CONABEARE ACOUSTICS

ACOUSTIC PLANT ASSESSMENT

The Royal Free NHS Trust
Pond Street
Hampstead
London
NW3 2QG

New Transformer Project

Reference : CS8081-01
Revision : Original
Status : Draft Issue
Issue Date : 21st May 2018

Prepared By:

Stuart Metcalfe

Stuart Metcalfe MIOA

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BUILDING SERVICES ENGINEERS

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1 Introduction

Conabeare Acoustics Limited have been commissioned by Summit Design Limited, to undertake an Acoustic Survey and BS4142:2014 assessment in relation to noise emissions of proposed plant at The Royal Free NHS Trust, Pond Street, Hampstead, London NW3 2QG.

The Survey was undertaken by Stuart Metcalfe MIOA who has been practicing in Building Services Acoustics and Noise Control Engineering for in excess of 30 years, is a Member of the Institute of Acoustics (MIOA) and is a Director at Conabeare Acoustics Ltd.

2 Acoustic Criteria

BS4142:2014 Methods for rating and assessing industrial and commercial sound.

BS4142:2014 gives a method for rating sound from industrial and commercial sources affecting people inside or outside dwellings or premises used for residential purposes.

An initial estimate of the significance of the sound from the industrial/commercial nature can be assessed by subtracting the measured background noise level from the rating level (this is the specific sound level of the source with any corrections or penalties for distinctive acoustic characteristics).

Typically, the greater the difference, the greater the magnitude of the impact.

The site is located within the London Borough of Camden demise which states that any proposed plant should be at least 10dBA below the Background Sound level (L_{A90}) measured at 1 metre from the nearest effected residential property. Allowance should also be made for any tonal noise emanating from the proposed units.

London Borough of Camden Council's policies relating to noise from new mechanical services equipment are contained within the Council's Local Development Framework; Policy DP28.

In Summary, London Borough of Camden's noise conditions are:

Noise level from plant and machinery at which planning permission will not be granted:

Noise at 1m external to a sensitive façade	5dBA < LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1m external to a sensitive façade	10dBA < LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1m external to a sensitive façade	10dBA < LA90
Noise at 1m external to sensitive façade where LA90 > 60dB	55dB LAeq

Table 1: London Borough of Camden Council noise related planning conditions

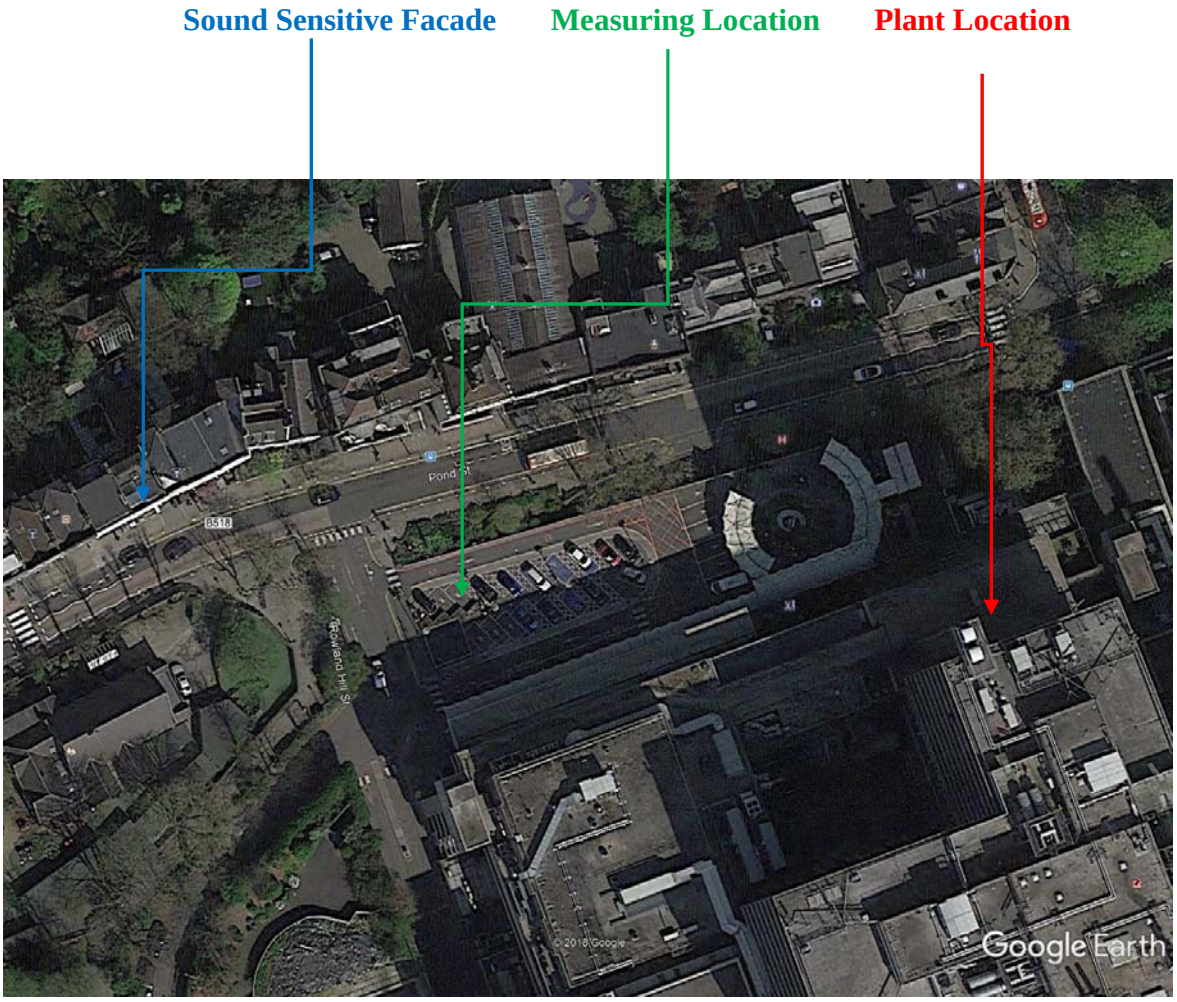
Each of the above is applicable over a period of 60 minutes and measured at 1m external to noise-sensitive facades (typically nearest residential windows).

