Acoustic assessment of proposed new mechanical services equipment

Ivy Asia, 51 Ship Street, Brighton BN1 1AF

Client: Ivy Restaurants

Report Reference: 210614-R003

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0. SUMMARY

0.1. ACA Acoustics Limited has been commissioned by Ivy Restaurants to assess the acoustic impact of proposed new mechanical services equipment to be installed at a new restaurant located at 51 Ship Street, Brighton.

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 the Local Authority.

0.3. A survey has been carried out in the vicinity to establish existing background sound levels. The background sound levels during the proposed restaurant opening hours are LA90 40dB at the monitoring position. It is understood the operating hours will be to around midnight throughout the week.

0.4. The most sensitive receptors have been assessed as the windows of the flats above the adjacent retail unit, overlooking the roof plant area. There is some screening benefit from the low parapet wall, however the benefit provided will be relatively limited due to the low height, and the overlooking position of the nearest receptor windows. Therefore, mitigation measures have been recommended in this report.

0.5. Calculations using manufacturer's sound level data for the new equipment, allowing for the recommendations as set out in this report, confirm that the rating level from the new equipment at the receptor is LAr 28dB.

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 relevant standards and requirements of the local authority.

1. INTRODUCTION

New mechanical services equipment associated with a new restaurant is to be installed at 51 Ship Street, Brighton.

ACA Acoustics Limited has been commissioned by Ivy Restaurants to carry out an assessment of noise emissions from the proposed new ventilation and air conditioning systems and, where necessary, make recommendation to reduce sound levels 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 development.

This report presents results of the assessment.

2. ACOUSTIC CRITERIA

Based on previous similar projects on the public planning portal, the author understands that Brighton & Hove City Council will require the rating level from new mechanical equipment to be at least 5dBA below the prevailing background sound level to 1m outside the closest noise-sensitive properties, when assessed in accordance with British Standard BS 4142:2014. The following condition has been stipulated on previous similar developments:

> *"The plant will need to be assessed in line with British Standard 4142 (BS 4142:2014) to show that the combined impact will be 5dB below background at one meter from the nearest noise sensitive premises, during the times it will be operational."*

BS 4142:2014 has been superseded, incorporating the 2019 amendments and it is anticipated that this latest edition of the Standard would be applicable.

The assessment method of BS 4142:2014+A1:2019 corrects the specific noise from the source under investigation to account for operating time periods and any tonal or intermittent features of the noise source to obtain a rating level. This rating level is compared against the prevailing background sound level outside the noise-sensitive property. Section 11 of the Standard provides a commentary of the assessment result and states that:

- *Typically, the greater this difference [between the rating level and background sound level], the greater the magnitude of the impact;*
- *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;*

- *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context;*
- *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.*

BS 4142:2014+A1:2019 does not advise of a specific acceptable criterion and instead advises that the context of the assessment should be considered alongside the numerical values. By designing noise emissions from the plant to a level at least 5dBA below the background sound level, as required by Brighton & Hove City Council, will ensure that noise from the plant is not disturbing or detrimental to the amenity of nearby occupants.

3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

Figure 1 below details the proposed mechanical system layout in relation to the nearest noise-sensitive receptor. Most of the plant will be installed internally within the basement. There will be an air handling unit providing ventilation to this basement and will be ducted to street level where there is a small courtyard area/alleyway. There are only offices and commercial premises in the vicinity of this courtyard area which are not normally considered noise-sensitive and as such are not assessed in this report.

The most noise-sensitive receptor (NSR) has been assessed as the windows of the flats directly above an adjacent unit, overlooking the roof area. There will be a kitchen extract fan discharging at this roof level, along with 3 existing condenser units which are understood to already have planning permission and as such are not included in this assessment.

The proposed operating times of the plant is understood to be during restaurant opening hours only. The client has advised this is likely to be between 09:00 - 00:00 hours daily.

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

4. BACKGROUND SOUND LEVEL

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

The background sound level was measured via an unattended survey at the position indicated in the figure above (MP1). The survey was conducted between Wednesday 23rd June and Thursday 24th June 2021.

