

Acoustic Assessment of Proposed New Mechanical Services Equipment

2 Spinningfields, Manchester RG1 2BH



Client: Caprice Restaurants

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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 2 Spinningfields, Manchester.
- 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 Local Authority's requirements for such a development.
- 0.3. A survey has been carried out in the vicinity to establish existing background sound levels on two separate periods, as a manned survey at ground floor level until 23:00 hours, and as an unmanned survey over a 24-hour period at roof level. The background sound levels during the most sensitive time of the proposed operating hours are LA90 53dB at both positions.
- 0.4. The most significant residential noise-sensitive receptor (NSR) has been assessed as the top-floor windows of the Yotel Manchester Deansgate hotel. This is the closest residential location, albeit significantly removed at over 100 meters from the proposed plant area.
- 0.5. Calculations using manufacturers' 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 when assessed in accordance with the requirements of BS 4142:2014+A1:2019 at the receptor is significantly less than the criterion of LAr 48dB at the receptor. Overnight when the proposed catering condensers have the potential to remain operating, the calculated rating level is even lower.
- 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 planning requirements of Manchester City Council.

1. INTRODUCTION

New mechanical equipment is to be installed at 2 Spinningfields, Manchester.

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 assessment.

2. ACOUSTIC CRITERIA

Based on planning conditions imposed on a recent similar development within the Borough, it is anticipated that Manchester City Council will require the rating sound level from the new equipment, when assessed in accordance with BS 4142:2014+A1:2019, to not exceed a level 5dB below the background sound level.

The scope of BS 4142:2014+A1:2019 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+A1:2019 is commonly used to assess the potential for loss of amenity due to noise from industrial and commercial processes and is considered appropriate for this application.

The assessment method of BS 4142:2014+A1:2019 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+A1:2019 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.*

BS 4142:2014+A1:2019 requires that assessment of noise be conducted considering the context of the development.

3. REVIEW OF SITE LOCATION

New mechanical equipment, comprising of supply and extract fans, and air conditioning and catering condensers, is being installed at roof level and 1st floor level of the premises. The nearest residential windows have been identified as top floor windows of the Yotel Deansgate Manchester hotel, which, although significantly removed from the plant position at around 100 meters, will have line of sight to some items of plant.

Figure 1 below shows the location of the proposed equipment within the unit.

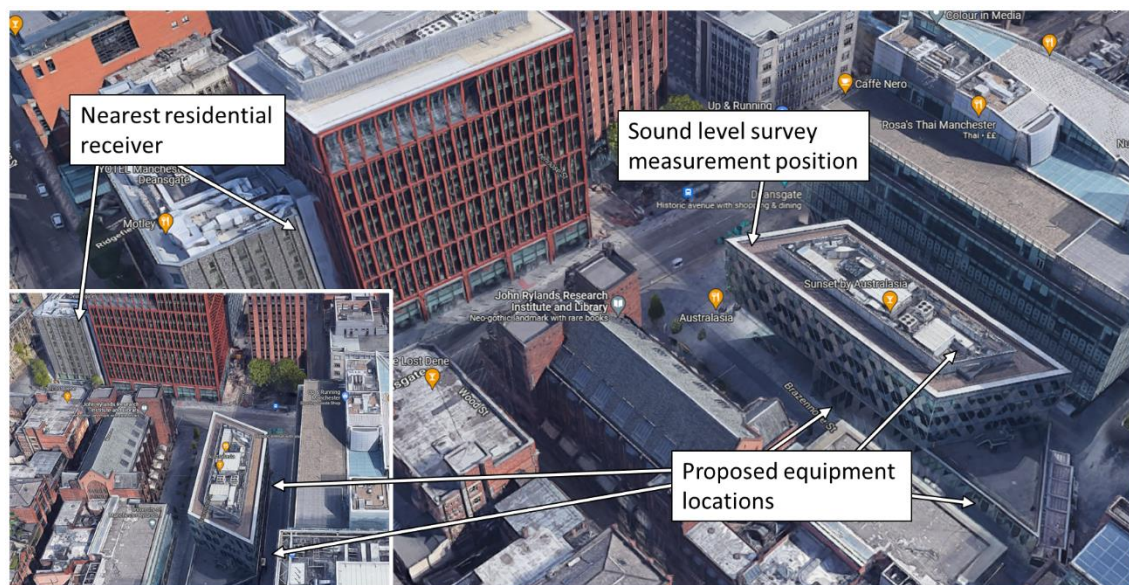


Figure 1: Drawing showing equipment location and most noise-sensitive receptor

Proposed operating times of the equipment are understood to be between the hours of 07:00 and 03:00, although the proposed catering condensers will have the potential to operate over a 24-hour period.

