

Acoustic assessment of proposed new mechanical services equipment

107 Broad Street, Reading



Client: Chapman Ventilation Limited

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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 a new restaurant located at 107 Broad Street, Reading.
- 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 Reading Borough Council.
- 0.3. A survey has been carried out in the vicinity to establish existing background sound levels. The minimum background sound levels during the most sensitive time of the proposed restaurant opening hours were LA90 40dB at the monitoring position. It is assumed the operating hours will be to around 23:00 hours throughout the week. The lowest measured background sound levels overnight were LA90 37dB.
- 0.4. The most sensitive residential receptors have been assessed as the top floor windows of 35-39 Broad Street.
- 0.5. Calculations using manufacturer's sound level data for the new equipment, allowing for the proposed discharge attenuator, confirm that the specific level from the new equipment at the receptor is LAeq 26dB during the daytime and LAeq -5dB during the night-time. When assessed in accordance with BS 4142:2014+A1:2019 this equates to a rating level of LAr 26dB during the daytime and LAr -5dB during the night-time. The specific sound level and rating level are both more than 10dBA below the measured background sound level during operating times of the equipment.
- 0.6. Noise from the proposed new equipment will not be disturbing or detrimental to the amenity of any nearby residential occupants and complies with the requirements of Reading Borough Council.

1. INTRODUCTION

New mechanical services equipment associated with a new restaurant is to be installed at 107 Broad Street, Reading.

ACA Acoustics Limited has been commissioned by Chapman Ventilation Limited on behalf of the client to carry out an assessment of noise emissions from the proposed new kitchen extract ventilation system to ensure that the amenity of nearby noise-sensitive properties is not compromised.

The assessment is required to be submitted in support of a planning application for the new equipment. This report presents results of the assessment.

2. ACOUSTIC CRITERIA

Based on planning conditions imposed on a recent similar development within the Borough, it is anticipated that Reading Borough Council will require noise from the new equipment to be at least 10dBA below the lowest measured background sound level and the rating level, when assessed in accordance with BS 4142:2014+A1:2019, to not exceed the background sound level.

The criteria are applicable over a period of 60 minutes during the daytime (07:00 to 23:00 hours) and 15-minutes overnight (23:00 to 07:00 hours) and measured at a position 1m external to noise sensitive façades (typically outside residential windows).

At this level noise from the new equipment will be low, should not increase the prevailing background sound level and would not be detrimental to the amenity of nearby residents.

3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

The development site is at 107 Broad Street, Reading. A restaurant is being formed within the unit and a planning application is being prepared for new mechanical equipment associated with the restaurant.

The extract fans will be installed internally and ducted to high level at the rear flat roof. In addition the existing VRF condensing units are to be replaced with the proposed air conditioning units. The supply louvre will be located internally and ducted to the front façade.

It is anticipated that the restaurant will operate during daytime hours only, between 07:00 to 23:00 hours. The proposed equipment includes a catering condenser which will have the potential to operate over a 24 hour period.

Figure 1 below details the proposed plant location in relation to the nearest noise-sensitive receptors.

The most sensitive residential receptors have been assessed as the top floor windows at 35-39 Broad Street, to the front of the unit.



Figure 1: showing equipment location and closest noise-sensitive receptor (available at www.google.com/maps)

4. BACKGROUND SOUND LEVEL

To assess sound levels from the new mechanical equipment in accordance with Reading Borough Council's criteria it is necessary to establish existing background sound levels in the vicinity.

As the site was considered secure, the background sound level was measured via an unattended survey at the position indicated in Figure 1 above (MP1). The survey was conducted between the 15th – 16th December 2021.

The background sound level survey measurement position was selected at flat roof level. The nearby mechanical plant (including the VRF units proposed for replacement) were not operating, however other non-associated plant was subjectively audible above the acoustic climate.

During the survey, the acoustic environment in the vicinity of the receptor was influenced predominantly by local and distant road traffic and pedestrian activity.

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
Rion Class 1 sound level meter type NL-52 complete with weatherproof and lockable outdoor environmental kit	00564867
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003	83826

Table 1: Equipment used

Weather conditions during the survey were dry and calm and meteorological conditions are not considered to have adversely impacted the outcome of the assessment.

