

NOISE AND VIBRATION MONITORING REPORT MAY 2024

**LIVERPOOL HEALTH AND ACADEMIC
PRECINCT**

LENDLEASE CONSTRUCTION PTY LTD



PROPERTY RISK AUSTRALIA



STATEMENT OF LIMITATIONS

This report has been prepared by Property Risk Australia Pty Ltd (PRA) for the benefit of Lendlease Construction Pty Ltd (hereafter the 'Client') in accordance with the agreement/contract between PRA and the Client. The works carried out in preparing this report have been performed in accordance with the proposal, scope of works, general terms and conditions and special terms and conditions, agreed in consultation with the Client.

This report has been prepared with information available at the time of report preparation and within the time and budgetary constraints imposed by the Client. PRA does not accept responsibility for inaccurate or incomplete information provided by the Client or third parties, nor for updates or changes to information made after the preparation of this report.

This report is solely for the use of the Client and has not been prepared for use by any other person or third party. This report must only be presented in full and may not be used by any person or third party, other than the Client, unless agreed to in writing by PRA. This will allow PRA to ensure that the intended use or interpretation of the report is fit for purpose and agreed to by the Client. PRA accepts no responsibility for damages arising from use of this report or supplementary information.

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DOCUMENT QUALITY CONTROL

Report Title:	Noise and Vibration Monitoring Report - May 2024			
Site Name:	Liverpool Health and Academic Precinct			
Site Address:	Goulburn Street, Liverpool NSW 2170			
Client Name:	Lendlease Construction Pty Ltd			
Job Number:	PRJ-000719			
Revision Number	Revision Date	Author(s)	Reviewer(s)	Status
1	12/06/2024	Brendon Phan	Gary Mace	Final



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1 INTRODUCTION

Property Risk Australia Pty Ltd (PRA) conducted construction noise and vibration monitoring on behalf of **Lendlease Construction Pty Ltd** (Lendlease, the 'Client') for the redevelopment works at Liverpool Health and Academic Precinct, Goulburn Street, Liverpool NSW 2170 (hereafter the 'site') throughout the duration of main stage 1 and 2 works. The site and redevelopment locations are provided in **Appendix A – Figures 1 and 2**.

1.1 Scope

The objective of the noise and vibration monitoring is to assist with management during the works by providing ongoing unattended noise monitoring to assess compliance against the project Noise Management Levels (NMLs) and real-time vibration monitoring. Noise and vibration alerts are provided to the project team based on real time monitoring at sensitive receivers located at the site's periphery. This report will provide guidance to Lendlease regarding the noise and vibration levels present at Liverpool Hospital during May 2024.

2 GUIDELINES AND STANDARDS

The primary guidelines, specifications, and policy documents relevant to the monitoring include, but are not limited to:

- o NSW DECC. (2009). *Interim Construction Noise Guideline* (ICNG).
- o NSW EPA. (2020). *Draft Construction Noise Guideline* (DCNG).
- o NSW DEC. (2006). *Assessing Vibration: A Technical Guideline*.
- o Australian Standard. (2010). AS 2436:2010: *Acoustics – Guide to Noise Control on Construction, Maintenance and Demolition Sites*.
- o British Standards Institute. (2008). BS 6472-1:2008. *Guide to evaluation of human exposure to vibration in buildings, Part 1: Vibration sources other than blasting*.¹
- o British Standards Institute. (1993). BS 7385-2:1993. *Evaluation and measurement of vibration in buildings – Guide to damage levels from groundborne vibration*.
- o British Standards Institute. (2014). BS 5228-2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*.
- o DIN Standards Committee Building and Civil Engineering (DIN). (2016). DIN 4150-3:2016-12. *Vibration in buildings – Part 3: Effects on structures*.

3 PROJECT OVERVIEW

3.1 Site Location and Existing Environment

Liverpool Hospital, located 26 kilometres south-west of the Sydney CBD, is part of the South-Western Sydney Local Health District. It is bound by Goulburn Street to the West, Elizabeth Street to the South and Campbell Street to the North and is bisected by the Sydney Trains Main South Railway Line.

The area immediately surrounding the hospital features a variety of usages including Bigge Park to the south, educational institutions such as Liverpool Boys and Girls High Schools to the North and TAFE NSW to the south. A variety of mixed use (MU1) and high-density residential properties (R4) are located to the west, whilst general industrial (E4) activity dominates the east.

¹ Together with BS 6472-2:2008 this part of BS 6472 supersedes BS 6472:1992, which is withdrawn.

The sites regional setting and stages of work are presented in **Appendix A – Figure 1**.

3.2 Summary of Works

The Liverpool Health and Academic Precinct is a large-scale upgrade to the existing Liverpool Hospital facility which includes the following:

- o An integrated cancer centre with inpatient, ambulatory, diagnostic, outpatient, and research facilities.
- o Critical care services including an emergency department, intensive care facilities and specialist care nursery.
- o Maternity and podiatric inpatient and ambulatory facilities.
- o An aged care and rehabilitation centre.
- o Ambulatory care and outpatient clinical services.
- o A new multi-storey carpark.