4. SOUND LEVEL SURVEY

To assess sound levels from the new mechanical equipment, it is necessary to establish the representative background sound levels in the vicinity during the proposed plant operating times.

ACA Acoustics have undertaken an unmanned sound level survey at flat roof level over a nominal 24-hour period between the 19th – 20th January 2022. The survey was conducted at flat roof level, with the microphone extended over the parapet wall on an extendable pole. Photograph of the sound level survey location is included in Figure 2.

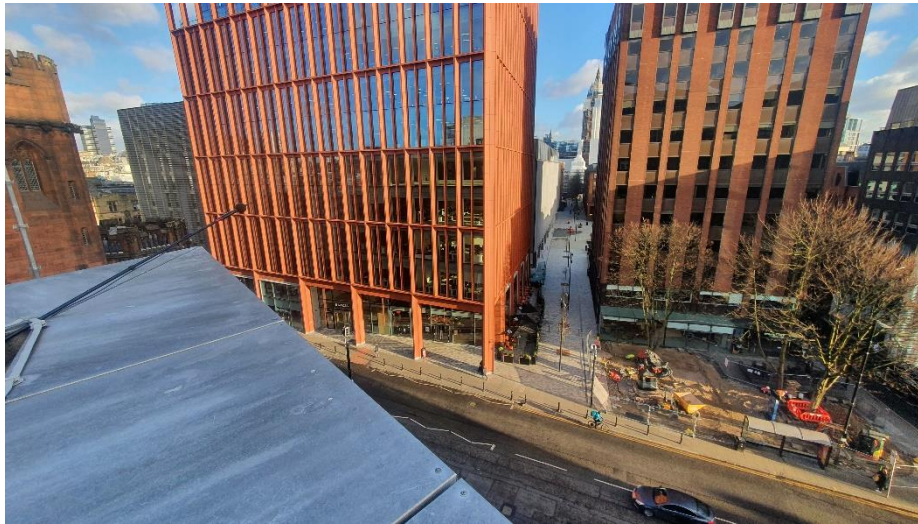


Figure 2: Sound level survey location

During the survey, ambient sound levels in the vicinity consisted of road traffic on nearby routes, along with mechanical services equipment also situated on the flat roof. The equipment was subjectively audible at a low level, although it was partially screened from the measurement location.

Construction activity on Spinningfields Square was also subjectively clearly audible during daytime periods, but will not have impacted sound levels in the evening and overnight, which will be the determining factor for the appropriate criteria and will therefore not have adversely impacted the survey results.

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 Class 1 sound level meter type XL2 complete with weatherproof and lockable outdoor environmental kit	A2A-06294-E0
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003 (Calibrated to a reference traceable to NIST)	83826

Table 1: Equipment used for the sound level survey

Weather conditions at the time of setting up the survey were cool, dry, and calm, and are not considered to have adversely impacted the outcome of the assessment.

Results of the survey are shown in Figure 3 below.

