

Acoustic Assessment of 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. ACA Acoustics understand that Manchester City Council consider offices to be noise-sensitive and therefore the previous assessment has been updated accordingly.
- 0.3. A survey has been carried out in the vicinity to establish existing background sound levels over a 24-hour period. The background sound levels during the most sensitive time of the proposed operating hours are LA90 53dB to the latest operating times of the plant and LA90 57dB during typical daytime office hours.
- 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. The closest commercial offices with openable windows have been identified as offices within Manchester Magistrates Court, to the west of the site.
- 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 residential receptor is LAr 35dB. This is significantly less than the criterion of LAr 48dB. Overnight when the proposed catering condensers have the potential to remain operating, the calculated rating level is even lower.
- 0.6. Calculated sound levels to the closest noise-sensitive offices are LAr 51dB. This is more than 5dBA below the background sound level during daytime hours.
- 0.7. Noise from the proposed new equipment will not be disturbing or detrimental to the amenity of any nearby residential or commercial occupants and complies with the planning requirements of Manchester City Council.

1. INTRODUCTION

New mechanical equipment has been installed at 2 Spinningfields, Manchester.

ACA Acoustics Limited has been commissioned to carry out an assessment of noise emissions from the 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

It is understood that Manchester City Council 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.

Although BS 4142:2014+A1:2019 specifically advises that the methodology is suitable to assess the impacts on dwellings or premises used for residential purposes, Manchester City Council have advised that they consider commercial offices as being noise sensitive and will require adherence to the same criteria. ACA Acoustics have therefore updated our previous assessment to consider noise from the new equipment to outside the closest openable office windows.

3. REVIEW OF SITE LOCATION

New mechanical equipment, comprising of supply and extract fans, and air conditioning and catering condensers, has been 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. The closest noise-sensitive offices are Manchester Magistrates Court, to the west of the site.

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

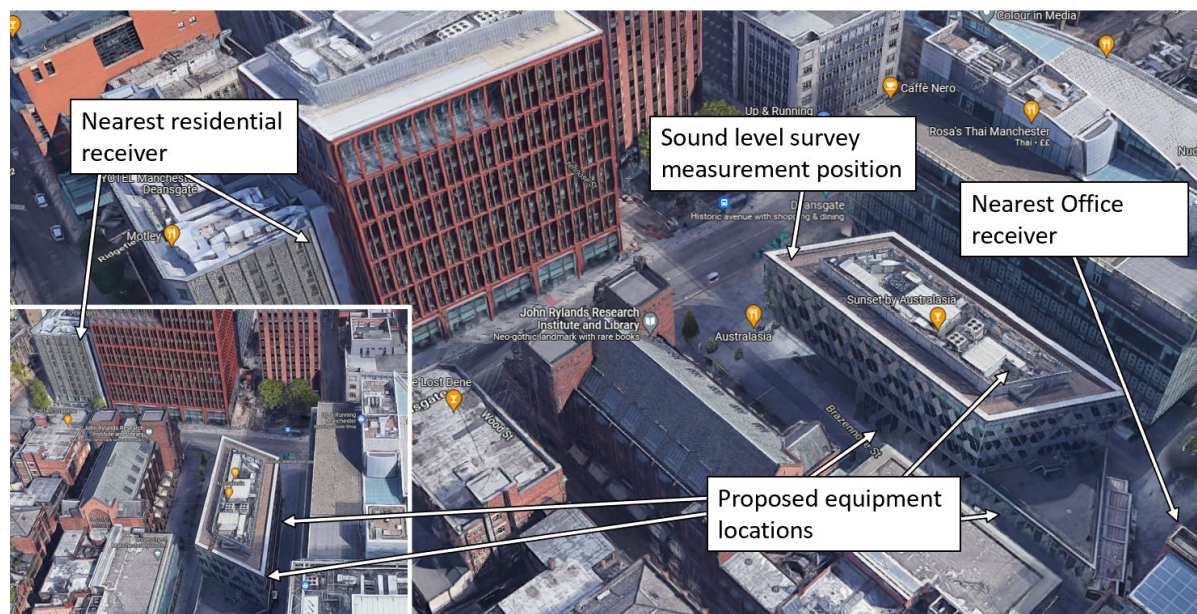


Figure 1: Drawing showing equipment location and noise-sensitive receptors

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.

