ENVIRONMENTAL MONITORING REPORT

Document and Revision History

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Revisions

Rev	Date	Description	Prepared by	Reviewed by	Approved by
00	20/09/2023	For Review	Eric Zhang	Hamish Russell	Paul Dalziel
01	18/10/2023	Updated in response to comments	Eric Zhang	Hamish Russell	Paul Dalziel

1 Project Summary

The Botany Line connects Port Botany to the Enfield Intermodal Logistics Centre and is critical to the Sydney Freight Metropolitan network. The Botany Line has several constraints which restrict the capacity of the line, and it is ARTC's intention to alleviate all constraints and increase capacity to meet current and future container freight demand. The Botany Duplication Project forms part of this strategy.

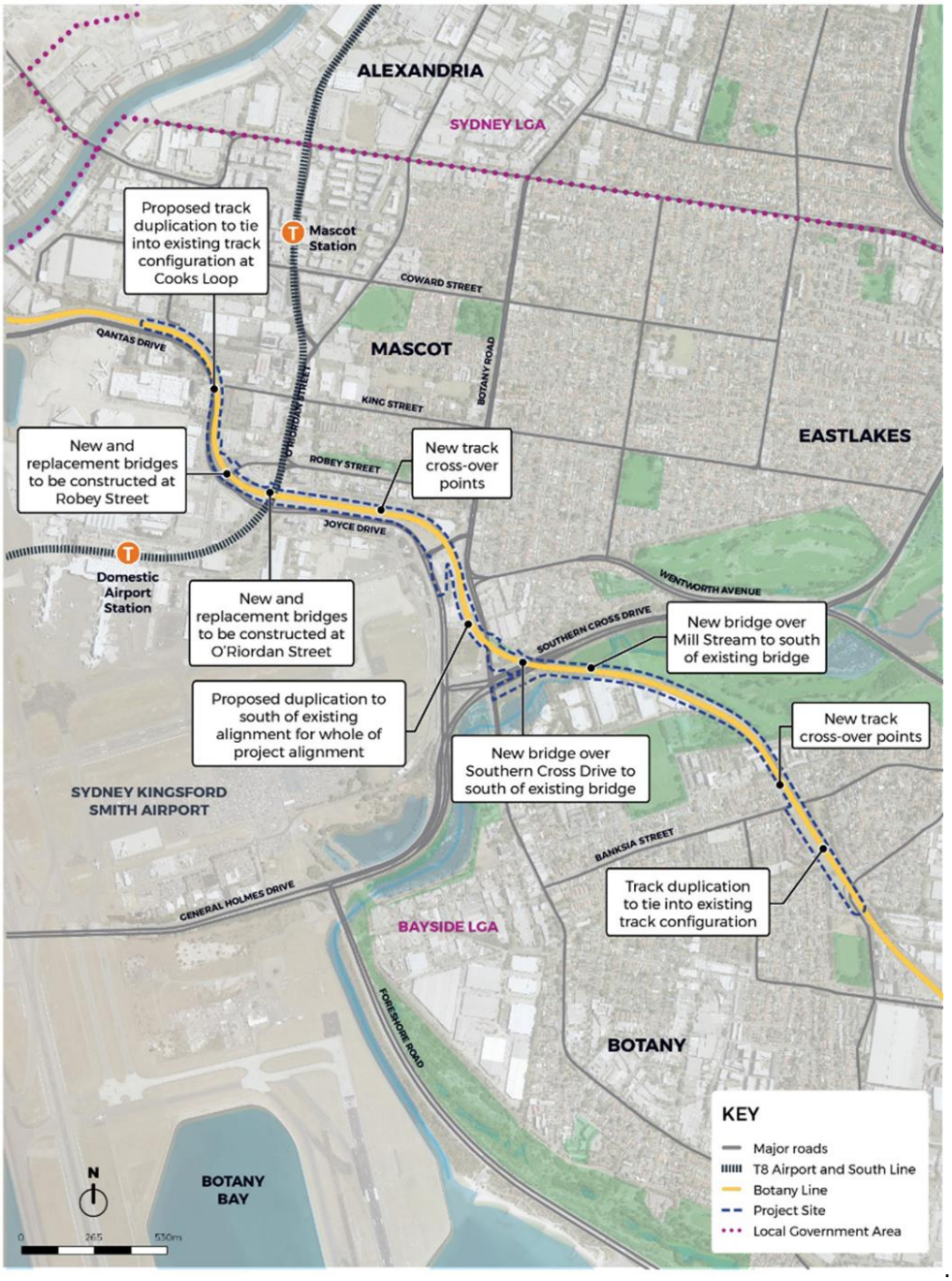


Figure 1: Project Overview

2 Construction Noise and Vibration Monitoring Program Requirements

A Construction Noise and Vibration Monitoring Program (the Program) was produced as part of the Construction Noise and Vibration Management Plan (CNVMP) in accordance with CoA C9. The Program defines how John Holland Pty Ltd will monitor potential noise and vibration impacts during construction on the Project.

The following report details environmental monitoring undertaken during this reporting period 13 February 2023 – 13 August 2023 conducted in accordance with the Program and CNVMP.

A summary of the program and requirements is provided in Table 1 below, the full program and CNVMP can be found by following the link on the ARTC website: Botany rail duplication - Botany Rail Duplication (artc.com.au).

Table 1: BRD Monitoring Requirements

CoA No.	Condition of Approval Requirement	CNVMP Details	Monitoring Report Reference
C10(c)	Details of all monitoring of the project to be undertaken	A5.1 Activity based monitoring	Section 3.0
		A5.2 Plant and equipment noise audits	Section 3.1
		A5.3 Groundborne noise monitoring	Section 3.2
		A6 Vibration Monitoring	Section 3.3

3.0 Activity Based Noise Monitoring

Activity based noise monitoring was carried out at the start of new activities during representative day, evening and night periods as well as periodically during Out of Hours works and in response to complaints. Tables N1 to N6 provide details of noise monitoring results, works, compliance against predictions and performance requirements (which includes all reasonable and feasible mitigation measures such as respite and community notification) applied to the works.

During the reporting period, measured noise levels associated with the construction works were found to be compliant or below the predicted noise levels. Dominant noise sources measured during the monitoring periods included traffic, train and airport noise, which contributed to overall measured LAeq levels above predictions during measurement periods. Where feasible, noise contributions from the works were based on periods where construction noise was discernible from the ambient noise levels to determine compliance with predictions as detailed in Tables N1 to N6.

Mitigation measures which have been implemented, associated with the BRD works include:

* Working with nearby and sensitive receptors to schedule/carry out works during less sensitive periods
* Use of noise blankets and barriers for localised noisy works
* Sequencing works to avoid cumulative noise impacts
* Choosing less noisy equipment or construction methods (where available and feasible).

