Sapphire Wind Farm

Noise Compliance Testing

November 2019

sonus.

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Reviewer	:	Jason Turner, MAAS

Contents

GLOSSARY

A weighting	Frequency adjustment representing the response of the human ear.
Associated Residences	Residences included in a commercial agreement with the wind farm.
Critical Non-Associated Residences	Non-Associated Residences used to demonstrate compliance with the Project Approval Conditions. The residences are selected based on having the highest predicted noise level in a range of directions around the wind farm. Compliance at these residences demonstrates compliance at all Non-Associated Residences.
C weighting	Frequency adjustment which places emphasis on the low frequency range
dB(A)	A weighted noise level measured in decibels.
dB(C)	C weighted noise level measured in decibels.
L_{A90}	The A weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured.
L_{Aeq}	The A weighted equivalent continuous noise level – the energy-average of noise levels occurring over a measurement period.
L_{C90}	The C weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured.
Test Plan	Sonus Document *S3216C5.* Noise Compliance Test Plan dated August 2018 which provides the compliance testing methodology.
Non-Associated Residences	Residences not included in a commercial agreement with the wind farm.
Pre-Construction Noise	Noise in the absence of the wind farm determined by monitoring conducted prior to the operation of the wind farm
Post-Construction Noise Monitoring	Noise monitoring conducted during the operation of the wind farm, which is used to determine the total noise from the wind farm and other noise sources.
Project Approval	Notice of Modification for Project Approval "09_0093", dated 30 June 2016
Project Approval Conditions	Operational noise related conditions of the Project Approval, as detailed in Appendix A.
Residential Logging Location	A location where noise loggers are placed to represent the noise at Critical Non-Associated Residences

1 EXECUTIVE SUMMARY

Operational noise testing has been conducted which confirms compliance with the Project Approval Conditions for the Sapphire Wind Farm.

The testing included:

- noise level monitoring at four residences;
- measuring the tonality from the wind farm;
- measuring the low frequency noise from the wind farm; and
- measuring the noise level from ancillary infrastructure.

2 INTRODUCTION

This report summarises the noise testing conducted to determine compliance with the operational noise related Project Approval Conditions for the Sapphire Wind Farm. The Project Approval Conditions are consistent with the *New South Wales Wind Energy: Noise Assessment Bulletin for State significant wind energy development December 2016* (the Bulletin) and relate to noise at Non-Associated Residences. The Project Approval Conditions are detailed in Appendix A.

The testing was conducted in accordance with the Sapphire Wind Farm Noise Compliance Test Plan (the **Test Plan**). The Test Plan was designed to overcome the inherent difficulty of measuring noise from a wind farm in the presence of (often significant) sources such as wind in trees and insects. In particular, the test plan prioritised the measurement of noise at locations where Pre-Construction Noise has previously been measured to allow the Pre-Construction Noise to be subtracted from the Post Construction Noise (which includes the total noise from the wind farm and other noise sources). This subtraction enables the noise from the wind farm to be better identified from within the combined noise of all sources in the environment.

3 RESIDENTIAL LOGGING LOCATIONS

A noise impact assessment was conducted by SLR Consulting and was summarised in report "40-1822-R1", dated 26 August 2011. The assessment was subsequently updated and was summarised in report "640.11227R1", dated 1 March 2016 (the SLR Assessment).

As part of the SLR Assessment, Pre-Construction Noise monitoring was conducted at the locations shown in the table below. The table also shows the progression of names used for these residences. All future references in report relate to the "New ID".

Receiver			Coordinates (UTM, GDA 94)	
SLR ID 2011 Assessment	SLR ID 2016 Assessment	New ID	Northing	Easting
175-Falkland *	R3-Falkland *	No ID**	360082	6715875
199-Springfield	R64-Springfield	No ID**	361040	6719272
43- Ardleigh *	R43- Ardleigh	R4- Ardleigh*	353963	6715399
194- Down Field *	R5- Down Field *	R5- Down Field	356394	6711085
11-Kingshill *	R14-Kingshill *	R14-Kingshill *	347698	6712560
54-Carinya *	R23-Carinya *	R23-Carinya *	346594	6718876
71-Tralee *	R28-Tralee *	R28-Tralee *	342175	6715048
227-Yarrawah Park *	R36-Yarrawah Park *	R36 Yarrawah Park *	348460	6705713
23-Mindora	R44-Mindora	R44-Mindora*	352071	6705883
153-Mt Buckley	R10-Mt Buckley	R10-Mt Buckley*	356198	6706640
32-Warrandah *	R19-Warrandah *	R19-Warrandah *	348550	6715477

* *Associated Residence*

** *Turbines are no longer proposed in the vicinity of these residences and therefore they have been removed from current wind farm drawings*

Of these measurement locations, only R5 remains a Non-Associated Residence in the vicinity of the wind farm.

It is considered that the Critical Non-Associated Residences are R5, R27, R45 and R87. That is, compliance at these residences demonstrates compliance of the overall wind farm with the Project Approval Conditions. It is normal practice that compliance monitoring is conducted at locations where Pre-Construction Noise monitoring was previously conducted, so that the influence of the Pre-Construction Noise environment can be subtracted from the noise levels measured during operation. However, as Pre-Construction Noise monitoring was not conducted at all of the Critical Non-Associated Residences prior to construction, some alternate measurement locations have been determined. The rationale for the selection of the alternate locations and for the relative adjustment of the results to the Critical Non-Associated Residences is repeated from the Test Plan:

- Pre-Construction Noise monitoring was conducted at R5 and therefore R5 has been used as a Residential Logging Location.

- The closest Pre-Construction Noise monitoring location to R27 is R28. As R28 is closer to the wind farm, the predicted noise level is 5 dB(A) higher than at R27. Therefore compliance monitoring has been conducted at R28 and the results have been extrapolated (by subtracting 5 dB(A)) to suit R27).

- The closest Pre-Construction Noise monitoring location to R45 is R44. As R44 is closer to the wind farm, the predicted noise level is 1 dB(A) higher than at R45. Therefore compliance monitoring has been conducted at R44 and the results have been extrapolated (by subtracting 1 dB(A)) to suit R45).

- The closest Pre-Construction Noise monitoring location to R87 is R23. As R23 is closer to the wind farm, the predicted noise level is 6 dB(A) higher than at R87. Therefore compliance monitoring has been conducted at R23 and the results have been extrapolated (by subtracting 6 dB(A)) to suit R87).

The locations chosen for the noise logging, the Non-Associated Residences which they represent and the adjustments to be applied (the **Noise Level Extrapolation**) are summarised in the table below.

Residential Logging Location	Represents Critical Non-Associated Residence	Noise Level Extrapolation
R5	R5	-
R28	R27	-5 dB(A)
R44	R45	-1 dB(A)
R23	R87	-6 dB(A)

4 CRITERIA FOR CRITICAL NON-ASSOCIATED RESIDENCES

The operational noise criteria for most Non-Associated Residences are specifically listed in the Project Approval Conditions. However, the Project Approval does not include specific noise criteria for R5 as it was previously considered an Associated Residence. For this residence, the criteria have been determined in accordance with the following;

"The higher of 35 dB(A) or the existing Background Noise level ($L_{A90\ (10\text{-}minute)}$) plus 5 dB(A)"

In order to determine the "existing Background Noise level", reference was made to the SLR Assessment, which provides the Background Noise level measured at R5. The table below summarises the criteria at the Critical Non-Associated Residences, based on the Project Approval Conditions for R27, R45 and R87 and the SLR Assessment for R5.