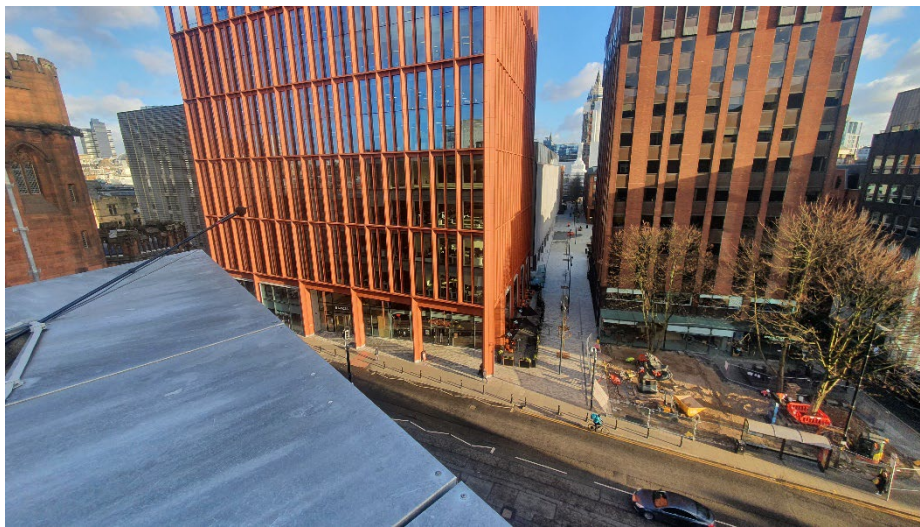


Figure 2: Sound level survey location

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.

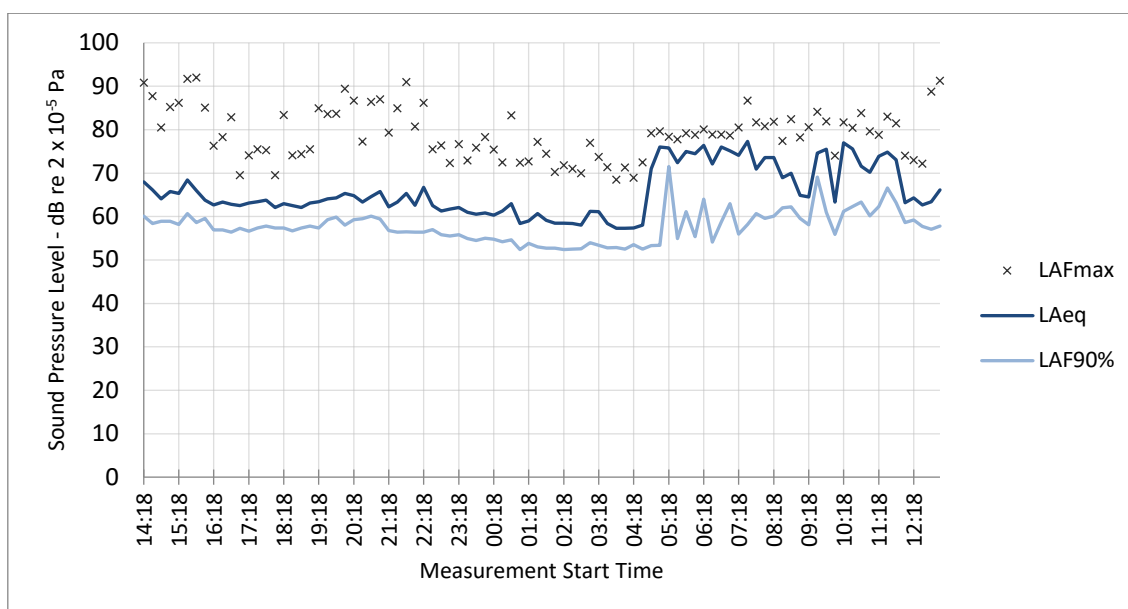


Figure 3: Sound level survey results

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. 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.

