UCL Kathleen Lonsdale Building Refurbishment

Noise Impact Assessment

November 2014

ATKINS

Plan Design Enable

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Introduction

Kathleen Lonsdale Building is a Grade II listed building owned by the University College of London (UCL), located on Gower Place in the borough of Camden.

It was built in 1915 as the first purpose-built Chemistry Building for UCL, however, over the years it has been adapted to suit different UCL departments and as a result has become fragmented, with complex circulation routes. To improve the utilization of the space, the building will undergo extensive refurbishment, the existing cellular labs and offices will be transformed into contemporary open-plan multifunctional areas including shared studios, break out spaces and student hubs. The refurbishment works will also include the replacement of the two existing chillers located on the roof.

Atkins Acoustics, Noise and Vibration has been appointed to carry out a background noise survey at the site to allow noise limits to be set in accordance with Camden Borough Council requirements and perform a Noise Impact Assessment to support the Planning Application in relation to the refurbishment of Kathleen Lonsdale Building.

This document details the methodology and results of the noise survey, sets out plant limits to which the proposed chillers will need to adhere and describes the assessment of the plant noise impact.

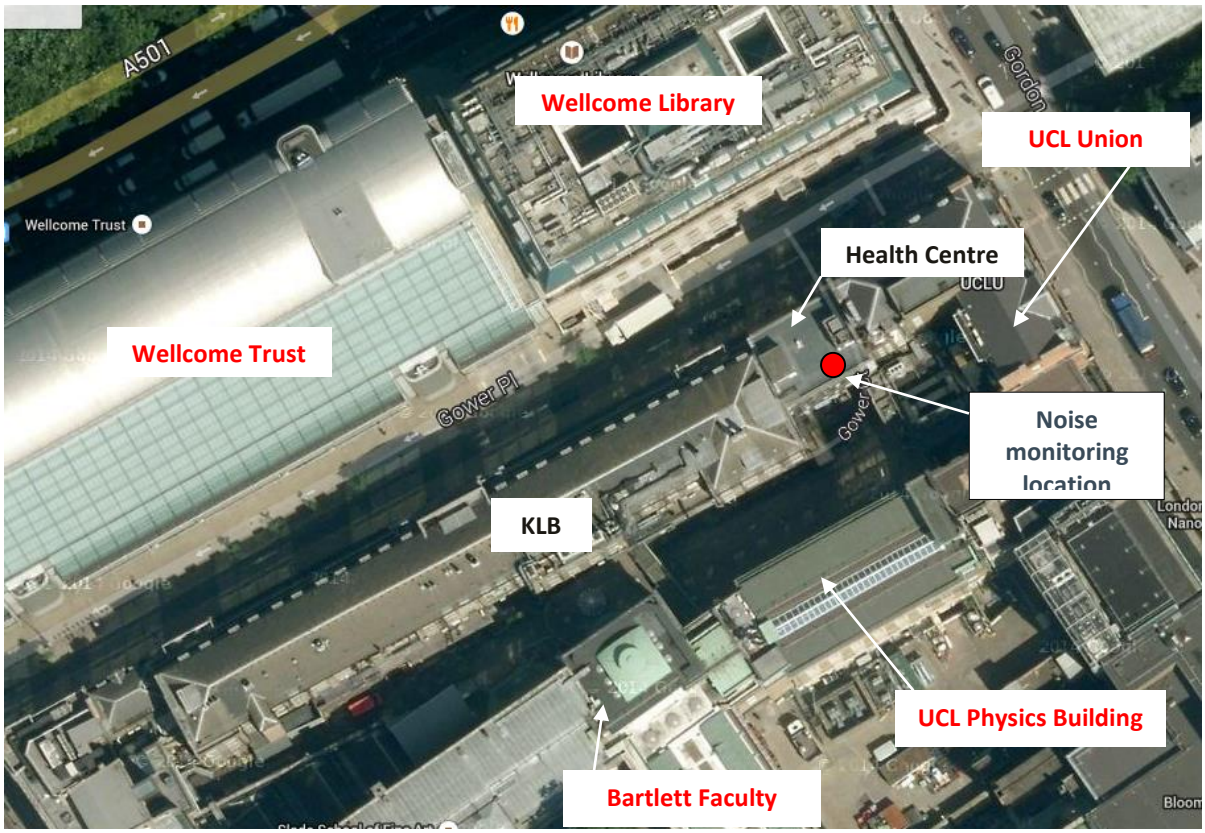
1. Ambient Noise Survey

An ambient noise survey was undertaken by Atkins Acoustics, Noise and Vibration on Wednesday 18th and Thursday 19th June 2014, prior to the refurbishment of the University building. Due to difficulties in accessing the roof of the Kathleen Lonsdale Building, a measurement location was chosen on the rooftop area of the adjacent Health Centre building. A rooftop location for the acoustic measurements was chosen (as opposed to a ground level measurement location) as the noise data obtained would representative of noise levels and climate incident upon the facades of the building and external windows of the adjacent noise sensitive receptors, which are principally subject to noise generated by plant equipment located on all the nearby rooftops.

Continuous noise measurements were taken over a 24 hour period using a Rion NL-52 sound level meter and external microphone mounted in a free field position, on a tripod 1.5m above the roof level. The meter was field-calibrated using a Rion NC-74 both before and on completion of the survey, with no significant drift observed. Equipment details and full certificates are included in Appendix B. The roof top area contained a number of items of plant which were operational during the monitoring period. The logger was positioned such that their operation did not unduly contribute to the overall measured noise levels (refer to Figure 1-1).

Atkins understands that the nearest noise sensitive receivers to the Kathleen Lonsdale Building are the Wellcome Trust and Collection on Gower Place, the UCL Physics Building, the Bartlett Faculty of the Built Environment and the UCL Union on Gower Court. All of these receivers have direct line of sight to the proposed rooftop plant. No residential accommodation is located in the vicinity of the Kathleen Lonsdale Building.

Figure 1-1 Noise Monitoring Position



1.1. Survey Observations

At the beginning and the end of the noise monitoring period, the dominant noise sources were noted to be rooftop plant noise from the nearby UCL buildings, local road traffic noise from Gower Place and Gordon Street and distant road traffic noise from Euston Road, construction works being carried out on Gower Place as well as noise from delivery trucks parked on Gower Court.

Weather and wind conditions have been recorded at the beginning and the end of the measurement period and they can be considered suitable to obtain representative noise measurements.

1.2. Survey Results

Sound pressure level measurements are normally taken with an A-weighting electronic filter (denoted by a subscript 'A', e.g. dB L_{Aeq}) to approximate the frequency response of the human ear. A more detailed explanation of these quantities can be found in BS7445-1:2003 "*Description and measurement of environment noise, Part 1. Guide to quantities and procedures*".

Although a range of statistical noise data was recorded, the $L_{Aeq,15min}$ $L_{A90,15min}$ and L_{Amax} indices are reported here:

- dB L_{Aeq} – The A weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period, in this case 15 minutes.
- dB L_{A90} – The L_{A90} is defined as the 90th percentile level or noise level that is exceeded for 90% of the measurement period, and is commonly referred to as the Background Noise Level.
- dB L_{Amax} – The L_{Amax} is the highest noise level occurred over the whole measurement period.

A summary of the logarithmic mean of the L_{Aeq} measurements, linear mean of the L_{A90} measurements and maximum noise levels L_{Amax} are summarised in Table 1-1 below for day, evening and night time periods. Full measurements details and octave band sound pressure levels can be found in Appendix A.

Table 1-1 Noise survey results - summary

Day-time (07:00 – 19:00)			Evening (19:00 – 23:00)			Night time (23:00 – 07:00)		
dB L_{Aeq}	**dB L_{A90}**	**dB L_{Amax}**	**dB L_{Aeq}**	**dB L_{A90}**	**dB L_{Amax}**	**dB L_{Aeq}**	**dB L_{A90}**	**dB L_{Amax}**
60.9	59.6	81.6	59.7	59.1	80.2	58.9	58.2	74.5

The measured noise survey data show fairly constant noise levels both during the day and night-time and this is due to the building services plant from the surrounding buildings being constantly operational and continuous distant road traffic noise from Euston Road. These levels are to be used as the project's design noise levels in defining the ventilation strategy and environmental noise emission targets. Details are presented in the following section.

