University College London Hospitals
Mortimer Market

Assessment of noise from new mechanical plant

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Audit Sheet

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EXECUTIVE SUMMARY

- Plans have been prepared to install a new Air Handling unit and three Condensing units on the roof of the existing Mortimer Market Centre to serve a new internal layout including operating theatre space
- An acoustic survey has been carried out in order to establish the existing noise environment around the site and to set noise emissions limits in accordance with London Borough of Camden noise policy. This document provides an assessment of the proposals and identifies noise control measures to be included in the design.
- Calculations have determined that without any noise reduction measures, the proposed noise limit which is set relative to the existing background noise conditions at nearest noise sensitive premises, which are within 25 metres of the proposed new installation, would be exceeded and that mitigation is required.
- It has been demonstrated that adequate noise reduction for can be achieved through the use of silencers to the air handling unit fresh air intake and exhaust opening, which is a relatively conventional provision.

- **CONTENTS**

1. INTRODUCTION

Plans have been produced to install a new Air Handling unit and three Condensing units on the roof of the existing Mortimer Market Centre to serve a new internal layout including operating theatre space
A background noise survey has been carried out to determine the existing noise environment around the development.

The results of the survey have been used set noise emissions limits which will inform the selection of new mechanical plant and where necessary identify requirements for noise reduction.

2. SITE DESCRIPTION

The site is located in the Borough of Camden between Mortimer Market and Capper Street, London, surrounded by the Shropshire House, Rayne Building of the University Collage of London, University College Hospital Macmillan Cancer Centre and offices. Figure 1 shows the location of the site, highlighting neighbouring noise sensitive premises.

Figure 1 – Mortimer Market Centre site and surrounding area

2.1 Local Noise Environment

Surrounding roads, most notably Tottenham Court Road, are the main cause of background noise affecting the area, and in some discrete areas, noise from building services plant on roofs is also noticeable.

3. ACOUSTIC DESIGN STANDARDS

Well established guidance on noise measurement and related acoustic design is available from a variety of references including:

- London Borough of Camden – Unitary Development Plan, 2006
- BS 4142 (1997): 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'

3.1 London Borough of Camden – Unitary Development Plan, 2006

London Borough of Camden state that they will only grant planning permission for plant or machinery, including ventilation or air handling equipment, if it can be operated without causing a loss to local amenity and does not exceed defined thresholds which have been reproduced in Table 1, below.

Additionally, LBC recommend, that any assessment of noise emissions from new plant associated with development should be in accordance with the procedures of BS 4142.

BS 4142 proposes a method for rating the impact of introducing a noise generating development/equipment to a noise sensitive area. The general principle of the BS 4142 assessment criteria is that noise nuisance can be avoided provided there is no significant change in the prevailing background noise conditions at any surrounding noise sensitive premises once the new equipment is operational.

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 facade	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 facade	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}

Table 1: Noise levels from plant and machinery above which planning permission will not be granted

4. BASELINE NOISE SURVEY

A fixed location sound level meter was set up on the roof of the building to record background noise levels throughout the daytime, evening and night-time. Figure 2 shows the monitoring location which was deemed from site observations to provide a good representation of the background noise conditions at surround premises.

The fixed monitor recorded five minute contiguous samples from approximately 11:45 on 31st October 2013 to 10:30 on 04th November 2013. Due to the weather condition only the data recorded from 12:00 on 31st October 2013 to 12:00 on 1st November 2013 has been considered for the setting of limits

Details of the measurements are shown in Appendix B.

Figure 2 – Mortimer Market Centre background noise monitoring position

4.1 Survey results

Table 2 summarises the ambient and underlying background noise levels recorded at the fixed monitor position.

Table 2 – Noise Levels obtained from the long term monitor

Period	Lowest Background noise level L_{A90}
Day (07:00-19:00)	53
Evening (19:00-23:00)	53
Night (23:00-07:00)	50

5. PLANT NOISE EMISSION LIMITS

Noise emission limits for new plants associated with the development are proposed in Table 4. Limits are based on the LBC requirements in Table 1, 5 dB below the measured background noise level.

