

M1 Pacific Motorway Extension to Raymond Terrace - Stage 1 – Black Hill to Tomago

6 Monthly Construction Noise & Vibration Monitoring Report November 2024 – May 2025

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Revisions

Draft issues of this document are identified as Revision A, B, C, etc. Upon initial issue (generally Contract Award) this will be changed to a sequential number commencing at Revision 0. Revision numbers will continue at Revision 1, 2, etc.

Rev	Date	Prepared By [Name]	Reviewed By [Name]	Approved By [Name]	Remarks
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1	3/07/2025	I. Aspinall	K Lloyd	K Lloyd	For external distribution

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Terms and Abbreviations

Term/Abbreviation	Definition/Expanded text
ABL	Assessment Background Level – A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening, or night-time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background LA90 noise levels, i.e. the measured background noise is above the ABL 90% of the time.
ABN	Airborne noise
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
AMS	Activity Method Statements
AQMP	Air Quality Management Sub-Plan
Attenuation	The reduction in the level of sound or vibration.
At-property acoustic treatment	Includes courtyard walls and building treatments. Building treatments may include but are not limited to ventilation, acoustic blinds/curtains, glazing, window and door seals, sealing of vents or underfloor areas, shutters and secondary glazing.
AVTG	Assessing Vibration – A Technical Guideline
BH2T	Black Hill to Tomago, or the Project
BMP	Blast Management Plan
CS	Communications Strategy
CEMP	Construction Environmental Management Plan
CMP	Construction Monitoring Program
CNVG	Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime Services 2016b)
CoA	Conditions of Approval
Construction	Includes all activities required to construct the CSSI as defined in the Project Description described in the documents listed in Condition A1, including commissioning trials of equipment and temporary use of any part of the CSSI but excludes Low Impact Work which is carried out or completed prior to approval of the CEMP and works approved under a Site Establishment Management Plan.
Consultation	To provide information and actively engage with and obtain and consider feedback from stakeholders during development of post approval documents. How the feedback has been considered and whether any changes have been made in response to this feedback is then documented and communicated back to stakeholders. Consultation should not be limited to one-way notification about the project.
Continuously	Includes any period during which there is less than one hour between ceasing and recommencing any of the work.
CSSI	Critical State Significant Infrastructure
D&C	Design and Construct
dB(A)	Decibels using the A-weighted scale which is accepted as being representative of the frequency response of the human ear.
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment and Climate Change and Water
DPHI	Former Department of Planning and Environment, now Department of Planning, Housing and Infrastructure
EIS	Environmental Impact Statement
EMS	Environmental Management System
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.

Term/Abbreviation	Definition/Expanded text
Environmental incident	An unexpected event that has, or has the potential to, cause harm to the environment and requires some action to minimise the impact or restore the environment.
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPL	Environment Protection Licence
ER	Environmental Representative
EWMS	Environmental Work Method Statement
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
GBN	Ground-borne noise
Highly Noise Affected	As defined in the Interim Construction Noise Guideline (DECC, 2009)
Highly noise intensive works/ particularly annoying	Work which is defined as annoying under the ICNG including: use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work a. grinding metal, concrete or masonry; b. rock drilling; c. line drilling; d. vibratory rolling; e. bitumen milling or profiling; f. jackhammering, rock hammering or rock breaking; and g. impact piling Note: when modelled, these activities/plant and equipment will incur a 5dB(A) penalty.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	Industrial Noise Policy
ISCA	Infrastructure Sustainability Council of Australia
JHGA JV	John Holland Gamuda Australia Joint Venture
LA(max)	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LAeq(15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail, and the community.
LA1	The A-weighted sound pressure level that is exceeded for 1 per cent of the time for which the given sound is measured.
LA90	The A-weighted sound pressure level that is exceeded for 10 per cent of the time for which the given sound is measured.
M12RT	M1 Pacific Motorway Extension to Raymond Terrace
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
NMG	Noise Mitigation Guideline

Term/Abbreviation	Definition/Expanded text
NML	Noise Management Level as defined in the Interim Construction Noise Guideline (DECC, 2009)
NPfI	Noise Policy for Industry
NVA	Noise and Vibration Assessment
NVIS	Noise and Vibration Impact Statement
NVMP	Noise and Vibration Management Sub-Plan
ONR	Operational Noise Review
OOHW	Out of Hours Works
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
PPV	Peak Particle Velocity – the highest velocity of a particle (such as part of a building structure) as it vibrates. Most sound level meters measure root mean squared (RMS) values; it is common to approximate the PPV based on an RMS measurement. PPV is commonly used as a vibration criterion, and is often interpreted as a PPV based on the L _{max} or L _{max,spec} index.
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night).
REMM	Revised Environmental Management Measures
RMS	Root Mean Squared
RNP	Road Noise Policy
ROL	Road Occupancy Licence
Sensitive land use(s)	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), childcare centres, passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces), and industrial premises as identified by the Planning Secretary.
Submissions Report	The Proponent's response to issues raised in the submission received in relation to the application for approval of the CSSI under the EP&A Act.
SMART	Specific, Measurable, Achievable, Relevant and Time-Bound
SPL	Sound Pressure Level
Transport	Transport for New South Wales, or TfNSW
VMS	Variable Message Signs
Work	Any physical activity for the purposes of the CSSI including construction, Low Impact Work, enabling works, utility works and site establishment activities but not including operational maintenance works.
WRA	Work Risk Assessment

1. Introduction

1.1. Overview

This Six-Monthly Construction Monitoring Report provides the results of all noise and vibration monitoring that has been undertaken during the reporting period to validate predicted impacts, measure the effectiveness of environmental controls and to address approval requirements for the M1 Pacific Motorway Extension to Raymond Terrace (M12RT) Black Hill to Tomago (BH2T, or the Project). This includes monitoring undertaken in accordance with the Construction Environmental Management Plan (CEMP) and associated Sub-plans. The Noise and Vibration Management Sub-plan (NVMP) contains the Noise and Vibration Monitoring Program.

This monitoring report includes an analysis of the results including, but not limited to, exceedances of relevant criteria/targets/goals, reasons for any exceedances, trends in the data, and maximum, minimum and average data results for all monitored parameters. The report also details management and mitigation measures that were implemented to address exceedances during the reporting period, in accordance with CoA C18.

1.2. Report distribution

In accordance with CoA C12(a) and C18 and Section 10 of the Noise and Vibration Monitoring Program, the agencies listed in Table 1 will be provided with a copy of this report.

Table 1 Agencies outlined in Noise and Vibration Monitoring Program to receive report

Agency Name	
Transport for New South Wales	City of Newcastle Council
DPHI	Port Stephens Council
EPA	Maitland City Council

1.3. Works undertaken

The CEMP was approved on 13th November 2023, with full commencement of construction on 14th November 2023. This monitoring report covers the reporting period from 13th November 2024 to 12th May 2025. Work activities during this period are summarised in Table 2 below.

Table 2 Details of works undertaken during construction

Month	Activity
November (13 th – 30 th) 2024	• Project wide bulk earthworks – excavation and general fill placement • Project wide material delivery e.g. bridge girders, drainage pits etc. • Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, Form Reo Pour (FRP) works, concrete deck pours etc. • Pile case placement in the Hunter River via vibratory and impact hammer works • Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. • Project wide clearing and mulching • Pug Mill operating in Tomago adjacent to Bridge 6 Abutment A • Pavement works on the M1 Pacific Motorway (M1), John Renshaw Dr (JRD), New England Highway (NEH) and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. • Line marking & removal, and concrete barrier placement on public roads • Noise wall construction consisting of piling, post driving and panel installation on the M1
December 2024	• Project wide bulk earthworks – excavation and general fill placement • Project wide material delivery e.g. bridge girders, drainage pits etc. • Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours etc. • Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. • Project wide clearing and mulching • Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. • Pug Mill operating in Tomago adjacent to Bridge 6 Abutment A • Pile case placement in the Hunter River via vibratory and impact hammer works, including casing extensions • Line marking & removal, and concrete barrier placement on public roads • Noise wall construction consisting of piling, post driving and panel installation on the M1

Month	Activity
January 2025	• Project wide bulk earthworks – excavation and general fill placement • Project wide material delivery e.g. bridge girders, drainage pits etc. • Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours, road furniture etc. • Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. • Project wide clearing and mulching • Pug Mill operating in Ancillary Facility 3 (AS3) • Pile case placement in the Hunter River via vibratory and impact hammer works, including casing extensions • Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. • Line marking & removal, and concrete barrier placement on public roads • Noise wall construction consisting of piling, post driving and panel installation on the M1
February 2025	• Project wide bulk earthworks – excavation and general fill placement • Project wide material delivery e.g. bridge girders, drainage pits etc. • Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours, road furniture etc. • Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. • Project wide clearing and mulching • Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. Traffic switches on the Pacific Hwy at Heatherbrae and Lenaghans Dr at Black Hill completed. • Pug Mill operating in AS3 • Pile case placement in the Hunter River via vibratory and impact hammer works, including casing extensions • Noise wall construction consisting of piling, post driving and panel installation on the M1 • Line marking & removal, and concrete barrier placement on public roads

Month	Activity
March 2025	- Project wide bulk earthworks – excavation and general fill placement - Project wide material delivery e.g. bridge girders, drainage pits etc. - Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours, road furniture etc. - Pug Mill operating in AS3 - Line marking & removal, and concrete barrier placement on public roads - Noise wall construction consisting of piling, post driving and panel installation on the M1 and Anderson Dr off ramp - Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. - Extension of casings, vibratory and hammer works in the Hunter River, as well as excavation and concreting of pile casings and pile cap shells. Commencement of barge piling works - Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc.
April 2025	- Project wide bulk earthworks – excavation and general fill placement - Project wide material delivery e.g. bridge girders, drainage pits etc. - Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours, road furniture etc. - Pug Mill operating in AS3 - Line marking & removal, and concrete barrier placement on public roads - Noise wall construction consisting of piling, post driving and panel installation on the M1 and Anderson Dr off ramp - Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. - Extension of casings, vibratory and hammer works in the Hunter River, as well as excavation and concreting of pile casings and pile cap shells. Barge piling works - Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. Traffic switch on the Pacific Hwy at Tomago completed.

Month	Activity
May 2025	• Project wide bulk earthworks – excavation and general fill placement • Project wide material delivery e.g. bridge girders, drainage pits etc. • Construction works for bridges 1, 2, 3, 4, 5, 6 and 8 including piling, girder placement, FRP works, concrete deck pours, road furniture etc. • Pug Mill operating in AS3 • Line marking & removal, and concrete barrier placement on public roads • Noise wall construction consisting of piling, post driving and panel installation on the Anderson Dr off ramp • Project wide utilities and services relocation and installation e.g. underbores, drainage, electrical, gas mains, telecom lines etc. • Hunter River barge piling works • Excavation and concreting of Hunter River pile casings and pile cap shells • Eastern Hunter Riverbank stabilisation works – rock blanket and timber piles • Pavement works on the M1, JRD, NEH and Pacific Highway. Pavement works are inclusive of spray seal, asphaltting, kerb placement, mill and re-sheet, verge widening works etc. Traffic switch on the Pacific Hwy at Tomago completed.

1.4. Weather and rainfall

Weather observations are as provided by the Project Automatic Weather Station (AWS) located at 35 New England Highway, Tarro in Table 3 below.

Table 3 Weather and Rainfall Summary

Month	Min temp	Max temp	Total rainfall	Max 24hr rainfall	Max wind gust
November 2024 (13 th -30 th)	11.9°C	38.8°C	19.6 mm	4.8 mm	55.6 km/h
December 2024	12.7°C	41.8°C	26.4 mm	10.6 mm	68.6 km/h
January 2025	13.8°C	42.2°C	214 mm	51.6 mm	74.5 km/h
February 2025	11.4°C	38.1°C	32.2 mm	8.6 mm	52.1 km/h
March 2025	15.1°C	39.5°C	135.8 mm	37.4 mm	63.9 km/h
April 2025	11.7°C	30.4°C	211 mm	116.2 mm	71 km/h
May 2025 (1 st -12 th)	10.4°C	26.2°C	40.6 mm	17.8 mm	48.5 km/h

2. Noise and Vibration Monitoring

2.1. Noise monitoring

2.1.1. Noise monitoring requirements

The Noise and Vibration Monitoring Program details the construction noise monitoring requirements to be undertaken by JHGA JV and is summarised in Table 4 below.

