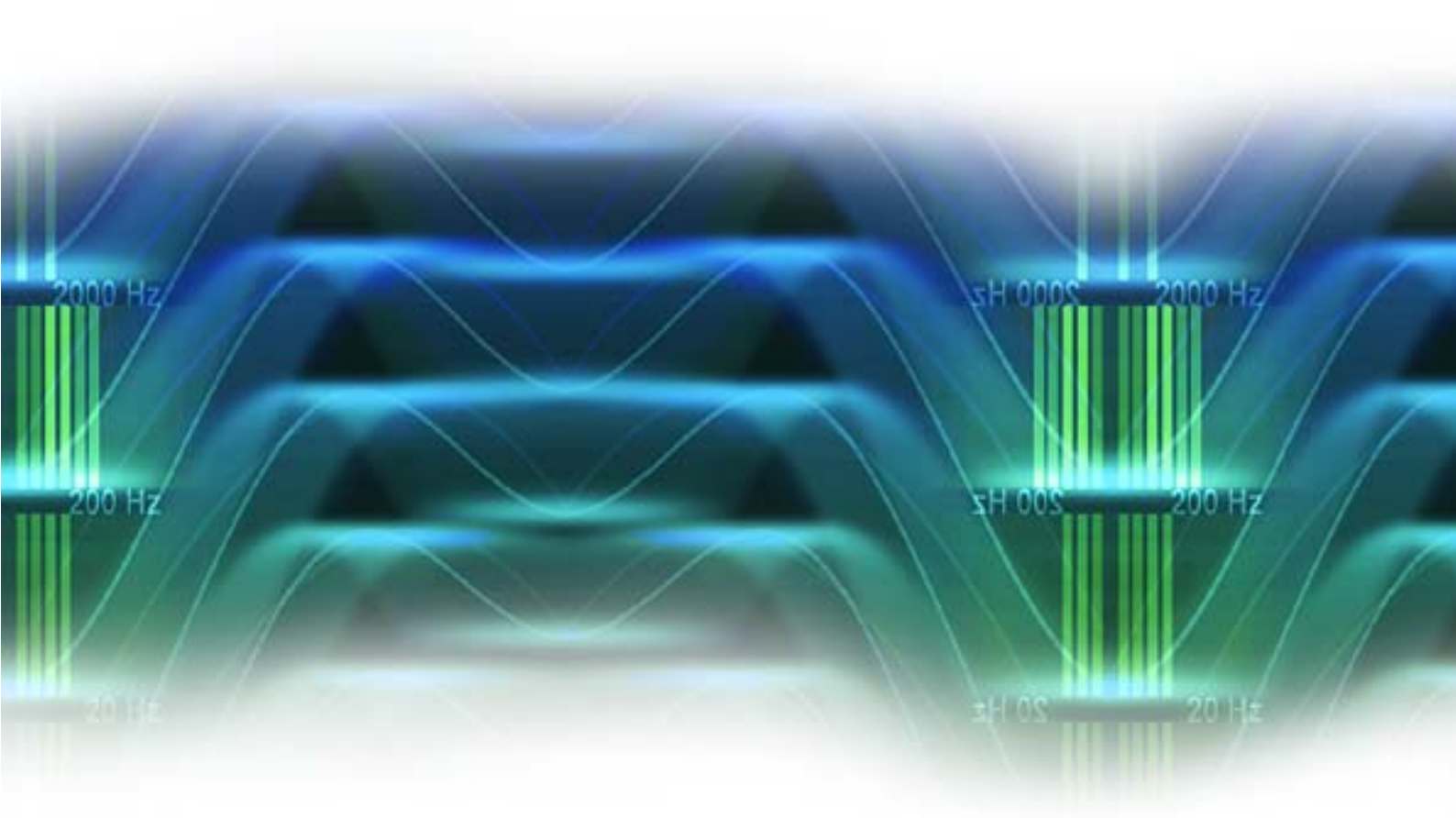
Planning Noise Assessment
for Proposed New Mechanical Plant
at URC, 86 Tavistock Place, London WC1H 9RT

Report ref.
JW1218/16182

Date
June 2016

Issued to
Peldon Rose Limited



Issued by
James Ward BSc(Hons) AMIOA
Senior Consultant

Spectrum
ACOUSTIC CONSULTANTS

SECTION **TITLE** **PAGE**

1. SUMMARY 1

2. INTRODUCTION 2

3. SITE DESCRIPTION AND PROPOSALS 2

3.1 GENERAL DESCRIPTION OF THE SITE AND AREA 2
3.2 DETAILS OF PLANT 2

4. CRITERIA 3

5. SURVEY 3

5.1 MEASUREMENT PROCEDURE 3
5.2 INSTRUMENTATION 3
5.3 MEASUREMENT RESULTS 4

6. ASSESSMENT 4

6.1 DESCRIPTION OF CALCULATIONS 4
6.2 INITIAL RESULTS 5
6.3 MITIGATED RESULTS 6

7. DISCUSSION 7

8. CONCLUSIONS 7

Appendix A: Aerial photograph of the site

Appendix B: Proposed site layout drawings

Appendix C: Noise survey results

Appendix D: Proposed plant datasheets

Appendix E: Proposed condenser acoustic enclosures

1. SUMMARY

- Peldon Rose Ltd propose to install new mechanical plant to as part of the refurbishment works to the United Reformed Church House, 86 Tavistock Place, London. The proposals include 4 large condenser units, one smaller condenser, and air handling unit installed externally in a courtyard to the rear of the building.
- The Local Authority, Camden Council, require a noise impact assessment in accordance with their current guidelines, to ensure that the proposed plant items meet their planning noise criteria.
- An ambient noise survey has been carried out over a 24 hour period to determine existing background noise levels in the area. The minimum background noise level during the night at the nearest noise-sensitive location was $L_{A90,5MIN}$ 35 dB. During office hours, when all plant will be operational, the minimum measured background noise level was $L_{A90,5MIN}$ 41 dB.
- This report describes the analysis carried out in determining the noise emission levels from the proposed condenser units and the resultant sound pressure levels outside the nearest noise-sensitive location for assessment purposes.
- An assessment in accordance with Camden's requirements shows that external noise levels at the receiver location will be 5 dB(A) or more below the lowest measured background noise level during the time when all plant may be operational. Outside of this period, when only a single condenser could operate, the plant noise level is predicted to be 9 dB(A) or more below the lowest measured background noise level.
- A number of conservative assumptions are included within the analysis that over-predicts the noise impact. In general, the actual noise impact will be below that considered here.
- Accordingly, the operation of the plant will comply with Camden Council's planning noise criteria to demonstrate it will not give rise to unacceptable levels of noise for nearby sensitive locations.

2. INTRODUCTION

Peldon Rose Limited propose to install new mechanical plant at the rear of the United Reformed Church House, 86 Tavistock Place, London as part of the fit-out works to the offices.

As part of planning policy Camden Council require an acoustic report to be prepared assessing the noise impact of the proposed mechanical plant installation.

Spectrum Acoustic Consultants have been commissioned to assess the noise impact from the proposed equipment.

This report presents the results of the assessment, including:

- Details of Camden Council's noise policy
- Measurements of existing background noise levels
- Manufacturers noise data for the proposed condenser units
- Predictions of noise levels to the nearest noise-sensitive receptor

3. SITE DESCRIPTION AND PROPOSALS

3.1 GENERAL DESCRIPTION OF THE SITE AND AREA

Peldon Rose Limited are carrying out fit-out works to offices at the United Reformed Church House, and are proposing the installation of new condensers and an air handling unit to serve these offices.

The subject building is 5 storeys high, which is predominantly offices belonging to the URC, however there are residential flats on the top floor. There is an enclosed courtyard at the rear of the building which is the proposed plant location. The ambient noise at this location is generally road traffic on surrounding roads.

The closest affected noise-sensitive properties to the proposed new condensers are the residential flats on the top floor of the URC House building. The windows of these flats do not directly overlook the courtyard as they are set back via a terrace, therefore the line of site to the proposed mechanical plant is interrupted.

Aerial photographs of the building are shown in Appendix A. Site layout drawings showing the proposed condenser location are shown in Appendix B.

3.2 DETAILS OF PLANT

The layout drawing in Appendix B shows the proposed new plant, which includes 5 condensers and an air handling unit. The air handling unit and 4 of the condensers supply heating/cooling to the offices and will only operate during office hours, which are 07:30-19:00. The remaining condenser cools the comms room and therefore could potentially operate at any time during a 24 hour period. Therefore the assessment shall consider the lowest measured background noise level corresponding to the potential operating times above.

Product datasheets for the proposed plant, including noise emission data, are given in Appendix D. The maximum sound power levels of the proposed equipment are summarised in Table 1 below.

No. of units	Manufacturer	Model	Lw, dB(A)
1	Mitsubishi	PURY-P300	86
3	Mitsubishi	PURY-P350	86
1	Mitsubishi	PUHZ-ZRP100KVA	63
1	Eco Air Box	EAB2000-TW-HP	74 (Inlet duct) 81 (Outlet duct)

Table 1: Maximum sound power level of proposed equipment

4. CRITERIA

The Camden Council Development Policy DP28 sets out the requirements for acceptability of noise from mechanical plant in Table E as shown below:

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB$L_{Aeq'}$

5. SURVEY

5.1 MEASUREMENT PROCEDURE

An unmanned 24 hour background noise survey has been carried out between 2nd and 3rd June 2016. The measurement position was located in the courtyard with the microphone extended up to 2nd floor level. Although the residential flats are located on the 4th floor of the building, the measurement position is still considered representative of the nearest noise-sensitive windows. The measurement location is indicated on Appendix A.

5.2 INSTRUMENTATION

The following instrumentation was used during the survey:

- Bruel & Kjaer Type 2260 Sound Level Meter s/n 2027587
- Bruel & Kjaer Type 4189 Microphone s/n 2906873
- Bruel & Kjaer Type 4231 Acoustic Calibrator s/n 2229825

Before and after the survey, the sound level meter was field-calibrated in accordance with the manufacturer's guidelines, and no significant drift was observed. The meter, microphone and field calibrator are laboratory calibrated biennially in accordance with UKAS procedures or to traceable National Standards.

