Mechanical Noise Assessment

soundsolution CONSULTANTS

WHSmith Europe Travel, 124 Holborn,
Holborn Circus, London EC1N 2QX

TECHNICAL REPORT

21479 R1

Mechanical Noise Assessment

Technical Report

Prepared for: CMC Projects, New Cambridge House, Bassingbourn Road, Litlington, Nr Royston, Hertfordshire SG8 0SS

Site location: WHSmith Europe Travel, 124 Holborn, Holborn Circus, London EC1N 2QX

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DOCUMENT REVISION AND CHANGE CONTROL		
REVISION	**CHANGE DESCRIPTION**	**SUPPLEMENT TO**
1	Original Report	-

1 INTRODUCTION

1.1 Sound Solution Consultants Limited has been commissioned to undertake an environmental noise assessment of proposed mechanical plant at 124 Holborn, London SW4; to assess the impact with regard to noise sensitive locations in the vicinity of the site.

1.2 It is intended for this document to be submitted to London Borough of Camden Council as a review of mechanical plant noise and mitigation requirements in line with the planned proposals to install 3 No. VRF units within a first floor services courtyard.

1.3 The objective of this study is to quantify the acoustic environment at the development site by carrying out a noise assessment using the methodology outlined in BS4142. Consultation with the Environmental Health Department of Camden Council has highlighted the 1997 method is reflected in local noise policy and can be used within the noise impact assessment.

2 DEVELOPMENT SITE

2.1 The following mechanical systems are planned to be installed as part of development proposals on 124 Holborn. The equipment sound pressure levels are shown in Appendix C with scheme illustration in Appendix D. The following units are proposed to be installed within a first floor courtyard central to the building:

- *1 No. environmodula 2.2.25AC TS4 acoustic enclosure, containing:*
    - *1 No. Toshiba MMY-MAP1604HT8-E*
- *1 No. environmodula 2.2.25AC TS6 acoustic enclosure, containing:*
    - *2 No. MMY-MAP1204HT8-E.*

2.2 The adjacent offices of the same building are taken to be the nearest noise sensitive locations to mechanical plant; with windows of first floor offices nominally 3-4m away.

2.3 Given the close proximity of the nearest receptor to the location of proposed mechanical plant, the developer intends to install commensurate noise mitigation, as required to achieve compliance with suitable noise levels in accordance with London Borough of Camden Council requirements.

2.4 The following tasks have been undertaken as part of this noise assessment:

- *Survey of noise levels at the application site, representing the noise climate of properties closest to the proposed development.*
- *Calculation of noise levels from the proposed scheme at the nearest noise sensitive locations using manufacturers' specific noise data.*
- *Assessment of the background noise level with regard to the proposed development against the guidance provided by BS4142:1997 – Rating industrial noise affecting mixed residential and industrial areas.*

3 NOISE CRITERIA

BS4142:1997 RATING INDUSTRIAL NOISE IN MIXED RESIDENTIAL AND INDUSTRIAL AREAS

NB It is understood at the time of writing that BS 4142:1997 has been revised to BS 4142:2014. As local policy requirements and inferred noise criteria from Camden LBC refer to the former standard, the 1997 standard and assessment method it is used for assessment of mechanical noise within this report. This approach has been agreed with the Environmental Health Department.

3.1 The most relevant criteria to assess the impact of industrial noise levels on residential dwellings are contained within BS4142:1997 – Rating industrial noise affecting mixed residential and industrial areas. This British Standard describes a method of determining the level of a noise of an industrial nature, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity.

3.2 The likelihood of complaint in response to a noise depends on factors including the margin by which it exceeds the background noise level, its absolute level, time of day, change in the noise environment, as well as local attitudes to the premises and the nature of the neighbourhood. BS4142:1997 is only concerned with the rating of a noise of an industrial nature, based on the margin by which it exceeds a background noise level with an appropriate allowance for the acoustic features present in the noise. As this margin increases, so does the likelihood of complaint.

3.3 Certain acoustic features can increase the likelihood of complaint over that expected from a simple comparison between the specific noise level and the background noise level. Where present as part of the assessment, such features are taken into account by adding 5 dB to the specific noise level to obtain the rating level:

+ *The noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.);*
+ *The noise contains distinct impulses (bangs, clicks, clatters, or thumps);*
+ *The noise is irregular enough to attract attention.*

3.4 The rating level is equal to the specific noise level if there are no such features present or expected to be present.

3.5 To assess the likelihood of complaints using BS4142:1997 the measured background noise level is subtracted from the rating level. The greater this difference the greater the likelihood of complaints, such as:

- *A difference of around +10 dB or more indicates that complaints are likely.*
- *A difference of around + 5 dB is of marginal significance.*
- *If the rating level is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.*

4 ENVIRONMENTAL NOISE SURVEY

4.1 A study of site noise was undertaken from Thursday 14th to Monday 18th May 2015 to determine background noise levels in accordance with BS4142.

4.2 The equipment used during the survey consisted of the following precision noise monitoring equipment listed below. All equipment listed has traceable calibration history to relevant British Standards, valid in accordance with BS 4142 at the time of assessment.

Manufacturer	Model No.	Description	Serial No.	Calibration Date
Larson Davis	824	3rd Octave Band Sound Level Meter	3189	03/14
Larson Davis	902	Microphone pre-amplifier	1308	03/14
Larson Davis	2541	½" Condenser microphone	7069	03/14
Larson Davis	CAL200	Sound Level Calibrator	9861	12/14

Table 1 – Noise monitoring equipment.