The work is divided into two stages with the first stage including redevelopment of the hospitals main entrance, maternity services, outpatient and support services, and includes the development of a new pathology department and expansion of the pre-existing emergency department. The second stage of works includes construction of the new Integrated Services Building (ISB), a new wellness centre and loading dock. Other areas of the hospital are also scheduled to be refurbished throughout the works.

4 CONSTRUCTION NOISE MONITORING

4.1 Unattended Noise Monitoring

Two (2) NATA-calibrated unattended noise monitoring systems were deployed at Liverpool Hospital to conduct noise monitoring throughout May 2024. Noise monitoring was performed using ARL NGARA 4G Class 1 sound level meters which were field calibrated using handheld Pulsar model 105 field calibrators prior to monitoring. Monitoring was continuous, taking place during day, evening, and night periods with a trigger point set at the project noise management levels to capture exceedances which alerts the Client via email. The relevant NATA calibration certificates can be found in **Appendix C**.

The monitors were placed at locations representative of the ambient noise experienced by the hospital occupants and neighbouring sensitive receivers in general accordance with the guiding principles and application notes outlined in the *DCNG* (NSW EPA, 2020), *ICNG* (DECC, 2009) and AS 2436:2010.

The residential sensitive receiver monitoring station was located at 55-59 Goulburn Street, Liverpool NSW 2170. The noise monitor was located on the Level 1 balcony, approximately 10 m from the nearest residence. The noise receiver was set up approximately 1.5 m from the ground with a direct line of sight to the LHAP construction site.

The hospital sensitive receiver monitoring station was located within the Audiology department where the health assessments (hearing assessments) were determined to be most sensitive to construction noise. The noise monitor was originally installed within the Audiology unit manager's office; however, the monitor was relocated to the Audiology storeroom adjacent to the hearing assessment booths in June 2023 to minimise effect of noise related to office activities (such as staff talking) and better represent construction noise experienced within the hearing assessment booth. The noise receiver was set up approximately 1.5 m from the hearing assessment booth (separated by a sound isolating wall) and approximately 2 m above the ground due to space constraints.

4.2 Noise Management Levels

Background noise monitoring was undertaken by Acoustic Logic in June 2018 (EIS ref.: *Appendix A SSD Acoustic Assessment 4_kh*) to establish rating background levels (RBLs) for the site. The RBLs were used to calculate the Noise Management Levels (NMLs) for the site (**Table 1**) in accordance with the *ICNG* (DECC, 2009).

Table 1: Unattended Noise Monitor Locations and Rating Background Levels

Monitor Number	Receiver	Noise Management Levels, $L_{Aeq, 15min}$ (dB)		
		Day (7am – 6pm)	Evening (6pm -10pm)	Night (10pm – 7am)
N1	External, Goulburn residential balcony	52	47	44
N2	Internal, level 1, Audiology storeroom	45		

4.3 Unattended Noise Monitoring Results

Table 2 contains a summary of the noise data by comparing the percentage of noise readings during construction that exceed the NMLs by various amounts. **Appendix B** contains a time history of noise results for the month.

Table 2: Summary of Unattended Noise Monitoring During Construction Hours

Criterion	Exceedance	N1: 55-59 Goulburn Street, balcony	N2: Level 1, Audiology storeroom
Noise Affected NML $L_{Aeq, 15min}$ (dB)	≤0 dB	0.00%	89.70%
	>0 and ≤5 dB	12.92%	8.45%
	>5 and ≤10 dB	68.50%	1.27%
	>10 and ≤15 dB	14.78%	0.08%
	>15 and ≤20 dB	3.13%	0.00%
	>20 dB	0.68%	0.51%
Highly Noise Affected NML , $L_{Aeq, 15min}$ (dB)	Exceedance >75 dB(A)	0.51%	0.08%

4.4 Noise Monitoring Discussion

At the N1 Goulburn Residential location, there were exceedances above the Highly Noise Affected NML of 75 dB $L_{Aeq, 15min}$ on:

- o 11th May 2024 at 14:00hrs (76 dB $L_{Aeq, 15min}$)
- o 15th May 2024 at 17:30hrs (75.3 dB $L_{Aeq, 15min}$)
- o 16th May 2024 at 12:00hrs (75.5 dB $L_{Aeq, 15min}$)
- o 16th May 2024 at 12:15hrs (77.2 dB $L_{Aeq, 15min}$)
- o 16th May 2024 at 13:30hrs (77.0 dB $L_{Aeq, 15min}$)

Noise levels were not recorded below the Noise Affected NML (0.00%) at any time within the site's operating hours. This indicates that noise from other sources, most notably from road traffic on Goulburn Road, is a significant influence and likely attributable to many of exceedances during operating hours. Noise levels during operating hours did not exceed the Noise Affected NML by more than 10 dB over two-thirds of the time (81.42%) during the monitoring period.

There was a notable increase in noise levels within the >5 to ≤10 dB, >10 to ≤15 dB and >15 to ≤20 dB exceedance categories from the previous month (April 2024). This was reciprocated by a decrease in the proportion of noise levels within the >0 to ≤5 dB exceedance category. Noise levels during standard construction hours have apparently increased during the May 2024 period. It is recommended to review construction practices to minimise the impact of noise on surrounding residential receivers.