Location	**Noise Limits (dB(A))**									
Integer wind speed (m/s) at 10 metres above ground level	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
R5	44	43	43	43	44	45	46	47	48	48
R27	35	35	35	36	36	37	39	42	46	52
R45	35	35	36	37	38	40	43	48	56	66
R87	35	35	35	35	36	39	41	45	51	57

5 EQUIPMENT

The noise logging at residences was conducted between 20 March and 1 May 2019 using Rion NL52 (Class 1) and Rion NL21 (Class 2) sound level meters. These sound level meters have a noise floor no greater than 20 dB(A). Rion WS-15 windshields were used to minimise noise on the microphone. The table below details the sound level meter serial number and calibration date. Calibration Certificates are shown in Appendix B.

Residence	Sound Level Meter	Serial Number	Calibration Date
R5	NL-21	00198361	19 Jun 2017
R28	NL-52	00320651	13 Sep 2018
R44	NL-21	01298928	19 Jun 2017
R23	NL-52	00320649	14 Mar 2019

A Rion NC-74 calibrated reference sound source was also used before and after the compliance testing regime to confirm that the sound level meter calibration had not drifted.

Wind at microphone height was also recorded at Residences R28 and R44. Rain was recorded at Residence R28.

Photographs of the sound level meters at each residence can be seen below.

Figure 2 Noise logger at residence R5

Figure 3 Noise logger at residence R28

Figure 4 Noise logger at residence R44

Figure 5 Noise logger at residence R23

6 DATA

The loggers at residences collected L_{A90} noise data continuously over 10 minute intervals. Data filtering removed time periods:

(i) affected by rain or wind based on a weather logger placed at an equivalent location to noise loggers. Data were considered to be adversely affected where precipitation occurred in a 10 minute period or where a wind speed greater than 5 m/s was exceeded for 90% of a 10 minute period.

(ii) where the wind direction was not within 45° either side of the direct line between the nearest WTG and the Residential Logging Location.

Following removal of the data defined above, all of the remaining noise data for the full monitoring period were correlated with the corresponding wind speed (referenced to 10m above ground) for each Residential Logging Location. The 10m wind speed was determined based on measured wind speed at hub height of the closest turbine, sheared to a reference height of 10m. The Pre-Construction Noise was logarithmically subtracted from the correlated data. The Noise Level Extrapolation was then applied.

The results provide the wind farm noise levels at the Critical Non-Associated Residences for the purposes of comparison with the Project Approval Conditions.

7 RESULTS

The noise recorded at the Residential Logging Location and correlated with wind speed is shown in the figures below. In the tables below each figure, the Pre-Construction Noise is subtracted from the Post Construction Noise, and the Noise Level Extrapolation is applied to enable a comparison with the relevant criteria.

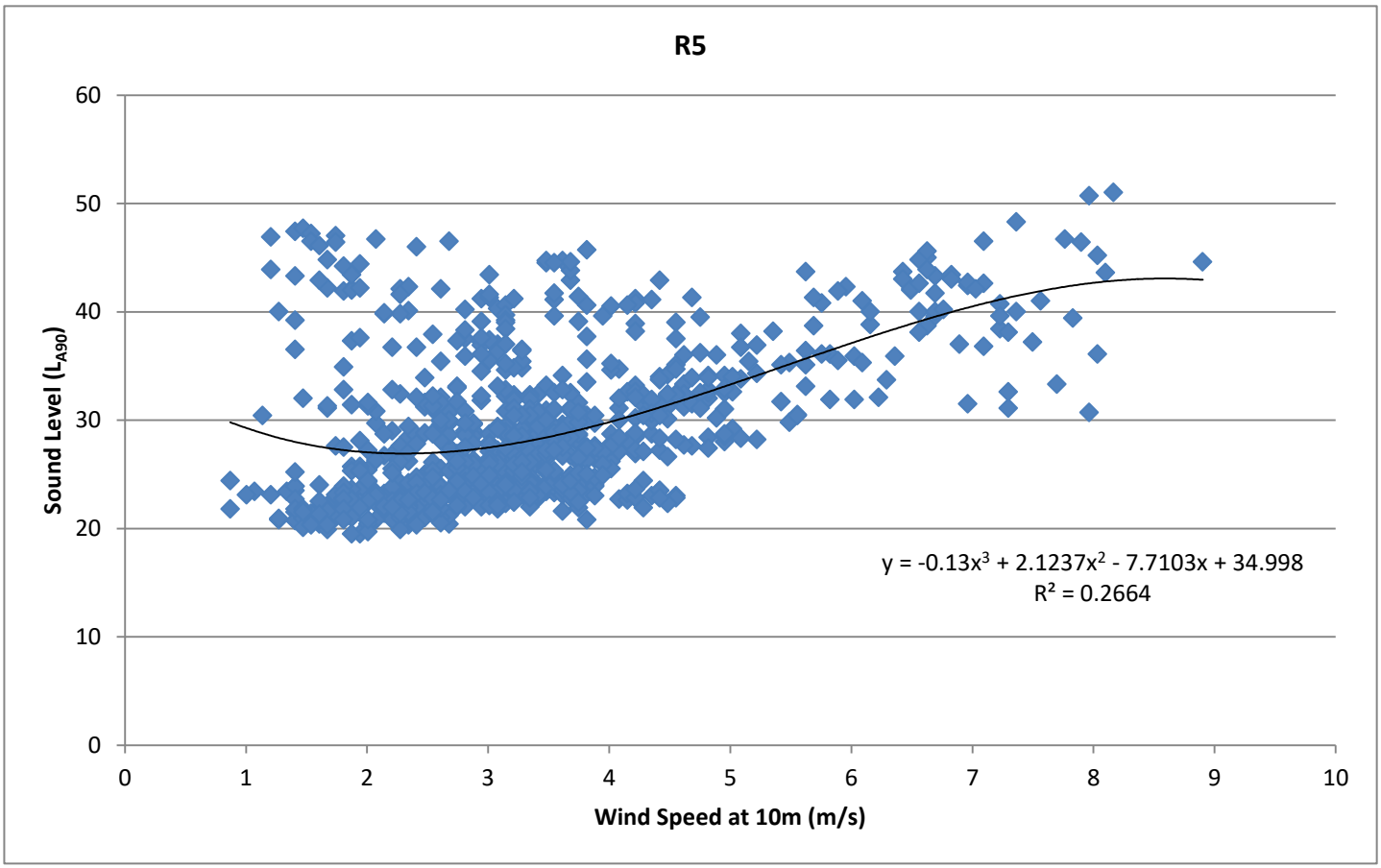


Figure 6 Post-construction measured noise correlated with wind speed

Wind Speed (m/s)	3	4	5	6	7	8	9	10	11	12
Post-Construction Level (L_{A90})	27	30	33	37	40	43	43	43	43	43
Pre-Construction Level (L_{A90})	39	38	38	38	39	40	41	42	43	43
Derived Wind Farm Level at R5 (L_{A90}) [1]	24	27	30	34	37	40	40	40	40	40
Criterion at R5 (L_{A90})	44	43	43	43	44	45	46	47	48	48
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

[1] A maximum of 3 dB(A) has been subtracted from the post construction levels to account for pre-construction noise and where the correlation curve falls at higher wind speeds, the peak of the curve has been used for the higher wind speeds.

