration. Medium pressure rating (+1000/-750Pa).
ATT/15	MUB062 INTAKE 015 Atmosphere side	Rectangular LG02V/2B/L/SN	676	676	1600	3	7	14	21	18	10	5	2	3.50	77	1	Unit delivered in 2 sections, split in length. 20mm profile flanges. Non-standard element configuration. Medium pressure rating (+1000/-750Pa).
ATT/16	MUB062 OUTLET 060 Atmosphere side	Rectangular LG01V/2B/L/S	676	676	650	2	4	7	12	10	6	4	2	3.50	70	1	20mm profile flanges. Medium pressure rating (+1000/-750Pa).
ATT/17	MUB062 OUTLET 090 Atmosphere side	Rectangular LG01V/2B/L/S	676	676	950	3	6	10	16	13	8	4	2	3.50	73	1	20mm profile flanges. Medium pressure rating (+1000/-750Pa).
ATT/18	MUB062 OUTLET 012 Atmosphere side	Rectangular LG01V/2B/L/S	676	676	1250	3	7	13	20	17	9	5	2	3.50	76	1	20mm profile flanges. Medium pressure rating (+1000/-750Pa).
9226	MUB 100 INLET	Rectangular SG01V/3B/L/SN	876	876	1250	4	5	12	23	23	15	11	8	3.00	24	1	20mm profile flanges. Non-standard element configuration.

Figure A4.1 Systemair outlet attenuator insertion loss
Selected option: MUB042 Outlet 012

Sound power level		63	125	250	500	1k	2k	4k	8k	Tot
Inlet	dB(A)	49	66	67	72	77	78	75	67	83
Outlet	dB(A)	51	68	68	74	79	79	77	68	84

Sound Power level		63	125	250	500	1k	2k	4k	8k	Tot
Casing break out	dB(A)	30	47	50	45	50	54	54	32	59

Figure A4.2 Systemair MUB 042 500E4 Soleo Multibox Sound Power Levels

Typical Noise Reduction (dB) - Centre Band Frequency

Product Code	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
CP01 - M30 - 030	2	3	6	12	15	18	16	8
CP01 - M30 - 060	3	5	9	16	22	24	16	14
CP01 - M30 - 090	4	7	10	20	31	28	17	14
CP01 - M30 - 120	6	9	14	23	32	32	18	15

Typical noise reduction data is derived from continual testing to BS4718 and other standards in independent UKAS certified laboratories, which includes where appropriate, re-generated or self noise testing in both forward and reverse flow conditions. If you request system analysis from our technicians all predictions will be assessed using the relevant certified insertion loss data together with relevant dynamic corrections.

Dimensional Data

Product Code	A (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
CP01 - M30 - 030	298	401	35	300	6
CP01 - M30 - 060	298	401	35	600	11
CP01 - M30 - 090	298	401	35	900	15
CP01 - M30 - 120	298	401	35	1200	20

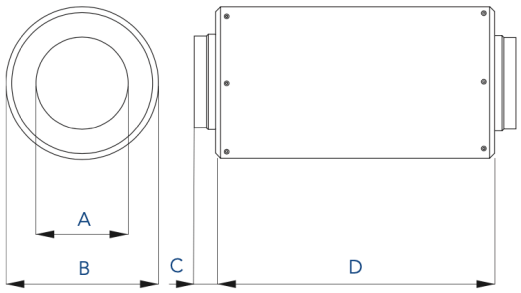

Figure A4.3 Acoustica CP01 M Series Silencer

Selected option: CP01-M10-120

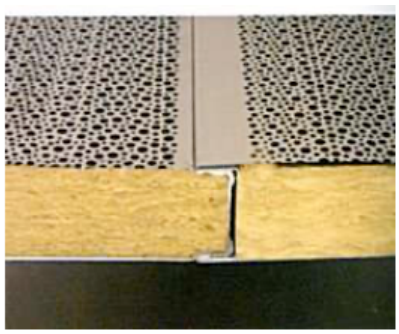

Figure A4.4 a & b Acustimodule-80
Example of suitable panel construction and insertion loss (RdB) performance for specified acoustic enclosure