Table 4 Noise Monitoring Requirements

Monitoring Type	Requirements
Attended Noise Monitoring	Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared which identifies that validation monitoring is required (Section 9.4 of the NVMP) to confirm that actual noise levels are consistent with noise impact predictions and that the management measures that have been implemented are appropriate, Prior to any changes in methodology, plant or equipment which may result in a significant increase in construction noise impact that may require implementation of additional mitigation measures, Where appropriate in response to a noise related complaint(s) (determined on a case-by- case basis) and in accordance with EPL Condition, As directed by an authorised officer of the EPA, As otherwise required by the NVIS, Out of Hours Works (OOHW) Protocol or EPL, Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels, and Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction equipment. Spot checks would be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.
Unattended Noise Monitoring	Unattended noise monitoring may be used to provide real-time monitoring throughout construction works or may be used in place of attended noise monitoring, where it is deemed appropriate. When unattended noise monitoring is completed, monitoring results will be compared against a log of activities recorded during the monitoring period. This can be used to determine whether project activities are influencing noise levels at the monitoring location.
Out Of Hours Work Noise Monitoring	Noise monitoring must be undertaken in accordance with the requirements of the work specific out of hours work (OOHW) permit to validate predicted noise impacts. Section 7.1 of the Out-of-Hours Works Protocol identifies that noise verification monitoring would be undertaken in the following circumstances: - Attended noise monitoring at representative directly affected residents and sensitive land use(s) in the first instance of an activity predicted to be moderately intrusive or worse during OOHW Period 1 or clearly audible or worse during OOHW Period 2. - Additional noise monitoring and review if complaints about the activity are received. - Attended noise monitoring at appropriate representative stages of OOHW that has been determined by the ER to be low or medium risk to verify predictions.

2.1.2. Noise monitoring methodology and locations

Long-term noise monitoring was carried out between June and July 2018 at nine locations (L01 to L09) with short-term noise measurements at three locations (L01A, L04A and L05A) to determine the Relative Background Level (RBL) and evaluate project noise objectives. These monitoring locations and their corresponding noise catchment areas (NCA) are described within Figure 1 and Table 5. Each NCA contains sensitive receptors with residential receivers being considered 'noise affected' when construction noise levels are greater than their relevant NCA's Noise Management Level (NML), project NMLs can be seen in Table 6.

The project's key construction stages and activities were identified along with other construction works in the vicinity of the project for the purpose of managing cumulative impacts. The predicted noise outcomes of these activities combined with the project noise objectives were summarised within the NVIS (Noise & Vibration Impact Statement). In addition to the initial modelling of key activities, where any new activities and/or significant changes to the site layout or construction methodology were proposed, additional noise assessments were undertaken. These site and activity-specific noise assessments were prepared to assess all construction activities, as well as the operation of ancillary facilities or proposed minor ancillary facilities.

Noise assessments relevant to planned out of hours works (OOHW) were compiled into a works permit and issued to OOHW supervisor to be reviewed and signed by nightshift crews at each OOHW pre-start. This permit describes which work activities are permitted to be undertaken on specified nights (specific hours of works may also be outlined where appropriate as opposed to a full night shift). All OOHW must be undertaken in accordance with the permit which has been reviewed and signed by both the Environmental Manager and Community Manager (or delegates).

To manage project noise impacts and objectives, noise validation monitoring was completed. Validation monitoring was undertaken monthly during standard hours within each NCA and during OOHW where the predicted noise level was above the NML or in instances where the works had the potential to be above the NML for nearby sensitive land uses. If construction noise was found to be greater than or equal to LAeq(15 minute) 25 dB(A) above the NML at any given residence at any time, that residential receiver was considered to be highly noise affected and appropriate mitigation measures were implemented.

All noise monitoring events were recorded in the Project online records system. The records include the following:

- Date and time of measurement,
- Name of person undertaking the measurement,
- Type and model number of monitoring instrumentation,
- Results of field calibration checks,
- Time of day, length of measurement and any measurement time intervals,
- Monitoring location (including a sketched map/photo of area),
- Measurement location details and number of measurements at each location,
- Weather conditions during measurements,
- Operation and activities of the noise sources under investigation,
- Estimated contribution of the Project's activities (if Project activities are audible), and
- Noise due to other extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects).

All monitoring was undertaken by competent personnel, appropriately qualified, suitability trained and experienced in undertaking noise measurements.

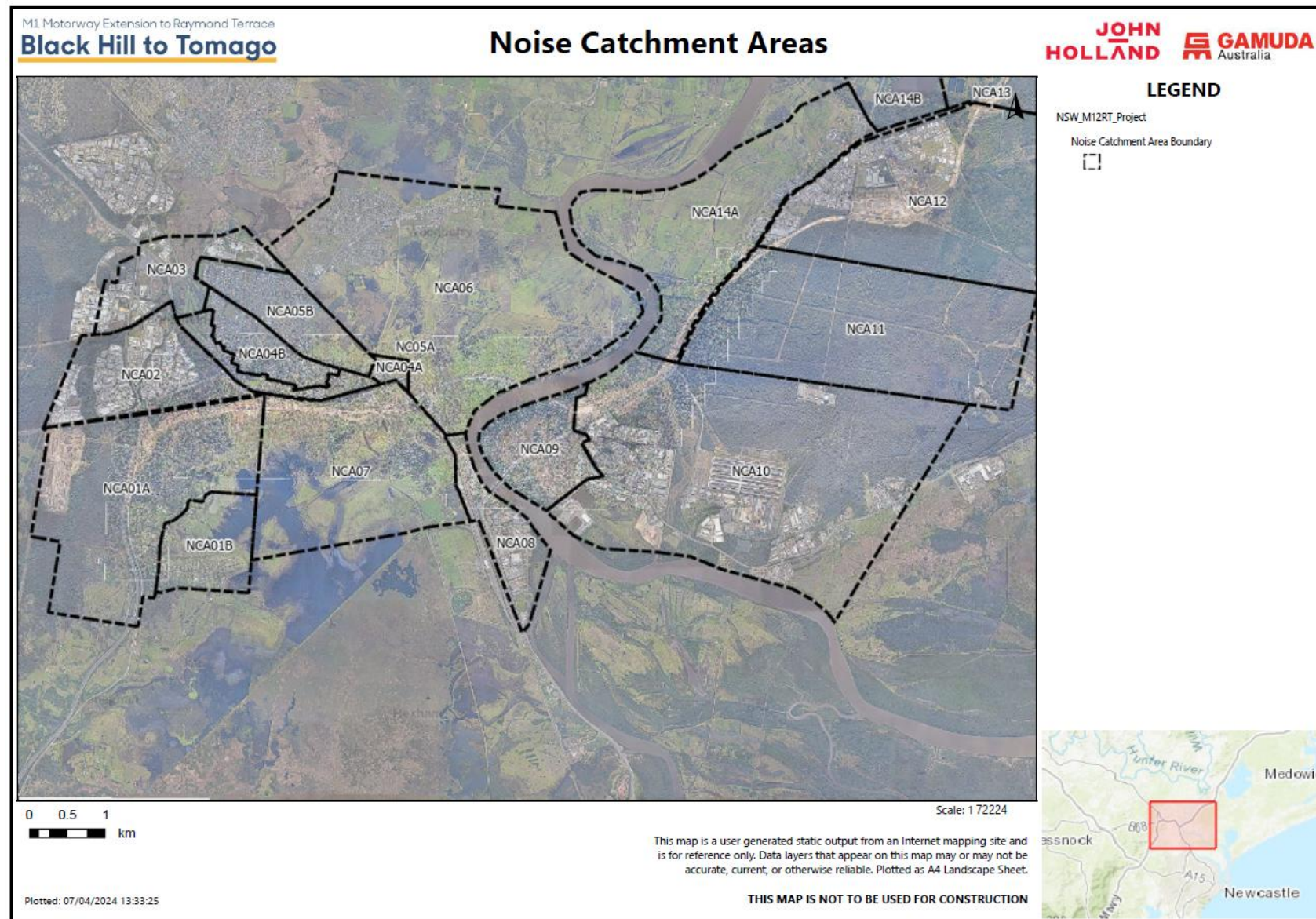


Figure 1 Noise Catchment Areas (NCA) for M12RT - BH2T Project

Table 5 Noise Monitoring Locations

ID	NCA	Address	Measured RBL, dB (A) ¹		
			Day	Evening	Night
L01	NCA01A	23 Cahill Close, Black Hill	51	49	46
L01A	NCA01B	24 Walter Parade, Black Hill ²	37	38	36
L02	NCA03	54 Weakleys Drive, Beresfield	66	60	47
L04	NCA04A	1/15 Quarter Sessions Road, Tarro	51	49	41
L04A	NCA04B	22 Lenox Street, Beresfield ²	45	45	39
L05	NCA05A	11 Anderson Drive, Tarro	55	51	45
L05A	NCA05B	49 Beresford Avenue, Beresfield ²	41	38	35
L06	NCA06	61 Redbill Drive, Woodberry	38	36	34
L03	NCA07	51 New England Highway, Tarro	43	46	43
L07	NCA08	179 Old Maitland Road, Hexham	41	40	37
L08	NCA09	838 Tomago Road, Tomago	52	47	45
L09	NCA14A	2213 Pacific Highway, Heatherbrae	54	49	42

¹ Day (7am – 6pm), evening (6pm - 10pm) and night (10pm – 7am) periods as defined in the Traffic Noise Monitoring Program and Monitoring Report provided in Appendix F per (NPfI) (EPA 2017).

² Background noise levels for locations L01A, L04A, and L05A based on correlation with nominated long term monitoring locations with similar noise environments.

Table 6 Project Noise Management Levels

NCA ¹	Monitoring Location	LAeq(15 minute) NML, dB(A)				Sleep disturbance screening level (RBL + 15dB) ⁶
		Standard hours (RBL + 10dB) Day ²	Extended / out of hours (RBL + 5dB)			
			Day ³	Evening ⁴	Night ⁵	
NCA01A	L01	61	56	54	51	61
NCA01B	L01A	47	42	43	41	51
NCA03	L02	76	65	65	52	62
NCA04A	L04	61	56	54	46	56
NCA04B	L04A	55	50	50	44	54
NCA05A	L05	65	60	56	50	60
NCA05B	L05A	51	46	43	40	50
NCA06	L06	48	43	41	39	49
NCA07	L03	53	48	51	48	58
NCA08	L07	51	46	45 ⁷	42 ⁷	52
NCA09	L08	62	57	52	50	60
NCA14A	L09	64	59	54	47	57

¹ NCA02, NCA10 and NCA11 comprise of commercial and industrial type receivers and are not presented in this table

² Day standard construction hours: 7.00am to 6.00pm Monday to Friday and 8.00am to 5.00pm Saturday

³ Day out-of-hours: 5.00pm to 6.00pm on Saturday and 8.00am to 6.00pm on Sundays and public holidays

⁴ Evening: 6.00pm to 10.00pm Monday to Saturday.

⁵ Night: 10.00pm to 7.00am Monday to Friday, 10:00pm Friday to 8:00am Saturday, 6:00pm to 8:00am Sundays, and Public Holidays.

⁶ Sleep disturbance assessed for night time period only. Calculated during monitoring based on the following:

- L_{Aeq, 15 min} 40dB(A) or the prevailing RBL plus 5dB, whichever is greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 5dB, whichever is greater

⁷ Where the evening RBL is higher than the day RBL, the day RBL is adopted. Where the night RBL is higher than the evening RBL, the evening RBL is adopted

⁸ Caravan parks assessed as residential type receivers.

2.1.3. Noise monitoring results

Noise monitoring results are summarised in Table 7 below. The full tabulated results are provided in Appendix A.

Table 7 Noise Monitoring Results Summary

Monitoring NCA	Type of monitoring	Monitoring Occasions	Exceedance of Predicted Noise Level	Average exceedance LAeq 15min (dB)	Exceedance caused by works
NCA01A	Standard Hours	6	0	-	-
	OOHW	4	0	-	-
NCA01B	Standard Hours	6	3 exceedances	9.9	No – extraneous noise sources dominant
	OOHW	0	-	-	-
NCA03	Standard Hours	6	0	-	-
	OOHW	0	-	-	-
NCA04A	Standard Hours	6	5 exceedances	9.6	No – extraneous noise sources dominant
	OOHW	8	6 exceedances	6.2	No – extraneous noise sources dominant
NCA04B	Standard Hours	6	3 exceedances	10.0	No – extraneous noise sources dominant
	OOHW	0	-	-	-
NCA05A	Standard Hours	6	3 exceedances	6.2	No – extraneous noise sources dominant
	OOHW	0	-	-	-
NCA05B	Standard Hours	6	6 exceedances	6.0	No – extraneous noise sources dominant
	OOHW	0	-	-	-
NCA06	Standard Hours	6	6 exceedances	8.7	No – extraneous noise sources dominant
	OOHW	0	-	-	-
NCA07	Standard Hours	6	6 exceedances	4.9	No – extraneous noise sources dominant
	OOHW	6	6 exceedance	8.6	Project works contributed to 1 exceedance however extraneous noise sources were still dominant
NCA08	Standard Hours	6	6 exceedances	26.9	No – extraneous noise sources dominant
	OOHW	0	-	-	-

NCA09	Standard Hours	6	6 exceedances	8.7	No – extraneous noise sources dominant
	OOHW	1	1 exceedance	21.1	No – extraneous noise sources dominant
NCA14A	Standard Hours	6	6 exceedances	2.8	No – extraneous noise sources dominant
	OOHW	4	4 exceedances	20.3	No – extraneous noise sources dominant

During the 6-month monitoring period (13th November 2024 to 12th May 2025) there was one exceedance of the night Predicted Noise Level (PNL) within NCA07. The exceedance was identified during validation monitoring and while not primarily attributable to project work mitigation measures were implemented. There were no other exceedances of daytime, evening, or night PNLs identified as a result of BH2T construction activities and were instead attributed to external noise dominant sources. Dominant noise sources primarily included highway and local road traffic due to the volume and frequency of light vehicle and truck movements (un-related to the BH2T project). See Appendix A for the details of individual noise monitoring sessions undertaken within the monitoring period.