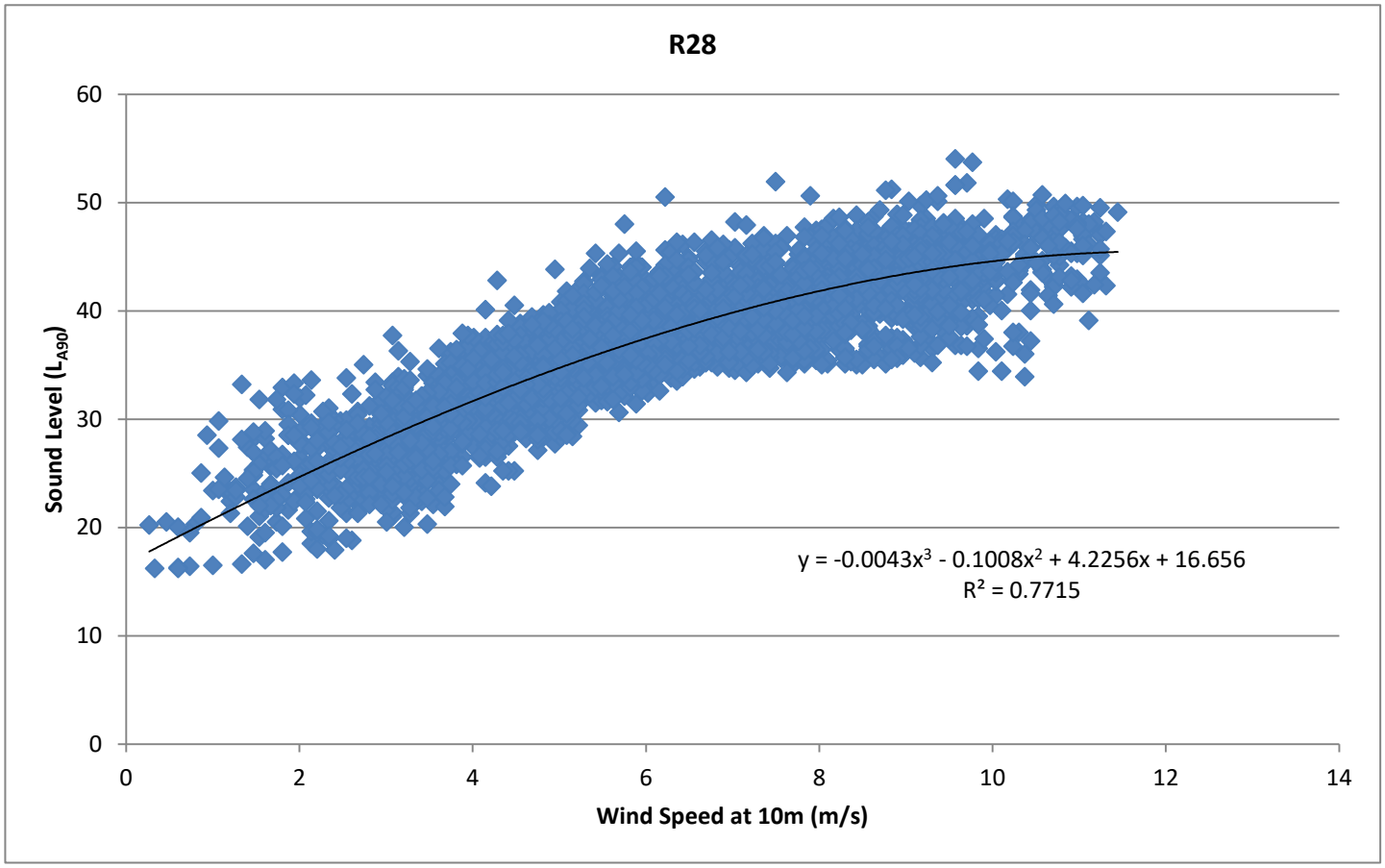


Figure 7 Post-construction measured noise correlated with wind speed

Wind Speed (m/s)	3	4	5	6	7	8	9	10	11	12
Post-Construction Level (L_{A90})	28	32	35	37	40	42	43	45	45	45
Pre-Construction Level (L_{A90})	28	30	30	31	31	32	34	37	41	47
Derived Wind Farm Level at R28 (L_{A90})	25	29	33	36	39	41	43	44	44	44
Noise Level Extrapolation from R28 to R27	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
Derived Wind Farm Level at R27 (L_{A90})	20	24	28	31	34	36	38	39	39	39
Criterion at R27 (L_{A90})	35	35	35	36	36	37	39	42	46	52
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

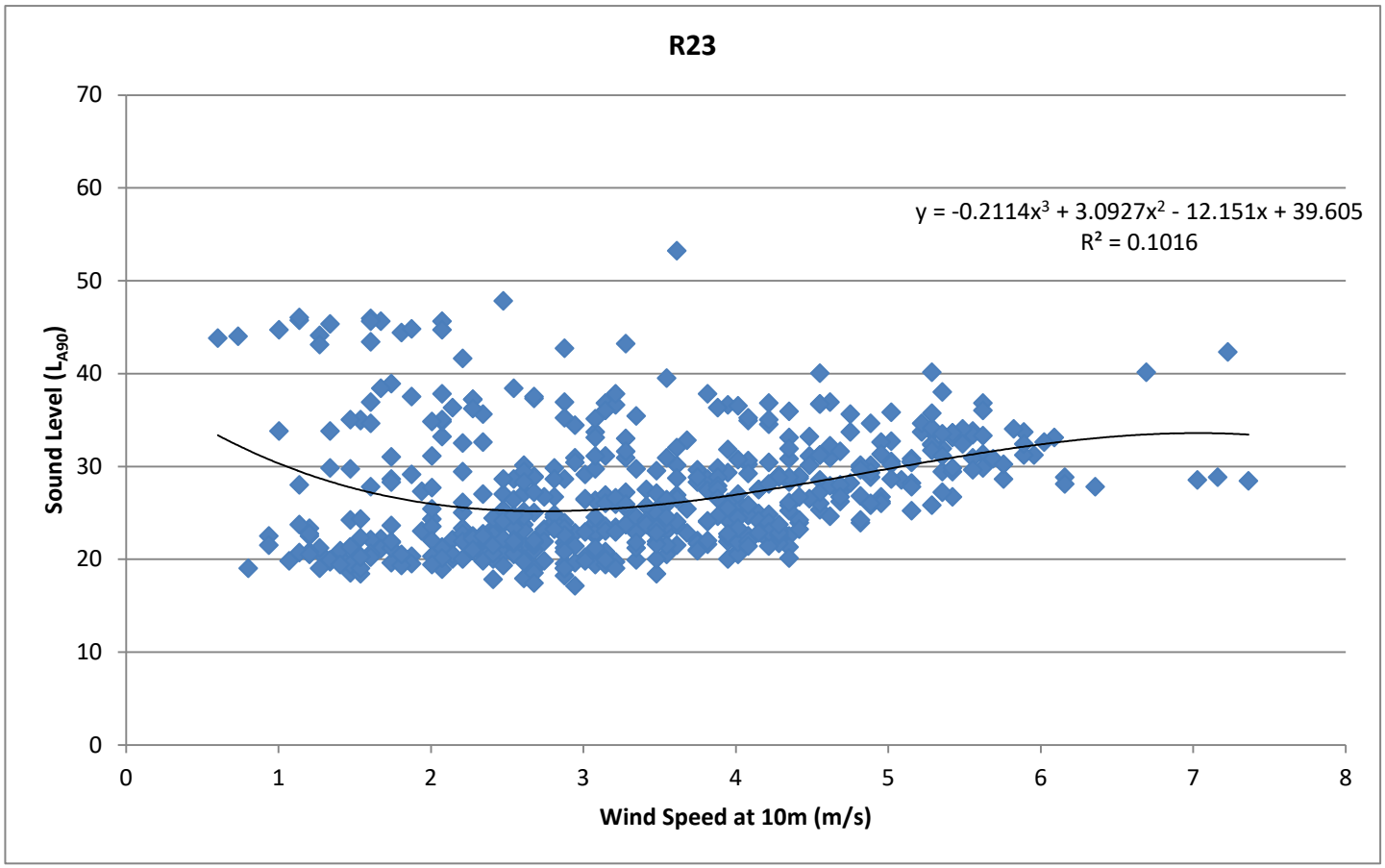


Figure 8 Post-construction measured noise correlated with wind speed

Wind Speed (m/s)	3	4	5	6	7	8	9	10	11	12
Post-Construction Level (L_{A90})	25	27	30	32	34	34	34	34	34	34
Pre-Construction Level (L_{A90})	26	27	29	30	31	34	36	40	46	52
Derived Wind Farm Level at R23 (L_{A90})	22	24	27	29	31	31	31	31	31	31
Noise Level Extrapolation from R23 to R87	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
Derived Wind Farm Level at R87 (L_{A90})	16	18	21	23	25	25	25	25	25	25
Criterion at R87 (L_{A90})	35	35	35	35	36	39	41	45	51	57
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