Table N1: February 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored by	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
14/02/23	McBurney Avenue	BRD04	SCD Centre Pier	Barrier Installation	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	57.6	53	Levels dominated by traffic and freight train. Noise from works below predicted noise levels.	Community notification.
14/02/23	McBurney Avenue	BRD04	SCD Centre Pier	Barrier Installation	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	45.5	53	Noise levels below predictions, noise environment dominated by local traffic at Botany Road.	Community notification
14/02/23	McBurney Avenue	BRD04	SCD Centre Pier	Barrier Installation	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	47.4	53	Noise levels below predictions, noise environment dominated by airport noise.	Community notification
28/02/23	McBurney Avenue	BRD04	SCD Centre Pier	Barrier Installation & Centre Pier Works	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	63.5	64	Noise levels below predictions, noise dominated by freight train	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored by	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
28/02/23	McBurney Avenue	BRD04	SCD Centre Pier	Barrier Installation & Centre Pier Works	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	61.3	64	Noise levels below predictions, noise dominated by freight train	Community notification

Note: Noise monitoring equipment is detailed in Section 4.0, all noise monitoring in February 2023 used John Holland Equipment

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

Table N2: March 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
02/03/23	Stamford	OSR	O'Riordan Street Bridge	Core Drilling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	68.3	75	Noise levels below predictions, noise dominated by works.	Community notification
02/03/23	Robey Street	BRD03	O'Riordan Street Bridge	Core Drilling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	57.5	50	Noise levels dominated by traffic. Noise from works discernible.	Community notification
07/03/23	Baxter Road	BRD03	O'Riordan Street Bridge	Core Drilling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	56.4	69	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
22/03/23	Stamford	OSR	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	67.3	94	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
22/03/23	Robey Street	BRD03	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	59.8	69	Noise levels dominated by traffic. Noise from works discernible.	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
22/03/23	Baxter Road	BRD03	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	66.4	66	Noise levels dominated by traffic. Noise from works discernible.	Community notification
22/03/23	Stamford	OSR	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	60	94	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
22/03/23	Robey Street	BRD03	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	55.9	69	Noise levels dominated by traffic. Noise from works discernible.	Community notification

Note: Noise monitoring equipment is detailed in Section 4.0, all noise monitoring in March 2023 used John Holland Equipment

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

Table N3: April 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise LevelsdB(A)	Compliance Assessment	Performance Requirements
22/04/23	Baxter Road	BRD03	WE43	Saw Cutting Track	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	65.1	77	Noise levels below predictions, noise dominated by works.	Community notification
22/04/23	Baxter Road	BRD03	WE43	SDM Piling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	65.3	61	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
22/04/23	Baxter Road	BRD03	WE43	SDM Piling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	64.7	61	Noise levels below predictions, noise dominated by works.	Community notification
22/04/23	Bay Street	BRD08	WE43	Concrete Placing	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter	Attended	JH	Night	61	67	Noise levels below predictions, noise dominated by works.	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise LevelsdB(A)	Compliance Assessment	Performance Requirements
					Calibrator Rion NC-75							
22/04/23	Baxter Road	BRD03	WE43	SDM Piling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	63.2	61	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
23/04/23	Baxter Road	BRD03	WE43	SDM Works	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	64.7	61	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
23/04/23	Myrtle Street	BRD07	WE43	Drainage Excavation	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	62.8	64	Noise levels below predictions, noise dominated by works.	Community notification

Note: Noise monitoring equipment is detailed in Section 4.0, all noise monitoring in April 2023 used John Holland Equipment

Note 1: Predictions and noise measurements include 5dBA correction for ‘annoying’ noise characteristics

Table N1: May 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
06/05/23	Baxter Road	BRD03	WE45	Removal of track	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	67.2	80	Noise levels below predictions, noise dominated rail saw and works.	Community notification.
06/05/23	Myrtle Street	BRD07	WE45	Loading out Ballast	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	72.1	73	Noise levels below predictions, noise dominated by works.	Community notification
06/05/23	Baxter Road	BRD03	WE45	SDM Piling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	64.6	65	Noise levels below predictions, noise dominated by traffic and passing vehicles on Baxter Road.	Community notification
06/05/23	Baxter Road	BRD03	WE45	SDM Piling	Type 1 Sound	Attended	JH	Night	64.1	65	Noise levels below	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
					Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75						predictions, noise dominated by traffic and passing vehicles on Baxter Road.	
07/05/23	Myrtle Street	BRD07	WE45	Backfill Drainage	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	51.7	73	Noise levels below predictions, noise dominated by traffic and works.	Community notification
07/05/23	Baxter Road	BRD03	WE45	SDM Backfilling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	69	67	Noise levels dominated by traffic and airport noise. Noise from works below predicted noise levels.	Community notification
07/05/23	Robey Street	BRD03	WE45	Tamping	Type 1 Sound Level Meter Rion NL-52EX	Attended	JH	Day	63.4	54	Noise levels elevated due to local traffic. Works not discernible.	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
					Type 1 Sound Level Meter Calibrator Rion NC-75							
07/05/23	Baxter Road	BRD03	WE45	SDM Piling	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	69.1	65	Noise levels dominated by traffic and airport noise. Noise from works below predicted noise levels.	Community notification
07/05/23	Baxter Road	BRD03	WE45	Tamping	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Day	60.1	64	Noise levels below predictions, noise dominated by works. Noise levels influenced by traffic.	Community notification
16/05/2023	Stamford conference Room	OSR	Stamford South	Jack hammering	Type 1 Sound Level Meter NTi XL2 Type 1 Sound Level	Attended	Renzo Tonin	Day	58	-	The community has been notified and verification monitoring has been conducted.	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
					Meter Calibrator B&K 4231							
8/05/2023	Botany Road	BRD04	Outside Park and Fly	Watermain Works	Type 1 Sound Level Meter NTi XL2 Type 1 Sound Level Meter Calibrator B&K 4231	Attended	Renzo Tonin	Night	65	60	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
22/05/23	Baxter Road	BRD03	O'Riordan Street Bridge	Concrete Pour at Girder	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	59.9	47	Noise levels dominated by traffic and airport noise. Noise from works below predicted noise levels.	Community notification

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

Table N4: June 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
05/06/23	Stamford Hotel	OSR	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	74[1]	81	Noise levels below predictions, noise dominated by rail cutting and traffic passing.	Community notification
05/06/23	Stamford Hotel (Internal)	OSR	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter NTi XL2 Type 1 Sound Level Meter Calibrator Brüel & Kjær 4231	Attended	Renzo Tonin	Night	28[1]	40	Noise levels below predictions, noise dominated by rail cutting and traffic passing.	Community notification
06/06/23	Baxter Road	BRD03	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	50.1[1]	52	Noise levels below predictions, Noise dominated by traffic.	Community notification

Date	Monitoring Location	NCA	Works Location	Activity	Monitoring Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
06/06/23	Robey Street	BRD03	O'Riordan Street Bridge	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	69.1[1]	63	Noise levels dominated by traffic. Noise from works below predicted noise levels.	Community notification
16/06/23	McBurney Avenue	BRD04	SCD	Concrete Pour	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	64.7	52	Noise levels dominated by traffic and freight train. Noise from works below predicted noise levels.	Community notification