2.1.4. Management and mitigation measures implemented to address noise exceedances

Noise monitoring was undertaken on the 27th of November 2024 from 5:25am until 5:40am to validate noise levels associated with concrete pour works on the Bridge 5 viaduct deck. The concrete pour was audible and noise monitoring results indicated that the works contributed to an overall increase in the general noise level. These works had previously been validated on the 22nd of November 2024 and were confirmed to be compliant from 6:20am onwards. Given the previous compliant noise monitoring result for identical works undertaken on the Bridge 5 viaduct, works on the 27th of November were paused at 5:40am and were allowed to resume at 6:20am.

No additional management or mitigation measures were required to be implemented during the reporting period as all other exceedances recorded during noise monitoring events were attributed to extraneous sources.

2.2. Vibration monitoring

2.2.1. Vibration Monitoring Requirements

The Noise and Vibration Monitoring Program details the construction vibration monitoring requirements to be undertaken by JHGA JV and is summarised in Table 8 below.

Table 8 Vibration Monitoring Requirements

Monitoring Type	Requirements
Attended monitoring	At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded or as determined by a vibration assessment
	At the commencement of vibration generating activities that have the potential to impact on property/assets to confirm/identify the minimum working distances to prevent cosmetic damage
	Where vibration sensitive locations are determined to fall within the 'minimum working distances' established for each item of plant, so to refine the indicative minimum working distances

	Where appropriate in response to a vibration related complaint(s) (determined on a case-by- case basis) and in accordance with the EPL
	As directed by an authorised officer of the EPA
	As otherwise required by the NVIS, OOHV Protocol (Section 7) or EPL (i.e. as directed by authorised officer of the EPA)
Unattended monitoring	Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive works, an unattended vibration monitoring system will be installed where initial monitoring to establish safe buffer zones is insufficient to ensure goal levels are met, due to changing plant or unknown ground conditions.
Out-of-hours Protocol	Attended vibration monitoring at representative directly affected residents and sensitive land use(s) in the first instance of work where vibration levels are predicted to exceed maximum levels
	Additional vibration monitoring and review if complaints about the activity are received

Vibration limits to minimise impacts on human comfort are presented in the Noise and Vibration Assessment (NVA) in accordance with Assessing Vibration – A Technical Guideline (DEC, 2006) (AVTG). AVTG presents limits (vibration dose values (combines the magnitude of vibration and the time at which it occurs)), above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be adversely affected by construction work.

The applicable criteria for intermittent vibration are shown in Table 9 as vibration dose value ($\text{m/s}^{1.75}$). The vibration guideline also specifies limits for continuous and impulsive vibration. These vibration limits are expressed in acceleration (rate of change of velocity) (m/s^2) and peak particle velocity (velocity of vibration) (mm/s) as presented in Appendix C of the AVTG and reproduced in Table 9 and Table 10.

Table 9 Vibration limits for human exposure from intermittent vibration

Location	Assessment Period ¹	Vibration Dose Value ($\text{m/s}^{1.75}$) ²	
		Preferred value	Maximum value
Residences	Daytime ¹	0.2	0.4
	Night-time	0.13	0.26
Offices, schools, educational institutions, and places of worship	Anytime	0.4	0.8
Workshops	Anytime	0.8	1.6

¹ Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

² Preferred and maximum levels for human comfort (intermittent vibration) (Metres per second)

Table 10 Preferred and maximum values for continuous and impulsive vibration

Location	Assessment Period ¹	² RMS Acceleration m/s ³				³ Peak Particle Velocity mm/s	
		Preferred values		Maximum values		Preferred values	Preferred values
		Z axis	X & Y axes	Z axis	X & Y axes		
Continuous Vibration							
Critical areas	Daytime or night-time	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Daytime ⁴	0.010	0.0071	0.020	0.014	0.28	0.56
	Night-time	0.007	0.005	0.014	0.010	0.20	0.40
Offices, schools, educational institutions, and places of worship ⁴	Daytime or night-time	0.020	0.014	0.040	0.028	0.56	1.1

Location	Assessment Period ¹	² RMS Acceleration m/s ³				³ Peak Particle Velocity mm/s	
		Preferred values		Maximum values		Preferred values	Preferred values
		Z axis	X & Y axes	Z axis	X & Y axes		
Workshops	Day or night-time	0.04	0.29	0.080	0.0058	1.1	2.2
Impulsive vibration							
Critical areas	Day or night-time	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Daytime ⁴	0.3	0.21	0.60	0.42	8.6	17.0
	Night-time	0.10	0.071	0.20	0.14	2.8	5.6
Offices, schools, educational institutions, and places of worship ⁴	Daytime or night-time	0.64	0.46	1.28	0.92	18.0	36.0
Workshops	Daytime or night-time	0.64	0.46	1.28	0.92	18.0	36.0

¹ Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

² Values derived from z-axis critical frequency range

³ Values given for the most critical frequency range >8 Hz assuming sinusoidal motion. Where required, a more detailed analysis can be conducted as per AS 2670.2-1990.

⁴ Sufficient justification should accompany the use of a peak velocity approach if used in an assessment.

⁵ Specific values depend on social and cultural factors, psychological attitudes and expected degree of intrusion.

Vibration limits for cosmetic and structural damage caused by vibration is outlined in the NVA in line with German Standard DIN 4150 (1999) Part 3: Structural Vibration in Buildings: Effects on Structures. These limits are summarised in Table 11 and Table 12.

Table 11 Recommended vibration limits for cosmetic damage

Type of Structure	Guideline values for velocity, v_i , in mm/s, of vibration in horizontal plane of highest floor, at all frequencies ¹
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	2.5

¹ If a building is subjected to harmonic vibration, then the maximum values can also occur in floors other than the top floor, or in the foundation. The values given in the table also apply in these cases.

Table 12 Recommended vibration limits for short-term vibration on structures

Type of structure	Guideline values for velocity, v_i , in mm/s		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

¹ At frequencies above 100 Hz, the values given in this column may be used as a minimum value.

Vibration impacts from construction has the potential to affect services and utilities such as tunnels, buried pipelines, and fibre optic cables. Specific vibration criteria would be determined on a case-by-case basis. Where these utilities are encountered, the structure or utility's owner will be consulted to determine acceptable vibration levels in accordance with REMM NV04. In lieu of specific criteria, the NVA provides limits for short term vibration on these structures/utilities based on guidance in *German Standard DIN 4150 (1999) Part 3: Structural Vibration in Buildings: Effects on Structures*. These limits are reproduced in Table 13.

Table 13 Guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework

Pipe Material	Guideline values for velocity measured on the pipe, v_i , in mm/s
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastic	50

Table 14 details the minimum working distances for operating vibration intensive plant as per Table 4-3 of the Project Noise and Vibration Construction Monitoring Program.

Table 14 Recommended minimum working distances for vibration intensive plant and equipment

Plant item	Rating/activity description	Recommended minimum working distance		
		Cosmetic damage		Human response ³
		Structurally sound ¹ (e.g. residential & light commercial)	Structurally unsound ² (e.g. unsound heritage structures)	
Vibratory roller	< 50 kN (typically 1-2 t)	5m	11m	15m to 20m
	< 100 kN (typically 2-4 t)	6m	13m	20m
	< 200 kN (typically 4-6 t)	12m	15m	40m
	< 300 kN (typically 7-13 t)	15m	31m	100m
	> 300 kN (typically 13-18 t)	20m	40m	100m
	> 300 kN (typically > 18 t)	25m	50m	100m
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2m	5m	7m
Medium hydraulic hammer	900 kg – 12 to 18 t excavator	7m	15m	23m
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22m	30m	73m
Vibratory pile driver	Sheet piles	2 m to 20 m	5 m to 30 m	20 m to 50 m
Pile boring	≤ 800 mm	2m	5m	5m
Jackhammer	Handheld	1m	3m	5m
Blasting operations ⁴		Based on charge size – see Note ⁴		

Notes:

¹ Referenced from either the CNVG or against the criteria in the British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2

² Criteria referenced from DIN 4150-3:2016 Vibration in buildings – Effects on structures (including heritage items)

³ Referenced from either the CNVG or the criteria referenced in the EPA's Assessing Vibration: a technical guideline (December 2006)

⁴ To be determined during test blasts to establish appropriate propagation characteristics for the site and increase the accuracy of blasting predictions and confirmed

2.2.2. Vibration monitoring methodology

Vibration monitoring for human comfort, structural damage and heritage structures is undertaken in accordance with the guidelines and associated vibration reference levels and working distance set out in Table 11 to 14.

The procedure followed when undertaking vibration assessments ensures:

- Vibration monitoring equipment is placed outside at the footings or foundations of the building of interest, closest to the vibrating plant,
- The surface is solid and rigid to best represent the vibration entering the structure of the building under investigation,
- The vibration sensor or transducer is not mounted on loose tiles, loose gravel or other resilient surfaces,
- The vibration sensor or transducer is directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest, and
- Where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length is driven into solid ground adjacent to the building of interest and the vibration sensor or transducer shall be mounted on that.

Where vibration monitoring is undertaken to measure tactile vibration levels, vibration monitoring results shall be assessed and reported against the acceptable values of human exposure to vibration set out in Table 9 and Table 10.

For each monitoring event, the following information was recorded in the Project online records system:

- Date and time of measurements,
- Name of person undertaking the measurements,
- Type and model number of instrumentation,
- Description of the time aspects of each measurement (i.e. sample times, measurement time intervals and time of day),
- Sketch/photo map of area and measurement location,
- Measurement location details and number of measurements at each location,
- Operation and load conditions of the vibrating plant under investigation, and
- Possible vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic, etc.).

All monitoring was undertaken by competent personnel, appropriately qualified, suitably trained and experienced in undertaking vibration measurements. All vibration instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards.

2.2.3. Vibration monitoring results

As detailed in Table 14, and in accordance with Transport's Construction Noise and Vibration Guideline, no vibratory works occurred within minimum working distances for cosmetic damage in the reporting period and as such monitoring was not undertaken for this aspect. One vibration complaint was received and investigated in accordance with Transport's Construction Noise and Vibration Guidelines. The investigation found that the distance between the property and project construction works was approximately 360m and therefore below the threshold for property damage.

2.2.4. Management and mitigation measures implemented to address vibration exceedances

A review of planned work activities during the monitoring period determined there were no new vibratory activities in the vicinity of sensitive receivers that required monitoring for cosmetic damage and/or human comfort. Also, monitoring was not carried out for the one vibration complaint received during the reporting period. A detailed review of the complaint and activities underway during the period determined potential vibration impacts were well below thresholds for property damage and human comfort criteria.

3. Noise and Vibration Complaints

A total of two noise and vibration complaints were received during the reporting period as shown in Figure 3-1, below. The sole noise complaint was not linked to a specific incident but was instead a cumulative complaint arising from construction-generated noise during both standard construction hours and out-of-hours work. The vibration complaint did not specify whether the residents' concerns were related to works undertaken during standard construction hours or out-of-hours work. The complaint was regarding the potential for property damage. However, the resident is located approximately 360m away from the nearest project works, which is beyond the safe working distance for cosmetic damage for all plant and equipment used on the Project. All complaints have been investigated and closed out in accordance with the processes and procedures detailed in the Communications Strategy. Details of the complaints are provided in Appendix 3.

