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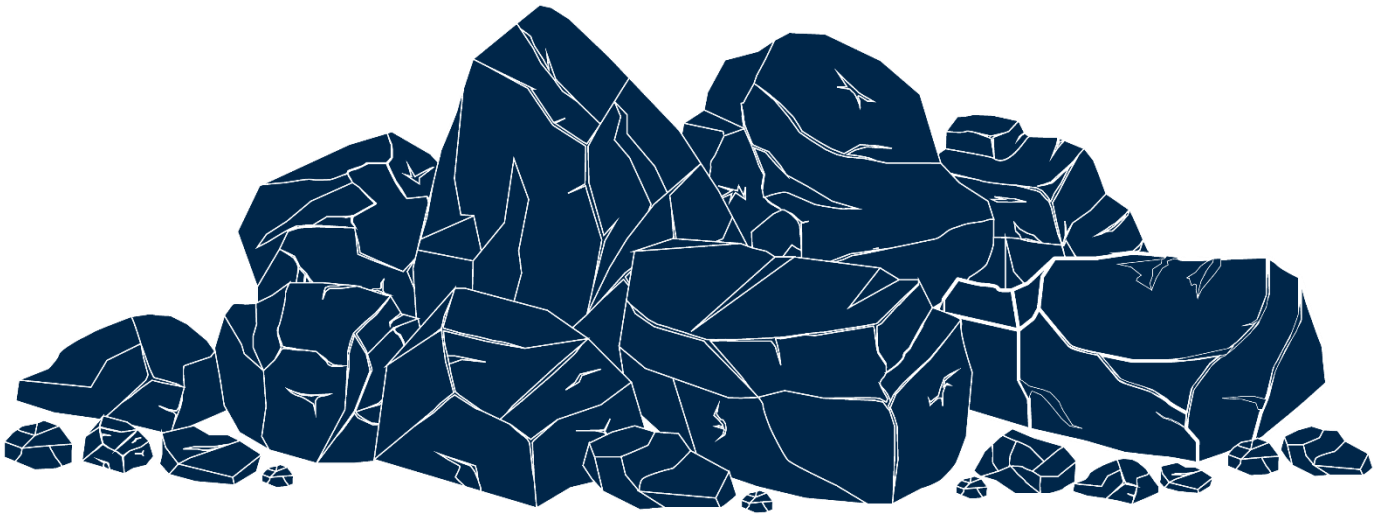
Karuah Hard Rock Quarry

Environmental Monitoring Report

December 2025



Contents

1.0 Introduction

This report has been completed to meet the requirements of Section 66(6) of the *Protection of the Environment Operations Act 1997* and the NSW Environmental Protection Authority's (EPA) Requirements for Publishing Pollution Monitoring Data (EPA, 2013). This report summarises the required monitoring data under Environmental Protection Licence 11569 (the EPL) and Development Consent for the Karuah Hard Rock Quarry (the Quarry) as summarised by **Table 1** and **Table 2** respectively.

Table 1 Summary of Environment Protection Licence, EPL 11569

EPL Number:	EPL 11569
Licensee's Name:	Hunter Quarries Pty Ltd
Licensee's Address:	Karuah Hard Rock Quarry PO Box 3284, Thornton NSW 2322 Corner of Andesite Road and The Branch Lane, Karuah NSW 2324.
Link to Full Licence on the EPA website:	EPL 11569

Table 2 Summary of Project Approval, DA 265-10-2004

Project Approval:	DA 265-10-2004
Applicant:	Hunter Quarries Pty Ltd
Consent Authority:	Minister for Infrastructure, Planning and Natural Resources
Link to Full Project Approval on the NSW Planning website:	Development Consent DA 265-10-2004

A summary of the environmental monitoring data for the December 2025 Reporting Period (the Reporting Period) is covered in this report. Tables throughout this report provide key monitoring information from the EPL and the Consent, including:

- location of monitoring;
- pollutant;
- unit of measurement; and
- monitoring frequency required.

Monitoring locations are illustrated by the site plan provided by **Appendix 1**.

2.0 Air Quality Monitoring

Dust emissions generated by the Quarry operation must not cause additional exceedances of ambient air quality criterion outlined in Schedule 3, Condition 13 of the Consent and summarised by **Table 3**, **Table 4** and **Table 5**.

Deposited dust monitoring is undertaken at the locations listed in **Table 6**, in accordance with the Approved Methods of Sampling and Analysis of Air Pollutants in NSW (EPA, 2022).

Table 3 Long-term Assessment Criteria for Deposited Dust (DA 265-10-2004).

Pollutant	Averaging Period	Maximum Increase in Deposited Dust Level[1]	Maximum Total Deposited Dust Level[1]
Deposited Dust	Annual	2 g/m^2/month	4 g/m^2/month

[1] Deposited dust is assessed as insoluble solids as defined by AS 3580.10.1-2003.

Table 4 Long-term Assessment Criteria for Particulate Matter (DA 265-10-2004).

Pollutant	Averaging Period	Criterion
Total Suspended Particulates	Annual	90 $\mu g/m^3$
Particulate Matter < 10 µm (PM10)	Annual	30 $\mu g/m^3$

Table 5 Short-term Assessment Criteria for Particulate Matter (DA 265-10-2004).

Pollutant	Averaging Period	Criterion
Particulate Matter < 10 µm (PM10)	24-hour	50 $\mu g/m^3$

Table 6 Air Quality Monitoring Locations (EPL 11569).

Site Monitoring Point ID	EPL Monitoring Point ID	Location	Address
DDG 1	6	South-West of Karuah Hard Rock Quarry	54 Mill Hill Close, Karuah NSW 2324
DDG 2	7	South-West of Karuah Hard Rock Quarry	64 Mill Hill Close, Karuah NSW 2324
DDG 3	8	South-West of Karuah Hard Rock Quarry	Lot 251 DP1092111, Karuah NSW 2324
DDG 4	9	East of Karuah Hard Rock Quarry	21 Halloran Road, North Arm Cove NSW 2324

Deposited dust results for the 12-months prior-to and including December 2025 are summarised by **Table 7**.

Table 7 Deposited dust monitoring results.

Reporting Period	Start Date	End Date	Days	DDG 1 (EPL ID 2) EPL ID 6	DDG 2 (EPL ID 3) EPL ID 7	DDG 3 (EPL ID 4) EPL ID 8	DDG 4 (EPL ID 5) EPL ID 9
Dec-24	29/11/2024	30/12/2024	29	(0.6)	(1.4)	(1.3)	(3.1)
Jan-25	30/12/2024	31/01/2025	32	(3.8)	(1.7)	(1.9)	(1.3)
Feb-25	31/01/2025	03/03/2025	31	(1.2)	(0.9)	(1.1)	(1.2)
Mar-25	03/03/2025	03/04/2025	31	(0.7)	(1.0)	(1.4)	
	04/03/2025	03/04/2025	30				(1.1)
Apr-25	03/04/2025	05/05/2025	32	1.2	3.2	0.4	(1.0)
May-25	05/05/2025	03/06/2025	29	2.0	3.9	0.2	(0.3)
Jun-25	03/06/2025	01/07/2025	28	2.9	1.0	0.6	0.4
Jul-25	01/07/2025	01/08/2025	31	10.1*	0.5	0.4	0.2
Aug-25	01/08/2025	01/09/2025	31	0.9	2.3	0.5	0.8
Sep-25	01/09/2025	01/10/2025	30	1.7	1.3	1.0	0.7
Oct-25	1/10/2025	31/10/2025	30	1.1	1.7	1.7	1.2
Nov-25	31/10/2025	02/12/2025	32	1.0	2.5	2.1	1.1
Dec-25	02/12/2025	02/01/2026	31	1.8	1.6	1.3	1.5
Progressive Annual Average				**2.4**	**1.8**	**1.1**	**0.9**

Monitoring results for the Reporting Period at the four DDG monitoring sites are within the long-term annual deposited dust limit of 4 g/m^2/month.

**Note:* *Recorded anomalous exceedance which was subsequently reported to the NSW Department of Planning, Housing & Infrastructure (NSW Planning), the NSW EPA and surrounding landholders in accordance with the relevant conditions of the Consent and EPL.*

3.0 Blast Monitoring

Blast monitoring is undertaken for all blasts at the Quarry at the nearest residential location to ensure that air blast overpressure and ground vibration remain within the compliance limits, as summarised by **Table 8**; with the monitoring results summarised by **Table 9**.

There was one blast undertaken within the Reporting Period, which was observed to be within compliance limits.