Table 3 - External plant emission noise limits in dB

Day, 07:00-19:00	Evening, 19:00-23:00	Night, 23:00-07:00
48	48	45

6. PLANT NOISE ASSESSMENT

Noise emissions from the proposed development have been assessed to identify requirements for noise control in order to satisfy the criteria noise requirements. Nearby noise sensitive facades have been identified and are shown in **Error! Reference source not found.**.

6.1 Overview of the proposal

Plans are to install a new air handler unit (AHU) and three condensing units (CU's) on the roof of the Mortimer Market Centre. The sketch below shows the positions of the new units.

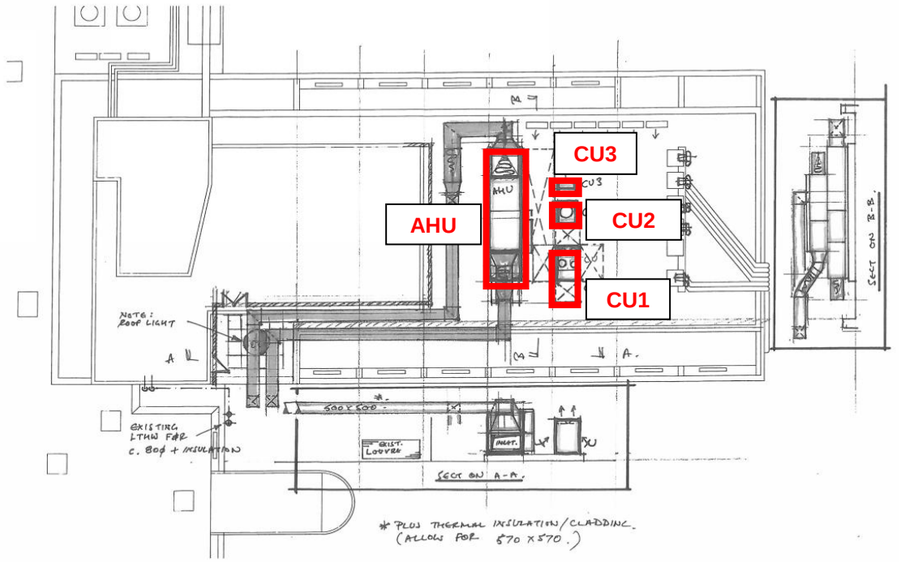

Figure 3 – Sketch of the new unit position on Mortimer Market Centre's roof

6.2 Assessment of plant noise on existing noise sensitive facades

Technical specifications and calculations used in this section are presented in Appendices C and D.
In the assessment, specific noise attenuations have not been considered. The sound power for each mechanical unit has been considered taking into account a tolerance as shown in Appendix D.

6.2.1 New Air Handling Unit

The proposed AHU for the purpose of early space and cost planning is a Flakt Wood Supply/Extract 1.25 m^3/s. Technical specifications of the unit are presented in Appendix C.

The nearest noise sensitive façade to the AHU is the neighbouring commercial building approximately 20 m away to the west side of the site. The UCLH Macmillan Cancer Centre lies to the other side but is slightly further away at approximately 25 m.

Table 4 presents the predicted noise at the nearest noise sensitive façade.

Table 4 – Predicted noise emissions at the nearest noise façade from the AHU

Calculation Step	Fresh air connection dB(A)	Exhaust connection dB(A)
Source level, L_w, dB(A)	85	86
Noise emissions at 1m from nearest noise sensitive façade ($L_{Aeq,\ T}$), dB(A)	53	53
Noise emissions limit, dB(A)	45	45
Assessment	Noise reduction required	Noise reduction required
Possible Solutions	Silencer	Silencer

Noise breaking out from the AHU does not result to contribute significantly to the overall noise emission of the unit.

6.2.2 New Condensing Units

Three new condensing units are proposed:

- Flakt Wood Condensing Unit (CU1)
- Toshiba VRF Condensing Unit 10HP unit (CU2)
- Toshiba Split System 11kW unit (CU3)

Technical details of the models are shown in Appendix C.