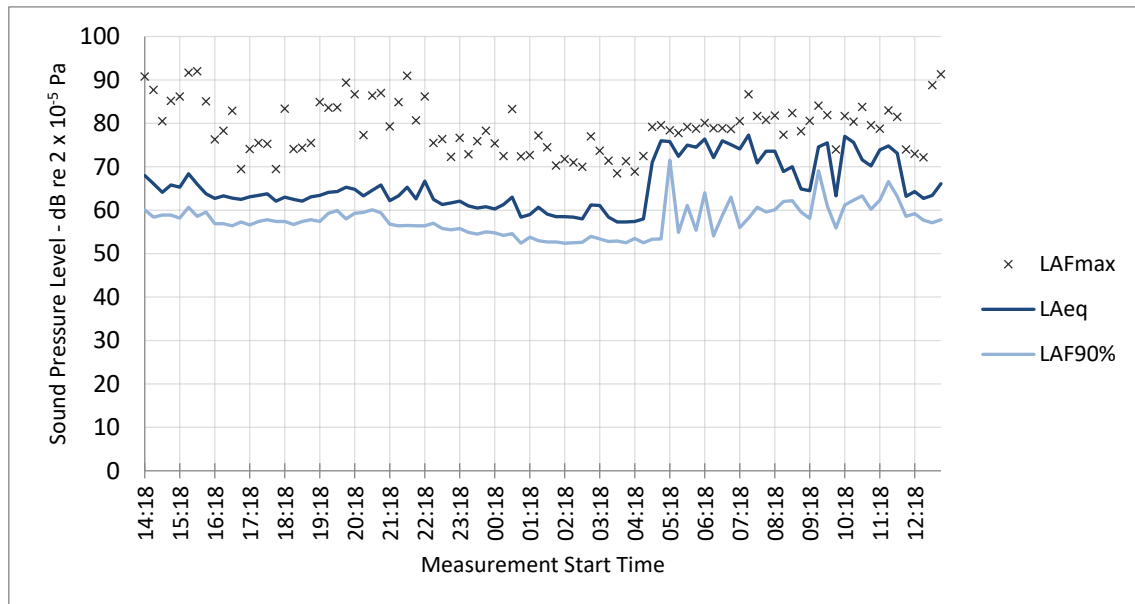


Figure 3: Sound level survey results

As can be seen in Figure 3, activity at around 04:00 hours resulted in a large increase in measured sound levels. This source was not clearly identifiable while on site, however it is likely it was caused by non-associated equipment operating on the roof. This period has been excluded from the assessment, with only sound levels between 23:00 – 04:18 being considered representative of the background sound level overnight at the receptor position.

In accordance with the methodology set out in BS 4142:2014+A1:2019, the background sound level is not necessarily the lowest recorded value. Instead, the background sound level should be a level which is representative of the underlying soundscape at the receptor location.

A statistical analysis of the measured LA90 results during the surveyed period is shown in Figure 4 below, following guidance set out in the Standard.

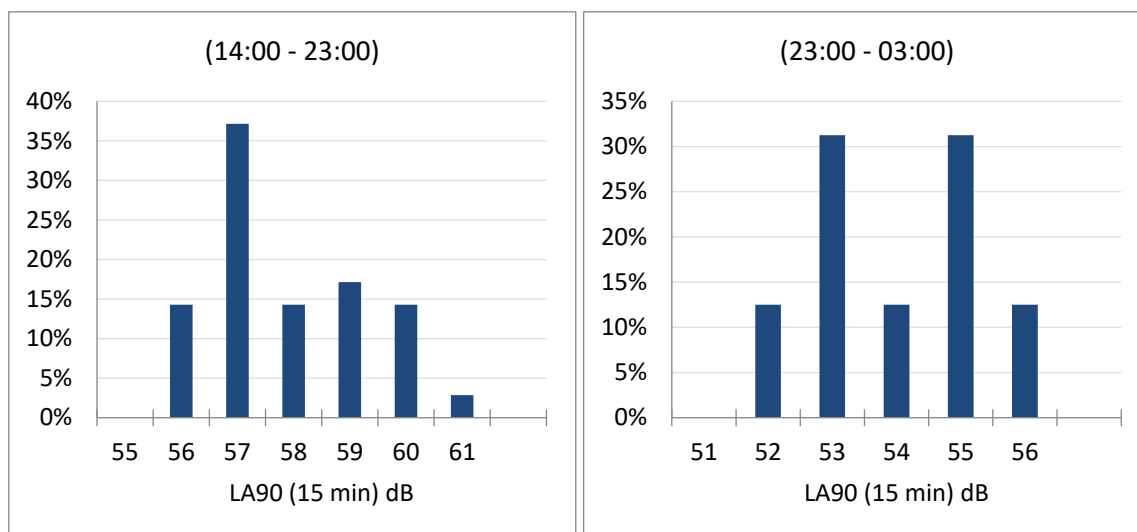


Figure 4: Statistical analysis of measured LA90 sound levels during the survey for opening times during the day and opening hours during the night.