During the survey, the acoustic environment in the vicinity of the receptor was influenced predominantly by local and distant road traffic, seagull calls, commercial & pedestrian activity, and the occasional overhead aircraft.

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
Svantek Class 1 sound level meter type SVAN971, complete with MOLES weatherproof and lockable outdoor environmental kit	28263
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003	83826

Table 1: Equipment used

Weather conditions at the time of setting up the survey consisted of a temperature of 18°C, partly cloudy with a light south westerly breeze and dry ground conditions. Weather conditions have been reviewed at www.worldweatheronline.com, using the closest available commercial weather station. The extended nature of the survey ensures that a reasonable sample of results have been recorded with appropriate weather conditions 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:

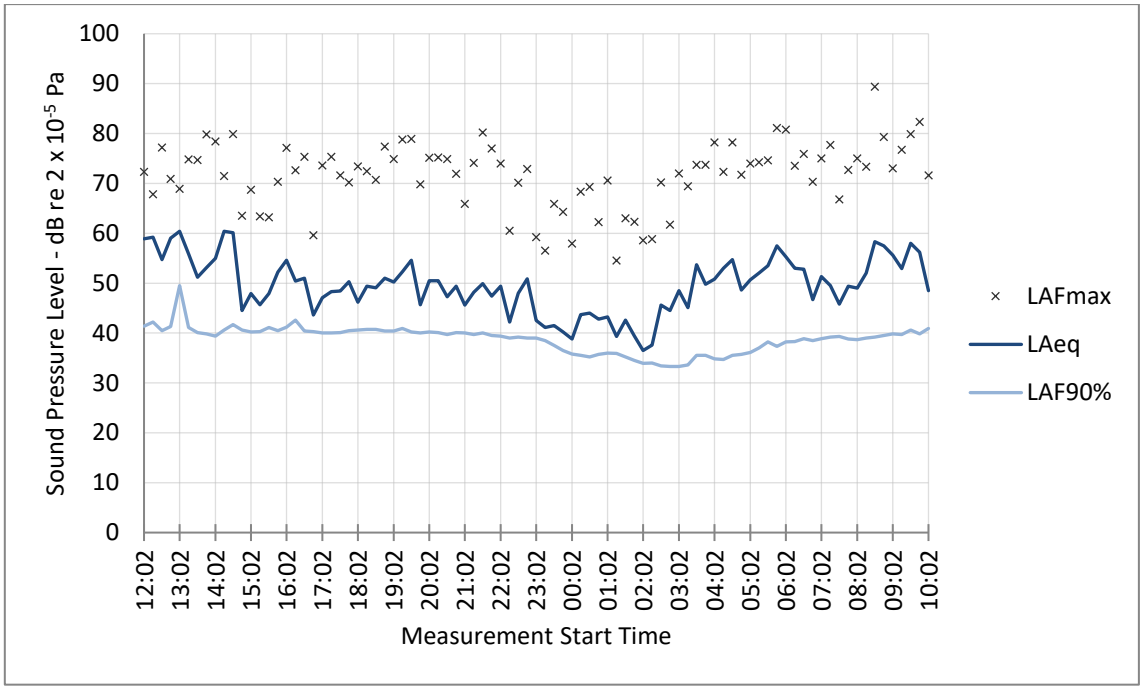


Figure 2: Sound level survey results at Position MP1

In accordance with BS 4142:2014+A1:2019 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. The highest modal value is 40dBA and will be used to derive the criteria. Distribution of the measured LA90 sound levels is shown in Figure 3 below.