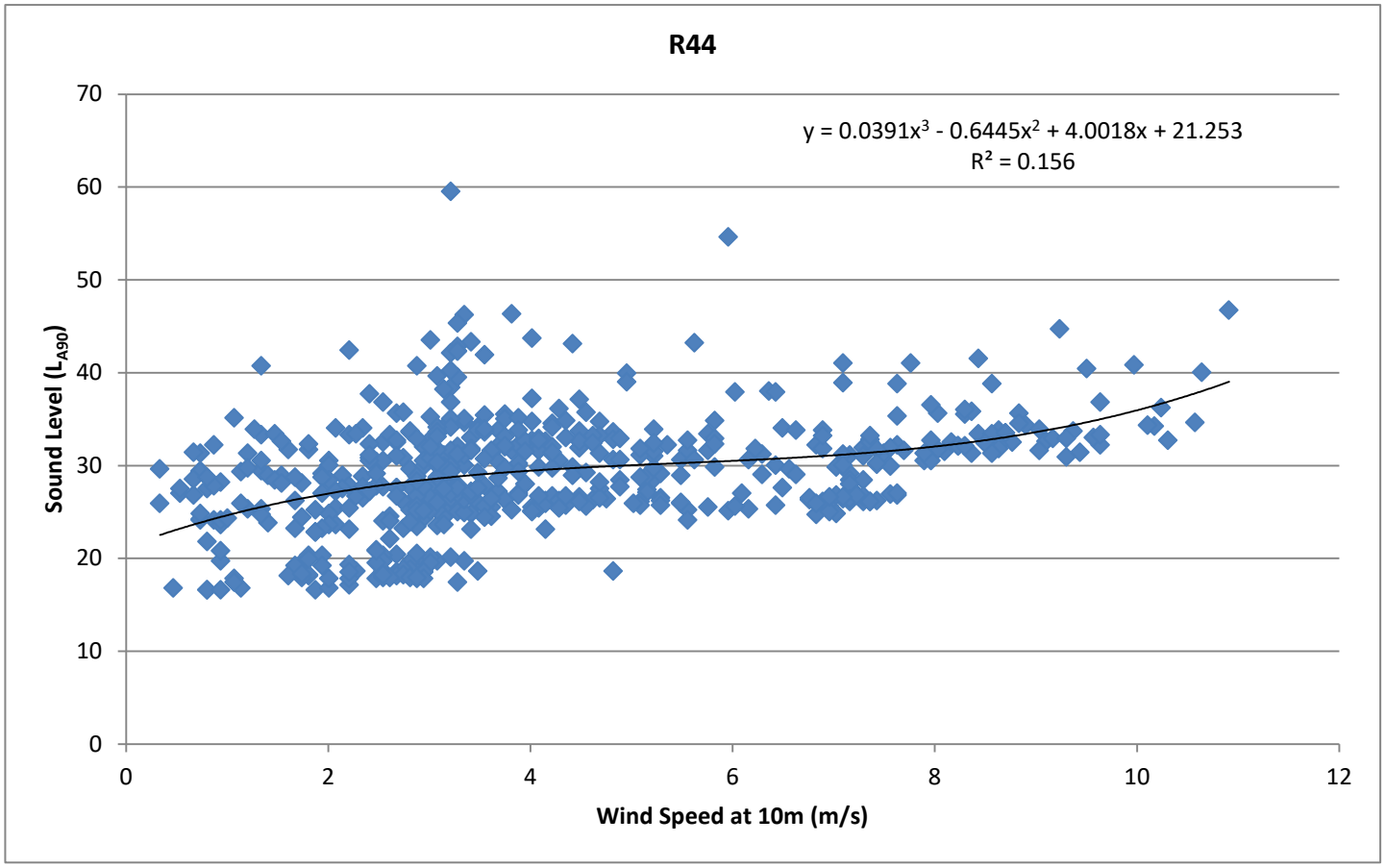


Figure 9 Post-construction measured noise correlated with wind speed

Wind Speed (m/s)	3	4	5	6	7	8	9	10	11	12
Post-Construction Level (L_{A90})	29	29	30	31	31	32	34	36	39	44
Pre-Construction Level (L_{A90})	29	30	31	32	33	35	38	43	51	61
Derived Wind Farm Level at R44 (L_{A90})	26	26	27	28	28	29	31	33	36	41
Noise Level Extrapolation from R44 to R45	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Derived Wind Farm Level at R45 (L_{A90})	25	25	26	27	27	28	30	32	35	40
Criterion at R45 (L_{A90})	35	35	36	37	38	40	43	48	56	66
Compliance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

8 TONALITY

An assessment of tonality was conducted in two parts:

- A near field assessment was conducted to determine the frequency and wind speed of any tonality being emitted by the turbines;
- An assessment of tonality was conducted on the noise data collected at the closest Residential Logging Location (R28) for the specific wind speeds and frequencies where tonality was found in the near field.

Near Field

The near field measurements were conducted at Turbine T29. This turbine was selected as it is a significant distance (more than 900m) from other turbines, which allows the downwind test to be conducted for all wind directions with other turbines continuing to operate. The testing was conducted on two occasions to enable high wind speeds and low wind speeds to be assessed.

Tonality at high wind speeds was measured between 4:50pm on 10 April 2019 and 9:30am on 11 April. The noise was measured with a Class 1 Rion NL52 sound level meter, which was placed approximately 100m west of the turbine to be in a downwind position.

The one-third octave band noise levels were measured in 10 second intervals. For this period of testing, 10 minute average wind speeds from the nacelle anemometer were available. These wind speeds (referenced to 10m above ground) ranged of 5m/s to 11m/s. The wind direction was within 31 degrees of the downwind direction to the microphone throughout the monitoring.

A test for tonality, in accordance with the method of Appendix 3 of the Project Approval, was conducted on each of the 10 second intervals. Two of the intervals showed tonality at a frequency of 2,000Hz and one of the intervals showed tonality at 4,000Hz. A review of the digital audio for these periods indicated that these tones were associated with birds close to the microphone. None of the approximately 6,000 intervals showed tonality from the turbines.

Tonality at low wind speeds was measured from 4:00pm on 10 September until 7:00am on 11 September. Three Class 1, Rion NL52 sound level meters were placed approximately 200m from the turbines in a range of directions to be in a downwind position for a range of wind directions.

The one-third octave band noise levels were measured in 10 second intervals. For this period of testing, 10 second wind speeds from the closest wind mast were available. These wind speeds (referenced to 10m above ground ranged between 3m/s and 5m/s. The noise samples closest to the integer wind speed in a downwind direction (+/- 15^{o}) were analysed for tonality in accordance with the method of Appendix 3 of the Project Approval. The tones identified for each integer wind speed are shown in the table below:

Wind Speed (at 10m)	3 m/s	4 m/s	5m/s
Samples Analysed	102	39	33
Samples where Tonality Identified	5	0	0
Tonal Frequencies (Hz)	630, 1000	-	-

The table shows that tonality was identified only at 3m/s at frequencies of 630Hz and 1000Hz.