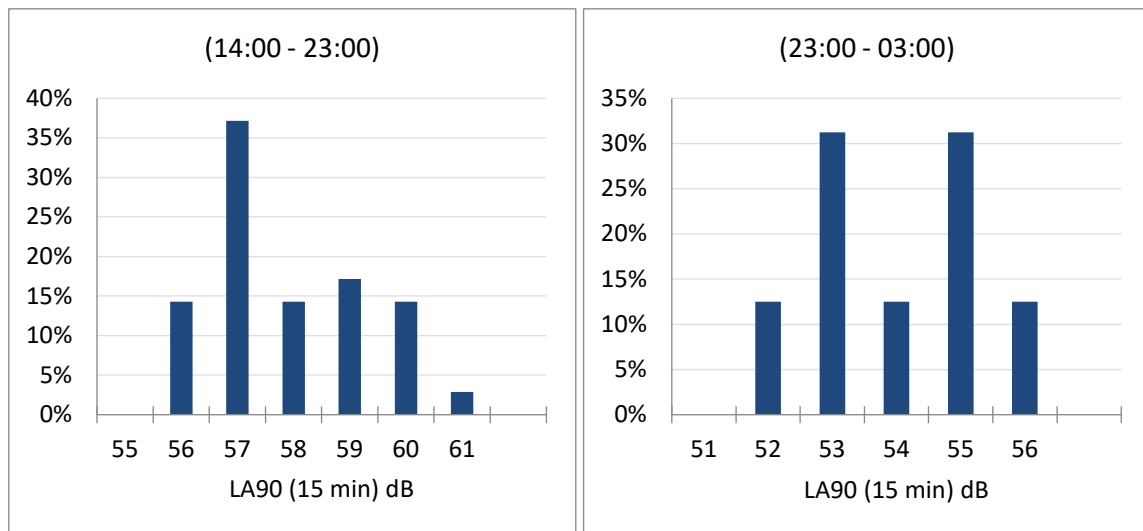


Figure 4: Statistical analysis of measured LA90 sound levels during the survey for opening times during the day and opening hours during the night.

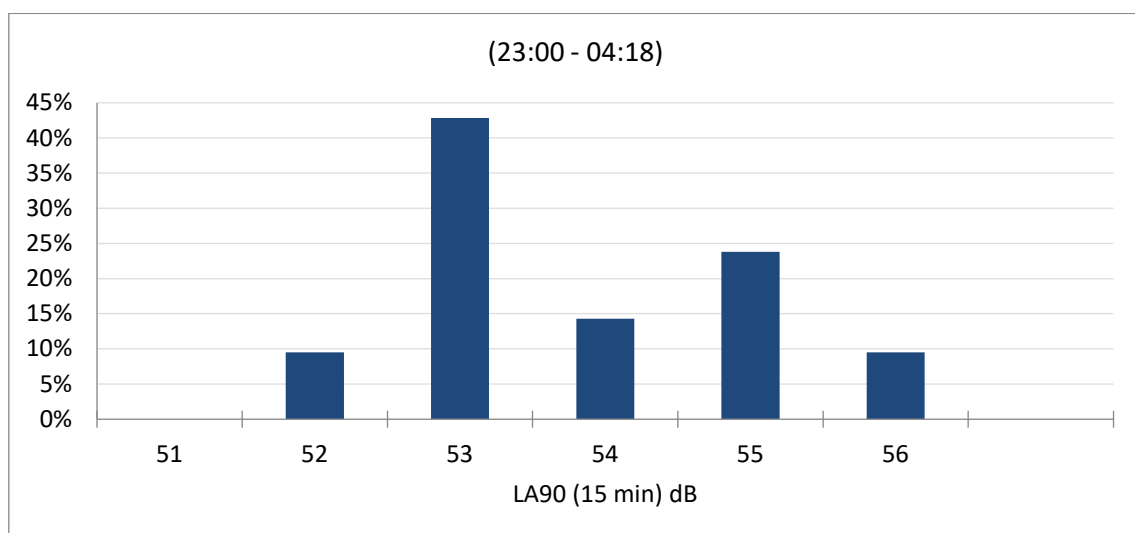


Figure 5: Statistical analysis of measured LA90 sound levels during the survey during the most affected night time period while the catering condensers will remain operating.

Based on the statistical analysis of the survey results, the author considers a level of LA90 57dB as representative during the daytime to nearby offices, 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
Daytime hours when offices may be occupied	57dB
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 new extract and supply fans along with air conditioning and catering condensers. 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	Mitsubishi PURY-P900YSNW-A2	N/A	86dBA	1
AC Condenser CU2	Mitsubishi PURY-P700YSNW-A2	N/A	84dBA	1
Catering Condenser (Chiller)	JEHR-0150-B2-M-1	N/A	68dBA	3
Catering Condenser (Freezer)	JEHR-0175-B2-L-3	N/A	71dBA	3
Kitchen extract fan (KEF)	No.33 Beaufort 'F' Backward Inclined Fan	8	Discharge: 102dBA	1
Northern Supply Fan	ER63C-fDN.G7.CR	3.5	Inlet: 82dBA	1
South Supply Fan	ER63C-4DN.G7.CR	3.8	Inlet: 82dBA	1
BOH Supply	K 315L Sileo	0.22	Inlet: 75dBA	1
BOH Extract	K 315L Sileo	0.22	Discharge: 77dBA	1
WC Extract Fan	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1
Northern General Extract Fan	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1