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

Table N1: August 2023 Noise Monitoring Data

Date	Monitoring Location	NCA	Works Location	Activity	Monitored Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
03/08/23	Stamford Hotel	BRD03	O'Riordan Street	Concrete Cutting	Type 1 Sound Level Meter (XL2) NTi XL2 Calibrator Type 4231 B&K	Attended	Renzo Tonin	Night	81[1]	82	Noise levels below predictions, noise dominated by concrete cutting and traffic passing	Community notification
03/08/23	Robey Street	BRD03	O'Riordan Street	Concrete Cutting	Type 1 Sound Level Meter (XL2) NTi XL2	Attended	Renzo Tonin	Night	55[1]	50	Noise levels dominated by traffic. The community has been notified and verification monitoring has been conducted.	Community notification
03/08/23	Baxter Road	BRD03	O'Riordan Street	Concrete Cutting	Calibrator Type 4231 B&K	Attended	Renzo Tonin	Night	55[1]	50	Noise levels dominated by traffic. The community has been notified and verification monitoring has been conducted.	Community notification
08/08/23	Robey Street	BRD03	O'Riordan Street Bridge Centre Island	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator	Attended	JH	Night	66.7[1]	68	Noise levels below predictions, noise dominated by traffic (Botany Road/SCD). Rain impacted noise measurement	Community notification.

Date	Monitoring Location	NCA	Works Location	Activity	Monitored Equipment	Monitoring Type	Monitored By	Time	Measured LAeq dB(A)	Predicted Noise Levels dB(A)	Compliance Assessment	Performance Requirements
					Rion NC-75							
09/08/23	Stamford	OSR	O'Riordan Street Bridge Centre Island	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	81.6[1]	81	Noise levels from works below predictions. Passing traffic influenced noise measurement	Community notification.
09/08/23	Baxter Road	BRD03	O'Riordan Street Bridge Centre Island	Concrete Cutting	Type 1 Sound Level Meter Rion NL-52EX Type 1 Sound Level Meter Calibrator Rion NC-75	Attended	JH	Night	64[1]	61	Noise levels from works below predictions. Noise dominated by traffic on General Holmes Drive	Community notification.

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

3.1 Plant and Equipment Noise Audits

Plant/ equipment noise audits were carried out for noise intensive plant and equipment to ensure compliance with the noise levels for construction equipment assumed in the noise model.

The audits during this monitoring period included, equipment monitoring of new equipment/methodologies prior to implementation on-site and additional activities required to improve accuracy of the Gatewave Modelling Results of the noise audits are presented in Table NA1.

Table NA1: Noise Audit Monitoring Results

Location	Plant/Activity	Calculated Overall Sound Power Level (dBA)	Calculated LAmax Sound Power Level	Measured LAeq (dBA)	Comments
King Street Site	Plasser Unimat 08-275/3S tamping machine	114 (+5)[1]	119	-	Noise levels included in Gatewave model

Note 1: Predictions and noise measurements include 5dBA correction for 'annoying' noise characteristics

3.2 Plant and Equipment Vibration Trials

Plant/ equipment vibration audits were carried out for vibration intensive plant and equipment to ensure compliance with the vibration levels for construction equipment assumed in the vibration model.

The audits consisted of equipment monitoring prior to delivery to site as well as spot checks during construction. Audits have been carried out as required on a case-by-case basis, such as changes in methodology or in response to a plant/equipment specific noise related complaint or during noise and vibration assessment validation monitoring. Results of the vibration audits are presented in Table VA1.

Table VA1: Vibration Audit Monitoring Results

Location	Plant	Monitoring Requirement	Distance from source	Calculated eVDV	Maximum PPV	Comments
Rail corridor adjacent to Bay Street	Front-end Loader	Cosmetic damage / Human Comfort	26m	0.43	1.01	-
			34m	-	0.95	
	12t smooth drum roller	Cosmetic damage / Human Comfort	30m	0.09	0.39	On static mode
			30m	0.1	0.72	On low vibratory mode
Boundary fence of 127 Banksia Street, Botany	12T smooth drum roller	Cosmetic damage	26m	-	0.94	On static mode
			26m	-	3.33	On low vibratory mode
			26m	-	6.08	On high vibratory mode
32m from source (At closest impacted residence, 127 Banksia Street, Botany)	12T smooth drum roller	Human comfort	32m	0.2	-	On static mode
			32m	0.6	-	On low vibratory mode
			32m	1.5	-	On high vibratory mode

3.4 Groundborne Noise Monitoring

No construction works occurred during the monitoring period predicted to result in groundborne noise or resulted in groundborne noise complaints requiring monitoring.

3.4 Vibration Monitoring

Vibration monitoring was undertaken in the following circumstances:

- At the commencement of construction for each plant or activity on-site where the vibration screening criteria is likely to be exceeded,
- Where vibration generating activities have the potential to impact on heritage items
- To confirm minimum working distances
- Where there is risk of potential cosmetic damage to buildings and structures
- In response to vibration related complaints

Vibration monitoring results have been compared to the vibration goals outlined in the CNVMP based on the relevant Construction Noise and Vibration Guidelines, British Standard BS7385 Part 2-1993 and German Standard DIN 4150: Part 3 – 2016, these goals include:

- Vibration dose value (VDV) for human comfort
- Peak Component Particle Velocity (PPV) for cosmetic damage

Likely vibration impact was initially determined using screening tests as detailed in the CNVMP. Vibration monitoring included in this report uses the estimated vibration dose value determined by the acoustic consultants for human comfort and the acoustic consultants analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure within the PPV goals for cosmetic damage.

The vibration intensive activities identified during the monitoring period include:

- Vibro driving of pile casings as part of the O'Riordan Street piling works
- Vibro driving of pile casings as part of the Southern Cross Drive piling works
- Jack hammering/breaking activities
- Vibratory rolling activities

Tables V1 to V6 provide details of vibration monitoring results, works and compliance against the established vibration criterion.

Vibration monitoring found levels for cosmetic damage were below the vibration criterion at all locations.

Human comfort levels were found to be generally below the vibration dose value goals, where vibration levels were measured above this dose value for an eight-hour shift, operational times were reduced in the vicinity of the properties to reduce the impacts as well as changing to less vibration intensive modes on equipment such as static or low vibration mode on the vibratory roller.