5.3 MEASUREMENT RESULTS

Continuous measurements were taken over a 24-hour period, at 5 minute samples. Noise metrics consisted of equivalent continuous ($L_{Aeq,5min}$) noise levels and maximum (L_{Amax}) noise levels as well as statistical noise levels (termed Ln, where n is the percentage of time the level is exceeded during the measurement period) including $L_{A90,5min}$ levels (the noise level exceeded for 90% of the individual measurement period) which is taken to be the background noise level. Overall A-weighted measurements were stored for later analysis.

Results of the background noise survey are included graphically in Appendix C. Table 2 below summarises the measured noise levels and details the proposed equipment noise limit with regards to Camden Council's noise criteria.

Operating Period	Lowest measured background noise level $L_{A90,5min}$	Equipment noise limit L_{Aeq}
All plant on (07:30-19:00)	41	36
Comms condenser only (24 hours)	35	30

Table 2: Measured noise levels and resultant equipment noise limits (5 dB below the L_{A90} noise level as defined by Camden's DP28)

6. ASSESSMENT

6.1 DESCRIPTION OF CALCULATIONS

The proposed equipment datasheets are shown in Appendix D. The corresponding sound power levels are summarised in Table 1 above. Calculations of noise propagation from the plant were undertaken based on these sound power levels, which is the maximum noise output from each unit.

Noise propagation to the receptor location has been calculated based on the following conservative assumptions:

- Attenuation is due only to distance from noise source (geometric spreading).
- There is no atmospheric or ground absorption.
- All equipment is operating simultaneously at full duty

6.2 INITIAL RESULTS

The nearest noise-sensitive receptor is the top floor flat of the URC House building. The direct path distance between the proposed condenser and the window of this flat is 14m. There line of sight between the plant location and the flat is interrupted due to the building itself which steps out approximately 2m to accommodate a terrace. Therefore the receptor has a degree of screening from the proposed plant and an allowance of 6dB(A) reduction has been allowed for in the calculations below, which is a conservative estimate.

Plant Item	SWL, dB(A)	Distance to Receiver, m (r)	SPL at Receiver, dB $Lw - 10log\left(\frac{Q}{4\pi r^2}\right)$	Screening, dB(A)	Receiver Level, dB(A)
PURY-P250	84	14	55	-6	47
PURY-P300	86	14	55	-6	49
PURY-P400	86	14	55	-6	49
PURY-P400	86	14	55	-6	49
PUHZ-ZRP100KVA	63	14	32	-6	26
AHU Inlet	74	14	43	-6	37
AHU Outlet	81	14	50	-6	44
				Total	**55**

Table 3: Calculations of noise level at receptor location [*Directivity, Q=2*]

The external noise level from the proposed plant at the nearest sensitive window is calculated to be L_{Aeq} 55 dB. This is 14 dB(A) above the lowest measured background noise level of $L_{A90,5min}$ 41 dB, and therefore exceeds Camden's planning noise criterion by 19 dB(A).

Various noise mitigation measures have been discussed in detail with the Mechanical Contractor, including attenuators, enclosures and relocation of some items. Due to site constraints it is not possible to relocate any plant items, and therefore attenuators and enclosures have been sized and designed in order to meet the noise limit of 36 dB(A) at the receptor location. In summary, the necessary mitigation measures are:

- AHU inlet attenuator 1500mm long. Performance as specified in Table 4 below.
- AHU outlet attenuator 1800mm long. Performance as specified in Table 4 below.
- EnvironModula 2.2.25AC MES5 Acoustic Enclosure to house the PURY-P250 and P300 units
- EnvironModula 2.2.25AC MES6 Acoustic Enclosure to house both PURY-P400 units

Datasheets for the Environ acoustic enclosures are provided in Appendix E.

Attenuator	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
AHU Inlet 1500mm long	11.5	6	13	23	37	43	44	35	20
AHU Outlet 1800mm long	15.5	8	16	28	43	47	47	39	22

Table 4: AHU Attenuator Insertion Loss, provided by the manufacturer

6.3 MITIGATED RESULTS

Table 5 below summarises the predicted noise level including for the above attenuators and acoustic enclosures.

Plant Item	SWL, dB(A)	Distance to Receiver, m (r)	SPL at Receiver, dB $Lw - 10log\left(\frac{Q}{4\pi r^2}\right)$	Screening dB(A)	Enclosure/ Silencer Attenuation	Receiver Level, dB(A)
PURY-P250	84	14	55	-6	-20	27
PURY-P300	86	14	55	-6	-20	29
PURY-P400	86	14	55	-6	-20	29
PURY-P400	86	14	55	-6	-20	29
PUHZ-ZRP100KVA	63	14	32	-6	N/A	26
AHU Inlet	74	14	43	-6	-11.5	25.5
AHU Outlet	81	14	50	-6	-15.5	28.5
					Total	**36**

Table 3: Calculations of noise level at receptor location [*Directivity, Q=2*]

The external noise level from the proposed plant at the nearest sensitive window, with the proposed mitigation in place, is calculated to be L_{Aeq} 36 dB. This is 5 dB(A) below the lowest measured background noise level of $L_{A90,5min}$ 41 dB and therefore meets Camden Council's planning noise criterion.

For the 24 hour operation when only the comms room condenser (PUHZ-ZRP100KVA) is in operation, the predicted noise level at the nearest sensitive window is L_{Aeq} 26 dB. This is 9 dB(A) below the lowest measured background noise level of $L_{A90,5min}$ 35 dB and therefore meets Camden Council's planning noise criterion.

At more distant or shielded locations, this noise level will be even lower. Accordingly, acceptable noise levels which comply with the current noise standards will occur with the proposed plant following the above acoustic mitigation proposals.

7. DISCUSSION

The above analysis and the calculations indicate that acceptable plant noise conditions will be achieved at this development.

It must be borne in mind that, in carrying out this assessment, a number of conservative assumptions about noise emission from the plant have been included. These are:

- There is considerable acoustic and visual screening between the source and receiver provided by the building itself. The actual level of acoustic screening is likely to provide attenuation of more than the assumed 6 dB(A).
- There is considerable acoustic and visual screening between the source and receiver provided by the plant items which has not been included in the calculation process. For example, the AHU and associated ducting will further shield the condensers from direct line of site to the receptor location, therefore resulting in lower noise levels due to screening.
- The condensers operate at their full rated duty, all of the time. In fact, the function of the condenser is demand based, and therefore would only operate as and when at the required duty.
- The heating/cooling equipment is controlled by thermostatic controls. It is very unlikely that all equipment would operate together, as assumed in the predictions.
- This operating condition has been compared with the lowest L_{A90} noise levels, i.e. those that occur late at night when activity in the surrounding area is low. During the rest of the time background noise levels are higher, and therefore the noise impact will be less.

Accordingly, plant noise levels will generally be lower than predicted, with a resultant reduction in the likelihood of disturbance.

8. CONCLUSIONS

Peldon Rose Limited propose to install new external mechanical plant as part of their refurbishment works to the United Reformed Church House, 86 Tavistock Place, London. The proposals include 4 large condenser units, one smaller condenser, and and air handling unit installed externally in a courtyard to the rear of the building.

The Local Authority require a noise impact assessment to be carried out prior to the installation of any external mechanical plant items. A noise survey has been carried out to determine the existing ambient background levels, and noise emission from the proposed plant has been calculated at the nearest noise-sensitive receptor, which is a residential flat on the top floor of the subject building.

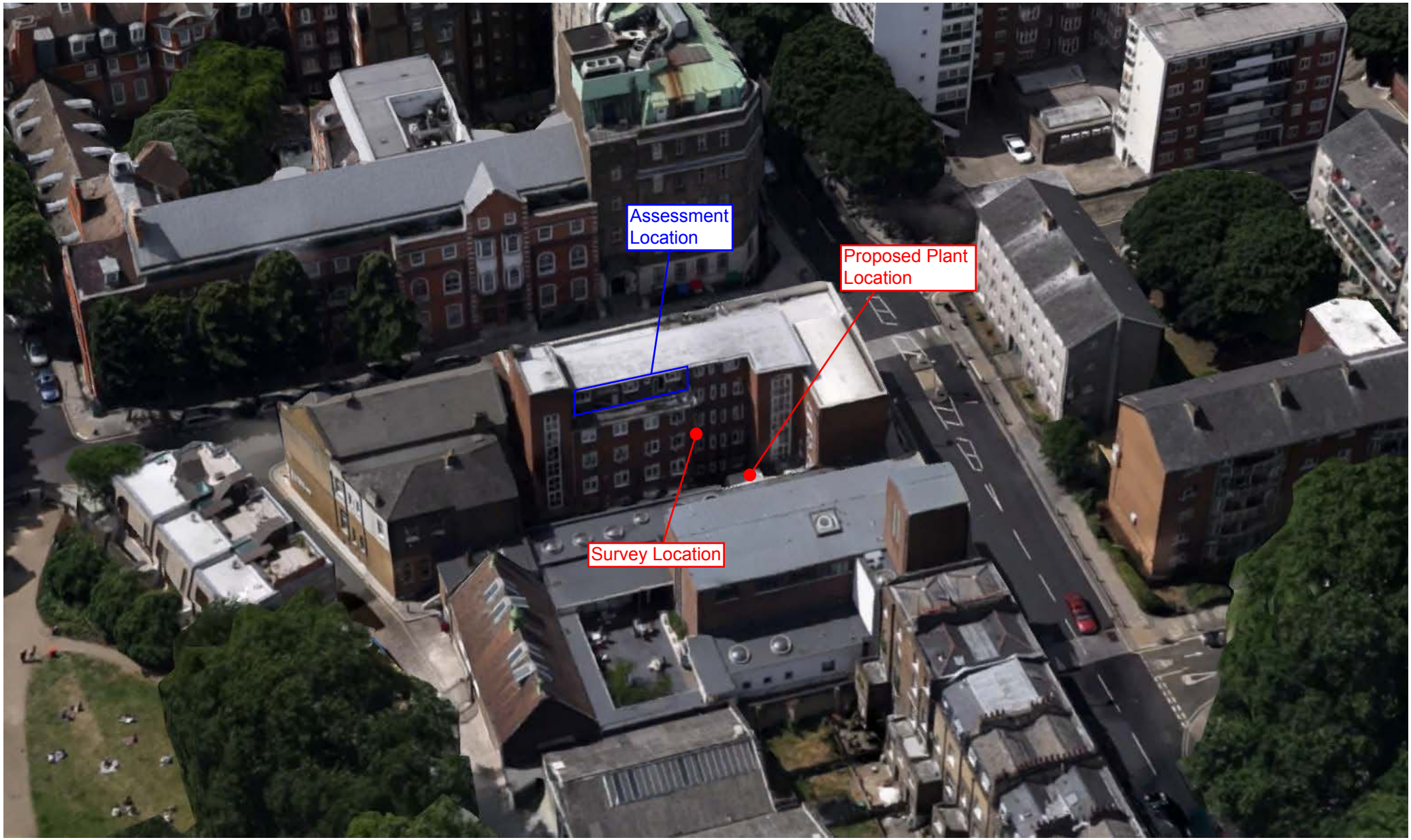
Noise from the proposed plant was initially calculated to exceed Camden Council's planning noise criterion at the nearest noise sensitive receptor. A scheme of acoustic mitigation has been designed in order to reduce predicted noise levels to the required figure, including high-performance acoustic enclosures for the condensers, and inlet and outlet attenuators for the AHU.

