Acoustic assessment of proposed new mechanical services equipment

37-39 South End Road, London

Client: TFT Consultants

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0. SUMMARY

0.1. ACA Acoustics Limited has been commissioned to assess the acoustic impact of proposed new mechanical services equipment to be installed at 37-39 South End Road, London.

0.2. 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.

0.3. ACA Acoustics have previously carried out a sound level survey at 37-39 South End Road over nominally a 3 day period between 3rd and 6th September 2019. Whilst on site, the author considered the sound climate during the daytime periods to be comprised primarily of traffic on South End Road and other routes in the vicinity. The prevailing background sound level measured at first floor flat roof level equivalent to that of the upper floor apartments overlooking the new equipment were LAF90 55dB during the period of the proposed equipment's operation between 07:00 – 19:00.

0.4. Calculations using manufacturer's sound level data for the new equipment confirm that the rating level of the new equipment to upper floor apartments of 35 and 41 South End Road will not exceed LAr 43 dB when assessed in accordance with BS 4142:2014. This is at least 10dBA below the measured background sound level during the proposed equipment operating period of 07:00 – 19:00 hours.

0.5. Noise from the proposed new equipment will not be disturbing or detrimental to the amenity of any nearby residential occupants.

1. INTRODUCTION

New mechanical services equipment is to be installed at 37-39 South End Road, London.

ACA Acoustics Limited has been commissioned to carry out an assessment of noise emissions from the proposed mechanical plant and, where necessary, make recommendation 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. ACOUSTIC CRITERIA

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)	SOAEL (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 terms "LOAEL" and "SOAEL" are defined as the "Lowest Observed Adverse Effect Level" and "Significant Observed Adverse Effect Level" in the Planning Practice Guidance – Noise (PPG-N) and Noise Policy Statement for England (NPSE). The NPSE and PPG-N both require that significant adverse impacts are avoided and that where the impact lies somewhere between the LOAEL and SOAEL all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life, whilst considering the guiding principles of sustainable development as set out in the National Planning Policy Framework.

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 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

New extraction fan and condensing units are proposed to the roof during the refurbishment and development of new offices at 37-39 South End Road, London.

Closest residential properties have been identified as residential windows at 35 South End Road, overlooking the new equipment location, and 41 South End Road overlooking South End Road.

Proposed operating times of the equipment is understood to be between 07:00 – 19:00 hours.

4. SOUND LEVEL SURVEY

To assess sound levels from the new mechanical equipment it is necessary to establish existing background sound levels in the vicinity. ACA Acoustics have measured sound levels in the vicinity nominally over a 3 day period. Details of the sound level survey carried out by ACA Acoustics are provided below.

The background sound level survey measurement position was selected at roof level of 37-39 South End Road, at a position equivalent to nearest residential properties overlooking the proposed equipment location. Existing background sound levels are raised due to traffic activity in the area and non-associated mechanical equipment in the vicinity.

The site was considered secure and therefore an unattended survey was carried out over nominally a 48-hour period between 12th and 14th March 2019. The survey was conducted typically following procedures set out in BS 4142:2014+A1:2019.

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

Equipment	Serial Number
NTi Audio sound level meter type XL2 Class 1 complete with weatherproof and lockable outdoor environmental kit	A2A-06294-E0
Castle calibrator type 4226. Compliant to IEC 60942-1:2003 (Calibrated to a reference traceable to NIST)	1551589

Table 2: Equipment used

The following weather conditions were recorded at the start of the survey.

Time	Temperature	Wind Speed m/s	Wind Direction	Comments
12:00 12th March 2019	21 °C	2	West	Dry with light cloud and light breeze

Table 3: Recorded meteorological conditions

Results of the survey are shown in Figure 1 on the following page.