Residential Logging Location

As tonality was identified in the near field location, the data collected at the closest Residential Logging Location R28 were analysed. The data collected for wind speeds of 2.5m/s to 3.5m/s in a downwind direction +/-45^{o} were analysed. The number of samples analysed and the number of tones identified at 630Hz and 1000Hz are summarised in the table below:

Tonal Frequency	630Hz	1000Hz
Samples Analysed	339	339
Samples where Tonality Identified	1	1

One sample was identified as tonal at 630Hz and one sample at 1000Hz. As this is well below 10% of the samples analysed, tonality is not a *repeated characteristic* as defined in the method of Appendix 3 of the Project Approval and no adjustment to the measured noise levels is warranted.

9 LOW FREQUENCY NOISE

The low frequency noise was conducted at R28 to represent the noise at R27. The C-weighted L_{90} noise level has been correlated with the wind speed (referenced to a height of 10m) for the day and night periods when the wind was in a downwind direction (+/- 45°). The day and night correlations are shown in Figure 10 and Figure 11 respectively.

The Project Approval Conditions consider that the wind farm is exhibiting excessive low frequency noise where the noise from the wind farm is *repeatedly greater than 65 dB(C) during the day time or 60 dB(C)) during the night time at any relevant receiver*. As the closest *relevant receiver* (Non-Associated Residence R27) is further from the wind farm than the Residential Logging Location at R28, the low frequency noise will be higher at R28 than at R27. Noise modelling indicates that there that the low frequency noise level at R28 is 4 dB(C) higher at R28 than at R27. Therefore, a line of 69 dB(C) (65 + 4) has been shown on the figure for the day and 64 dB(C) (60 + 4) has been shown on the figure for night.

The figures show that none of the data points are above the relevant criteria for low frequency noise. As low frequency noise is not a repeated characteristic, no penalty is warranted.