2. Environmental Noise Emissions

As part of the proposed development, two air cooled packaged chillers located on the roof are to be replaced with new units in order to meet the requirements of the refurbished space below. In addition a new plant room will be created on the first floor for the ventilation plant of the Earth Science laboratories on the first floor. This section considers the noise issues relating to the operational airborne noise generated by the new chillers and first floor plant room as well as the impact these may have on persons living or working in the vicinity.

2.1. Implications for Building Services

The response to noise is subjective and affected by many factors (acoustic and non-acoustic).The likelihood of complaint in response to noise depends upon factors including the margin by which it exceeds the background noise level, its absolute level, the time of day, the change in noise environment etc. as well as local attitudes to the premises and the nature of the neighbourhood. The operational noise impacts of the chillers have been assessed in accordance with BS 4142:1997 "*Method for rating industrial noise affecting mixed residential and industrial areas*". This is a comparative standard which can be used in assessing the measured or calculated noise levels from sources of an industrial nature. This standard is only applicable to residential receptors, however, for the purposes of this assessment it has also been used in order to provide an indicative assessment of noise impacts at all buildings in the vicinity of the Kathleen Lonsdale building.

BS 4142:1997 defines a number of noise level descriptors in order to calculate and assess the effects of industrial noise. The "specific noise level" is defined as the constant noise level over the given duration produced by the specific noise source under investigation which contains the same energy as the time varying noise level. For day time periods, BS 4142 defines the reference time interval over which the impact should be assessed as being 1 hour. A +5dB correction may be added to this noise level where the nature of the noise is tonal, impulsive or otherwise irregular so that it may attract attention. The resulting noise level, either with or without the correction, is described as the "rating level". The "residual noise level" is therefore defined as the ambient noise level remaining when the specific noise source is suppressed to a degree that it does not contribute to the ambient noise.

BS 4142 advises that a rating level of 5dB above the background noise level of the residual noise is regarded as 'marginal significance', a rating level 10dB greater than the background noise level indicates that 'complaints are likely'. A rating level of 10dB below the background noise level is a 'positive indication that complaints are unlikely'.

Camden Development Policy 28 requires noise levels arising from new plant or machinery to be at least 5dB below the lowest background L_{A90} at 1 m from the external façade of noise sensitive premises during the typical operational period of the plant. Noise sensitive developments include housing, schools and hospitals as well as offices, workshop and open spaces. In this case, the noise levels arising from new plant must be equal to or lower than 54.1dB at 1m form the external façade of noise sensitive properties.

2.1.1. Noise assessment - Chillers

The replacement chillers will have the same footprint as the existing chillers and be installed on the same steel supports. Due to the difference in height between the roof top area where the chillers will be located and adjacent building elements, the chillers will be completely screened to all receptors located adjacent to the Kathleen Lonsdale building on Gower Place (The Wellcome Trust) and the rear façade of the UCL Health Centre building and partially screened to the rear façade of the UCL Union building. Data supplied by the manufacturer, shown in Appendix C indicates that during operation, the airborne sound pressure level of the proposed chiller unit at a distance of 5m will be 67 dB(A)[1].

Noise levels from the chillers have been assessed at a number of adjacent locations using the ambient noise measurement data. For each identified receptor, distances from the chillers have been calculated from plan views of the site and are tabulated in Table 2-1.

[1] Sound pressure values calculated in accordance with ISO 3744.

Table 2-1 Assumed distance between the chillers and adjacent receptors

Receptor	Receptor Type	Distance (m)
UCL Slade School of Fine Art	Higher Education Facility	20
UCL The Bartlett Faculty for the Built Environment	Higher Education Facility	20
UCL Physics Laboratory	Higher Education Facility	24
UCL Health Centre	Health Centre	35
UCL Union	Office	63
The Wellcome Trust	Office/Library/Gallery	30

For the purposes of this assessment it has been assumed as a working approximation that if the existing building features surrounding the chillers completely screen the view from receivers, 10dB attenuation could be expected. If the chillers are partially screened from receivers, 5dB attenuation has been assumed. If there is a direct line of sight between the chillers and receiver no attenuation has been assumed.
Assuming hemispherical propagation, noise levels from the operation of the chillers at the noise sensitive receptors have been calculated and are shown in Table 2-2.

Table 2-2 Predicted noise levels from the chillers at noise sensitive receptors

Receptor	Overall SPL from 2 chillers	Distance (m)	Attenuation due to distance	Barrier Correction	Resulting noise level at receptor dB(A)
UCL Slade School of Fine Art	70	20	12.0	0	58.0
UCL The Bartlett Faculty for the Built Environment		20	12.0	0	58.0
UCL Physics Laboratory		24	13.6	0	56.4
UCL Health Centre		35	16.9	-10	43.1
UCL Union		63	22.0	-5	43.0
The Wellcome Trust		30	15.6	-10	44.4

It is assumed that all adjacent receptors would be occupied during the daytime (07:00 to19:00) and evening (19:00 to 23:00) periods only. As a consequence the assessment has been undertaken using noise data from the evening period when the measured background noise levels are at their lowest (59.1 dB L_{A90}).

Frequency data supplied by the manufacturer indicate that during operation the noise from chiller units will not contain acoustic features which may increase the likelihood of complaint. Moreover, manufacturers' data confirm that the selected chiller units will be low noise version units and that the compression compartment of the chiller units will be lined with sound absorbing and sound insulating material, reducing the noise produced by the compressors. As such, a +5dB distinct character correction is not assumed as part of this assessment in determining the rating noise levels. Using the information described above, an indicative BS 4142 assessment is shown in Table 2-3.

Table 2-3 BS4142 assessment summary

Receptor	Resulting noise level at receptor dB(A)	Acoustic feature correction (dB)	Rating Level (dB)	Measured dB L_{A90}	Level Difference
UCL Slade School of Fine Art	58.0	0	58.0	59.1	-1.1
UCL The Bartlett Faculty for the Built Environment	58.0		58.0		-1.1
UCL Physics Laboratory	56.4		56.4		-2.7
UCL Health Centre	43.1		43.1		-16.0
UCL Union	43.0		43.0		-16.1
The Wellcome Trust	44.4		44.4		-14.7

The indicative assessment shows that for receptors with a direct line of sight to the chillers (UCL Slade School of Fine Art, UCL The Bartlett Faculty for he Built Environment, UCL Physics Laboratory), the rating level is approximately -1dB lower than the measured background noise level.

For all other receptors, the rating level is lower than 10dB below the measured background level and it complies with the LB Camden Policy.

The predicted rating noise level from the rooftop plant does not meet the LB Camden Policy requirement of 5dB below the background noise level at all the nearest noise sensitive receptors. However, since the noise sensitive receptors where the Camden Policy criteria are not met are part of the UCL campus, it can be assumed that the only receptor that should comply with the criteria is The Wellcome Trust, where the predicted rating noise level from the rooftop plant is lower than the existing background noise level. Moreover, it should be noted that the existing chiller will be replaced with a newer, more efficient model and this should result an improvement on the current situation.

In addition, it should be noted that no residential properties are affected by the rooftop plant replacement at Kathleen Lonsdale Building.

2.1.2. Noise assessment – First Floor plant room

To ensure that the internal ambient noise levels within the refurbished Kathleen Lonsdale building and other adjacent UCL buildings are not compromised by noise from new mechanical plant associated with the Kathleen Lonsdale building, any mechanical plant should be designed and situated such that the predicted noise level at the nearest building façade is 5 dB below the measured background noise level L_{A90}.