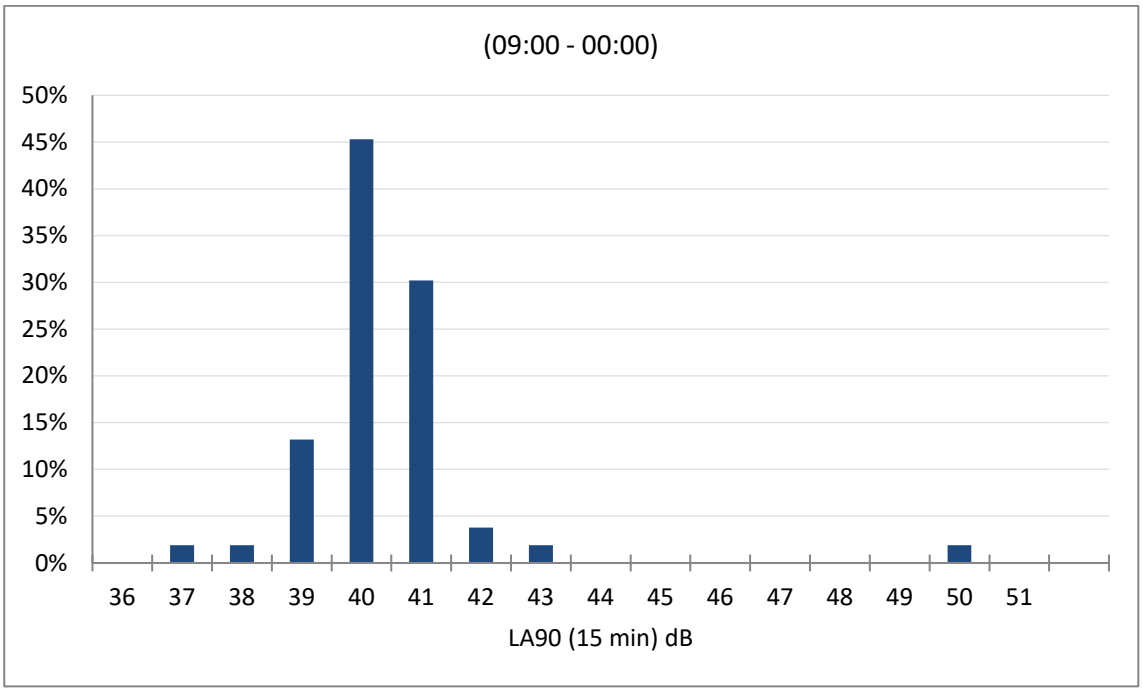


Figure 3: Statistical analysis of measured LA90 sound levels – 07:00 – 23:00

The pertinent results of the survey are summarised in Table 2 below.

Monitoring Position	Period	Representative Background Sound Level LA90	Criteria LAr
MP1	09:00 – 00:00	40dB	35dB

Table 2: Summary sound level survey results

5. ACOUSTIC ASSESSMENT

Confirmation of the equipment models used in the assessment is provided in Table 3 below. The assessment only includes externally located or terminating plant. As discussed in Section 3, the coldroom condensers have also been excluded.

Description/Reference	Equipment Model	Location	Quantity
EF1 – Kitchen Extract Fan	FlaktWoods CVEQ 036	Roof	1
AHU 1	Flaktwoods ACON-02842828	Basement – ducted to street level alleyway	1

Description/Reference	Equipment Model	Location	Quantity
EF2 – BOH extract fan	SystemAir Prio 315	Ground Floor - ducted to street level alleyway	3
Heat Exchangers	Daikin RKXYQ8T	Basement – ducted to street level alleyway	5

Table 3: Proposed new mechanical equipment used in the assessment

It is the authors understanding that all extract fans and other equipment will be located internally, as per the M&E drawings issued by the client.

Sound emissions from the mechanical equipment can be determined from manufacturer's published data. Where the condensers are to be ducted to outside, manufacturers data is provided as sound power levels for the unit as a whole, and not separated out between levels to the discharge and inlet. In this instance, ACA Acoustics have assumed that sound power levels to the discharge of the condensing units are equal to those of the manufacturers data, and levels to the inlet will be nominally 3dB lower.

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

The assessment assumes that all mitigation measures are implemented as detailed in Section 6 of this report.

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
R1	28dBA

Table 4: 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 5 below.