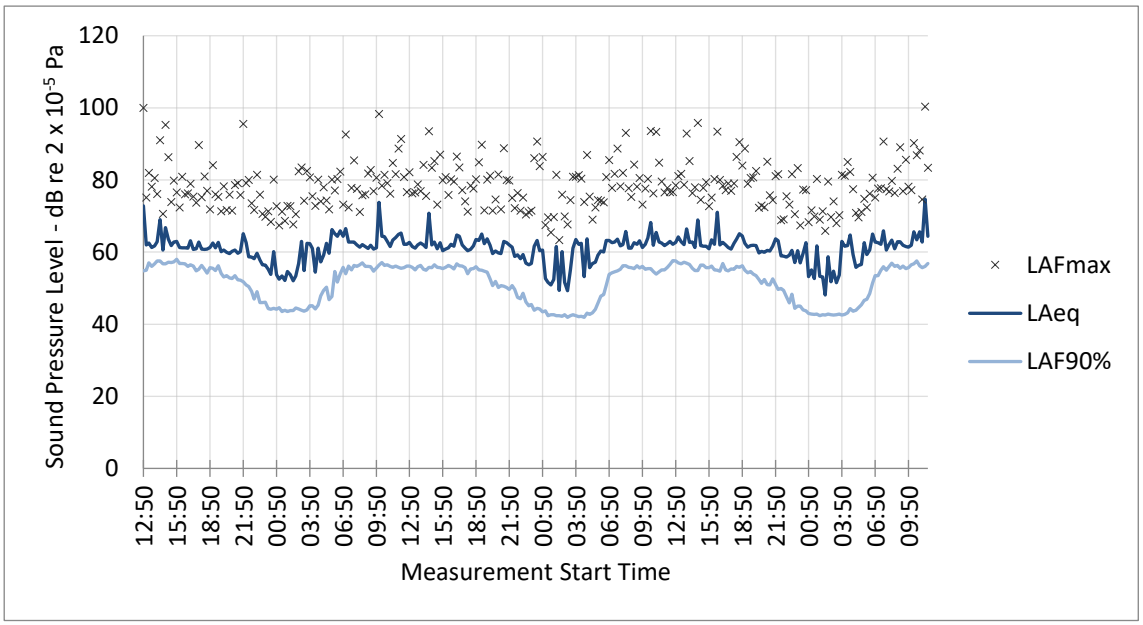


Figure 1: Unmanned sound level survey results

In accordance with BS 4142:2014, 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 in the area over a defined period. A statistical analysis of the measured background sound levels has been carried out, generally following suggested guidance contained in Section 8 of the Standard. Distribution of the measured LA90 sound levels during anticipated operating times of the new equipment are shown below.