Noise levels at location N2 (Audiology) exceeded the Highly Noise Affected NML of 75 dB $L_{Aeq, 15min}$ during the May 2024 reporting period on a single occasion:

- o 9th May 2024 at 18:00hrs (76.9 dB $L_{Aeq, 15min}$)

The exceedance may be related to hospital staff finishing work for the day as construction would likely have ceased for the day at 18:00hrs.

Noise levels at location N2 did not exceed the Noise Affected NML (45 dB $L_{Aeq, 15min}$) most of the time (89.70%) during operating hours. Noise levels during operating hours did not exceed the Noise Affected NML by more than 10 dB almost all of the time (99.41%).

5 VIBRATION MONITORING

5.1 Vibration Criteria

Condition C20 of the Planning approval (SSD 10389) states that vibration caused by construction must be limited to the criteria contained within the latest version of (German) *DIN Standards Committee Building and Civil Engineering (DIN)*. (2016). *DIN 4150-3:2016-12. Vibration in buildings – Part 3: Effects on structures*. The standard provides recommendations for vibration levels below which cosmetic or structural damage is unlikely. Vibration criteria are specified in terms of Peak Particle Velocity (PPV) in millimetres per second (mm/s) for various frequency ranges for different types of building construction.

Vibration criteria to assess human response are specified within the NSW DEC (now NSW EPA) guidelines *Assessing Vibration: A Technical Guideline* (2006). The guideline was based on British Standard *BS 6472:1992 Evaluation of human exposure to vibration in buildings (1-80 Hz)* (currently superseded by *BS 6472-1:2008*). The standard evaluates the probability of adverse comment from occupants of various buildings usages in terms of Vibration Dose Value (VDV). VDV is a root-mean-quadrant average of frequency-weighted vibration acceleration on the floor(s) of the building. Table C1.1 in Appendix C of the *Assessing Vibration: A Technical Guideline* (DEC, 2006) presents vibration criteria for exposure to continuous and impulsive vibration in different units.

The hospital sensitive receiver was selected as the basis for adopted site vibration criteria. The *critical working areas* (e.g. *hospital operating theatres, precision laboratories*) criteria were selected as most applicable to the hospital receiver with peak velocity measured in mm/s. For construction, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concern of potential building damage.

Table 3 contains vibration criteria adopted for the project. These are guideline values for vibration peak particle velocity (PPV) derived from *Appendix C* of the DEC (2006) guidelines.

Table 3: Project Vibration Criteria

Place	Period	Preferred Value, PPV (mm/s)	Maximum Value, PPV (mm/s)
Critical Working Areas (e.g., hospital operating theatres, precision laboratories)	Day or Night-Time	0.14	0.28

For additional context, **Table 4** reproduces suggestions of expected community reactions to various levels of constriction vibration from British Standard *BS 5228-2:2009*.

Table 4: Guidance on the Effects of Vibration Levels (*BS 5228-2:2009*, Annex B)

Peak Vibration Level (mm/s)	Likely Stakeholder Response
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

5.2 Unattended Vibration Monitoring

One (1) NATA calibrated unattended vibration monitor was deployed within the Liverpool Hospital oncology bunker to conduct building vibration monitoring. Vibration monitoring was performed using a Svantek SV-803, which records Peak Particle Velocity (PPV) over time. The NATA-accredited calibration certificate is presented in **Appendix C**.

5.3 Vibration Results

Table 5 provides a summary of the results of the vibration assessment for May 2024. The results time history for the monitoring period is available in **Appendix B**.

Table 5: Summary of Unattended Vibration Monitoring During Construction Hours

Orientation	Preferred Value, PPV (mm/s)	Maximum Value, PPV (mm/s)
Location: Oncology, ground floor, fire hose reel cupboard		
x	0.01%	0.00%
y	0.00%	0.00%
z	0.00%	0.00%



5.4 Vibration Discussion

Vibration levels were generally very low throughout the period. During operating hours, there were no exceedances above the maximum value PPV of 0.28 mm/s.

Levels were commensurate with what is expected within typical office and residential environments. Levels were mostly below 0.14 mm/s PPV (99.99% during the reporting period).

The preferred value PPV (>0.14 mm/s) was exceeded during four (4) events on the x-axis during the May 2024 reporting period occurring on the 20th, 24th and 28th of May 2024. With reference to **Table 4**, these vibration levels are not expected to be perceptible to most occupants of the hospital.



APPENDIX A FIGURES



Title:	Site Location and Regional Context
Project ID:	PRJ-000719
Project Location:	Liverpool Health and Academic Precinct Elizabeth and Goulburn Street, Liverpool NSW 2170
Figure Number:	01
Client:	Lendlease Construction Pty Ltd
Map Scale:	1:8,000
CRS:	GDA2020 / MGA zone 56
Source:	SixMaps
Prepared By:	Brendon Phan
Reviewed By:	Scott Bamford
Date:	05/07/2023
Revision:	V1

Legend

Site Boundary	
Buildings	
Scheduled for Demolition	
Hospital Structure	
Sensitive Receptor	
Demolished	
Critical Infection Control Zones	

All extents and locations are approximate.