Results of the survey are shown in Figure 2 below:

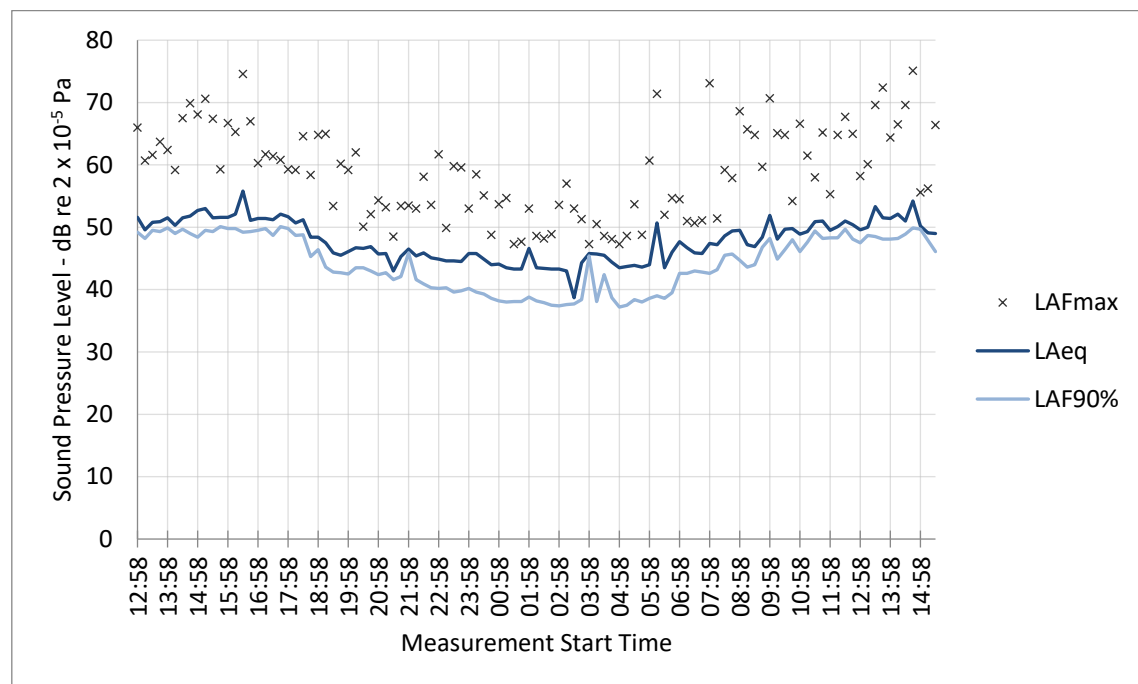


Figure 2: Sound level survey results at Position MP1

Summary of the measured sound levels are shown in Table 2 below.

Monitoring Position	Period	Minimum background sound level LA90	Reading Borough Council's Criteria LAeq
MP1	07:00 – 23:00	40dB	≤30dB
MP1	23:00 – 07:00	37dB	≤27dB

Table 2: Summary sound level survey results

The values recorded by ACA Acoustics Limited are used as basis for acoustic design such that sound emissions from any new equipment operating during daytime hours only are ≤30dBA outside the closest noise-sensitive windows. Equipment operating overnight are to be designed to not exceed LAeq 27dB overnight.

5. ACOUSTIC ASSESSMENT

The development includes the installation of a new ventilation and air conditioning system. Confirmation of the equipment model used in the assessment is provided in Table 3 below.

Description/Reference	Equipment Model	Quantity
Kitchen extract fan EF1	Flakt Woods Estoc Targe 80-560-3	1
Supply fan SF1	Systemair MUB062 630D4-IE3	1
Extract fans EF2 & EF3	Systemair K250 L	2
A/C Condensers	Toshiba RAV-GM1101ATP-E	3
Fridge Condenser	Foster FKEC20-6L	1
Freezer Condenser	Foster FKEC25-6L	1

Table 3: Proposed new mechanical equipment used in the assessment

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

Drawings for the proposed ductwork and equipment layout have not yet been finalised. As a result assumptions of nominal worst-case duct layouts have been assumed.

A computer model has been used to calculate the noise contribution from the proposed fan to outside nearest noise-sensitive windows. The model includes losses through the ductwork system set out in CIBSE Guide B4. Environmental corrections are based on the methodology in ISO 9613-2:1996.

The cumulative calculated specific sound level to outside the most sensitive receptors with all equipment operating is shown in Table 4 below. Summary printouts from the calculation models are included in Appendix A.

Receptor Location	Calculated Equipment Sound Level (All Plant)
R1	26dBA

Table 4: Calculated cumulative equipment sound levels at 1m outside noise-sensitive windows

The calculated specific sound level to outside the most sensitive receptors with just the catering condenser operating is shown in Table 5 below.