Table 8 Blasting Airblast Overpressure and Ground Vibration Criteria (DA 265-10-2004 & EPL 11569).

Location	Airblast Overpressure (dB(L))	Ground Vibration (mm/s)	Allowable Exceedance
Private Residence B	120	10	0%
	115	5	5% over 12-month reporting period.

Table 9 Blasting Monitoring Results.

Date	Time	Location	Airblast Overpressure (dB(L))	Ground Vibration (mm/s)
04/12/2025	12:00	Pit Sump	105.0	0.55

***Not triggered = n/t**
Ground Vibration < 0.5 mm/s
Overpressure < 108 dB(L)

4.0 Noise Monitoring

Noise monitoring is undertaken in accordance with the EPL and NSW Planning approved Environmental Management Strategy & Monitoring Program (EMS&MP), which requires attended and unattended noise monitoring to be conducted on a 6-monthly basis.

During the Reporting Period, attended monitoring was completed on Thursday 04 December 2025; whilst unattended monitoring continued from Thursday, 04 December to Wednesday, 10 December 2025.

The noise monitoring results were within the compliance limits for the H2 2025 monitoring round as outlined by the Noise Monitoring Report provided in **Appendix 2**.

5.0 Surface Water Monitoring

Water monitoring is undertaken in accordance with the EPL and NSW Planning approved Site Water Management Plan, with daily monitoring of surface water being discharged from the Quarry via the licenced discharge point in accordance with Condition L2 and M2 of the EPL.

No discharge events occurred during the Reporting Period, as summarised by **Table 10**.

Table 10 Discharge Water Monitoring Results.

Date	Oil and Grease	pH	Total Suspended Solids, TSS (mg/L)	Nitrogen (total) (mg/L)	Phosphorus (total) (mg/L)	Discharge Type
LDP1 – Sediment Dam 2						
-	-	-	-	-	-	-
Sediment Basin 4						
-	-	-	-	-	-	-

6.0 Weather Station Monitoring

The Quarry operates and maintains a permanent meteorological monitoring station to record weather parameters including temperature, wind speed and direction, solar radiation and rainfall. **Figure 1** below outlines the weather records for the Reporting Period.

Monthly Weather Summary

Site: **Karuah Quarry Complex**
Month: **December 2025**

Date	Day	Temperature @ 2m			Temperature @ 10m			Winds			Solar Radiation		Rain[2]
		Max[1]	Min[2]	Ave[1]	Max[1]	Min[2]	Ave[1]	Max Speed[1]	Ave Speed[1]	Ave Direction[1]	Max[1]	Ave[1]	
		°C	°C	°C	°C	°C	°C	km/h	km/h	deg	W/m²	W/m²	mm
1	Mon	32.4	9.2	22.1	30.8	10.6	22.0	26.9	6.4	208	1128.3	302.2	0.0
2	Tue	27.8	9.9	18.9	26.4	10.7	18.6	26.5	8.3	244	1091.7	249.6	3.0
3	Wed	24.3	10.4	17.6	21.0	11.2	16.8	23.0	6.1	179	1039.9	315.3	0.0
4	Thu	27.6	11.9	20.4	24.5	12.9	19.8	21.2	5.3	153	1040.7	303.1	0.0
5	Fri	34.1	15.1	24.8	31.1	16.5	24.6	22.8	5.3	173	1010.0	303.3	0.0
6	Sat	39.8	17.5	28.3	36.7	19.2	28.8	20.1	4.7	214	993.3	316.6	0.0
7	Sun	40.3	21.4	30.0	37.7	22.2	29.8	21.1	5.4	177	1059.1	268.4	0.4
8	Mon	24.7	18.2	20.8	23.9	18.5	20.3	22.7	6.7	140	1045.0	83.5	0.0
9	Tue	31.9	17.6	23.5	29.4	18.3	23.0	18.9	6.0	187	1205.8	267.7	0.0
10	Wed	36.4	21.2	26.4	33.3	20.8	25.4	21.5	6.9	120	934.2	286.4	0.0
11	Thu	28.3	20.8	23.1	25.3	20.8	22.3	18.1	6.0	127	1116.7	164.5	0.0
12	Fri	23.8	18.7	20.2	23.3	18.7	20.0	23.6	5.2	165	1234.2	90.2	14.0
13	Sat	24.8	15.8	18.5	23.2	15.7	18.2	17.3	3.4	189	716.7	92.2	12.2
14	Sun	29.3	19.3	23.1	26.3	19.1	22.3	17.5	4.8	169	1024.2	283.8	4.0
15	Mon	34.9	19.5	26.0	33.8	19.7	25.5	21.9	7.9	171	1111.6	270.8	0.0
16	Tue	28.0	17.4	21.8	24.8	17.3	20.8	21.6	6.9	116	1112.4	250.4	2.0
17	Wed	23.9	18.3	20.2	22.2	18.4	19.9	21.5	4.6	159	1205.0	110.6	0.0
18	Thu	29.4	14.3	22.2	26.9	15.0	21.7	21.0	5.6	184	1190.0	271.4	0.0
19	Fri	36.9	19.5	27.6	34.5	21.1	27.3	16.3	4.6	175	949.1	317.5	0.0
20	Sat	43.4	22.0	30.4	40.7	22.3	30.0	24.7	5.7	188	961.6	244.9	0.8
21	Sun	33.7	19.6	27.5	31.3	20.6	27.3	15.4	3.9	171	1155.0	195.1	0.0
22	Mon	43.3	25.3	32.9	41.6	25.5	32.6	20.2	6.1	205	982.4	262.2	0.0
23	Tue	31.9	22.0	24.5	31.0	21.7	24.0	19.3	4.2	162	688.3	110.8	0.4
24	Wed	34.5	18.9	24.8	32.6	19.2	23.8	26.9	6.8	124	1099.1	262.2	0.0
25	Thu	31.0	19.3	25.0	28.6	19.6	24.0	21.9	6.6	143	1122.4	250.0	0.0
26	Fri	27.1	15.3	20.4	24.1	15.2	19.4	23.5	8.9	95	1080.8	245.9	0.6
27	Sat	19.0	9.4	14.7	17.9	9.8	14.7	20.9	4.7	172	495.0	82.1	1.6
28	Sun	24.7	12.2	18.1	21.3	12.8	17.2	22.6	6.2	175	1375.7	274.6	0.2
29	Mon	24.4	11.5	18.1	21.6	12.2	17.6	24.7	6.0	160	1270.7	233.0	1.0
30	Tue	25.5	10.1	18.2	22.7	10.9	17.3	23.4	5.2	170	1164.2	319.4	0.0
31	Wed	28.1	11.9	19.5	24.4	12.5	18.7	18.7	5.2	139	1001.7	313.8	0.0
Ave or Total		**30.5**	**16.6**	**22.9**	**28.2**	**17.1**	**22.4**	**21.5**	**5.8**	**166.2**	**1051.8**	**236.8**	**40.2**
High		**43.4**	**25.3**	**32.9**	**41.6**	**25.5**	**32.6**	**26.9**	**8.9**		**1375.7**	**319.4**	**14.0**
Low		**19.0**	**9.2**	**14.7**	**17.9**	**9.8**	**14.7**	**15.4**	**3.4**		**495.0**	**82.1**	
												No. rain days >1mm:	**6**

Notes: 1. Values are for the 24 hour period from 9am to 9am next day.
2. Values are for the 24 hours to 9am.

Figure 1 Weather Records Summary.

7.0 Production Data

Monthly monitoring of sales and truck movements are summarised by **Table 11**.

Table 11 Quarry Production Data.

Month	Truck Movements	Quarry Product Sales (t)
Jan-25	352	12,215
Feb-25	794	26,011
Mar-25	745	23,981
Apr-25	329	10,524
May-25	576	20,295
Jun-25	1,126	39,666
Jul-25	569	19,637
Aug-25	316	11,005
Sep-25	843	27,642
Oct-25	808	26,552
Nov-25	774	24,824
Dec-25	570	18,940
Progressive Annual Total	**7,802**	**261,292**

8.0 Reporting

8.1 Reportable Environmental Incidents

During the Reporting Period, no reportable environmental incidents occurred at the Quarry.

8.2 Reportable Non-Compliances

During the Reporting Period, one air-quality related non-compliance occurred at the Quarry, as outlined below:

- An exceedance of short-term (daily) particulate monitoring criteria occurred on 08 December 2025 as a result of southerly winds pushing bushfire smoke across the Lower Hunter Region from the Pacific Highway, Bulahdelah bushfire that continued burning between Crawford River and Nerong.