Table V1: February 2023 Vibration Monitoring Data

Monitoring Date	Location	Receiver	Works	Monitoring Equipment	Monitoring Type	Monitoring Requirement	Measured VDV ($m/s^{1.75}$)	VDV Goal ($m/s^{1.75}$)	Measured PPV (mm/s)	PPV Goal (mm/s)	Compliance Assessment
16/02/23 – 23/02/23	Stamford Hotel	Stamford Hotel (Stamford Hotel Façade)	Vibratory Piling Works	Type 1 Signal Analyser Sinus Soundbook 2 Accelerometer Endevco 61C13 Accelerometer PCB 393B12 Type 1 Sound Level Meter NTi XL2	Unattended	Cosmetic Damage	-	-	5.62	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage
17/02/23	Stamford Hotel	Stamford Hotel (Internal)	Vibratory Piling Works	Type 1 Signal Analyser Sinus Soundbook 2 Accelerometer Endevco 61C13 Accelerometer PCB 393B12 Type 1 Sound Level Meter NTi XL2	Attended	Human Comfort	0.27	0.4	-	-	Vibration monitoring were below the established vibration goal for human comfort

Table V3: April 2023 Vibration Monitoring Data

Monitoring Date	Location	Receiver	Works	Monitoring Equipment	Monitoring Type	Monitoring Requirement	Measured/ Calculated VDV ($m/s^{1.75}$)	VDV Goal ($m/s^{1.75}$)	Measured PPV (mm/s)	PPV Target (mm/s)	Compliance Assessment
20/04/23	Bay Street	Residential	Vibratory Roller Works	Type 1 Signal Analyser NTI XL2 A2A-16217-E0 Accelerometer Endevco 61C3	Attended	Cosmetic Damage/ Human Comfort	0.44	0.4	0.95	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage, additional mitigations measures to be implemented including limiting duration of Vibratory roller for human comfort

Note: Vibration Dose Value/Human Comfort (VDV) and Peak Particle Velocity/Cosmetic Damage (PPV)

Table V4: May Vibration Monitoring Data

Monitoring Date	Location	Receiver	Works	Monitoring Equipment	Monitoring Type	Monitoring Requirement	Measured/ Calculated VDV ($m/s^{1.75}$)	VDV Target ($m/s^{1.75}$)	Measured PPV (mm/s)	PPV Target (mm/s)	Compliance Assessment
06/05/23	Stamford Hotel	Stamford Hotel (Façade)	WE45 (Jack hammering)	Type 1 Signal Analyser Soundbook-2 Accelerometer B&K Type 4524B (SN: 39142)	Attended	Cosmetic Damage/Human Comfort	0.35	0.4	0.91	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage and human comfort.
06/05/23	Baxter Road	Residential	WE45 (Vibratory Roller Works)	Type 1 Signal Analyser Soundbook-2 Accelerometer B&K Type 4524B (SN: 39142)	Attended	Cosmetic Damage/Human Comfort	0.27	0.4	0.41	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage and human comfort.
06/05/23	Rex Building	Commercial	WE45 (Vibratory Roller Works)	Type 1 Signal Analyser Soundbook-2 Accelerometer B&K Type 4524B (SN: 39142)	Attended	Cosmetic Damage/Human Comfort	0.27	0.4	0.48	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage and human comfort.
06/05/23	Park & Fly	Parking Building	WE45 (Vibratory Roller Works)	Type 1 Signal Analyser Soundbook-2 Accelerometer B&K Type 4524B (SN: 39142)	Attended	Cosmetic Damage	-	-	0.37	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage.
22/05/23	Banksia Street	Residential	Vibratory Roller Works	Type 1 Signal Analyser Soundbook-2 Accelerometer B&K Type 4524B (SN: 39142)	Attended	Cosmetic Damage/Human Comfort	2.37	0.4	6.08	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage, additional mitigations measures to be implemented including limiting duration of Vibratory roller for human comfort

Note: Vibration Dose Value/Human Comfort (VDV) and Peak Particle Velocity/Cosmetic Damage (PPV)

Table V5: June Vibration Monitoring Data

Monitoring Date	Location	Receiver	Works	Monitoring Equipment	Monitoring Type	Monitoring Requirement	Measured/ Calculated VDV ($m/s^{1.75}$)	VDV Target ($m/s^{1.75}$)	Measured PPV (mm/s)	PPV Target (mm/s)	Compliance Assessment
19/06/23	Baxter Road	REX Building	Vibratory Roller Works	Type 1 Signal Analyser Sinus Soundbook Accelerometer B&K Type 4524B (SN: #39142)	Attended	Cosmetic Damage/Human Comfort	0.55	0.8	0.62	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage and human comfort.

Note: Vibration Dose Value/Human Comfort (VDV) and Peak Particle Velocity/Cosmetic Damage (PPV)

Table V6: July Vibration Monitoring Data

Monitoring Date	Location	Receiver	Works	Monitoring Equipment	Monitoring Type	Monitoring Requirement	Measured/ Calculated VDV ($m/s^{1.75}$)	VDV Target ($m/s^{1.75}$)	Measured PPV (mm/s)	PPV Target (mm/s)	Compliance Assessment
20/07/23	McBurney Ave	Residential	SCD Piling Works	Type 1 Signal Analyser Sinus Soundbook Accelerometer B&K 4506B Type 1 Sound Level Meter NTi XL2 Type 1 Calibrator B&K 4231	Attended	Cosmetic Damage/Human Comfort	0.75	0.26	1.36	7.5	Vibration monitoring were below the established vibration goal for cosmetic damage, additional mitigations measures to be implemented including limiting duration of piling for human comfort

Note: Vibration Dose Value/Human Comfort (VDV) and Peak Particle Velocity/Cosmetic Damage (PPV)