Receptor Location	Calculated Equipment Sound Level (Catering Condenser Only)
R1	-5dBA

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

Assessment of the calculated rating levels in accordance with BS 4142:2014+A1:2019 is provided in Table 6 below. The sound level of the catering condenser alone is substantially below the criteria and as such only the cumulative level of all the plant will be assessed.

Description	R1 Receptor (Daytime)	R1 Receptor (24-hours)	Relevant Clause	Commentary
Calculated specific sound level to	LAeq 26dB	LAeq -5dB	7.1 7.3.6	New equipment operating. Refer to calculation sheets in
Background sound level	LA90 40dB	LA90 37dB	8.1.3 8.3	Measured representative background sound level.
Acoustic feature correction	0dB	0dB	9.2	The equipment will be significantly below the residual sound level and subjectively inaudible to the nearest receptors.
Rating level	LAr 26dB	LAr -5dB	9.2	
Excess of rating level over background sound level	-14dB	-42dB	11	Assessment indicates negligible likelihood of adverse impact

Table 6: BS 4142:2014+A1:2019 Assessment

Table 6 shows the rating level of the proposed new equipment will be significantly below the representative background LA90 sound level to outside the closest noise-sensitive properties. This fully complies with the requirements of London Borough of Richmond upon Thames Council.

BS 4142:2014+A1:2019 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 -1dBA (14dBA – 15dBA). This is significantly below guideline levels for sleeping in bedrooms of LAeq 30dB, 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 CONTROL TREATMENTS

As discussed above, noise control treatments are incorporated in the design to ensure that noise emissions from the new plant are low and not disturbing to nearby residential occupants.

The calculation model includes benefit of duct-mounted attenuators to the supply fans. 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 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 recommended that the attenuators are installed adjoining the fan and internally within the building.

It is important airflow regenerated noise from the atmospheric 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.

7. CONCLUSION

A planning application is to be submitted for the installation of new mechanical services equipment for a proposed restaurant at 107 Broad Street, Reading.

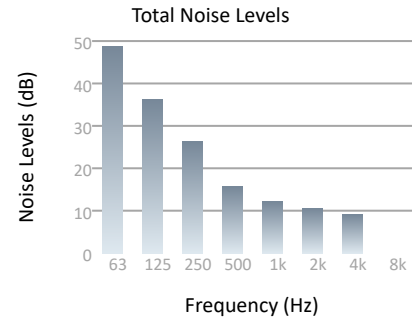
ACA Acoustics have undertaken an assessment of noise from the proposed equipment using manufacturer's published acoustic data. The calculated specific sound level for the new plant is at least 10dB below the lowest measured background sound level during operating times of the new equipment when assessed at 1m from the closest noise-sensitive windows of the receptor.

The author considers that the proposed new mechanical services equipment achieves Reading Borough Council's planning requirements and will not be detrimental to the amenity of nearby residential occupants.

Appendix A

Acoustic Calculations

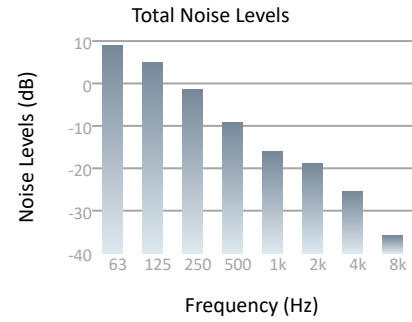
Project Name	Popeye Oxford
Project Reference	211209
Reference	35-39 Broad Street during operating hours
Description	
Noise Limit	40
dBA	26



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
CU1	1	17	13	5	-1	-7	-14	-20	-34
EF1 Discharge	1	18	21	17	9	1	-12	-19	-29
CU1	1	17	13	5	-1	-7	-14	-20	-34
CU1	1	17	13	5	-1	-7	-14	-20	-34
Chiller catering condenser	1	6	2	-4	-12	-19	-22	-28	-39
Freezer catering condenser	1	6	2	-4	-12	-19	-22	-28	-39
EF2	1	22	19	18	5	2	-2	-11	-
EF2	1	22	19	18	5	2	-2	-11	-
SF1 Inlet	1	49	36	24	13	11	10	9	-

Project Name	Popeye Oxford
Project Reference	211209
Reference	35-39 Broad Street 24 hours
Description	
Noise Limit	37
dBA	-5