Description	Equipment Model	Airflow m ³ /s	Sound Power	Quantity
Southern General Extract Fan A	PRIO 400 EC Inlet	0.82	Discharge: 81dBA	1
Southern General Extract Fan B	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 AB, 21368/011 rev AB, and 21368/021 rev AB, 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)
Manchester Magistrates Court	51dBA
Residential - Restaurant opening hours	35dBA
Residential - Overnight catering condensers only	14dBA

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	Offices All Equipment Operating	Residential All Equipment Operating	Residential Catering Condensers Only Overnight	Relevant Clause	Commentary
Calculated specific sound level to receptor	LAeq 51dB	LAeq 35dB	LAeq 14dB	7.1 7.3.6	New equipment operating. Refer to calculation sheets in Appendix A.
Background sound level	LA90 57dB	LA90 53dB	LA90 53dB	8.1.3 8.3	Measured representative background sound level.
Acoustic feature correction	0dB	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 51dB	LAr 35dB	LAr 14dB	9.2	
Excess of rating level over background	-6dB	-18dB	-39dB	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 5dB below the representative background LA90 sound level to outside the closest noise-sensitive properties. This fully complies with the requirements of Manchester City Council.

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 20dBA (35dBA – 15dBA). This is below guideline levels for sleeping in bedrooms of LAeq 30dB, set out in BS 8233:2014. Sound levels inside commercial offices will be approximately 31dBA. This is below guideline criteria for a good standard of amenity within commercial offices, set out in BS 8233:2014.

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 existing site plant.

The nearest and most affected residential 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. Similarly, the methodology of BS 4142 is intended to assess the impact of occupants within residential properties and the occupants of nearby commercial offices are less likely to be affected by noise from the new equipment.

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

Noise control treatments which have been installed have been included in the calculation model. Confirmation of the mitigation measures is provided below.

6.1. Kitchen Extract Fan Acoustic Enclosure

The kitchen extract fan has been installed within an acoustic panelled enclosure. The enclosure is formed 50mm thick acoustic panels incorporating 18swg steel outer casing, 50mm mineral wool insulation and perforated steel inner casing.

6.2. Duct Mounted Attenuators

The calculation model includes benefit of duct-mounted attenuators to some of the fans. Schedule of dynamic insertion loss performance for the attenuators is provided in Appendix B.

6.3. Vibration Control

To control potential for structure-borne noise and vibration from the equipment affecting adjoining occupants, the condensers and fans have been installed on vibration isolators. The condensers are installed on rubber turret type resilient mounts providing typically 8mm deflection at the working

load. The fans are installed on steel spring type mounts providing minimum 25mm deflection. Flexible connections are fitted between the equipment and adjoining ductwork both sides.

7. CONCLUSION

New mechanical equipment associated with a restaurant has been installed at 2 Spinningfields, Manchester.

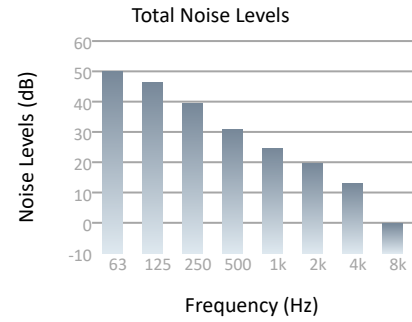
ACA Acoustics have undertaken an assessment of noise from the equipment to the closest residential and commercial noise-sensitive receptors.

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 and complies with the minimum requirements of Manchester City Council. No further mitigation measures are required to the plant.