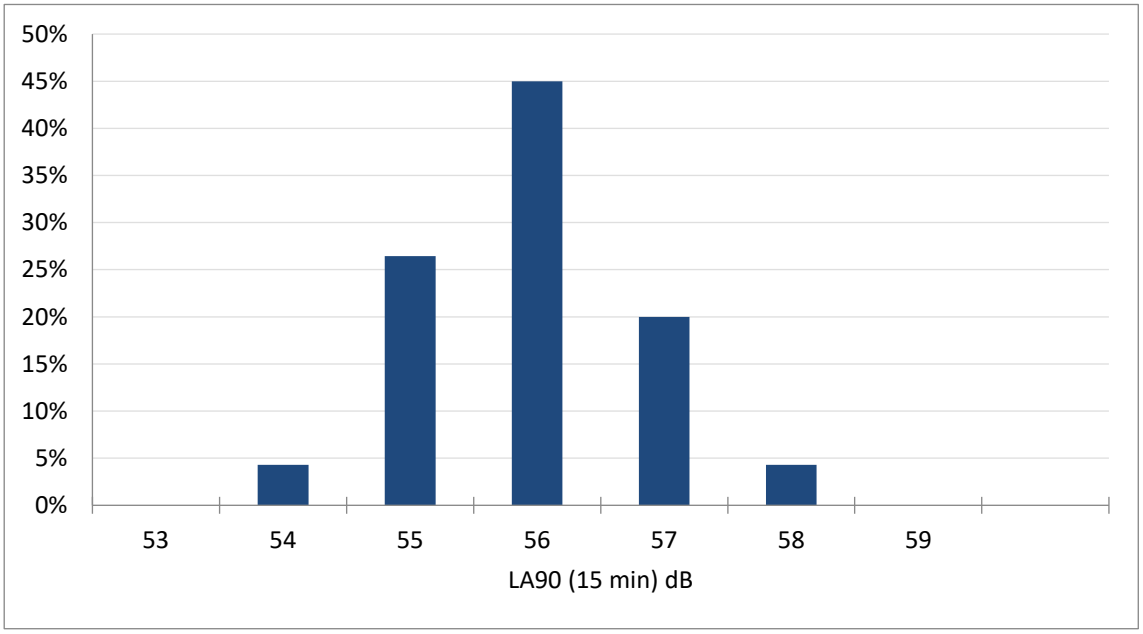


Figure 2: Statistical analysis of measured LA90 sound levels between 07:00 – 19:00

For this assessment, background sound levels are at a level of 55dBA or higher for 96% of the assessment, and so a level of LAF90 55dBA is considered appropriate for use within the assessment.

5. ACOUSTIC ASSESSMENT

The development includes the installation of an extract fan and two new condensing units. Confirmation of the equipment models used in the assessment is provided in Table 4 below.

Description	Equipment Model	Quantity
Condensing unit CU1	Mitsubishi PUZ-M140VKA	1
Condensing unit CU2	Mitsubishi PUZ-SM71VA	1
Extract fan EF1	Systemair RS 70-40 EC	1

Table 4: Proposed new mechanical equipment used in the assessment

Sound emissions from the mechanical equipment can be determined from manufacturer's published data.

A computer model has been used to calculate the noise contribution from the proposed plant to outside nearest noise-sensitive windows. Environmental corrections are calculated using the assessment method of ISO 9613-2:1996.

The cumulative calculated specific sound level from the plant to outside nearby residential windows with all plant operating is shown in Table 5. Summary print-outs from the calculation models are included in Appendix A.

Receptor Location	Calculated Equipment Sound Level
Residential windows at 35 South End Road	38dBA
Residential windows at 41 South End Road	43dBA

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

Assessment of the calculated specific sound levels in accordance with BS 4142:2014 is provided in Table 6 below

Description	External receiver 35 South End Road	External receiver 41 South End Road	Relevant Clause	Commentary
Calculated specific sound level to noise-sensitive	LAeq 38dB	LAeq 43dB	7.1 7.3.6	New plant operating. Refer calculation sheets in Appendix A
Background sound level	LA90 55dB	LA90 55dB	8.1.3 8.3	Measured background sound level during equipment operating period
Acoustic feature correction	+0dB	+0dB	9.2	The calculated specific sound level is more than 10dBA below the background sound level therefore no acoustic characteristics will be audible.
Rating level	LAeq 38dB	LAeq 43dB	9.2	
Excess of rating level over background sound	**-17dB**	**-12dB**	**11**	**Assessment indicates negligible likelihood of adverse impact**

Table 6: Calculated cumulative equipment sound levels at 1m outside noise-sensitive windows

Table 6 shows the cumulative rating level of the proposed new equipment will be at least 10dBA below the representative background LA90 sound level to outside the closest noise-sensitive properties.

BS 4142:2014 requires an assessment to consider the context of the development, rather than simply adhering to numerical values. Considering the calculated numerical value of the specific sound, allowing a reduction through partially open windows of 15dBA, as recommended in BS 8233:2014, sound levels inside the neighbouring dwellings due to the proposed new equipment will be approximately 28dBA. This is significantly below guideline daytime levels for bedrooms and livingrooms of LAeq 35dB, set out in BS 8233:2014 and is further confirmation that sound levels from the new mechanical equipment should not be detrimental to the amenity of any noise-sensitive receptors in the vicinity.

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.

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.