4.3 The calibration of the sound level meter was checked using a reference tone of 114dB at 1kHz before any measurements were taken. A validation check at the end of the survey indicated that all instruments had operated within permitted tolerances for drift and measured level.

4.4 The weather at the start of the noise survey was measured using a Kestrel 4500 weather station as 10°C, 70% relative humidity and a light breeze typically averaging less than 0.5m/s. Reasonable measurement conditions were reported throughout the noise survey, such that the weather is not expected to have significantly adversely influenced the noise levels monitored.

4.5 One noise monitoring location was used to determine incident environmental noise levels over a period of three consecutive days from Friday 31st May to Monday 3rd June 2013. The measurement position is annotated on the site plan in Appendix B and described below.

Position 1) A microphone was placed at first-floor level in the corner of the courtyard; nominally 4m from the façade of the building with unrestricted line of sight to the neighbouring area. This measurement position is used to evaluate environmental noise levels to adjacent offices and is considered to be free-field.

4.6 Interval noise data was recorded at the measurement location at 15-minute periods, time synchronised between to BST. The sound level meter was configured to record average equivalent (L_{Aeq}), maximum (L_{Amax}), minimum (L_{Amin}) and statistical (L_n) parameters in octave bands. Measurements were primarily taken to evaluate the representative daytime (07:00 to 23:00) $L_{Aeq,16h}$ and night time (23:00 to 07:00) $L_{Aeq,8h}$ and L_{Amax} noise levels in octave bands for the entire site, along with other measurement times of key activity. The data is used in this section to review L_{A90} background noise levels.

4.7 The operating times of the proposed equipment are taken to be continuous during day or night. The measured L_{A90} noise levels at Position 1 are therefore considered between 07:00 and 23:00 for daytime use and 23:00 to 07:00 for night time use.

4.8 The 'typical' background noise levels for BS 4142 noise assessment has been established from histograms of the recorded $L_{A90,15min}$ noise data at the monitoring location. In practice, there is no single level for background noise as this is a fluctuating parameter, although the standard recommends that a representative value of the period should be used. *Note this is not either the lowest or mean average value of $L_{A90,15min}$.*

4.9 Free-field background sound levels of 45-53dB $L_{A90,15min}$ have been recorded between the hours of 07:00 – 23:00 where it is considered that the mechanical plant will be in use on the site. The background level at the nearest noise sensitive location is deemed to lie at 48dB $L_{A90,15min}$ as this is a representative value inside the range that can occur and was most-commonly recorded.

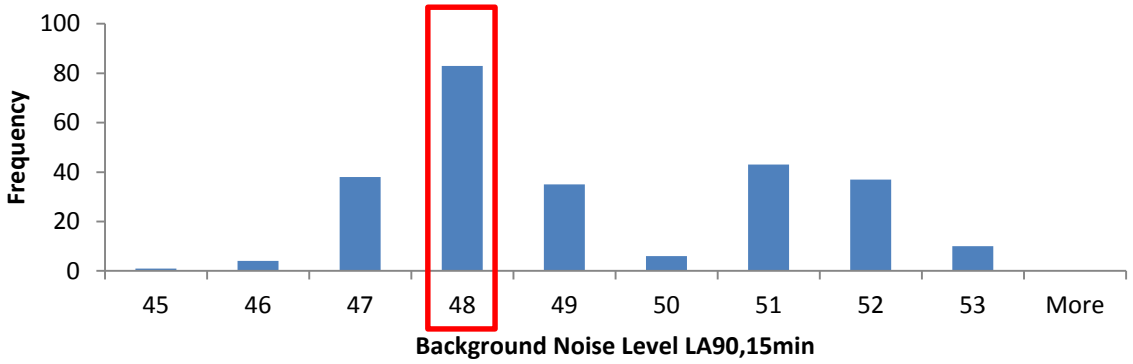


Figure 1 – Histogram of $L_{A90,15min}$ data to determine the day time background noise level during the hours of 07:00 to 23:00 in the assessment of mechancial plant.

4.10 For night time sound level measurements during the period of 23:00 – 07:00, values of 43-52dB $L_{A90,15min}$ have been noted at Position 1. The background level at the nearest noise sensitive location is deemed to lie at 46dB $L_{A90,15min}$ as this is a representative value inside the range that can occur and was most-commonly recorded.

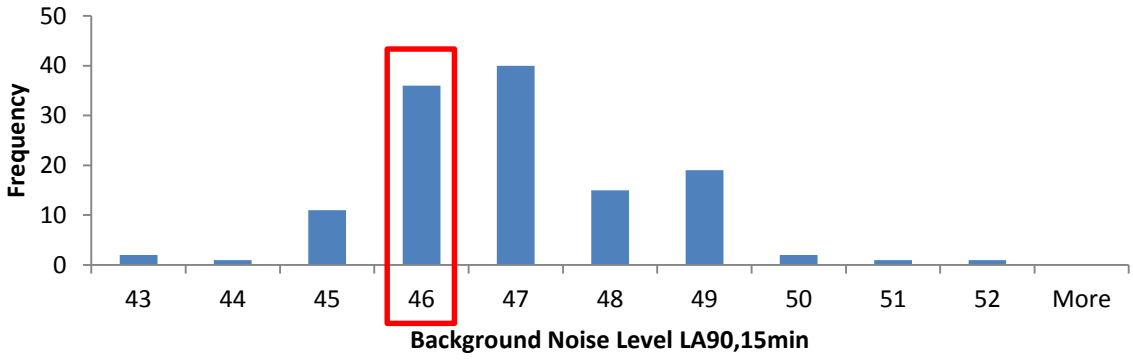


Figure 2 – Histogram of $L_{A90,15min}$ data to determine the night time background noise level during the hours of 23:00 to 07:00 in the assessment of mechanical plant.

