

# **NOISE AND VIBRATION MONITORING REPORT JUNE 2023**

**LIVERPOOL HEALTH AND ACADEMIC  
PRECINCT**

**LENDLEASE BUILDING 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.

## PRA CONTACT DETAILS

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## DOCUMENT QUALITY CONTROL

<b>Report Title:</b>	Noise and Vibration Monitoring Report - June 2023			
<b>Site Name:</b>	Liverpool Health and Academic Precinct			
<b>Site Address:</b>	Goulburn Street, Liverpool NSW 2170			
<b>Client Name:</b>	Lendlease Construction Pty Ltd			
<b>Job Number:</b>	PRJ-000719			
Revision Number	Revision Date	Author(s)	Reviewer(s)	Status
1	5 July 2023	Brendon Phan	Scott Bamford	Final



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## 1 INTRODUCTION

Property Risk Australia Pty Ltd (PRA) conduct 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 June 2023.

## 2 GUIDELINES AND STANDARDS

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

- o NSW DECCW *Interim Construction Noise Guideline (ICNG) 2009*.
- o NSW DEC *Assessing Vibration: A Technical Guideline 2006*.
- o Australian Standard AS 2436:2010 '*Acoustics – Guide to Noise Control on Construction, Maintenance and Demolition Sites*'.
- o British Standard 6472: *Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*.
- o British Standard 7385: Part 2 – *Evaluation and measurement of vibration in buildings*.
- o German Standard DIN 4150: *Structural Vibration in Buildings - 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 (B4) and high-density residential properties (R4) are located to the west and whilst general industrial (IN1) activity dominates the east.

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 \$790 million dollar project to located at Liverpool Hospital. Early works, which included various services and infrastructure upgrades, concluded in August 2021 and are now followed by main stage work which include 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, 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 June 2023. 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 sends alerts to the client. Each of 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 accordance with the NSW DECCW *Interim Construction Noise Guidelines (ICNG)* and AS 2436:2010.

Due to calibration requirements, the N1 noise monitor located within the Goulburn Street residential apartment courtyard was swapped over with a new unit on 13<sup>th</sup> June 2023 at 16:00hrs. The N2 noise monitor located within the Audiology department nursing unit manager (NUM) office was also swapped over with a new unit and relocated to the Audiology department storeroom on 14<sup>th</sup> June 2023. The relocation was undertaken to reduce the incidence of office ambient noise affecting the noise levels.

### 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.

**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 full list of the noise readings 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 NUM Office
<b>Noise Affected NML</b> $L_{Aeq, 15min}$ (dB)	≤0 dB	0.4%	72.9%
	>0 and ≤5 dB	14.9%	10.6%
	>5 and ≤10 dB	50.8%	7.0%
	>10 and ≤15 dB	30.9%	6.8%
	>15 and ≤20 dB	2.8%	2.0%
	>20 dB	0.3%	0.7%
<b>Highly Noise Affected NML,</b> $L_{Aeq, 15min}$ (dB)	Exceedance	0.2%	0.3%

### 4.4 Noise Discussion

Noise levels at location N1 (residential property opposite the site on Goulburn Road) generally did not exceed the Highly Noise Affected NML during operational hours; there were two (2) exceedance above 75 dB $L_{Aeq, 15min}$  on Saturday the 24<sup>th</sup> of June 2023 between 11:30-12:00hrs. Noise levels were rarely (0.4%) below the Noise Affected NML at any time of the day, evening, or night, on any day, within the site’s operating hours and hardly ever (0.5%) outside 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 two thirds (66.1%) of the time. This was approximately 12% less than outside of operating hours (78.1%).

Noise levels at location N2 (Audiology) did not exceed the Noise Affected NML for over two thirds of the time (72.9%) during operating hours. Noise levels during operating hours did not exceed the Noise Affected NML by more than 10 dB most of the time (90.5%). During the period where the noise monitor was in the NUM office, noise from staff working near the monitor is likely to have influenced the measurements. The NML of 45 dB  $L_{Aeq, 15min}$  is a low noise level. For context, AS 2822-1985 *Acoustics – Methods of Assessing and Predicting Speech Privacy and Speech Intelligibility* suggests that a noise level of 45 dB is equivalent to conversational speech 4 m away. Based on this, we may expect most

speech within or near to the Audiology NUM Office to result in a reported exceedance of the NML to some extent. While there were almost no exceedances outside the operating hours, we do not know the operational hours of the Audiology Department. If they are broadly consistent with that of the site, then some or many exceedances may be attributable to internal noise from hospital operations. Once the noise monitor was relocated to the storeroom opposite the NUM office, the incidences of noise exceedances above the NML dropped significantly (from 14<sup>th</sup> June onwards).