With the proposed scheme of acoustic mitigation in place, noise from the plant has been calculated to be L_{Aeq} 36 dB at the nearest noise-sensitive location, which is 5 dB(A) below the lowest measured background noise level, which meets Camden Council's planning noise criterion.

Report Code: A/PRA/EM

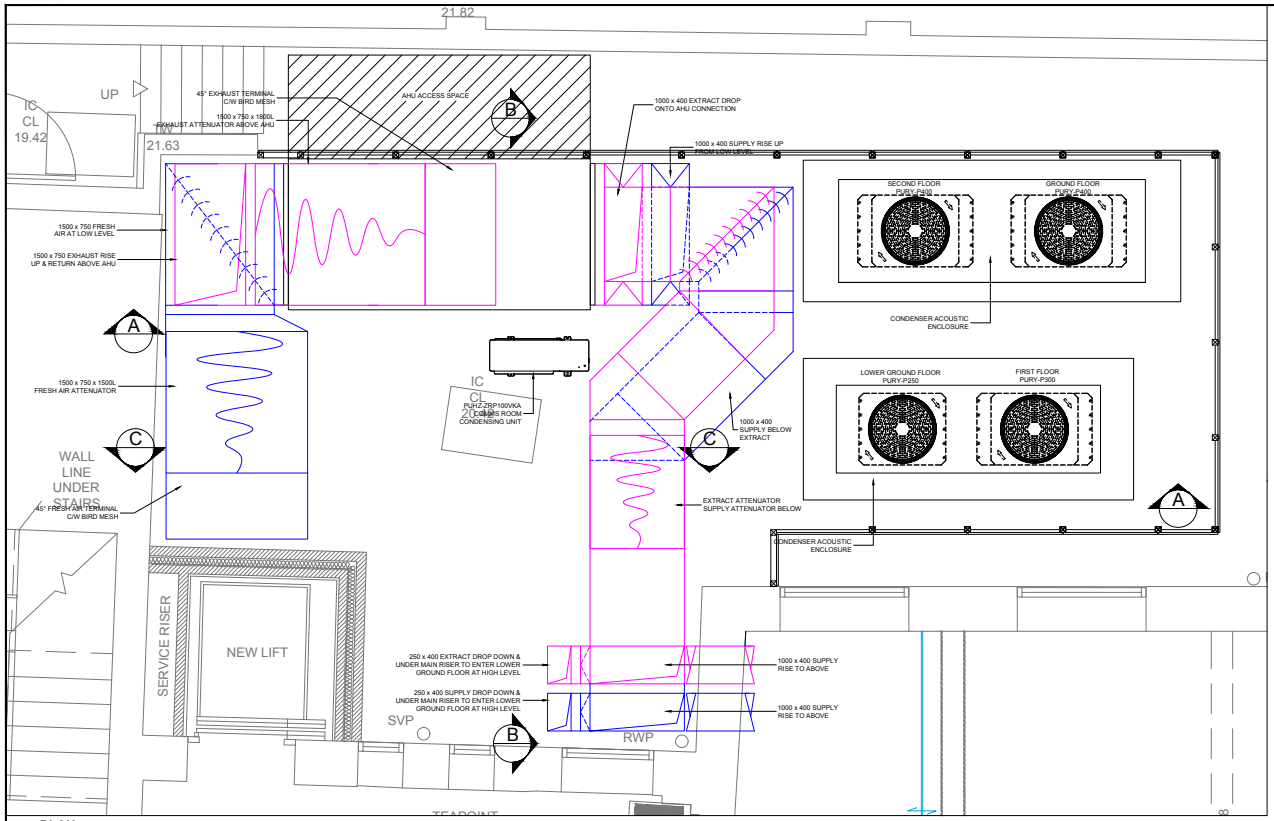
APPENDIX A

Aerial photograph of the site

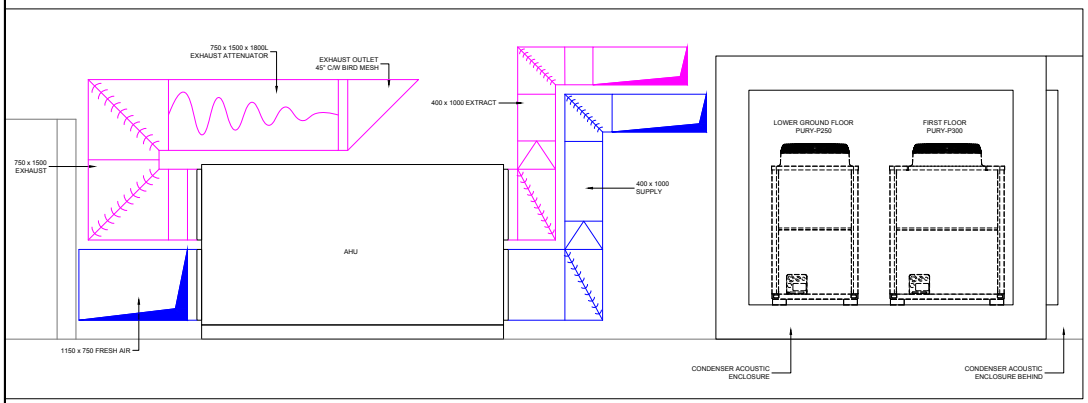

Assessment Location
Proposed Plant Location
Survey Location

APPENDIX B

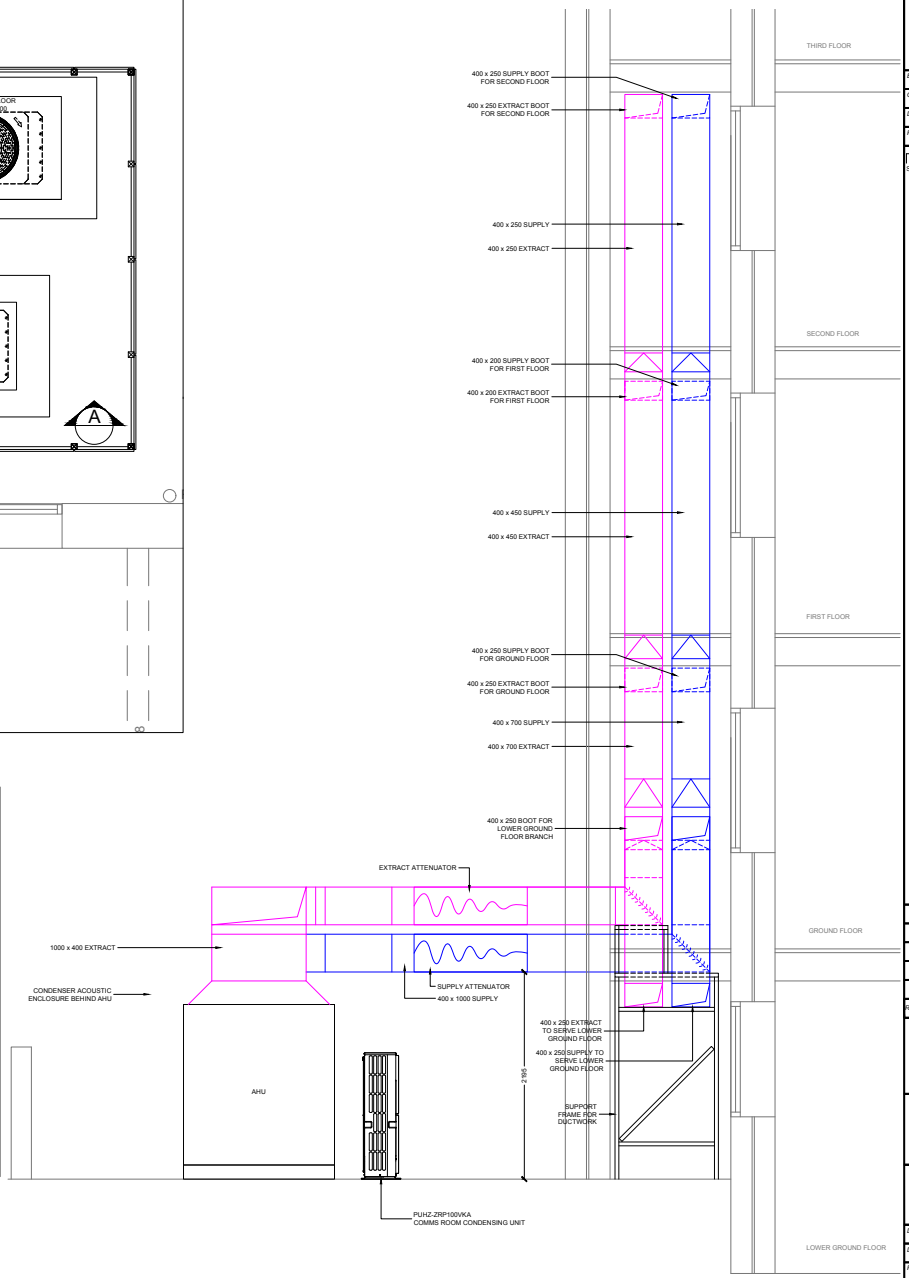
Proposed site layout drawings



PLAN
SCALE - 1:20



SECTION A-A
SCALE - 1:20



SECTION B-B
SCALE - 1:20

WARNING
- DO NOT SCALE THIS DRAWING.
- IF IN DOUBT ASK BEFORE ACTING.
- THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL OTHER BUILDING CITYSERVE MECHANICAL DRAWINGS ASSOCIATED WITH THIS PROJECT.
- ANY DISCREPANCIES MUST BE REPORTED TO CITYSERVE MECHANICAL OFFICE.