4.11 The following design criteria are considered applicable for mechanical plant at the nearest residential premises, based on the BS 4142:1997 assessment method. Resulting noise levels depend on whether the noise source is anonymous or has distinguishable features definable within Section 8.2 of BS4142:1997 and warrants a 5dB rating penalty.

Design Description	Design Description	Noise Level LAeq,T dB re. 20µPa	
		Day Time 07:00 – 23:00	Night Time 23:00 – 07:00
Anonymous mechanical noises 5dB(A) below existing background	Achieves Camden Council policy	43	41
Distinguishable mechanical noises 10dB(A) below existing background	Achieves Camden Council policy	38	36

Table 2 – Design noise levels for proposed mechanical equipment.

4.12 BS 4142:1997 indicates that where the rating level of noise from industrial sources is below the background (L_{A90}) noise level by 10dB(A) or greater, then this is a positive indication that complaints are unlikely. As a consequence, this is defined as the design objective for developing sites. A design standard of -10dB(A) helps to avoid undesirable environmental effects such as 'background creep' at the nearest noise sensitive premises.

4.13 It has been confirmed via consultation with the Environmental Health Department of Camden Council that the design should seek to achieve a level at least 5dB below the background L_{A90} level if 'anonymous' in nature, else 10dB below if 'distinguishable'. These limits are set by Local Policy requirements and refer to the 1997 assessment method of BS 4142.

PREDICTION OF NOISE FROM MECHANICAL PLANT

4.14 Manufacturers sound pressure level data has been used to determine noise levels 1m from nearest noise sensitive window adjacent to the mechanical plant at 124 Holborn. Consideration is given to adjacent office receptor locations in accordance with BS4142, where the rating level is assessed during the proposed operational hours over a 24-hour period.

Ref	Description	Data	Mechanical Noise Level $L_{Aeq,T}$ dB re. 20µPa	
			Enclosure 1	Enclosure 2
1	Manufacturers highest rated sound pressure level	Appendix B dB(A) at 1m	44	47
2	Total noise level	Log sum Line 1	49	
3	Distance to nearest window	20log(1/3) i.e. At least 3m away	-10	
4	Noise level outside nearest noise sensitive window	Lines 1+2+3 dB(A)	**39**	

Table 3 – Simple calculation of resulting noise level outside nearest noise sensitive location.

4.15 The above result demonstrates that acoustic enclosures are commensurate mitigation to reduce mechanical plant noise at the nearest noise sensitive windows as to achieve Camden Policy requirements.

5 NOISE IMPACT ASSESSMENT

5.1 The predicted noise level from mechanical plant has been assessed 1m from the nearest noise sensitive windows of in accordance with BS 4142. The difference between the rating noise level and background noise level has been calculated.

5.2 Rating penalties specified in Section 3.3 are not considered applicable to the proposed mechanical equipment; where noise levels from these sources will be typically broadband in nature and constant in duration. The resulting noise levels are considered unlikely to contain tonal noises.

5.3 The following BS 4142 assessment can be made for the proposed development:

Usage Description and Receiver Location	Specific Noise Level dB(A)	Rating Penalty dB	BS4142:1997 Rating Level dB(A)	Typical $L_{A90,\ 15min}$ Noise Level	BS4142:1997 Rating Assessment
1m from Nearest Window Daytime (07:00 – 23:00)	**39**	0	42	48	**-9***
1m from Nearest Window Night time (23:00 – 07:00)	**39**	0	35	46	**-7***

**Achieves local policy requirement for 5dB below LA90.*

'Complaint is unlikely'
'Marginal significance'
'Complaint is likely'

Table 4 – BS4142:1997 assessment at the nearest noise sensitive location.

5.4 BS 4142 states that where the rating level is 10dB below the measured background noise level then this a positive indication that complaints are unlikely. Use of the proposed scheme permissible operating hours is predicted to have negligible impact on the neighbouring offices with a -7dB to -9dB rating; tending towards the assessment that *complaint is unlikely*.

5.5 Considering that open window loss of 10-15dB will apply to the noise level inside the nearest neighbouring residential buildings; anticipated noise levels will lie below BS 8233:2014 internal noise guidelines of 40dB(A) daytime for an office. The specified scheme is unlikely to cause negative effects with respect to annoyance inside nearby offices.

5.6 The noise assessment in this section confirms that the use of low-noise acoustic enclosures will be commensurate to abate mechanical noise levels to a sufficiently low level at the nearest noise sensitive windows.

6 CONCLUSIONS

6.1 Environmental noise levels were recorded over weekday and weekend periods and are summarised in Section 4 and Appendix E of this assessment. Representative L_{A90} background noise levels have been established for daytime (07:00 – 23:00) and night time (23:00 – 07:00) periods.