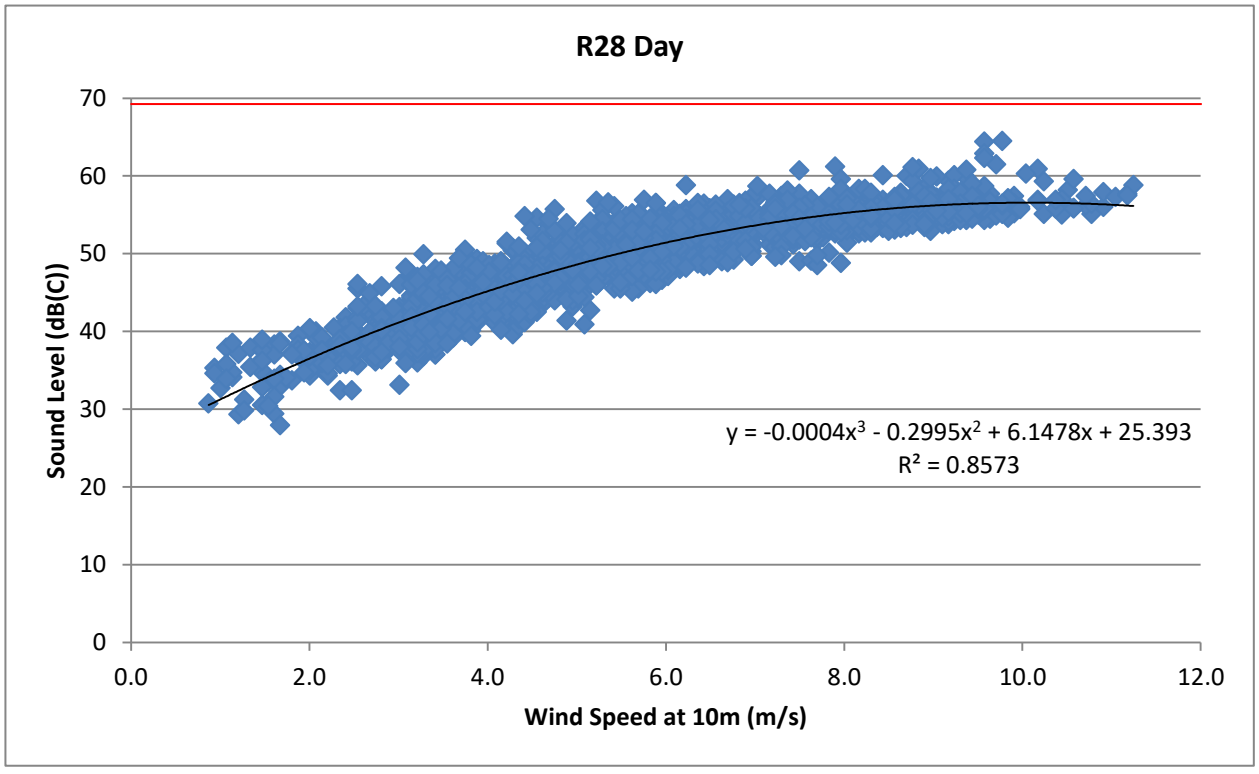


Figure 10 Day time dB(C) measured noise correlated with wind speed

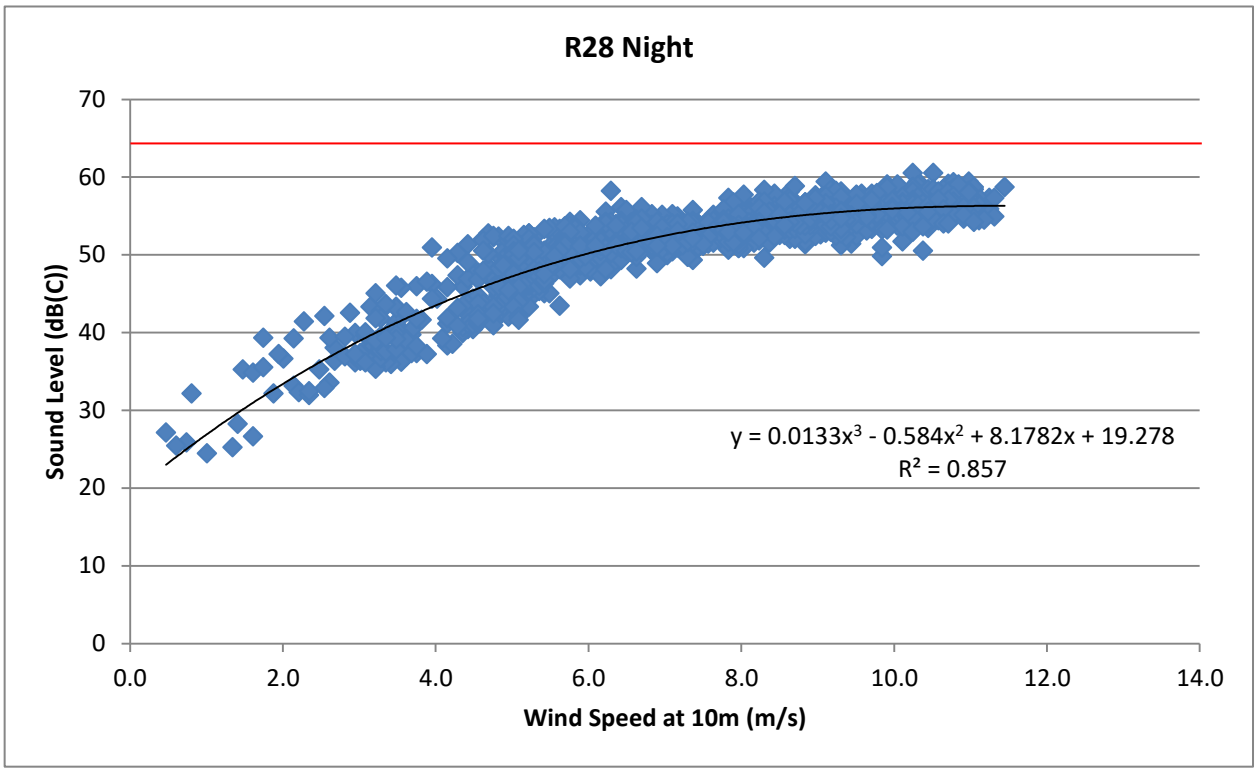


Figure 11 Night time dB(C) measured noise correlated with wind speed

10 ANCILLARY INFRASTRUCTURE

The noise from the substation was measured at a distance of 30m to one transformer and 60m to the second transformer. A noise level of 51 dB(A) was measured. During the measurement, the noise from other sources was higher than the noise from the transformers. If it is conservatively assumed that all of the measured noise was from the transformers, the predicted noise at the closest residence in worst case meteorological conditions would be less than 20 dB(A). As the predicted noise level is no greater than 35 dB(A) (even if a 5 dB(A) penalty for tonality is conservatively applied), the noise from the substation is compliant with the Conditions of Project Approval.

APPENDIX A – RELEVANT CONDITIONS OF THE PROJECT APPROVAL

NOISE

Operational Noise Criteria – Wind Turbines

F6. The Proponent shall ensure that the noise generated by the operation of the wind turbines does not exceed the relevant criteria in Table 1 at any non-associated residence.

Table 1 – Noise criteria

Location	Noise Limits (dB(A))									
Integer wind speed (m/s) at 10 metres above ground level	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
R25, R84, R87	35	35	35	35	36	39	41	45	51	57
R27, R29, R30, R32, R89, R90	35	35	35	36	36	37	39	42	46	52
R35	35	35	35	36	37	38	40	42	45	49
R78	35	35	35	37	40	44	47	48	48	46
R10, R48	35	35	35	38	41	45	48	51	53	54
R47	35	35	35	37	41	44	48	52	55	58
R39, R40, R41, R42, R44, R45, R46	35	35	36	37	38	40	43	48	56	66
R7	43	43	44	46	47	48	49	49	49	49
R17	43	44	45	46	47	48	50	53	56	60
All other non-associated receptors	The higher of 35 dB(A) or the existing background noise level ($L_{A90\ (10\text{-}minute)}$) plus 5 dB(A)									

Note: To identify the residences referred to in Table 1, see Appendix 1.

Noise generated by the operation of the wind turbines is to be measured in accordance with the relevant requirements of the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (or its latest version), as modified by the provisions in Appendix 3. If this guideline is replaced by an equivalent NSW guideline, then the noise generated is to be measured in accordance with the requirements in the NSW guideline.

F7. Deleted

F8. Deleted

F9. Deleted

F10. Deleted

Operational Noise Criteria – Ancillary Infrastructure

F11. The Proponent shall ensure that the noise generated by the operation of ancillary infrastructure does not exceed 35 dB(A) $L_{Aeq(15\ minute)}$ at any non-associated residence.

Noise generated by the project is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy* (or its equivalent) as modified by the provisions in Appendix 3.

Noise Monitoring

F12. Within 3 months of the commencement of operations, the Proponent shall:

- undertake noise monitoring to determine whether the project is complying with the relevant conditions of this consent; and
- submit a copy of the monitoring results to the Department and the EPA.

F13. The Proponent shall undertake further noise monitoring of the project if required by the Secretary.

F14. Deleted

F15. Deleted

F16. Deleted

F17. Deleted

APPENDIX 3
NOISE COMPLIANCE ASSESSMENT

PART A: SOUTH AUSTRALIAN WIND FARMS: ENVIRONMENTAL NOISE GUIDELINES 2009 (MODIFIED)

South Australian *Wind Farms: Environmental Noise Guidelines 2009* (Modified) refers to the South Australian EPA document modified for use in NSW. The modifications are as follows:

Tonality

The presence of excessive tonality (a special noise characteristic) is consistent with that described in *ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels* and is defined as when the level of one-third octave band measured in the equivalent noise level Leq(10minute) exceeds the level of the adjacent bands on both sides by:

- 5dB or more if the centre frequency of the band containing the tone is in the range 500Hz to 10,000Hz;
- 8dB or more if the centre frequency of the band containing the tone is in the range 160 to 400Hz; and/or
- 15dB or more if the centre frequency of the band containing the tone is in the range 25Hz to 125Hz.

If tonality is found to be a repeated characteristic of the wind turbine noise, 5 dB(A) should be added to measured noise levels from the wind farm. If tonality is only identified for certain wind directions and speeds, the penalty is only applicable under these conditions. The tonal characteristic penalty applies only if the tone from the wind turbine is audible at the relevant receiver. Absence of tone in noise emissions measured at an intermediate location is sufficient proof that the tone at the receiver is not associated with the wind farm's operation. The assessment for tonality should only be made for frequencies of concern from 25 Hz to 10 KHz and for sound pressure levels above the threshold of hearing (as defined in *ISO 389.7: 2005 Acoustics - Reference zero for the calibration of audiometric equipment - Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions*).

Low Frequency Noise

The presence of excessive low frequency noise (a special noise characteristic) [i.e. noise from the wind farm that is repeatedly greater than 65 dB(C) during the day time or 60 dB(C)) during the night time at any relevant receiver] will incur a 5 dB(A) penalty, to be added to the measured noise level for the wind farm, unless a detailed internal low frequency noise assessment demonstrates compliance with the proposed criteria for the assessment of low frequency noise disturbance (UK Department for Environment, Food and Rural Affairs (DEFRA, 2005)) for a steady state noise source.

Notes:

- *For the purposes of these conditions, a special noise characteristic is defined as a repeated characteristic if it occurs for more than 10% of an assessment period. This equates to being identified for more than 144 minutes during any 24 hour period. This definition refers to verified wind farm noise only.*
- *The maximum penalty to be added to the measured noise level from the wind farm for any special noise characteristic individually or cumulatively is 5 dB(A).*

PART B: NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions – Wind Turbines

1. The noise criteria in Table 3 of the conditions are to apply under all meteorological conditions.

Applicable Meteorological Conditions – Other Facilities

2. The noise criteria in Condition F11 are to apply under all meteorological conditions except the following:
   a) wind speeds greater than 3 m/s at 10 m above ground level; or
   b) temperature inversion conditions between 1.5 ºC and 3ºC/100m and wind speeds greater than 2 m/s at 10 m above ground level; or
   c) temperature inversion conditions greater than 3ºC/100m.

APPENDIX B – SOUND LEVEL METER CALIBRATION CERTIFICATES

NATacoustic
Acoustic Calibration & Testing Laboratory
Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Meter

Calibration Date	19/6/2017	Job No	RB555	Operator	SN
Client Name	SONUS PTY LTD				
Client Address	17 RUTHVEN AVE, ADELAIDE, SA 5000				

Test Item

Instrument Make	RION	Model	NL-21	Serial No	#00196361
Microphone Make	RION	Model	UC-52	Serial No	#123586
Preamplifier Make	RION	Model	NH-21	Serial No	#29720
Ext'n Cable Make	Nil	Model	N/A	Serial No	N/A
Accessories	Nil			Firmware	N/A

SLM Type	2
Filters Class	N/A

Environmental Conditions	Measured Start	End
Air Temp. (°C)	25.4	24.0
Rel. Humidity (%)	36.0	43.0
Air Pressure (kPa)	101.0	101.0

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3 :2013

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Function Generator Model 33220A SN MY43004013
Agilent Digital Multimeter Model 34401A SN MY41004386

Traceability:
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. This document shall not be reproduced, except in full.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
The uncertainty is stated at a confidence level of 95% using a k factor of 2.