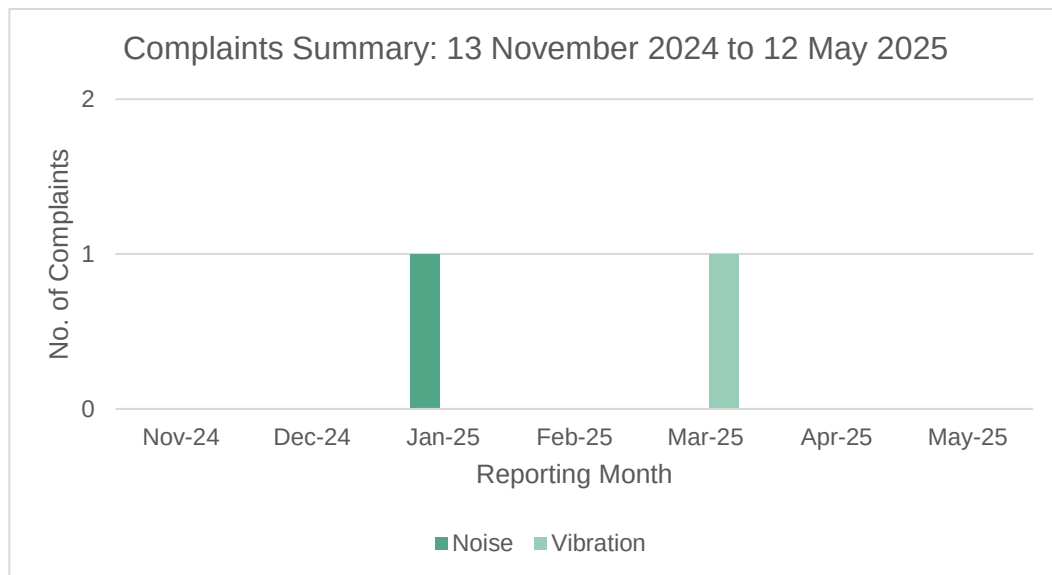


Figure 3-1: Complaints Summary

Appendix 1 – Noise Monitoring Results

Location Description	NCA	Activity	Date	Time Start	Time End	NML			PNL (LAeq 15min)	Results			Project OOHW Compliance	Comments/Field Observations
						Day	Evening	Night		LAeq 15min	Lamin	LAmaz		
33 Eastern Ave, Tarro NSW 2322, Australia	NCA04B	Structures – Anderson Rd off ramp noise wall construction	19/11/2024	15:28	15:43	55	50	44	50	59.8	52.4	72.2	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2 Anderson Dr, Tarro NSW 2322, Australia	NCA05A	Structures (Bridge 5)	19/11/2024	15:50	15:05	65	56	50	60	68.8	61.3	79.7	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
14 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridge 1)	20/11/2024	07:41	07:56	61	54	51	56	50.4	42.3	73.2	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
13 Walter Pde, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures (Bridge 1)	20/11/2024	08:09	08:24	47	43	41	42	58.7	37.1	85.6	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
53 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures (Bridge 1)	20/11/2024	09:05	09:20	76	65	52	65	70.9	52.2	87.7	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	20/11/2024	09:30	09:45	64	54	47	64	65.1	52.9	80.6	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1/15 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	20/11/2024	10:04	10:19	61	54	46	56	75.8	61.2	85.9	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridge 6)	20/11/2024	10:15	10:15	62	52	50	62	68.8	43.2	82.6	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Structures (Bridge 5)	20/11/2024	10:26	10:41	51	45	42	51	79	61.6	89.9	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
23 Lawson Ave, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities, structures	20/11/2024	11:58	11:13	48	41	39	43	64.8	43.4	79	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridge 5)	20/11/2024	10:55	11:10	53	51	48	53	57.7	51.3	74.3	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.
35 Anderson Dr, Tarro NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	20/11/2024	11:19	11:34	51	43	40	46	64.9	59	77.7	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Structures - Concrete deck pour	22/11/2024	06:18	06:34	53	51	48	51.3	57.4	53	69.7	Compliant	Validation monitoring was undertaken to confirm compliance with NCA07 NML to allow early starts for Bridge 5 Viaduct concrete deck pours. Traffic from New England Hwy and adjacent rail corridor proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Pavement - Material crushing/Pug mill operation	26/11/2024	05:48	06:03	62	52	50	52	71.1	58.1	83.1	Compliant	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Structures – Bridge 5 concrete deck pour	27/11/2024	05:25	05:40	53	51	48	51.3	59.8	52.3	82.1	Compliant	Validation monitoring was undertaken to confirm compliance with NCA07 NML to allow early starts for Bridge 5 Viaduct concrete deck pours. Traffic from New England Hwy and adjacent rail corridor proved to be noise dominant sources throughout the monitoring period. The deck pour works however could be heard and contributed to an overall increase in the general noise level. Project works were recorded between 57dB and 59dB. Works were paused at 5:40am and resumed at 6:20am. Works with an identical plant/equipment list and methodology were previously (22/11/2024) validated and confirmed compliant from 6:20am onwards.
3 Anderson Dr, Tarro NSW 2322, Australia	NCA04A	Lift and install of Bridge 5 girders over NEH, 30min road closures whilst lift takes place	9/12/2024	22:00	22:15	61	54	46	52.8	47.7	38.2	62	Compliant	Traffic from New England Hwy and adjacent rail corridor proved to be a consistent noise source throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Lift and install of Bridge 5 girders over NEH, 30min road closures whilst lift takes place	9/12/2024	23:45	00:00	53	51	48	55.9	50.7	39.2	64.7	Compliant	Traffic from New England Hwy and adjacent rail corridor proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below the PNL and therefore works were compliant. Project works were recorded between 41dB and 44dB.

Location Description	NCA	Activity	Date	Time Start	Time End	NML			PNL (LAeq 15min)	Results			Project OOHW Compliance	Comments/Field Observations
						Day	Evening	Night		LAeq 15min	L Amin	L Amax		
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	13/12/2024	10:34	10:49	64	54	47	64	69.1	59.4	81.6	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Earthworks, pavements, utilities, structures (Bridge 5)	13/12/2024	13:36	13:51	51	45	42	51	78	65.9	90.8	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridge 6)	16/12/2024	07:30	07:45	62	52	50	62	69.6	46.8	83.7	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
56 Redbill Dr, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities, structures	16/12/2024	15:58	16:13	48	41	39	48	56	37.8	75.8	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridge 5)	17/12/2024	08:50	09:05	53	51	48	53	57.7	49.6	75.9	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.
2 Anderson Dr, Tarro NSW 2322, Australia	NCA05A	Earthworks, pavements, utilities, structures (Bridge 5)	17/12/2024	09:20	09:35	65	56	50	65	72.2	61.8	90.4	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
49 Beresford Ave, Beresfield NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures	17/12/2024	09:47	10:02	51	43	40	51	53	36.8	78.7	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
22 Lenox St, Beresfield NSW 2322 Australia	NCA04B	Earthworks, pavements, utilities, structures	17/12/2024	10:22	10:37	55	50	44	55	60.1	41.5	73.3	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridge 1)	19/12/2024	08:41	08:56	61	54	51	61	57	52.8	-	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
20 Walter Pde, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures (Bridge 1)	19/12/2024	09:14	09:29	47	43	41	47	46.8	41.7	61	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
33 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	19/12/2024	13:16	13:31	61	54	46	61	68.1	57.6	86.2	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
53 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures	19/12/2024	13:46	13:59	76	65	52	76	68.4	54.5	83.2	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridge 1)	23/01/2025	11:41	11:56	61	54	51	61	53.6	48.9	65.6	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
20 Walter Parade, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures (Bridge 1)	23/01/2025	12:12	12:27	47	43	41	47	43.7	37.2	65.4	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
54 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures	23/01/2025	12:47	13:02	76	65	52	76	71.9	52.2	86.8	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
3 Anderson Dr, Tarro NSW 2322, Australia	NVA05A	Earthworks, pavements, utilities, structures (Bridge 5)	29/01/2025	08:56	9:11	65	56	50	65	72.5	59	81.1	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
49 Beresford Ave, Beresfield NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures	29/01/2025	10:06	10:21	51	43	40	51	54.2	40.5	70.5	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
14 Quarter Sessions Rd, Tarro NSW 2322, Australia	NVA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	29/01/2025	08:35	8:50	61	54	46	61	58.7	47.9	68.3	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
54 Redbill Dr, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities, structures	29/01/2025	10:33	10:48	48	41	39	48	53	37.3	73.7	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
22 Lenox St, Beresfield NSW 2322, Australia	NCA04B	Earthworks, pavements, utilities, structures	29/01/2025	09:30	9:55	55	50	44	55	75	47.7	90.8	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridges 5)	30/01/2025	10:05	10:20	53	51	48	53	53.6	45.8	78.3	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.

Location Description	NCA	Activity	Date	Time Start	Time End	NML			PNL (LAeq 15min)	Results			Project OOHW Compliance	Comments/Field Observations
						Day	Evening	Night		LAeq 15min	L Amin	L Amax		
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Earthworks, pavements, utilities, structures (Bridge 5)	30/01/2025	09:37	09:52	51	45	42	51	79.6	61.7	100.4	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridge 6)	30/01/2025	09:08	09:23	62	52	50	62	71.4	49.9	84.3	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	30/01/2025	08:24	08:39	64	54	47	64	64.2	52.4	83.4	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Pavement - Northern northbound traffic switch	10/02/2025	20:39	20:54	64	54	47	58.8	73.1	47.8	100.7	Compliant	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Pavement – Northern northbound traffic switch	11/02/2025	00:29	00:44	64	54	47	58.8	68.8	37.1	85.7	Compliant	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Pavement - Lenaghans Dr/Gate 1a traffic switch and asphaltting	12/02/2025	20:34	20:49	61	54	51	63.6	51.2	47.6	59.5	Compliant	Traffic from M1 Pacific Motorway proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below both the NML and PNL and therefore works were compliant. Project works were recorded to be no more than 53dB. All applicable mitigation measures were implemented to reduce project noise impacts.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Pavement - Lenaghans Dr/Gate 1a traffic switch and asphaltting	12/02/2025	23:01	23:16	61	54	51	63.6	49.6	43.9	63.6	Compliant	Traffic from M1 Pacific Motorway proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below both the NML and PNL and therefore works were compliant. Project works were recorded to be no more than 52dB. All applicable mitigation measures were implemented to reduce project noise impacts.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Pavement - Milling and Re-sheet M1 southbound lanes	19/02/2025	23:53	00:08	61	54	51	63.4	46.4	41.3	65.1	Compliant	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Structures - Parapet installation on Span 9 of Bridge 5	19/02/2025	00:25	00:40	53	51	48	40.4	54.1	42.5	80.8	Compliant	Traffic from New England Hwy and adjacent rail corridor proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Pavement - Milling and Re-sheet M1 southbound lanes	19/02/2025	22:20	22:35	61	54	51	63.4	48	44	55.6	Compliant	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Structures - Parapet installation and handrail removal (Bridge 5)	19/02/2025	22:52	23:07	53	51	48	40.4	55.7	46.5	68.9	Compliant	Traffic from New England Hwy and adjacent rail corridor proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
21 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridge 1)	20/02/2025	08:12	08:27	61	54	51	61	57.6	51.4	71.9	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1/15 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Pavement - Milling and re-sheet NEH northbound lanes	20/02/2025	22:28	22:43	61	54	46	72.4	62.1	51.6	80.1	Compliant	Traffic from New England Hwy proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below the PNL and therefore works were compliant. Project works were recorded between 53dB and 65dB. All applicable mitigation measures were implemented to reduce project noise impacts.
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Earthworks, pavements, utilities, structures (Bridge 5)	21/02/2025	15:49	16:04	51	45	42	51	76	57.9	86.8	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridge 6)	21/02/2025	15:15	15:30	62	52	50	62	71.2	56.8	84.7	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	21/02/2025	14:42	14:57	64	54	47	64	65.7	52.1	76	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridge 5)	21/02/2025	14:08	14:23	53	51	48	53	57.5	49.1	73.1	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.
11 Anderson Dr, Tarro NSW 2322, Australia	NCA05A	Earthworks, pavements, utilities, structures (Bridge 5)	21/02/2025	12:33	12:48	65	56	50	65	64.6	56.8	76	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.

Location Description	NCA	Activity	Date	Time Start	Time End	NML			PNL (LAeq 15min)	Results			Project OOHw Compliance	Comments/Field Observations
						Day	Evening	Night		LAeq 15min	L Amin	L Amax		
56 Redbill Dr, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities, structures	21/02/2025	12:05	12:20	48	41	39	48	57.9	34.5	81.4	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
49 Beresford Ave, Beresfield NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures	21/02/2025	11:40	11:55	51	43	40	51	55.2	33.1	74.3	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
22 Lenox St, Beresfield NSW 2322, Australia	NCA04B	Earthworks, pavements, utilities, structures	21/02/2025	11:13	11:28	55	50	44	55	51.4	40.1	71	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1/15 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	21/02/2025	09:16	09:31	61	54	46	61	69.8	57	81	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
64 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures (Bridge 1)	21/02/2025	08:50	09:05	76	65	52	76	73.6	50.2	90.4	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
20 Walter Parade, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures (Bridge 1)	21/02/2025	08:18	08:33	47	43	41	47	56.8	42.7	70.1	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
29 Eastern Ave, Tarro NSW 2322, Australia	NCA04A	Structures – Anderson Rd off ramp noise wall construction (drilled piling)	3/03/2025	22:52	23:07	61	54	46	46.6	53.6	43.4	62.7	Compliant	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
29 Eastern Ave, Tarro NSW 2322, Australia	NCA04A	Structures – Anderson Rd off ramp noise wall construction (drilled piling)	4/03/2025	21:04	21:19	61	54	46	46.6	53.3	45.8	65	Compliant	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
29 Eastern Ave, Tarro NSW 2322, Australia	NCA04A	Structures – Anderson Rd off ramp noise wall construction (drilled piling)	4/03/2025	22:16	22:26	61	54	46	46.6	55.1	45.7	65.8	Compliant	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
75 Allendale St, Beresfield NSW 2322, Australia	NCA04A	Pavement - Line marking adjacent to JRD flyover	4/03/2025	21:38	21:52	61	54	46	61.7	51.6	44.2	61.5	Compliant	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
42 Sapphire Dr, Tarro NSW 2322, Australia	NCA04A	Pavement - Material crushing/Pug mill operation	7/03/2025	05:30	05:45	61	54	46	51.5	53.8	47.8	73.4	Compliant	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Pavement - Northern southbound traffic switch	13/03/2025	22:38	22:53	64	54	47	58.8	70.6	56.9	103.5	Compliant	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Pavement - Northern southbound traffic switch	13/03/2025	21:10	21:25	64	54	47	58.8	70.7	59.3	82.2	Compliant	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were inaudible and therefore works were compliant.
54 Redbill Dr, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities	21/03/2025	09:23	09:38	48	41	39	48	53.9	41	76.4	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridge 6)	21/03/2025	07:50	08:05	62	52	50	62	71.1	52	85.5	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridge 5)	21/03/2025	08:26	08:41	53	51	48	53	61	54.2	77.2	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.
7 Anderson Dr, Tarro NSW 2322, Australia	NCA05A	Earthworks, pavements, utilities, structures (Bridge 5)	21/03/2025	08:55	09:10	65	56	50	65	62.9	54.2	74.9	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. Ausgrid works unrelated to the project were ongoing throughout the monitoring period, also attributing to the LAeq. BH2T works were compliant.
1/15 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	25/03/2025	11:15	11:30	61	54	46	61	69.9	59.7	81	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
54 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures (Bridges 1)	25/03/2025	11:43	11:58	76	65	52	76	73.4	53.2	88.6	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
14 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Pavement - Milling and re-sheet NEH northbound lanes	25/03/2025	22:12	22:27	61	54	46	63.8	53.6	48.4	69	Compliant	Traffic from New England Hwy proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below the PNL and therefore works were compliant. Project works were recorded between 55dB and 60dB. All applicable mitigation measures were implemented to reduce project noise impacts.