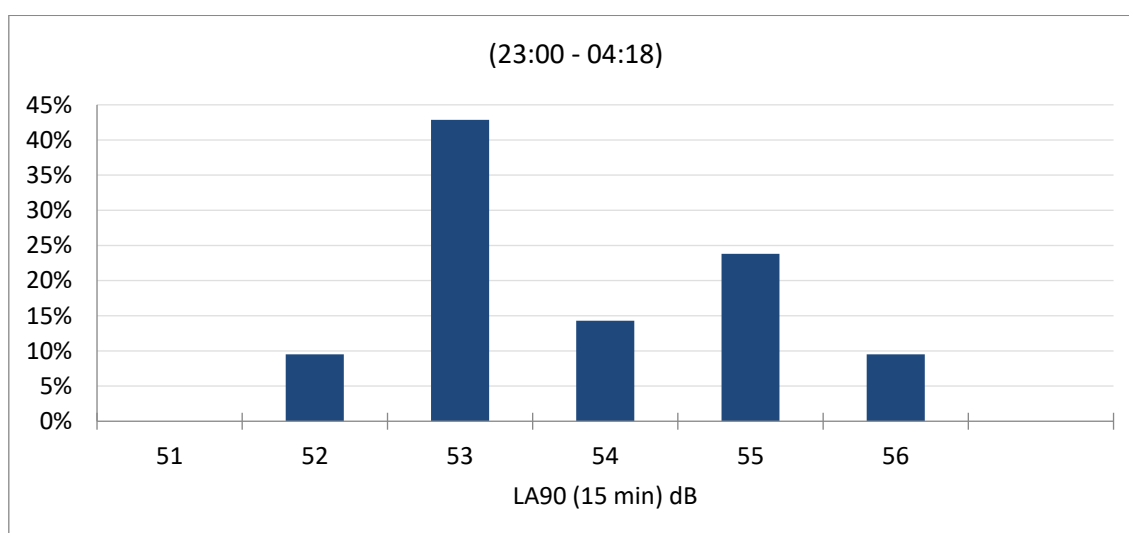


Figure 5: Statistical analysis of measured LA90 sound levels during the survey during the most affected night time period while the catering condensers will remain operating.

Based on the statistical analysis of the survey results, the author considers a level of LA90 53dB is representative of the background sound level in the vicinity during operating times, and a level of LA90 53dB is also representative for the background through the night – after closing time when the catering condensers may remain operating.

Period	Background Sound Level During Operating Period LA90
Restaurant opening times to 03:00	53dB
Nighttime period 23:00 – 04:18 as detailed above	53dB

Table 2: Summary sound level survey results

5. ACOUSTIC ASSESSMENT

The development includes the installation of a new extract and supply fan as well as two air conditioning condensers. The fans will be installed internally to discharge at the rear. Confirmation of the equipment models used in the assessment is provided in Table 3 below.

Description	Equipment Model	Airflow m ³ /s	Sound Power	Quantity
AC Condenser CU1 & CU2	Mitsubishi PURY-P900YSNW-A2	N/A	86dBA	2
AC Condenser CU3 & CU4	Mitsubishi PURY-P700YSNW-A2	N/A	84dBA	2
Catering Condenser (Chiller)	JEHR-0150-B2-M-1	N/A	68dBA	1
Catring Condenser (Freezer)	JEHR-0175-B2-L-3	N/A	71dBA	1
Kitchen extract fan (KEF)	No.33 Beaufort 'F' Backward Inclined Fan	8	Discharge: 102dBA	1
Back of house supply fan	ER63C-4DN.G7.CR	3.8	Inlet: 82dBA	1
Northern Supply Fan	ER63C-fDN.G7.CR	3.5	Inlet: 82dBA	1
South Supply Fan	ER63C-4DN.G7.CR inlet	3.8	Inlet: 82dBA	1
WC Extract Fan	K 315L Sileo	0.22	Discharge: 77dBA	1
Northern General Extract Fan A	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1
Northern General Extract Fan B	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1
Southern General Extract Fan	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1

Table 3: Proposed new mechanical equipment used in the assessment

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

A computer model has been used to calculate the noise contribution from the proposed plant to outside nearest noise-sensitive windows. The model incorporates losses within the ductwork system based on the calculation method of CIBSE Guide B4 Noise and vibration control for HVAC along with environmental corrections set out in ISO 9613-2:1996.

The assessment has been undertaken using drawings reference 21368/010 rev E, 21368/011 rev F, and 21368/021, as provided by the client.

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 operating)
Restaurant opening hours	43dBA
Overnight catering condensers only	21dBA

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	All Equipment Operating	Only Catering Condensers Operating Overnight	Relevant Clause	Commentary
Calculated specific sound level to receptor	LAeq 44dB	LAeq 21dB	7.1 7.3.6	New equipment operating. Refer to calculation sheets in Appendix A.
Background sound level	LA90 53dB	LA90 53dB	8.1.3 8.3	Measured representative background sound level.
Acoustic feature correction	0dB	0dB	9.2	The calculated specific sound levels do not indicate any tonal/impulsivity/intermittency component and the equipment will be significantly below the residual sound level.
Rating level	LAr 44dB	LAr 21dB	9.2	
Excess of rating level over background sound level	-9dB	-32dB	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 more than 5dB below the representative background LA90 sound level to outside the closest noise-sensitive properties.