Specific details regarding mechanical plant to be installed within the new plant room on the first floor or any ventilation louvers/stacks and openings in the plant room facade are not known. As a consequence indicative calculations have been performed, in accordance with the BS4142:1997 methodology to define the maximum permissible noise level from building plant which would ensure the above performance criterion is met, the results of which are shown in Table 2-4.

The acoustic characteristics of the mechanical plant noise could be expected to contain clearly audible tonal elements which could be significantly different from that of the existing ambient noise. Therefore a +5dB distinct character correction is assumed as part of this assessment in determining rating noise levels.

Table 2-4 Building service plant noise level limit from the new first floor plant room

BS4142 calculation step	Noise level or correction
Background Noise L_{A90} Measured[2]	59.1
Target 'excess of rating level over background noise level', dB(A)	-5
Target 'specific noise level' dB $L_{Ar,Tr}$ at building facade	54.1
'Acoustic feature correction', dB(A)	+5
Target 'rating level' dB $L_{Aeq,T}$ at building facade	49.1

From the results shown in Table 2-4 above, it can be concluded that building services need to be specified such that predicted noise levels from all plant at any ventilation louver, stack or opening does not exceed 49.1 dB $L_{Aeq,T,}$ at the facades of defined receivers, to ensure noise levels are 5dB below the measured background noise level $L_{A90.}$

Further consideration and calculations should be undertaken when plant specifications are known.

[2] It is assumed that the KL building and other UCL buildings in the vicinity of the new first floor plant room would be occupied during the daytime (07:00 to19:00) or evening (19:00 to 23:00) periods only. As a consequence the assessment has been undertaken for the evening period when the measured background noise levels are at their lowest.

3. Conclusions

Kathleen Lonsdale Building will soon undergo extensive refurbishment works, including the replacement of the two existing air cooled packaged chillers located on the roof with new units and the installation of a new mechanical plant room on the First Floor of the building in order to meet the requirements of the refurbished spaces.

Atkins Acoustics, Noise and Vibration has been appointed to carry out a background noise survey at the site to allow noise limits to be set in accordance with Camden Borough Council requirements and perform a Noise Impact Assessment to support the Planning Application in relation to the refurbishment of Kathleen Lonsdale Building.

Based on the noise survey results and BS4142 plant noise assessment carried out by Atkins Acoustics, Noise and Vibration and detailed in Section 1 and 2 of this report, the rating level resulting from the proposed noise source (chillers) is approximately -1dB lower than the measured background noise level for receptors with a direct line of sight to the chillers (UCL Slade School of Fine Art, UCL The Bartlett Faculty for he Built Environment, UCL Physics Laboratory). For all other receptors (Wellcome Trust, ULC Union, UCL Health Centre) the rating level is lower than 10dB below the measured background level and it complies with LB Camden requirements.

The predicted rating noise level from the rooftop plant does not meet the LB Camden Policy requirement of 5dB below the background noise level at all the nearest noise sensitive receptors. However, since the noise sensitive receptors where the Camden Policy criteria are not met are part of the UCL campus, it can be assumed that the only receptor that should comply with the criteria is The Wellcome Trust, where the predicted rating noise level from the rooftop plant is lower than the existing background noise level. Moreover, it should be noted that the existing chiller will be replaced with a newer, more efficient model and this should result an improvement on the current situation.

In addition, it should be noted that no residential properties are affected by the rooftop plant replacement at Kathleen Lonsdale Building.

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Appendices

Appendix A. Measured Frequency Spectra

The following tables show the full measured frequency spectrum results in octave bands for L_{Aeq}, L_{A90} and L_{Amax}.

Table A-1 Measured L_{Aeq} frequency data, in octave bands

Position	Date	Time	Duration	L_{Aeq}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	11:32	15	61.8	7.9	34.4	42.6	46.6	53.6	54.5	56.9	54.1	52.2	39.1
1	18/06/2014	11:47	15	60.5	8.5	34.7	43	46.6	53	53.4	54.7	52.7	51.6	37.9
1	18/06/2014	12:02	15	60.1	7.7	34.4	42.6	46.2	52.8	52.8	54.4	52	51	37
1	18/06/2014	12:17	15	60.9	8	34.4	43.1	46.9	53.1	53.9	55.4	53	51.6	38
1	18/06/2014	12:32	15	60.5	7.7	34.3	42.8	46.5	52.9	53.3	54.9	52.7	51.3	37.4
1	18/06/2014	12:47	15	60.3	8.4	34.4	43.1	46.6	53.1	53.4	54.7	51.8	51.4	36.6
1	18/06/2014	13:02	15	60.3	8.2	34.3	42.9	46.8	53	53.5	54.4	51.9	51.1	36.6
1	18/06/2014	13:17	15	61	9.2	34.7	43.3	47.5	53.6	53.9	55.3	53.3	51.7	37.5
1	18/06/2014	13:32	15	60.6	9.8	34.6	43.2	47.2	53.3	53.5	54.7	52.7	51.2	36.5
1	18/06/2014	13:47	15	62.7	10.7	34.5	44.1	50.3	56.3	56.5	56.5	54	51.8	36.3
1	18/06/2014	14:02	15	61.9	10.7	35	43.6	47.8	53.7	55.1	56.5	54.3	52.7	38.4
1	18/06/2014	14:17	15	62.4	9.9	35.1	43.8	47.8	54.9	55.6	56.6	55	52.8	39.7
1	18/06/2014	14:32	15	62.3	9.1	34.6	44.5	47.6	54.4	55.6	56.7	54.6	52.9	40.2
1	18/06/2014	14:47	15	62.3	15.9	35.2	44.6	48.5	54.7	56.1	56.9	53.8	52.5	38.2
1	18/06/2014	15:02	15	60.6	8.1	34.5	43.2	46.9	53.2	53.7	54.9	52.3	51.8	36.6
1	18/06/2014	15:17	15	60.8	9	34.5	43.7	46.9	53.5	53.8	55.1	52.7	51.9	36.7
1	18/06/2014	15:32	15	61.2	8.1	34.8	44.2	48.3	53.8	54.2	55.5	53	52.2	37.6
1	18/06/2014	15:47	15	61.2	8.7	34.4	43.3	47	53.8	54.3	55.7	52.9	51.9	37.4
1	18/06/2014	16:02	15	60.5	7.5	34.1	42.8	46.2	53.2	53.7	54.9	52	51.6	36.6
1	18/06/2014	16:17	15	60.6	8.4	34.3	42.9	45.4	53.2	53.7	54.9	52.1	51.8	36.4
1	18/06/2014	16:32	15	60.3	8.1	33.9	42.9	45.2	52.9	53.2	54.9	52.1	51.5	36
1	18/06/2014	16:47	15	60.3	8.3	34.1	42.9	45.5	53.1	53.3	54.6	51.7	51.6	36.2
1	18/06/2014	17:02	15	60	7.8	33.8	42.7	45.4	53	53.1	54.3	51.1	51.5	36
1	18/06/2014	17:17	15	60.4	7.6	33.9	42.3	45.1	52.8	53.6	55	51.5	51.8	36
1	18/06/2014	17:32	15	59.8	7.6	33.7	42.3	45	52.6	52.7	54.2	50.9	51.6	35.9
1	18/06/2014	17:47	15	59.9	7.4	33.6	42.1	44.9	52.6	52.7	54.3	51.1	51.7	35.7
1	18/06/2014	18:02	15	60	7.4	33.7	42.5	45.2	52.7	52.8	54.5	51	51.6	35.7
1	18/06/2014	18:17	15	60.5	7.5	33.7	42.5	45.3	52.6	53.3	55.6	52.1	51.3	35.9
1	18/06/2014	18:32	15	60.9	8.8	34	42.7	46.3	53	53.9	56.4	51.8	51.5	35.8
1	18/06/2014	18:47	15	60.2	7.5	33.9	42.6	45.5	52.5	53.3	55	51.3	51.6	35.9
1	18/06/2014	19:02	15	59.7	7.1	33.8	42.3	45	52.3	52.8	54.3	50.6	50.9	35.6
1	18/06/2014	19:17	15	60	7.1	33.7	42.4	45.1	52.4	52.9	54.9	51	51.1	35.8
1	18/06/2014	19:32	15	59.7	6.9	33.7	42.5	45.2	52.4	52.9	54.3	50.7	50.8	35.6
1	18/06/2014	19:47	15	59.8	7	33.7	42.5	45.2	52.4	52.8	54.6	51.4	50.3	35.6
1	18/06/2014	20:02	15	59.8	7	33.6	42.2	44.9	52.3	52.8	54.2	51.6	50.8	35.6
1	18/06/2014	20:17	15	59.6	6.8	33.3	41.9	44.5	52	52.5	54.1	51.7	50.6	35.8
1	18/06/2014	20:32	15	59.5	6.7	33.6	42	45.6	52	52.3	54.1	51.3	50.3	35.5
1	18/06/2014	20:47	15	59.8	6.9	33.3	41.8	45.2	52.2	52.7	54.3	52	50.8	35.9