  Refer to the Karuah East Quarry Environmental Monitoring Report for December 2025 available on the Hunter Quarries' website (https://hunterquarries.com.au/reporting/) for further details.

8.3 Community Complaints

During the Reporting Period, no community complaints were reported to the Quarry.

Appendix 1 – EPL 11569 Monitoring Locations

Karuah Hard Rock Quarry

Environmental Monitoring Report

APPENDIX 1 - Environmental Monitoring Locations

Appendix 2 – H2 2025 Noise Monitoring Report

Karuah Quarry

Biannual Attended Noise Monitoring - Semester 2 2025

Prepared for Hunter Quarries Pty Limited

December 2025

Karuah Quarry

Biannual Attended Noise Monitoring - Semester 2 2025

Hunter Quarries Pty Limited

E250042 RP#6

December 2025

Version	Date	Prepared by	Reviewed by	Comments
1	12 December 2025	Lucas Adamson	Robert Kirwan	Final

Approved by

Robert Kirwan
Senior Associate – Team Leader
12 December 2025

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Appendices

Tables

Figures

1 Introduction

1.1 Background

EMM Consulting Pty Ltd (EMM) was engaged by Hunter Quarries Pty Limited to conduct a bi-annual noise survey of operations at Karuah Quarry (KQ, the site) located at Blue Rock Close, Karuah NSW. The survey purpose was to quantify the acoustic environment and compare site noise levels against specified limits.

Attended environmental noise monitoring described in this report was done during the day period on Thursday 4 December 2025 at two monitoring locations, required by the environmental monitoring program (EMP). It is of note that the site currently operates during the day period only and as such, noise monitoring during the evening and nigh-time periods is not required.

1.2 Attended monitoring locations

The monitoring locations are detailed in Table 1.1 and shown on Figure 1.1. It should be noted that Figure 1.1 shows actual monitoring positions, not necessarily the location of residences.

Table 1.1 Attended noise monitoring locations

Location descriptor/ID	Description/address near-by	Coordinates (MGA56)	
		Easting	Northing
NM1	Private Residence - 74 Mill Hill Close, Karuah	406623	6388704
NM2	Private Residence - 64 Mill Hill Close, Karuah	406405	6388859

KEY

- Site boundary
- A Noise monitoring location
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary
- Waterbody
- NPWS reserve
- State forest

Source: EMM (2021); ADW Johnson (2020); DFSI (2017); ICSM (2012); GA (2011); ASGC (2006)

0 0.5 1 km

GDA 1994 MGA Zone 56

N

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Noise monitoring locations

Karuah Quarry
Bi-annual noise monitoring
Figure 3.1

EMM
creating opportunities

1.3 Terminology and abbreviations

Some definitions of terms and abbreviations which may be used in this report are provided in Table 1.2.

Table 1.2 Terminology and abbreviations

Term/descriptor	Definition
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to approximate how humans hear noise.
L_{Amax}	The maximum root mean squared A-weighted noise level over a time period.
L_{A1}	The A-weighted noise level which is exceeded for 1 per cent of the time.
$L_{A1,1minute}$	The A-weighted noise level which is exceeded for 1 per cent of the specified time period of 1 minute.
L_{A10}	The A-weighted noise level which is exceeded for 10 percent of the time.
L_{Aeq}	The energy average A-weighted noise level.
L_{A50}	The A-weighted noise level which is exceeded for 50 per cent of the time, also the median noise level during a measurement period.
L_{A90}	The A-weighted noise level exceeded for 90 percent of the time, also referred to as the "background" noise level and commonly used to derive noise limits.
L_{Amin}	The minimum A-weighted noise level over a time period.
L_{Ceq}	The energy average C-weighted noise energy during a measurement period. The "C" weighting scale is used to take into account low-frequency components of noise within the audibility range of humans.
SPL	Sound pressure level. Fluctuations in pressure measured as 10 times a logarithmic scale, with the reference pressure being 20 micropascals.
Hertz (Hz)	The frequency of fluctuations in pressure, measured in cycles per second. Most sounds are a combination of many frequencies together.
AWS	Automatic weather station used to collect meteorological data, typically at an altitude of 10 metres
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude.
Sigma-theta	The standard deviation of the horizontal wind direction over a period of time.
IA	Inaudible. When site noise is noted as IA then there was no site noise at the monitoring location.
NM	Not Measurable. If site noise is noted as NM, this means some noise was audible but could not be quantified.
Day	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.

Appendix A provides further information that gives an indication as to how an average person perceives changes in noise level, and examples of common noise levels.

2 Noise limits

2.1 Development consent

Karuah Quarry noise limits are detailed in Condition 1 of Schedule 3 of Development Consent (DC) DA 265-10-2004. Relevant sections of DA 265-10-2004 are reproduced in Appendix B.

2.2 Environment protection licence

There are no noise limits detailed in the site's Environment Protection Licence (EPL) 11569.

2.3 Environmental monitoring program

The approved EMP adopts two attended noise monitoring locations that are representative of residences outlined in DA 265-10-2004. Relevant sections of the EMP are reproduced in Appendix B.2.

2.4 Noise limits

Noise impact limits based on the development consent are provided in Table 2.1.

Table 2.1 Noise impact limits, dB

Location	Day $L_{Aeq,15minute}$	Evening $L_{Aeq,15minute}$	All other times $L_{Aeq,15minute}$
NM1	48	47	46
NM2	48	47	46

Notes: 1. Day: 7:00 am–6:00 pm Monday to Saturday; 8:00 am–6:00 pm Sundays and public holidays; Evening: 6:00 pm–10:00 pm; Night: All other times: 10:00 pm–7:00 am Monday to Saturday; 10:00 pm–8:00 am Sundays and public holidays.

2.5 Meteorological conditions

PA 09_0175 specifies that noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW EPA 'Noise Policy for Industry' (NPfI) issued in October 2017.

The EPA requirements in Condition L4.3 of EPL 20611 state that noise limits do not apply under the following meteorological conditions:

- wind speeds greater than 3 m/s at 10 m above ground level;
- stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
- stability category G temperature inversion conditions.

2.6 Additional requirements

Monitoring and reporting have been done in accordance with the NSW EPA 'Approved methods for the measurement and analysis of environmental noise in NSW' (Approved Methods) issued in January 2022.

2.7 Very noise-enhancing meteorological conditions

In accordance with the approved methods, noise monitoring for the site is scheduled to occur during forecasted meteorological conditions where noise limits in Table 2.1 will be applicable. However, in cases where actual meteorological conditions do not align with forecasts and noise limits are subsequently not directly applicable, it is the expectation of regulators that noise impact still be managed.

The NPfI states that:

> Noise limits derived for consents and licences will apply under the meteorological conditions used in the environmental assessment process, that is, standard or noise-enhancing meteorological conditions. For 'very noise-enhancing meteorological conditions' … a limit is set based on the limit derived under standard or noise-enhancing conditions (whichever is adopted in the assessment) plus 5 dB. In this way a development is subject to noise limits under all meteorological conditions.

Therefore, if monthly noise monitoring occurs during meteorological conditions outside of those specified in Section 2.5, site limits will be adjusted based on Table 2.1 plus 5 dB.

3 Methodology

3.1 Overview

Attended environmental noise monitoring was done as guided by Australian Standard AS1055 'Acoustics, Description and Measurement of Environmental Noise' and relevant EPA requirements. Meteorological data was obtained from the site automatic weather station (AWS) which allowed correlation of atmospheric parameters with measured site noise levels.

3.2 Attended noise monitoring

During this survey, attended noise monitoring was conducted during the day period at each location. The duration of each measurement was 15 minutes. Atmospheric conditions were measured at each monitoring location.

Measured sound levels from various sources were noted during each measurement, and particular attention was paid to the extent of site's contribution (if any) to measured levels. At each monitoring location, the site only $L_{Aeq,15minute}$ were measured directly or determined by other methods detailed in Section 7.1 of the NPfI.

If exact noise levels from site could not be established due to masking by other noise sources in a similar frequency range, but site noise was determined to be at least 5 dB lower than relevant limits, then a maximum estimate of it may be provided. This is expressed as a 'less than' quantity, such as <20 dB or <30 dB.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may be used in this report. When site noise is noted as IA, it was inaudible at the monitoring location. When site noise is noted as NM, this means it was audible but could not be quantified. All results noted as NM in this report were due to one or more of the following:

- Site noise levels were extremely low and unlikely, in many cases, to be noticed.
- Site noise levels were masked by other more dominant noise sources that are characteristic of the environment, such as breeze in foliage or continuous road traffic noise, that cannot be eliminated by monitoring at an alternate or intermediate location.
- It was not feasible or reasonable to employ methods such as to move closer and back calculate. Cases may include rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

3.3 Unattended noise monitoring

The unattended noise monitoring was carried out using two Acoustic Research Labs (ARL) Ngara unattended noise loggers. These environmental noise loggers were in place from Thursday 4 to Wednesday 10 December 2025.