6.2 The methodology and assessment criteria used within this report are contained in the British Standard 4142:1997 – *Rating industrial noise affecting mixed residential and industrial areas*. Specific noise levels have been calculated 1m away from the nearest noise sensitive windows, using manufacturer's data of the proposed mechanical plant.

6.3 The noise assessment demonstrates that the proposed acoustic enclosures will be commensurate mitigation to abate mechanical noise at the nearest noise sensitive office windows. The rating assessment is compliant with Camden Council requirements and tends towards the conclusion that *complaint is unlikely* in accordance with BS 4142:1997. No further noise mitigation measures are deemed necessary for development.

6.4 Where the development follows noise abatement highlighted in this report, it is estimated that suitably low noise levels will result such that planning approval can be granted.

Appendix A: Glossary of Acoustic Terms

'A' weighting dB(A): Filtering of the sound frequencies designed to reflect the response of the human ear to noise. The human ear is more sensitive to noise at frequencies in the middle-high end of the audible range than to either very high or very low frequencies. Noise measurements are often A-weighted (using a electronic filter) to compensate for the sensitivity of the ear.

Attenuation: Noise reduction, measured in decibels.

Calibration: A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level.

Decibel: The unit of sound level and noise exposure measurement. The range of audible sound pressures is approximately 0 dB to 140 dB.

Equivalent continuous sound pressure level (LAeq,T): A measure of the average A-weighted sound pressure level during a period of time, in dB(A). It is a notional steady sound level which would cause the same A-weighted sound energy to be received as that due to the fluctuating sound level over a given period of time (T).

Frequency (Hz): The pitch of the sound, measured in Hertz.

Frequency analysis: Analysis of a sound into its frequency components.

Hz: Hertz, the unit of frequency.

Noise spectrum: A noise represented by its frequency components.

Octave-bands: A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit. The width of the octave-bands increases at higher frequencies.

Octave-band centre frequency: The frequency at the centre of an octave band.

Pa: Pascal, unit of measurement of sound pressure.

Sound level meter (SLM): Instrument for measuring various noise parameters.

Sound pressure level (SPL): The basic measure of sound, expressed in decibels, usually measured with an appropriate frequency weighting (e.g. the A-weighted SPL in dB(A)).

