IQE Newport

Noise Assessment

IQE Plc

2 March 2018

Notice

This document and its contents have been prepared and are intended solely for IQE Plc's information and use in relation to the permitting of IQE Newport.

ATKINS Acoustics assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 20 pages including the cover.

Document history

Job number: 5161526			**Document ref: 2018/Mar/02**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Draft for comment	AM	DP			19/10/17
Rev 2.0	Draft for issue	DP	AL	AL	AL	20/11/17
Rev 2.1	Draft for issue	DP	AL	AL	AL	21/11/17
Rev 2.2	Issue	DP	AL	AL	AL	22/11/17
Rev 3.0	Revised fan specification	DP	AL	AL	AL	02/03/18

Client signoff

Client	IQE Plc
Project	IQE Newport
Document title	IQE Newport
Job no.	5161526
Copy no.	
Document reference	2018/Mar/02

Table of contents

Chapter		Pages
1.	**Introduction**	**4**
2.	**Regulation, Planning and Context**	**5**
2.1.	Policy	5
2.2.	Technical Guidance	5
2.3.	British Standard 4142: 2014 Methods for rating and assessing industrial and commercial sound	5
3.	**Site Description**	**7**
4.	**Baseline Noise Survey**	**9**
4.1.	Equipment	9
4.2.	Weather	9
4.3.	Measured Sound Levels	9
5.	**Plant Noise Assessment**	**11**
5.1.	Plant Noise Data	11
5.2.	Plant Noise Assessment	11
6.	**Conclusion**	**13**
Appendices		**14**
Appendix A.	**Glossary Of Terms**	**15**
Appendix B.	**Equipment Details**	**18**
Appendix C.	**Survey Data**	**19**

Tables

Table 2-1	WHO Guideline Noise Values	5
Table 3-5	Summary of Sample Results	9

Figures

Figure 3-1 Satellite image showing NSR locations 7
Figure 3-2 Site redline boundary 8

1. Introduction

Atkins Acoustics, Noise and Vibration has been commissioned by IQE to undertake a noise assessment as part of the permitting process for a proposed external plant items on the IQE facility in Newport, Gwent. The assessment has been undertaken to determine noise limits for the operational phase and any potential noise impacts associated with the proposed development on the surrounding noise sensitive receptors.

A baseline noise survey has been undertaken at nearby noise sensitive receptors to establish the baseline noise climate.

This report describes the methodology and results of the noise survey, the determination of noise limits and the impact on the surrounding noise sensitive receptors.

A glossary of acoustic terminology is provided in Appendix A.

2. Regulation, Planning and Context

The following documents are relevant to the assessment of the likely noise impacts.

2.1. Policy

2.1.1. Environmental Protection Act, 1990

Section 79 of the Environmental Protection Act 1990 places a duty on local authorities to inspect their areas periodically for statutory nuisances and to take such steps as are reasonably practicable to investigate complaints of statutory nuisance. Where a local authority is satisfied that a statutory nuisance exists, or is likely to occur or recur, the local authority is obliged to serve an abatement notice requiring the abatement of the nuisance or prohibiting or restricting its occurrence or recurrence. Section 79 (1(g)) includes “noise emitted from premises so as to be prejudicial to health or a nuisance”.

Local authorities can defer serving an abatement notice under section 80 of the Environmental Protection Act for statutory nuisance from noise for up to seven days in order to take other appropriate steps to abate the statutory nuisance.

The optional seven day deferral was introduced by the Clean Neighbourhoods and Environment Act 2005.

2.2. Technical Guidance

2.2.1. World Health Organization (WHO) Guidelines for Community Noise

Published by the World Health Organization (WHO) in 2000, this document was prepared as a response to a need for action together with a generic need for improvements in legislation at a national level.

In the document are guideline noise levels in specific human environments. There is also information on the likely ‘critical health effects’ associated with noise levels exceeding the guideline values. The guideline levels which are relevant in this case are set out in Table 2-1.