Calibration of instrumentation was checked prior to and following measurements. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates (refer Appendix C).

Data affected by adverse meteorological conditions and by spurious or uncharacteristic events has been excluded from the results in accordance with methodologies provided in the NPfI.

3.4 Meteorological data

Meteorological data for the monitoring period was sourced from the Karuah Quarry on-site meteorological station to determine applicability of criteria in accordance with the DC.

3.5 Modifying factors

All measurements were evaluated for potential modifying factors in accordance with the NPfI. Assessment of modifying factors is undertaken at the time of measurement if the site was audible and directly quantifiable. If applicable, modifying factor penalties have been reported and added to measured site only L_{Aeq} noise levels.

Low-frequency modifying factor penalties have only been applied to site-only L_{Aeq} levels if the site was the only contributing low-frequency noise source. Specific methodology for assessment of each modifying factor is outlined in Fact Sheet C of the NPfI.

3.6 Instrumentation

Attended noise monitoring was conducted by Lucas Adamson. Qualifications, experience, and/or demonstration of competence is in accordance with the Approved methods and supportive documentation is available upon request.

The equipment used to measure environmental noise levels is detailed in Table 3.1. Calibration certificates are provided in Appendix C.

Table 3.1 Noise monitoring equipment

Item	Serial number	Calibration due date	Relevant standard
Hottinger Brüel and Kjær 2255 sound level meter	100299	14/08/2026	IEC 61672-1:2013
SVAN SV-36 acoustic calibrator	140737	02/10/2027	IEC 60942:2017
ARL Ngara unattended noise logger	87801F	20/06/2026	IEC 61672-3:2013
ARL Ngara unattended noise logger	878017	20/11/2026	IEC 61672-3:2013

4 Results

4.1 Attended noise monitoring

4.1.1 Total measured noise levels and atmospheric conditions

Overall noise levels measured at each location during attended measurements are provided in Table 4.1. Discussion as to the noise sources responsible for these measured levels is provided in Section 5.1 of this report.

Table 4.1 Total measured 15-minute noise levels (attended) – Semester 2 2025[1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
NM2	4/12/2025 9:57	77	73	69	67	66	63	57
NM1	4/12/2025 10:14	59	55	54	52	51	48	46

Notes: 1. Levels in this table are not necessarily the result of activity at site.

Atmospheric condition data measured by the operator during each measurement using a hand-held weather meter is shown in Table 4.2. The wind speed, direction and temperature were measured at approximately 1.5 metres (m) above ground. Attended noise monitoring is not done during rain, hail, or wind speeds above 5 metres per second (m/s) at microphone height.

Table 4.2 Measured atmospheric conditions – Semester 2 2025

Location	Start date and time	Temperature °C	Wind speed m/s	Wind direction °Magnetic north [1]	Cloud cover 1/8s
NM2	4/12/2025 9:57	24.1	<0.5	-	0
NM1	4/12/2025 10:14	24.0	<0.5	-	0

Notes: 1. "-" indicates calm conditions at monitoring location.

4.1.2 Site only noise levels

i Modifying factors

There were no modifying factors, as defined in the NPfI, applicable during the survey.

ii Monitoring results

Table 4.3 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Limits are applicable if weather conditions were within specified parameters during each measurement.

Table 4.3 Site noise levels and limits – Semester 2 2025

Location	Start Date and Time	Wind		Stability Class	Standard limits apply? [1]	Limits, dB	Site levels, dB	Exceedances, dB [1]
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	$L_{Aeq,15minute}$ [2]	$L_{Aeq,15minute}$
NM2	4/12/2025 9:57	1.9	211	A	Yes	48	IA	Nil
NM1	4/12/2025 10:14	1.4	229	A	Yes	48	IA	Nil

Notes: 1. Noise emission limits are applicable if weather conditions were within parameters specified in Section 2.5. N/A in exceedance column indicates that limits were not applicable due to weather conditions.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.2 Unattended noise monitoring

Overall noise levels measured at each location during unattended measurements are provided in Table 4.4. Discussion as to the noise sources responsible for these measured levels is provided in Section 5.2 of this report.

Table 4.4 Total measured noise levels (unattended) – Semester 2 2025[1]

Location	Period	Measured noise levels, dB	
		RBL	$L_{Aeq,period}$
NM1 4-10 December 2025	Day	45	53
	Evening	44	54
	Night	38	52
NM2[2] 4-10 December 2025	Day	56	64
	Evening	47	64
	Night	41	62

Notes: 1. Levels in this table are not necessarily the result of activity at site.

5 Discussion

5.1 Attended noise monitoring

5.1.1 Noted noise sources

During attended monitoring, the time variations (temporal characteristics) of noise sources are considered in each measurement via statistical descriptors. From these observations, summaries have been derived for each location and provided in this section. Statistical 1/3 octave-band analysis of environmental noise was undertaken and the following figures display frequency ranges of various noise sources at each location for L_{A1}, L_{A10}, L_{Aeq}, L_{A50}, and L_{A90} descriptors. These figures also provide, graphically, statistical information for these noise levels.

An example is provided as Figure 5.1, where frogs, insects and birds are seen to be generating noise at frequencies above 1000 Hz, while industrial noise is observed at frequencies less than 1000 Hz.