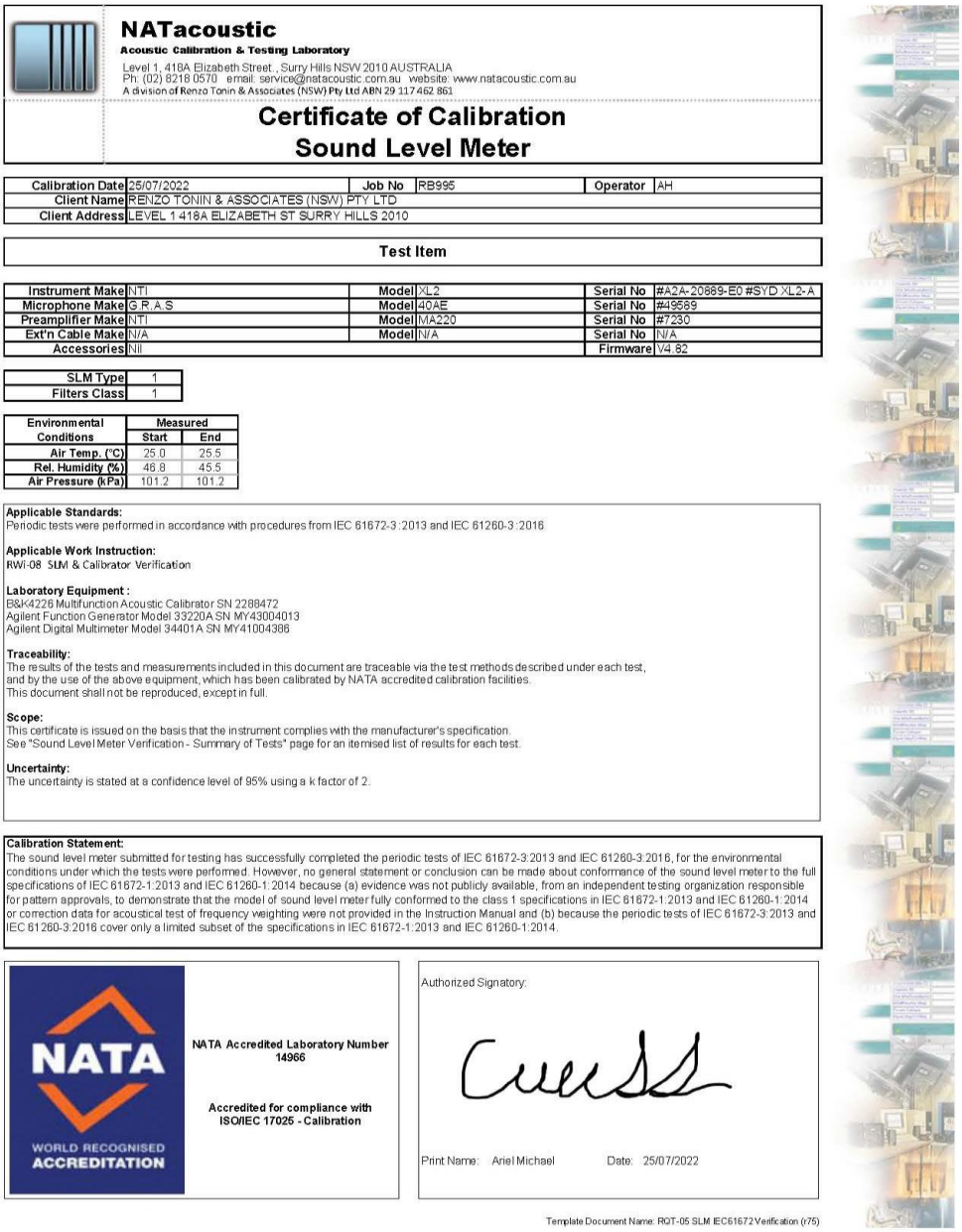
4.0 Equipment and Calibration

Monitoring during the period has been carried out internally by John Holland as well as by the Project Noise and Vibration consultants. All equipment used for the monitoring was calibrated and in date with records maintained electronically on the John Holland system. Table C1 provides details of the calibration dates and equipment used for the monitoring with calibration certificates contained in Appendix A.

Owner	Instrument	Make	Model	Serial Number	External Calibration Date	Place of Calibration	Calibration Certificate
Renzo Tonin & Associates	Type 1 Sound Level Meter	NTi	XL2	A2A-20889-E0	25 July 2022	Natacoustic	RB995F00 NTI SLM #SYD XL2-A #A2A-20889-E0 (r1)
Renzo Tonin & Associates	Type 1 Sound Level Meter	NTi	XL2	A2A-19156-E0	10 March 2022	NTi Audio (Factory Calibration)	#A2A-19156-E0 (XL2-C) FACTORY CALIBRATION CERTIFICATE
Renzo Tonin & Associates	Type 1 Sound Level Meter	NTi	XL2	A2A-13529-E0	9 February 2022	Natacoustic	RB938F00 NTi SLM MODEL XL2-TA #A2A-13529-E0 #RTA07-021 (r1)
Renzo Tonin & Associates	Type 1 Sound Level Meter	NTi	XL2	A2A-16217-E0	4 August 2023	Natacoustic	RD015F02 NTi SLM MODEL XL2 #A2A-16217-E0 #XL2-B (r2)
Renzo Tonin & Associates	Type 1 Sound Level Meter Calibrator	Brüel & Kjær	4231	2677710	11 January 2023	Natacoustic	RC035F01 B&K CALIBRATOR MODEL 4231 #2677710 #XL2-A (r1)
Renzo Tonin & Associates	Type 1 Sound Level Meter Calibrator	Brüel & Kjær	4231	3009707	17 January 2023	Natacoustic	RC035F05 B&K CALIBRATOR MODEL 4231 #3009707 #XL2-B (r1)
Renzo Tonin & Associates	Type 1 Sound Level Meter Calibrator	Brüel & Kjær	4231	3016756	3 July 2023	Natacoustic	RD001F00 B&K CALIBRATOR MODEL 4231 #3016756 #BOX 1 (r1)
Renzo Tonin & Associates	Type 1 Sound Level Meter Calibrator	Brüel & Kjær	4231	3027924	02 June 2023	Natacoustic	RC077F00 B&K CALIBRATOR MODEL 4231 #3027924 #XL2-C (r1)
Renzo Tonin & Associates	Type 1 Signal Analyser	Sinus	Soundbook	7039	11 November 2022	Sinus (Factory Calibration)	#7039 2022 11 11 SINUS manufacturers test 3234_001
Renzo Tonin & Associates	Accelerometer	Endevco	61C13	10764	21 April 2021	Natacoustic	RB880F07 ENDEVCO ACCELEROMETER 61C13 #10764 #1 (r1)
Renzo Tonin & Associates	Accelerometer	PCB	393B12	32172	20 April 2021	Natacoustic	RB880F00 PCB ACCELEROMETER 393B12 #32172 #1 (r1)

Renzo Tonin & Associates	Accelerometer	Brüel & Kjær	4524B	39142	21 November 2022	B&K (Factory Calibration)	2022 11 21 B&K ACCELEROMETER 4524B #39142
Renzo Tonin & Associates	Accelerometer	Brüel & Kjær	4506B	11474	26 May 2021	Natacoustic	RB880F12 B&K ACCELEROMETER 4506B #11474 (r1)
Renzo Tonin & Associates	Triaxial Transducers	Sigicom	C12	66830	25 February 2021	Natacoustic	RB859F00 CALIBRATION OF SIGICOM C12 #66830 (r1)
Renzo Tonin & Associates	Triaxial Transducers	Sigicom	C22	102477	2 May 2022	Natacoustic	RB969F03 Sigicom C22 #102477 #001 (r3)
John Holland	Type 1 Sound Level Meter	Rion	NL-52EX	00810625	21/02/2022	Acoustic Research Labs	C22104
John Holland	Type 1 Sound Level Meter Calibrator	Rion	NC-75	34123821	21/02/2022	Acoustic Research Labs	C22105

Appendix A: Equipment Calibration Certificates



NATacoustic
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A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Sound Level Meter

Calibration Date	25/07/2022	Job No	RB995	Operator	AH
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Instrument Make	NTI	Model	XL2	Serial No	#A2A-20889-E0 #SYD XL2-A
Microphone Make	G.R.A.S	Model	40AE	Serial No	#49589
Preamplifier Make	NTI	Model	MA220	Serial No	#7230
Ext'n Cable Make	N/A	Model	N/A	Serial No	N/A
Accessories	Nil			Firmware	V4.82

SLM Type	1
Filters Class	1

Environmental Conditions	Measured Start	Measured End
Air Temp. (°C)	25.0	25.5
Rel. Humidity (%)	46.8	45.5
Air Pressure (kPa)	101.2	101.2

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 and IEC 61260-3:2016.