Table 2-1 WHO Guideline Noise Values

Specific Environment	Critical health effect(s)	L_{Aeq} (dB)	Time base (hours)	$L_{AF,max}$, (dB)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45*
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60*

* With regard to the assessment of maximum noise levels, it is suggested in Section 3.4 of the WHO Guidelines that the levels as shown in Table 2-1 should not be exceeded more than 10- 15 times per night.

2.3. British Standard 4142: 2014 Methods for rating and assessing industrial and commercial sound

British Standard 4142: 2014 ‘*Methods for rating and assessing industrial and commercial sound*’ (BS 4142) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of noise amounting to a nuisance is beyond the scope of the standard.

The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level and the context in which the sound occurs.

The reference time interval for the specific sound source 'Tr' is 60 minutes during the daytime and 15 minutes during the night. The reduced reference time at night reflects the increased sensitivity to noise during this period. The relevant time periods for daytime and night-time are as follows:

- Daytime – 07:00 to 23:00 hours; and
- Night-time – 23:00 to 07:00 hours.

The assessment method considers the characteristics of the sound, such as tonality, impulsivity and intermittency. Corrections are applied to the specific noise source to account for these characteristics in order to obtain the rating noise level; the corrections account for acoustic features which have the potential to increase disturbances.

An initial estimate of the impact of the sound source is obtained by subtracting the measured background sound level from the rating level and considering the following:

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, the standard adds a character correction to the specific sound level to obtain the rating level. Character corrections can be included for tonality, impulsivity, other sound characteristics that make it "readily distinctive", and intermittency.

For this assessment the following impact scale has been adopted.

Table 2-2 Noise Impact Assessment Scale

Plant Noise Level	Impact	Significance
Below background noise level	Negligible	Not-significant
0 to 5 dB greater than background noise level	Minor Adverse	Not-significant
More than 5 dB greater than background noise level	Moderate Adverse	Significant
More than 10 dB greater than background noise level	Major Adverse	Significant

3. Site Description

The site is located on Celtic Way, Newport. It is bounded to the north, east and south by business units and development sites. To the east is the Imperial Park business estate, comprising offices, production units, warehousing, manufacturing, and data centres. None of the adjacent business units are considered to be noise sensitive.

The closest noise sensitive receptors (NSRs) are as follows:

- NSR 1 – Residential dwellings on Pencarn Ave approximately 300m to the north,
- NSR 2 – Residential dwellings on Powis Close approximately 500m to the south east
- NSR 3 – Residential dwellings on Blacksmiths Way approximately 700m to the west.
- NSR 4 – Teddies Nursery pre-school approximately 500m to the north west.

Residential dwellings are considered to be noise sensitive at all times of day and night. The nursery is only considered to be noise sensitive during daytime hours.