BS 4142:2014+A1:2019 requires an assessment to consider the context of the development as well as 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 29dBA (44dBA – 15dBA). This is 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.

Additionally, the proposals involve new items of mechanical equipment being introduced to an area with other commercial and retail uses in the vicinity. In this scenario, the change in acoustic character, and subsequent potential for loss of amenity, is lower than if, say, there were no other similar businesses in the area. In addition, the new plant is likely to be much quieter than the existing site plant.

The nearest, and most affected receptor, is to a hotel. Occupants of these are less likely to be disturbed than occupier of residential dwellings. This will lower the potential impact.

The author considers that the context of the assessment further lowers slightly 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. ACOUSTIC MITIGATION TREATMENTS

As discussed in Section 5, noise control treatments have been included in the calculation model. Acoustic specification for the mitigation scheme is provided below.

6.1. Kitchen Extract Fan Acoustic Enclosure

It is advised that the extract and 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.

6.2. Kitchen Extract Fan Inlet Duct Mounted Attenuator

The calculation model includes benefit of duct-mounted attenuators to the kitchen extract fan inlet. Schedule of minimum dynamic insertion loss performance for the attenuator 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.

Any transformation sections between the fan and attenuator should be formed with double-skinned casings.

It is important airflow generated 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.

6.3. Vibration Control

To control potential for structure-borne noise and vibration from the equipment affecting adjoining occupants, it is recommended the condensers and fans are installed on vibration isolators. The condensers should be installed on rubber turret type resilient mounts providing typically 8mm deflection at the working load. The fans should be installed on steel spring type mounts providing minimum 25mm deflection, and that flexible connections are fitted between the equipment 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).

7. CONCLUSION

A planning application is to be submitted for the installation of new mechanical plant and equipment for an existing premises at 2 Spinningfields, Manchester.

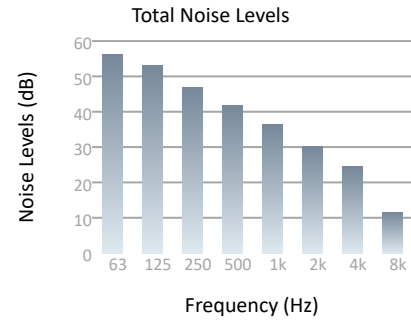
ACA Acoustics have undertaken an assessment of noise from the proposed equipment using manufacturer's published acoustic data. Calculated rating level for the new plant is significantly below the background sound level during operating times of the new equipment when assessed at 1m from the closest noise-sensitive windows.

The author considers that the proposed new condensers and extraction equipment achieve the Local Authority's planning requirements for this development and will not be detrimental to the amenity of nearby residential occupants.

Appendix A

Acoustic Calculations

Project Name	Sexy Fish, 2 Spinningfields, Manchester
Project Reference	211004
Reference	Yotel Deansgate
Description	
Noise Limit	53
dBA	44.2