## 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 standard *DIN 4150-3 Vibrations in buildings - Part 3: Effects on structures*. That 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 various frequency ranges for different types of building construction. The criteria apply to vibration in the building foundations.

Vibration criteria to assess human response are specified within the EPA guidelines *Assessing Vibration: A Technical Guideline* (2006). The guideline is based on British Standard *BS 6472:1992 Evaluation of human exposure to vibration in buildings (1-80 Hz)*. That 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-quad average of frequency-weighted vibration acceleration on the floor(s) of the building.

**Table 3** contains vibration criteria adopted for the project. These are in terms of vibration velocity (PPV) and are from *Appendix C* of the EPA 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 construction vibration from British Standard *BS 5228-2:2009*.

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

Peak Vibration Level (mm/s)	Likely Stakeholder Response
0.14	Barely perceptible to all but the most sensitive situations for construction related environmental vibration.
0.3	Barely perceptible in residential settings.
1.0	Strong likelihood for a complaint – it is recommended warning is given before work commences.
10	Vibration is intolerable for any more than a very brief exposure period.

## 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 Profound Vibra+, which log Peak Particle Velocity (PPV). **Appendix C** contains copies of the NATA calibration certificate.

## 5.3 Vibration Results

**Table 5** provides a summary of the results of the vibration assessment for June 2023. Full results for the monitoring period are available in **Appendix B**.

**Table 5: Summary of Unattended Vibration Monitoring During Construction Hours**

Orientation	Maximum Value, PPV (mm/s)	Preferred Value, PPV (mm/s)
<b>V2: Ground Level, Oncology M7 Bunker</b>		
x	0.0%	0.0%
y	0.0%	0.0%
z	0.0%	0.0%

## 5.4 Vibration Discussion

Vibration levels were generally low throughout the period. Levels were commensurate with what is expected within typical office environments. Levels were mostly below 0.1 mm/s PPV. With reference to **Table 4**, such levels are not expected to be perceptible to most occupants of the hospital.

Vibration results were unavailable from 9<sup>th</sup>-14<sup>th</sup> June 2023 due to power outage and results were unavailable from 19<sup>th</sup>-30<sup>th</sup> June 2023 due to a technical power issue and hospital access restrictions.



## **APPENDIX A    FIGURES**





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

**Legend**

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

All extents and locations are approximate.