Table 5 – Predicted noise emissions at the nearest noise façade from CU's

Calculation Step	CU1	CU2	CU3
Source Level, L_w dB(A)	75	73*	67
Noise emissions at 1m from nearest noise sensitive façade ($L_{Aeq,\ T}$), dB(A)	44	42	36
Noise emissions limit, dB(A)	45	45	45

**derived from sound pressure level*

6.2.3 Cumulative noise emission from new mechanical units

Prior sections indicate the individual noise impact of each item of plant.

Table 7 shows the overall level produced by all the new mechanical units operating simultaneously.

Table 6 Cumulative noise emissions at the nearest noise façade from all the new mechanical services

Unit	AHU		CU1	CU2	CU3	Total
Noise level at the nearest façade, dB(A)	53	50	44	42	36	**55**

6.2.4 Possible solutions

The results of the propagation calculation show that an overall reduction of the noise from the new mechanical services of 10 dB is therefore needed in order to not exceed the assessed noise limit at the noise sensitive facades.

It is understood that CU1 will not operate between 1900 and 0700 hours.

The AHU will be attenuated such that the noise emissions are no more than 40 dB(A) at the noise sensitive location. The noise reduction can be achievable by using;

- Silencer to the fresh air connection of the air handler unit
- Silencer to for the exhaust connection of the air handler unit

Based on the above the daytime cumulative noise level due to the plant operation will be:

- 0700-1900 hours 47 dB(A)
- 1900-0700 hours 45 dB(A)

7. CONCLUSIONS

To comply with London Borough of Camden noise policy, the proposed new building services plant, needed as part of the internal refurbishment, will require noise reduction measures The air handling unit shall incorporate silencers to the fresh air intake and exhaust.

On the basis of this above assessment noise is not expected to be a limited factor in relation to achieving planning approval.

APPENDIX A - GLOSSARY OF ACOUSTICAL TERMS

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

Octave and Third Octave Bands

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

A-Weighting

The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB (A).

Equivalent Continuous Sound Level $L_{eq,}$

The L_{eq}, is a parameter defined as the equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. The $L_{eq,T}$ can be seen to be an "average" sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an 'A' weighted noise level in dB(A). It is commonly used to describe all types of environmental noise sources.

Background Noise Level L_{90}

The $L_{90,\,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe the prevailing background noise level or underlying noise level.

Rating Level

The specific noise level of the source plus any adjustment for characteristic features of the noise.

APPENDIX B – SITE SURVEY EQUIPMENT

List of equipment used
Fixed noise monitor

Equipment	Make and Model	Serial No.	Calibration Cert.	Date of calibration expiration
Sound Level Meter	Rion NL-31	00431026	06500	01/05/2014
Microphone	Rion UC-53	311043	06500	01/05/2014
Calibrator	Rion NC-74	34172704	07160	22/05/2014

Results

A graph plotting the results over the survey period is presented on the next page.