Appendix B: Noise Measurement Location

Measurement location

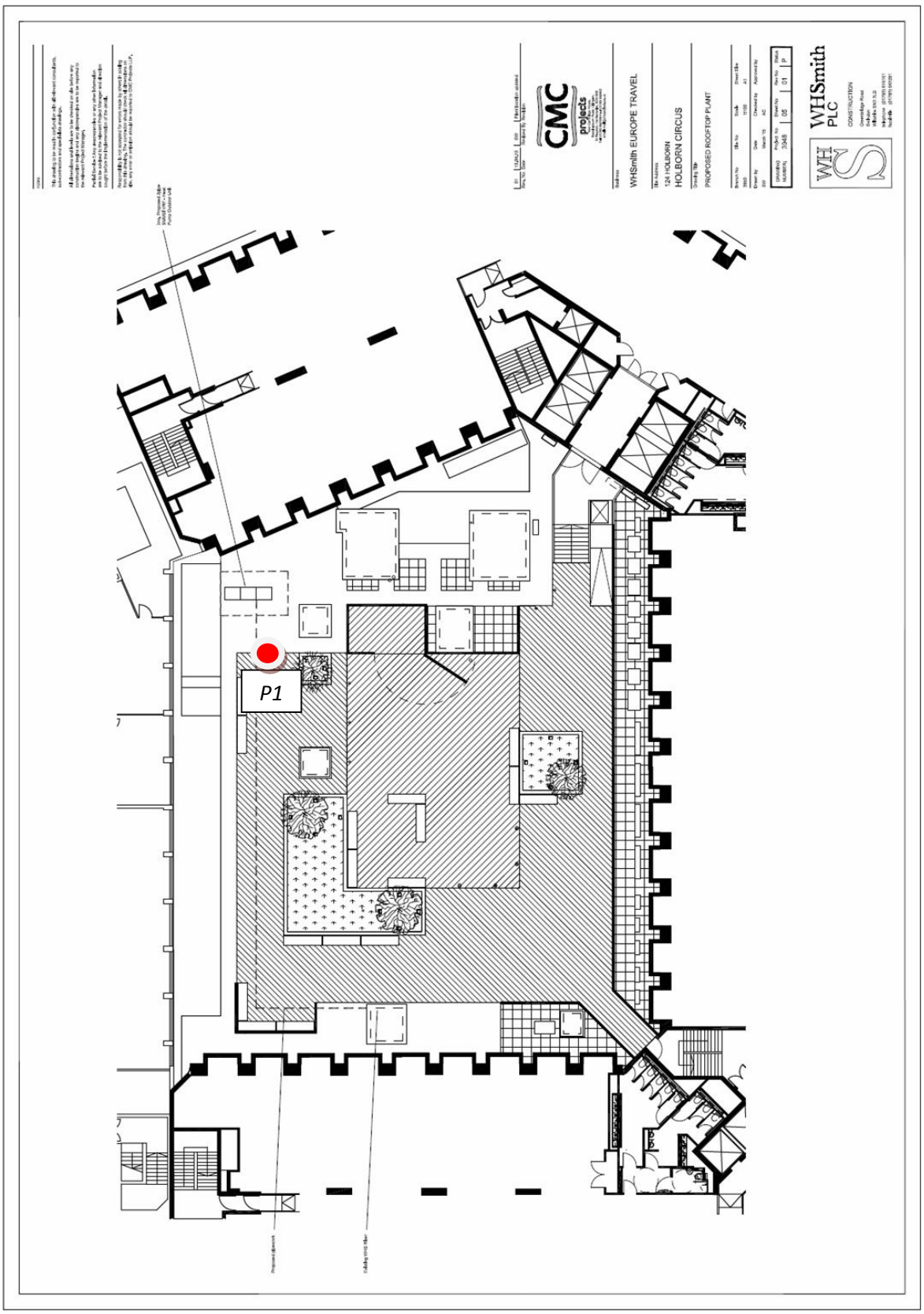
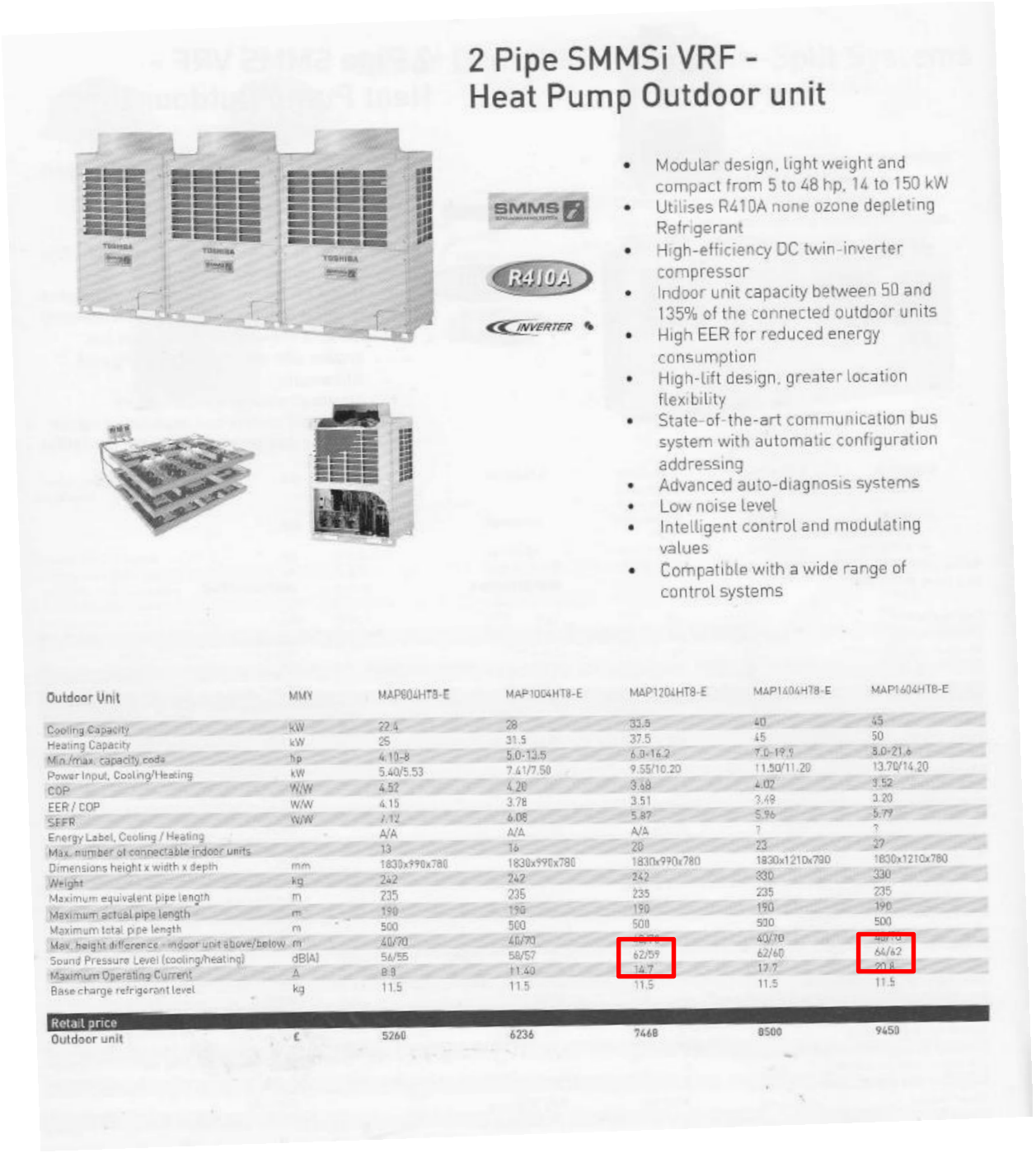


Figure B1 – Noise measurement location.