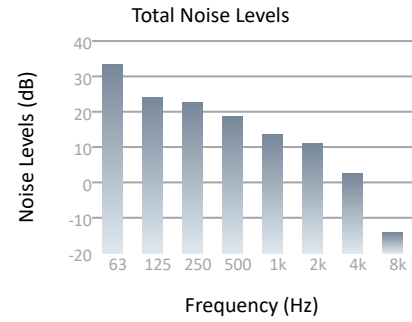


Calculated Lp at Receptor

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
CU1	1	42.0	30.3	31.8	29.7	24.5	18.8	11.2	-2.3
CCU Chiller	1	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3
KEF Discharge	1	50.1	49.4	44.8	40.5	35.1	28.5	22.9	10.4
CU2	1	42.0	30.3	31.8	29.7	24.5	18.8	11.2	-2.3
CU3	1	40.0	36.3	28.8	26.7	21.5	17.8	13.2	-0.3
CU4	1	40.0	36.3	28.8	26.7	21.5	17.8	13.2	-0.3
CCU Chiller	1	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3
CCU Freezer	1	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3
CCU Freezer	1	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3
North Supply Fan Inlet	1	8.5	19.0	19.9	12.9	12.2	6.8	0.3	-10.6
South Supply Fan Inlet	1	-11.4	-7.2	-8.7	-13.4	-11.6	-14.6	-22.6	-39.0
WC Discharge	1	26.2	28.0	22.0	16.4	11.9	6.6	-2.4	-13.8
GEF North Discharge A	1	36.2	29.0	30.0	21.4	15.9	5.6	-4.4	-19.8
GEF North Discharge B	1	36.2	29.0	30.0	21.4	15.9	5.6	-4.4	-19.8
North Supply Fan Inlet	1	8.5	19.0	19.9	12.9	12.2	6.8	0.3	-10.6
GEF South Discharge	1	14.8	-1.1	-3.7	-10.3	-13.5	-21.5	-32.5	-54.9
KEF Breakout	1	50.3	49.2	39.9	28.5	17.3	9.6	0.0	-12.5
KEF Inlet	1	51.6	42.6	32.5	21.4	14.3	13.5	4.9	-7.6

211004-ER-1-R001

Project Name	Sexy Fish, 2 Spinningfields, Manchester
Project Reference	211004
Reference	Yotel Deansgate Manchester, Overnight
Description	
Noise Limit	53
dBA	20.5



Calculated Lp at Receptor

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
CCU Chiller	1	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3
CCU Chiller	1	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3
CCU Freezer	1	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3
CCU Freezer	1	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3

211004-ER-2-R001

Calculation Sheet

CU1 to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU1								
Noise Levels	94.0	85.0	87.0	85.0	80.0	75.0	70.0	66.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	42.0	30.3	31.8	29.7	24.5	18.8	11.2	-2.3

Calculation Sheet

CCU Chiller to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Chiller								
Noise Levels	82.0	75.0	73.0	64.0	59.0	49.0	47.0	47.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3

Calculation Sheet

CU2 to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU2								
Noise Levels	94.0	85.0	87.0	85.0	80.0	75.0	70.0	66.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	42.0	30.3	31.8	29.7	24.5	18.8	11.2	-2.3

Calculation Sheet

CU3 to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU3								
Noise Levels	92.0	91.0	84.0	82.0	77.0	74.0	72.0	68.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	40.0	36.3	28.8	26.7	21.5	17.8	13.2	-0.3

Calculation Sheet

CU4 to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU4								
Noise Levels	92.0	91.0	84.0	82.0	77.0	74.0	72.0	68.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	40.0	36.3	28.8	26.7	21.5	17.8	13.2	-0.3

Calculation Sheet

CCU Chiller to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Chiller								
Noise Levels	82.0	75.0	73.0	64.0	59.0	49.0	47.0	47.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3

Calculation Sheet

CCU Freezer to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Freezer								
Noise Levels	72.0	67.0	70.0	70.0	65.0	64.0	58.0	49.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3

Calculation Sheet

CCU Freezer to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Freezer								
Noise Levels	72.0	67.0	70.0	70.0	65.0	64.0	58.0	49.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3

Calculation Sheet

CCU Chiller to Yotel Deansgate Manchester, Overnight

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Chiller								
Noise Levels	82.0	75.0	73.0	64.0	59.0	49.0	47.0	47.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate Manchester, Overnight Sound Pressure, Lp:	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3

Calculation Sheet

CCU Chiller to Yotel Deansgate Manchester, Overnight

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Chiller								
Noise Levels	82.0	75.0	73.0	64.0	59.0	49.0	47.0	47.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate Manchester, Overnight Sound Pressure, Lp:	30.0	20.3	17.8	8.7	3.5	-7.2	-11.8	-21.3

Calculation Sheet

CCU Freezer to Yotel Deansgate Manchester, Overnight

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Freezer								
Noise Levels	72.0	67.0	70.0	70.0	65.0	64.0	58.0	49.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate Manchester, Overnight Sound Pressure, Lp:	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3

Calculation Sheet

CCU Freezer to Yotel Deansgate Manchester, Overnight

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CCU Freezer								
Noise Levels	72.0	67.0	70.0	70.0	65.0	64.0	58.0	49.0
Noise Control Treatments								
Treatment - none								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc - Condenser Directivity								
	-2.9	-5.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate Manchester, Overnight Sound Pressure, Lp:	20.0	12.3	14.8	14.7	9.5	7.8	-0.8	-19.3