Calibration Statement:
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, 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 AS IEC 61672-1:2013 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 2 specifications in AS IEC 61672-1:2013 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 cover only a limited subset of the specifications in AS IEC 61672-1:2013.

NATA
WORLD RECOGNISED ACCREDITATION

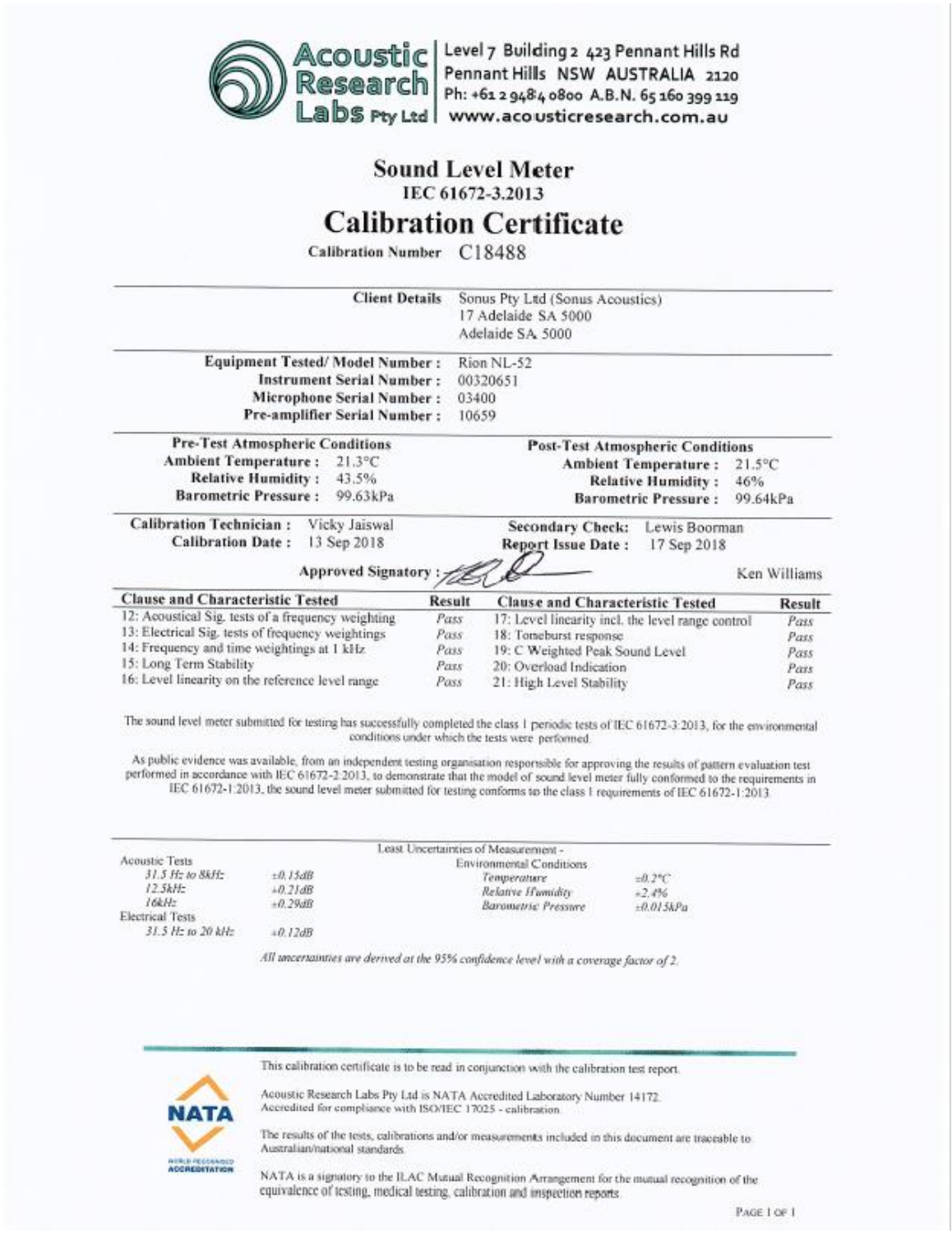
NATA Accredited Laboratory Number 14988

Authorized Signatory:

Print Name: Renzo Tonin Date: 25 June 2017

Template Document Name: RQT-05 (rev 42) SLM ISO Verification

Figure B1 Calibration certificate for sound level meter used at residence R5



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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate
Calibration Number C18488

Client Details	Sonus Pty Ltd (Sonus Acoustics) 17 Adelaide SA 5000 Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320651
Microphone Serial Number :	03400
Pre-amplifier Serial Number :	10659

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	21.3°C	**Ambient Temperature :**	21.5°C
Relative Humidity :	43.5%	**Relative Humidity :**	46%
Barometric Pressure :	99.63kPa	**Barometric Pressure :**	99.64kPa

Calibration Technician :	Vicky Jaiswal	**Secondary Check:**	Lewis Boorman
Calibration Date :	13 Sep 2018	**Report Issue Date :**	17 Sep 2018

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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Accredited for compliance with ISO/IEC 17025 - calibration.

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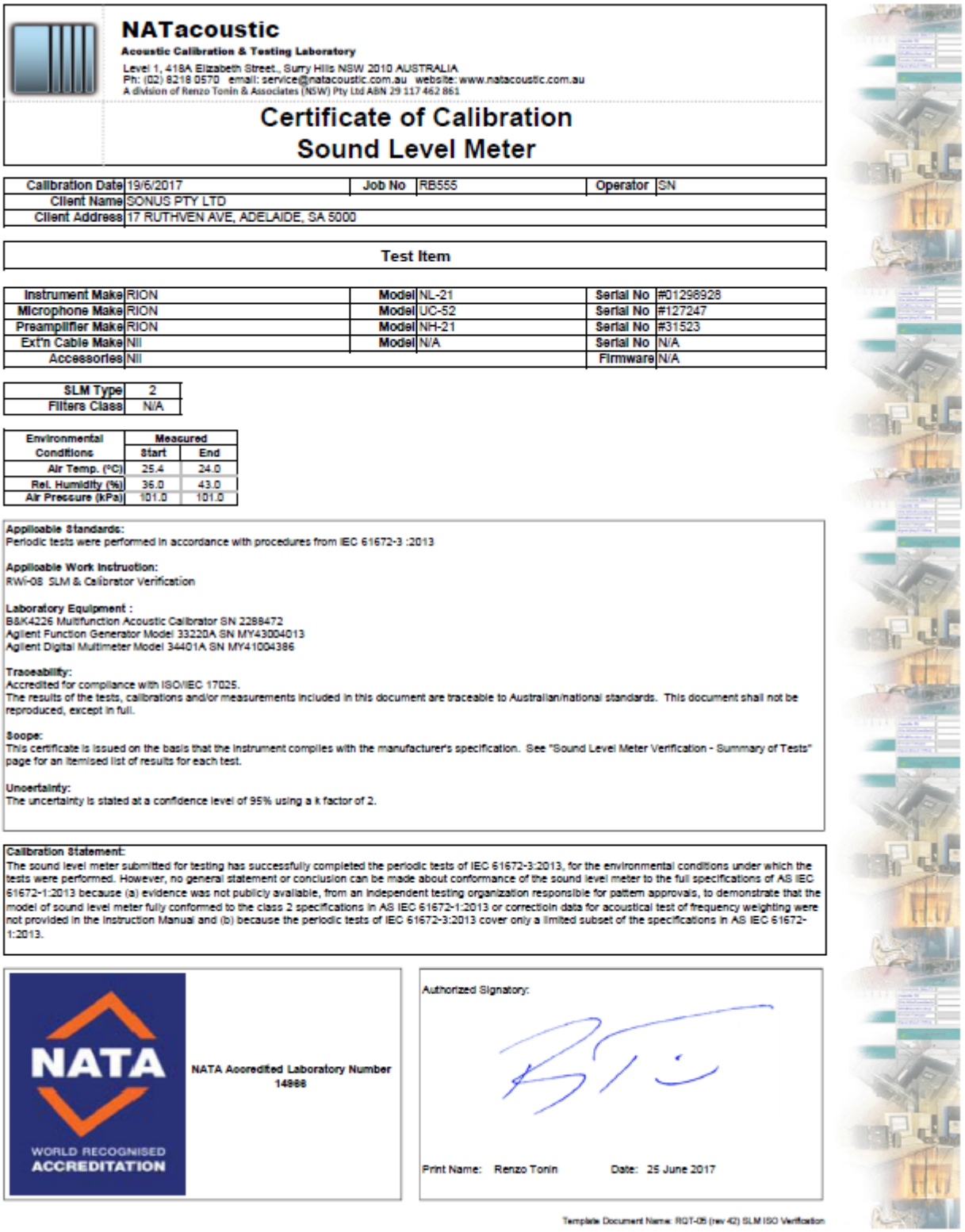
Figure B2 Calibration certificate for sound level meter used at residence R28