Position	Date	Time	Duration	L_{Aeq}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	21:02	15	59.7	6.8	33.4	41.8	44.5	52.2	52.4	54.1	52	50.9	35.8
1	18/06/2014	21:17	15	59.8	6.9	33.6	41.9	44.5	52	52.2	54.1	52.4	51.4	36.1
1	18/06/2014	21:32	15	59.6	6.9	33.4	41.7	44.2	51.9	52.2	54	52	51.1	35.9
1	18/06/2014	21:47	15	60.3	6.7	33.1	41.7	44.5	52.1	52.6	54.3	53.8	51.8	38.1
1	18/06/2014	22:02	15	59.6	6.7	33.4	41.8	44.3	52	52.5	54.2	51.8	50.2	36
1	18/06/2014	22:17	15	59.4	6.7	33	41.7	44.3	52	52.4	54	51.3	50.2	35.7
1	18/06/2014	22:32	15	59.7	6.6	33.1	41.7	44.4	52.1	52.6	54.5	51.5	50.5	35.6
1	18/06/2014	22:47	15	59.4	6.6	33	41.7	44.4	52.1	52.5	53.9	50.8	50.6	35.6
1	18/06/2014	23:02	15	59.6	6.6	33	41.6	44.5	52.2	52.6	54.1	50.9	51.1	36
1	18/06/2014	23:17	15	60	7.6	33.1	41.8	45.2	52.4	53.5	54.6	51.4	50.7	35.7
1	18/06/2014	23:32	15	59.3	6.6	32.9	41.6	44.3	51.9	52.3	53.9	50.9	50.5	35.6
1	18/06/2014	23:47	15	59.6	6.5	32.9	41.6	43.9	51.9	52.3	54	51.6	51.4	36.9
1	19/06/2014	00:02	15	59.5	6.8	32.8	41.8	44.4	51.9	52.5	54.1	51.2	50.6	35.8
1	19/06/2014	00:17	15	59.2	6.7	32.6	41.6	44.2	51.8	52.3	53.8	50.7	50.3	35.7
1	19/06/2014	00:32	15	59.1	6.6	32.9	41.6	44.1	51.9	52.2	53.7	50.4	50.1	35.7
1	19/06/2014	00:47	15	59.1	6.5	32.7	41.5	44.1	51.8	52.2	53.7	50.4	50.2	35.9
1	19/06/2014	01:02	15	58.5	6.4	32.8	41.6	44.1	51.8	51.3	52.6	49.6	50.2	35.2
1	19/06/2014	01:17	15	58.4	6.4	32.6	41.4	43.9	51.9	51.1	52.6	49.1	50.2	35.4
1	19/06/2014	01:32	15	58.4	6.3	32.8	41.3	43.7	51.7	51.3	52.6	49	50.2	35.6
1	19/06/2014	01:47	15	58.4	6.3	32.8	41.4	43.8	51.6	51.3	52.6	49	50.1	35.5
1	19/06/2014	02:02	15	58.4	6.3	32.7	41.4	43.9	51.5	51.3	52.6	49.1	49.9	35.6
1	19/06/2014	02:17	15	58.5	6.5	32.6	41.4	44	51.8	51.4	52.8	49.1	50	35.6
1	19/06/2014	02:32	15	58.4	6.4	32.6	41.3	43.6	51.5	51.3	52.4	48.9	50.8	35.4
1	19/06/2014	02:47	15	58.4	6.4	32.7	41.3	43.8	51.9	51.3	52.6	48.9	50.3	35.4
1	19/06/2014	03:02	15	58.7	7	32.8	41.3	43.8	51.8	52	53	49.2	50.2	35.5
1	19/06/2014	03:17	15	58.7	7.4	32.8	41.4	44.1	51.7	51.8	53	49.4	50.2	35.6
1	19/06/2014	03:32	15	58.5	6.4	32.7	41.2	43.6	51.6	51.1	52.6	49	51.3	35.8
1	19/06/2014	03:47	15	58.6	6.4	32.8	41.3	43.7	51.6	51	52.3	49.7	51.7	35.9
1	19/06/2014	04:02	15	58.8	6.7	32.9	41.5	44.6	52	51.2	52.5	49.9	51.5	36
1	19/06/2014	04:17	15	58.7	7	32.8	41.8	46.3	52	51.6	52.9	49.8	49.1	35.7
1	19/06/2014	04:32	15	58.3	6.5	32.6	41.4	43.8	51.7	51.5	52.4	49.2	49	35.4
1	19/06/2014	04:47	15	58.4	6.5	32.9	41.3	43.8	51.8	51.6	52.5	49.2	49.7	35.8
1	19/06/2014	05:02	15	58.5	6.9	33.1	42.3	44	51.7	51.6	52.8	49.6	49.3	36.2
1	19/06/2014	05:17	15	58.4	6.6	32.9	41.4	43.9	52.1	51.5	52.7	49.3	48.9	35.8
1	19/06/2014	05:32	15	58.4	6.8	33.1	41.7	44	51.9	51.5	52.7	49.4	48.7	35.6
1	19/06/2014	05:47	15	58.5	6.9	33.3	41.6	44.1	51.7	51.4	53.1	49.9	49.1	35.5
1	19/06/2014	06:02	15	59	7.2	33.4	41.8	44.3	51.8	51.5	53.4	50.3	50.7	35.9
1	19/06/2014	06:17	15	60.4	7.3	34.2	41.9	44.6	52.3	52.5	54.8	54.2	51.5	36.9
1	19/06/2014	06:32	15	59.6	7.1	34.3	42	45.1	52.2	52.3	53.9	50.7	52	36.4
1	19/06/2014	06:47	15	60.3	7.7	33.8	42.6	46.9	53.2	53.6	54.6	51	51.6	36.6
1	19/06/2014	07:02	15	59.9	7.6	33.6	42.2	45.4	52.6	52.8	54.1	51	51.9	37.1
1	19/06/2014	07:17	15	59.2	7.2	33.6	41.8	44.8	52.1	52	53.3	49.8	51.9	36.3
1	19/06/2014	07:32	15	59.8	7.7	35	42.6	45.3	52.3	52.6	53.9	51.8	51.5	37.1
1	19/06/2014	07:47	15	61.4	8.5	35.1	42.8	45.5	52.6	53.9	55.3	55.5	52.6	39.5
1	19/06/2014	08:02	15	60.3	8	35	43.2	45.6	52.5	53.8	54.4	52	51.9	39.5
1	19/06/2014	08:17	15	64	8.4	35.9	43.2	47	53	54.3	62	53.8	51.8	40.8
1	19/06/2014	08:32	15	62	7.8	34	42.6	47.2	54	55	56.9	54.5	52.4	39.8
1	19/06/2014	08:47	15	62.2	7.5	34.7	43	47	54.6	55	56.4	55.2	52.8	39.3