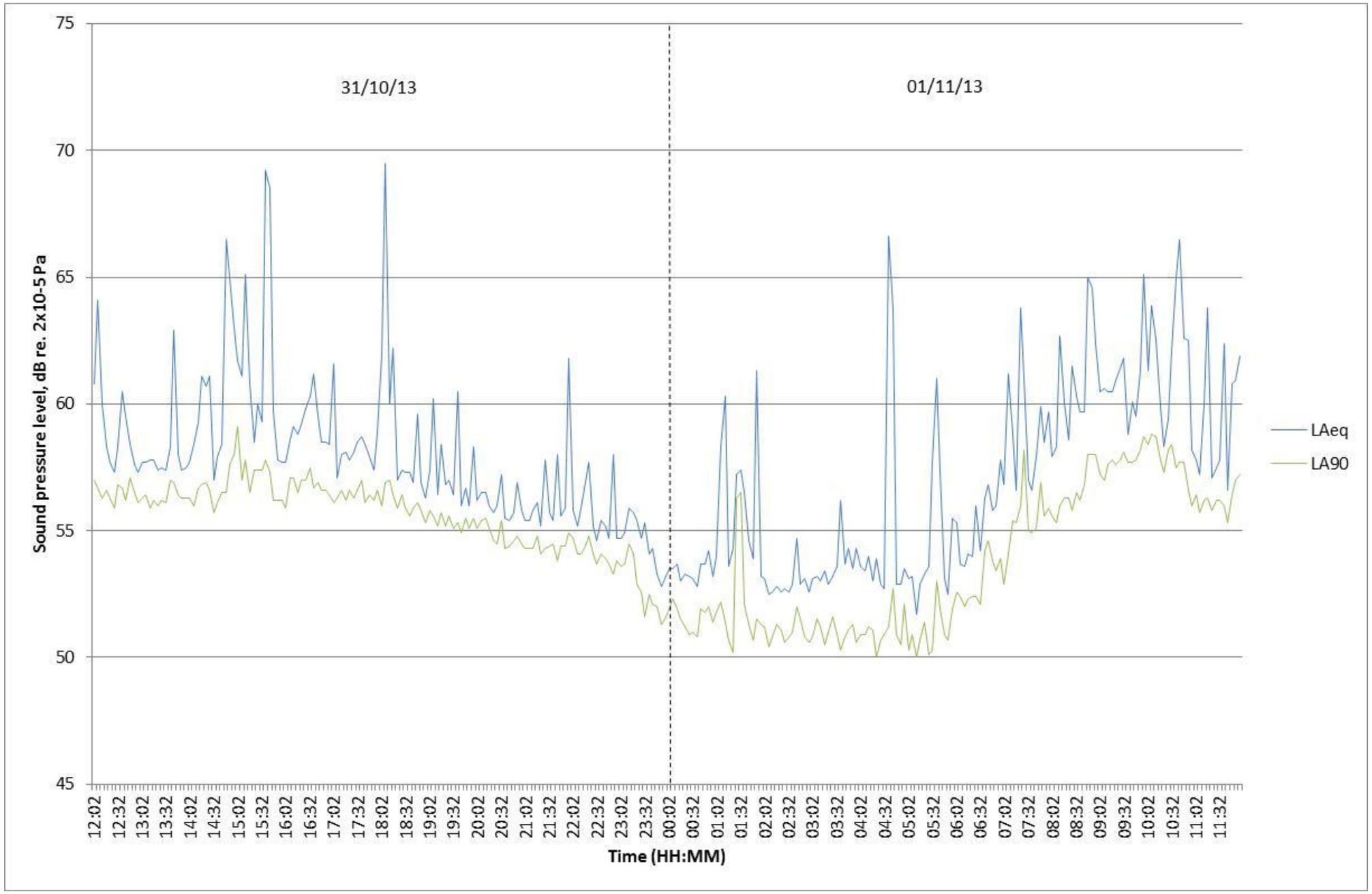

Figure 4 - Long term measurement chart

APPENDIX C – THECNICAL SPECIFICATIONS

AHU

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

FläktWoods

AIR HANDLING UNIT eQ

Project	15887 (') / Mortimer MarketUCH	*2.7.131023.3*
AOC	ACON-01349823	
Unit	5 (DC) / Supply/Extract AHU 1.25 m3/s	2013-10-23
Size	018	Page 3
Customer	Hoare Lea	
Customers ref.		
Our ref.	David Compton	

Supply air flow	1,25 m³/sec	Exhaust air flow	1,25 m³/sec
Ext. static pressure	200 Pa	Ext. static pressure	150 Pa
Voltage	3 x 400V + N, 50 Hz	Weight	1855 kg
SFP_v	1,76 kW/(m³/s)	Dimensioned for wet condition	
Ref. density	1,2 kg/m³	Ref. altitude above sea level	0 m

SUMMARY

Functional sections in direction of air flow	v0 (m/s)	Et (%)	tw (°C)	ts (°C)	dP* (Pa)
Supply air:					
Connection section	2,4				2
Preheater	1,8		-4 / 5		14
Filter	1,8				72
Centrifugal fan		75,0	5 / 5,9	30 / 31,1	654
Inspection section					0
Heat exchanger	1,7		5,9 / 13,5	31,1 / 27,7	91
Inspection section					0
Air cooler	1,8			27,7 / 12	103
Inspection section					0
Air heater	1,9		13,5 / 20		19
Filter	1,7				91
Connection section	2,2				1
General loss					61
Supply outlet					200
Exhaust air:					
Exhust inlet					150
Connection section	2,3				2
Filter	1,8				73
Heat exchanger	1,8		23 / 15,5	24 / 27,4	91
Inspection section					0
Centrifugal fan		67,9			346
General loss					30