3 Plant Location and Measurement Position

The site is located on Pond Street in the Hampstead District in North West London.

The area consists of a mixture of residential and commercial premises with the sound sensitive façade in question being adjudged to be the residential premises in Pond Street.

The sound sensitive façade is at a distance of approximately 110 metres from the proposed plant.



4 Existing Noise Climate

The area is generally a mixture of commercial premises with transportation noise from the area being adjudged to be the dominant background noise source during the survey period with the plant isolated.

The survey location was chosen so as to minimise the effect of existing plant noise in the locality.

5 Noise Survey

5.1 Measurements

The Survey commenced at approximately 01:40 hours on Friday 18th May 2018 until approximately 02:40 hours.

The Analyser was programmed to record 15 minute sampling periods over the survey duration.

The microphone was located on a tripod at approximately 1.5 metres above a reflecting plane and 1 metre from the nearest sound sensitive facade.

The measurements and their interpretation are in accordance with BS 7445: Parts 1 and 2. All readings are Sound Pressure Levels (Lp) in dB (re 20µPa).

5.2 Weather during Survey Period

The weather was warm and dry. The weather did not, in our opinion, adversely influence the readings obtained.

5.3 Instrumentation

The instrumentation used was a Type 1 Larson Davis LxT Sound Expert Sound Level Analyser confirming to IEC 651-1979 Type 1, EN60651 Type 1 and IEC 804-1985 Type 1, EN60804 Type 1.

- **Larson Davis LxT Sound Level Analyser, Serial Number 0005588.**
- **Larson Davis PRMLxT1L Preamplifier, Serial Number 055664.**

The Sound Analyser and Preamplifier are new items of equipment and were factory calibrated on 20th April 2018, Certificate Numbers 2018004098 and 2018004083 respectively.

Field calibration checks were made using the Calibrator and no significant drift was noted against the Calibration level of 114.0dB ± 0.2dB at 1000Hz ± 0.2%.

5.4 Survey Results

The following details the lowest L_{A90} level recorded.

$L_{A90,15min}$ 45.0dB(A) between 11:00 hours to 11:10 hours.

6 Assessment Methodology: BS4142:2014

A revision of British Standard BS 4142 was published at the end of October 2014 and replaces the previous 1997 edition. The main aim of the standard is to provide an assessment and rating method that is proportionate, sufficiently flexible and suitable for use by practitioners to inform professional judgement. The foreword to the standard clearly states that:

"The execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced."