Position	Date	Time	Duration	L_{Aeq}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	19/06/2014	09:02	15	60	7.4	34.5	43.1	46.6	52.7	53.2	54	51.8	50.8	36.8
1	19/06/2014	09:17	15	60.1	7.5	34.4	43.2	46.7	52.9	53.3	54.2	51.6	50.6	36.7
1	19/06/2014	09:32	15	60.1	7.2	34.3	43	46.4	52.7	52.9	53.9	52.1	51.9	40.1
1	19/06/2014	09:47	15	60	7.5	34.4	43.3	46.9	52.8	52.9	54	51.8	51.2	36.7
1	19/06/2014	10:02	15	60	8.4	34	42.7	46.3	52.8	52.8	54.3	51.8	51.5	36.7
1	19/06/2014	10:17	15	60.5	8.1	34.3	43.3	46.7	52.7	52.8	55.3	53	51.3	36.9
1	19/06/2014	10:32	15	60.3	7.4	34	42.9	46.7	53.1	53.7	54.4	51.7	51.4	36.8

Table A-2 Measured L_{A90} frequency data, in octave bands

Position	Date	Time	Duration	L_{A90}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	11:32	15	59.5	3.8	32.1	40.4	44.9	51.6	52.2	53.6	51.2	50	36.2
1	18/06/2014	11:47	15	59.1	4.1	31.9	40.5	44.8	51.2	51.5	52.9	50.6	49.5	35.6
1	18/06/2014	12:02	15	59.5	3.8	32	40.6	44.8	51.6	52	53.5	50.9	49.1	35.9
1	18/06/2014	12:17	15	59.7	4	31.9	40.6	45	51.6	52.4	54	51.1	49.7	35.9
1	18/06/2014	12:32	15	59.5	3.8	32	40.8	44.9	51.5	52.2	53.8	50.8	49.4	35.8
1	18/06/2014	12:47	15	59.7	3.9	32	41	45.2	51.9	52.5	53.9	50.9	49.4	35.7
1	18/06/2014	13:02	15	59.7	3.9	32.1	41	45.4	51.8	52.7	53.8	51.1	49.4	35.6
1	18/06/2014	13:17	15	60	4.4	32.2	41.2	45.8	52.1	52.8	53.9	51.3	49.8	35.5
1	18/06/2014	13:32	15	59.8	4.4	32.3	41.1	45.8	52	52.7	53.6	51	49.5	35.3
1	18/06/2014	13:47	15	60	4.7	32	41.3	46	52.2	52.8	53.9	51.3	50	35.3
1	18/06/2014	14:02	15	60.2	4.4	32.2	41.2	45.6	52	53	54.3	51.6	50.2	35.5
1	18/06/2014	14:17	15	60.3	4.7	32.4	41.6	46.1	52.8	53.4	54.3	51.8	50.7	36.2
1	18/06/2014	14:32	15	61.1	4.3	32.2	42.6	46.1	53.2	54.1	55.1	52.8	50.9	38
1	18/06/2014	14:47	15	60.6	4.5	32.2	41.8	46	52.8	53.3	54.8	52.1	50.9	36.3
1	18/06/2014	15:02	15	60	4	32.1	41.2	45.5	51.9	52.9	53.9	51.3	50.2	35.6
1	18/06/2014	15:17	15	60.2	4.1	32.1	41.3	45.3	52.2	52.9	54.2	51.6	50.3	35.8
1	18/06/2014	15:32	15	60.1	4	32.2	41.3	45.6	52.3	53	54.1	51.3	50.1	35.7
1	18/06/2014	15:47	15	60.3	3.9	31.9	41.3	45.5	52.4	53.1	54.4	51.4	50.3	35.7
1	18/06/2014	16:02	15	60	3.7	31.9	41	44.6	51.8	52.8	54.1	51.1	50.1	35.5
1	18/06/2014	16:17	15	59.9	3.8	31.9	41	44.1	51.9	52.9	53.9	50.9	50.1	35.4
1	18/06/2014	16:32	15	59.6	3.9	31.7	41	43.9	51.6	52.4	53.8	50.7	49.8	35.1
1	18/06/2014	16:47	15	59.7	3.9	31.7	40.9	44.1	51.7	52.6	53.8	50.8	49.8	35.2
1	18/06/2014	17:02	15	59.5	3.9	31.4	40.7	44	51.8	52.4	53.4	50.3	49.9	35.1
1	18/06/2014	17:17	15	59.5	3.8	31.7	40.4	43.6	51.6	52.2	53.8	50.3	50.3	35.2
1	18/06/2014	17:32	15	59.3	3.4	31.4	40.3	43.6	51.4	52	53.3	50	49.9	35
1	18/06/2014	17:47	15	59.3	3.5	31.2	40.2	43.6	51.4	52	53.4	50.2	50	34.9
1	18/06/2014	18:02	15	59.4	3.5	31	40.5	43.8	51.5	52.1	53.6	50.3	50.1	35
1	18/06/2014	18:17	15	59.4	3.6	31.4	40.5	43.9	51.2	52.2	53.8	50.2	49.7	35
1	18/06/2014	18:32	15	59.7	3.5	31.7	40.7	44.1	51.3	52.3	54.5	50.6	50.1	35
1	18/06/2014	18:47	15	59.5	3.5	31.6	40.8	44	51.1	52.3	53.8	50.4	49.9	35.1
1	18/06/2014	19:02	15	59.2	3.3	31.6	40.4	43.6	51	52	53.4	49.9	49.2	34.9
1	18/06/2014	19:17	15	59.4	3.3	31.5	40.5	43.7	51.1	52.2	53.6	50.3	49.6	35.2
1	18/06/2014	19:32	15	59.2	3.1	31.5	40.6	43.9	51.1	52.1	53.4	50	49.1	35
1	18/06/2014	19:47	15	59.2	3.2	31.4	40.5	43.8	51	52	53.8	50.3	48.9	34.9
1	18/06/2014	20:02	15	59.2	3.2	31.3	40.3	43.6	50.9	52	53.5	50.9	49.3	35
1	18/06/2014	20:17	15	59.1	3.1	31.1	40	43.2	50.7	51.7	53.3	50.8	49.2	35
1	18/06/2014	20:32	15	59	3	31.4	40.1	43.2	50.6	51.6	53.4	50.6	48.9	34.9
1	18/06/2014	20:47	15	59.1	3.1	31.2	40	43.2	50.7	51.6	53.5	50.9	49.2	35.2
1	18/06/2014	21:02	15	59.2	3.1	31.1	39.9	43.2	50.9	51.6	53.5	51.3	49.4	35.2
1	18/06/2014	21:17	15	59.1	3	31.2	39.9	43	50.7	51.6	53.4	51.2	49.3	35.2
1	18/06/2014	21:32	15	59.1	3.1	31.1	39.9	42.9	50.6	51.5	53.4	51.3	49.3	35.2
1	18/06/2014	21:47	15	59.1	3	30.8	39.9	43.1	50.6	51.6	53.3	51.1	49.1	35.4
1	18/06/2014	22:02	15	59	3.1	31.1	39.8	43.1	50.6	51.7	53.5	51.1	48.7	35.3
1	18/06/2014	22:17	15	58.9	2.9	30.8	39.8	43	50.5	51.7	53.3	50.3	48.9	35.1
1	18/06/2014	22:32	15	58.9	2.8	30.9	39.9	43.1	50.6	51.7	53.3	50.2	49.4	35.1
1	18/06/2014	22:47	15	59	2.8	30.9	39.8	43.1	50.6	51.7	53.3	50.2	49.5	35.1