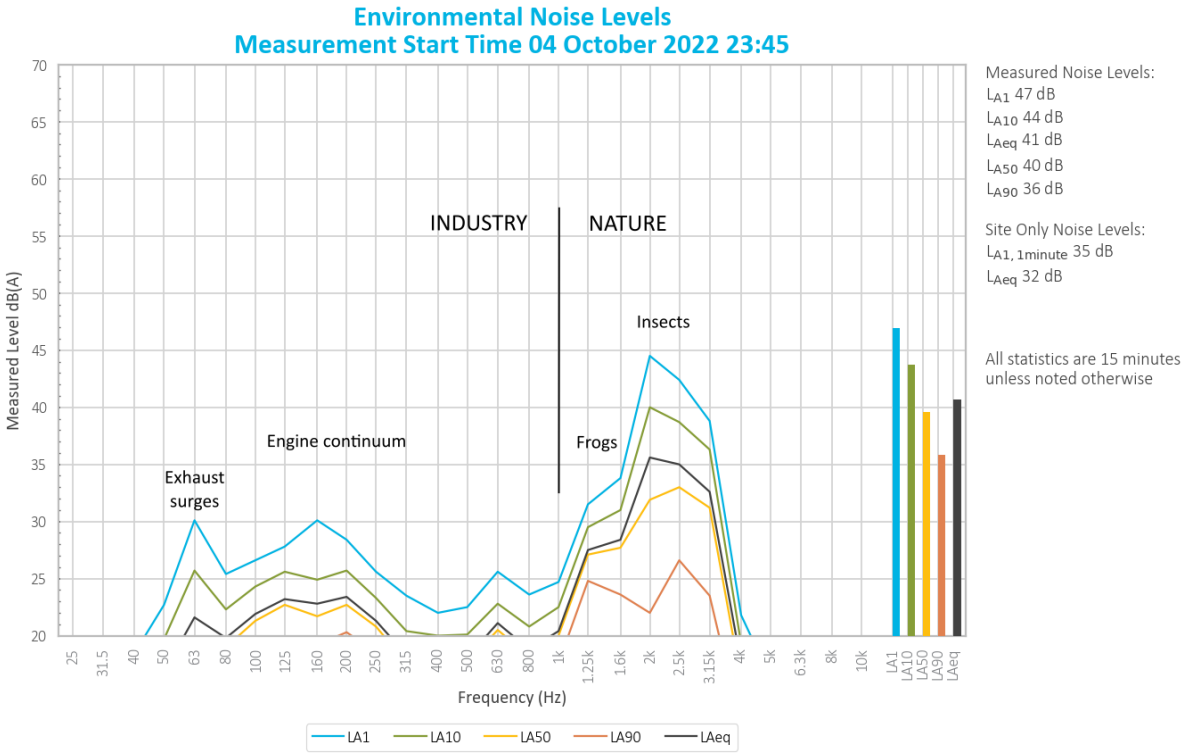

Figure 5.1 Example graph

5.1.2 NM1

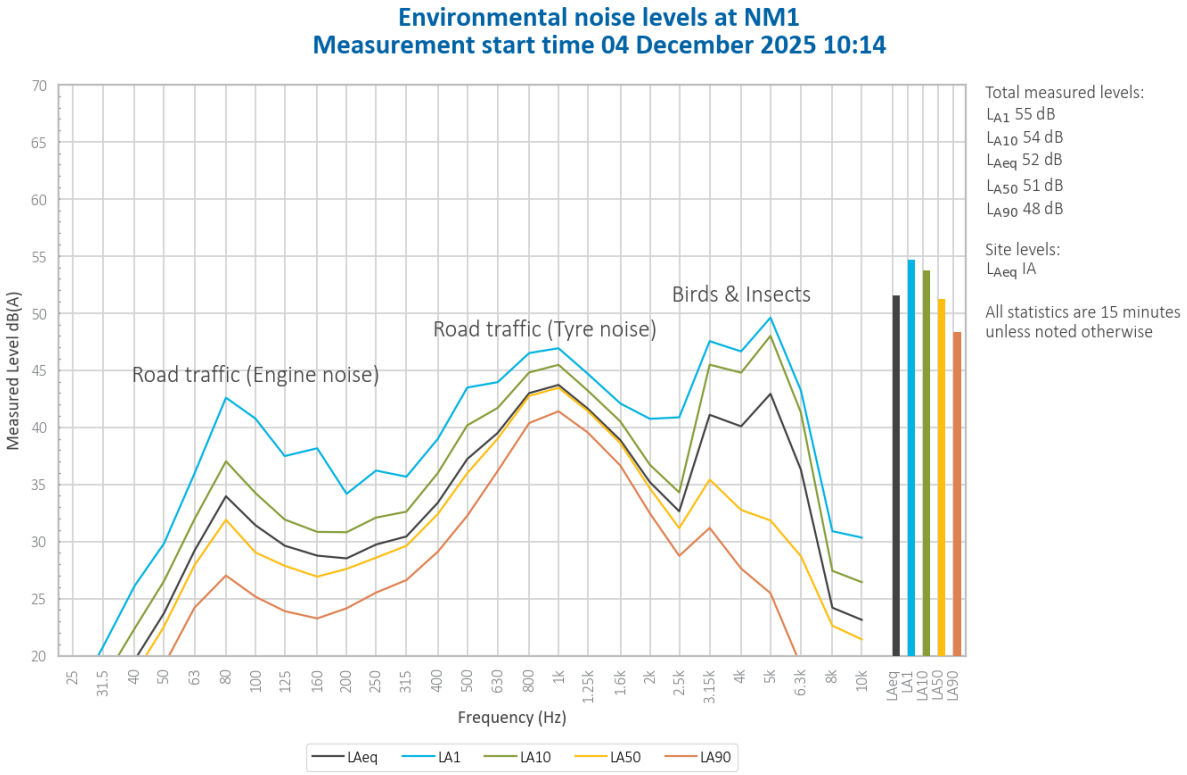

Figure 5.2 Environmental Noise Levels – NM1

Karuah Quarry operations were inaudible during the entire measurement.

Road traffic noise dominated total measured noise levels.

Noise from birds and insects was also noted.

5.1.3 NM2

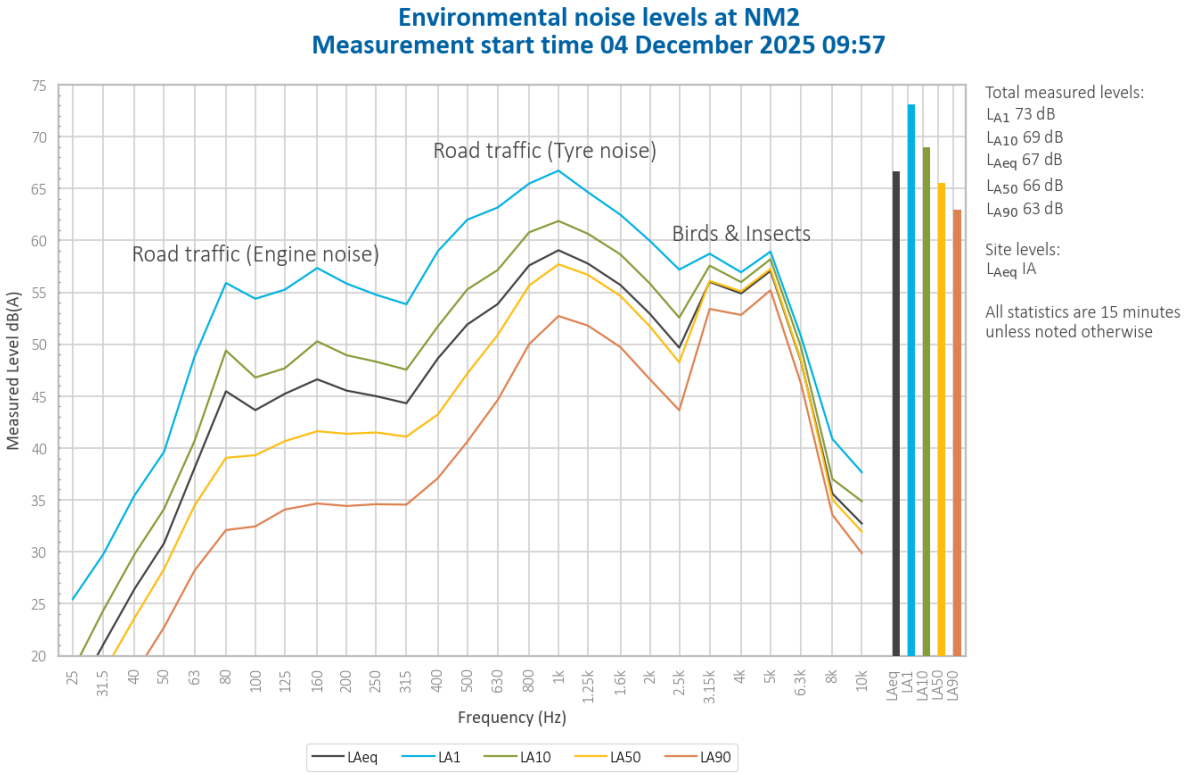

Figure 5.3 Environmental Noise Levels – NM2

Karuah Quarry operations were inaudible during the entire measurement.

Road traffic noise dominated total measured noise levels.

Noise from birds and insects was also noted.

5.2 Unattended noise monitoring

Observations during the operator attended measurements indicate that the dominant source of noise at both unattended noise monitoring locations is road traffic noise from the Pacific Highway (particularly during peak traffic periods), with insects, birds and dogs barking also noted to be audible.

Notwithstanding, a review of the unattended noise monitoring data has found no correlation between recorded noise levels and events associated with Karuah Quarry operations. Without an operator present to discern the noise sources contributing to the measured noise levels, it is difficult to establish any meaningful conclusions or trends from the unattended noise monitoring data.

6 Summary

EMM was engaged by Hunter Quarries Pty Limited to conduct a bi-annual noise survey of operations at the site surrounds. The survey purpose was to quantify the acoustic environment and compare site noise levels against specified limits.

Attended environmental noise monitoring described in this report was done during the day period on Thursday 4 December 2025 at two monitoring locations, as required by the EMP.

Noise levels from site complied with relevant limits at all monitoring locations during the Semester 2 2025 survey.

A review of the unattended noise monitoring data found that no meaningful conclusions, events or trends could be associated with Karuah Quarry operations.

Appendix A
Noise perception and examples

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A.1 Noise levels

Table A.1 gives an indication as to how an average person perceives changes in noise level. Examples of common noise levels are provided in Figure A.1.