NATacoustic
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Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au
A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Meter

Calibration Date	19/6/2017	Job No	RB555	Operator	SN
Client Name	SONUS PTY LTD				
Client Address	17 RUTHVEN AVE, ADELAIDE, SA 5000				

Test Item

Instrument Make	RION	Model	NL-21	Serial No	#01298928
Microphone Make	RION	Model	UC-52	Serial No	#127247
Preamplifier Make	RION	Model	NH-21	Serial No	#31523
Ext'n Cable Make	NII	Model	N/A	Serial No	N/A
Accessories	NII			Firmware	N/A

SLM Type	2
Filters Class	N/A

Environmental Conditions	Measured Start	End
Air Temp. (°C)	25.4	24.0
Rel. Humidity (%)	36.0	43.0
Air Pressure (kPa)	101.0	101.0

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3 :2013

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Function Generator Model 33220A SN MY43004013
Agilent Digital Multimeter Model 34401A SN MY41004386

Traceability:
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. This document shall not be reproduced, except in full.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
The uncertainty is stated at a confidence level of 95% using a k factor of 2.

Calibration Statement:
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, 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 AS IEC 61672-1:2013 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 2 specifications in AS IEC 61672-1:2013 or correctioin 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 cover only a limited subset of the specifications in AS IEC 61672-1:2013.

NATA
WORLD RECOGNISED ACCREDITATION

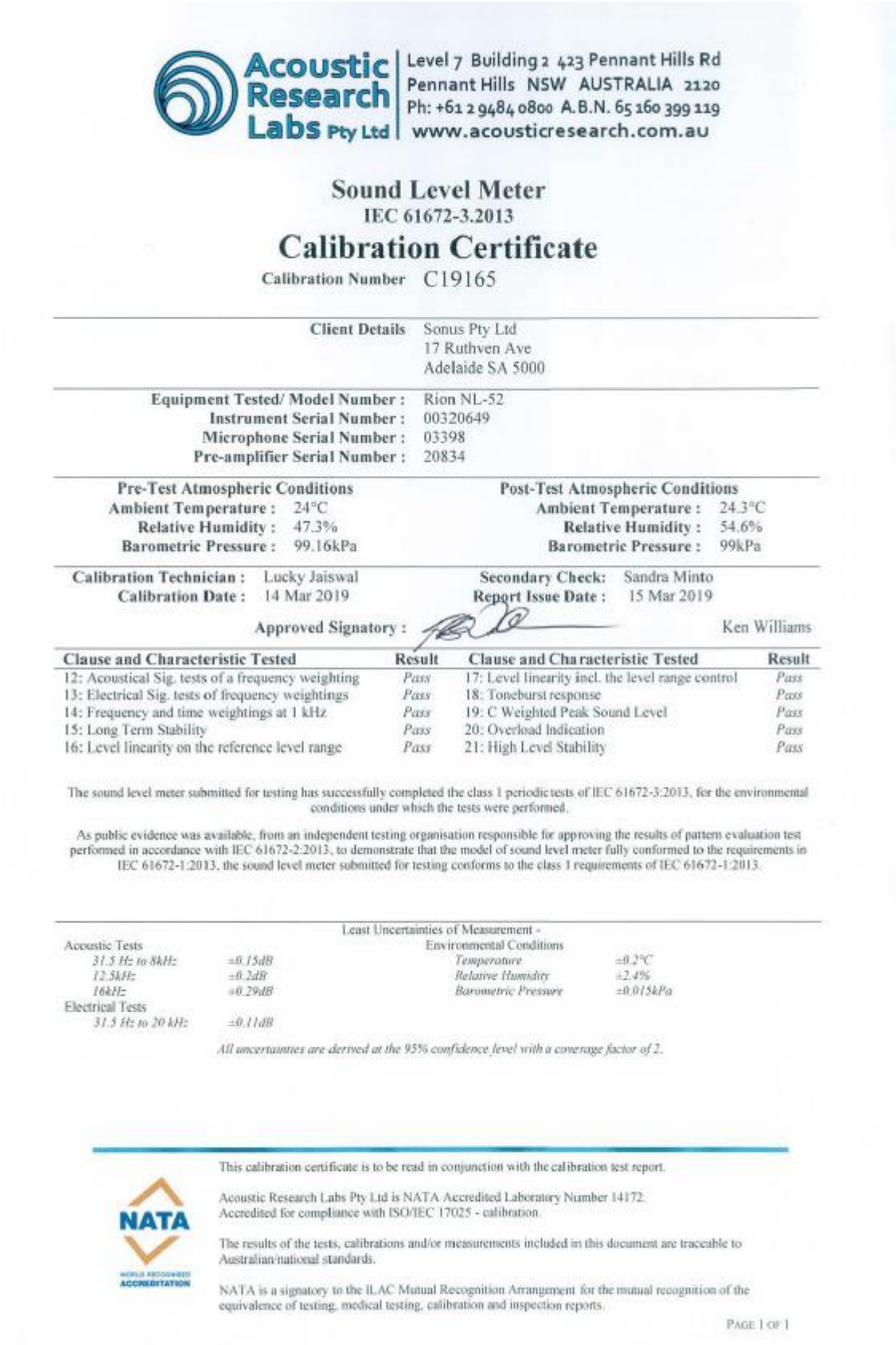
NATA Accredited Laboratory Number 14888

Authorized Signatory:

Print Name: Renzo Tonin Date: 25 June 2017

Template Document Name: RQT-05 (rev 42) SLM ISO Verification

Figure B3 Calibration certificate for sound level meter used at residence R44



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Sound Level Meter
IEC 61672-3.2013

Calibration Certificate

Calibration Number C19165

Client Details	Sonus Pty Ltd 17 Ruthven Ave Adelaide SA 5000
Equipment Tested/ Model Number :	Rion NL-52
Instrument Serial Number :	00320649
Microphone Serial Number :	03398
Pre-amplifier Serial Number :	20834

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24°C	**Ambient Temperature :**	24.3°C
Relative Humidity :	47.3%	**Relative Humidity :**	54.6%
Barometric Pressure :	99.16kPa	**Barometric Pressure :**	99kPa

Calibration Technician : Lucky Jaiswal
Secondary Check: Sandra Minto
Calibration Date : 14 Mar 2019
Report Issue Date : 15 Mar 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.11dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

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Figure B4 Calibration certificate for sound level meter used at residence R23