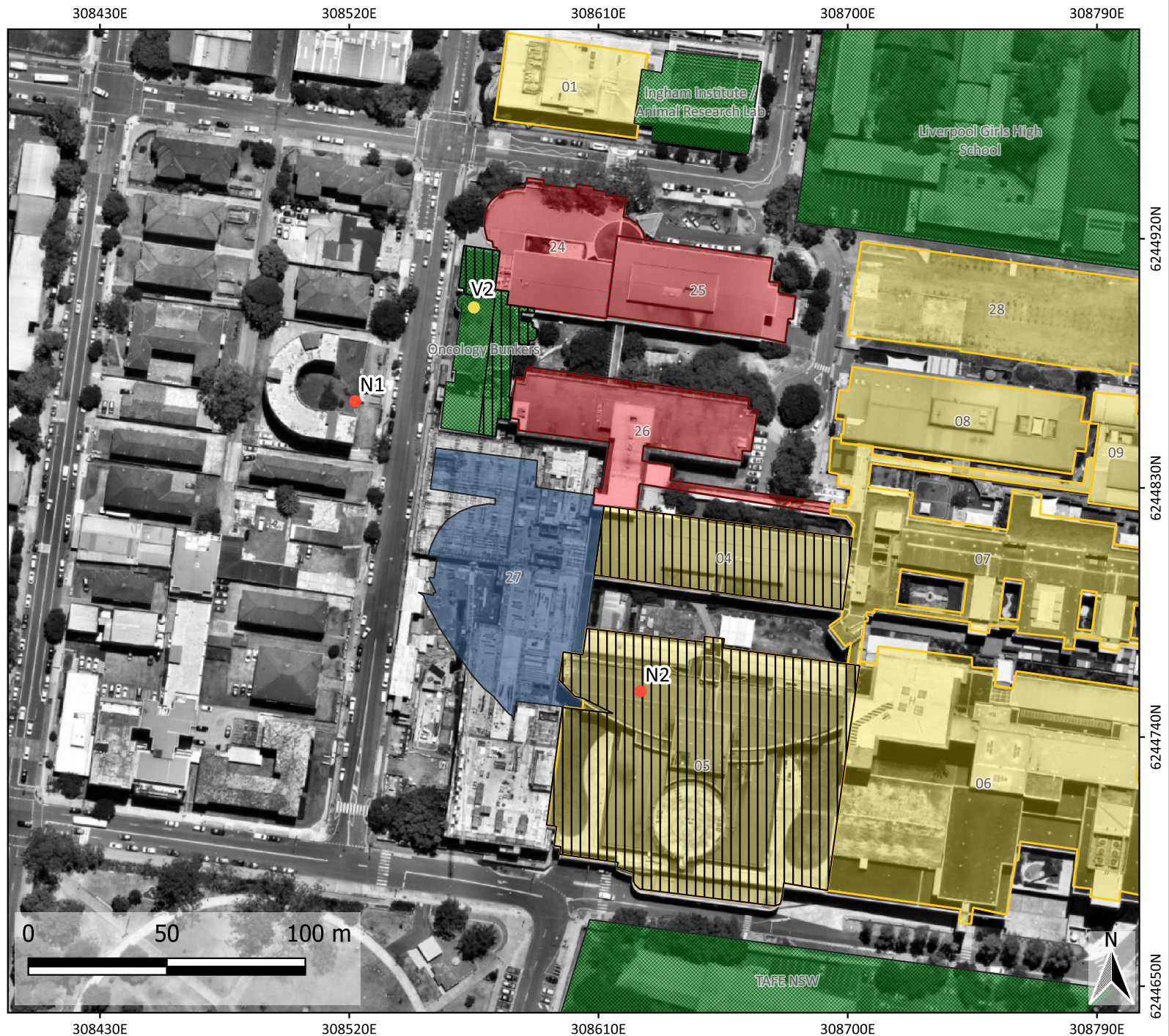


Title:	Noise and Vibration Monitoring Locations
Project ID:	PRJ-000719
Project Location:	Elizabeth & Goulburn Street, Liverpool, NSW 2170
Project Description:	Environmental Noise and Vibration Monitoring at Liverpool Health and Academic Precinct Site
Figure Number:	02
Client:	Lendlease Construction Pty 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.