Table A.1 Perceived change in noise

Change in sound pressure level (dB)	Perceived change in noise
up to 2	Not perceptible
3	Just perceptible
5	Noticeable difference
10	Twice (or half) as loud
15	Large change
20	Four times (or quarter) as loud

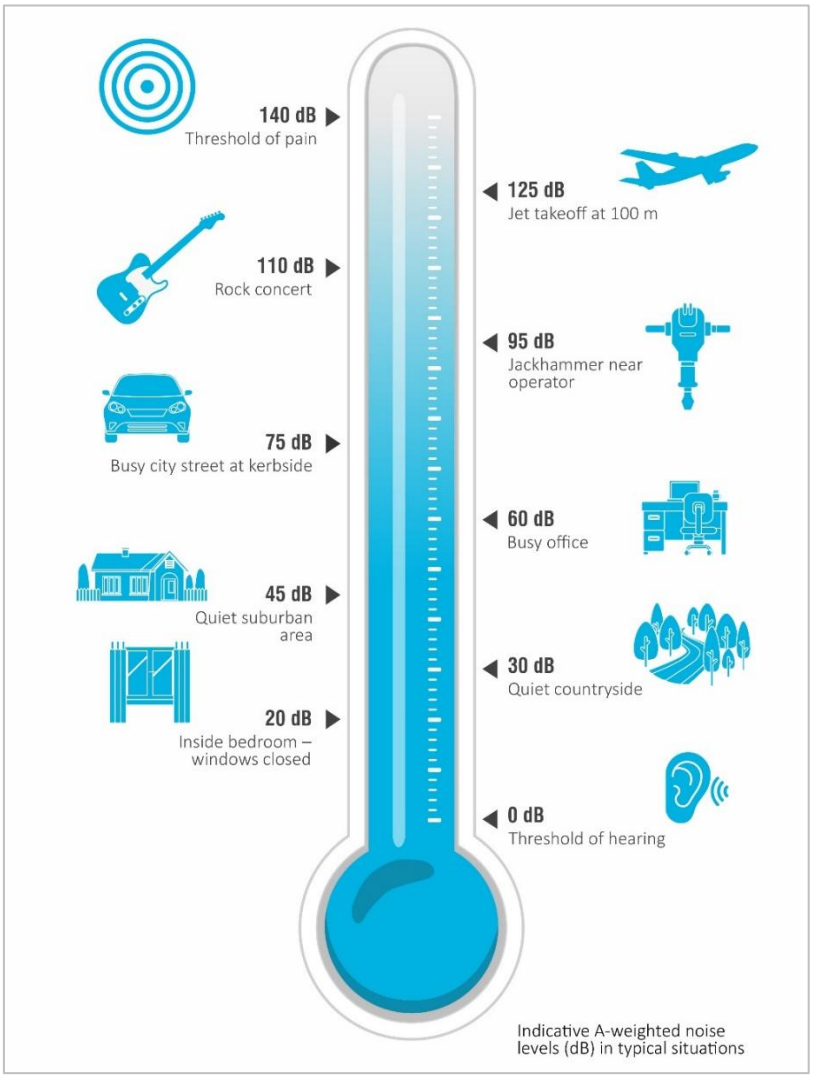

Figure A.1 Common noise levels

Appendix B
Regulator documents

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B.1 Development Consent

SCHEDULE 3
SPECIFIC ENVIRONMENTAL CONDITIONS

[1]NOISE

Noise Impact Assessment Criteria

1. The Applicant shall ensure that the noise generated by the development does not exceed the criteria specified in Table 2 at any residence or noise sensitive receptor on privately owned land.

Time Period	Noise Limits dB(A)
	$L_{Aeq\ (15minute)}$
Day (7am to 6pm) Monday to Friday and 7am to 1pm Saturday	48
Evening (6pm to 10pm) Monday to Friday	47
At all other times	46

Table 2: Noise Impact Assessment Criteria for the Development

Notes:

- *Noise from the site is to be measured within thirty meters of any residence or other noise sensitive areas to determine compliance with the noise criteria set out in Table 2.*
- *$LA_{eq(15\ minute)}$ is the equivalent continuous noise level - the level of noise equivalent to the energy average of noise levels occurring over a measurement period.*
- *For the purpose of noise measures required for this condition, the LA_{eq} noise level must be measured or computed at the point defined in this condition over a period of 15 minutes using "FAST" response on the sound level meter.*
- *For the purpose of the noise criteria for this condition, 5dBA must be added to the measured level if the noise is substantially tonal or impulsive in character. The location or point of impact can be different for each development, for example, at the closest residential receiver or at the closest boundary of the development. Measurement locations can be:*
  - *a) 1 meter from the facade of the residence for night time assessment;*
  - *b) at the residential boundary;*
  - *c) 30 meters from the residence (rural situations) where boundary is more than 30 meters from residence.*
- *The noise emission limits identified in this condition apply for prevailing meteorological conditions (winds up to 3m/s), except under conditions of temperature inversions. Noise impacts that may be enhanced by temperature inversions must be addressed by:*
  - *a) documenting noise complaints received to identify any higher level of impacts or patterns of temperature inversions;*
  - *b) where levels of noise complaints indicate a higher level of impact then actions to quantify and ameliorate any enhanced impacts under temperature inversions conditions should be developed and implemented.*

Operating Hours

2. The Applicant shall comply with the operating hours in Table 1:

Activity	Days of the Week	Time
• Construction	Monday – Friday	7am to 6pm
• Extraction and processing	Saturday	7am to 1pm
• Internal and off-site transportation of product	Sunday and public holidays	No work at any time
Minor maintenance works on plant and machinery	7 days a week and public holidays	7am to 6pm

Table 1: Operating Hours for the Development

Note: Delivery of material outside of the hours of operation permitted by condition 2 is only allowed, where that delivery is required by the police or other authorities for safety reasons; and/or where the operation or personnel or equipment are endangered. In such circumstances, prior notification should be provided to the DEC and affected residents as soon as possible, or within a reasonable period in the case of emergency.

Noise Monitoring

3. Within 6 months of the date of this consent, the Applicant shall prepare and implement a Noise Monitoring Program for the development to evaluate compliance with the noise impact assessment criteria in this consent, in consultation with the DEC, and to the satisfaction of the Director-General.

[1] Incorporates DEC GTAs

B.2 Environmental monitoring program

4.3 Blast Monitoring

In accordance with Schedule 3, Condition 6 of the Development Consent, blasting will only be conducted between 9.00 am and 3.00 pm Monday to Friday, and within a maximum of one blast per week. No blasting will occur on weekends or public holidays. Any blasting outside of these hours will be conducted with prior approval of NSW Planning.

It should be noted that the blast event, may consist of a number of blasts in the same vicinity, within a short period of time, typically less than two minutes.

In accordance with Schedule 4, Condition 4 and Condition 5 of the Development Consent, all blasts will be monitored for overpressure and ground vibration at the nearest residential receptor, currently located on Mill Hill Close, as illustrated in **Figure 4**, to ensure blasting remains within compliance criteria summarised by **Table 8.**

Table 8 Summary of Blasting Compliance Criteria.

Location	Airblast Overpressure [dBL (Lin Peak)]	Ground Vibration, PPV (mm/s)	Allowable Exceedance
Any residence on privately-owned land	120	10	0%
	115	5	5% of the total number of blasts over a period of 12-months

4.4 Noise Monitoring

Schedule 3, Condition 11 of the Development Consent provides noise impact assessment criteria for the site as summarised by **Table 9**. The noise monitoring regime is outlined below.

Table 9 Summary of Noise Compliance Criteria.

Assessment Period	Time Period	Noise Limits [dB(A) $LA_{eq(15min)}$]
Day	7am to 6pm Monday to Friday; and 7am to 1pm Saturday	48
Evening	6 pm to 10pm Monday to Friday	47
At all other times		46

Noise monitoring rounds occur on a six-monthly basis consisting of both attended and unattended noise monitoring at the two nearest residential receivers (NM1 and NM2) located on Mill Hill Close, as illustrated by **Figure 4**.

The continuous unattended monitoring will occur over a period of at least four full days; and the attended monitoring will be undertaken for 15-minute intervals during both day and evening assessment periods by a suitably qualified noise consultant.

During the attended monitoring surveys, on-site climatic data will be logged to ensure that the noise assessment periods will be completed during favourable weather conditions as defined by the EPA's *Approved methods for the measurement and analysis of environmental noise in NSW*.

Appendix C
Calibration certificates

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Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C24877

Client Details	EMM Consulting Suite 9.10, Level 9, 454 Collins Street Melbourne VIC, 3000
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	878017
Microphone Serial Number :	21991
Pre-amplifier Serial Number :	27806
Firmware Version :	v12.6

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	24.7 °C	**Ambient Temperature :**	24.8 °C
Relative Humidity :	48.4 %	**Relative Humidity :**	48.2 %
Barometric Pressure :	101.25 kPa	**Barometric Pressure :**	101.22 kPa

Calibration Technician :	Jeff Yu	**Secondary Check:**	Cooper Sallway
Calibration Date :	20 Nov 2024	**Report Issue Date :**	25 Nov 2024

Approved Signatory :  Ken Williams

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

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

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

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.11 kPa*
Electrical Tests	*±0.13 dB*		

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

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

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

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

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

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

Calibration Number C24877

Client Details EMM Consulting
Suite 9.10, Level 9, 454 Collins Street
Melbourne VIC, 3000

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878017
Microphone Serial Number : 21991
Pre-amplifier Serial Number : 27806
Firmware Version : v12.6

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.7 °C	**Ambient Temperature :**	24.8 °C
Relative Humidity :	48.4 %	**Relative Humidity :**	48.2 %
Barometric Pressure :	101.25 kPa	**Barometric Pressure :**	101.22 kPa

Calibration Technician : Jeff Yu
Secondary Check: Cooper Sallway
Calibration Date : 20 Nov 2024
Report Issue Date : 25 Nov 2024

Approved Signatory :  Ken Williams

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

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

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

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.11 kPa*
Electrical Tests	*±0.13 dB*		

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

1. OVERVIEW

This report presents the calibration test results of a ARL Ngara 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*.