6.1 Duct Mounted Attenuators

The calculation model includes benefit of duct-mounted attenuators to the inlet and discharge sides of the extract fan. Schedule of minimum dynamic insertion loss performance for the attenuators along with description of typical silencer to comply with the specified performance is provided in Appendix B. Note that the dimensions and free-area shown are nominal and the successful supplier should confirm their own selections to meet the minimum specified insertion loss performance.

It is important airflow regenerated noise from the discharge terminal does not increase the cumulative sound level at nearby noise-sensitive properties. Suitable airflow velocity is dependent on the profile of the terminal used and should be verified with the manufacturer accordingly.

To control potential for structure-borne noise and vibration from the fans affecting adjoining commercial occupants, it is recommended that the fans are installed on vibration isolators providing minimum 25mm deflection at the working load, and that flexible connections are fitted between the fans and adjoining ductwork both sides. Most acoustic hardware suppliers would be able to select suitable isolators based on the fan weight and operating speed, including Allaway Acoustics Limited (www.allawayacoustics.co.uk).

6.2 Acoustic Panelled Enclosure

It is advised that the extract fan is housed within an acoustic panelled enclosure. This would typically be formed from 50mm thick acoustic panels incorporating 18swg steel outer casing, 50mm mineral wool insulation and perforated steel inner casing. The enclosure should be enlarged such that the flexible connections are housed internally within the enclosure. Apertures in the panels where the duct penetrates the enclosure should be sealed airtight with foam strips and a non-hardening flexible mastic.

Any transformation sections between the fan and attenuators should be formed with double-skinned casings, or alternatively the transformation section also be installed within the enclosure.

7. CONCLUSION

A planning application is to be submitted for the installation of new mechanical services equipment at 37-39 South End Road, London.

ACA Acoustics have undertaken sound level surveys in the vicinity and assessment of noise from the proposed equipment using manufacturer's published acoustic data.

Calculated specific sound level for the new plant is at least 10dBA below the lowest measured background sound level. This achieves criteria as specified by London Borough of Camden Council.

It is the author's opinion that the proposed new mechanical services equipment will not be detrimental to the amenity of nearby residential occupants.

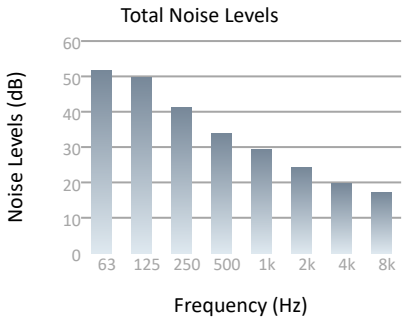
APPENDIX A

Acoustic Calculations

ACA acoustics

37-39 South End Road, London

Project Name	37-39 South End Road, London
Project Reference	190810
Reference	35 South end road
Description	
Noise Limit	45
dBA	38



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
CU1	1	51	48	38	31	28	20	15	6
EF1 Discharge	1	40	35	29	19	15	19	17	13
EF1 Inlet	1	41	36	23	6	-3	-1	-9	-14
CU2	1	40	44	38	29	23	19	11	15
EF1 Breakout	1	37	39	24	9	-3	-7	-15	-21

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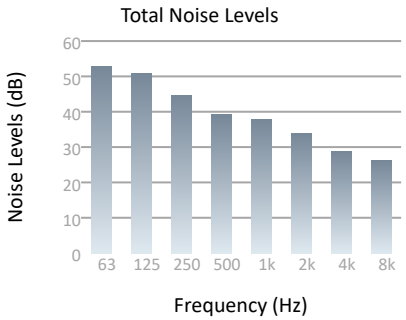
ACA acoustics

37-39 South End Road, London

Project Name	37-39 South End Road, London
Project Reference	190810
Reference	41 South end road
Description	Rear side windows
Noise Limit	45
dBA	43



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
EF1 Discharge	1	47	48	42	30	25	27	25	21
CU1	1	50	45	39	36	36	30	25	15
CU2	1	39	41	39	34	31	29	21	24
EF1 Inlet	1	44	39	26	9	0	2	-5	-10
EF1 Breakout	1	29	31	16	1	-11	-15	-23	-29