Title:	Noise and Vibration Monitoring Locations
Project ID:	PRJ-000719
Project Location:	Elizabeth & Goulburn Street, Liverpool, NSW 2170
Project Description:	Environmental Noise and Vibration Monitoring at Liverpool Health and Academic Precinct Site
Figure Number:	02
Client:	Lendlease Construction Pty Ltd
Map Scale:	1:2,000
CRS:	GDA2020 / MGA zone 56
Source:	Nearmap (18 Jan 2023)
Prepared By:	Brendon Phan
Reviewed By:	Scott Bamford
Date:	04/07/2023
Revision:	V1

Legend

Buildings

Scheduled for Demolition

Hospital Structure

Sensitive Receptor

Demolished

Critical Infection Control Zones

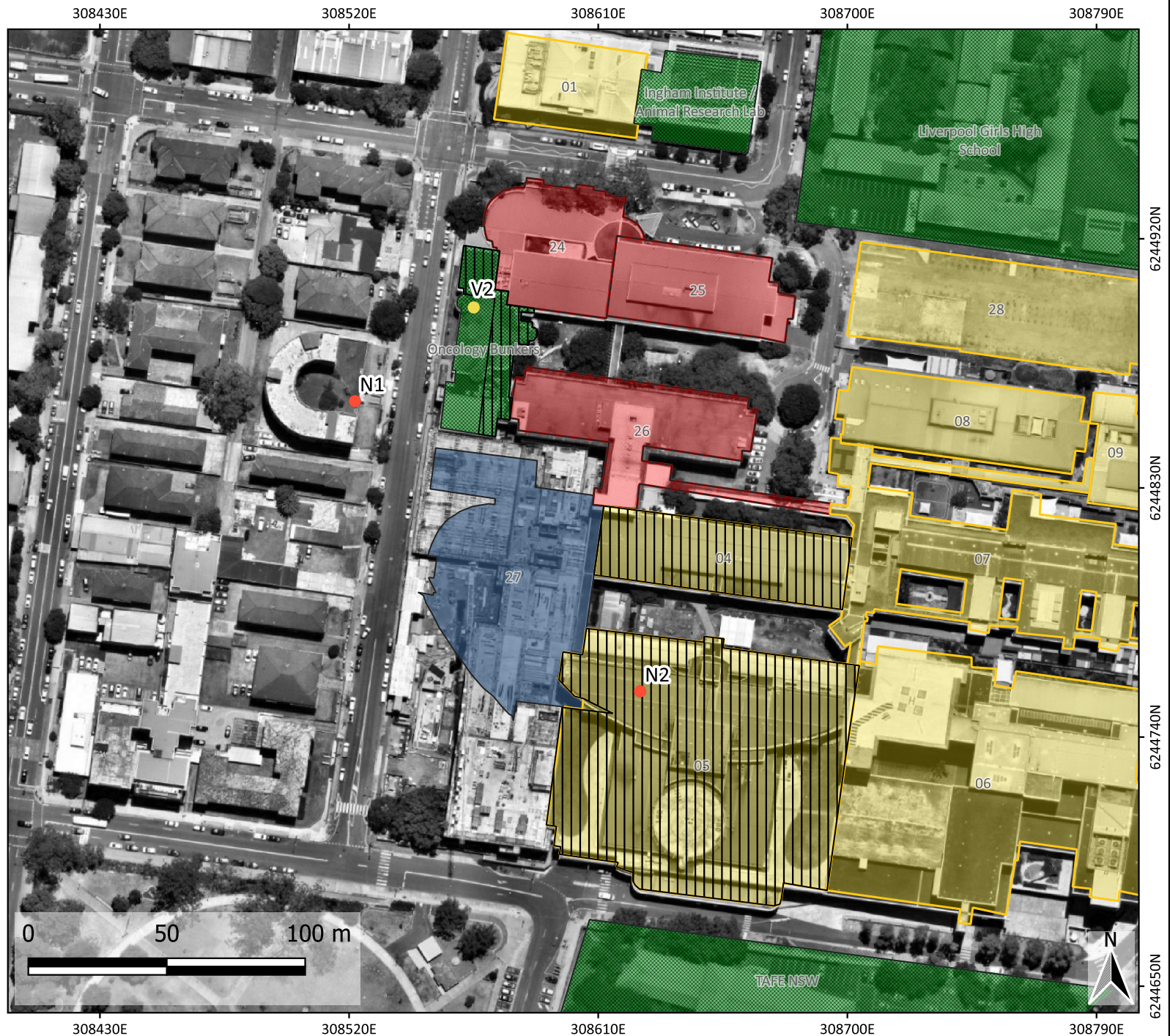
Environmental Monitors

Ground Vibration Monitor

Noise Logger



All extents and locations are approximate.



Disclaimer: Property Risk Australia Pty Ltd (PRA) compiled this map from numerous sources to provide a summary of spatial information for this project. This map is not prepared for or suitable for legal, engineering or surveying purpose.