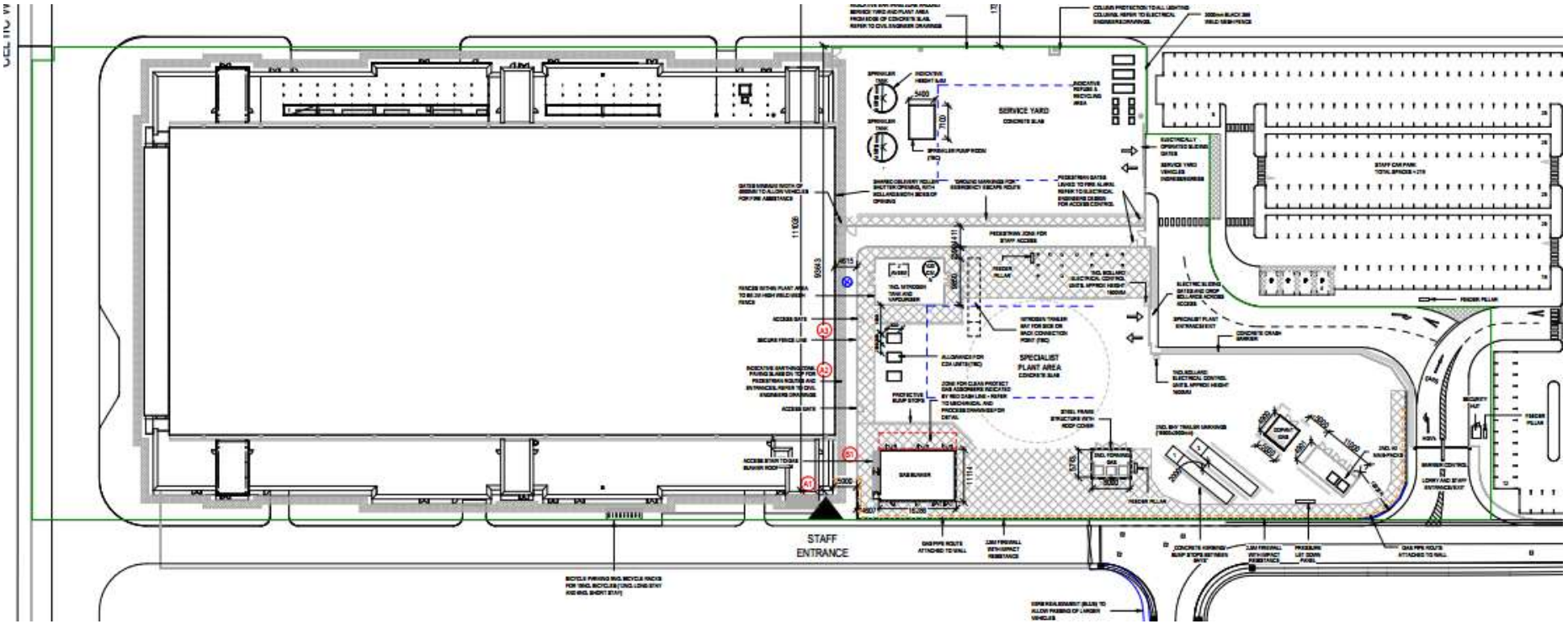
The nearest NSR locations are shown on the satellite image in Figure 3-1 with the site location marked with a red box and the installation boundary is shown by the green line in Figure 3-2.



Figure 3-1 Satellite image showing NSR locations

The ground conditions are considered to be approximately 50% acoustically hard ground and 50% acoustically soft ground between the source and the NSRs.

Figure 3-2 Installation Boundary



4. Baseline Noise Survey

An acoustic survey was carried out on the night of the 19th to the 20th September 2017. Sample measurements were taken at four locations during the night to gain an understanding of the night-time acoustic climate at the nearest noise sensitive receptors.

The locations were:

- Position 1 – 11 Pencarn Avenue (co-ordinates: 328445, 184814)
- Position 2 – Powers Close (co-ordinates: 328788, 184249)
- Position 3 – Blacksmith Way (co-ordinates: 327630, 184618)
- Position 4 – Buchanan Way (co-ordinates: 327847, 184808)

A full range of acoustical parameters was recorded including the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90}.

4.1. Equipment

All equipment was field calibrated on site before and after each measurement period with no noticeable drift in calibration. All equipment has been laboratory calibrated within the required period. Equipment details can be found in Appendix B.

4.2. Weather

During the survey notes were taken on the weather conditions for each measurement, this included the temperature and wind-speed. The weather conditions are considered appropriate for noise surveys.

4.3. Measured Sound Levels

The results of baseline noise monitoring are shown in Table 4-1.

Table 4-1 shows a summary of measured noise levels at the sample monitoring locations. The equivalent continuous noise level ($L_{Aeq,T}$) shown is the logarithmic average of individual 15 minute readings. The L_{Amax} is the maximum level that was recorded during any of the sample measurement periods. The L_{A90} and L_{A10} levels shown in Table 4-1 have been approximated by the arithmetic means of the individual L_{A10} and L_{A90} during each sample measurement. Further definitions of the parameters recorded can be found in the Glossary of Acoustic Terms to be found in Appendix A.