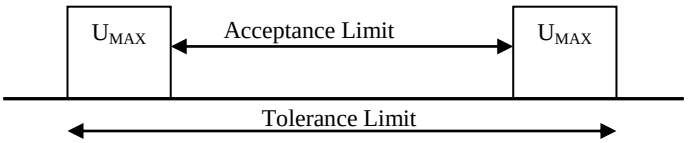
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version v41 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 – AG44204) 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	94.62	94.08	94.08	94.00
C	94.58	94.04	94.04	93.96
Z	N/A	N/A	N/A	N/A

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)

18.80	18.70	18.70	18.70	18.70
18.70	18.70	18.70	18.70	18.70

Acoustic Noise Floor : 18.7 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)

16.60	16.80	16.70	16.50	16.40
16.70	16.70	16.50	16.50	16.40

Random Readings dB(C)

18.10	18.40	18.20	18.30	17.90
18.60	18.30	18.20	18.10	18.00

Random Readings dB(Z)

N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	16.6	18.2	N/A

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	94.0	94.0	94.0	0.13
8 000	87.8	87.8	87.8	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uncertainty (dB)
		Actual	re 1kHz	
125.90	-0.06	93.84	-0.08	0.13
1005.10	-0.08	93.92	0.00	0.13
7915.10	0.07	87.87	-6.05	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	0.00	0.00	0.20
1005.10	0.00	0.20	0.00	0.00	0.10	0.20
7915.10	3.00	0.30	0.00	0.00	0.20	0.30

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	0.31	0.60
1005.10	94.02	0.00	0.0	±0.7	0.00	P	0.31	0.60
7915.10	91.07	-2.95	-3.0	+1.5 / -2.5	0.05	P	0.45	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 75dB. 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	74.7	74.7	N/A	0.13
125	74.8	74.9	N/A	0.11
250	74.9	74.9	N/A	0.10
500	74.9	75.0	N/A	0.10
1 000	75.0	75.0	N/A	0.10
2 000	75.0	75.0	N/A	0.10
4 000	75.0	75.0	N/A	0.10
8 000	74.9	74.8	N/A	0.10
15 850	72.2	72.1	N/A	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	0.00	0.00	0.20
125	0.10	0.30	0.00	0.00	0.00	0.20
250	0.10	0.20	0.00	0.00	0.00	0.20
500	0.00	0.20	0.00	0.00	0.00	0.20
1 000	0.00	0.20	0.00	0.00	0.10	0.20
2 000	0.00	0.30	0.00	0.00	0.40	0.20
4 000	0.10	0.30	0.00	0.00	0.20	0.20
8 000	0.00	0.30	0.00	0.00	0.20	0.30
15 850	-0.80	0.50	0.00	0.00	0.40	0.30

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	74.80	-0.30	±1.0	P	0.39	0.60
125	74.90	-0.20	±1.0	P	0.38	0.60
250	75.00	-0.10	±1.0	P	0.30	0.60
500	74.90	-0.20	±1.0	P	0.30	0.60
1 000	75.10	0.00	±0.7	P	0.30	0.60
2 000	75.40	0.30	±1.0	P	0.38	0.60
4 000	75.30	0.20	±1.0	P	0.38	0.60
8 000	75.10	0.00	+1.5 / -2.5	P	0.44	0.70
15 850	71.80	-3.30	+2.5 / −16	P	0.60	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	74.80	-0.30	±1.0	P	0.39	0.60
125	75.00	-0.10	±1.0	P	0.38	0.60
250	75.00	-0.10	±1.0	P	0.30	0.60
500	75.00	-0.10	±1.0	P	0.30	0.60
1 000	75.10	0.00	±0.7	P	0.30	0.60
2 000	75.40	0.30	±1.0	P	0.38	0.60
4 000	75.30	0.20	±1.0	P	0.38	0.60
8 000	75.00	-0.10	+1.5 / -2.5	P	0.44	0.70
15 850	71.70	-3.40	+2.5 / −16	P	0.60	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	N/A	N/A	±1.0	N/A	0.39	0.60
125	N/A	N/A	±1.0	N/A	0.38	0.60
250	N/A	N/A	±1.0	N/A	0.30	0.60
500	N/A	N/A	±1.0	N/A	0.30	0.60
1 000	N/A	N/A	±0.7	N/A	0.30	0.60
2 000	N/A	N/A	±1.0	N/A	0.38	0.60
4 000	N/A	N/A	±1.0	N/A	0.38	0.60
8 000	N/A	N/A	+1.5 / -2.5	N/A	0.44	0.70
15 850	N/A	N/A	+2.5 / −16	N/A	0.60	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	N/A	N/A	N/A	±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)
72.8	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
115.0	115.0	0.0	±0.8	P	0.1	0.3
116.0	116.0	0.0	±0.8	P	0.1	0.3
117.0	117.0	0.0	±0.8	P	0.1	0.3
118.0	118.0	0.0	±0.8	P	0.1	0.3
119.0	119.0	0.0	±0.8	P	0.1	0.3
120.0	120.0	0.0	±0.8	P	0.1	0.3
121.0	120.9	-0.1	±0.8	P	0.1	0.3

Overload indication at 122.0dB.

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	34.1	0.1	±0.8	P	0.1	0.3
30.0	30.1	0.1	±0.8	P	0.1	0.3
29.0	29.2	0.2	±0.8	P	0.1	0.3
28.0	28.2	0.2	±0.8	P	0.1	0.3
27.0	27.3	0.3	±0.8	P	0.1	0.3
26.0	26.4	0.4	±0.8	P	0.1	0.3
25.0	25.5	0.5	±0.8	P	0.1	0.3

No under range indicated.

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 117.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	116.0	0.0	±0.5	P	0.1	0.3
2ms	99.0	0.0	+1.0 / -1.5	P	0.1	0.3
0.25ms	89.9	-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	109.6	0.0	±0.5	P	0.1	0.3
2ms	90.0	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	109.8	-0.2	±0.5	P	0.1	0.3
2ms	89.8	-0.2	+1.0 / -1.5	P	0.1	0.3
0.25ms	80.6	-0.4	+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 dB(C).

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 of119.0dB(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 17 - Overload Indication

Signal Orientation	Overload Response (dB)	Difference (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive	119.8	-0.3	±1.5	P	0.10	0.25
Negative	120.0					

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 18 - 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	119.0	119.0	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	119.0	119.0	0.0	±0.1	P	0.10	0.10

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C24453

Client Details	EMM Consulting PO Box 21, Ground Floor, Suite 01, 20 Chandos Street St Leonards NSW, 2065
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	87801F
Microphone Serial Number :	22143
Pre-amplifier Serial Number :	28696
Firmware Version :	12.6

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	23 °C	**Ambient Temperature :**	22.2 °C
Relative Humidity :	36.5 %	**Relative Humidity :**	37.5 %
Barometric Pressure :	100.46 kPa	**Barometric Pressure :**	100.45 kPa

Calibration Technician :	Shaheen Boaz	**Secondary Check:**	Cooper Sallway
Calibration Date :	20 Jun 2024	**Report Issue Date :**	21 Jun 2024
Approved Signatory :			Ken Williams

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

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

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

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.11 kPa*
Electrical Tests	*±0.13 dB*		

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

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

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

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

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

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

Calibration Number C24453

Client Details EMM Consulting
PO Box 21, Ground Floor, Suite 01, 20 Chandos Street
St Leonards NSW, 2065

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 87801F
Microphone Serial Number : 22143
Pre-amplifier Serial Number : 28696
Firmware Version : 12.6

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23 °C	**Ambient Temperature :**	22.2 °C
Relative Humidity :	36.5 %	**Relative Humidity :**	37.5 %
Barometric Pressure :	100.46 kPa	**Barometric Pressure :**	100.45 kPa

Calibration Technician : Shaheen Boaz
Calibration Date : 20 Jun 2024
Secondary Check: Cooper Sallway
Report Issue Date : 21 Jun 2024

Approved Signatory : Ken Williams

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

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

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

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13 dB*	*Temperature*	*±0.1 °C*
1kHz	*±0.13 dB*	*Relative Humidity*	*±1.9 %*
8kHz	*±0.14 dB*	*Barometric Pressure*	*±0.11 kPa*
Electrical Tests	*±0.13 dB*		

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

1. OVERVIEW

This report presents the calibration test results of a ARL Ngara 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*.