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Calculation Sheet

CU1 to 35 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Sound Power Levels	**74.0**	**73.0**	**66.0**	**63.0**	**63.0**	**57.0**	**52.0**	**43.0**
Noise Control Treatments								
Treatment - none								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Dc - Condenser Directivity								
	4.4	*2.4*	*-0.4*	*-3.7*	*-7.1*	*-9.0*	*-9.0*	*-9.0*
Adiv - Geometrical Divergance								
	-23.0	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.5*
Agr - Ground Attenuation								
	3.0	*-0.4*	*-0.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	-7.8	*-4.4*	*-4.5*	*-4.8*	*-4.8*	*-4.8*	*-4.8*	*-4.8*
External Receiver								
External Receiver - 35 South end road								
Sound Pressure, Lp:	**50.6**	**47.6**	**37.7**	**31.5**	**28.1**	**20.1**	**15.1**	**5.7**

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Calculation Sheet

EF1 Discharge to 41 South end road

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF1 Discharge									
Noise Levels		**84.0**	**87.0**	**84.0**	**79.0**	**77.0**	**74.0**	**69.0**	**62.0**
Silencer									
		-6.0	*-10.0*	*-14.0*	*-20.0*	*-22.0*	*-15.0*	*-12.0*	*-8.0*
End Reflection									
		-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity									
		-0.4	*-1.2*	*-2.5*	*-3.8*	*-5.2*	*-6.5*	*-6.5*	*-6.5*
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	10.0								
Source Height (m)	4.0								
Receiver Height (m)	4.0								
Q Factor - Plane									
		-25.0	*-25.0*	*-25.0*	*-25.0*	*-25.0*	*-25.1*	*-25.3*	*-26.2*
ISO 9613 Barrier Attenuation									
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver									
External Receiver - 41 South end road									
Sound Pressure, Lp:		**46.8**	**48.2**	**41.7**	**29.9**	**24.7**	**27.4**	**25.1**	**21.3**

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Calculation Sheet

CU1 to 41 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Sound Power Levels	**74.0**	**73.0**	**66.0**	**63.0**	**63.0**	**57.0**	**52.0**	**43.0**
Noise Control Treatments								
Treatment - none								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-32.6	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.4*	*-1.4*
Agr - Ground Attenuation								
	3.0	*-1.1*	*-0.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver								
External Receiver - 41 South end road								
Sound Pressure, Lp:	**50.4**	**45.3**	**38.5**	**36.4**	**36.4**	**30.3**	**25.0**	**15.0**

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Calculation Sheet

CU2 to 41 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU2								
Sound Power Levels	**63.0**	**69.0**	**66.0**	**61.0**	**58.0**	**56.0**	**48.0**	**52.0**
Noise Control Treatments								
Treatment - none								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-32.6	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*	*-32.6*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.4*	*-1.4*
Agr - Ground Attenuation								
	3.0	*-1.1*	*-0.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver								
External Receiver - 41 South end road								
Sound Pressure, Lp:	**39.4**	**41.3**	**38.5**	**34.4**	**31.4**	**29.3**	**21.0**	**24.0**

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Calculation Sheet

EF1 Discharge to 35 South end road

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF1 Discharge									
Noise Levels		**84.0**	**87.0**	**84.0**	**79.0**	**77.0**	**74.0**	**69.0**	**62.0**
Silencer									
		-6.0	*-10.0*	*-14.0*	*-20.0*	*-22.0*	*-15.0*	*-12.0*	*-8.0*
End Reflection									
		-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity									
		-7.2	*-14.7*	*-15.0*	*-15.0*	*-15.0*	*-15.0*	*-15.0*	*-15.0*
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	10.0								
Source Height (m)	4.0								
Receiver Height (m)	4.0								
Q Factor - Plane									
		-25.0	*-25.0*	*-25.0*	*-25.0*	*-25.0*	*-25.1*	*-25.3*	*-26.2*
ISO 9613 Barrier Attenuation									
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver									
External Receiver - 35 South end road									
Sound Pressure, Lp:		**39.9**	**34.7**	**29.1**	**18.7**	**14.9**	**18.9**	**16.7**	**12.8**