Table 4-1 Summary of Sample Results

Position		L_{AeqT}, dB	$L_{Amax,fast}$ dB	Average L_{A90}, dB
1	11 Pencarn Avenue	41.5	50.5	39.1
2	Powers Close	36.8	43.6	34.4
3	Blacksmith Way	52.3	75.0	46.8
4	Buchanan Way	50.1	63.3	47.5

Throughout the attended measurement process observations were made on the existing noise climate at each location, as noted below:

- Position 1 – Road traffic noise from the M4, water from a local stream/water feature

- Position 2 – Distant road traffic noise from the M4, plant noise from IQE
- Position 3 – Road traffic noise from the M4
- Position 4 – Road traffic noise from the M4

5. Plant Noise Assessment

5.1. Plant Noise Data

The proposed plant is three chiller units, of which no more than two would operate at any given time, and two fans above the hydrogen dilution plant and a further two at the gas bunker. Both hydrogen dilution fans will be run at 50% load and this has been taken into account in the noise calculations. Of the gas bunker fans, one is a duty fan and the other is a standby unit, so only one of these operating at any given time has been assessed.

Octave band sound power level data has been provided, and is shown in Table 5-1.

Table 5-1 Plant Sound Power Level Data

Plant	Sound Power Level, dB						
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	dB(A)
Chillers - 20171013A	84	87	88	92	77	67	94
Hydrogen Dilution Fans	87	93	98	96	93	88	100
Attenuated Gas Bunker Fans	83	85	87	84	79	70	88

A correction of +1dB has been applied to all octave bands of the chiller sound power level data to account for pumps which are not included in the manufacturer's data. The 1dB correction has been agreed with the manufacturer by email, and is included the values given Table 5-1.

As the chillers may be tonal and will operate intermittently a +2dB tonality penalty and a +3dB intermittency penalty is added for safety. These penalties have been combined into a total +5dB penalty.

The hydrogen dilution and gas bunker fans would operate continuously so no intermittency penalty is applied. A tonal penalty of +2dB is applied to each of these fans.

No correction has been applied for any potential noise screening or barrier effects, and penalties are not applied for impulsive sounds or for other acoustic characteristics.

5.2. Plant Noise Assessment

The noise impact assessment at each receptor location is shown in Table 5-2. The distances between the proposed plant and the receptor locations has been measured, and the reduction of noise over this distance is also shown, assuming 50% transmission over acoustically hard ground (such as concrete) and 50% transmission over acoustically soft ground (such as grassland), and a worst case assessment of no acoustic screening has been carried out.

The rating noise level at each receptor location is also given, which is the calculated noise level taking into account the number of each type of equipment, the conversion from sound power level into sound pressure level, the BS4142 acoustic corrections described above, and sound propagation over the distances given.

Table 5-2 Noise impact predictions

NSR	Location	Distance		Measured background noise level	Rating noise level, L_{ArTr}	Impact
		meters	Correction*, dB	Night, $L_{A90,15min}$ dB	Night, $L_{A90,15min}$ dB	Night, $L_{A90,15min}$ dB
1	11 Pencarn Avenue	300	-73	39	35	-4
2	Powers Close	500	-78	34	30	-5
3	Blacksmith Way	700	-82	47	26	-20
4	Buchanan Way	500	-78	48	30	-18 (n/a)

* Correction includes Sound Power Level to Sound Pressure Level conversion as well as distance loss.

This shows that based on the measured background levels and the predicted noise levels a negligible impact can be expected at all NSRs at night.

It is considered likely that daytime noise levels would be at least 5-10dB higher than the measured night time levels indicating a negligible impact at all NSRs during the day.

6. Conclusion

The potential noise impacts from operation of external roof mounted chillers and a fan unit at IQE Newport have been assessed. Noise levels from plant were corrected to the nearest noise sensitive receptor locations, including BS4142 penalties, and compared to estimated background noise levels for the area. The background noise levels used were measured during the night-time period to ascertain a representative lowest background noise level.

The distances between the proposed plant and the receptor locations has been measured, and the reduction of noise over this distance is also shown, assuming 50% transmission over acoustically hard ground (such as concrete) and 50% transmission over acoustically soft ground (such as grassland), and a worst case assessment of no acoustic screening has been carried out.