## **APPENDIX B    RESULTS**

## Overall Performance for Project

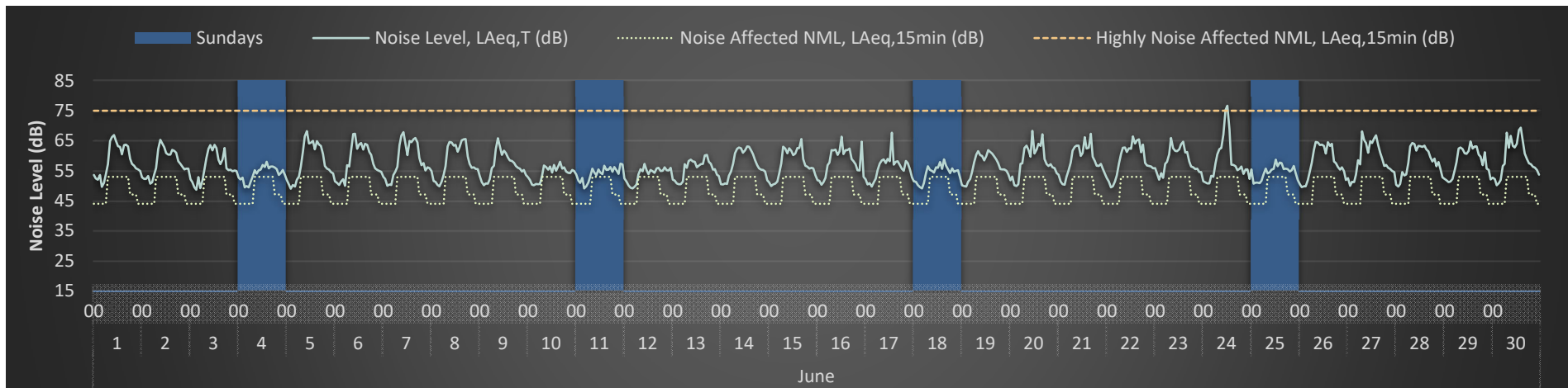
### Percentages of period

	Within approved operating hours	Outside approved operating hours	Combined
<b>Highly Noise Affected NML, LAeq,15min (dB)</b>			
Exceedance	0.1%	0%	0.1%
Non-exceedance	99.9%	100%	99.9%
<b>Noise Affected NML, LAeq,15min (dB)</b>			
<=0 dB	0%	1%	1%
>0 and <=05 dB	25%	21%	22%
>05 and <=10 dB	51%	58%	56%
>10 and <=15 dB	21%	18%	19%
>15 and <=20 dB	2%	1%	2%
>20 dB	0%	0%	0%

## Performance During June, 2023

### Percentages of period

	Within approved operating hours	Outside approved operating hours	Combined
<b>Highly Noise Affected NML, LAeq,15min (dB)</b>			
Exceedance	0.2%	0%	0.1%
Non-exceedance	99.8%	100%	99.9%
<b>Noise Affected NML, LAeq,15min (dB)</b>			
<=0 dB	0%	1%	0%
>0 and <=05 dB	15%	15%	15%
>05 and <=10 dB	51%	63%	58%
>10 and <=15 dB	31%	21%	24%
>15 and <=20 dB	3%	1%	2%
>20 dB	0%	0%	0%



## Overall Performance for Project

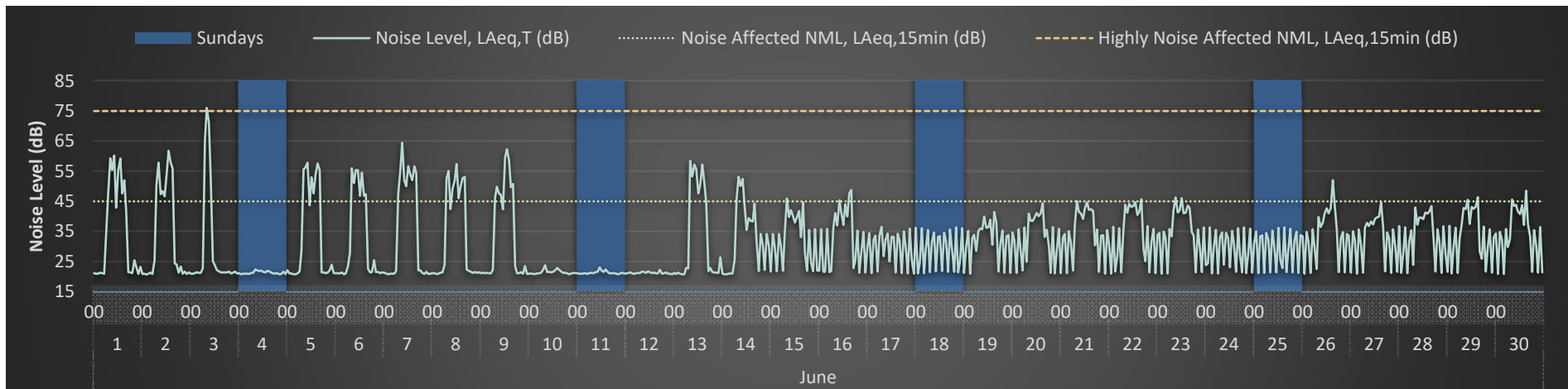
### Percentages of period

	Within approved operating hours	Outside approved operating hours	Combined
<b>Highly Noise Affected NML, LAeq,15min (dB)</b>			
Exceedance	0.5%	0%	0.2%
Non-exceedance	99.5%	100%	99.8%
<b>Noise Affected NML, LAeq,15min (dB)</b>			
<=0 dB	63%	99%	87%
>0 and <=05 dB	13%	0%	5%
>05 and <=10 dB	10%	0%	4%
>10 and <=15 dB	9%	0%	3%
>15 and <=20 dB	4%	0%	1%
>20 dB	1%	0%	1%