Appendix A

Acoustic Calculations

Project Name Sexy Fish, 2 Spinningfields, Manchester
Project Reference 211004
Reference Yotel
Description
Noise Limit 48
Calculated Cumulative dBA 35



Calculated Lp at Receptor

Reference	Qty	Noise Levels (dB)								dBA
		63	125	250	500	1k	2k	4k	8k	
CU1	1	42	27	29	27	21	16	8	-5	
CU2	1	40	33	26	24	18	15	10	-3	
CCU Chiller	1	24	13	9	-2	-9	-23	-30	-41	
CCU Chiller	1	24	13	9	-2	-9	-23	-30	-41	
CCU Chiller	1	24	13	9	-2	-9	-23	-30	-41	
CCU Freezer	1	14	5	6	4	-3	-8	-19	-39	
CCU Freezer	1	14	5	6	4	-3	-8	-19	-39	
CCU Freezer	1	14	5	6	4	-3	-8	-19	-39	
North Supply Fan Inlet	1	10	22	24	17	17	11	2	-9	
WC North Discharge	1	33	24	23	11	2	-9	-22	-39	
GEF North Discharge	1	33	24	23	11	2	-9	-22	-39	
South Supply Fan Inlet	1	-7	-8	-18	-23	-27	-29	-32	-42	
GEF South Discharge A	1	30	20	19	11	8	1	-10	-29	
GEF South Discharge B	1	23	8	1	-18	-29	-32	-40	-55	
BOH Extract	1	15	12	2	-6	-11	-15	-23	-35	
BOH Supply	1	12	11	2	-6	-15	-20	-26	-37	
KEF Discharge	1	38	38	31	17	4	0	-4	-13	
KEF Inlet	1	43	42	35	23	10	5	-2	-17	
KEF Breakout	1	46	42	33	21	10	3	-7	-20	

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Calculation Sheet
CU1 to Yotel

	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	-13.3
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	41.9	27.3	28.8	26.7	21.5	15.8	8.2	-5.4

Calculation Sheet

CCU Chiller to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	23.9	13.2	9.3	-1.8	-9.4	-22.7	-30.2	-41.4

Calculation Sheet
CU2 to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU2								
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	-13.3
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	39.9	33.3	25.8	23.7	18.5	14.8	10.2	-3.4

Calculation Sheet

CCU Chiller to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	23.9	13.2	9.3	-1.8	-9.4	-22.7	-30.2	-41.4

Calculation Sheet

CCU Freezer to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	13.9	5.2	6.3	4.2	-3.4	-7.7	-19.2	-39.4

Calculation Sheet

CCU Freezer to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	13.9	5.2	6.3	4.2	-3.4	-7.7	-19.2	-39.4

Calculation Sheet

KEF Breakout to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Breakout								
Sound Power Levels	94.0	99.0	98.0	93.0	90.0	84.0	79.0	74.0
Enclosure								
	-1.6	-7.7	-15.9	-22.2	-30.2	-31.2	-33.2	-31.2
Dc - Directivity								
DI Index - 3dB								
	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	-13.3
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	46.2	42.1	32.8	21.4	10.2	2.5	-7.1	-19.6

Calculation Sheet

CCU Chiller to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	23.9	13.2	9.3	-1.8	-9.4	-22.7	-30.2	-41.4

Calculation Sheet

CCU Freezer to Yotel

	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								
	0.1	-2.6	-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	-13.3
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	-9.0	-8.5	-10.0	-12.0	-14.4	-17.0	-19.8	-21.5
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	13.9	5.2	6.3	4.2	-3.4	-7.7	-19.2	-39.4

Calculation Sheet

KEF Discharge to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Discharge								
Sound Power Levels	101.0	106.0	105.0	100.0	97.0	91.0	86.0	81.0
Silencer								
	-4.0	-7.0	-12.0	-18.0	-24.9	-19.9	-15.9	-11.0
Bend Loss								
	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-7.7	-5.9	-6.8	-9.3	-12.5	-15.0	-15.0	-15.0
Dc - Reflections & Directivity								
	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	38.2	38.0	31.0	17.4	4.2	-0.1	-3.7	-13.3

Calculation Sheet

South Supply Fan Inlet to Yotel

	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
Silencer								
	-5.6	-15.0	-23.6	-20.3	-23.3	-22.3	-19.0	-18.1
End Reflection & Directional Directivity								
	-6.0	-6.6	-9.0	-12.2	-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								
	-51.4	-51.4	-51.4	-51.4	-51.4	-51.4	-51.4	-51.4
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.4	-12.3
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-19.5	-22.3	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	-6.5	-8.4	-18.2	-23.1	-27.1	-28.7	-31.9	-41.8

Calculation Sheet

BOH Extract to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - BOH Extract								
Noise Levels	82.0	82.0	77.0	73.0	71.0	69.0	63.0	59.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.2	-11.5
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-18.4	-21.2	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	15.2	12.0	2.4	-5.6	-11.0	-14.8	-23.0	-35.3