*Refers to the fan design case

SOUND POWER LEVELS

(standard: EN13053 ISO/CD 13347-2)

	Lw per octave band (dB)								LwA
Octave band (Hz)	63	125	250	500	1k	2k	4k	8k	dB(A)
Fresh air connection	72	73	72	81	77	71	64	53	81
Supply air connection	61	70	66	70	59	57	50	41	69
Extract connection	72	74	74	72	69	61	52	47	73
Exhaust connection	70	79	87	77	74	73	66	62	82
To surroundings	66	63	58	55	52	47	40	30	57

TOLERANCE

According to EN 13053 the LwA tolerance is 4dB. Octave band tolerances are presented in the tolerance table

	Lw per octave band (dB)								LwA
Octave band (Hz)	63	125	250	500	1k	2k	4k	8k	dB(A)
Tolerance	8	6	6	6	6	4	4	7	4

Frequency converters and motors mourted external are not included in the sound power levels

CU1

Flakt Woods	Frequency, Hz								dBA
	63	125	250	500	1000	2000	4000	8000	
SWL	80	84	75	73	69	63	60	42	75

CU2

TOSHIBA Leading Innovation

18

Outdoor unit specifications

Single units

Technical specifications

Equivalent HP				8HP	10HP	12HP	14HP
Model name			(MMY-)	MAP0804FT8-E	MAP1004FT8-E	MAP1204FT8-E	MAP1404FT8-E
Outdoor unit type				Inverter			
Cooling capacity (*1)			(kW)	22.4	28.0	33.5	40.0
Heating capacity (*1)			(kW)	25.0	31.5	37.5	45.0
Power supply (*2)				3-phase 4 wires 50Hz 400V (380-415V)			
Electrical characteristics (*1)	Cooling	Power consumption	(kW)	5.17	7.28	8.38	11.30
		EER (Energy Efficiency Ratio)		4.33	3.85	4.00	3.54
	Heating	Power consumption	(kW)	5.68	7.50	9.05	12.70
		COP (Coefficient of Performance)		4.40	4.20	4.14	3.54
External dimensions (Height / Width / Depth)			(mm)	1,830 / 990 / 780	1,830 / 990 / 780	1,830 / 1,210 / 780	1,830 / 1,210 / 780
Total weight			(kg)	259	259	334	334
Compressor	Motor output		(kW)	2.3 x 2	3.1 x 2	2.6 x 3	3.1 x 3
Fan unit	Motor output		(kW)	1.0	1.0	1.0	1.0
	Air volume		(m^3/h)	8,700	9,400	12,000	13,000
Refrigerant piping	Connecting port diameter	Suction gas side	(mm)	ø 22.2	ø 22.2	ø 28.6	ø 28.6
		Discharge gas side	(mm)	ø 19.1	ø 19.1	ø 19.1	ø 22.2
		Liquid side	(mm)	ø 12.7	ø 12.7	ø 12.7	ø 15.9
		Balance pipe	(mm)	ø 9.5	ø 9.5	ø 9.5	ø 9.5
Sound pressure level (Cooling/Heating)			(dB(A))	55.0 / 57.0	57.0 / 59.0	60.0 / 62.0	62.0 / 64.0