BASE DRAWING REFERENCE:

COMPANY: ARCHITECTS

DRAWING NUMBER: ##### ##### #####

REVISION: 0

SCALE CHECK @ 1:1

REV	DATE	REVISION DESCRIPTION	DRAWN BY
E	20/05/16	CONDENSER ACOUSTIC ENCLOSURES ROTATED	DP / DP
D	29/04/16	ATTENUATOR SIZES AMENDED. CONDENSER ACOUSTIC ENCLOSURES ADDED	DP / DP
C	15/04/16	NOTATION TO COMMS ROOM CONDENSING UNITS REVISED	DP / DP
B	13/04/16	NOTATION TO CONDENSING UNITS REVISED	DP / DP
A	25/03/16	REVISED LAYOUT FOLLOWING SITE SURVEY	DP / DP

CLIENT:
PELDON ROSE

PROJECT:
UNITED REFORM CHURCH
CHURCH HOUSE
86 TAVISTOCK PLACE
LONDON WC1H 9RT

DETAIL:
EXTERNAL PLANT LAYOUT

DRAWING No: CML152-M-05 SHEET 1 of 2

DRAWING STATUS: PROVISIONAL

REVISION: E

SCALE: 1:20 PAPER SIZE: A0

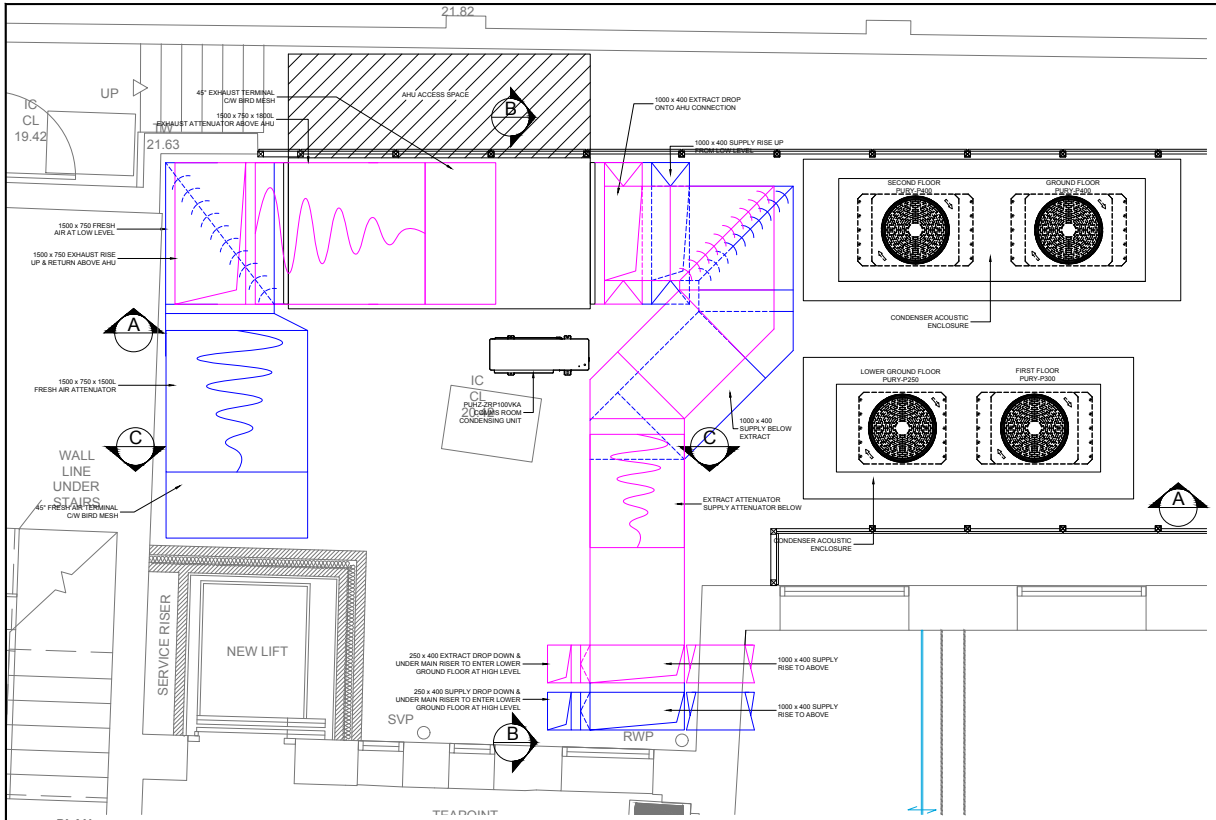
DATE: 20/05/16

CHECKED BY: MPD

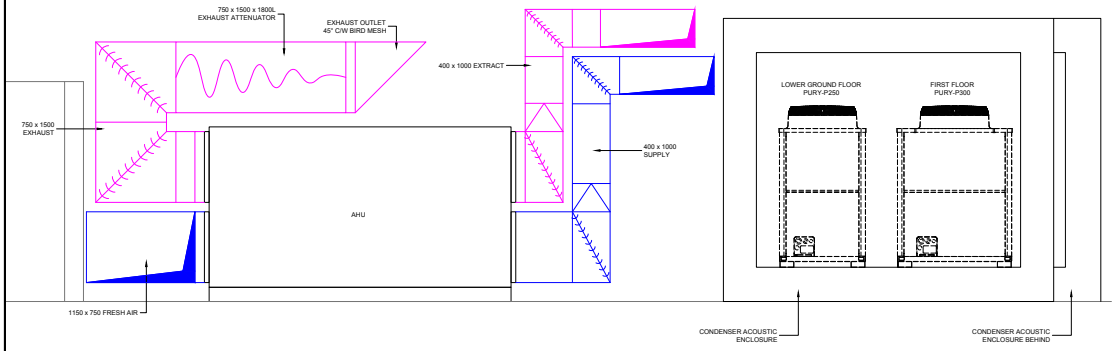
DRAWN BY: DP

CityServe Mechanical
Cooper House
Corbett Business Park
Shaw Lane, Stoke Prior
Bromsgrove, B60 4EA

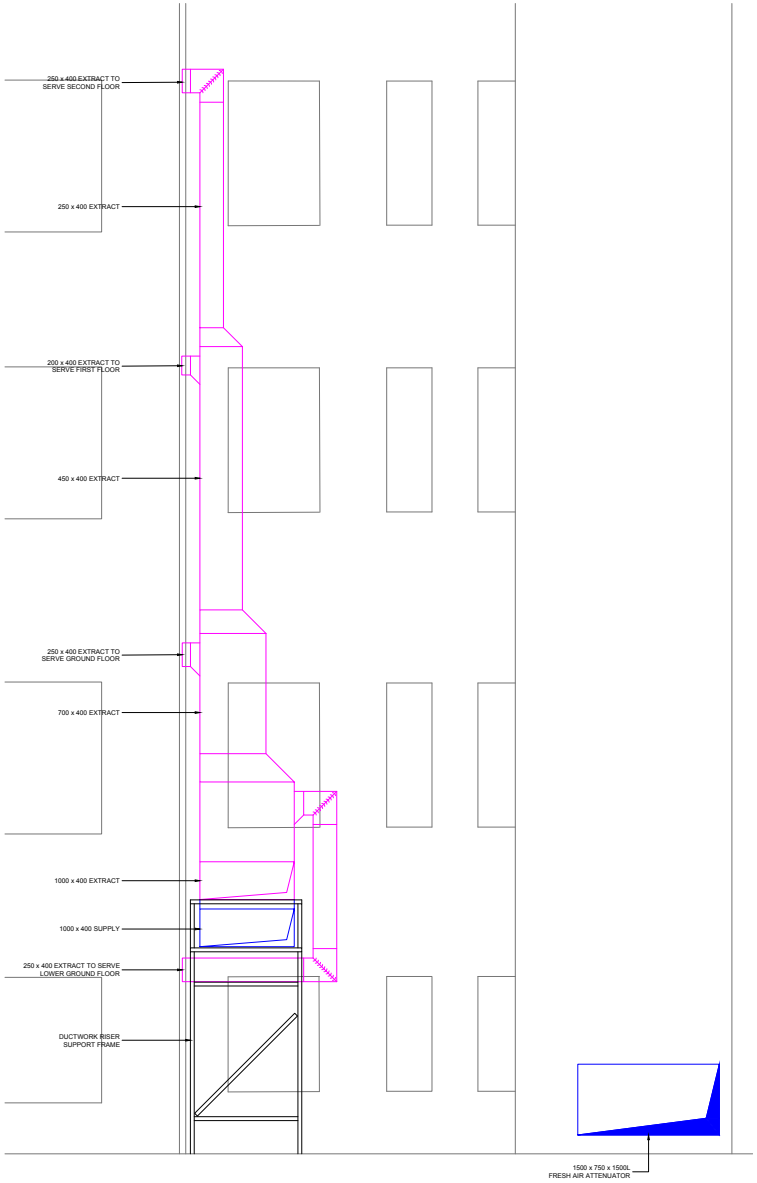
Tel: 01527492780



PLAN
SCALE - 1:20



SECTION A-A
SCALE - 1:20



SECTION C-C
SCALE - 1:20

WARNING
- DO NOT SCALE THIS DRAWING.
- IF IN DOUBT ASK BEFORE ACTING.
- THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL OTHER BUILDING CITYSERVE MECHANICAL DRAWINGS ASSOCIATED WITH THIS PROJECT.
- ANY DISCREPANCIES MUST BE REPORTED TO CITYSERVE MECHANICAL OFFICE.