Calculation Sheet

KEF Breakout to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - KEF Breakout									
Sound Power Levels		101.0	106.0	105.0	100.0	97.0	91.0	86.0	81.0
Enclosure									
Gap Around Equipment	0.2								
Surface Area - m ²	4.7								
Surface Finish - Acoustic Panel									
Q Factor - Semi-Absorptive Enclosure									
Area of Panel	3.9								
Panel Construction - Acoustic panel									
Aperture Area	0.0								
Louvre/Aperture Construction - Acoustic panel		-1.6	-7.7	-15.9	-22.2	-30.2	-31.2	-33.2	-31.2
Dc - Directivity									
DI Index - 0dB		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Adiv - Geometrical Divergence									
		-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption									
		0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation									
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver									
External Receiver - Yotel Deansgate									
Sound Pressure, Lp:		50.3	49.2	39.9	28.5	17.3	9.6	0.0	-12.5

Calculation Sheet

KEF Discharge to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Discharge								
Sound Power Levels	105.8	103.8	100.8	98.8	96.8	93.8	90.8	87.8
Bend Loss								
	-1.0	-2.0	-3.0	-3.0	-3.0	-2.9	-2.9	-3.0
Rect Duct Losses								
	-0.5	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
End Reflection & Directional Directivity								
	-8.1	-6.0	-6.6	-9.0	-12.1	-15.0	-15.0	-15.0
Dc - Reflections & Directivity								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Adiv - Geometrical Divergence								
	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1	-52.1
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.1	-3.7	-13.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	50.1	49.4	44.8	40.5	35.1	28.5	22.9	10.4

Calculation Sheet

North Supply Fan Inlet to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - North Supply Fan Inlet									
Noise Levels		67.0	78.0	80.0	75.0	77.0	75.0	71.0	69.0
Rect Duct Losses									
		-1.0	-0.6	-0.4	-0.2	-0.2	-0.2	-0.2	-0.2
Bend Loss									
Width (m)	1.5								
Height (m)	0.5								
Face Velocity (m/s)	4.7								
Bend Type - Radius									
Type - Unlined Radius Bend									
		-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity									
		-2.1	-0.1	0.8	1.3	1.5	1.6	1.6	1.6
Dc - Reflections & Directivity									
		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence									
		-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5
Aatm - Atmospheric Absorption									
		0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.5	-12.5
Agr - Ground Attenuation									
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation									
		-10.9	-12.7	-14.9	-17.5	-20.3	-23.0	-23.0	-23.0
External Receiver									
External Receiver - Yotel Deansgate									
Sound Pressure, Lp:		8.5	19.0	19.9	12.9	12.2	6.8	0.3	-10.6

Calculation Sheet

South Supply Fan Inlet to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - South Supply Fan Inlet									
Noise Levels		67.0	78.0	80.0	75.0	77.0	75.0	71.0	69.0
Rect Duct Losses									
		-1.5	-0.9	-0.6	-0.3	-0.3	-0.3	-0.3	-0.3
Bend Loss									
Width (m)	1.5								
Height (m)	0.5								
Face Velocity (m/s)	5.1								
Bend Type - Radius									
Type - Unlined Radius Bend									
		-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity									
		-9.4	-12.9	-15.3	-15.1	-15.0	-15.0	-15.0	-15.0
Dc - Reflections & Directivity									
		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence									
		-55.7	-55.7	-55.7	-55.7	-55.7	-55.7	-55.7	-55.7
Aatm - Atmospheric Absorption									
		0.0	-0.1	-0.2	-0.3	-0.6	-1.7	-5.6	-20.0
Agr - Ground Attenuation									
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation									
		-18.8	-21.6	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver									
External Receiver - Yotel Deansgate									
Sound Pressure, Lp:		-11.4	-7.2	-8.7	-13.4	-11.6	-14.6	-22.6	-39.0

Calculation Sheet

WC Discharge to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - WC Discharge								
Noise Levels	82.0	82.0	77.0	73.0	71.0	69.0	63.0	59.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-3.8	-0.9	0.4	1.1	1.4	1.6	1.6	1.6
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.3	-0.8	-2.8	-10.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-10.3	-11.9	-13.9	-16.4	-19.1	-21.9	-23.0	-23.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	26.2	28.0	22.0	16.4	11.9	6.6	-2.4	-13.8