## Performance During June, 2023

### Percentages of period

	Within approved operating hours	Outside approved operating hours	Combined
<b>Highly Noise Affected NML, LAeq,15min (dB)</b>			
Exceedance	0.3%	0%	0.1%
Non-exceedance	99.7%	100%	99.9%
<b>Noise Affected NML, LAeq,15min (dB)</b>			
<=0 dB	73%	100%	90%
>0 and <=05 dB	11%	0%	4%
>05 and <=10 dB	7%	0%	3%
>10 and <=15 dB	7%	0%	2%
>15 and <=20 dB	2%	0%	1%
>20 dB	1%	0%	0%

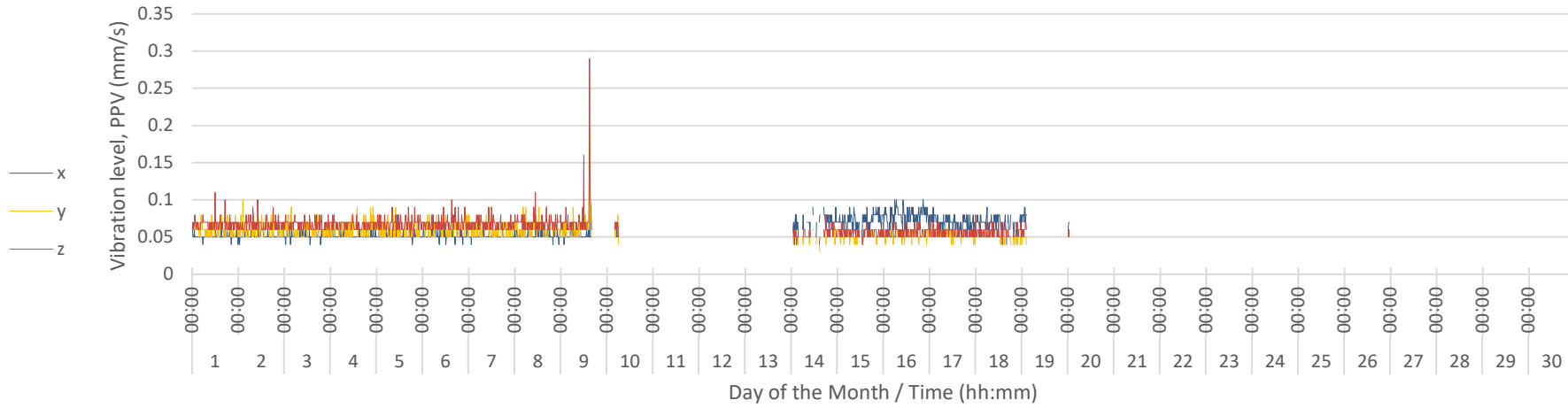




NOISE AND VIBRATION MONITORING  
LIVERPOOL HEALTH AND ACADEMIC PRECINCT  
GOULBURN STREET, LIVERPOOL NSW 2170

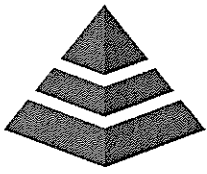
June 2023

V2: Ground Level, Oncology M7 Bunker





## **APPENDIX C    CALIBRATION CERTIFICATES**



TRtechrentals

# Certificate of Calibration Conformance

Certificate Number : 34272

Reference : 589730

Model : ARL,NGARA-4G

**Asset Number : 204307**

**Description : ARL NGARA Environmental Noise Logger with modem**

Date Calibrated : 26/02/2021

Technician : Paul James

Serial No. : 8781F1

Calibration valid for : 365 days.

The performance of the above listed equipment has been verified for measurement accuracy to the manufacturers relevant published specification, in accordance with our Quality Assurance Procedures, using the appropriate calibrated equipment, traceable to nationally recognised standards.