Calculation Sheet

GEF North Discharge to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF North Discharge								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.2	-11.5
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-9.3	-10.4	-12.0	-14.1	-16.5	-19.2	-22.1	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	33.4	24.4	22.8	11.0	2.1	-9.4	-21.5	-38.7

Calculation Sheet

WC North Discharge to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - WC North Discharge								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.2	-11.5
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-9.3	-10.4	-12.0	-14.1	-16.5	-19.2	-22.1	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	33.4	24.4	22.8	11.0	2.1	-9.4	-21.5	-38.7

Calculation Sheet

North Supply Fan Inlet to Yotel

	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
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-1.0	-0.6	-0.4	-0.2	-0.2	-0.2	-0.2	-0.2
Bend Loss								
	-3.0	-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								
	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8	-50.8
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.2	-11.5
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-9.3	-10.4	-12.0	-14.1	-16.5	-19.2	-22.1	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	9.8	22.1	23.5	17.0	16.6	11.4	2.3	-8.9

Calculation Sheet

GEF South Discharge A to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF South Discharge A								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
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
End Reflection & Directional Directivity								
	-1.2	1.3	2.7	3.7	4.4	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-53.6	-53.6	-53.6	-53.6	-53.6	-53.6	-53.6	-53.6
Aatm - Atmospheric Absorption								
	0.0	-0.1	-0.1	-0.3	-0.5	-1.3	-4.4	-15.7
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-15.3	-17.9	-20.7	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	29.9	19.8	19.3	10.8	8.3	0.6	-9.5	-28.8

Calculation Sheet

KEF Inlet to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Inlet								
Sound Power Levels	101.0	106.0	105.0	100.0	97.0	91.0	86.0	81.0
Silencer								
	-4.0	-7.0	-12.0	-18.0	-24.9	-19.9	-15.9	-11.0
Duct Break-Out								
	-7.8	-7.8	-8.8	-9.8	-12.8	-15.8	-19.8	-24.8
ISO 9613 Calculation								
	-45.8	-48.9	-48.9	-49.0	-49.2	-49.9	-52.4	-61.7
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								
Sound Pressure, Lp:	43.3	42.3	35.2	23.1	10.0	5.4	-2.2	-16.5

Calculation Sheet

GEF South Discharge B to Yotel

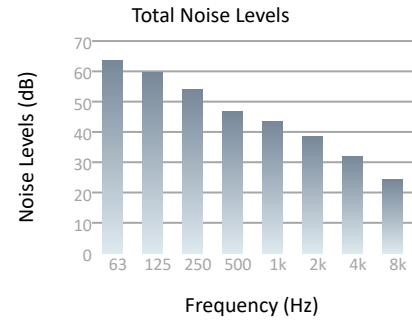
	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF South Discharge B								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	-2.0	-2.0	-5.0	-12.0	-16.9	-11.9	-10.8	-8.9
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-2.9	-2.9
End Reflection & Directional Directivity								
	-6.0	-6.6	-9.0	-12.2	-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								
	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.5	-12.6
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-18.4	-21.2	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	22.9	8.5	1.2	-18.0	-29.0	-31.6	-39.9	-55.0

Calculation Sheet

BOH Supply to Yotel

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - BOH Supply								
Noise Levels	80.0	82.0	77.0	73.0	68.0	65.0	61.0	59.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6	-51.6
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.2	-0.4	-1.0	-3.5	-12.6
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-18.4	-21.2	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Yotel								
Sound Pressure, Lp:	12.3	11.1	1.6	-6.4	-14.9	-19.7	-26.2	-37.2

Project Name	Sexy Fish, 2 Spinningfields, Manchester
Project Reference	211004
Reference	Manchester Magistrates Court
Description	
Noise Limit	52
Calculated Cumulative dBA	51