Appendix C: Manufacturers Sound Data



2 Pipe SMMSi VRF - Heat Pump Outdoor unit

- Modular design, light weight and compact from 5 to 48 hp, 14 to 150 kW
- Utilises R410A none ozone depleting Refrigerant
- High-efficiency DC twin-inverter compressor
- Indoor unit capacity between 50 and 135% of the connected outdoor units
- High EER for reduced energy consumption
- High-lift design, greater location flexibility
- State-of-the-art communication bus system with automatic configuration addressing
- Advanced auto-diagnosis systems
- Low noise level
- Intelligent control and modulating values
- Compatible with a wide range of control systems

Outdoor Unit	MMY	MAP804HT8-E	MAP1004HT8-E	MAP1204HT8-E	MAP1404HT8-E	MAP1604HT8-E
Cooling Capacity	kW	22.4	28	33.5	40	45
Heating Capacity	kW	25	31.5	37.5	45	50
Min./max. capacity code	hp	4.10-8	5.0-13.5	6.0-16.2	7.0-19.9	8.0-21.6
Power Input, Cooling/Heating	kW	5.40/5.53	7.41/7.50	9.55/10.20	11.50/11.20	13.70/14.20
COP	W/W	4.52	4.20	3.68	4.02	3.52
EER / COP	W/W	4.15	3.78	3.51	3.49	3.20
SEER	W/W	7.12	6.08	5.87	5.96	5.77
Energy Label, Cooling / Heating		A/A	A/A	A/A	?	?
Max. number of connectable indoor units		13	16	20	23	27
Dimensions height x width x depth	mm	1830x990x780	1830x990x780	1830x990x780	1830x1210x790	1830x1210x780
Weight	kg	242	242	242	330	330
Maximum equivalent pipe length	m	235	235	235	235	235
Maximum actual pipe length	m	190	190	190	190	190
Maximum total pipe length	m	500	500	500	500	500
Max. height difference - indoor unit above/below	m	40/70	40/70	[illegible]	40/70	[illegible]
Sound Pressure Level (cooling/heating)	dB(A)	56/55	58/57	62/59	62/60	64/62
Maximum Operating Current	A	8.8	11.40	14.7	17.7	20.8
Base charge refrigerant level	kg	11.5	11.5	11.5	11.5	11.5
Retail price Outdoor unit	€	5260	6236	7468	8500	9450

Figure C1 – Toshiba MAPXXXXHT8-E sound pressure levels.

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SELECTION MATRIX

environmodula 2.2.25AC TS4 May 19, 2015

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
Toshiba	MMY-MAP1604HT8-E	H - 3 Sides	V

WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)	AIRFLOW (M^3s^{-1})	SPL dB(A)	DISTANCE (M)
1210	780	1830	3.61	64	1

INNER CUBE DIMENSIONS		
2000	765	2175
WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
3.61	1.0	64
AIRFLOW (M^3s^{-1})	DISTANCE (M)	SPL dB(A)

ENCLOSURE DETAIL		
2500	1600	2750
WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
3.6	1.0	38-44
AIRFLOW (M^3s^{-1})	DISTANCE (M)	SPL dB(A)

INLET AIRWAYS		
2000	250	2
WIDTH (MM)	HEIGHT (MM)	NO.

DESIGN CRITERIA		
OK	OK	OK
UNIT SIZE	OUTLET	INLET

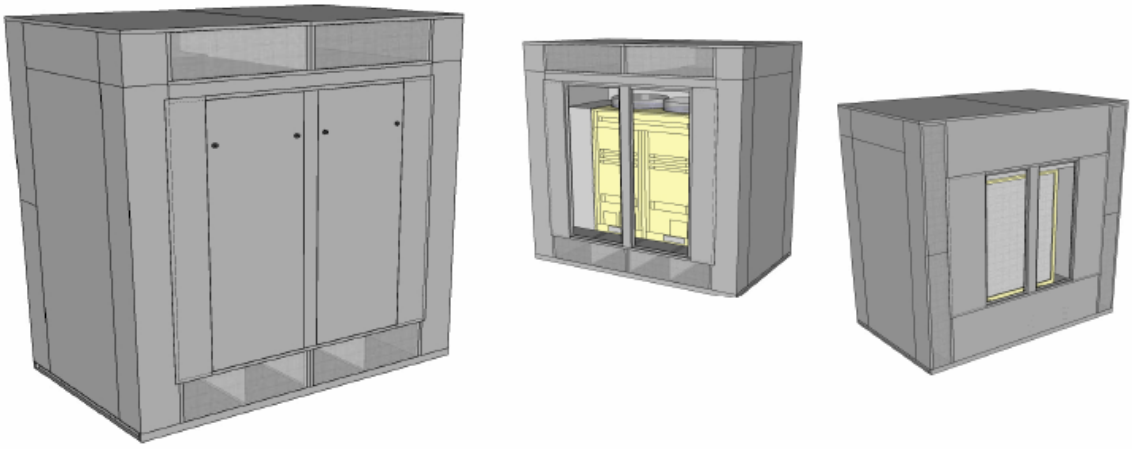
OUTLET AIRWAYS		
200	2725	2
WIDTH (MM)	HEIGHT (MM)	NO.

AIRFLOW INFORMATION		
15	3.3	3.6
PD (NM^{-3})	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	2000		250
OUTLET AIRWAY	200		2725
EXTERNAL SIZE	2500	1600	2800
SOUND LEVEL RANGE @ 1.0m (Free Field)	38-44	SPL dB(A) SOUND PRESSURE	

NOTES CONCERNING ENCLOSURE DESIGN



Environ acoustic designs are protected under patent
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Figure C2 – environmodula 2.2.25AC TS4 acoustic enclosure summary specification sheet.