APPENDIX B RESULTS



Liverpool Health and Academic Precinct - Noise Monitoring
N1: 55-59 Goulburn Street Balcony
May 2024



Overall Project Performance¹

Within approved
operating hours

Highly Noise Affected NML - LAeq, 15min (dB)

Exceedance	0.57%
Non-exceedance	99.43%

Noise Affected NML - LAeq, 15min (dB)

≤0 dB	9.32%
>0 and ≤5 dB	23.65%
>5 and ≤10 dB	46.05%
>10 and ≤15 dB	16.38%
>15 and ≤20 dB	3.40%
>20 dB	1.21%

Monthly Performance

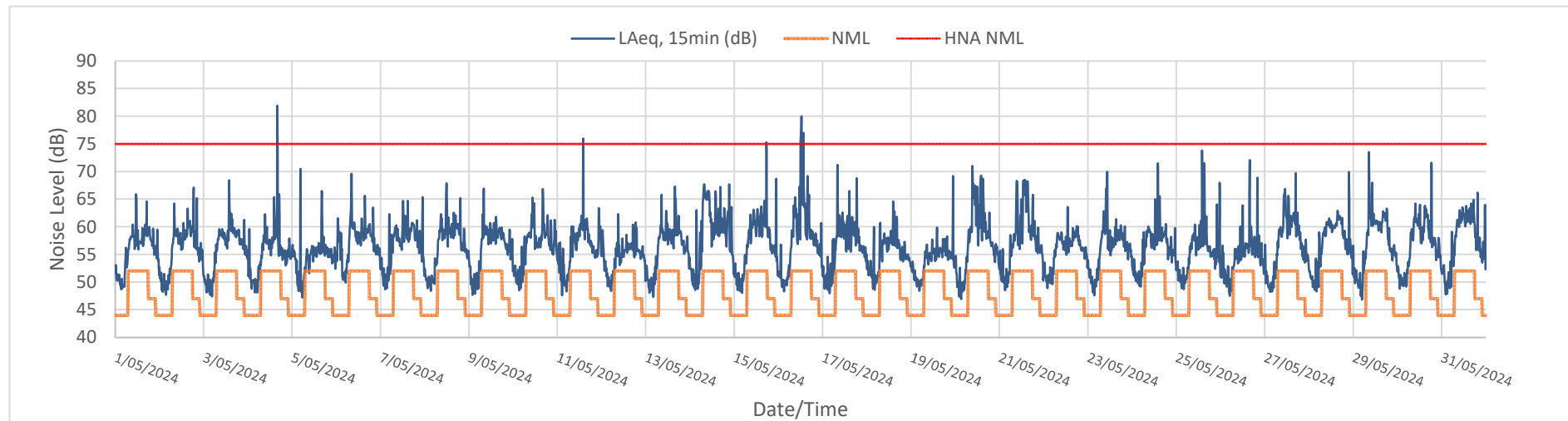
Within approved
operating hours

Highly Noise Affected NML - LAeq, 15min (dB)

Exceedance	0.51%
Non-exceedance	99.49%

Noise Affected NML - LAeq, 15min (dB)

≤0 dB	0.00%
>0 and ≤5 dB	12.92%
>5 and ≤10 dB	68.50%
>10 and ≤15 dB	14.78%
>15 and ≤20 dB	3.13%
>20 dB	0.68%



¹ Results for the overall project performance at N1 location are available between 1 October 2021 to 4 May 2022 and 11 October 2022 to present.



Liverpool Health and Academic Precinct - Noise Monitoring

N2: Level 1 Audiology

May 2024



Overall Project Performance

Within approved
operating hours

Highly Noise Affected NML - LAeq, 15min (dB)

Exceedance	0.34%
Non-exceedance	99.66%

Noise Affected NML - LAeq, 15min (dB)

≤0 dB	72.60%
>0 and ≤5 dB	11.62%
>5 and ≤10 dB	6.65%
>10 and ≤15 dB	5.71%
>15 and ≤20 dB	2.46%
>20 dB	0.95%