Calculation Sheet

GEF North Discharge A to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF North Discharge A								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-3.8	-0.9	0.4	1.1	1.4	1.6	1.6	1.6
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.3	-0.8	-2.8	-10.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-10.3	-11.9	-13.9	-16.4	-19.1	-21.9	-23.0	-23.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	36.2	29.0	30.0	21.4	15.9	5.6	-4.4	-19.8

Calculation Sheet

GEF North Discharge B to Yotel Deansgate

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF North Discharge B								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-3.8	-0.9	0.4	1.1	1.4	1.6	1.6	1.6
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8	-49.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.3	-0.8	-2.8	-10.2
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-10.3	-11.9	-13.9	-16.4	-19.1	-21.9	-23.0	-23.0
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	36.2	29.0	30.0	21.4	15.9	5.6	-4.4	-19.8

Calculation Sheet

North Supply Fan Inlet to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - North Supply Fan Inlet									
Noise Levels		67.0	78.0	80.0	75.0	77.0	75.0	71.0	69.0
Rect Duct Losses									
		-1.0	-0.6	-0.4	-0.2	-0.2	-0.2	-0.2	-0.2
Bend Loss									
Width (m)	1.5								
Height (m)	0.5								
Face Velocity (m/s)	4.7								
Bend Type - Radius									
Type - Unlined Radius Bend									
		-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity									
		-2.1	-0.1	0.8	1.3	1.5	1.6	1.6	1.6
Dc - Reflections & Directivity									
		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence									
		-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5
Aatm - Atmospheric Absorption									
		0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.5	-12.5
Agr - Ground Attenuation									
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation									
		-10.9	-12.7	-14.9	-17.5	-20.3	-23.0	-23.0	-23.0
External Receiver									
External Receiver - Yotel Deansgate									
Sound Pressure, Lp:		8.5	19.0	19.9	12.9	12.2	6.8	0.3	-10.6

Calculation Sheet

GEF South Discharge to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - GEF South Discharge									
Noise Levels		92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Rect Duct Losses									
		-0.9	-0.6	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1
Bend Loss									
Width (m)	0.5								
Height (m)	0.5								
Face Velocity (m/s)	3.3								
Bend Type - Radius									
Type - Unlined Radius Bend									
		-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Rect Duct Losses									
Width (m)	0.5								
Height (m)	0.5								
Length (m)	0.5								
Face Velocity (m/s)	3.3								
		-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
End Reflection & Directional Directivity									
		-9.4	-12.9	-15.3	-15.1	-15.0	-15.0	-15.0	-15.0
Dc - Reflections & Directivity									
		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence									
		-55.7	-55.7	-55.7	-55.7	-55.7	-55.7	-55.7	-55.7
Aatm - Atmospheric Absorption									
		0.0	-0.1	-0.2	-0.3	-0.6	-1.7	-5.6	-20.0
Agr - Ground Attenuation									
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation									
		-18.8	-21.6	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
External Receiver								
External Receiver - Yotel Deansgate								
Sound Pressure, Lp:	14.8	-1.1	-3.7	-10.3	-13.5	-21.5	-32.5	-54.9

Calculation Sheet

KEF Inlet to Yotel Deansgate

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - KEF Inlet									
Sound Power Levels		105.8	103.8	100.8	98.8	96.8	93.8	90.8	87.8
Silencer									
Silencer Type - Rectangular									
Silencer Reference - KEF Inlet									
Width (m)	1.0								
Height (m)	1.8								
% Free Area (%)	45.0								
Face Velocity (m/s)	9.9								
		-6.0	-10.0	-14.0	-20.0	-21.9	-15.0	-12.0	-8.0
Duct Break-Out									
		-5.1	-8.1	-11.1	-14.1	-17.1	-21.1	-27.1	-31.1
ISO 9613 Calculation									
Horiz. Distance (m)	113.0								
Source Height (m)	18.0								
Receiver Height (m)	24.0								
Q Factor - Junction									
		-43.1	-43.1	-43.2	-43.3	-43.5	-44.2	-46.8	-56.3
ISO 9613 Barrier Attenuation									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver									
External Receiver - Yotel Deansgate									
Sound Pressure, Lp:		51.6	42.6	32.5	21.4	14.3	13.5	4.9	-7.6

Appendix B

Noise Control Treatments

Attenuator Schedule

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
KEF Inlet		900L 45% Free Area c/w Melinex	6	10	14	20	22	15	12	8

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.