Location Description	NCA	Activity	Date	Time Start	Time End	NML			PNL (LAeq 15min)	Results			Project OOHW Compliance	Comments/Field Observations
						Day	Evening	Night		LAeq 15min	Lamin	LAmx		
29 Eastern Ave, Tarro NSW 2322, Australia	NCA04A	Pavement - Milling and re-sheet NEH northbound lanes	25/03/2025	22:46	23:01	61	54	46	65.6	49.3	42.5	58.1	Compliant	Traffic from New England Hwy proved to be a consistent noise source throughout the monitoring period. BH2T works were audible, however the resulting LAeq was below the PNL and therefore works were compliant. Project works were recorded between 50dB and 55dB. All applicable mitigation measures were implemented to reduce project noise impacts.
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Earthworks, pavements, utilities, structures (Bridge 5)	26/03/2025	15:40	15:55	51	45	42	51	77.9	60.3	89.7	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	26/03/2025	15:00	15:15	64	54	47	64	69.1	56.9	79.7	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
49 Beresford Ave, Beresfield NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures	26/03/2025	14:24	14:39	51	43	40	51	60.4	37.4	85.7	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
22 Lenox St, Beresfield NSW 2322, Australia	NCA04B	Earthworks, pavements, utilities, structures	26/03/2025	14:02	14:17	55	50	44	55	53.2	38.5	72.9	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
20 Walter Parade, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures	26/03/2025	12:00	12:15	47	43	41	47	55.1	40.6	79.9	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. Dogs within the neighbourhood were also barking consistently, contributing to LAeq. BH2T works were compliant.
23 Cahill Cl, Black Hill NSW 2322, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridges 1)	26/03/2025	11:35	11:50	61	54	51	61	53.9	44.2	71.9	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
23 Cahill Cl, Black Hill, NSW, Australia	NCA01A	Earthworks, pavements, utilities, structures (Bridges 1)	14/04/2025	10:38	10:53	61	54	51	61	57.4	46.7	78.1	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
54 Weakleys Dr, Beresfield NSW 2322, Australia	NCA03	Earthworks, pavements, utilities, structures (Bridges 1)	14/04/2025	10:10	10:25	76	65	52	76	70.2	47.8	87.3	N/A standard working hours	Traffic from Weakleys Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1/15 Quarter Sessions Rd, Tarro NSW 2322, Australia	NCA04A	Earthworks, pavements, utilities, structures (Bridges 2, 3 & 4)	14/04/2025	09:40	09:55	61	54	46	61	69.3	50.9	78.8	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
20 Walter Parade, Black Hill NSW 2322, Australia	NCA01B	Earthworks, pavements, utilities, structures (Bridges 1)	14/04/2025	11:05	11:20	47	43	41	47	44.8	39.1	61.2	N/A standard working hours	Traffic from M1 Pacific Motorway proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
22 Lenox St, Beresfield NSW 2322, Australia	NCA04B	Earthworks, pavements, utilities, structures	16/04/2025	11:38	11:53	55	50	44	55	53.9	42.7	75.6	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
49 Beresford Ave, Beresfield NSW 2322, Australia	NCA05B	Earthworks, pavements, utilities, structures	16/04/2025	12:00	12:15	51	43	40	51	54.5	41.7	76.8	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
61 Redbill Dr, Woodberry NSW 2322, Australia	NCA06	Earthworks, pavements, utilities, structures	16/04/2025	13:31	13:46	48	41	39	48	54.5	39.8	73.2	N/A standard working hours	Traffic from multiple residential roads adjacent to monitoring location proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
11 Anderson Dr, Tarro NSW 2322, Australia	NCA05A	Earthworks, pavements, utilities, structures (Bridges 5)	16/04/2025	13:56	14:11	65	56	50	65	64.5	57.2	78.6	N/A standard working hours	Traffic from New England Hwy and Anderson Dr proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
1 Woodlands Cl, Tarro NSW 2322, Australia	NCA07	Earthworks, pavements, utilities, structures (Bridges 5)	16/04/2025	14:18	14:33	53	51	48	53	60.1	46.5	83.3	N/A standard working hours	Traffic from New England Hwy and local roads proved to be noise dominant sources throughout the monitoring period. Passenger and coal trains were also in frequent operation within the nearby rail corridor (~150m away). BH2T works were compliant.
205 New England Hwy, Hexham NSW 2322, Australia	NCA08	Earthworks, pavements, utilities, structures (Bridges 5)	29/04/2025	10:42	10:57	51	45	42	51	77.1	55.2	88.7	N/A standard working hours	Traffic from New England Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
838 Tomago Rd, Tomago NSW 2322, Australia	NCA09	Earthworks, pavements, utilities, structures (Bridges 6)	29/04/2025	10:13	10:28	62	52	50	62	72.3	50.2	92.2	N/A standard working hours	Traffic from Pacific Hwy and Tomago Rd proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.
2137 Pacific Hwy, Heatherbrae NSW 2324, Australia	NCA14A	Earthworks, pavements, utilities	29/04/2025	12:33	12:48	64	54	47	64	68	47.9	82.8	N/A standard working hours	Traffic from Pacific Hwy proved to be noise dominant sources throughout the monitoring period. BH2T works were compliant.

Appendix 2 – Noise and Vibration Complaints

Date	Suburb	Issue	Complaint Details	Investigation Outcome	Response Provided to Stakeholder	Status
30/01/2025	Tarro	Noise	Resident complaint about noise waking them up early in the morning / through the night.	The project team reviewed out of hours works and confirmed that Project works undertaken on the 29-30/01 would have been audible at the residence. A review of recent OOHW permits indicate noise levels up to "noticeable" disturbance criteria (<5dbA above NML) at this residence during recent night work. The resident advised that there was not a particular incident / noise that had led to the complaint but rather the cumulative impact of the project including noise - particularly from the compound. The residents advised they were more concerned about the long-term impacts of traffic noise and said they had not been offered any noise treatments.	CSE Lead and residents agreed on the following actions at the time of the complaint: - CSE Lead to email TfNSW to request response on operational noise. TfNSW to respond to operational noise concerns. - CSE lead to arrange for additional mitigation for the residents. - Project team also to be reminded via toolbox meetings to keep noise to a minimum at the compound on night shift by reducing reversing / turning off squawkers. - Residents advised to call as soon as anything in particular bothers them so the team can attempt to rectify immediately.	Closed
19/03/2025	Tarro	Vibration	Resident complained about vibration occurring at the rear of the property which they believed may cause damage to the house. Resident advised they had not noticed any damage as yet, but they could hear / feel the house rattle and was concerned that it would cause damage.	CSE Lead advised resident they would discuss with the Project environment team and check if a pre-construction survey had been undertaken and call them back once they had this information	CSE Lead advised resident that nearest work was 360m away and beyond the safe working distance for cosmetic damage associated with vibration. CSE Lead advised that if resident did happen to notice damage at any stage to please contact the Project.	Closed

Appendix 3 – Sound Level Meters, Sound Calibrators and Vibration Monitor Calibration Records



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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C25195-V1

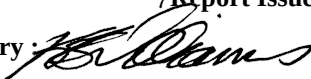
Client Details JOHN HOLLAND GAMUDA JV
35 New England Highway
Tarro NSW 2322

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534928

Atmospheric Conditions

Ambient Temperature : 21 °C
Relative Humidity : 44.9 %
Barometric Pressure : 100.51 kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 07-Apr-2025
Secondary Check: Emanuel Eid
Report Issue Date : 29-May-2025

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	94.09	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	Temperature
Frequency	Relative Humidity
Distortion	Barometric Pressure

±0.10 dB
±0.07 %
±0.20 %

±0.1 °C
±1.9 %
±0.11 kPa

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



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

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.



Sound Calibrator

IEC 60942:2017

Calibration Test Report

Calibration Number C25195-V1

Client Details	JOHN HOLLAND GAMUDA JV 35 New England Highway Tarro NSW 2322		
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Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534928

Atmospheric Conditions

Ambient Temperature : 21 °C
Relative Humidity : 44.9 %
Barometric Pressure : 100.51 kPa

Calibration Technician :	Shaheen Boaz	Secondary Check:	Emanuel Eid
Calibration Date :	07-Apr-2025	Report Issue Date :	29-May-2025

Approved Signatory :

Ken Williams

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

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

		Uncertainties of Measurement -	
Specific Tests		Environmental Conditions	
Generated SPL	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.11 kPa

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.

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1. REVISION HISTORY

Revision	Date	Description
1	29-May-2025	Original Issue

2. OVERVIEW

This report presents the calibration test results of a NC-75 Acoustic Calibrator, and associated equipment. Calibration is carried out in accordance with *IEC 60942-2017, Electroacoustics - Sound Calibrators*.

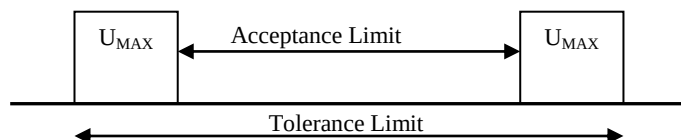
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

This report was generated using template version identifier of 64f64c78.

2.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.



Where deviations from the design goals are provided to determine conformance to performance specifications, each measurement is reported with:

- The measured deviation from the design goal
- Associated acceptance limits for the test
- Maximum allowable uncertainty of measurement for the test
- Actual expanded uncertainty for each measurement

2.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

3. GENERAL

3.1 DEVICE UNDER TEST

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534928

Instrument received in fair condition.

3.2 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

All tolerance limits stated apply to measurements made at and around reference environmental conditions within the following ranges:

80 kPa to 105 kPa

20°C to 26°C

25% to 90% relative humidity

3.3 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of IEC 60942-2017 Annex B.

3.4 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

3.4.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N – 2985012) was used as the reference for the sound pressure level and the signal frequency.

3.4.2 Sound Level Meter

ARL Ngara Class 1 (S/N – 878035). This device was used for converting acoustic signals into voltages which may be measured by the multimeter.

3.4.3 Audio Analyser

Abonet Audio Analyzer AVR-3710 (S/N – V859B9018). This device was used for measuring the AC voltage output of the reference Ngara unit. The AC level is proportional to the sound pressure level and frequency applied to the reference microphone.

3.4.4 Environmental Monitoring

A MHB-382SD (S/N – AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

4. CALIBRATION TEST RESULTS

4.1 SOUND PRESSURE LEVEL

4.1.1 Generated Sound Pressure Level

The sound pressure level generated by the sound calibrator was measured three times as an average over 20 s of operation. During each measurement the sound calibrator was decoupled and rotated from the microphone to ensure any variations in operation were captured.

Table 1 – Generated Sound Pressure Level Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Level (dB)	Deviation (dB)	Acceptance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)	Measured Output
94	1000	94.09	0.09	±0.25	P	0.10	0.15	

4.2 FREQUENCY OUTPUT

The frequency generated by the sound calibrator was measured as an average over 20s of operation. The deviation from expected values is calculated as the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency.

Table 2 – Frequency Output Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Frequency (Hz)	Deviation (Hz)	Acceptance Limit (Hz)	P/F	Uncertainty (Hz)	Maximum Permitted Uncertainty (Hz)	Measured Output
94	1000	1000.00	0.00	±7.00	P	0.70	2.00	

4.3 TOTAL HARMONIC DISTORTION AND NOISE

The total harmonic distortion and noise (THD+N), measured over the frequency range from 22,5 Hz to 20 kHz, was measured as an average over 20s of operation.

Table 3 – THD+N Results

Nominal Level (dB)	Nominal Frequency (Hz)	Distortion (%)	Acceptance Limit (%)	P/F	Uncertainty (%)	Maximum Permitted Uncertainty (%)	Measured Output
94	1000	0.15	±2.50	P	0.20	0.50	



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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C25194-V1

Client Details JOHN HOLLAND GAMUDA JV
35 New England Highway
Tarro NSW 2322

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534930

Atmospheric Conditions

Ambient Temperature : 21 °C
Relative Humidity : 45.9 %
Barometric Pressure : 100.51 kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 07-Apr-2025

Secondary Check: Emanuel Eid
Report Issue Date : 29-May-2025

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	94.09	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	Temperature
Frequency	Relative Humidity
Distortion	Barometric Pressure

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.
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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.