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Calculation Sheet

CU2 to 35 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU2								
Sound Power Levels	**63.0**	**69.0**	**66.0**	**61.0**	**58.0**	**56.0**	**48.0**	**52.0**
Noise Control Treatments								
Treatment - none								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Dc - Condenser Directivity								
	4.4	*2.4*	*-0.4*	*-3.7*	*-7.1*	*-9.0*	*-9.0*	*-9.0*
Adiv - Geometrical Divergance								
	-23.0	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.5*
Agr - Ground Attenuation								
	3.0	*-0.4*	*-0.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	-7.8	*-4.4*	*-4.5*	*-4.8*	*-4.8*	*-4.8*	*-4.8*	*-4.8*
External Receiver								
External Receiver - 35 South end road								
Sound Pressure, Lp:	**39.6**	**43.6**	**37.7**	**29.5**	**23.1**	**19.1**	**11.1**	**14.7**

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Calculation Sheet

EF1 Breakout to 35 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - EF1 Breakout								
Noise Levels	**67.0**	**77.0**	**69.0**	**59.0**	**55.0**	**52.0**	**46.0**	**39.0**
Noise Control Treatments								
Treatment - AE1								
	-13.0	*-17.0*	*-24.0*	*-30.0*	*-38.0*	*-39.0*	*-41.0*	*-39.0*
Dc - Directivity								
DI Index - Corner								
	9.0	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*	*9.0*
Adiv - Geometrical Divergance								
	-29.1	*-29.1*	*-29.1*	*-29.1*	*-29.1*	*-29.1*	*-29.1*	*-29.1*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*	*-0.9*
Agr - Ground Attenuation								
	3.0	*-0.8*	*-0.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver								
External Receiver - 35 South end road								
Sound Pressure, Lp:	**36.9**	**39.1**	**24.3**	**8.9**	**-3.1**	**-7.1**	**-15.3**	**-21.0**

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Calculation Sheet

EF1 Breakout to 41 South end road

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - EF1 Breakout								
Noise Levels	**67.0**	**77.0**	**69.0**	**59.0**	**55.0**	**52.0**	**46.0**	**39.0**
Noise Control Treatments								
Treatment - AE1								
	-13.0	*-17.0*	*-24.0*	*-30.0*	*-38.0*	*-39.0*	*-41.0*	*-39.0*
Dc - Directivity								
DI Index - Plane								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Adiv - Geometrical Divergance								
	-31.0	*-31.0*	*-31.0*	*-31.0*	*-31.0*	*-31.0*	*-31.0*	*-31.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*	*-1.2*
Agr - Ground Attenuation								
	3.0	*-1.0*	*-0.7*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Abar - Barrier Attenuation								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
External Receiver								
External Receiver - 41 South end road								
Sound Pressure, Lp:	**29.0**	**31.0**	**16.3**	**1.0**	**-11.0**	**-15.1**	**-23.3**	**-29.2**

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APPENDIX B

Noise Mitigation Treatments

Schedule of Noise Control Treatments

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
AE1	EF1	50mm Thick Panel	13.0	17.0	24.0	30.0	38.0	39.0	41.0	39.0

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Attenuator Schedule

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
ATT 1	EF1 Inlet	900L 45% Free Area c/w Melinex	6.0	10.0	14.0	20.0	22.0	15.0	12.0	8.0
ATT 2	EF1 Discharge	900L 45% Free Area c/w Melinex	6.0	10.0	14.0	20.0	22.0	15.0	12.0	8.0

Notes:
1. All dimensions in mm
2. Performance shown as static insertion loss. Dynamic insertion loss performance allowing for airflow generated noise is shown on the relevant calculation sheet.
3. Selections are nominal and the successful supplier should ensure their proposal achieves the minimum required static and dynamic insertion loss performance.

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