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SELECTION MATRIX

environmodula 2.2.25AC TS6 19 May 2015

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
Toshiba	MMY-MAP1204 x 2	H - 3 Sides	V

WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)	AIRFLOW (M^3S^{-1})	SPL dB(A)	DISTANCE (M)
1210+1210	780	1830	7.22	67	1

INNER CUBE DIMENSIONS		
3200	760	2275
WIDTH (MM)	817	HEIGHT (MM)
7.22	1.0	67
AIRFLOW (M^3S^{-1})	DISTANCE (M)	SPL dB(A)

ENCLOSURE DETAIL		
4000	1500	3000
WIDTH (MM)	DEPTH (MM)	HEIGHT (MM)
7.2	1.0	42-47
AIRFLOW (M^3S^{-1})	DISTANCE (M)	SPL dB(A)

INLET AIRWAYS		
3250	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		
16	4.1	3.7
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	3250		300
OUTLET AIRWAY	300		2925
EXTERNAL SIZE	4000	1500	3000
SOUND LEVEL RANGE @ 1 M (Free Field)	42-47	SPL dB(A) SOUND PRESSURE	

NOTES CONCERNING ENCLOSURE DESIGN
Approximate weight excluding VRV 1500kg
Combined Air Flow

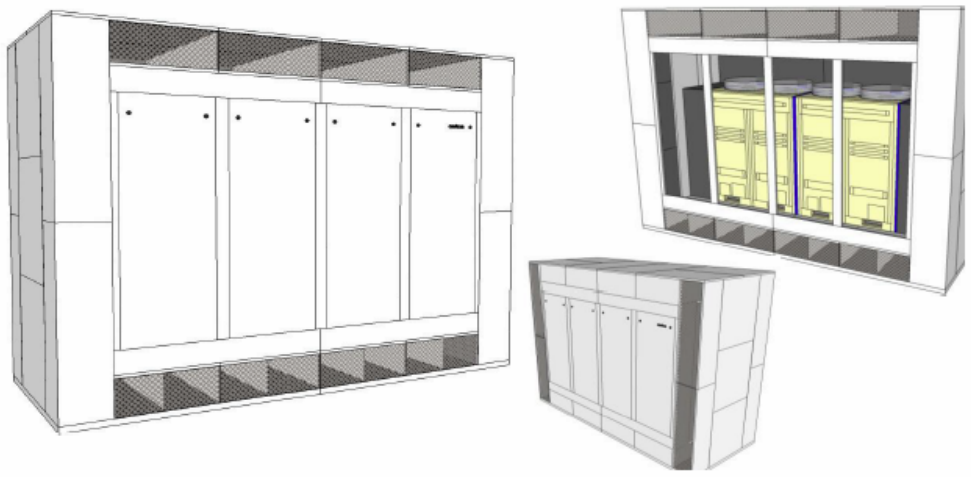

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Figure C3 – environmodula 2.2.25AC TS6 acoustic enclosure summary specification sheet.