Position	Date	Time	Duration	L_{A90}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	23:02	15	59.1	2.8	30.8	39.7	43.1	50.7	51.8	53.5	50.2	49.9	35.2
1	18/06/2014	23:17	15	59	3	30.7	39.8	43.3	50.6	51.8	53.4	50.1	49.5	35.1
1	18/06/2014	23:32	15	58.9	2.9	30.7	39.8	42.9	50.4	51.6	53.3	50.2	49.3	35.2
1	18/06/2014	23:47	15	58.9	2.8	30.7	39.7	42.7	50.4	51.6	53.3	50.2	49.4	35.2
1	19/06/2014	00:02	15	58.9	2.9	30.5	39.9	43	50.6	51.7	53.4	50.3	49.3	35.3
1	19/06/2014	00:17	15	58.8	2.9	30.3	39.8	42.9	50.6	51.6	53.2	50.1	49	35.2
1	19/06/2014	00:32	15	58.7	2.9	30.7	39.8	42.9	50.5	51.5	53.2	49.9	49.1	35.2
1	19/06/2014	00:47	15	58.7	2.7	30.5	39.7	42.8	50.5	51.4	53.1	49.9	49	35.4
1	19/06/2014	01:02	15	58	2.5	30.6	39.7	42.7	50.4	50.5	51.9	48.9	49	34.7
1	19/06/2014	01:17	15	58	2.6	30.4	39.6	42.5	50.4	50.5	52	48.6	49.1	34.8
1	19/06/2014	01:32	15	57.9	2.6	30.7	39.5	42.5	50.3	50.5	52	48.5	49.1	35.1
1	19/06/2014	01:47	15	57.9	2.5	30.7	39.5	42.5	50.1	50.5	52	48.4	49.1	34.9
1	19/06/2014	02:02	15	57.9	2.5	30.6	39.5	42.6	50.2	50.6	52	48.6	48.8	34.9
1	19/06/2014	02:17	15	57.9	2.7	30.5	39.5	42.6	50.3	50.6	52.1	48.5	49	34.9
1	19/06/2014	02:32	15	57.9	2.6	30.5	39.4	42.4	50.1	50.5	51.8	48.4	49.4	34.8
1	19/06/2014	02:47	15	57.9	2.7	30.5	39.4	42.4	50.4	50.4	51.9	48.3	49	34.7
1	19/06/2014	03:02	15	57.9	2.8	30.6	39.4	42.3	50.3	50.4	51.9	48.4	48.9	34.8
1	19/06/2014	03:17	15	57.9	2.7	30.6	39.4	42.5	50.2	50.5	52.1	48.5	49	34.9
1	19/06/2014	03:32	15	58	2.6	30.6	39.4	42.4	50.2	50.3	52	48.4	49.3	35.1
1	19/06/2014	03:47	15	58.1	2.4	30.8	39.4	42.4	50.1	50.4	51.8	48.9	49.9	35.1
1	19/06/2014	04:02	15	58.2	2.8	30.7	39.5	42.5	50.5	50.4	51.9	49.1	48.6	35
1	19/06/2014	04:17	15	58	3	30.6	39.7	42.8	50.6	50.8	52.2	48.9	48.1	34.8
1	19/06/2014	04:32	15	57.8	2.8	30.5	39.5	42.6	50.3	50.6	51.8	48.6	48	34.9
1	19/06/2014	04:47	15	57.8	2.8	30.8	39.5	42.5	50.4	50.7	51.8	48.4	48.4	35
1	19/06/2014	05:02	15	57.9	3	30.6	39.6	42.5	50.3	50.7	51.9	48.6	48.1	35
1	19/06/2014	05:17	15	57.9	2.8	30.7	39.5	42.6	50.6	50.7	52	48.6	47.8	35.1
1	19/06/2014	05:32	15	57.9	3	30.7	39.7	42.7	50.5	50.6	52.1	48.6	47.6	34.8
1	19/06/2014	05:47	15	57.9	3.1	30.9	39.7	42.7	50.3	50.6	52.4	48.9	47.7	34.7
1	19/06/2014	06:02	15	58.3	3.1	31.1	39.9	42.9	50.4	50.6	52.6	49.1	48.5	35.1
1	19/06/2014	06:17	15	58.7	3.5	31.3	39.9	43.2	50.8	51.1	53	49.4	49.4	35.2
1	19/06/2014	06:32	15	58.6	3.2	31	39.9	43.1	50.6	50.9	52.7	49.1	49.9	35.2
1	19/06/2014	06:47	15	58.6	3.5	31	40	43.3	50.8	51.1	52.9	49.2	49.4	35.2
1	19/06/2014	07:02	15	58.6	3.4	31	39.9	43.3	50.7	51.1	52.7	49.2	49.5	35.5
1	19/06/2014	07:17	15	58.7	3.3	31.2	39.9	43.3	50.7	51.1	52.7	49.1	50	35.5
1	19/06/2014	07:32	15	58.5	3.5	31.3	40.1	43.5	50.5	51.2	52.7	49.2	49.4	35.5
1	19/06/2014	07:47	15	58.9	3.6	31.7	40.3	43.6	50.8	51.6	52.8	49.5	50	35.6
1	19/06/2014	08:02	15	59	3.7	31.7	40.5	43.7	50.9	52.1	52.9	49.7	49.3	35.6
1	19/06/2014	08:17	15	59.2	3.8	31.6	40.4	44.5	51.4	52.3	53.2	50	49.5	35.6
1	19/06/2014	08:32	15	60.2	3.7	31.6	40.5	45.4	52.2	53	54.1	51.9	50	36.1
1	19/06/2014	08:47	15	59.4	3.5	32.2	40.8	45.1	51.9	52.1	53	50.5	50.1	35.8
1	19/06/2014	09:02	15	59.2	3.6	31.9	41.1	45.2	51.4	52.1	52.9	50.4	48.9	35.6
1	19/06/2014	09:17	15	59.4	3.6	32.1	41.2	45.3	51.7	52.3	53.2	50.3	49.2	35.6
1	19/06/2014	09:32	15	59.1	3.4	31.9	41	45.1	51.4	51.9	52.8	50.2	49.3	35.5
1	19/06/2014	09:47	15	59.3	3.7	31.9	41.1	45.3	51.6	52	52.9	50.4	49.4	35.6
1	19/06/2014	10:02	15	59.3	3.4	31.6	40.9	45	51.5	52	53.1	50.5	49.6	35.7
1	19/06/2014	10:17	15	59.2	3.6	31.6	41	45.2	51.4	51.9	52.9	50.3	49.5	35.7
1	19/06/2014	10:32	15	59.2	3.4	31.6	40.8	45.3	51.4	51.8	52.8	50.4	49.4	35.6