It does this by providing a method for the determination of:

- rating levels for sources of an industrial and/or commercial nature; and
- ambient, background and residual sound levels.

An assessment framework is provided to allow the practitioner to use the rating, ambient, background and residual sound levels determined using the standard for the purposes of:

1) investigating complaints;

2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and

3) assessing sound at proposed new dwellings or premises used for residential purposes.

The scope of the standard has now been widened to rating and assessing:

a) sound from industrial and manufacturing processes;
b) sound from fixed installations which comprise mechanical and electrical plant and equipment;
c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site."

It can also be seen from above that the standard explicitly states that it can be used to investigate complaints and has been significantly widened to cover not only new,

modified or additional sources of sound, but also the assessment of sound affecting new dwellings or premises to be used for residential purposes.

Like the 1997 edition, the standard provides a method for correcting the specific sound levels so as to account for acoustic features that are present at the assessment location. The approach in the 1997 edition was purely subjective and allowed for a +5 dB correction irrespective of how prominent the feature was or whether there was one feature only or a combination of tones, impulses or other features irregular enough to attract attention. The 2014 edition provides for scaled corrections up to +6 dB for tones and up to +9 dB for impulses, depending upon the prominence of the tones or impulses, as well as +3 dB corrections for:

- other sound characteristics that are neither tonal nor impulsive; and/or
- intermittent features when the sound has identifiable on/off conditions.

The corrections for tones and impulses can be assessed using subjective or reference methods. There is also an objective method for tones, which is based upon the prominence of sound pressure levels in the one-third-octave-band containing a tone in comparison to the sound pressure levels in the adjacent one-third-octave-bands.

The objective method however, does not allow for different corrections to be applied for tones differing in prominence as it only allows for a single correction of +6 dB for clearly prominent tones.

The 1997 edition assessed the likelihood of complaints using the difference between the rating level and the background sound level. A difference of around +10 dB or more indicated complaints are likely, a difference of around +5 dB was of marginal significance and a difference of more than 10 dB below the background was considered to provide a positive indication that complaints were unlikely.

The 2014 edition no longer assesses the likelihood of complaints. Instead, it can be used to assess adverse impacts.

This change was introduced because the likelihood of complaints is not a particularly appropriate benchmark, especially when it is used in a planning context, and it also aligns the standard more closely with the type of language and benchmarks that are suitable for the assessment of sound at the planning stage for new proposed development.

It continues to use the difference between the rating level and the background sound level, though it also introduces the requirement to consider the context and states that:

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) 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."

The context includes consideration of pertinent factors, such as:

- the absolute level of sound;
- the character and level of the residual sound compared to the character and level of the specific sound;
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

7 Noise Assessment

The objective of any specification limiting new noises should therefore be to ensure that sound emission from the new building services plant should not materially add to the existing sound climate.

The proposed plant therefore being assessed is as detailed below;

- 1250kVATransformer - 1 number – Wilson Power Solutions

Specific Noise Source

The Specific Noise Source is 61dBA at 1 metre.

Acoustic Feature Correction

We have allowed for a 3dB Acoustic Correction Feature for the sound sensitive façade and a 6dBA Acoustic Correct ion Feature for the additional surfaces close to the installation location.

Distance Attenuation

The nearest sound sensitive façade is at a distance of approximately 110 metres from the proposed plant. The additional distance loss will be 41dB.

Barrier Attenuation

There are no barriers between the plant and the sound sensitive façade however the building roof line does partially obstruct the line of site and therefore we have allowed a 5dB line of site barrier reduction.

Transformer

BS4142 Assessment

BS4142 Assessment – 24 Hours	dBA
Specific Noise Level	61
Acoustic Feature Correction	9
Additional Distance Attenuation	-41
Barrier Attenuation	-5
Rating Level	24
Background (L_{A90}) Level	45
Rating Above Background Level	-21

This item of plant therefore is therefore 21dBA **below** the measured Background Level.

8 Recommendations

No mitigating measures would be required as this item of plant would be inaudible at the sound sensitive façade.

9 Conclusion

A background Noise Survey was carried out during a typical night time period at a location representative of the nearest sound sensitive receivers.

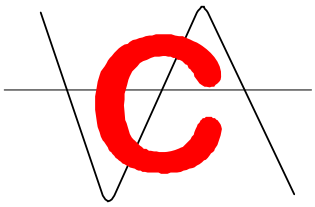
An assessment has then been carried out in respect of the individual item of plant.