Sound Calibrator IEC 60942:2017 Calibration Test Report

Calibration Number C25194-V1

Client Details JOHN HOLLAND GAMUDA JV 35 New England Highway Tarro NSW 2322			
Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534930
Atmospheric Conditions			
Ambient Temperature :	21 °C		
Relative Humidity :	45.9 %		
Barometric Pressure :	100.51 kPa		
Calibration Technician :	Shaheen Boaz	Secondary Check:	Emanuel Eid
Calibration Date :	07-Apr-2025	Report Issue Date :	29-May-2025

Approved Signatory :

Ken Williams

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

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

Uncertainties of Measurement -			
Specific Tests	Environmental Conditions		
	Generated SPL	±0.10 dB	Temperature ±0.1 °C
	Frequency	±0.07 %	Relative Humidity ±1.9 %
	Distortion	±0.20 %	Barometric Pressure ±0.11 kPa

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



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1. REVISION HISTORY

Revision	Date	Description
1	29-May-2025	Original Issue

2. OVERVIEW

This report presents the calibration test results of a NC-75 Acoustic Calibrator, and associated equipment. Calibration is carried out in accordance with *IEC 60942-2017, Electroacoustics - Sound Calibrators*.

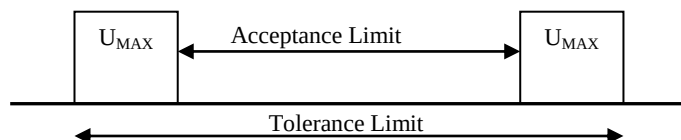
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

This report was generated using template version identifier of 64f64c78.

2.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.



Where deviations from the design goals are provided to determine conformance to performance specifications, each measurement is reported with:

- The measured deviation from the design goal
- Associated acceptance limits for the test
- Maximum allowable uncertainty of measurement for the test
- Actual expanded uncertainty for each measurement

2.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

3. GENERAL

3.1 DEVICE UNDER TEST

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34534930

Instrument received in fair condition.

3.2 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

All tolerance limits stated apply to measurements made at and around reference environmental conditions within the following ranges:

80 kPa to 105 kPa

20°C to 26°C

25% to 90% relative humidity

3.3 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of IEC 60942-2017 Annex B.

3.4 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

3.4.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N – 2985012) was used as the reference for the sound pressure level and the signal frequency.

3.4.2 Sound Level Meter

ARL Ngara Class 1 (S/N – 878035). This device was used for converting acoustic signals into voltages which may be measured by the multimeter.

3.4.3 Audio Analyser

Abonet Audio Analyzer AVR-3710 (S/N – V859B9018). This device was used for measuring the AC voltage output of the reference Ngara unit. The AC level is proportional to the sound pressure level and frequency applied to the reference microphone.

3.4.4 Environmental Monitoring

A MHB-382SD (S/N – AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

4. CALIBRATION TEST RESULTS

4.1 SOUND PRESSURE LEVEL

4.1.1 Generated Sound Pressure Level

The sound pressure level generated by the sound calibrator was measured three times as an average over 20 s of operation. During each measurement the sound calibrator was decoupled and rotated from the microphone to ensure any variations in operation were captured.

Table 1 – Generated Sound Pressure Level Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Level (dB)	Deviation (dB)	Acceptance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)	Measured Output
94	1000	94.09	0.09	±0.25	P	0.10	0.15	

4.2 FREQUENCY OUTPUT

The frequency generated by the sound calibrator was measured as an average over 20s of operation. The deviation from expected values is calculated as the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency.

Table 2 – Frequency Output Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Frequency (Hz)	Deviation (Hz)	Acceptance Limit (Hz)	P/F	Uncertainty (Hz)	Maximum Permitted Uncertainty (Hz)	Measured Output
94	1000	1000.00	0.00	±7.00	P	0.70	2.00	

4.3 TOTAL HARMONIC DISTORTION AND NOISE

The total harmonic distortion and noise (THD+N), measured over the frequency range from 22,5 Hz to 20 kHz, was measured as an average over 20s of operation.

Table 3 – THD+N Results

Nominal Level (dB)	Nominal Frequency (Hz)	Distortion (%)	Acceptance Limit (%)	P/F	Uncertainty (%)	Maximum Permitted Uncertainty (%)	Measured Output
94	1000	0.30	±2.50	P	0.20	0.50	



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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C25056-V1

Client Details John Holland Gamuda JV
35 New England Highway
Tarro, NSW, 2322

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34735012

Atmospheric Conditions

Ambient Temperature : 23.9 °C
Relative Humidity : 50.9 %
Barometric Pressure : 100.47 kPa

Calibration Technician : Jeff Yu	Secondary Check: Rhys Gravelle
Calibration Date : 03-Feb-2025	Report Issue Date : 04-Feb-2025

Approved Signatory :

Ken Williams

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

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.01	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	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.11 kPa

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



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

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The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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Sound Calibrator

IEC 60942:2017

Calibration Test Report

Calibration Number C25056-V1

Client Details	John Holland Gamuda JV 35 New England Highway Tarro, NSW, 2322		
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Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34735012

Atmospheric Conditions

Ambient Temperature : 23.9 °C
Relative Humidity : 50.9 %
Barometric Pressure : 100.47 kPa

Calibration Technician : Jeff Yu
Calibration Date : 03-Feb-2025

Secondary Check: Rhys Gravelle
Report Issue Date : 04-Feb-2025

Approved Signatory :

Ken Williams

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

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

Uncertainties of Measurement -			
Specific Tests		Environmental Conditions	
Generated SPL	±0.10 dB	Temperature	±0.1 °C
Frequency	±0.07 %	Relative Humidity	±1.9 %
Distortion	±0.20 %	Barometric Pressure	±0.11 kPa

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



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1. REVISION HISTORY

Revision	Date	Description
1	04-Feb-2025	Original Issue

2. OVERVIEW

This report presents the calibration test results of a NC-75 Acoustic Calibrator, and associated equipment. Calibration is carried out in accordance with *IEC 60942-2017, Electroacoustics - Sound Calibrators*.

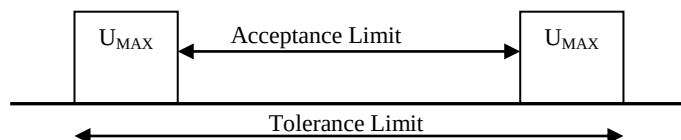
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

This report was generated using template version identifier of 14a2494f.

2.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.



Where deviations from the design goals are provided to determine conformance to performance specifications, each measurement is reported with:

- The measured deviation from the design goal
- Associated acceptance limits for the test
- Maximum allowable uncertainty of measurement for the test
- Actual expanded uncertainty for each measurement

2.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

3. GENERAL

3.1 DEVICE UNDER TEST

Equipment Tested :	<i>Manufacturer</i>	<i>Model</i>	<i>Serial</i>
Instrument :	Rion	NC-75	34735012

Instrument received in fair condition.

3.2 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

All tolerance limits stated apply to measurements made at and around reference environmental conditions within the following ranges:

80 kPa to 105 kPa

20°C to 26°C

25% to 90% relative humidity

3.3 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of IEC 60942-2017 Annex B.

3.4 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

3.4.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N – 2985012) was used as the reference for the sound pressure level and the signal frequency.

3.4.2 Sound Level Meter

ARL Ngara Class 1 (S/N – 878035). This device was used for converting acoustic signals into voltages which may be measured by the multimeter.

3.4.3 Audio Analyser

Abonet Audio Analyzer AVR-3710 (S/N – V859B9018). This device was used for measuring the AC voltage output of the reference Ngara unit. The AC level is proportional to the sound pressure level and frequency applied to the reference microphone.

3.4.4 Environmental Monitoring

A MHB-382SD (S/N – AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

4. CALIBRATION TEST RESULTS

4.1 SOUND PRESSURE LEVEL

4.1.1 Generated Sound Pressure Level

The sound pressure level generated by the sound calibrator was measured three times as an average over 20 s of operation. During each measurement the sound calibrator was decoupled and rotated from the microphone to ensure any variations in operation were captured.

Table 1 – Generated Sound Pressure Level Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Level (dB)	Deviation (dB)	Acceptance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)	Measured Output
94	1000	94.01	0.01	±0.25	P	0.10	0.15	

4.2 FREQUENCY OUTPUT

The frequency generated by the sound calibrator was measured as an average over 20s of operation. The deviation from expected values is calculated as the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency.

Table 2 – Frequency Output Results

Nominal Level (dB)	Nominal Frequency (Hz)	Measured Frequency (Hz)	Deviation (Hz)	Acceptance Limit (Hz)	P/F	Uncertainty (Hz)	Maximum Permitted Uncertainty (Hz)	Measured Output
94	1000	1000.00	0.00	±7.00	P	0.70	2.00	

4.3 TOTAL HARMONIC DISTORTION AND NOISE

The total harmonic distortion and noise (THD+N), measured over the frequency range from 22,5 Hz to 20 kHz, was measured as an average over 20s of operation.

Table 3 – THD+N Results

Nominal Level (dB)	Nominal Frequency (Hz)	Distortion (%)	Acceptance Limit (%)	P/F	Uncertainty (%)	Maximum Permitted Uncertainty (%)	Measured Output
94	1000	0.31	±2.50	P	0.20	0.50	



Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23504

Client Details		John Holland Gamuda JV 796 Hunter Street Newcastle West NSW 2302
Equipment Tested/ Model Number :		NL-53EX
Instrument Serial Number :		00330124
Microphone Serial Number :		22762
Pre-amplifier Serial Number :		32798
Firmware Version :		1.0
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 21.9 °C		Ambient Temperature : 22 °C
Relative Humidity : 45 %		Relative Humidity : 45 %
Barometric Pressure : 102.4 kPa		Barometric Pressure : 102.4 kPa
Calibration Technician : Max Moore		Secondary Check: Megan Williams
Calibration Date : 25 Jul 2023		Report Issue Date : 26 Jul 2023
Approved Signatory : 		Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	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.

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

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

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



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

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Accredited for compliance with ISO/IEC 17025 - Calibration.

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

Calibration Number C23504

Client Details John Holland Gamuda JV
796 Hunter Street
Newcastle West NSW 2302

Equipment Tested/ Model Number : NL-53EX
Instrument Serial Number : 00330124
Microphone Serial Number : 22762
Pre-amplifier Serial Number : 32798
Firmware Version : 1.0

Pre-Test Atmospheric Conditions
Ambient Temperature : 21.9 °C
Relative Humidity : 45 %
Barometric Pressure : 102.4 kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 22 °C
Relative Humidity : 45 %
Barometric Pressure : 102.4 kPa

Calibration Technician : Max Moore
Calibration Date : 25 Jul 2023

Secondary Check: Megan Williams
Report Issue Date : 26 Jul 2023

Approved Signatory : 

Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	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.

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

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

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



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

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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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1. OVERVIEW

This report presents the calibration test results of a NL-53EX Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3:2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

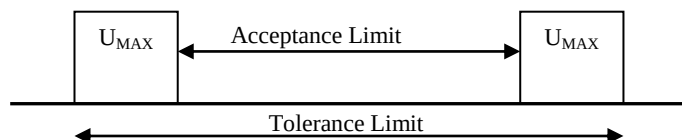
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version as provided by the manufacturer.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.