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Chiller catering condenser	1	6	2	-4	-12	-19	-22	-28	-39
Freezer catering condenser	1	6	2	-4	-12	-19	-22	-28	-39

Calculation Sheet

CU1 to 35-39 Broad Street during operating hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Sound Power Levels	77.0	78.0	75.0	72.0	69.0	63.0	58.0	50.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street during operating hours								
Sound Pressure, Lp:	17.0	13.0	4.7	-1.2	-7.1	-13.9	-20.4	-33.9

Calculation Sheet

CU1 to 35-39 Broad Street during operating hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Sound Power Levels	77.0	78.0	75.0	72.0	69.0	63.0	58.0	50.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street during operating hours								
Sound Pressure, Lp:	17.0	13.0	4.7	-1.2	-7.1	-13.9	-20.4	-33.9

Calculation Sheet

CU1 to 35-39 Broad Street during operating hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Sound Power Levels	77.0	78.0	75.0	72.0	69.0	63.0	58.0	50.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street during operating hours								
Sound Pressure, Lp:	17.0	13.0	4.7	-1.2	-7.1	-13.9	-20.4	-33.9

Calculation Sheet

Chiller catering condenser to 35-39 Broad Street during operating hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Chiller catering condenser								
Sound Power Levels	66.0	67.0	66.0	61.0	57.0	55.0	50.0	45.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street during operating hours								
Sound Pressure, Lp:	6.0	2.0	-4.3	-12.2	-19.1	-21.9	-28.4	-38.9

Calculation Sheet

Freezer catering condenser to 35-39 Broad Street during operating hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Freezer catering condenser								
Sound Power Levels	66.0	67.0	66.0	61.0	57.0	55.0	50.0	45.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street during operating hours								
Sound Pressure, Lp:	6.0	2.0	-4.3	-12.2	-19.1	-21.9	-28.4	-38.9

Calculation Sheet

Chiller catering condenser to 35-39 Broad Street 24 hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Chiller catering condenser								
Sound Power Levels	66.0	67.0	66.0	61.0	57.0	55.0	50.0	45.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street								
24 hours								
Sound Pressure, Lp:	6.0	2.0	-4.3	-12.2	-19.1	-21.9	-28.4	-38.9

Calculation Sheet

Freezer catering condenser to 35-39 Broad Street 24 hours

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Freezer catering condenser								
Sound Power Levels	66.0	67.0	66.0	61.0	57.0	55.0	50.0	45.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-3.4	-6.2	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Adiv - Geometrical Divergence								
	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3	-47.3
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.6	-2.1	-7.6
Agr - Ground Attenuation								
	3.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	-12.3	-11.1	-14.0	-16.8	-19.6	-20.0	-20.0	-20.0
External Receiver								
External Receiver - 35-39 Broad Street								
24 hours								
Sound Pressure, Lp:	6.0	2.0	-4.3	-12.2	-19.1	-21.9	-28.4	-38.9

Calculation Sheet

EF1 Discharge to 35-39 Broad Street during operating hours

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF1 Discharge									
Sound Power Levels		85.0	87.0	86.0	83.0	80.0	73.0	67.0	63.0
Silencer									
Silencer Type - None									
Silencer Reference - none									
Width (m)	0.5								
Height (m)	0.5								
% Free Area (%)	100.0								
Face Velocity (m/s)	15.5								
		0.1	0.1	0.0	0.1	0.1	0.5	1.3	0.6
Bend Loss									
		-0.9	-2.0	-3.0	-3.0	-3.0	-2.9	-2.9	-2.8
Rect Duct Losses									
		-1.8	-1.2	-0.9	-0.3	-0.3	-0.3	-0.3	-0.3
End Reflection									
		-8.1	-4.0	-1.5	-0.5	-0.1	0.0	0.0	0.0
External Grille Directivity									
		-1.0	-2.3	-4.7	-7.8	-11.1	-14.5	-15.0	-15.0
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	65.0								
Source Height (m)	12.0								
Receiver Height (m)	10.5								
Q Factor - Freefield									
		-44.3	-44.3	-44.3	-44.4	-44.5	-44.9	-46.4	-51.9
ISO 9613 Barrier Attenuation									
		-11.0	-12.8	-15.1	-17.7	-20.5	-23.0	-23.0	-23.0
External Receiver									
External Receiver - 35-39 Broad Street during operating hours									
Sound Pressure, Lp:		18.0	20.5	16.5	9.5	0.6	-12.2	-19.2	-29.4