Table A-3 Measured L_{Amax} frequency data, in octave bands

Position	Date	Time	Duration	L_{Amax}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	11:32	15	78.4	9.9	37.8	52.3	60.9	69.9	74.7	73.3	69	64.5	54.3
1	18/06/2014	11:47	15	81.6	9	44.8	52.6	61.7	70.6	76.4	76.3	75.1	70.7	62.9
1	18/06/2014	12:02	15	70.6	10.9	35.6	44.1	48.9	57.3	59.1	62.7	66	66.1	56.5
1	18/06/2014	12:17	15	74.5	11.5	37.7	48	58.6	63	66	69.4	69.4	66.4	55
1	18/06/2014	12:32	15	73.1	6.8	34.7	43.5	48.1	53.2	53.8	70.2	69.6	52.3	39.5
1	18/06/2014	12:47	15	64.2	11.7	33.7	44.5	47.4	56.4	60.2	58.5	53.2	53.1	36.7
1	18/06/2014	13:02	15	63.8	13	38.4	44.5	47.8	53.9	55.1	58.1	58.3	56.3	43.6
1	18/06/2014	13:17	15	79.6	4.4	34.1	43.5	48.7	60.2	71.8	74.4	76.2	67.8	56.6
1	18/06/2014	13:32	15	70.1	8.1	34.7	43.1	48.6	53.6	53.5	67.9	65.6	52.6	35.9
1	18/06/2014	13:47	15	77.8	5.5	36.4	48.1	63.6	74.2	72	70.4	67.2	59.3	44.2
1	18/06/2014	14:02	15	73.8	21.2	41.9	51.4	55.7	61.8	70.2	69.7	64.1	53	35.6
1	18/06/2014	14:17	15	71.6	8.2	33.1	42.8	46.9	58.5	63.6	66.7	67	62.7	54.7
1	18/06/2014	14:32	15	74	7.1	34.9	46	65.4	67.7	71	65.7	60.2	56.2	40.8
1	18/06/2014	14:47	15	75.4	18.3	38.5	53.5	61.6	64.2	71.6	71.1	65.5	54.9	37.7
1	18/06/2014	15:02	15	64.8	9.9	36.8	45.5	47.2	53.6	53.7	63.5	53.3	52.8	36.5
1	18/06/2014	15:17	15	74.5	7.6	51.6	63.9	64.5	66.7	68.8	67.9	66.6	60.8	43.3
1	18/06/2014	15:32	15	78	10.6	39.2	48.3	54.4	65.5	72.6	72.9	70.7	69.5	59.9
1	18/06/2014	15:47	15	72.4	11.2	36.4	44.8	50.8	56	59.7	64.8	68.3	67.9	58.8
1	18/06/2014	16:02	15	63.9	8.4	33.4	42.9	46	52.4	61.2	56.4	53.8	54.8	36.5
1	18/06/2014	16:17	15	67.3	10.1	34.4	44.6	44.9	53.9	65.2	61.2	54.6	54.4	37.5
1	18/06/2014	16:32	15	67.5	13.4	36.3	44.7	46	52.1	53.5	65.2	62.2	51.4	36.3
1	18/06/2014	16:47	15	69.8	15.7	35.9	46.3	54.3	62.5	64.6	66.7	55.6	52.9	39.2
1	18/06/2014	17:02	15	62.4	7.4	33.8	46.2	53.9	58.4	54.8	54.1	51.4	50.7	36.2
1	18/06/2014	17:17	15	70.3	10.6	34.6	41.2	46.7	51.3	69.3	61.5	55.8	54	36.8
1	18/06/2014	17:32	15	66.3	7.2	33.5	41.4	46.4	55.4	59.8	60.7	61.6	55.7	39.7
1	18/06/2014	17:47	15	62.4	6.9	36.6	43.9	46.1	54.4	54.5	57.9	53.8	55	40.1
1	18/06/2014	18:02	15	63.6	11.2	34.6	42.5	45.7	54.2	52.5	56.7	61	52.1	35.7
1	18/06/2014	18:17	15	72.4	3.8	33.5	43.2	45.9	52.3	53	70.7	67.7	53.2	36.7
1	18/06/2014	18:32	15	73.8	24.1	36.1	48.2	62	67.7	69.2	68.8	60	53.3	36.2
1	18/06/2014	18:47	15	69.2	7	33.2	42	50.5	61.5	65.8	64.5	56.9	52.9	36.1
1	18/06/2014	19:02	15	64.5	7.4	31.8	44.6	54.9	58.9	59	57.7	54.4	50.7	35.8
1	18/06/2014	19:17	15	65.6	5.7	34.3	42.3	46	53.6	55.2	59.9	62.7	54.8	38.1
1	18/06/2014	19:32	15	62.6	9.6	34.8	43.1	47.1	54.4	55.8	59.4	52.5	49.6	35.6
1	18/06/2014	19:47	15	70	6.4	32.9	41.3	46.2	53	53.4	68.9	62.5	50.5	35.5
1	18/06/2014	20:02	15	62.3	5.5	33.5	47.6	52.8	58.3	53.8	54.3	52.3	49.7	35.9
1	18/06/2014	20:17	15	64.3	4.6	33.9	42.7	45.8	54.3	55.2	59.8	59	55.5	43
1	18/06/2014	20:32	15	64.9	10.1	34.3	52.6	57.8	60.6	55.7	57.4	52.8	54.5	37.7
1	18/06/2014	20:47	15	64.3	9	34.6	43.1	46.6	56.1	60.2	59.2	55.2	50.3	35.9
1	18/06/2014	21:02	15	63.9	7.5	32.7	41.1	46.4	52.3	52.7	62.4	54.2	50.4	35.8
1	18/06/2014	21:17	15	67.6	5.3	32	40.8	44.4	53.4	52.8	59	65.4	60.2	48.1
1	18/06/2014	21:32	15	62.5	8.4	33.4	42.6	43.6	52.3	52.8	58.1	57.3	53.7	36.3
1	18/06/2014	21:47	15	80.2	4.5	31.3	42.3	56	65.3	66.7	71.9	78.3	71.8	60.1
1	18/06/2014	22:02	15	61.9	6.4	33.1	44	45.4	53.7	57.5	55.8	53.4	51.1	38
1	18/06/2014	22:17	15	64.2	7.3	30.6	43.6	44.2	53.1	53.1	57.5	61.7	53.9	39
1	18/06/2014	22:32	15	68.1	5.6	35.2	45.6	45.1	52.2	52.9	65.1	64.5	51.4	35.3
1	18/06/2014	22:47	15	67.4	9.6	31.7	38.9	47.3	54.2	57.4	65.4	60.2	54.1	36.4