Appendix D: Scheme Design

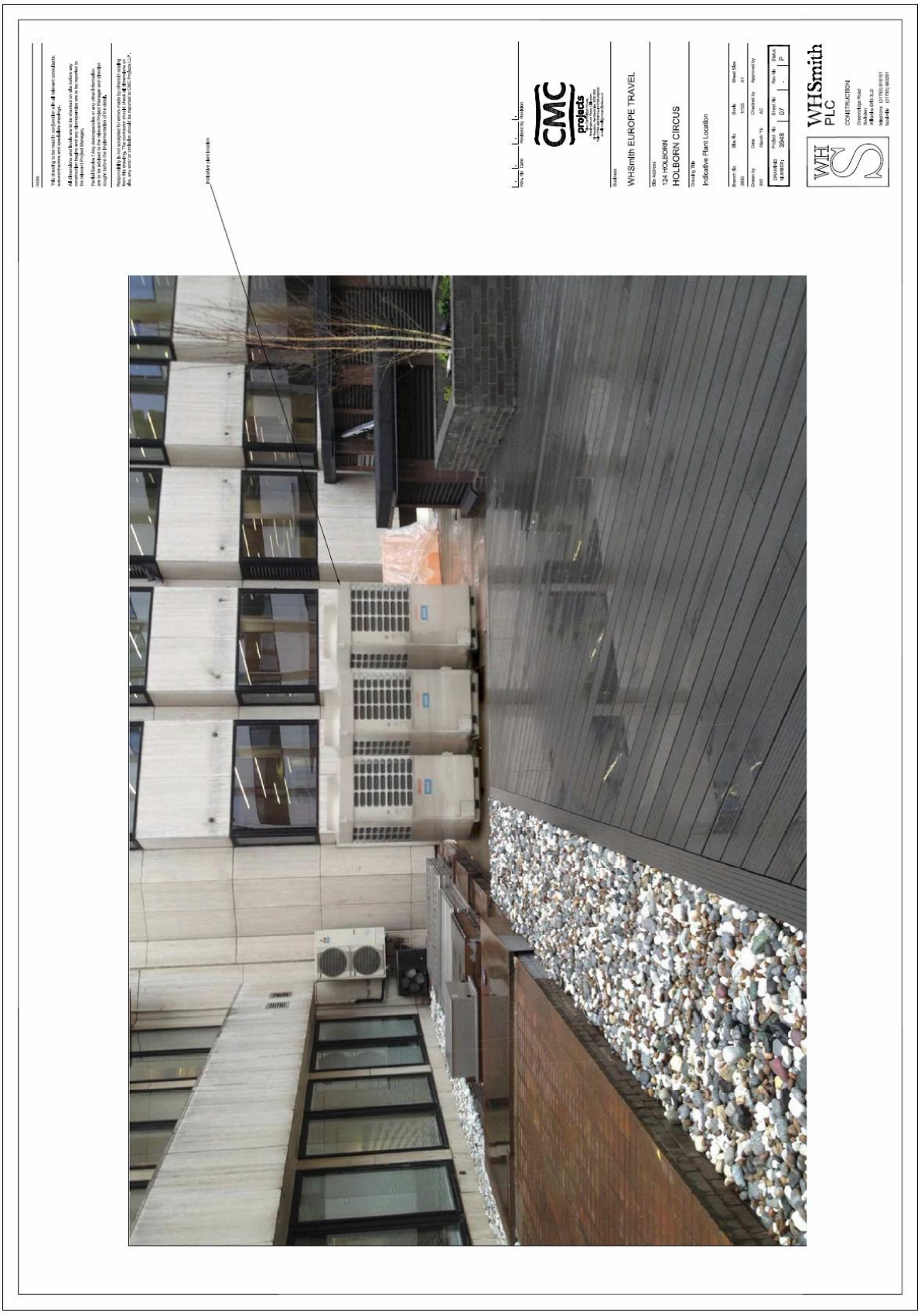

Figure D1 – Indicative mechanical plant location on first floor courtyard of 124 Holborn.

Note acoustic enclosures are not illustrated.

Appendix E: Noise Survey Data

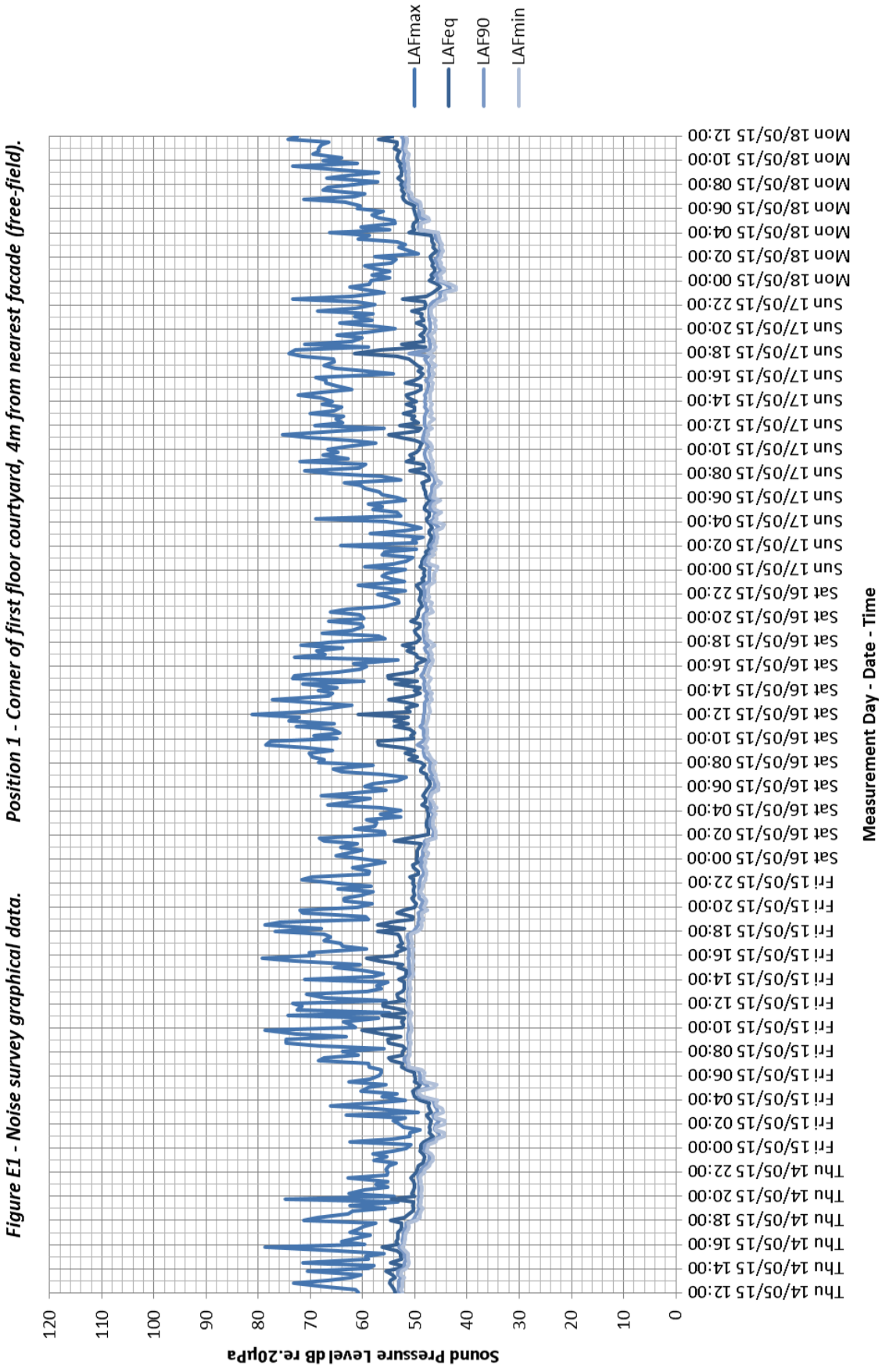

Figure E1 - Noise survey graphical data. Position 1 - Corner of first floor courtyard, 4m from nearest facade (free-field).