Description	R1 Receptor	Relevant Clause	Commentary
Calculated specific sound level to receptor	LAeq 28dB	7.1 7.3.6	New equipment operating. Refer to calculation sheets in Appendix A.
Background sound level	LA90 40dB	8.1.3 8.3	Measured representative background sound level.
Acoustic feature correction	0dB	9.2	The mitigation measures will reduce the level at the receptor to a point where any distinguishing characteristics will be subjectively inaudible.
Rating level	LAr 28dB	9.2	
Excess of rating level over background sound level	-12dB	11	Assessment indicates negligible likelihood of adverse impact

Table 5: BS 4142:2014+A1:2019 Assessment

Table 5 shows the rating level of the proposed new equipment will be at least 5dBA below the representative background LA90 sound level to outside the closest noise-sensitive properties. This fully complies with the requirements of Brighton & Hove City 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 13dBA (28dBA – 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. RECOMMENDATIONS

As discussed above, it is recommended that 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 kitchen extract fan EF1.

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 assumed the attenuators will be installed immediately adjacent to the fans. Where the attenuators are removed from the fan then intermediate ductwork and transformation sections may require double-skinned casings to control noise breakout.

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.

7. CONCLUSION

New mechanical equipment is to be installed for a proposed restaurant at 51 Ship Street, Brighton.

ACA Acoustics have undertaken an assessment of noise from the proposed equipment using manufacturer's published acoustic data. The calculated rating level for the new plant is around 12dBA below the 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 assessment includes benefit of noise control treatments shown in Appendix B. No additional mitigation measures are required.

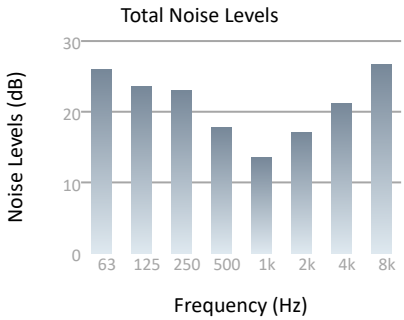
The author considers that the proposed new mechanical equipment achieves Brighton & Hove City Councils planning requirements and will not be detrimental to the amenity of nearby residential occupants.

Appendix A

Acoustic Calculations

Ivy Asia, Brighton

Project Name	Ivy Asia, Brighton
Project Reference	210614
Reference	R1
Description	Flats above adjacent unit
Noise Limit	35
dBA	28



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
EF1 Discharge Atmos	1	22	19	21	15	13	17	21	27
EF1 Duct Breakout	1	15	7	7	-1	-8	-9	-10	-7
AHU 1 Inlet	1	18	17	17	12	1	-1	-7	-1
EF2	1	-22	-15	-25	-21	-25	-31	-38	-45
5 x Heat Exchangers	1	18	16	9	8	0	-7	-12	-22
5 x Heat Exchangers	1	18	16	9	8	0	-7	-12	-22

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Calculation Sheet

EF1 Discharge Atmos to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - EF1 Discharge Atmos								
Sound Power Levels	**76.0**	**76.0**	**87.0**	**83.0**	**84.0**	**82.0**	**80.0**	**77.0**
Silencer								
	-11.2	*-16.4*	*-25.5*	*-28.7*	*-31.3*	*-24.8*	*-19.6*	*-13.0*
Bend Loss								
	-1.0	*-1.9*	*-3.0*	*-2.9*	*-2.9*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses								
	-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
End Reflection								
	-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity								
	0.1	*-0.3*	*-0.9*	*-1.6*	*-2.2*	*-2.8*	*-2.8*	*-2.8*
ISO 9613 Environmental Corrections								
	-27.3	*-27.3*	*-27.3*	*-27.3*	*-27.3*	*-27.4*	*-27.6*	*-28.4*
ISO 9613 Barrier Attenuation								
	-7.7	*-7.7*	*-7.7*	*-7.6*	*-7.3*	*-6.8*	*-5.7*	*-3.0*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**21.9**	**19.1**	**21.2**	**14.5**	**12.8**	**17.0**	**21.2**	**26.7**