Plant noise levels, including penalties for intermittency and potential tonality, are predicted to lead to negligible impacts at all NSRs. Impacts at NSRS are also expected to be negligible during the day.

Appendices

Appendix A. Glossary Of Terms

ACTIVITY, L_{Aeq}

The value of the equivalent continuous A-weighted sound pressure level determined at a distance of 10m from and over the period of a given activity. The activity may involve the operation of more than one item of plant.

AIRBORNE SOUND

Sound which is transmitted from the source via the surrounding air, as distinct from transmission through the structure which supports the sound source (cf. structure borne sound).

AMBIENT NOISE

Totally encompassing sound in a given situation at a given time usually composite of sounds from many sources near and far.

A - WEIGHTING dB(A)

The sound pressure level determined when using the frequency-weighting network A. The A-weighting network modifies the electrical response of a sound level meter so that the sensitivity of the meter varies with frequency in approximately the same way that the sensitivity of the human hearing system varies with frequency.

The human ear has a non-linear frequency response; it is less sensitive at low and high frequencies and most sensitive in the range 1 to 4 kHz. The A-weighting is applied to measured or calculated sound pressure levels so that these levels correspond more closely to the response of the human ear. A-weighted sound levels are often denoted as dB(A).

BACKGROUND NOISE LEVEL, L_{A90}, T

The A-weighted sound pressure level of non-specific noise in decibels exceeded for 90% of the given time, T.

DECIBEL (dB)

1. Unit level which denotes the ratio between two quantities that are proportional to power; the number of decibels corresponding to the ratio of two amounts of power is 10 times the logarithm to the base 10 of this ratio.

2. A linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers.

3. A unit which indicates that a quantity has a certain LEVEL above some pre-defined reference value.

4. The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear.

EQUIVALENT CONTINUOUS A-WEIGHTED SOUND PRESSURE LEVEL (L_{Aeq})

1. The hypothetical continuous, A-weighted, sound pressure level which would contain the same amount of acoustic energy a time-varying, A-weighted, sound pressure level when assessed over the same, specified, time period.

2. Value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T starting at t_1 and ending at t_2 and measured in decibels, has the same mean square sound pressure as the sound under consideration whose level varies with time.

FACADE NOISE LEVEL

A facade noise level is the noise level 1m in front of the most exposed window or door in a building facade. The effect of reflection, is to produce a slightly higher (+2.5 dB) sound level than it would be if the building was not there.

FAST (F) - See Time Weightings

FREE FIELD

1. A free sound field is a field in a homogeneous, isotropic medium free from boundaries. In practice it is a field in which the effects of the boundaries are negligible over the region of interest. The actual pressure impinging on an object (e.g., a microphone) placed in an otherwise free sound field will differ from the pressure which would exist at the point with the object removed, unless the acoustic impedance of the object matches the acoustic impedance of the medium.

2. An environment in which there are no reflective surfaces within the frequency region of interest.

3. A region in which no significant reflections of sound occur.

4. It is considered that free-field environmental noise measurements need to be made at least 3.5m from any reflecting structure.

HERTZ, Hz

This is the unit of frequency representing the number of times a periodic wave repeats itself per second.

MAXIMUM SOUND LEVEL, $L_{A,max}$

The highest value of the A-weighted sound pressure level that occurs during a given event or time period. The time-weighting should be specified.

MEASUREMENT TIME INTERVAL, T_M

The total time over which measurements are taken.

OCTAVE BANDS, OCTAVE BAND SOUND PRESSURE LEVEL

1. A range of frequencies whose upper limit is twice the frequency of the lower limit.

2. The octave-band pressure level of a sound is the band pressure level for a frequency band corresponding to a specified octave. (The location of the octave-band pressure level on a frequency scale is usually denoted by the geometric mean of the upper and lower frequencies of the octave.) The ISO standard octave centre frequencies are 32, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k Hz (etc.).