Monthly Performance

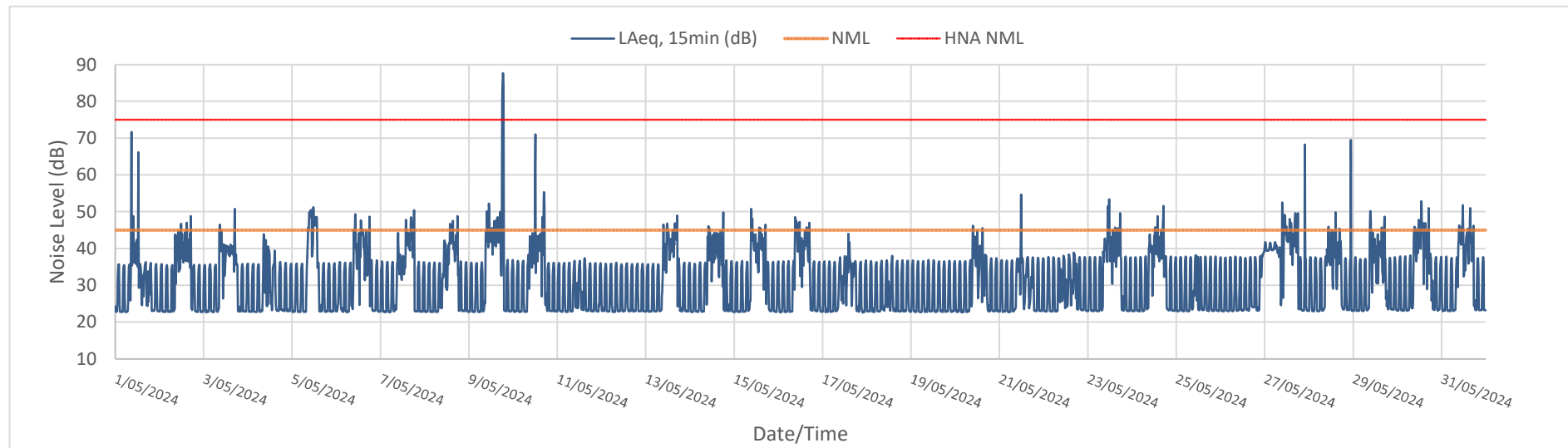
Within approved
operating hours

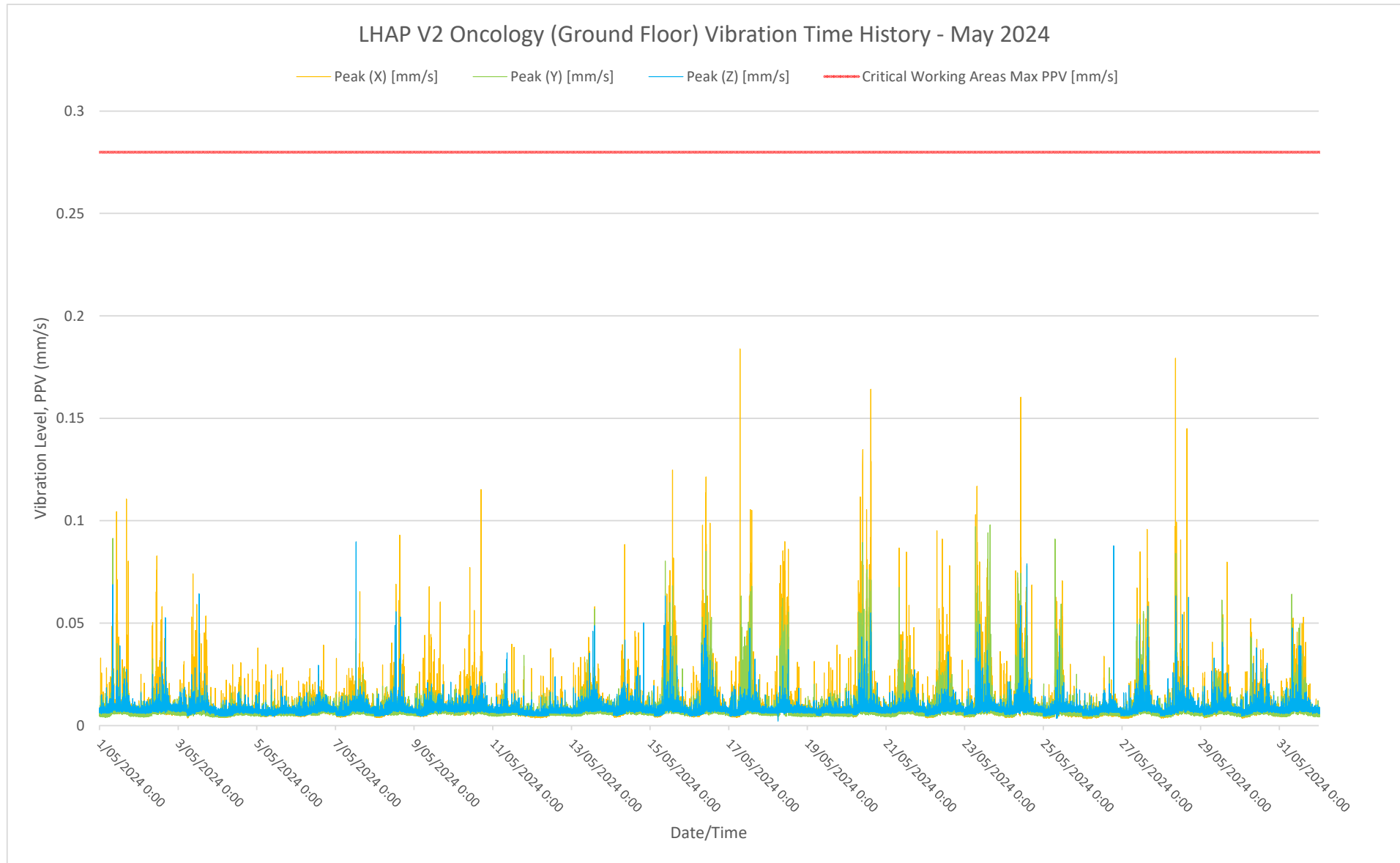
Highly Noise Affected NML - LAeq, 15min (dB)

Exceedance	0.08%
Non-exceedance	99.92%

Noise Affected NML - LAeq, 15min (dB)

≤0 dB	89.70%
>0 and ≤5 dB	8.45%
>5 and ≤10 dB	1.27%
>10 and ≤15 dB	0.08%
>15 and ≤20 dB	0.00%
>20 dB	0.51%