BASE DRAWING REFERENCE:

COMPANY: ARCHITECTS

DRAWING NUMBER: ##### ##### #####

REVISION: 0

SCALE CHECK @ 1:1

REV	DATE	REVISION DESCRIPTION	DRAWN BY
E	20/06/16	CONDENSER ACOUSTIC ENCLOSURES ROTATED	DP / DP
D	29/06/16	ATTENUATOR SIZES AMENDED. CONDENSER ACOUSTIC ENCLOSURES ADDED	DP / DP
C	16/06/16	NOTATION TO COMMS ROOM CONDENSING UNITS REVISED	DP / DP
B	13/06/16	NOTATION TO CONDENSING UNITS REVISED	DP / DP
A	25/05/16	REVISED LAYOUT FOLLOWING SITE SURVEY	DP / DP

CLIENT:
PELDON ROSE

PROJECT:
UNITED REFORM CHURCH
CHURCH HOUSE
86 TAVISTOCK PLACE
LONDON WC1H 9RT

DETAIL:
EXTERNAL PLANT LAYOUT

DRAWING No: CML152-M-05 SHEET 2 of 2

DRAWING STATUS: PROVISIONAL

REVISION: E

SCALE: 1:20 PAPER SIZE: A0

DATE: 20/05/16

CHECKED BY: MPD

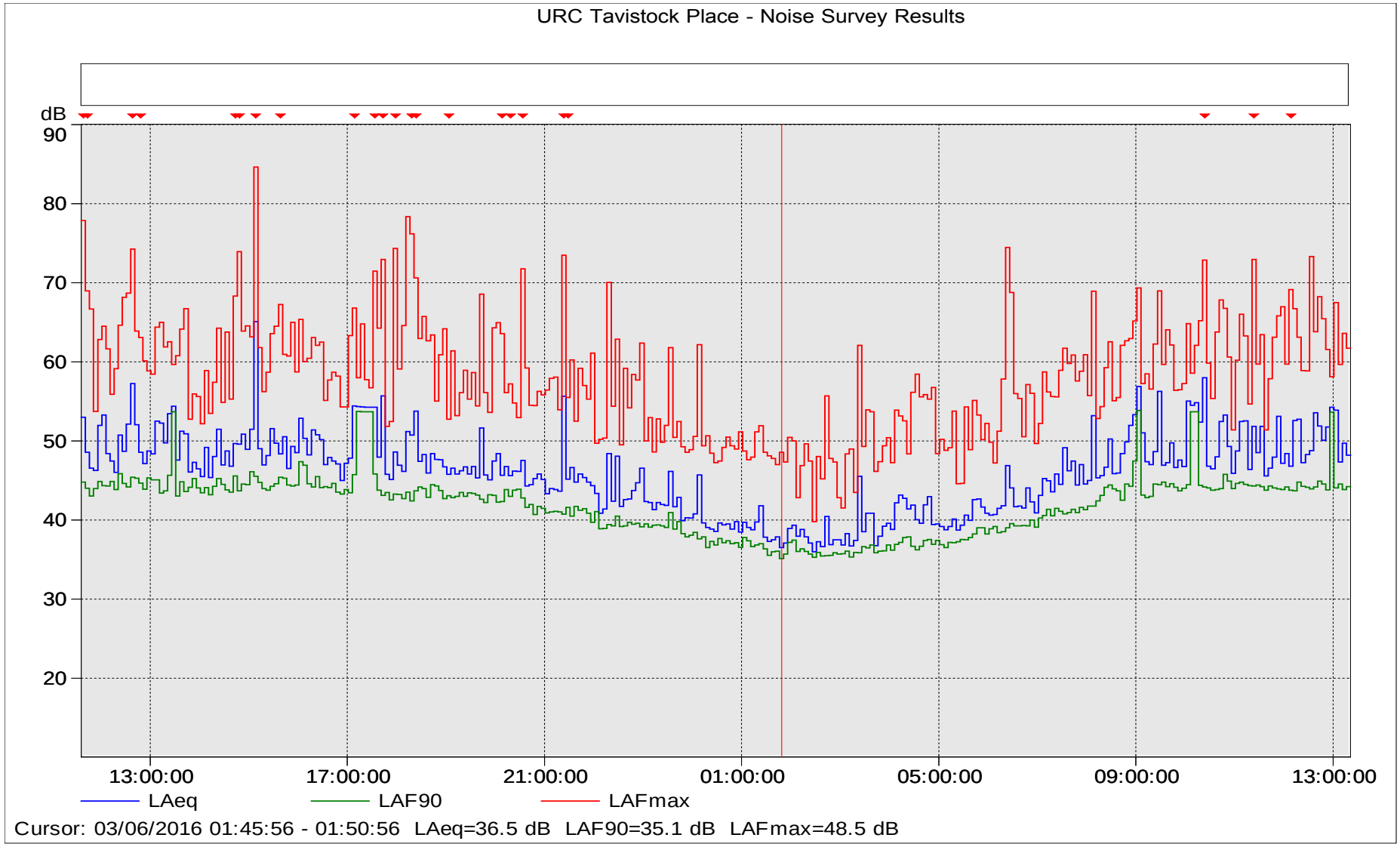
DRAWN BY: DP

CityServe Mechanical
Cooper House
Corbett Business Park
Shaw Lane, Stoke Prior
Bromsgrove, B60 4EA

Tel: 01527492780

APPENDIX C

Noise survey results


URC Tavistock Place - Noise Survey Results
dB
90
80
70
60
50
40
30
20
13:00:00
17:00:00
21:00:00
01:00:00
05:00:00
09:00:00
13:00:00
LAeq
LAF90
LAFmax
Cursor: 03/06/2016 01:45:56 - 01:50:56 LAeq=36.5 dB LAF90=35.1 dB LAFmax=48.5 dB

APPENDIX D

Proposed plant datasheets

OUTDOOR UNIT
R2 Series
PURY-P YLM-A1(-BS)

▸ Specifications

Model			PURY-P200YLM-A1 (-BS)	PURY-P250YLM-A1 (-BS)	PURY-P300YLM-A1 (-BS)	PURY-P350YLM-A1 (-BS)
Power source			3-phase 4-wire 380-400-415 V 50/60 Hz	3-phase 4-wire 380-400-415 V 50/60 Hz	3-phase 4-wire 380-400-415 V 50/60 Hz	3-phase 4-wire 380-400-415 V 50/60 Hz
Cooling capacity (Nominal)	*1	kW	22.4	28.0	33.5	40.0
	*1	BTU / h	76,400	95,500	114,300	136,500
	Power input	kW	5.29	6.98	9.10	11.76
	Current input	A	8.9-8.4-8.1	11.7-11.1-10.7	15.3-14.5-14.0	19.8-18.8-18.1
	EER	kW / kW	4.23	4.01	3.68	3.40
Temp. range of cooling *3	Indoor	W.B.	15.0~24.0°C (59~75°F)	15.0~24.0°C (59~75°F)	15.0~24.0°C (59~75°F)	15.0~24.0°C (59~75°F)
	Outdoor	D.B.	-5.0~46.0°C (23~115°F)	-5.0~46.0°C (23~115°F)	-5.0~46.0°C (23~115°F)	-5.0~46.0°C (23~115°F)
Heating capacity (Nominal)	*2	kW	25.0	31.5	37.5	45.0
	*2	BTU / h	85,300	107,500	128,000	153,500
	Power input	kW	5.49	7.32	9.37	11.59
	Current input	A	9.2-8.8-8.4	12.3-11.7-11.3	15.8-15.0-14.4	19.5-18.5-17.9
	COP	kW / kW	4.55	4.30	4.00	3.88
Temp. range of heating *3	Indoor	D.B.	15.0~27.0°C (59~81°F)	15.0~27.0°C (59~81°F)	15.0~27.0°C (59~81°F)	15.0~27.0°C (59~81°F)
	Outdoor	W.B.	-20.0~15.5°C (-4~60°F)	-20.0~15.5°C (-4~60°F)	-20.0~15.5°C (-4~60°F)	-20.0~15.5°C (-4~60°F)
Indoor unit connectable	Total capacity		50~150%	50~150% of outdoor unit capacity	50~150% of outdoor unit capacity	50~150% of outdoor unit capacity
	Model / Quantity		P15~P250/1~20	P15~P250/1~25	P15~P250/1~30	P15~P250/1~35
Sound pressure level (measured in anechoic room)		dB <A>	59	60	62.5	62.5
Sound power level (measured in anechoic room)		dB <A>	82.5	83.5	86	86
Refrigerant piping diameter	High pressure	mm (in.)	15.88 (5/8) Brazed	19.05 (3/4) Brazed	19.05 (3/4) Brazed	19.05 (3/4) Brazed
	Low pressure	mm (in.)	19.05 (3/4) Brazed	22.2 (7/8) Brazed	22.2 (7/8) Brazed	28.58 (1-1/8) Brazed
FAN	Type x Quantity		Propeller fan x 1	Propeller fan x 1	Propeller fan x 1	Propeller fan x 1
	Air flow rate	m^3/min	185	185	230	230
		L/s	3,083	3,083	3,833	3,833
		cfm	6,532	6,532	8,121	8,121
	Driving mechanism		Inverter-control, Direct-driven by motor	Inverter-control, Direct-driven by motor	Inverter-control, Direct-driven by motor	Inverter-control, Direct-driven by motor
	Motor output	kW	0.92 x 1	0.92 x 1	0.92 x 1	0.92 x 1
*4	External static press.		0 Pa (0 mmH_2O)	0 Pa (0 mmH_2O)	0 Pa (0 mmH_2O)	0 Pa (0 mmH_2O)
Compressor	Type x Quantity		Inverter scroll hermetic compressor	Inverter scroll hermetic compressor	Inverter scroll hermetic compressor	Inverter scroll hermetic compressor
	Starting method		Inverter	Inverter	Inverter	Inverter
	Motor output	kW	5.6	6.9	8.1	10.5
	Case heater	kW	–	–	–	–
External finish			Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>	Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>	Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>	Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>
External dimension HxWxD		mm	1,710 (1,650 without legs) x 920 x 740	1,710 (1,650 without legs) x 920 x 740	1,710 (1,650 without legs) x 1,220 x 740	1,710 (1,650 without legs) x 1,220 x 740
		in.	67-3/8 (65 without legs) x 36-1/4 x 29-3/16	67-3/8 (65 without legs) x 36-1/4 x 29-3/16	67-3/8 (65 without legs) x 48-1/16 x 29-3/16	67-3/8 (65 without legs) x 48-1/16 x 29-3/16
Protection devices	High pressure protection		High pressure sensor, High pressure switch at 4.15 MPa (601 psi)	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)
	Inverter circuit (COMP./FAN)		Over-heat protection, Over-current protection	Over-heat protection, Over-current protection	Over-heat protection, Over-current protection	Over-heat protection, Over-current protection
	Compressor		–	–	–	–
	Fan motor		–	–	–	–
Refrigerant	Type x original charge		R410A x 9.5 kg (21 lbs)	R410A x 9.5 kg (21 lbs)	R410A x 10.3 kg (23 lbs)	R410A x 10.3 kg (23 lbs)
Net weight		kg (lbs)	205 (452)	205 (452)	248 (547)	248 (547)
Heat exchanger			Salt-resistant cross fin & copper tube	Salt-resistant cross fin & copper tube	Salt-resistant cross fin & copper tube	Salt-resistant cross fin & copper tube
Optional parts			Joint: CMY-Y102SS-G2, CMY- Y102LS-G2,CMY-R160-J1 BC controller: CMB-P104,105,106,108, 1010,1013,1016V-G1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104, 108V-GB1,CMB-P1016V-HB1	Joint: CMY-Y102SS-G2, CMY-Y102LS-G2,CMY-R160-J1 BC controller: CMB-P104,105,106,108, 1010,1013,1016V-G1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104, 108V-GB1,CMB-P1016V-HB1	Joint: CMY-Y102SS-G2, CMY-Y102LS-G2,CMY-R160-J1 BC controller: CMB-P104,105,106,108, 1010,1013,1016V-G1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104, 108V-GB1,CMB-P1016V-HB1	Joint: CMY-Y102SS-G2, CMY-Y102LS-G2,CMY-R160-J1 BC controller: CMB-P104,105,106,108, 1010,1013,1016V-G1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104, 108V-GB1,CMB-P1016V-HB1