SOURCE ASSET 125545 CAL.SUB-CONTRACTED REPORT 549154 DUE 16/02/2022

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Cris Ascenzo  
National Service Manager

QSF 326-1/C

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

Calibration Number C23097

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


**Equipment Tested/ Model Number :** ARL Ngara  
**Instrument Serial Number :** 87823E  
**Microphone Serial Number :** 323017  
**Pre-amplifier Serial Number :** 28675  
**Firmware Version :** 12.6

**Pre-Test Atmospheric Conditions**  
**Ambient Temperature :** 26°C  
**Relative Humidity :** 51.9%  
**Barometric Pressure :** 100.65kPa

**Post-Test Atmospheric Conditions**  
**Ambient Temperature :** 23.8°C  
**Relative Humidity :** 41%  
**Barometric Pressure :** 101.48kPa

**Calibration Technician :** Shaheen Boaz  
**Calibration Date :** 10 May 2023

**Secondary Check:** Rhys Gravelle  
**Report Issue Date :** 11 May 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	±0.13dB	Temperature	±0.1°C
1kHz	±0.13dB	Relative Humidity	±1.9%
8kHz	±0.14dB	Barometric Pressure	±0.014 kPa
Electrical Tests	±0.13dB		

*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.

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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www.acousticresearch.com.au

## Sound Calibrator

IEC 60942:2017

# Calibration Certificate

Calibration Number C23098

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

**Equipment Tested/ Model Number :** Pulsar Model 105  
**Instrument Serial Number :** 99013

### Atmospheric Conditions

**Ambient Temperature :** 23.7°C  
**Relative Humidity :** 46.8%  
**Barometric Pressure :** 100.33kPa

**Calibration Technician :** Shaheen Boaz  
**Calibration Date :** 27 Mar 2023  
**Secondary Check:** Rhys Gravelle  
**Report Issue Date :** 11 May 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	94.03	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..

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

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.

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## Sound Level Meter IEC 61672-3:2013 Calibration Certificate

Calibration Number C21117

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

**Equipment Tested/ Model Number :** ARL Ngara  
**Instrument Serial Number :** 878217  
**Microphone Serial Number :** 16666  
**Pre-amplifier Serial Number :** 28581

<b>Pre-Test Atmospheric Conditions</b>	<b>Post-Test Atmospheric Conditions</b>
Ambient Temperature : 22.7°C	Ambient Temperature : 23°C
Relative Humidity : 51.5%	Relative Humidity : 52.6%
Barometric Pressure : 99.9kPa	Barometric Pressure : 99.6kPa

**Calibration Technician :** Lucky Jaiswal  
**Calibration Date :** 1 Mar 2021  
**Secondary Check:** Max Moore  
**Report Issue Date :** 2 Mar 2021

**Approved Signatory :** *Ken Williams* 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	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.

Least Uncertainties of Measurement -			
Acoustic Tests		Environmental Conditions	
125Hz	±0.12dB	Temperature	±0.2°C
1kHz	±0.11dB	Relative Humidity	±2.4%
8kHz	±0.13dB	Barometric Pressure	±0.015kPa
Electrical Tests	±0.10dB		

*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.



**T**techrentals

# Certificate of Calibration Conformance

Certificate Number : 34279

Reference : 589737

Model : ARL,NGARA-4G

**Asset Number : 204303**

**Description : ARL NGARA Environmental Noise Logger with modem**

Date Calibrated : 1/03/2021

Technician : Paul James

Serial No. : 878217

Calibration valid for : 365 days.

The performance of the above listed equipment has been verified for measurement accuracy to the manufacturers relevant published specification, in accordance with our Quality Assurance Procedures, using the appropriate calibrated equipment, traceable to nationally recognised standards.

SOURCE ASSET 125545 CAL.SUB-CONTRACTED REPORT 549154 DUE 16/02/2022

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Cris Ascenzo  
National Service Manager

QSF 326-1/C

Offices throughout Australia, New Zealand and Malaysia  
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TR0147





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## Sound Calibrator

IEC 60942-2017

# Calibration Certificate

Calibration Number C21118

<b>Client Details</b>	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
<b>Equipment Tested/ Model Number :</b> <b>Instrument Serial Number :</b>	Pulsar Model 105 90372
<b>Atmospheric Conditions</b>	
<b>Ambient Temperature :</b>	22.6°C
<b>Relative Humidity :</b>	50.6%
<b>Barometric Pressure :</b>	99.9kPa
<b>Calibration Technician :</b> Lucky Jaiswal <b>Calibration Date :</b> 01 Mar 2021	<b>Secondary Check:</b> Max Moore <b>Report Issue Date :</b> 2 Mar 2021
<b>Approved Signatory :</b> 	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	93.80	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.