CU3

Model	Outdoor Unit	RAV	SP564ATP-E	SP804ATP-E	SP1104AT-E	SP1404AT-E
	Indoor Unit	RAV	SM564CT-E	SM804CT-E	SM1104CT-E	SM1404CT-E
System Data	Cooling Capacity (Range)	kW	5.0 (1.2-5.6)	7.0 (1.9-8.0)	10.0 (2.6-12.0)	12.5 (2.6-14.0)
	Heating Capacity (Range)	kW	5.6 (0.9-7.4)	8.0 (1.3-10.6)	11.2 (2.4-13.0)	14.0 (2.4-16.5)
	Power Input, Cooling/Heating	kW	1.56/1.47	2.21/2.16	2.67/2.62	3.73/3.65
	COP	W/W	3.81	3.7	4.27	3.84
	EER	W/W	3.21	3.21	3.25	3.35
	SEER	W/W	4.26	4.74	5.37	5
	Annual Power Consumption, Cooling	kWh	780	1105	1335	1865
	Energy Label, Cooling / Heating		A/A	A/A	A/A	A/A
	UK Conditions - Cooling Capacity	kW	5.44	7.76	11.65	13.59
	UK Conditions - Sensible Cooling Capacity	kW	4.22	5.85	7.73	8.75
	UK Conditions - Heating Capacity	kW	5.21	7.08	9.68	12.29
Indoor	Air flow (Low/Medium/High)	l/s	167/186/217	308/278/243	458/400/353	500/433/385
	Sound Power Level (High/Medium/Low)	dB(A)	51/48/45	53/51/48	56/53/50	58/55/52
	Sound Pressure Level (High/Medium/Low)	dB(A)	36/33/30	38/36/33	41/38/35	43/40/37
Outdoor	Airflow	l/s (m3/h)	667 (2400)	833 (3000)	1683 (6060)	1716 (6180)
	Sound Power Level (cooling/heating)	dB(A)	64/65	65/66	66/67	68/69
	Sound Pressure Level (cooling/heating)	dB(A)	47/48	48/49	49/50	51/52
	Pipe Connections, Gas - Liquid	in	1/2 - 1/4	5/8 - 3/8	5/8 - 3/8	5/8 - 3/8
	Pipe Length, Maximum/Minimum	m	50/5	50/5	75/5	75/5
	Maximum Operating Current	A	7.03	10.2	12.28	16.93
	Suggested Fuse Size	A	10	16	20	20
	Base charge refrigerant level	Kg	1.1	2	3.1	3.1

APPENDIX D – CALCULATIONS

AHU

Table 7 – Assessment of the noise emissions at the nearest noise façade from the fresh air connection of the AHU

	Frequency, Hz								dBA
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
SWL	72	73	72	81	77	71	64	53	81
Uncertainty Added	8	6	6	6	6	4	4	7	4
SWL + Uncertainty	80	79	78	87	83	75	68	60	85
SPL @ Nearest Building, 20m	46	45	44	53	49	41	34	26	-
A weighting	-26	-16	-9	-3	0	1	1	-1	-
Noise Level @ Nearest Building, 20m	20	29	35	50	49	42	35	25	53

Table 8 – Assessment of the noise emissions at the nearest noise façade from the exhaust connection of the AHU

	Frequency, Hz								dBA
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
SWL	70	79	87	77	74	73	66	62	82
Uncertainty Added	8	6	6	6	6	0	0	7	4
SWL + Uncertainty	78	85	93	83	80	73	66	69	86
SPL @ Nearest Building, 20m	44	51	59	49	46	39	32	35	-
A weighting	-26	-16	-9	-3	0	1	1	-1	-
Noise Level @ Nearest Building, 20m	18	35	50	46	46	40	33	34	53

CU1

Table 9 – Assessment of the noise emissions at the nearest noise façade from the Flackt Wood Condensing Unit

	Frequency, Hz								dBA
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
SWL	80	84	75	73	69	63	60	42	75
Uncertainty Added	3	3	3	3	3	3	3	3	-
SWL + Uncertainty	83	87	78	76	72	66	63	45	-
SPL @ Nearest Building, 20m	49	53	44	42	38	32	29	11	-
A weighting	-26	-16	-9	-3	0	1	1	-1	-
Noise Level @ Nearest Building, 20m	23	37	35	39	38	33	30	10	44

CU2

Table 10 – Assessment of the noise emissions at the nearest noise façade from the Toshiba VRF Condensing Unit 10HP unit

SWL, dB(A)	73
Uncertainty Added, dB(A)	3
SWL + Uncertainty, dB(A)	76
Noise Level @ Nearest Building, 20m, dB(A)	42

CU3

Table 11 – Assessment of the noise emissions at the nearest noise façade from the Toshiba Split System 11kW unit

SWL	67
Uncertainty Added	3
SWL + Uncertainty	70
Noise Level @ Nearest Building, 20m, dB(A)	36