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Calculation Sheet

EF1 Duct Breakout to R1

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF1 Duct Breakout									
Sound Power Levels		**76.0**	**76.0**	**87.0**	**83.0**	**84.0**	**82.0**	**80.0**	**77.0**
Silencer									
Silencer Type - Rectangular									
Silencer Reference - ATT1-EF									
Width (m)	0.9								
Height (m)	0.9								
% Free Area (%)	40.0								
Face Velocity (m/s)	9.3								
		-11.2	*-16.4*	*-25.5*	*-28.7*	*-31.3*	*-24.8*	*-19.6*	*-13.0*
Bend Loss									
		-1.0	*-1.9*	*-3.0*	*-2.9*	*-2.9*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses									
		-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
Duct Break-Out									
		-12.8	*-15.8*	*-18.8*	*-21.8*	*-26.8*	*-32.8*	*-36.8*	*-36.8*
ISO 9613 Calculation									
Horiz. Distance (m)	6.0								
Source Height (m)	1.0								
Receiver Height (m)	8.0								
Q Factor - Freefield									
		-27.3	*-27.3*	*-27.3*	*-27.3*	*-27.3*	*-27.4*	*-27.6*	*-28.4*
ISO 9613 Barrier Attenuation									
		-7.2	*-6.6*	*-4.9*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
External Receiver									
External Receiver - R1									
Sound Pressure, Lp:		**15.3**	**7.2**	**6.9**	**-0.9**	**-7.5**	**-9.2**	**-10.2**	**-7.4**

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Calculation Sheet

Catering Condenser 2 to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Catering Condenser 2								
-	**70.0**	**72.0**	**70.0**	**65.0**	**61.0**	**59.0**	**54.0**	**51.0**
Noise Control Treatments								
	-5.0	*-6.0*	*-8.0*	*-11.0*	*-18.0*	*-25.0*	*-20.0*	*-16.0*
Dc - Condenser Directivity								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Adiv - Geometrical Divergance								
	-29.7	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*	*-1.0*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.9	*-7.9*	*-8.1*	*-8.4*	*-8.9*	*-9.8*	*-11.2*	*-13.1*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**33.5**	**34.4**	**30.2**	**21.9**	**10.4**	**0.4**	**-1.2**	**-2.8**

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Calculation Sheet

Catering Condenser 2 to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Catering Condenser 2								
-	**70.0**	**72.0**	**70.0**	**65.0**	**61.0**	**59.0**	**54.0**	**51.0**
Noise Control Treatments								
	-5.0	*-6.0*	*-8.0*	*-11.0*	*-18.0*	*-25.0*	*-20.0*	*-16.0*
Dc - Condenser Directivity								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Adiv - Geometrical Divergance								
	-29.7	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*	*-1.0*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.9	*-7.9*	*-8.1*	*-8.4*	*-8.9*	*-9.8*	*-11.2*	*-13.1*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**33.5**	**34.4**	**30.2**	**21.9**	**10.4**	**0.4**	**-1.2**	**-2.8**

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Calculation Sheet

Catering Condenser 2 to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - Catering Condenser 2								
-	**70.0**	**72.0**	**70.0**	**65.0**	**61.0**	**59.0**	**54.0**	**51.0**
Noise Control Treatments								
	-5.0	*-6.0*	*-8.0*	*-11.0*	*-18.0*	*-25.0*	*-20.0*	*-16.0*
Dc - Condenser Directivity								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Adiv - Geometrical Divergance								
	-29.7	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*	*-29.7*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*	*-1.0*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.9	*-7.9*	*-8.1*	*-8.4*	*-8.9*	*-9.8*	*-11.2*	*-13.1*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**33.5**	**34.4**	**30.2**	**21.9**	**10.4**	**0.4**	**-1.2**	**-2.8**