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:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
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 and IEC 61260-3:2016, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 and IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 and IEC 61260-1:2014 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 and IEC 61260-3:2016 cover only a limited subset of the specifications in IEC 61672-1:2013 and IEC 61260-1:2014.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 25/07/2022

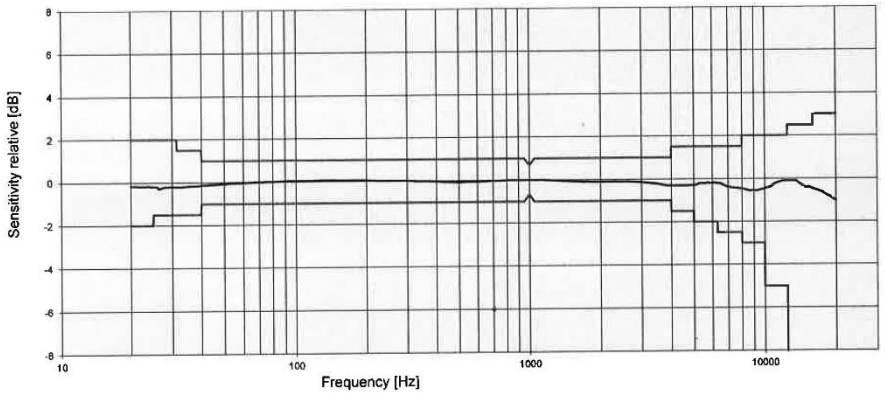
Template Document Name: RQT-05 SLM IEC61672 Verification (r75)

RB995 F00 NTI SLM #SYD XL2-A #A2A-20889-E0 (r1).xlsm 1 of 19 Certificate

NTi AUDIO

Frequency Response

Measurement Microphone **M2230** consisting of **MA220 PreAmplifier** S.No. **10617**
MC230A Capsule S.No. **A21889**



Sensitivity @ 1 kHz = 45.0 mV/Pa

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Certificate of Calibration
Sound Level Meter

Calibration Date	9/2/2022	Job No	RB938	Operator	AM
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Instrument Make	NTI	Model	XL2-TA	Serial No	#A2A-13529-E0 #RTA07-021
Microphone Make	NTI	Model	MC230A	Serial No	#A14698
Preamplifier Make	NTI	Model	MA220	Serial No	#7064
Ext'n Cable Make	NTI	Model	N/A	Serial No	N/A
Accessories	Nil			Firmware	4.40

SLM Type	1
Filters Class	1

Environmental Conditions	Measured	
	Start	End
Air Temp. (°C)	23.3	24.7
Rel. Humidity (%)	58.0	58.3
Air Pressure (kPa)	100.5	100.5

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 and IEC 61260-3:2016.

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:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
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 and IEC 61260-3:2016, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 and IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 and IEC 61260-1:2014 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 and IEC 61260-3:2016 cover only a limited subset of the specifications in IEC 61672-1:2013 and IEC 61260-1:2014.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 9/2/2022

Template Document Name: RQT-05 SLM IEC61672 Verification (r75)

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Certificate of Calibration
Sound Level Meter

Calibration Date	4/8/2023	**Job No**	RD015	**Operator**	KW
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Instrument Make	NTI	**Model**	XL2	**Serial No**	#A2A-16217-E0 #XL2-B
Microphone Make	NTI	**Model**	MC230A	**Serial No**	#A17363
Preamplifier Make	NTI	**Model**	MA220	**Serial No**	#8388
Ext'n Cable Make	Nil	**Model**	N/A	**Serial No**	N/A
Accessories	Nil			**Firmware**	V4.80

SLM Class	1
Filters Class	1

Environmental Conditions	**Measured**	
	Start	**End**
Air Temp. (°C)	24.0	24.0
Rel. Humidity (%)	49.5	51.7
Air Pressure (kPa)	102.3	102.4

Applicable Standards:
Periodic tests were performed in accordance with procedures from IEC 61672-3 :2013 and IEC 61260-3 :2016

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Function Generator Model 33511B SN MY59001831
Agilent Digital Multimeter Model 34401A SN MY41004386

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which through an unbroken chain of calibrations, is ultimately traceable to the International System of Units (SI).
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 2.04.

Calibration Statement:
The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013 and IEC 61260-3:2016, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 and IEC 61260-1:2014 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 and IEC 61260-1:2014 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 and IEC 61260-3:2016 cover only a limited subset of the specifications in IEC 61672-1:2013 and IEC 61260-1:2014.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 07/08/2023

Template Document Name: RQT-05 SLM IEC61672 Verification (r88)

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Certificate of Calibration
Sound Level Calibrator

Calibration Date	11/01/2023	**Job No**	RC035	**Operator**	AM EF
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Calibrator Make	B&K	**Model**	4231	**Serial No**	2677710
Accessories	N/A				

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	23.4	23.4
Rel. Humidity (%)	52.2	53
Air Pressure (kPa)	100.8	100.7

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Audio Tester AUDT30 v3.0 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
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 Calibrator Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:

Calibration Statement:
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. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 11/01/2023

Template Document Name: RQT-03 (rev 70) Calibrator Verification

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Certificate of Calibration
Sound Level Calibrator

Calibration Date	17/01/2023	**Job No**	RC035	**Operator**	AM
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Calibrator Make	B&K	**Model**	4231	**Serial No**	#3009707 #XL2-B
Accessories	N/A				

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	23.4	24
Rel. Humidity (%)	55.6	57.1
Air Pressure (kPa)	101.1	101.07

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Audio Tester AUDT30 v3.0 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which has been calibrated by NATA accredited calibration facilities.
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 Calibrator Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:

Calibration Statement:
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. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 17/01/2023

Template Document Name: RQT-03 (rev 70) Calibrator Verification

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Certificate of Calibration
Sound Level Calibrator

Calibration Date	3/07/2023	**Job No**	RD001	**Operator**	AM / KW
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Calibrator Make	B&K	**Model**	#4231	**Serial No**	#3016756 #BOX 1
Accessories	N/A				

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	22.8	22.7
Rel. Humidity (%)	51.5	51.7
Air Pressure (kPa)	102.1	102.13

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Vitrins Analyser Multi Instrument Pro V3.9 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which through an unbroken chain of calibrations, is ultimately traceable to the International System of Units (SI). 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 Calibrator 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 2.04.