Position	Date	Time	Duration	L_{Amax}	Frequency (Hz)									
					16	31.5	63	125	250	500	1000	2000	4000	8000
1	18/06/2014	23:02	15	63.2	7.1	33.9	41.9	45.2	54.1	55.9	57.7	57.8	53.5	41.3
1	18/06/2014	23:17	15	72.9	17.1	33.6	48.8	52.8	58.1	65.8	69.7	67.6	56.2	39.1
1	18/06/2014	23:32	15	63.9	7.1	29.3	42	45.2	53.4	58.6	57.4	58.8	51.6	39.1
1	18/06/2014	23:47	15	74.5	9.3	34.4	43.3	46.9	56.5	59.4	64.7	69.1	71.7	58.8
1	19/06/2014	00:02	15	65.8	12	33.9	42.3	45.2	52.1	53.7	55.4	63.9	57.7	41.7
1	19/06/2014	00:17	15	61.5	9.6	33.8	45.7	49.2	54.4	55	56.3	53.4	51.3	37.9
1	19/06/2014	00:32	15	62.6	9.2	33	41.9	45.1	60.2	54.2	54.4	51.4	49.2	35.9
1	19/06/2014	00:47	15	61.1	7.2	35.8	44.5	49.9	53.7	56.5	54.5	51.2	50.3	36.7
1	19/06/2014	01:02	15	62.9	8.3	33.5	47.2	57	57.2	53.7	53.9	53.8	53	37.5
1	19/06/2014	01:17	15	60.9	6.7	35.7	41.1	47.1	57.6	52.6	52.9	49.2	51.7	35.7
1	19/06/2014	01:32	15	60.6	3.6	33.4	42.2	43.7	50.8	52.4	53.4	56.8	52.1	36.7
1	19/06/2014	01:47	15	62.2	4.2	35.3	43.2	45.6	52.3	51.8	57.7	57.6	52.1	37.5
1	19/06/2014	02:02	15	62.1	8.9	32.8	41	44.1	51.9	51.2	53.3	58.1	56.6	42.8
1	19/06/2014	02:17	15	61.2	5.8	32.6	49.4	47.1	54.8	54	55.6	52.6	50.8	38.1
1	19/06/2014	02:32	15	61.1	7.1	34.4	40.6	46.7	52.9	53.9	57.3	52.4	51.5	36.6
1	19/06/2014	02:47	15	66.9	6.4	35.5	43.9	48.7	55	62.3	63.5	57	51	35.1
1	19/06/2014	03:02	15	67.4	12.8	35.5	44	46.1	54.4	63.9	62.6	58.4	51.2	35.7
1	19/06/2014	03:17	15	67.7	19.5	37.5	42.4	48.5	57.9	63.8	63.4	57.6	51.9	35.1
1	19/06/2014	03:32	15	60.5	8.1	33.7	41.3	46.3	53.8	54.6	54.8	50.5	51.5	35.5
1	19/06/2014	03:47	15	62.7	8	33.3	42.8	45.4	59	56.8	54.9	51.2	52.7	36.8
1	19/06/2014	04:02	15	66.1	6.9	31.9	41.6	45.1	52	53.2	62.3	62.2	57.1	42.7
1	19/06/2014	04:17	15	61.5	7.4	36.3	43.6	50.5	55.2	55.6	55.4	51.9	50.8	37.2
1	19/06/2014	04:32	15	60.6	5.5	32.5	41.2	45.5	51.5	55.5	54.7	53.4	51.1	38.7
1	19/06/2014	04:47	15	61.7	4.6	32.9	43	47.6	54.3	56.4	56.3	52.7	50.4	37
1	19/06/2014	05:02	15	64.5	14.1	34	61	51.5	53.7	54.7	56.5	55.3	52.2	41.6
1	19/06/2014	05:17	15	61.2	3.5	32.8	40.9	42.4	53.3	55.4	55.9	53.7	50.9	39.2
1	19/06/2014	05:32	15	61.9	6.3	36.4	41	44.5	52.1	58.4	54.3	55.4	48.7	35.7
1	19/06/2014	05:47	15	65.5	2.5	33.5	42.3	45.9	52.6	51.7	58.4	63.9	48.9	36.2
1	19/06/2014	06:02	15	64.6	9.2	33.8	47.1	46.5	54.1	55.9	60.5	58.9	54.9	41.6
1	19/06/2014	06:17	15	67.8	8.4	33.8	42.8	44.9	52.6	52.9	56.3	67.1	51.5	36.8
1	19/06/2014	06:32	15	68.5	8	34.1	46.4	57.5	58.9	60.6	64	62.1	58	46.1
1	19/06/2014	06:47	15	68.3	2.7	33.9	45	59.4	61.9	64.4	61.4	55.6	53.7	36.1
1	19/06/2014	07:02	15	70.4	8.9	35.1	41.9	46.1	53.6	63.3	67.7	64	56.6	39.4
1	19/06/2014	07:17	15	66.9	11.9	32.6	43.4	51.2	59.4	62.2	60.5	57.6	56.7	49.3
1	19/06/2014	07:32	15	73.8	9.6	33	44.9	47.3	54.2	53.8	57.1	73.5	56.7	48.8
1	19/06/2014	07:47	15	75.7	9.2	37.6	43.6	46.1	52.2	53.5	59.9	75.5	54.2	39.9
1	19/06/2014	08:02	15	73.3	5.4	35.9	47.8	54.4	63.8	69.2	69.7	62	54.6	42.9
1	19/06/2014	08:17	15	79.4	8	35.1	44.4	46	53.9	53.7	79.3	58.1	54.4	50.5
1	19/06/2014	08:32	15	74.3	6.1	35.8	41.7	54.7	63.3	67.1	69.9	69.3	63.3	51.2
1	19/06/2014	08:47	15	76.1	9	31.8	45.8	49.4	60.5	70	72.4	70.6	62.9	49.3
1	19/06/2014	09:02	15	70.4	9.4	35.1	44.5	50.6	56.7	59.2	62.8	65.9	65.5	56
1	19/06/2014	09:17	15	66.4	9.2	37	44.3	46.2	56.6	60.1	63.5	57.3	50.8	36.4
1	19/06/2014	09:32	15	68.4	4.2	34.8	44	46.7	53.4	54.8	59.1	64.3	63.6	57.5
1	19/06/2014	09:47	15	70.1	10	36.8	48.6	58.8	59.5	61.2	66.4	64.6	55.8	42.4
1	19/06/2014	10:02	15	65.8	9.5	33	42.9	46.4	53.6	52.6	63.7	59.8	51.5	36.3
1	19/06/2014	10:17	15	75.3	9.9	32.6	43.6	47.2	53.4	53.2	75.2	60.1	53.3	38.4
1	19/06/2014	10:32	15	75.7	9.7	36.3	51.3	50.8	63.5	71.7	72.6	64	53.6	36.4

Appendix B. Equipment Calibration Certificates

The noise survey was conducted using the following Class 1 specification noise measurement equipment.

Table B-1 Details of Survey Equipment (Set 37)

Set	Type	Manufacturer	Model	Serial	Date of Last Calibration	Calibration Certificate No.
40	Sound Level Meter	Rion	NL-52	620856	20/07/2012	CONF071218
	Microphone	Rion	UC-59	03692	20/07/2012	CONF071218
	Preamplifier	Rion	NH-25	20916	20/07/2012	CONF071218
	Calibrator	Rion	NC-74	35125801	07/12/2012	CONF111222

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**07 December 2012**
Customer	**Atkins Limited**
Certificate Number	**CONF111222**

	Manufacturer	**Type**	**Serial Number**
Acoustic Calibrator	Rion	NC-74	35125801

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 60942:2003 Class 1 (Electroacoustics - Sound Calibrators)

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed..... Position.Calibration Manager Date.07/12/12.....

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MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**20 July 2012**
Customer	**Atkins Noise & Vibration**
Certificate Number	**CONF071218**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00620856
Preamplifier	Rion	NH-25	20916
Microphone	Rion	UC-59	03692

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. Amrat C Patel Position. Laboratory Manager Date. 20/07/2012

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Appendix C. Chiller Technical Data

VHA SERIE SOUND DATA

Global Chiller Sound Level Values*

Model	Sound pressure	Sound Power	Frequency octave band (Hz) measured in - dB							
	5 m	LW(A)	63	125	250	500	1000	2000	4000	8000
VHA 427 01 SP	67		84	87	84	84	85	83	80	75

(*)
All datas for Overal values expressed in dB measured in the A Scale
All sound data are refered to the max load conditions with 35 °C ambient
Sound Pressure Levels are calculated in accordance to ISO 3744

ATTENTION: Sound pressure data are declared and valid for a "FREE FIELD CONDITION ONLY", Installations close to a reflective wall will increase sound level stated in the datasheet (generaly 3 dB for each side added)

PRELIMINARY TECHNICAL DATA			
MODELL		VHA 427 01 SP	
Design data :			
Total Cooling Capacity	kW	234.0	
Inlet Water Temperature	°C	12	
Outlet Water Temperature	°C	6	
Design Ambient Temperature	°C	35	
Refrigerant Circuits	n°	2	
Evaporator Fouling Factor	m2K/W	0.000044	
Power circuit voltage	V/Hz/Ph	400/3/50	
Refrigerant	Type	**R410A**	
Chiller performance :			
E.E.R.	coeff.	2.79	
Ethyl. Glycol	%	0.00	
Flowrate	m3/h	33.43	
Pressure Drop	KPa	52	
Compressors :			
Type	Type	scroll	
N° of Compressors	n°	2	2
Nominal Power Input (each)	kW	21.9	16.7
Running Current (each)	A	40.5	28.6
Max Current (each)	A	72	62
Starting Current (each)(soft starter)	A	320	260
Condenser coil :			
Type	Type	finned coil	
Pipe material	Type	copper	
Fins material	Type	alluminium	
Condenser AC Fan :			
Fans Diameter	mm	900	
Fans Quantity	n°	2	
Total Fans Airflow	m3/h	52000.00	
Total Fans Motor Power Input	kW	6.60	
Total Fans Circuit Amperes	A	12.60	
Evaporator :			
Evaporator Quantity	n°	1	
Type	Type	shell & tube	
Chiller Connections	"	2 x 2"½	
Electrical data :			
Total Power Input	kW	83.8	
Total Running Current	A	150.8	
Total Max Current	A	280.6	
Total Starting Current	A	430.3	
Physical Data :			
Length without electrical cabinet	mm	3200	
Width	mm	1500	
Height	mm	2525	
Approx Weight	Kg	2295	
Sound Data :			
sound pressure	dB(A) - 5m	67	

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