APPENDIX C CALIBRATION CERTIFICATES



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Sound Level Meter

IEC 61672-3:2013

Calibration Certificate

Calibration Number C23409

Client Details		Tech Rentals Pty Ltd 18 Joseph Street Blackburn North, VIC, 3130
Equipment Tested/ Model Number :		ARL Ngara
Instrument Serial Number :		87820B
Microphone Serial Number :		16659
Pre-amplifier Serial Number :		28575
Firmware Version :		12.6
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 21.5 °C		Ambient Temperature : 22.2 °C
Relative Humidity : 45.3 %		Relative Humidity : 43.6 %
Barometric Pressure : 100.67 kPa		Barometric Pressure : 100.61 kPa
Calibration Technician : Shaheen Boaz		Secondary Check: Rhys Gravelle
Calibration Date : 28 Jun 2023		Report Issue Date : 30 Jun 2023
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	N/A
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	N/A
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.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz	±0.13 dB	Temperature	±0.1 °C
1kHz	±0.13 dB	Relative Humidity	±1.9 %
8kHz	±0.14 dB	Barometric Pressure	±0.014 kPa
Electrical Tests	±0.13 dB		

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 SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.



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Sound Level Meter

IEC 61672-3:2013

Calibration Test Report

Calibration Number C23409

Client Details	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North, VIC, 3130
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	87820B
Microphone Serial Number :	16659
Pre-amplifier Serial Number :	28575
Firmware Version :	12.6
Pre-Test Atmospheric Conditions	Post-Test Atmospheric Conditions
Ambient Temperature : 21.5 °C	Ambient Temperature : 22.2 °C
Relative Humidity : 45.3 %	Relative Humidity : 43.6 %
Barometric Pressure : 100.67 kPa	Barometric Pressure : 100.61 kPa
Calibration Technician : Shaheen Boaz	Secondary Check: Rhys Gravelle
Calibration Date : 28 Jun 2023	Report Issue Date : 30 Jun 2023

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	N/A
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	N/A
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.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz	±0.13 dB	Temperature	±0.1 °C
1kHz	±0.13 dB	Relative Humidity	±1.9 %
8kHz	±0.14 dB	Barometric Pressure	±0.014 kPa
Electrical Tests	±0.13 dB		

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



This report applies only to the item tested and shall only be reproduced in full, unless approved in writing by Acoustic Research Labs.

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

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23410

Client Details	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North, VIC, 3130
-----------------------	--

Equipment Tested/ Model Number :	Pulsar Model 105
Instrument Serial Number :	90377

Atmospheric Conditions	
Ambient Temperature :	21.6 °C
Relative Humidity :	37.6 %
Barometric Pressure :	100.28 kPa

Calibration Technician :	Shaheen Boaz	Secondary Check:	Rhys Gravelle
Calibration Date :	26 Jun 2023	Report Issue Date :	30 Jun 2023
Approved Signatory :			Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	93.91	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -			
Specific Tests		Environmental Conditions	
Generated SPL	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.014 kPa

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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Sound Calibrator

IEC 60942:2017

Calibration Test Report

Calibration Number C23410

Client Details		Tech Rentals Pty Ltd 18 Joseph Street Blackburn North, VIC, 3130	
Equipment Tested/ Model Number :		Pulsar Model 105	
Instrument Serial Number :		90377	
Atmospheric Conditions			
Ambient Temperature :		21.6 °C	
Relative Humidity :		37.6 %	
Barometric Pressure :		100.28 kPa	
Calibration Technician :	Shaheen Boaz	Secondary Check:	Rhys Gravelle
Calibration Date :	26 Jun 2023	Report Issue Date :	30 Jun 2023
Approved Signatory :		 Ken Williams	

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -			
Specific Tests		Environmental Conditions	
Generated SPL	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.014 kPa

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



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Accredited for compliance with ISO/IEC 17025 - Calibration.

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**Acoustic
Research
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Unit 36/14 Loyalty Rd
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www.acousticresearch.com.au

Sound Level Meter

IEC 61672-3:2013

Calibration Certificate

Calibration Number C23426

Client Details		Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
Equipment Tested/ Model Number :		ARL Ngara
Instrument Serial Number :		8781F1
Microphone Serial Number :		16669
Pre-amplifier Serial Number :		28580
Firmware Version :		12.6
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 24.2 °C		Ambient Temperature : 23.8 °C
Relative Humidity : 40 %		Relative Humidity : 40 %
Barometric Pressure : 100.96 kPa		Barometric Pressure : 100.98 kPa
Calibration Technician : Shaheen Boaz		Secondary Check: Megan Williams
Calibration Date : 10 Jul 2023		Report Issue Date : 12 Jul 2023
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	N/A
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	N/A
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.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz	±0.13 dB	Temperature	±0.1 °C
1kHz	±0.13 dB	Relative Humidity	±1.9 %
8kHz	±0.14 dB	Barometric Pressure	±0.014 kPa
Electrical Tests	±0.13 dB		

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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Sound Level Meter IEC 61672-3:2013 Calibration Test Report

Calibration Number C23426

Client Details	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	8781F1
Microphone Serial Number :	16669
Pre-amplifier Serial Number :	28580
Firmware Version :	12.6
Pre-Test Atmospheric Conditions	Post-Test Atmospheric Conditions
Ambient Temperature : 24.2 °C	Ambient Temperature : 23.8 °C
Relative Humidity : 40 %	Relative Humidity : 40 %
Barometric Pressure : 100.96 kPa	Barometric Pressure : 100.98 kPa
Calibration Technician : Shaheen Boaz	Secondary Check: Megan Williams
Calibration Date : 10 Jul 2023	Report Issue Date : 12 Jul 2023