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Calculation Sheet

AHU 1 Inlet to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - AHU 1 Inlet								
Sound Power Levels	**82.0**	**83.0**	**86.0**	**84.0**	**76.0**	**76.0**	**71.0**	**79.0**
Silencer								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Bend Loss								
	-1.0	*-2.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses								
	-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
End Reflection								
	-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity								
	-1.5	*-3.4*	*-6.1*	*-9.4*	*-12.7*	*-15.0*	*-15.0*	*-15.0*
ISO 9613 Environmental Corrections								
	-35.8	*-35.8*	*-35.8*	*-35.8*	*-35.8*	*-36.0*	*-36.6*	*-38.6*
ISO 9613 Barrier Attenuation								
	-18.4	*-21.2*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**18.3**	**17.4**	**16.6**	**12.4**	**1.2**	**-1.2**	**-6.7**	**-0.8**

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Ivy Asia, Brighton

Calculation Sheet

EF2 to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - EF2								
Noise Levels	**41.0**	**51.0**	**44.0**	**51.0**	**50.0**	**46.0**	**40.0**	**35.0**
Silencer								
	0.2	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*
Bend Loss								
	-1.0	*-2.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses								
	-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
End Reflection								
	-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity								
	-1.5	*-3.4*	*-6.1*	*-9.4*	*-12.7*	*-15.0*	*-15.0*	*-15.0*
ISO 9613 Environmental Corrections								
	-35.8	*-35.8*	*-35.8*	*-35.8*	*-35.8*	*-36.0*	*-36.6*	*-38.6*
ISO 9613 Barrier Attenuation								
	-18.4	*-21.2*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**-22.5**	**-14.6**	**-25.3**	**-20.6**	**-24.8**	**-31.2**	**-37.7**	**-44.8**

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Calculation Sheet

5 x Heat Exchangers to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - 5 x Heat Exchangers								
Sound Power Levels	**82.0**	**82.0**	**78.0**	**80.0**	**75.0**	**70.0**	**66.0**	**58.0**
Silencer								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Bend Loss								
	-1.0	*-2.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses								
	-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
End Reflection								
	-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity								
	-1.5	*-3.4*	*-6.1*	*-9.4*	*-12.7*	*-15.0*	*-15.0*	*-15.0*
ISO 9613 Environmental Corrections								
	-35.8	*-35.8*	*-35.8*	*-35.8*	*-35.8*	*-36.0*	*-36.6*	*-38.6*
ISO 9613 Barrier Attenuation								
	-18.4	*-21.2*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**18.3**	**16.4**	**8.6**	**8.4**	**0.1**	**-7.2**	**-11.8**	**-21.8**

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Calculation Sheet

5 x Heat Exchangers to R1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - 5 x Heat Exchangers								
Sound Power Levels	**82.0**	**82.0**	**78.0**	**80.0**	**75.0**	**70.0**	**66.0**	**58.0**
Silencer								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Bend Loss								
	-1.0	*-2.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*	*-3.0*
Rect Duct Losses								
	-1.2	*-0.8*	*-0.6*	*-0.2*	*-0.2*	*-0.2*	*-0.2*	*-0.2*
End Reflection								
	-5.9	*-2.5*	*-0.8*	*-0.2*	*-0.1*	*0.0*	*0.0*	*0.0*
External Grille Directivity								
	-1.5	*-3.4*	*-6.1*	*-9.4*	*-12.7*	*-15.0*	*-15.0*	*-15.0*
ISO 9613 Environmental Corrections								
	-35.8	*-35.8*	*-35.8*	*-35.8*	*-35.8*	*-36.0*	*-36.6*	*-38.6*
ISO 9613 Barrier Attenuation								
	-18.4	*-21.2*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - R1								
Sound Pressure, Lp:	**18.3**	**16.4**	**8.6**	**8.4**	**0.1**	**-7.2**	**-11.8**	**-21.8**

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Appendix B

Noise Control Treatments

Schedule of Noise Control Treatments

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
ATT1-EF1	As close to extract fan outlet	1800mm L x 900mm W x 900mm H. 40% Free Area c/w/Melinex.	12	20	26	35	40	26	20	13

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