Least Uncertainties of Measurement - Environmental Conditions			
Specific Tests		Environmental Conditions	
Generated SPL	±0.14dB	Temperature	±0.2°C
Frequency	±0.09%	Relative Humidity	±2.4%
Distortion	±0.09%	Barometric Pressure	±0.015kPa

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

\* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.



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.

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**Sound Level Meter**  
**IEC 61672-3:2013**  
**Calibration Certificate**  
Calibration Number C22711

<b>Client Details</b>	Tech Rentals Pty Ltd 18 Joseph Street Blackburn North VIC 3130
-----------------------	--

<b>Equipment Tested/ Model Number :</b>	ARL Ngara
<b>Instrument Serial Number :</b>	878241
<b>Microphone Serial Number :</b>	21998
<b>Pre-amplifier Serial Number :</b>	28700
<b>Firmware Version :</b>	12.6

Pre-Test Atmospheric Conditions	Post-Test Atmospheric Conditions
<b>Ambient Temperature :</b> 22.4°C	<b>Ambient Temperature :</b> 23°C
<b>Relative Humidity :</b> 48.7%	<b>Relative Humidity :</b> 52.6%
<b>Barometric Pressure :</b> 101.17kPa	<b>Barometric Pressure :</b> 101.15kPa

<b>Calibration Technician :</b> Lucky Jaiswal	<b>Secondary Check:</b> Rhys Gravelle
<b>Calibration Date :</b> 9 Nov 2022	<b>Report Issue Date :</b> 14 Nov 2022

**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	±0.13dB	Temperature	±0.1°C
1kHz	±0.13dB	Relative Humidity	±1.9%
8kHz	±0.14dB	Barometric Pressure	±0.014kPa
Electrical Tests	±0.13dB		

*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.

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## Sound Calibrator

IEC 60942:2017

# Calibration Certificate

Calibration Number C22722

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

**Equipment Tested/ Model Number :** Pulsar Model 105  
**Instrument Serial Number :** 99001

### Atmospheric Conditions

**Ambient Temperature :** 24.6°C  
**Relative Humidity :** 47.3%  
**Barometric Pressure :** 100.9kPa

**Calibration Technician :** Lucky Jaiswal  
**Calibration Date :** 09 Nov 2022

**Secondary Check:** Dylan Selge  
**Report Issue Date :** 10 Nov 2022

**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	94.06	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
<i>Generated SPL</i> ±0.10dB	<i>Temperature</i> ±0.1°C
<i>Frequency</i> ±0.13%	<i>Relative Humidity</i> ±1.9%
<i>Distortion</i> ±0.20%	<i>Barometric Pressure</i> ±0.014kPa

*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.

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# CERTIFICATE OF CALIBRATION

CERTIFICATE No: **G29434**

**EQUIPMENT TESTED :** Ground Vibration Monitor


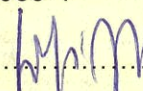
**Manufacturer:** Profound  
**Meter Type:** Vibra+ **Serial No:** VIBe0352  
**Transducers A:** Trri-axial **Serial No:** TDA03374

**Owner:** TR Pty Ltd  
18 Joseph Street  
Blackburn North, VIC 3130

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

**CONDITION OF TEST:**  
**Temperature** 23 °C ±1° C **Date of Receipt :** 28/04/2021  
**Relative Humidity** 51 % ±5% **Date of Calibration :** 30/04/2021  
**Date of Issue :** 30/04/2021

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

**CHECKED BY:**  ..... **AUTHORISED SIGNATURE:**  .....  
*Jack Kieft*

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.  
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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%.