ONE-THIRD OCTAVE BAND SOUND PRESSURE LEVELS

The ISO standard one-third octave band frequencies are 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3, 8 Hz and decade multiples thereof.

PERCENTILE LEVEL (STATISTICAL SOUND LEVEL INDICES, L_{AN}, L_{A90})

L_{AN} is the dBA level exceeded N% of the time measured on a sound level meter with Fast(F) time weighting, e.g. L_{A90} the dBA level exceeded for 90% of the time, is commonly used to estimate background noise level. LA10, the level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise.

SITE NOISE

That component of the ambient noise in the neighbourhood of a site that originates from the site.

SLOW (S) - See Time Weightings

SOUND PRESSURE LEVEL (L_p)

1. The level of the pressure of the sound above the internationally accepted reference value of 20 µPa ($2x10^{-5}N/m^2$), which corresponds to the pressure of the quietest sound an average person can hear at the frequency of 1000 Hz. It is a quantity that can be measured, thus the intensity of a sound can be derived from it.

2. The sound pressure level is a measure of a dynamic variation in atmospheric pressure. The pressure at a point in space minus the static pressure at that point.

3. A value equal to 20 times the logarithm to the base 10 of the ratio of the ratio of the root-mean-square pressure of a sound to a reference pressure, which is normally taken to be $2x10^{-5}N/m^3$.

SOUND POWER LEVEL (L_W)

1. The sound power level of a sound source, in decibels, is 10 times the logarithm to the base 10 of the ratio of sound power radiated by the source to a reference power. The reference power is 1 picowatt ($1x10^{-12}$ watt).

2. The sound power level is the fundamental measure of the total sound energy radiated by a source per unit time.

3. A value equal to 10 times the logarithm to the base 10 of the ratio of the total acoustic power emitted by a source to a reference power, which is normally taken to be 10^{-12} watt.

SPECIFIC NOISE LEVEL, L_{Aeq},T_r

The equivalent continuous A-weighted sound pressure level in decibels at the measurement position produced by the specific noise source over a given reference time interval. The specific noise level is quoted to the nearest whole number of decibels.

TIME WEIGHTINGS, FAST (F), SLOW (S) AND IMPULSE (I)

Time weighting is used in sound level meters to stabilize the reading. This is achieved by standardizing the speed with which the metering circuit and meter respond. Two different averaging's are used (1) 'FAST', 'F', which has a time constant of 125 ms, and (2) 'SLOW', 'S', which has a time constant of 1000 ms. The impulse (I) characteristic is sometimes used to measure gunshots, punch presses, etc. It has a rise time constant of 35 ms and a decay time constant of 1500 ms.

Appendix B. Equipment Details

Kit Number	Equipment	Type	Serial Number	Last Calibration Date
Set 40	Sound Level Meter	Rion NL-52	00620856	26/08/2016
	Microphone	Rion UC-59	20916	26/08/2016
	Pre-amplifier	Rion NH-25	03692	26/08/2016
	Calibrator	Rion NC74	35125801	26/08/2016

Appendix C. Survey Data

Position	File number	Start Date	Start time (hh:mm)	Sound Pressure Level (dB)			
				LAeq	LA90	LAFmax	LA10
1	2	20/09/2017	00:44:50	41.7	39.3	50.5	43.7
	5	20/09/2017	02:16:00	41.2	38.9	46.9	43.1
2	3	20/09/2017	01:15:44	35.4	33.3	43.1	37.1
	6	20/09/2017	02:36:39	37.8	35.4	43.6	39.7
3	4	20/09/2017	01:56:04	48.6	45.8	54.5	51.0
	7	20/09/2017	02:57:57	54.3	47.8	75.0	53.2
4	1	19/09/2017	23:59:37	50.1	47.5	63.3	51.7

Atkins
The Hub
500 Park Avenue
Aztec West
Almondsbury
Bristol
BS32 4RZ



© Atkins Ltd except where stated otherwise.

The Atkins logo, ‘Carbon Critical Design’ and the strapline ‘Plan Design Enable’ are trademarks of Atkins Ltd.