Notes:

*1,*2 Nominal conditions

	Indoor	Outdoor	Pipe length	Level difference
Cooling	27ºC DB/19ºC WB (81ºF DB/66ºF WB)	35ºC DB/24ºC WB (95ºF DB/75ºF WB)	7.5m (24-9/16ft.)	0m (0ft.)
Heating	20ºC DB(68ºF DB)	7ºC DB/6ºC WB(45ºF DB/43ºF WB)	7.5m (24-9/16ft.)	0m (0ft.)

*3 -5ºC DB (23ºF DB) / -6ºC WB (21ºF WB) to 21ºC DB (70ºF DB) / 15.5ºC WB (60ºF WB) with cooling/heating mixed operation.
*4 External static pressure option is available (30Pa, 60Pa / 3.1mmH_2O, 6.1mmH_2O).
*Nominal condition *1,*2 are subject to JIS B8615-2.
*Due to continuing improvement, above specification may be subject to change without notice.

OUTDOOR UNIT
R2 Series
PURY-P YLM-A1(-BS)

▸ Specifications

Model			PURY-P400YLM-A1 (-BS)	PURY-P450YLM-A1 (-BS)	PURY-P500YLM-A1 (-BS)
Power source			3-phase 4-wire 380-400-415 V 50/60 Hz	3-phase 4-wire 380-400-415 V 50/60 Hz	3-phase 4-wire 380-400-415 V 50/60 Hz
Cooling capacity (Nominal)	*1	kW	45.0	50.0	56.0
	*1	BTU / h	153,500	170,600	191,100
	Power input	kW	13.71	14.32	17.77
	Current input	A	23.1-21.9-21.1	24.1-22.9-22.1	29.9-28.4-27.4
	EER	kW / kW	3.28	3.49	3.15
Temp. range of cooling *3	Indoor	W.B.	15.0~24.0°C (59~75°F)	15.0~24.0°C (59~75°F)	15.0~24.0°C (59~75°F)
	Outdoor	D.B.	-5.0~46.0°C (23~115°F)	-5.0~46.0°C (23~115°F)	-5.0~46.0°C (23~115°F)
Heating capacity (Nominal)	*2	kW	45.0	56.0	58.0
	*2	BTU / h	153,500	191,100	197,900
	Power input	kW	11.42	14.93	16.06
	Current input	A	19.2-18.3-17.6	25.2-23.9-23.0	27.1-25.7-24.8
	COP	kW / kW	3.94	3.75	3.61
Temp. range of heating *3	Indoor	D.B.	15.0~27.0°C (59~81°F)	15.0~27.0°C (59~81°F)	15.0~27.0°C (59~81°F)
	Outdoor	W.B.	-20.0~15.5°C (-4~60°F)	-20.0~15.5°C (-4~60°F)	-20.0~15.5°C (-4~60°F)
Indoor unit connectable	Total capacity		50~150% of outdoor unit capacity	50~150% of outdoor unit capacity	50~150% of outdoor unit capacity
	Model / Quantity		P15~P250/1~40	P15~P250/1~45	P15~P250/1~50
Sound pressure level (measured in anechoic room)		dB <A>	62.5	62.5	63.5
Sound power level (measured in anechoic room)		dB <A>	86	86	87
Refrigerant piping diameter	High pressure	mm (in.)	22.2 (7/8) Brazed	22.2 (7/8) Brazed	22.2 (7/8) Brazed
	Low pressure	mm (in.)	28.58 (1-1/8) Brazed	28.58 (1-1/8) Brazed	28.58 (1-1/8) Brazed
FAN	Type x Quantity		Propeller fan x 1	Propeller fan x 2	Propeller fan x 2
	Air flow rate	m^3/min	230	320	380
		L/s	3,833	5,333	6,333
		cfm	8,121	11,299	13,418
	Driving mechanism		Inverter-control, Direct-driven by motor	Inverter-control, Direct-driven by motor	Inverter-control, Direct-driven by motor
	Motor output	kW	0.92 x 1	0.92 x 2	0.92 x 2
*4	External static press.		0 Pa (0 mmH_2O)	0 Pa (0 mmH_2O)	0 Pa (0 mmH_2O)
Compressor	Type x Quantity		Inverter scroll hermetic compressor	Inverter scroll hermetic compressor	Inverter scroll hermetic compressor
	Starting method		Inverter	Inverter	Inverter
	Motor output	kW	10.9	12.4	13.4
	Case heater	kW	–	–	–
External finish			Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>	Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>	Pre-coated galvanized steel sheets (+powder coating for -BS type) <MUNSELL 5Y 8/1 or similar>
External dimension HxWxD		mm	1,710 (1,650 without legs) x 1,220 x 740	1,710 (1,650 without legs) x 1,750 x 740	1,710 (1,650 without legs) x 1,750 x 740
		in.	67-3/8 (65 without legs) x 48-1/16 x 29-3/16	67-3/8 (65 without legs) x 68-15/16 x 29-3/16	67-3/8 (65 without legs) x 68-15/16 x 29-3/16
Protection devices	High pressure protection		High pressure sensor, High pressure switch at 4.15 MPa (601 psi)	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)	High pressure sensor, High pressure switch at 4.15 MPa (601 psi)
	Inverter circuit (COMP./FAN)		Over-heat protection, Over-current protection	Over-heat protection, Over-current protection	Over-heat protection, Over-current protection
	Compressor		–	–	–
	Fan motor		–	–	–
Refrigerant	Type x original charge		R410A x 10.3 kg (23 lbs)	R410A x 11.8 kg (27 lbs)	R410A x 11.8 kg (27 lbs)
Net weight		kg (lbs)	246 (543)	321 (708)	321 (708)
Heat exchanger			Salt-resistant cross fin & copper tube	Salt-resistant cross fin & copper tube	Salt-resistant cross fin & copper tube
Optional parts			Joint: CMY-Y102SS-G2,CMY-Y102LS-G2,CMY-R160-J1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104,108V-GB1,CMB-P1016V-HB1	Joint: CMY-Y102SS-G2,CMY-Y102LS-G2,CMY-R160-J1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104,108V-GB1,CMB-P1016V-HB1	Joint: CMY-Y102SS-G2,CMY-Y102LS-G2,CMY-R160-J1 Main BC controller: CMB-P108,1010,1013,1016V-GA1 Sub BC controller: CMB-P104,108V-GB1,CMB-P1016V-HB1

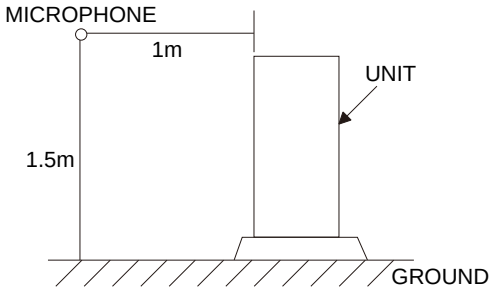
Notes:

*1,*2 Nominal conditions

	Indoor	Outdoor	Pipe length	Level difference
Cooling	27°C DB/19°C WB (81°F DB/66°F WB)	35°C DB/24°C WB (95°F DB/75°F WB)	7.5m (24-9/16ft.)	0m (0ft.)
Heating	20°C DB(68°F DB)	7°C DB/6°C WB(45°F DB/43°F WB)	7.5m (24-9/16ft.)	0m (0ft.)

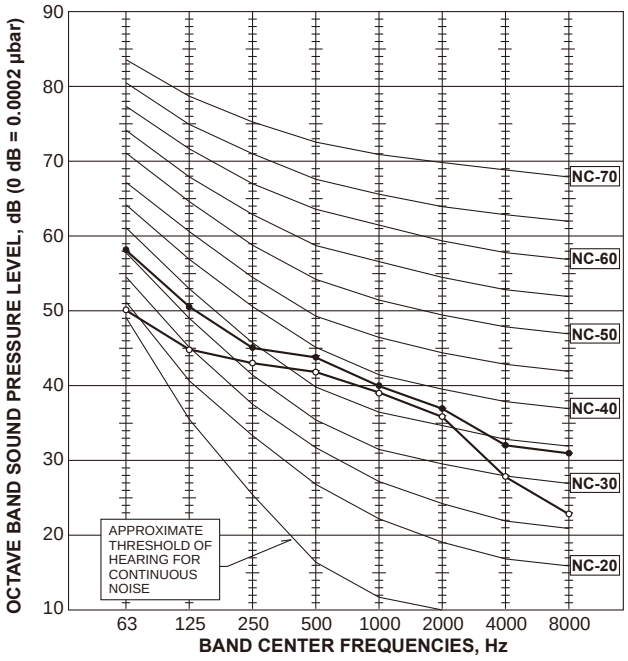
*3 -5°C DB (23°F DB) / -6°C WB (21°F WB) to 21°C DB (70°F DB) / 15.5°C WB (60°F WB) with cooling/heating mixed operation.
*4 External static pressure option is available (30Pa, 60Pa / 3.1mmH_2O, 6.1mmH_2O).
*Nominal condition *1,*2 are subject to JIS B8615-2.
*Due to continuing improvement, above specification may be subject to change without notice.