Calibration Statement:
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. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 05/07/2023

Template Document Name: RQT-03 (rev 70) Calibrator Verification

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 Calibrator

Calibration Date	2/06/2023	**Job No**	RC077	**Operator**	AM / KW
Client Name	RENZO TONIN & ASSOCIATES (NSW) PTY LTD				
Client Address	LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010				

Test Item

Calibrator Make	B&K	**Model**	4231	**Serial No**	#3027924 #XL2-C
Accessories	N/A				

Class (1 or 2)	1

Environmental Conditions	Measured	
	Start	End
Temperature (degC)	23.9	24.2
Rel. Humidity (%)	56.7	56.4
Air Pressure (kPa)	101.75	101.76

Applicable Standards:
IEC 60942:2017 "Electroacoustics - Sound calibrators"

Applicable Work Instruction:
RWI-08 SLM & Calibrator Verification

Laboratory Equipment :
GRAS Power Module type 12AK SN 1551616
GRAS 1/2" Pressure Microphone 40AD SN 252620 and preamplifier SN 292045
B&K4226 Multifunction Acoustic Calibrator SN 2288472
Agilent Digital Multimeter Model 34401A SN MY41004386
Vitrins Analyser Multi Instrument Pro V3.9 software
Behringer UCA222 USB Audio Interface U-Control

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described under each test, and by the use of the above equipment, which through an unbroken chain of calibrations, is ultimately traceable to the International System of Units (SI). 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 Calibrator 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 2.04.

Calibration Statement:
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. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14966

Accredited for compliance with ISO/IEC 17025 - Calibration

Authorized Signatory:

Print Name: Ariel Michael Date: 02/06/2023

Template Document Name: RQT-03 (rev 70) Calibrator Verification

SINUS Messtechnik GmbH
Föpplstrasse 13
D-04347 Leipzig, Germany
☎ +49 341 24429 0
+49 341 24429 99
http://www.sinusmess.de

Production Test for Device

SINUS Expander_71

Serial Number: #07039

This device was tested according ISO 61672, ISO 60651 and the internal test specifications of the SINUS Messtechnik GmbH.

Date:	11-Nov-2022
Recommended Interval:	24 months
Next Production Test:	Nov-2024
Operator:	TUL
Signature:	.....

NATacoustic
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A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861

Certificate of Calibration
Accelerometer

Calibration Date 21/04/2021 **Operator** AH
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer Endevco **Serial No** #10764 #1
Instrument Model 61C13

Applicable Work Instruction:
WiTC-99 Accelerometer and Geophone Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 14837-1:2005 Mechanical vibration Ground-borne noise and vibration arising from rail systems - Part 1: General guidance
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer
British Standard BS6472-1:2008 Guide to Evaluation of Human Exposure to Vibration in Buildings - Part 1: Vibration sources other than blasting
British Standard BS7385-2:1993 Evaluation and measurement for vibration in buildings
German Standard DIN 4150-3:2016 Vibrations in buildings - Part 3: Effects on structures
International Society of Explosives Engineers ISEE Performance Specifications for Blasting Seismographs 2017

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described in the applicable work instruction which references the listed international standards.
And by the use of the above lab equipment, which has been calibrated where required using reference equipment calibrated by NATA accredited calibration facilities.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.

Calibration Notes:

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 18/05/2021

Template: WiTC-99a Accelerometer Calibration (r2)

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Certificate of Calibration
Accelerometer

Calibration Date 20/04/2021 **Operator** AH
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer PCB **Serial No** #32172 (#1)
Instrument Model 393B12

Applicable Work Instruction:
WiTC-99 Accelerometer and Geophone Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 14837-1:2005 Mechanical vibration Ground-borne noise and vibration arising from rail systems - Part 1: General guidance
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German Standard DIN 4150-3:2016 Vibrations in buildings - Part 3: Effects on structures
International Society of Explosives Engineers ISEE Performance Specifications for Blasting Seismographs 2017

Laboratory Equipment :
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SpectraPLUS software
Reference accelerometer

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Scope:
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Calibration Notes:

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 18/05/2021

Template: WiTC-99a Accelerometer Calibration (r2)

Calibration Chart for Triaxial DeltaTron® Accelerometer Type 4524B

TEDS = V1.0

Brüel & Kjær

Serial No.: 39142

		X+	Y-	Z-	axis
Reference Sensitivity[1] at 159.2 Hz (ω = 1000 s⁻¹), 20 ms⁻² RMS, 4 mA supply current and 23.3 °C:		9.861 96.71	9.880 96.89	9.721 95.33	mV/ms⁻² mV/g
Frequency Range	Amplitude (±10%): Phase (± 5°):	0.2-5.5k 1.5-3.0k	0.25-3.0k 1.5-3.0k	0.25-3.0k 1.5-3.0k	Hz Hz
Mounted Resonance Frequency:		18	9	9	kHz
Transverse Sensitivity: Maximum (at 30 Hz, 100 ms⁻²)		< 5	< 5	< 5	%
Transverse Resonance Frequency:		9	9	9	kHz
Calculated values for TEDS[2]: F_{res}:		16.6	9.49	8.98	kHz
	Q:	13.0	169	178	
	Amp. Corr.:	-3.0	-2.8	-2.6	%/dec
	F_{lp}:	0.084	0.13	0.12	Hz
	F_{hp}:	300	300	300	kHz
Measuring Range:		±500 ms⁻² peak (±50 g peak)			

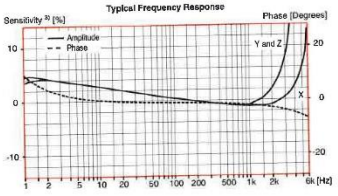
Polarity of the electrical signals is positive for an acceleration in the direction of the arrows on the drawing.

[1] This calibration is obtained on a modified Brüel&Kjær Calibration System Type 9640 System No.: 150157.3 and is traceable to the National Institute of Standards and Technology, USA and Physikalisch-Technische Bundesanstalt, Germany.
The expanded uncertainty is 1.0% determined in accordance with EAL-2. A coverage factor k = 2 is used. This corresponds to a coverage probability of 95% for a normal distribution.
[2] Transducer Electronic Data Sheet according to IEEE P 1451.4.
[3] Deviation from Reference Sensitivity.
Transducer principle patented US 5977487, US 6367851, US 5996412, JP 50952694, DK 169853.

For further information, please see http://www.bksv.com and Product Data Sheets.

X

Typical Frequency Response



Electrical:

Bias Voltage:	at full temperature and current range:	+ 13 V ± 1 V
Power Supply Requirements:	Constant Current:	+ 2 mA to + 10 mA
	Unloaded Supply Voltage:	+ 24 V to + 30 V
Note: All three axes must be powered! Single or dual axial supply is not possible.		
Output Impedance:		< 30 Ω
Start-up Time (to 90% of bias):		< 10 s
Inherent Noise, X-axis (RMS):		< 40 µV
Broadband (1 Hz to 6 kHz):		corresponding to < 0.004 ms⁻² (< 400 µg)
Spectral:	10 Hz:	1.6×10⁻⁴ ms⁻²/√Hz (16 µg/√Hz)
	100 Hz:	4×10⁻⁵ ms⁻²/√Hz (4 µg/√Hz)
	1000 Hz:	2×10⁻⁵ ms⁻²/√Hz (2 µg/√Hz)
Inherent Noise, Y- and Z-axes (RMS):		< 20 µV
Broadband (1 Hz to 6 kHz):		corresponding to < 0.002 ms⁻² (< 200 µg)
Spectral:	10 Hz:	0.8×10⁻⁴ ms⁻²/√Hz (8 µg/√Hz)
	100 Hz:	2×10⁻⁵ ms⁻²/√Hz (2 µg/√Hz)
	1000 Hz:	1×10⁻⁵ ms⁻²/√Hz (1 µg/√Hz)
Insulation Resistance (signal ground to case):		> 1 GΩ
Recommended Cables:		AO 0526 AO 0527 AO 0528 AO 0534