Accredited Lab No. 9262  
Acoustic and Vibration Measurements



Head Office & Calibration Laboratory  
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154  
(02) 9680 8133  
www.acu-vib.com.au



Frequency response and linearity characteristics for  
 Ground Vibration Monitor type **Vibra+** Serial No. **VIBe0352**  
 Geophone Type **Tri-axial** Serial No. **TDA03374**  
 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 U <sub>95</sub> %
Hz	Radians/sec		X Channel	Y Channel	Z Channel	
0.796	5.0	10	NA	NA	NA	1.25%
1.592	10.0	10	9.5	9.7	9.6	1.25%
3.183	20.0	10	9.8	9.9	9.8	1.25%
4.775	30.0	10	9.9	9.9	9.9	1.25%
7.958	50.0	10	10.2	10.3	9.9	1.00%
15.915	100.0	0.5	0.55	0.56	0.53	0.90%
15.915	100.0	1	1.07	1.07	1.03	0.90%
15.915	100.0	5	5.21	5.22	5.07	0.90%
<b>15.915</b>	<b>100.0</b>	<b>10</b>	<b>10.3</b>	<b>10.4</b>	<b>10.1</b>	<b>0.90%</b>
15.915	100.0	20	20.4	20.7	20.1	0.90%
15.915	100.0	50	51.3	56.2	50.0	0.90%
15.915	100.0	100	NA	NA	NA	0.90%
31.831	200.0	10	10.8	10.9	9.8	0.50%
79.577	500.0	10	10.3	10.2	8.5	0.50%
159.16	1000.0	10	5.5	5.7	5.1	0.50%
250.00	2000.0	1	NA	NA	NA	0.50%

Channel	As received	After Calibration	Actual indication for 10.0 mms <sup>-1</sup> Pk @15.915 Hz	Error % of actual from expected	Expanded uncertainty
					U <sub>95</sub> %
---	mV/ms <sup>-2</sup>	mV/ms <sup>-2</sup>	@15.915 Hz	Tolerance of 10 % applies	---
X	NA	NA	10.28	3%	0.90%
Y	NA	NA	10.45	4%	0.90%
Z	NA	NA	10.12	1%	0.90%
V-PPV	N/A	NA	N/A	N/A	0.90%

**Note1:** The laboratory has accreditation under ISO/IEC 17025 from NATA for calibration to ISO 16063-21 at frequencies from 0.5 Hz. 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.



# CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **G35524**

**EQUIPMENT TESTED :** Ground Vibration Monitor

**Manufacturer:** Profound (Asset: 204735)

**Meter Type:** Vibra+

**Serial No:** VIBe0813

**Transducers A:** Tri-axial

**Serial No:** TDA03188

**Owner:** TR Pty Ltd  
18 Joseph Street  
Blackburn North, VIC 3130

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

**CONDITION OF TEST:**

**Temperature** 23 °C ±1° C  
**Relative Humidity** 63 % ±5%

**Date of Receipt :** 10/03/2023  
**Date of Calibration :** 16/03/2023  
**Date of Issue :** 16/03/2023

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

**CHECKED BY:** *AKB*

**AUTHORISED SIGNATURE:** *Hen Soc*

Accredited for compliance with ISO/IEC 17025 - Calibration  
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Frequency response and linearity characteristics for  
 1 Vibration Monitor type **Vibra+** Serial No. **VIBe0813**  
 Geophone Type **Triaxial** Serial No. **TDA03188**  
 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 U <sub>95</sub> %
Hz	Radians/sec		X Channel	Y Channel	Z Channel	
0.796	5.0	10	NA	NA	NA	1.25%
1.592	10.0	10	10.0	9.8	10.1	1.25%
3.183	20.0	10	10.1	10.1	10.1	1.25%
4.775	30.0	10	10.1	10.2	10.2	1.25%
7.958	50.0	10	10.1	10.2	10.1	1.00%
15.915	100.0	0.5	0.54	0.55	0.54	0.90%
15.915	100.0	1	1.04	1.06	1.03	0.90%
15.915	100.0	5	5.06	5.09	5.02	0.90%
<b>15.915</b>	<b>100.0</b>	<b>10</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>	<b>0.90%</b>
15.915	100.0	20	20.3	20.1	20.1	0.90%
15.915	100.0	50	50.3	50.2	50.1	0.90%
15.915	100.0	100	OVL	OVL	OVL	0.90%
31.831	200.0	10	10.4	10.2	10.0	0.50%
79.577	500.0	10	9.2	9.1	8.5	0.50%
159.16	1000.0	2	1.1	1.0	0.7	0.50%
250.00	2000.0	1	0.57	0.44	0.13	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. Measurements at all frequencies and levels shown in the table above are made using reference equipment traceably calibrated to Australian National Standards.

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