Calculated Lp at Receptor

Reference	Qty	Noise Levels (dB)								dBA
		63	125	250	500	1k	2k	4k	8k	
CU1	1	51	36	38	36	31	26	20	12	
CU2	1	49	42	35	33	28	25	22	14	
CCU Chiller	1	40	29	26	17	12	2	-1	-5	
CCU Chiller	1	40	29	26	17	12	2	-1	-5	
CCU Chiller	1	40	27	25	16	11	0	-3	-7	
CCU Freezer	1	30	21	23	23	18	17	10	-3	
CCU Freezer	1	30	21	23	23	18	17	10	-3	
CCU Freezer	1	30	21	23	23	18	17	10	-3	
KEF Discharge	1	49	49	42	28	15	12	10	7	
KEF Inlet	1	53	52	45	33	20	16	10	2	
KEF Breakout	1	61	57	48	36	25	18	11	6	
North Supply Fan Inlet	1	5	15	18	14	16	13	8	2	
WC North Discharge	1	28	17	17	8	1	-7	-16	-28	
GEF North Discharge	1	28	17	17	8	1	-7	-16	-28	
South Supply Fan Inlet	1	25	29	24	23	23	22	20	15	
GEF South Discharge A	1	55	47	50	44	41	34	26	14	
GEF South Discharge B	1	54	45	44	29	21	19	12	2	
BOH Extract	1	43	45	41	37	36	34	27	19	
BOH Supply	1	41	45	41	37	33	30	25	19	

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Calculation Sheet

CU1 to Manchester Magistrates Court

	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								
	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.1	-0.4	-1.3	-4.7
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	51.0	36.4	37.9	35.9	30.8	25.6	19.6	12.3

Calculation Sheet

CCU Chiller to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	40.0	28.9	26.4	17.4	12.3	2.0	-1.2	-5.4

Calculation Sheet

CU2 to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CU2								
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								
	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1	-43.1
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.1	-0.4	-1.3	-4.7
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	49.0	42.3	34.9	32.8	27.8	24.5	21.6	14.2

Calculation Sheet

CCU Chiller to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	40.0	28.9	26.4	17.4	12.3	2.0	-1.2	-5.4

Calculation Sheet

CCU Freezer to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	30.0	20.9	23.4	23.4	18.3	17.0	9.8	-3.4

Calculation Sheet

CCU Freezer to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	30.0	20.9	23.4	23.4	18.3	17.0	9.8	-3.4

Calculation Sheet

KEF Breakout to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Breakout								
Sound Power Levels	94.0	99.0	98.0	93.0	90.0	84.0	79.0	74.0
Enclosure								
	-1.6	-7.7	-15.9	-22.2	-30.2	-31.2	-33.2	-31.2
Dc - Directivity								
DI Index - 3dB								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Adiv - Geometrical Divergence								
	-37.6	-37.6	-37.6	-37.6	-37.6	-37.6	-37.6	-37.6
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.7	-2.5
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	60.8	56.8	47.5	36.2	25.1	18.0	10.5	5.8

Calculation Sheet

CCU Chiller to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	40.0	27.4	24.9	15.9	10.8	0.5	-2.7	-6.9

Calculation Sheet

CCU Freezer to Manchester Magistrates Court

	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								
	0.1	-2.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-5.9
Agr - Ground Attenuation								
	3.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	30.0	20.9	23.4	23.4	18.3	17.0	9.8	-3.4

Calculation Sheet

KEF Discharge to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Discharge								
Sound Power Levels	101.0	106.0	105.0	100.0	97.0	91.0	86.0	81.0
Silencer								
	-4.0	-7.0	-12.0	-18.0	-24.9	-19.9	-15.9	-11.0
Bend Loss								
	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-7.7	-5.9	-6.8	-9.3	-12.5	-15.0	-15.0	-15.0
Dc - Reflections & Directivity								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Adiv - Geometrical Divergence								
	-41.2	-41.2	-41.2	-41.2	-41.2	-41.2	-41.2	-41.2
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.1	-0.3	-1.1	-3.8
Agr - Ground Attenuation								
	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Abar - Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	49.1	48.9	42.0	28.5	15.4	11.6	9.9	7.1

Calculation Sheet

South Supply Fan Inlet to Manchester Magistrates Court

	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
Silencer								
	-5.6	-15.0	-23.6	-20.3	-23.3	-22.3	-19.0	-18.1
End Reflection & Directional Directivity								
	-1.2	1.3	2.7	3.7	4.4	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.2	-0.4	-1.5	-5.3
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 - Manchester Magistrates Court								
Sound Pressure, Lp:	25.1	29.2	24.0	23.2	22.8	21.7	19.9	15.1

Calculation Sheet

BOH Extract to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - BOH Extract								
Noise Levels	82.0	82.0	77.0	73.0	71.0	69.0	63.0	59.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-3.1	0.2	2.1	3.2	4.0	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.2	-0.5	-1.6	-5.9
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 - Manchester Magistrates Court								
Sound Pressure, Lp:	42.9	45.2	41.1	37.1	35.9	34.0	26.9	18.6