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	N/A
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	N/A
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.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz	±0.13 dB	Temperature	±0.1 °C
1kHz	±0.13 dB	Relative Humidity	±1.9 %
8kHz	±0.14 dB	Barometric Pressure	±0.014 kPa
Electrical Tests	±0.13 dB		

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



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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C23427

Client Details	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
-----------------------	--

Equipment Tested/ Model Number :	Pulsar Model 105
Instrument Serial Number :	90374

Atmospheric Conditions	
Ambient Temperature :	23.8 °C
Relative Humidity :	40.5 %
Barometric Pressure :	100.98 kPa

Calibration Technician :	Shaheen Boaz	Secondary Check:	Megan Williams
Calibration Date :	10 Jul 2023	Report Issue Date :	12 Jul 2023

Approved Signatory :

Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.05	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -			
Specific Tests		Environmental Conditions	
Generated SPL	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.014 kPa

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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Sound Calibrator

IEC 60942:2017

Calibration Test Report

Calibration Number C23427

Client Details		Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
Equipment Tested/ Model Number :		Pulsar Model 105
Instrument Serial Number :		90374
Atmospheric Conditions		
Ambient Temperature :		23.8 °C
Relative Humidity :		40.5 %
Barometric Pressure :		100.98 kPa
Calibration Technician :	Shaheen Boaz	Secondary Check: Megan Williams
Calibration Date :	10 Jul 2023	Report Issue Date : 12 Jul 2023
Approved Signatory :		 Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Uncertainties of Measurement -			
Specific Tests	Environmental Conditions		
	Generated SPL	±0.10 dB	Temperature ±0.1 °C
	Frequency	±0.07 %	Relative Humidity ±1.9 %
	Distortion	±0.20 %	Barometric Pressure ±0.014 kPa

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



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CERTIFICATE OF CALIBRATION

CERTIFICATE No: **G36473**

EQUIPMENT TESTED : Ground Vibration Monitor

Manufacturer: Svantek

Meter Type: SV-803

Transducers A: Triaxial

Serial No: 141562

Serial No: 141562

Owner: Property Risk Australia (ACT) Pty Ltd
U2, 5-7 Kemble Court
Mitchell, ACT 2911

Tests Performed: Measured Frequency response, Correct level display,
Linearity display
Comments: Detailed overleaf.

CONDITION OF TEST:

Temperature 22 °C $\pm 1^{\circ}$ C

Relative Humidity 38 % $\pm 5\%$

Date of Receipt : 14/08/2023

Date of Calibration : 14/08/2023

Date of Issue : 14/08/2023

Acu-Vib Test Procedure: AVP15 (Ground vibration Monitor & Low Frequency
Transducer) based on AS2187.2 & DIN45669-1

CHECKED BY:

AUTHORISED SIGNATURE:
Alan Soe

Accredited for compliance with ISO/IEC 17025 - Calibration

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



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Measurements

Acu-Vib Electronics
CALIBRATIONS SALES RENTALS REPAIRS

Head Office & Calibration Laboratory
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www.acu-vib.com.au

Frequency response and linearity characteristics for
 1 Vibration Monitor type **SV 803** Serial No. **141562**
 Geophone Type **Triaxial** Serial No. **141562**
 Constant velocity of 10 mm/sec Peak applied for response
 (Except at 250.0 Hz where applied level limited to 1.0 mm/s peak)
 For amplitude linearity applied level varied at 15.915 Hz

Frequency		Expected indication mm/sec Peak	Indication mm/sec Peak			Expanded uncertainty
Hz	Radians/sec		X Channel	Y Channel	Z Channel	U ₉₅ %
0.796	5.0	10	NA	NA	NA	1.25%
1.592	10.0	10	10.6	10.8	10.7	1.25%
3.183	20.0	10	10.2	10.4	10.6	1.00%
4.775	30.0	10	10.0	10.1	10.4	0.90%
7.958	50.0	10	10.0	10.1	10.2	0.90%
15.915	100.0	0.5	0.52	0.53	0.55	0.90%
15.915	100.0	1	1.04	1.04	1.05	0.90%
15.915	100.0	5	5.07	5.06	5.12	0.90%
15.915	100.0	10	10.2	10.1	10.2	0.90%
15.915	100.0	20	20.4	20.3	20.7	0.90%
15.915	100.0	50	50.7	50.6	51.3	0.90%
15.915	100.0	100	102.3	101.5	103.5	0.90%
31.831	200.0	10	10.2	10.2	10.4	0.50%
79.577	500.0	10	10.4	10.3	10.4	0.50%
159.16	1000.0	10	10.5	10.7	10.8	0.50%
250.00	2000.0	1	1.09	1.19	1.07	0.50%

Note1: The laboratory has accreditation under ISO/IEC 17025 from NATA for calibration to ISO 16063-21 at frequencies from 0.5 Hz to 5kHz.
 Measurements at all frequencies and levels shown in the table above are made using reference equipment traceably calibrated to Australian National Standards.

Note2: The uncertainties quoted are estimated at a confidence level of 95% and a coverage factor of k=2 applies unless otherwise stated.