Where deviations from the design goals are provided to determine conformance to performance specifications, each measurement is reported with:

- The measured deviation from the design goal
- Associated acceptance limits for the test
- Maximum allowable uncertainty of measurement for the test
- Actual expanded uncertainty for each measurement

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3:2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 13pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 792819 2132). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Keysight 33511B (S/N – MY58001621) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG.44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	94.00	94.10	94.02	93.94
C	94.00	94.10	94.02	93.94
Z	94.00	94.10	94.02	93.94

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

14.50	14.60	14.80	14.40	14.30
14.50	14.40	14.50	14.80	14.80

Acoustic Noise Floor : 14.6 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

11.30	11.40	11.40	11.30	11.30
11.30	11.40	11.30	11.20	11.20

Random Readings dB(C)

15.10	14.60	14.70	13.80	11.30
15.40	14.50	15.20	14.40	14.50

Random Readings dB(Z)

21.6	19.3	19.9	17.8	19.9
20.5	22.8	21.4	19.4	19.3

Electric Noise Floor :

dB(A)	dB(C)	dB(Z)
11.3	14.4	20.2

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	Uncertainty (dB)
125	93.9	93.9	93.9	0.13
1 000	94.1	94.1	94.1	0.13
8 000	87.4	87.4	87.4	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uncertainty (dB)
		Actual	re 1kHz	
125.90	-0.06	93.84	-0.18	0.13
1005.10	-0.08	94.02	0.00	0.13
7915.10	0.00	87.40	-6.62	0.14

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq (Hz)	Pressure to Freefield (dB)	Uncertainty (dB)	Body Effects (dB)	Uncertainty (dB)	WS Effects (dB)	Uncertainty (dB)
125.90	0.00	0.20	0.00	0.15	0.00	0.15
1005.10	0.00	0.20	0.10	0.15	-0.10	0.15
7915.10	3.00	0.30	0.00	0.35	-0.10	0.35

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerance limits stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Actual	re 1kHz	re 1kHz	Tolerance Limit				
125.90	93.84	-0.18	-0.2	±1.0	0.02	P	0.32	0.60
1005.10	94.02	0.00	0.0	±0.7	0.00	P	0.32	0.60
7915.10	90.30	-3.72	-3.0	+1.5 / -2.5	-0.72	P	0.60	0.70

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 93dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq (Hz)	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	Uncertainty (dB)
63	94.1	94.0	94.1	0.13
125	94.0	94.0	94.0	0.11
250	93.9	94.0	94.0	0.10
500	94.0	94.0	94.0	0.10
1 000	94.0	94.0	94.0	0.10
2 000	94.1	94.1	94.0	0.10
4 000	94.0	94.0	94.0	0.10
8 000	94.0	94.0	94.0	0.10
15 850	93.3	93.3	94.0	0.13

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq (Hz)	Ufreq (dB)	Uncertainty (dB)	Body Effects (dB)	Uncertainty (dB)	WS Effects (dB)	Uncertainty (dB)
63	0.10	0.30	0.00	0.15	0.00	0.15
125	0.10	0.30	0.00	0.15	0.00	0.15
250	0.10	0.20	0.00	0.15	0.00	0.15
500	0.00	0.20	-0.10	0.15	-0.10	0.15
1 000	0.00	0.20	0.10	0.15	-0.10	0.15
2 000	0.00	0.30	0.10	0.15	-0.40	0.15
4 000	0.10	0.30	-0.10	0.20	-0.30	0.20
8 000	0.00	0.30	0.00	0.35	-0.10	0.35
15 850	-0.80	0.50	0.20	0.35	0.20	0.35

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerance limits stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	94.20	0.20	±1.0	P	0.39	0.60
125	94.10	0.10	±1.0	P	0.39	0.60
250	94.00	0.00	±1.0	P	0.31	0.60
500	93.80	-0.20	±1.0	P	0.31	0.60
1 000	94.00	0.00	±0.7	P	0.31	0.60
2 000	93.80	-0.20	±1.0	P	0.38	0.60
4 000	93.70	-0.30	±1.0	P	0.43	0.60
8 000	93.90	-0.10	+1.5 / -2.5	P	0.59	0.70
15 850	92.90	-1.10	+2.5 / -16	P	0.72	1.00

Table 8 - C Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	94.10	0.10	±1.0	P	0.39	0.60
125	94.10	0.10	±1.0	P	0.39	0.60
250	94.10	0.10	±1.0	P	0.31	0.60
500	93.80	-0.20	±1.0	P	0.31	0.60
1 000	94.00	0.00	±0.7	P	0.31	0.60
2 000	93.80	-0.20	±1.0	P	0.38	0.60
4 000	93.70	-0.30	±1.0	P	0.43	0.60
8 000	93.90	-0.10	+1.5 / -2.5	P	0.59	0.70
15 850	92.90	-1.10	+2.5 / -16	P	0.72	1.00

Table 9 - Z Weighted Electrical Response

Freq (Hz)	Response (dB)		Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
	Corrected	re 1kHz				
63	94.20	0.20	±1.0	P	0.39	0.60
125	94.10	0.10	±1.0	P	0.39	0.60
250	94.10	0.10	±1.0	P	0.31	0.60
500	93.80	-0.20	±1.0	P	0.31	0.60
1 000	94.00	0.00	±0.7	P	0.31	0.60
2 000	93.70	-0.30	±1.0	P	0.38	0.60
4 000	93.70	-0.30	±1.0	P	0.43	0.60
8 000	93.90	-0.10	+1.5 / -2.5	P	0.59	0.70
15 850	93.60	-0.40	+2.5 / -16	P	0.72	1.00

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance Limit (dB)	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
A	Fast	94.0	0.0	P	±0.2	0.10	0.20
	Leq	94.0	0.0	P	±0.2	0.10	0.20
	Slow	94.0	0.0	P	±0.2	0.10	0.20
C	Fast	94.0	0.0	P	±0.2	0.10	0.20
Z	Fast	94.0	0.0	P	±0.2	0.10	0.20

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance Limit (dB)	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
72.7	94	94.0	0.0	P	±0.1	0.10	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
94.0	94.0	0.0	±0.8	P	0.1	0.3
99.0	99.0	0.0	±0.8	P	0.1	0.3
104.0	104.0	0.0	±0.8	P	0.1	0.3
109.0	109.0	0.0	±0.8	P	0.1	0.3
114.0	114.0	0.0	±0.8	P	0.1	0.3
119.0	119.0	0.0	±0.8	P	0.1	0.3
124.0	124.0	0.0	±0.8	P	0.1	0.3
129.0	129.0	0.0	±0.8	P	0.1	0.3
133.0	133.0	0.0	±0.8	P	0.1	0.3
134.0	134.0	0.0	±0.8	P	0.1	0.3
135.0	135.0	0.0	±0.8	P	0.1	0.3
136.0	136.0	0.0	±0.8	P	0.1	0.3
137.0	137.0	0.0	±0.8	P	0.1	0.3

Overload indication at 138.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
94.0	94.0	0.0	±0.8	P	0.1	0.3
89.0	89.0	0.0	±0.8	P	0.1	0.3
84.0	84.0	0.0	±0.8	P	0.1	0.3
79.0	79.0	0.0	±0.8	P	0.1	0.3
74.0	74.0	0.0	±0.8	P	0.1	0.3
69.0	69.0	0.0	±0.8	P	0.1	0.3
64.0	64.0	0.0	±0.8	P	0.1	0.3
59.0	59.0	0.0	±0.8	P	0.1	0.3
54.0	54.0	0.0	±0.8	P	0.1	0.3
49.0	49.0	0.0	±0.8	P	0.1	0.3
44.0	44.0	0.0	±0.8	P	0.1	0.3
39.0	39.0	0.0	±0.8	P	0.1	0.3
34.0	34.0	0.0	±0.8	P	0.1	0.3
30.0	30.0	0.0	±0.8	P	0.1	0.3
29.0	29.0	0.0	±0.8	P	0.1	0.3
28.0	28.0	0.0	±0.8	P	0.1	0.3
27.0	27.0	0.0	±0.8	P	0.1	0.3
26.0	26.0	0.0	±0.8	P	0.1	0.3
25.0	25.0	0.0	±0.8	P	0.1	0.3

Under range indication at 23.9dB.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 135.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	134.0	0.0	±0.5	P	0.1	0.3
2ms	117.0	0.0	+1.0 / -1.5	P	0.1	0.3
0.25ms	107.9	-0.1	+1.0 / -3	P	0.1	0.3

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	127.6	0.0	±0.5	P	0.1	0.3
2ms	108.0	0.0	+1.0 / -3	P	0.1	0.3

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	128.0	0.0	±0.5	P	0.1	0.3
2ms	108.0	0.0	+1.0 / -1.5	P	0.1	0.3
0.25ms	98.9	-0.1	+1.0 / -3	P	0.1	0.3

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display 133.0dB(C).

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Overload Peak C	Maximum Permitted Uncertainty (dB)
136.3	-0.1	±2.0	P	0.22	N	0.35

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive	134.9	-0.5	±1.0	P	0.1	0.35
Negative	136.3	0.9	±1.0	P	0.1	0.35

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of 137.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 19 - Overload Indication

Signal Orientation	Overload Response (dB)	Difference (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive		N/A	±1.5	N/A	0.10	0.25
Negative						

Overload indication could not be verified due to insufficient output of the waveform generator.

Overload latch indication could not be verified due to insufficient output of the waveform generator.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Fast	137.0	137.0	0.0	±0.1	P	0.10	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10	0.10
Leq	137.0	137.0	0.0	±0.1	P	0.10	0.10



Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23502

Client Details		John Holland Gamuda JV 796 Hunter Street Newcastle West NSW 2302
Equipment Tested/ Model Number :		NL-53EX
Instrument Serial Number :		00330123
Microphone Serial Number :		22761
Pre-amplifier Serial Number :		32797
Firmware Version :		1.0
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 20°C		Ambient Temperature : 20.8°C
Relative Humidity : 47.7%		Relative Humidity : 45.9%
Barometric Pressure : 102.5kPa		Barometric Pressure : 102.5kPa
Calibration Technician : Ken Williams		Secondary Check: Megan Williams
Calibration Date : 25 Jul 2023		Report Issue Date : 26 Jul 2023
Approved Signatory : 		Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	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.

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.

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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 Test Report

Calibration Number C23502

Client Details		John Holland Gamuda JV 796 Hunter Street Newcastle West NSW 2302
Equipment Tested/ Model Number :		NL-53EX
Instrument Serial Number :		00330123
Microphone Serial Number :		22761
Pre-amplifier Serial Number :		32797
Firmware Version :		1.0
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 20°C		Ambient Temperature : 20.8°C
Relative Humidity : 47.7%		Relative Humidity : 45.9%
Barometric Pressure : 102.5kPa		Barometric Pressure : 102.5kPa
Calibration Technician : Ken Williams		Secondary Check: Megan Williams
Calibration Date : 25 Jul 2023		Report Issue Date : 26 Jul 2023

Approved Signatory :

Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	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.

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.

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1. OVERVIEW

This report presents the calibration test results of a NL-53EX Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3:2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version as provided by the manufacturer.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3:2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 13pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 792819 2132). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Keysight 33511B (S/N – MY58001621) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG.44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	93.90	94.00	94.00	93.92
C	93.90	94.00	94.00	93.92
Z	93.90	94.00	94.00	93.92

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

14.90	14.60	14.80	15.00	15.00
15.10	15.30	15.20	15.10	15.10

Acoustic Noise Floor : 15.0 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

12.20	11.90	12.20	12.10	12.20
12.10	12.20	12.10	12.40	11.90

Random Readings dB(C)

15.60	15.00	15.90	15.40	15.40
15.90	15.80	14.90	15.50	15.60

Random Readings dB(Z)

21.6	22.6	21.5	21.6	21.3
21.6	21.8	21.5	21.2	21.9

Electric Noise Floor :

dB(A)	dB(C)	dB(Z)
12.1	15.5	21.7

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	93.9	93.9	93.9	0.13
1 000	93.9	93.9	93.9	0.13
8 000	87.9	87.9	87.9	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.06	93.84	0.02	0.13
1005.10	-0.08	93.82	0.00	0.13
7915.10	0.00	87.90	-5.92	0.14

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	0.00	0.20	0.00	0.15	0.000	0.150
1005.10	0.00	0.20	0.10	0.15	-0.100	0.150
7915.10	3.00	0.30	0.00	0.35	-0.100	0.350

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	93.84	0.02	-0.2	±1.0	0.22	P	0.32
1005.10	93.82	0.00	0.0	±0.7	0.00	P	0.32
7915.10	90.80	-3.02	-3.0	+1.5 / -2.5	-0.02	P	0.60

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 93dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	93.0	93.0	93.0	0.13
125	92.9	93.1	93.0	0.11
250	92.9	93.0	93.0	0.10
500	93.0	93.0	93.0	0.10
1 000	93.0	93.0	93.0	0.10
2 000	93.0	92.9	93.0	0.10
4 000	93.0	93.0	93.0	0.10
8 000	93.0	93.0	93.0	0.10
15 850	92.3	92.2	93.0	0.13

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.100	0.300	0.000	0.150	0.000	0.100
125	0.100	0.300	0.000	0.150	0.000	0.100
250	0.100	0.200	0.000	0.150	0.000	0.100
500	0.000	0.200	0.100	0.150	0.100	0.100
1 000	0.000	0.200	-0.100	0.150	0.100	0.100
2 000	0.000	0.300	-0.100	0.150	0.400	0.150
4 000	0.100	0.300	0.100	0.200	0.300	0.150
8 000	0.000	0.300	0.000	0.350	0.100	0.200
15 850	-0.800	0.500	-0.200	0.350	-0.200	0.250

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.38
125	93.00	0.00	±1.0	P	0.37
250	93.00	0.00	±1.0	P	0.29
500	93.20	0.20	±1.0	P	0.29
1 000	93.00	0.00	±0.7	P	0.29
2 000	93.30	0.30	±1.0	P	0.38
4 000	93.50	0.50	±1.0	P	0.41
8 000	93.10	0.10	+1.5 / -2.5	P	0.51
15 850	91.10	-1.90	+2.5 / -16	P	0.67

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.38
125	93.20	0.20	±1.0	P	0.37
250	93.10	0.10	±1.0	P	0.29
500	93.20	0.20	±1.0	P	0.29
1 000	93.00	0.00	±0.7	P	0.29
2 000	93.20	0.20	±1.0	P	0.38
4 000	93.50	0.50	±1.0	P	0.41
8 000	93.10	0.10	+1.5 / -2.5	P	0.51
15 850	91.00	-2.00	+2.5 / -16	P	0.67

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.38
125	93.10	0.10	±1.0	P	0.37
250	93.10	0.10	±1.0	P	0.29
500	93.20	0.20	±1.0	P	0.29
1 000	93.00	0.00	±0.7	P	0.29
2 000	93.30	0.30	±1.0	P	0.38
4 000	93.50	0.50	±1.0	P	0.41
8 000	93.10	0.10	+1.5 / -2.5	P	0.51
15 850	91.80	-1.20	+2.5 / -16	P	0.67