Calculation Sheet

GEF North Discharge to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF North Discharge								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-6.1
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-19.9	-22.7	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	28.2	17.5	17.3	7.5	1.2	-7.3	-15.5	-27.9

Calculation Sheet

WC North Discharge to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - WC North Discharge								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-0.9	-0.4	-0.6	-0.4	-0.4	-0.4	-0.4	-0.4
End Reflection & Directional Directivity								
	-6.6	-6.0	-7.7	-10.6	-13.8	-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								
	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-6.1
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-19.9	-22.7	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	28.2	17.5	17.3	7.5	1.2	-7.3	-15.5	-27.9

Calculation Sheet

North Supply Fan Inlet to Manchester Magistrates Court

	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
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Duct Losses								
	-1.0	-0.6	-0.4	-0.2	-0.2	-0.2	-0.2	-0.2
Bend Loss								
	-3.0	-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								
	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4	-45.4
Aatm - Atmospheric Absorption								
	0.0	0.0	-0.1	-0.1	-0.2	-0.5	-1.7	-6.1
Agr - Ground Attenuation								
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Abar - Barrier Attenuation								
	-19.9	-22.7	-23.0	-23.0	-23.0	-23.0	-23.0	-23.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	4.7	15.2	18.0	13.6	15.8	13.5	8.3	1.8

Calculation Sheet

GEF South Discharge A to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF South Discharge A								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
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
End Reflection & Directional Directivity								
	-1.2	1.3	2.7	3.7	4.4	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.2	-0.4	-1.5	-5.3
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 - Manchester Magistrates Court								
Sound Pressure, Lp:	54.7	47.2	49.6	43.5	41.1	34.0	25.9	14.1

Calculation Sheet

KEF Inlet to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - KEF Inlet								
Sound Power Levels	101.0	106.0	105.0	100.0	97.0	91.0	86.0	81.0
Silencer								
	-4.0	-7.0	-12.0	-18.0	-24.9	-19.9	-15.9	-11.0
Duct Break-Out								
	-7.8	-7.8	-8.8	-9.8	-12.8	-15.8	-19.8	-24.8
ISO 9613 Calculation								
	-36.0	-39.0	-39.0	-39.0	-39.1	-39.3	-40.1	-43.1
ISO 9613 Barrier Attenuation								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External Receiver								
External Receiver - Manchester Magistrates Court								
Sound Pressure, Lp:	53.2	52.2	45.2	33.1	20.2	16.0	10.2	2.1

Calculation Sheet

GEF South Discharge B to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - GEF South Discharge B								
Noise Levels	92.0	83.0	85.0	78.0	75.0	68.0	61.0	53.0
Silencer								
	-2.0	-2.0	-5.0	-12.0	-16.9	-11.9	-10.8	-8.9
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-2.9	-2.9
End Reflection & Directional Directivity								
	-1.2	1.3	2.7	3.7	4.4	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1	-44.1
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.2	-0.4	-1.5	-5.3
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 - Manchester Magistrates Court								
Sound Pressure, Lp:	53.7	45.2	43.6	28.5	21.2	19.1	12.3	2.4

Calculation Sheet

BOH Supply to Manchester Magistrates Court

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - BOH Supply								
Noise Levels	80.0	82.0	77.0	73.0	68.0	65.0	61.0	59.0
Silencer								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bend Loss								
	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0	-3.0
End Reflection & Directional Directivity								
	-3.1	0.2	2.1	3.2	4.0	4.5	4.5	4.5
Dc - Reflections & Directivity								
	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Adiv - Geometrical Divergence								
	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Aatm - Atmospheric Absorption								
	0.0	0.0	0.0	-0.1	-0.2	-0.5	-1.6	-5.9
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 - Manchester Magistrates Court								
Sound Pressure, Lp:	40.9	45.2	41.1	37.1	32.9	30.0	24.9	18.6

Appendix B

Noise Control Treatments

Attenuator Schedule

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
KEF Discharge		750L x 1300W x 1300H	4	7	12	18	25	20	16	11
KEF Inlet		750L x 1300W x 1300H	4	7	12	18	25	20	16	11
Supply Air South		1500L 40% Free Area	9	17	27	39	52	41	31	19
General Extract South B		315dia 625L	2	2	5	12	17	12	11	9

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.