The proposed plant is well below the Local Authority requirement for noise levels and therefore should, in our opinion, be acceptable as regards the noise emissions.

CS8081 - The Royal Free Hospital, Pond Street, London NW3 2QG

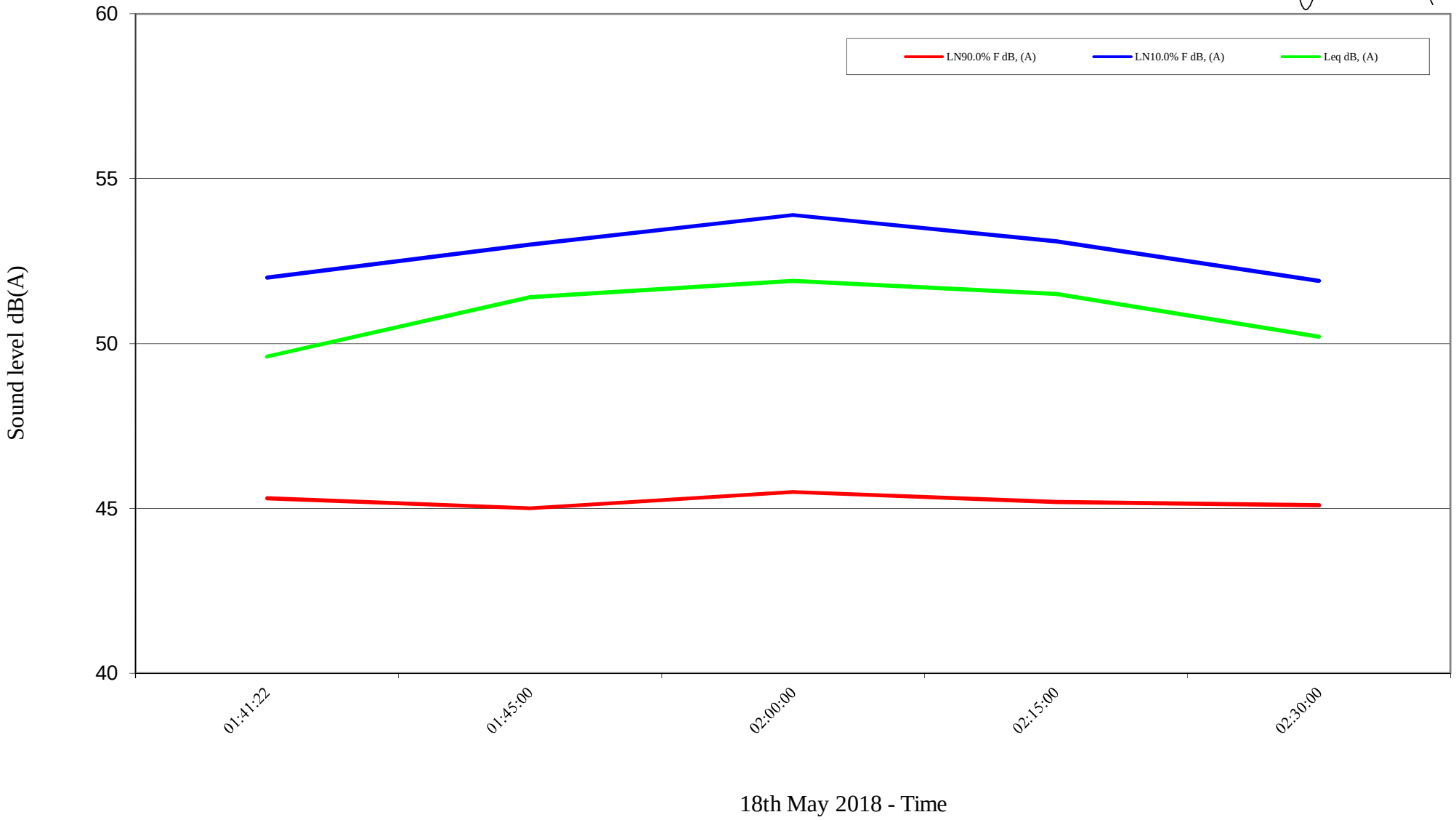
- Period result profile -

Overload occurred	No
Low battery occurred	No
Pause was used	No
Frequency weighting	A
Band	Broadband
Period time	15 min
Periods too short for LNs	No
First period listed	1 : 5