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHz

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
A	Fast	94.0	0.0	P	±0.2	0.10
	Leq	94.0	0.0	P	±0.2	0.10
	Slow	94.0	0.0	P	±0.2	0.10
C	Fast	94.0	0.0	P	±0.2	0.10
Z	Fast	94.0	0.0	P	±0.2	0.10

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
65.8	94	94.0	0.0	P	±0.1	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
99.0	99.0	0.0	±0.8	P	0.1
104.0	104.0	0.0	±0.8	P	0.1
109.0	109.1	0.1	±0.8	P	0.1
114.0	114.1	0.1	±0.8	P	0.1
119.0	119.1	0.1	±0.8	P	0.1
124.0	124.1	0.1	±0.8	P	0.1
129.0	129.1	0.1	±0.8	P	0.1
133.0	133.1	0.1	±0.8	P	0.1
134.0	134.1	0.1	±0.8	P	0.1
135.0	135.1	0.1	±0.8	P	0.1
136.0	136.0	0.0	±0.8	P	0.1
137.0	137.0	0.0	±0.8	P	0.1
138.0	138.0	0.0	±0.8	P	0.1

Overload indication at 138.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
89.0	89.1	0.1	±0.8	P	0.1
84.0	84.0	0.0	±0.8	P	0.1
79.0	79.0	0.0	±0.8	P	0.1
74.0	74.1	0.1	±0.8	P	0.1
69.0	69.0	0.0	±0.8	P	0.1
64.0	64.0	0.0	±0.8	P	0.1
59.0	59.0	0.0	±0.8	P	0.1
54.0	54.0	0.0	±0.8	P	0.1
49.0	49.1	0.1	±0.8	P	0.1
44.0	44.1	0.1	±0.8	P	0.1
39.0	39.1	0.1	±0.8	P	0.1
34.0	34.1	0.1	±0.8	P	0.1
30.0	30.1	0.1	±0.8	P	0.1
29.0	29.1	0.1	±0.8	P	0.1
28.0	28.1	0.1	±0.8	P	0.1
27.0	27.1	0.1	±0.8	P	0.1
26.0	26.1	0.1	±0.8	P	0.1
25.0	25.1	0.1	±0.8	P	0.1
24.0	24.1	0.1	±0.8	P	0.1

Under range indication at 24.1dB.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 135.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	134.0	0.0	±0.5	P	0.1
2ms	117.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	107.9	-0.1	+1.0 / -3	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	127.5	-0.1	±0.5	P	0.1
2ms	105.0	-3.0	+1.0 / -3	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	128.0	0.0	±0.5	P	0.1
2ms	108.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	98.9	-0.1	+1.0 / -3	P	0.1

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display 133.0dB(C).

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95	Overload Peak C
135.9	-0.5	±2.0	P	0.22	N

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95
Positive	136.0	0.6	±1.0	P	0.1
Negative	135.8	0.4	±1.0	P	0.1

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of 137.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 19 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive	135.0	0.0	±1.5	P	0.1
Negative	134.6				

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	137.0	137.0	0.0	±0.1	P	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10
Leq	137.0	137.0	0.0	±0.1	P	0.10



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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C23503

Client Details		John Holland Gamuda JV 796 Hunter Street Newcastle West NSW 2302
Equipment Tested/ Model Number :		NL-53EX
Instrument Serial Number :		00330121
Microphone Serial Number :		22759
Pre-amplifier Serial Number :		32795
Firmware Version :		01.00
Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions
Ambient Temperature : 21.1°C		Ambient Temperature : 21.6°C
Relative Humidity : 46.8%		Relative Humidity : 45%
Barometric Pressure : 102.5kPa		Barometric Pressure : 102.3kPa
Calibration Technician : Ken Williams		Secondary Check: Megan Williams
Calibration Date : 25 Jul 2023		Report Issue Date : 26 Jul 2023
Approved Signatory : 		Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	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.

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.

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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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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.

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1. OVERVIEW

This report presents the calibration test results of a NL-53EX Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3:2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version as provided by the manufacturer.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3:2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 13pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 792819 2132). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Keysight 33511B (S/N – MY58001621) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG.44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	93.90	94.00	94.10	94.02
C	93.80	94.00	94.10	94.02
Z	93.80	94.00	94.10	94.02

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

15.10	15.50	15.00	14.80	14.60
17.30	14.60	16.40	14.70	14.80

Acoustic Noise Floor : 15.3 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

11.60	11.60	11.50	11.60	11.60
11.70	11.60	11.60	11.60	11.60

Random Readings dB(C)

14.60	14.70	14.60	15.00	15.00
15.10	14.70	14.30	15.60	15.30

Random Readings dB(Z)

20.9	20.1	20.9	19.6	22.0
21.9	21.6	20.5	20.0	20.7

Electric Noise Floor :

dB(A)	dB(C)	dB(Z)
11.6	14.9	20.8

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	94.0	94.0	94.0	0.13
1 000	94.0	94.0	94.0	0.13
8 000	87.9	87.9	87.9	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.06	93.94	0.02	0.13
1005.10	-0.08	93.92	0.00	0.13
7915.10	0.00	87.90	-6.02	0.14

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	0.00	0.20	0.00	0.15	0.000	0.100
1005.10	0.00	0.20	-0.10	0.15	0.100	0.100
7915.10	3.00	0.30	0.00	0.35	0.100	0.200

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	93.94	0.02	-0.2	±1.0	0.22	P	0.30
1005.10	93.92	0.00	0.0	±0.7	0.00	P	0.30
7915.10	91.00	-2.92	-3.0	+1.5 / -2.5	0.08	P	0.52

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 93dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	93.0	93.0	93.0	0.13
125	92.9	93.0	93.0	0.11
250	92.9	93.0	93.0	0.10
500	93.0	93.1	93.0	0.10
1 000	93.0	93.0	93.0	0.10
2 000	93.1	93.1	93.0	0.10
4 000	93.0	93.0	93.0	0.10
8 000	93.0	93.0	93.0	0.10
15 850	92.3	92.3	93.0	0.13

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.100	0.300	0.000	0.150	0.000	0.150
125	0.100	0.300	0.000	0.150	0.000	0.150
250	0.100	0.200	0.000	0.150	0.000	0.150
500	0.000	0.200	-0.100	0.150	-0.100	0.150
1 000	0.000	0.200	0.100	0.150	-0.100	0.150
2 000	0.000	0.300	0.100	0.150	-0.400	0.150
4 000	0.100	0.300	-0.100	0.200	-0.300	0.200
8 000	0.000	0.300	0.000	0.350	-0.100	0.350
15 850	-0.800	0.500	0.200	0.350	0.200	0.350

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.39
125	93.00	0.00	±1.0	P	0.39
250	93.00	0.00	±1.0	P	0.31
500	92.80	-0.20	±1.0	P	0.31
1 000	93.00	0.00	±0.7	P	0.31
2 000	92.80	-0.20	±1.0	P	0.38
4 000	92.70	-0.30	±1.0	P	0.43
8 000	92.90	-0.10	+1.5 / -2.5	P	0.59
15 850	91.90	-1.10	+2.5 / -16	P	0.72

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.39
125	93.10	0.10	±1.0	P	0.39
250	93.10	0.10	±1.0	P	0.31
500	92.90	-0.10	±1.0	P	0.31
1 000	93.00	0.00	±0.7	P	0.31
2 000	92.80	-0.20	±1.0	P	0.38
4 000	92.70	-0.30	±1.0	P	0.43
8 000	92.90	-0.10	+1.5 / -2.5	P	0.59
15 850	91.90	-1.10	+2.5 / -16	P	0.72

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	93.10	0.10	±1.0	P	0.39
125	93.10	0.10	±1.0	P	0.39
250	93.10	0.10	±1.0	P	0.31
500	92.80	-0.20	±1.0	P	0.31
1 000	93.00	0.00	±0.7	P	0.31
2 000	92.70	-0.30	±1.0	P	0.38
4 000	92.70	-0.30	±1.0	P	0.43
8 000	92.90	-0.10	+1.5 / -2.5	P	0.59
15 850	92.60	-0.40	+2.5 / -16	P	0.72

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
A	Fast	94.0	0.0	P	±0.2	0.10
	Leq	94.0	0.0	P	±0.2	0.10
	Slow	94.0	0.0	P	±0.2	0.10
C	Fast	94.0	0.0	P	±0.2	0.10
Z	Fast	94.0	0.0	P	±0.2	0.10

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
70.8	94	94.0	0.0	P	±0.1	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
99.0	99.0	0.0	±0.8	P	0.1
104.0	104.0	0.0	±0.8	P	0.1
109.0	109.0	0.0	±0.8	P	0.1
114.0	114.0	0.0	±0.8	P	0.1
119.0	119.0	0.0	±0.8	P	0.1
124.0	124.0	0.0	±0.8	P	0.1
129.0	129.0	0.0	±0.8	P	0.1
133.0	133.0	0.0	±0.8	P	0.1
134.0	134.0	0.0	±0.8	P	0.1
135.0	135.0	0.0	±0.8	P	0.1
136.0	136.0	0.0	±0.8	P	0.1
137.0	137.0	0.0	±0.8	P	0.1
138.0	138.0	0.0	±0.8	P	0.1

Overload indication at 139.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
89.0	89.0	0.0	±0.8	P	0.1
84.0	84.0	0.0	±0.8	P	0.1
79.0	79.0	0.0	±0.8	P	0.1
74.0	74.0	0.0	±0.8	P	0.1
69.0	69.0	0.0	±0.8	P	0.1
64.0	63.9	-0.1	±0.8	P	0.1
59.0	59.0	0.0	±0.8	P	0.1
54.0	54.0	0.0	±0.8	P	0.1
49.0	49.0	0.0	±0.8	P	0.1
44.0	44.0	0.0	±0.8	P	0.1
39.0	39.0	0.0	±0.8	P	0.1
34.0	34.0	0.0	±0.8	P	0.1
30.0	29.9	-0.1	±0.8	P	0.1
29.0	29.0	0.0	±0.8	P	0.1
28.0	28.0	0.0	±0.8	P	0.1
27.0	26.9	-0.1	±0.8	P	0.1
26.0	26.0	0.0	±0.8	P	0.1
25.0	25.0	0.0	±0.8	P	0.1

Under range indication at 23.9dB.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 135.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	134.0	0.0	±0.5	P	0.1
2ms	117.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	107.9	-0.1	+1.0 / -3	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	127.6	0.0	±0.5	P	0.1
2ms	108.0	0.0	+1.0 / -3	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	128.5	0.5	±0.5	P	0.1
2ms	108.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	98.9	-0.1	+1.0 / -3	P	0.1

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display 133.0dB(C).

Table 17 - Single Cycle Response

Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95	Overload Peak C
135.3	-1.1	±2.0	P	0.22	N

Table 18 - Half Cycle Response

Signal Orientation	Response Peak C	Deviation (dB)	Tolerance (dB)	P/F	U95
Positive	134.9	-0.5	±1.0	P	0.1
Negative	135.0	-0.4	±1.0	P	0.1

No overload was noted during Peak C testing.

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of 137.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 19 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive		0.0	±1.5	N/A	0.1
Negative					

Overload indication could not be verified due to insufficient output of the waveform generator.

Overload latch indication could not be verified due to insufficient output of the waveform generator.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 20 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	137.0	137.0	0.0	±0.1	P	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10
Leq	137.0	137.0	0.0	±0.1	P	0.10

Enquiries: 0411 245 941
standlab@optusnet.com.au

Report No. SVT-136-24



Standards & Testing Laboratory
1 Merchant Ave.,
THOMASTOWN VIC. 3074

Certificate of Compliance and Calibration

INSTRUMENT: Ground Vibration & Airblast Monitor
MAKE/MODEL: Instantel Micromate
SERIAL NO. : UM22042
ACCESSORY: Tri-axial geophone assembly # UM22042
CLIENT: ECO Environmental Holdings Pty Ltd

<u>TEST REFERENCES *</u>	<u>Model</u>	<u>Serial No.</u>
Bruel & Kjaer accelerometer	8305S	1132492
Bruel & Kjaer Charge Amplifier	2635	1100067
Hewlett Packard Spectrum Analyzer	3580A	1415A04040
Hewlett Packard Frequency Counter	5323A	1216A00956
Bruel & Kjaer Vibration Exciter	4809	1075321
Bruel & Kjaer Measuring Amplifier	2636	88047
Bruel & Kjaer Microphone	4144	841301

The **Standards & Testing Laboratory** is an authorised **Instantel** testing facility that operates in accordance with **ISO/IEC 17025 (2005)** which meets in principle the management requirements of **ISO 9001**, and hereby certifies that this unit has been calibrated and that the **pre-** and **post-cal.** test results are consistent with the specifications published regarding this instrument.

* References are traceable to Australian national measurement standards.

N.B. It is recommended that the unit be calibrated at regular intervals.

Standards Engineer

M. Padalini

checked: _____

Dated this

second

day of

October

2024

Testronix (Aust.) Pty Ltd ABN 47 074 339 352
T/as Standards & Testing Laboratory
PO Box 166 BUNDOORA MDC VIC. 3083

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