Calculation Sheet

SF1 Inlet to 35-39 Broad Street during operating hours

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - SF1 Inlet									
Sound Power Levels		99.0	91.0	88.0	84.0	80.0	76.0	71.0	-
Silencer									
Silencer Type - Rectangular									
Silencer Reference - ATT01									
Width (m)	1.5								
Height (m)	0.6								
% Free Area (%)	40.0								
Face Velocity (m/s)	6.4								
		-11.0	-19.0	-29.9	-38.6	-37.0	-33.8	-29.1	-
Bend Loss									
		-2.0	-3.0	-3.0	-2.9	-2.9	-2.9	-3.0	-
Rect Duct Losses									
		-1.8	-1.2	-0.9	-0.3	-0.3	-0.3	-0.3	-
End Reflection									
		-6.0	-2.6	-0.9	-0.3	-0.1	0.0	0.0	-
External Grille Directivity									
		0.8	0.9	1.0	1.2	1.4	1.6	1.6	-
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	25.0								
Source Height (m)	3.0								
Receiver Height (m)	10.5								
Q Factor - Junction									
		-30.3	-30.3	-30.4	-30.4	-30.4	-30.6	-31.2	-
ISO 9613 Barrier Attenuation									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
External Receiver									
External Receiver - 35-39 Broad Street during operating hours									
Sound Pressure, Lp:		48.7	35.8	24.0	12.7	10.7	9.9	9.0	-

Calculation Sheet

EF2 to 35-39 Broad Street during operating hours

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF2									
Sound Power Levels		84.0	80.0	80.0	69.0	68.0	65.0	57.0	-
Silencer									
Silencer Type - None									
Silencer Reference - none									
Width (m)	0.6								
Height (m)	0.6								
% Free Area (%)	100.0								
Face Velocity (m/s)	6.4								
		0.0	0.0	0.0	0.0	0.0	0.0	0.1	-
Bend Loss									
		-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-
Rect Duct Losses									
		-1.8	-1.2	-0.9	-0.3	-0.3	-0.3	-0.3	-
End Reflection									
		-6.0	-2.6	-0.9	-0.3	-0.1	0.0	0.0	-
External Grille Directivity									
		0.8	0.9	1.0	1.2	1.4	1.6	1.6	-
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	65.0								
Source Height (m)	9.0								
Receiver Height (m)	10.5								
Q Factor - Plane									
		-41.3	-41.3	-41.3	-41.4	-41.5	-41.9	-43.4	-
ISO 9613 Barrier Attenuation									
		-12.3	-14.5	-17.0	-19.8	-22.6	-23.0	-23.0	-
External Receiver									
External Receiver - 35-39 Broad Street during operating hours									
Sound Pressure, Lp:		22.4	19.4	17.9	5.5	1.9	-1.6	-11.0	-

Calculation Sheet

EF2 to 35-39 Broad Street during operating hours

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF2									
Sound Power Levels		84.0	80.0	80.0	69.0	68.0	65.0	57.0	-
Silencer									
Silencer Type - None									
Silencer Reference - none									
Width (m)	0.6								
Height (m)	0.6								
% Free Area (%)	100.0								
Face Velocity (m/s)	6.4								
		0.0	0.0	0.0	0.0	0.0	0.0	0.1	-
Bend Loss									
		-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-
Rect Duct Losses									
		-1.8	-1.2	-0.9	-0.3	-0.3	-0.3	-0.3	-
End Reflection									
		-6.0	-2.6	-0.9	-0.3	-0.1	0.0	0.0	-
External Grille Directivity									
		0.8	0.9	1.0	1.2	1.4	1.6	1.6	-
ISO 9613 Environmental Corrections									
Horiz. Distance (m)	65.0								
Source Height (m)	9.0								
Receiver Height (m)	10.5								
Q Factor - Plane									
		-41.3	-41.3	-41.3	-41.4	-41.5	-41.9	-43.4	-
ISO 9613 Barrier Attenuation									
		-12.3	-14.5	-17.0	-19.8	-22.6	-23.0	-23.0	-
External Receiver									
External Receiver - 35-39 Broad Street during operating hours									
Sound Pressure, Lp:		22.4	19.4	17.9	5.5	1.9	-1.6	-11.0	-

Appendix B

Noise Control Treatments

Attenuator Schedule

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
ATT01		1800L 40% Free Area	11	19	30	44	55	46	36	21

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.