Period number	Flags	Date	Time	LN90.0% F	LN10.0% F	Leq
	OBPZ			dB, (A)	dB, (A)	dB, (A)
1	----	18/05/2018	01:41:22	45.3	52.0	49.6
2	----	18/05/2018	01:45:00	45.0	53.0	51.4
3	----	18/05/2018	02:00:00	45.5	53.9	51.9
4	----	18/05/2018	02:15:00	45.2	53.1	51.5
5	----	18/05/2018	02:30:00	45.1	51.9	50.2

CS8081 - Royal Free Hospital, Pond Street, London NW3 2QG



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Glossary of Terms

L_{A90}	The sound pressure level in dB(A) which is exceeded for 90% of the time and is taken to be the effective lowest background sound level for the period by such methods of sound rating as that recommended in BS4142:2014. It will also be used as a basis for selecting limiting sound levels from new plant by Local Planning Authorities when setting Planning Consent Conditions.
L_{eq}	The "equivalent continuous sound level" for the measuring period, defined as the level in dBA which, if held constant over the measuring period, would produce the same amount of sound energy as does the actual varying ambient sound level. It is a measure of the amount of sound energy affecting the site from sources other than new plant or operations.
L_{A10}	The sound level exceeded for 10% of the time over the sample period. Originally used as a measure of subjective reaction to traffic noise in particular, it can also be taken as an indication of the practical maximum sound level that the building envelope will have to protect against.
dBA	Describes measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dBA broadly agree with people's assessment of loudness. A change of 3dBA is the minimum perceptible under normal conditions, and a change of 10dBA corresponds roughly to halving or doubling the loudness of a sound.

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Calibration Certificate

Certificate Number 2018004098

Customer:

PC Environmental Ltd.
Unit 11 Mill Court
The Sawmills, Durley
Southampton, S032 2EJ, United Kingdom

Model Number	LxT SE
Serial Number	0005588
Test Results	**Pass**
Initial Condition	As Manufactured
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.302

Procedure Number	D0001.8384		
Technician	Ron Harris		
Calibration Date	20 Apr 2018		
Calibration Due			
Temperature	23.64	°C	± 0.25 °C
Humidity	50.4	%RH	± 2.0 %RH
Static Pressure	85.99	kPa	± 0.13 kPa

Evaluation Method

Tested with:

Larson Davis PRMLxT1L. S/N 055664
PCB 377B02. S/N 304334
Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108

Data reported in dB re 20 µPa.

Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.11 (R2009) Class 1
IEC 61260:2001 Class 1	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev J Supporting Firmware Version 2.301, 2015-04-30

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to 1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with precedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2017-09-19	2018-09-19	001250
SRS DS360 Ultra Low Distortion Generator	2017-06-23	2018-06-23	006311
Hart Scientific 2626-S Humidity/Temperature Sensor	2017-06-11	2018-06-11	006943
Larson Davis CAL200 Acoustic Calibrator	2017-07-25	2018-07-25	007027
Larson Davis Model 831	2018-02-28	2019-02-28	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2018-03-07	2019-03-07	007185

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.00	113.80	114.20	0.14	Pass

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.21	-0.20	-1.20	0.80	0.23	Pass
1000	0.19	0.00	-0.70	0.70	0.23	Pass
8000	-2.60	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	44.37

-- End of measurement results--

-- End of Report--

Signatory: *Ron Harris*

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ACCREDITED Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Calibration Certificate

Certificate Number 2018004083
Customer:
PC Environmental Ltd.
Unit 11 Mill Court
The Sawmills, Durley
Southampton, S032 2EJ, United Kingdom

Model Number	PRMLxT1L	***Procedure Number***	D0001.8383		
Serial Number	055664	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	20 Apr 2018		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.64	°C	± 0.01 °C
Description	Larson Davis 1/2" Preamplifier for LxT Class 1 -1 dB	***Humidity***	50.9	%RH	± 0.5 %RH
		Static Pressure	85.87	kPa	± 0.03 kPa

Evaluation Method Tested electrically using a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
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The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis Model 2900 Real Time Analyzer	03/07/2018	03/07/2019	003003
Hart Scientific 2626-S Humidity/Temperature Sensor	06/11/2017	06/11/2018	006943
Agilent 34401A DMM	06/28/2017	06/28/2018	007165
SRS DS360 Ultra Low Distortion Generator	10/05/2017	10/05/2018	007167