Built-in ID-information and TEDS[2] **according to IEEE P1451.4**

Mounting Technique:
The accelerometer can be fastened directly to the measuring object by glue, e.g., hot glue. However, if a reduced frequency range can be accepted, it is recommended to use one of the special mounting clips (see below) which is glued to the measuring object. In any case, the mounting surface must be clean and smooth.
Four types of mounting clips are available: UA 1407 (set of 100) is a low-profile clip recommended for mounting on plane surfaces. UA 1475 (set of 100) is a clip with a thick base which can be filed to fit a curved mounting surface. UA 1564 (set of 5) is a high-temperature clip. UA 1478 (set of 100) is a swivel base clip for use where the accelerometer is to be aligned according to a given coordinate system.
Applying a little grease to the mounting surface of the accelerometer as well as the clip will improve the frequency response.
See also ISO 5348.

Environmental:

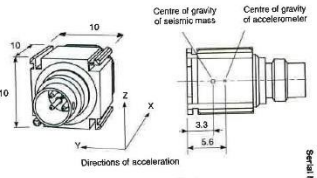
Temperature Range:	-54 to +100°C (-65 to +212°F)
Temperature Coefficient of Sensitivity:	+0.14%/°C
Temp. Transient Sensitivity (3 Hz Low. Lim. Frq. (-3 dB, 6 dB/oct)):	0.002 ms⁻²/°C
Magnetic Sensitivity (50 Hz, 0.038 T):	20 ms⁻²/T
Base Strain Sensitivity (at 250 µε in base plane): Mounted in Mounting Clip or on adhesive tape 0.09 mm thick:	0.0005 ms⁻²/µε
Max. Non-destructive Shock:	50 kms⁻² peak (5000 g peak)
Humidity:	Hermetic

Mechanical:

Case Material:	Titanium ASTM Grade 2
Sensing Element:	Piezoelectric, Type PZ 27
Construction:	OrthoShear®
Sealing:	Hermetic
Weight:	4.4 gram (0.15 oz.)
Electrical Connector:	4 pin, 1/4" - 28 UNF (Microtech compatible) All pins insulated from case

Pin Designation

Mounting Surface Flatness: < 3 µm



Directions of acceleration

All dimensions in millimetres

Date 21 nov 2022, 10:46 Operator HP

Specifications obtained in accordance with ANSI S2.11-1969 and ISO 5347.

Except for the frequency range all values are typical at 25°C (77°F) unless measurement uncertainty is specified.

BC 0357-12

Serial No.: 39142

040512

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Certificate of Calibration
Accelerometer

Calibration Date 26/05/2021 **Operator** AH
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer B&K **Serial No** #11474
Instrument Model 4506B

Applicable Work Instruction:
WiTC-99 Accelerometer and Geophone Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 14837-1:2005 Mechanical vibration Ground-borne noise and vibration arising from rail systems - Part 1: General guidance
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer
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International Society of Explosives Engineers ISEE Performance Specifications for Blasting Seismographs 2017

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
The results of the tests and measurements included in this document are traceable via the test methods described in the applicable work instruction which references the listed international standards.
And by the use of the above lab equipment, which has been calibrated where required using reference equipment calibrated by NATA accredited calibration facilities.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.

Calibration Notes:

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 26/05/2021

Template: WiTC-99a Accelerometer Calibration (r2)

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Certificate of Calibration
Accelerometer / Vibration Monitor

Calibration Date 25/02/2021 **Operator** AH
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1 418A ELIZABETH ST SURRY HILLS 2010

Test Item

Manufacturer Sigicom **Serial No** #66830
Instrument Model C12

Applicable Work Instruction:
WITC-101 Minimate Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
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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.

Calibration Notes:
Sensitivity of reference accelerometer and measurement chain was verified using a BK 4294 field accelerometer. The measured rms vibration level was within 0.1 dB of the reference level at 1000 rad/s.

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 25/02/2021

Template: WITC-101a Minimate Calibration Template (r0)

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Certificate of Calibration
Accelerometer / Vibration Monitor

Calibration Date 2/05/2022 **Operator** AH
Client Name RENZO TONIN & ASSOCIATES (NSW) PTY LTD
Client Address LEVEL 1, 418A, ELIZABETH ST, SURRY HILLS, NSW, 2010

Test Item

Manufacturer Sigicom **Serial No** #102477
Instrument Model Infra c22

Applicable Work Instruction:
WITC-100 Sigicom Calibration

Reference Standards:
International Standard ISO8041:2005 Human response to vibration -Measuring instrumentation
International Standard ISO 16063-1:1998 Methods for the calibration of vibration and shock transducers - Part 1: Basic concepts
International Standard ISO 16063-21:2003 Methods for the calibration of vibration and shock transducers - Part 21: Vibration calibration by comparison to a reference transducer

Laboratory Equipment :
Electrodynamic shaker - Ground Zero GZNW 18XSPL
Power Amplifier – Behringer Model NU3000DSP
Signal generator
DT 9837A 4-channel data acquisition card
SpectraPLUS software
Reference accelerometer

Traceability:
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Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification.

Calibration Notes:
Sensitivity of reference accelerometer and measurement chain was verified using a BK 4294 field accelerometer. The measured rms vibration level was within 0.1 dB of the reference level at 1000 rad/s.

Calibration Checked and Approved:

Print Name: Ariel Michael Date: 2/05/2022

Template: WITC-100a Sigicom Calibration Template (r6)

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www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22104

Client Details	Botany Rail Duplication Building D, 10 Bourke Road Mascot NSW 2020
Equipment Tested/ Model Number :	Rion NL-52EX
Instrument Serial Number :	00810625
Microphone Serial Number :	20026
Pre-amplifier Serial Number :	11168

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	25.2°C	**Ambient Temperature :**	25°C
Relative Humidity :	48.8%	**Relative Humidity :**	47.9%
Barometric Pressure :	99.84kPa	**Barometric Pressure :**	99.84kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 18 Feb 2022
Secondary Check: Max Moore
Report Issue Date : 21 Feb 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	*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.

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	*±0.10dB*		

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.

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Sound Calibrator
IEC 60942:2017

Calibration Certificate

Calibration Number C23289

Client Details	JHG Level 5, 410 Concord Road Rhodes NSW 2138
Equipment Tested/ Model Number :	NC-75
Instrument Serial Number :	34123821

Atmospheric Conditions

Ambient Temperature :	22.9°C
Relative Humidity :	40.1%
Barometric Pressure :	101.5kPa

Calibration Technician :	Max Moore	**Secondary Check:**	Dylan Selge
Calibration Date :	23 May 2023	**Report Issue Date :**	25 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	94.08	1000.00

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	*±0.10dB*	*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.

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