6-3. NOISE CRITERION CURVES



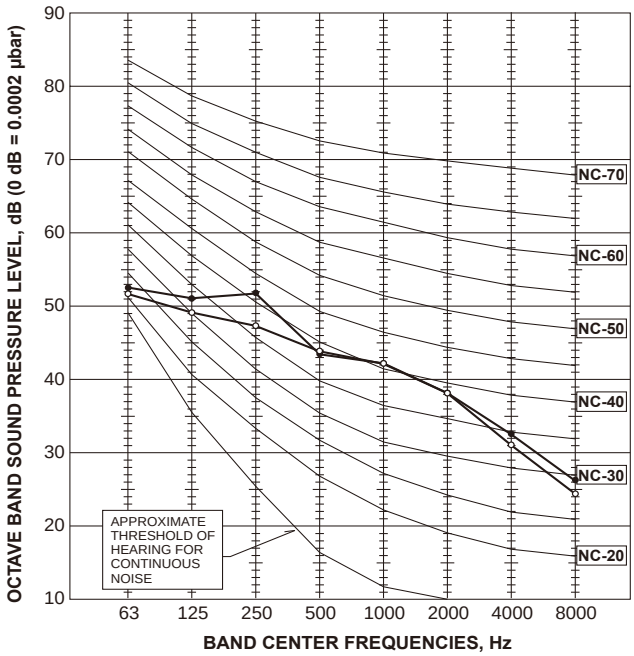
PUHZ-ZRP35VKA
PUHZ-ZRP35VKAR1(-ER/-ET)
PUHZ-ZRP50VKA
PUHZ-ZRP50VKAR1(-ER/-ET)

MODE	SPL(dB)	LINE
COOLING	44	
HEATING	46	



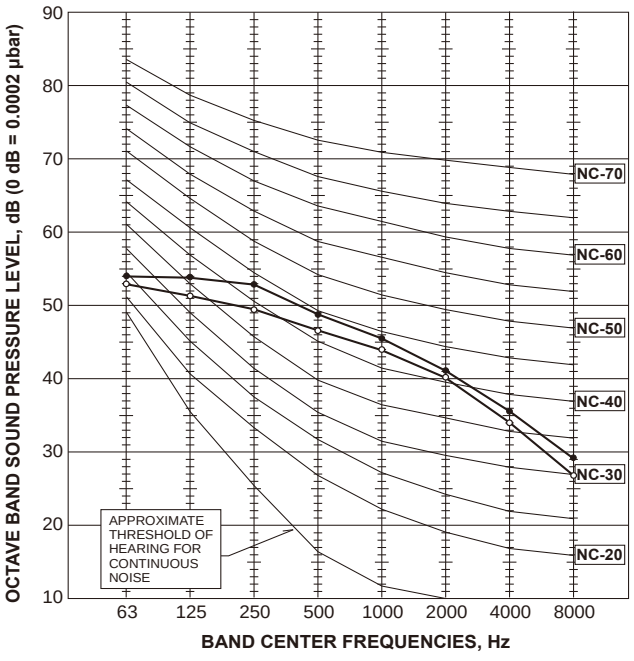
PUHZ-ZRP60VHA
PUHZ-ZRP60VHAR1(-ER/-ET)
PUHZ-ZRP71VHA
PUHZ-ZRP71VHAR1(-ER/-ET)

MODE	SPL(dB)	LINE
COOLING	47	
HEATING	48	



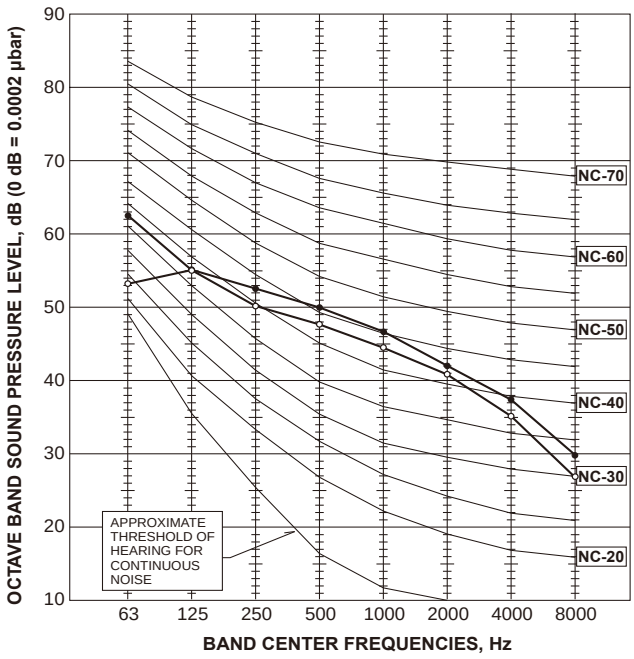
PUHZ-ZRP100VKA
PUHZ-ZRP100YKA
PUHZ-ZRP100YKAR1

MODE	SPL(dB)	LINE
COOLING	49	
HEATING	51	



PUHZ-ZRP125/140VKA
PUHZ-ZRP125/140YKA
PUHZ-ZRP125/140YKAR1

MODE	SPL(dB)	LINE
COOLING	50	
HEATING	52	



ECO AIR BOX PACKAGED HEAT RECOVERY AHU

Unit section (in direction of airflow):- Supply

1. Inlet spigot connection c/w 30mm flanges.
2. Open / Close damper.
3. Multi pocket Bag filters (F7).
4. **THERMAL WHEEL** heat exchanger c/w purge sector.
5. Supply 'EC' fans.
6. DX Coil – Reverse Cycle.
7. Supply duct connection spigot c/w 30mm Flanges.

Unit section (in direction of airflow):- Extract

1. Extract duct connection spigot c/w 30mm flanges.
2. Open / Close damper.
3. Panel filters (G4).
4. Digital scroll compressor section.
5. **THERMAL WHEEL** heat exchanger c/w purge sector.
6. Extract 'EC' fans.
7. Condensing Coil – Reverse Cycle.
8. Exhaust spigot.

ECO AIR BOX HEAT RECOVERY AHU – TECHNICAL SCHEDULE

Model number:	EAB2000-TW-HP	Quantity	1 (One)	Quotation No.	EABQ529
Project	United Reform Church			Unit Reference	AHU 1

DIMENSIONS – UNIT SUPPLIED IN ONE SECTION (DOUBLE DECK Arrangement)

Length	3200 mm		
Height	1700 mm (Exc: Base)	Approx dry Weight	1205 kg
Width	1600 mm		

AHU Features:-

1. 25mm Double skin infill and access panels
2. 0.7mm Galvanised inner panel.
3. 0.7 mm Plastisol outer panel.
4. Built in control system with Trend controller.
5. 100mm Base.

EER Cooling 6.00
EER Heating 10.58
Includes fan, compressor and Thermal Wheel

SUPPLY

MOTORISED DAMPER

Type	Opposed blade	Operation	Open / Close control

BAG FILTERS

Type	Multi Pocket	Efficiency	F7	100% RH Suitable

THERMAL WHEEL HEAT EXCHANGER HEATING

Type	Sorption wheel	Efficiency	68.2 %	Recovered kW	63.8 kW
Supply Air	-5 to 12.7 °C off the thermal wheel			Return Air On	21°C

THERMAL WHEEL HEAT EXCHANGER COOLING

Type	Sorption wheel	Efficiency	67.8 %	Recovered kW	29.5 kW
Supply Air	30 to 25.3 °C off the thermal wheel			Return Air On	23°C

FAN DETAILS – EC SUPPLY FAN (Speed controlled) **1 x GR50C**

Air Volume	2.00 m^3/s	External Resistance Pa MAX	250 Pa
Abs Power	1.783 kW (Medium Filter)	Motor Rated Power	3.5 kW

SUPPLY FAN SOUND POWER LEVEL

Spectrum	63	125	250	500	1k	2k	4k	8k
To Inlet	66	75	74	71	68	66	63	59
To Outlet	69	81	79	78	77	72	70	65

DX COIL - COOLING MODE

Type	R410a		
Duty	21.7 kW	Construction	Copper / Alu fins
Supply Air	25.3 °C On 17.2 °C Off	Total cooling in kW Inc Recovery	51.2

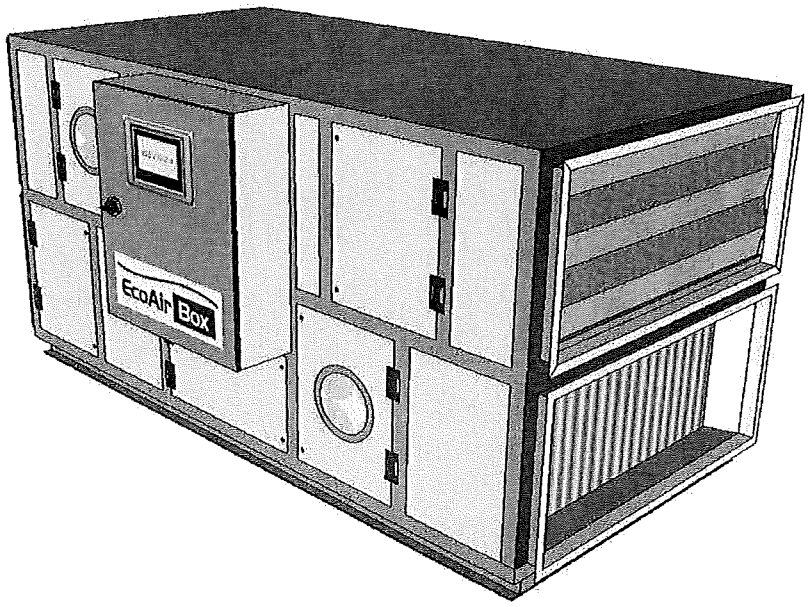
DX COIL - HEATING MODE

Type	R410a		
Duty	26.5 kW	Construction	Copper / Alu fins
Supply Air	12.7 °C On 23.65 °C Off	Total Heating in kW Inc Recovery	90.3

EXTRACT									
MOTORISED DAMPER									
Type	Opposed blade			Operation		Open / Close Control			
PANEL FILTERS									
Type	Panel			Efficiency		G4			
COMPRESSOR (Digital)									
Type	Scroll Compressor		ZPD72KCE-TFD			R410a			
Capacity	21.7 kW Cooling		26.5 kW Heating			Circuits			1
kW Input	5.02 kW					Evap °C	11.00	Cond °C	48.00
FAN DETAILS – EC EXTRACT FAN (Speed controlled)					**1 x GR50C**				
Air Volume	2.00	m^3/s				External Resistance Pa MAX			250 Pa
Abs Power	1.735	kW (Medium Filter)				Motor Rated Power		3.5	kW
EXTRACT FAN SOUND POWER LEVEL									
Spectrum	63	125	250	500	1k	2k	4k	8k	
To Inlet	66	75	73	71	67	66	63	59	
To Outlet	68	82	79	78	77	72	69	65	
CONDENSING COIL									
Type	R410a		Construction	Copper Tubes / Aluminium Fins					

Whole Unit SFP = **1.76** **On clean filter condition of our model EAB2000-TW-HP**
At the average supply / extract air volume of 2.00 m^3/s

Important note:
All fan data based on maximum air volume at an external resistance of 250 Pa Supply and 250Pa Extract.



APPENDIX E

Proposed condenser acoustic enclosures

Tel: 0870 383 3344
www.environ.co.uk

SELECTION MATRIX

environmodula 2.2.25AC MES5

24 June 2016

Acoustic enclosures for VRV/VRF Applications

CUSTOMER:	SITE / LOCATION / REFERENCE

ORIGINAL EQUIPMENT MANUFACTURERS PUBLISHED DATA

MAKE, MODEL, DIMENSIONS, AIR FLOW & SOUND PRESSURE LEVEL @1.0M FREE FIELD

MAKE:	MODEL:	AIR IN	AIR OUT
Mitsubishi Electric	PURY-P250 + PURY-P300	H-3 sides	V

WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)	AIRFLOW (M^3S^{-1})	SPL dB(A)	DISTANCE (M)
920+1220	740	1710	6.83	63	1

INNER CUBE DIMENSIONS		
2800	930	2275
WIDTH (MM)	817	HEIGHT (MM)
6.83	1.0	63
AIRFLOW (M^3S^{-1})	DISTANCE (M)	SPL dB(A)

ENCLOSURE DETAIL		
3500	1500	2925
WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
6.8	1.0	37-43
AIRFLOW (M^3S^{-1})	DISTANCE (M)	SPL dB(A) Range

INLET AIRWAYS		
2800	300	2
WIDTH (MM)	HEIGHT (MM)	NO.

DESIGN CRITERIA		
OK	OK	OK
UNIT SIZE	OUTLET	INLET

OUTLET AIRWAYS		
300	2925	2
WIDTH (MM)	HEIGHT (MM)	NO.

AIRFLOW INFORMATION		
20	3.9	4.1
PD (NM^{-2})	OUTLET (MS^{-1})	INLET (MS^{-1})

Select Inlet & Outlet Duct Sizes to Ensure Airflows are kept Below 6.0m/s

ENCLOSURE INFORMATION	WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
INLET AIRWAY	2800		300
OUTLET AIRWAY	300		2925
GENERAL DIMENSIONS	3500	1500	3000
Estimated SOUND LEVEL RANGE @ 1.0 m (Sound Pressure dB)	37-43	SPL dB(A) Free Field	

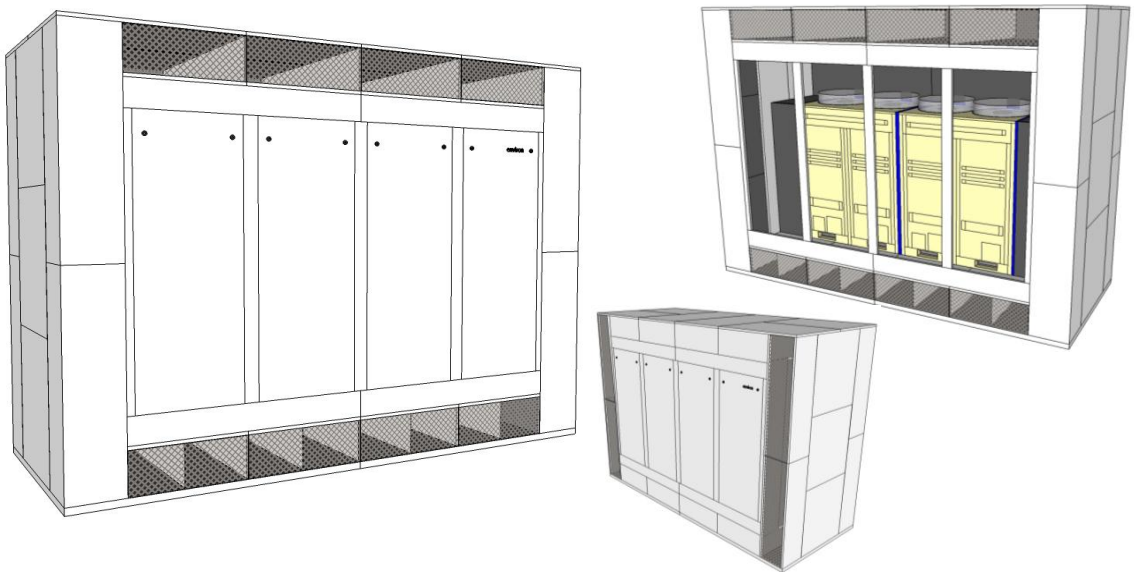
NOTES CONCERNING ENCLOSURE DESIGN

Combined Air Flow & Noise

Weight 1500kg

Removable Door Mullions/Panels for CDM Access Compliance.

*Estimated Sound Levels based on Free Field Conditions



Tel: 0870 383 3344
www.environ.co.uk

SELECTION MATRIX

environmodula 2.2.25AC MES6

24 June 2016

Acoustic enclosures for VRV/VRF/Chiller Applications

CUSTOMER:	SITE / LOCATION / REFERENCE

ORIGINAL EQUIPMENT MANUFACTURERS PUBLISHED DATA

MAKE, MODEL, DIMENSIONS, AIR FLOW & SOUND PRESSURE LEVEL @1.0M FREE FIELD

MAKE:	MODEL:	AIR IN	AIR OUT
Mitsubishi Electric	PURY-P800YLM-A	H - 3 Sides	Top

WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)	AIRFLOW (M^3S^{-1})	SPL dB(A)	DISTANCE (M)
1220 + 1220	740	1710	7.66	65	1

INNER CUBE DIMENSIONS		
3250	1090	2525
WIDTH (MM)	817	HEIGHT (MM)
7.66	1.0	65
AIRFLOW (M^3S^{-1})	DISTANCE (M)	SPL dB(A)

ENCLOSURE DETAIL		
4000	1500	3000
WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
7.7	1.0	40-45
AIRFLOW (M^3S^{-1})	DISTANCE (M)	Estimated SPL dB(A)

INLET AIRWAYS		
3600	300	2
WIDTH (MM)	HEIGHT (MM)	NO.

DESIGN CRITERIA		
OK	OK	OK
UNIT SIZE	OUTLET	INLET

OUTLET AIRWAYS		
325	2925	2
WIDTH (MM)	HEIGHT (MM)	NO.

AIRFLOW INFORMATION		
15	4.0	3.5
PD (NM^{-2})	OUTLET (MS^{-1})	INLET (MS^{-1})

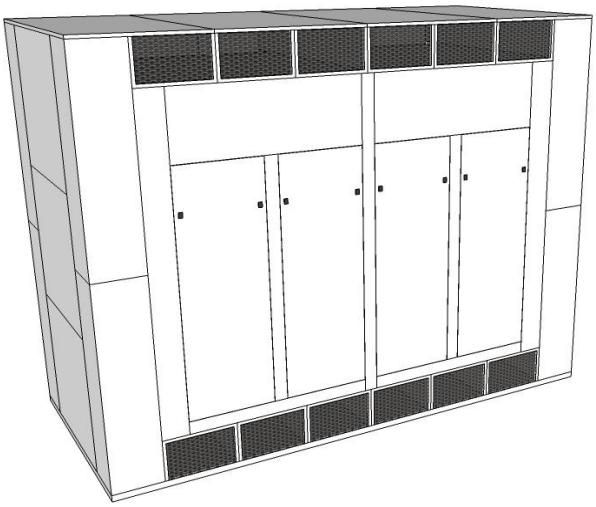
Select Inlet & Outlet Duct Sizes to Ensure Airflows are kept Below 6.0m/s

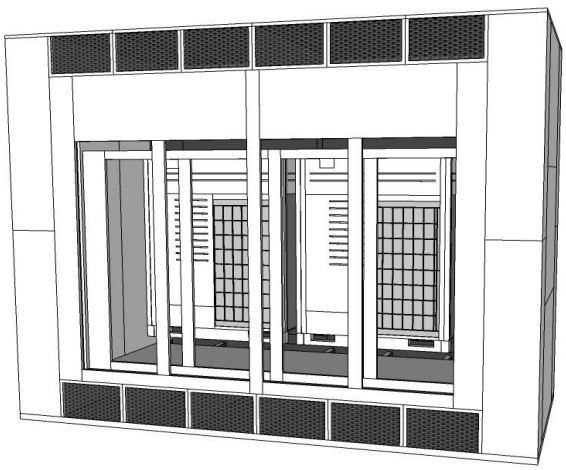
ENCLOSURE INFORMATION	WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
INLET AIRWAY	3600		300
OUTLET AIRWAY	300		2925
GENERAL DIMENSIONS	4000	1500	3000
ESTIMATED SOUND LEVELS @ 1m (Free Field*)	40-45	SPL dB(A) SOUND PRESSURE	

NOTES CONCERNING ENCLOSURE DESIGN

PURY-P400YLM + PURY-P400YLM Modules

Removable Door Mullions/Panels for CDM Access Compliance. Not compatible with Drain Tray Option.
*Estimated Sound Levels based on Free Field Conditions





www.spectrumacoustic.com

TELEPHONE: HEAD OFFICE: +44 (0)1767 318871 WIGAN: +44 (0)1257 473242