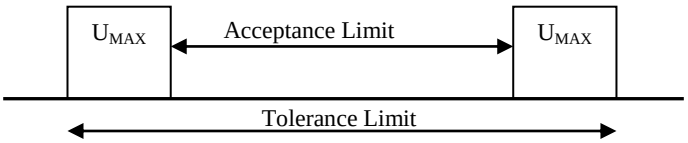
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 1 of the calibration work instruction manual.

Where required, reference is made to manual version V41 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 - 3215300) 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 – AH.88227) 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 : 100.0 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	94.21	94.09	94.09	94.00
C	94.17	94.05	94.05	93.96
Z	N/A	N/A	N/A	N/A

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)

19.40	19.20	19.50	19.20	19.20
19.20	19.30	18.90	19.10	18.80

Acoustic Noise Floor : 19.2 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)

16.50	16.60	16.50	16.50	16.60
16.50	16.50	16.50	16.50	16.60

Random Readings dB(C)

18.00	17.90	17.70	17.90	17.70
18.10	18.00	18.40	18.00	17.80

Random Readings dB(Z)

N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	16.5	18.0	N/A

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	94.0	94.0	94.0	0.13
8 000	88.2	88.2	88.2	0.14

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uncertainty (dB)
		Actual	re 1kHz	
125.90	-0.03	93.87	-0.04	0.13
1005.10	-0.09	93.91	0.00	0.13
7915.10	-0.11	88.09	-5.82	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	0.00	0.00	0.20
1005.10	0.00	0.20	0.00	0.00	0.10	0.20
7915.10	3.00	0.30	0.00	0.00	0.20	0.30

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	93.87	-0.14	-0.2	±1.0	0.06	P	0.31	0.60
1005.10	94.01	0.00	0.0	±0.7	0.00	P	0.31	0.60
7915.10	91.29	-2.72	-3.0	+1.5 / -2.5	0.28	P	0.45	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 75dB. 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	74.8	74.8	N/A	0.13
125	74.8	75.0	N/A	0.11
250	74.9	75.0	N/A	0.10
500	74.9	75.0	N/A	0.10
1 000	75.0	75.0	N/A	0.10
2 000	75.0	75.0	N/A	0.10
4 000	75.0	75.0	N/A	0.10
8 000	74.9	74.9	N/A	0.10
15 850	72.3	72.2	N/A	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	0.00	0.00	0.20
125	0.10	0.30	0.00	0.00	0.00	0.20
250	0.10	0.20	0.00	0.00	0.00	0.20
500	0.00	0.20	0.00	0.00	0.00	0.20
1 000	0.00	0.20	0.00	0.00	0.10	0.20
2 000	0.00	0.30	0.00	0.00	0.40	0.20
4 000	0.10	0.30	0.00	0.00	0.20	0.20
8 000	0.00	0.30	0.00	0.00	0.20	0.30
15 850	-0.80	0.50	0.00	0.00	0.40	0.30

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	74.90	-0.20	±1.0	P	0.39	0.60
125	74.90	-0.20	±1.0	P	0.38	0.60
250	75.00	-0.10	±1.0	P	0.30	0.60
500	74.90	-0.20	±1.0	P	0.30	0.60
1 000	75.10	0.00	±0.7	P	0.30	0.60
2 000	75.40	0.30	±1.0	P	0.38	0.60
4 000	75.30	0.20	±1.0	P	0.38	0.60
8 000	75.10	0.00	+1.5 / -2.5	P	0.44	0.70
15 850	71.90	-3.20	+2.5 / −16	P	0.60	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	74.90	-0.20	±1.0	P	0.39	0.60
125	75.10	0.00	±1.0	P	0.38	0.60
250	75.10	0.00	±1.0	P	0.30	0.60
500	75.00	-0.10	±1.0	P	0.30	0.60
1 000	75.10	0.00	±0.7	P	0.30	0.60
2 000	75.40	0.30	±1.0	P	0.38	0.60
4 000	75.30	0.20	±1.0	P	0.38	0.60
8 000	75.10	0.00	+1.5 / -2.5	P	0.44	0.70
15 850	71.80	-3.30	+2.5 / −16	P	0.60	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	N/A	N/A	±1.0	N/A	0.39	0.60
125	N/A	N/A	±1.0	N/A	0.38	0.60
250	N/A	N/A	±1.0	N/A	0.30	0.60
500	N/A	N/A	±1.0	N/A	0.30	0.60
1 000	N/A	N/A	±0.7	N/A	0.30	0.60
2 000	N/A	N/A	±1.0	N/A	0.38	0.60
4 000	N/A	N/A	±1.0	N/A	0.38	0.60
8 000	N/A	N/A	+1.5 / -2.5	N/A	0.44	0.70
15 850	N/A	N/A	+2.5 / −16	N/A	0.60	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	N/A	N/A	N/A	±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)
72.8	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
115.0	115.0	0.0	±0.8	P	0.1	0.3
116.0	116.0	0.0	±0.8	P	0.1	0.3
117.0	117.0	0.0	±0.8	P	0.1	0.3
118.0	118.0	0.0	±0.8	P	0.1	0.3
119.0	119.0	0.0	±0.8	P	0.1	0.3
120.0	120.0	0.0	±0.8	P	0.1	0.3
121.0	121.0	0.0	±0.8	P	0.1	0.3

Overload indication at 122.0dB.

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	34.1	0.1	±0.8	P	0.1	0.3
30.0	30.1	0.1	±0.8	P	0.1	0.3
29.0	29.2	0.2	±0.8	P	0.1	0.3
28.0	28.3	0.3	±0.8	P	0.1	0.3
27.0	27.4	0.4	±0.8	P	0.1	0.3
26.0	26.5	0.5	±0.8	P	0.1	0.3
25.0	25.6	0.6	±0.8	P	0.1	0.3

No under range indicated.

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 117.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
200ms	116.0	0.0	±0.5	P	0.1	0.3
2ms	99.0	0.0	+1.0 / -1.5	P	0.1	0.3
0.25ms	89.9	-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	109.6	0.0	±0.5	P	0.1	0.3
2ms	90.0	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	110.0	0.0	±0.5	P	0.1	0.3
2ms	89.9	-0.1	+1.0 / -1.5	P	0.1	0.3
0.25ms	80.8	-0.2	+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 dB(C).

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 of119.0dB(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 17 - Overload Indication

Signal Orientation	Overload Response (dB)	Difference (dB)	Tolerance Limit (dB)	P/F	Uncertainty (dB)	Maximum Permitted Uncertainty (dB)
Positive	119.7	-0.2	±1.5	P	0.10	0.25
Negative	119.9					

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 18 - 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	119.0	119.0	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	119.0	119.0	0.0	±0.1	P	0.10	0.10

Sydney Calibration Laboratory
Unit 21, 1 Talavera Road, Macquarie Park NSW 2113, Australia
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301

CERTIFICATE OF CALIBRATION

Certificate No: CAU2400803

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2255	No: 2255-100299
Microphone:	Brüel & Kjær	4966	No: 3403563
Preamplifier:	Brüel & Kjær	ZC-0043	No: 3399249
Supplied Calibrator:	None		
Software version:	BZ7300 Version 1.2.0.1325	Pattern Approval:	-
Instruction manual:	BE1917-11	Identification:	N/A

CUSTOMER:

EMM Consulting Pty Limited
20 Chandos Street
St Leonards NSW 2065

CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 °C
Environment conditions:	*see actual values in **Environmental conditions** sections*

SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-3:2006 class 1. Procedures from IEC 61672-3:2006 were used to perform the periodic tests. The measurements included in this document are traceable to Australian / International standards through accredited calibration of all relevant reference equipment.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 8.6 - DB: 8.60) and test procedure 2255-N, 4966 (BZ-7300).

RESULTS:

X	Initial calibration		Calibration prior to repair/adjustment
	Calibration without repair/adjustment		Calibration after repair/adjustment

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 14/08/2024

Certificate issued: 14/08/2024

Barath Chandar Rajendran
Calibration Technician

Sajeeb Tharayil
Approved signatory

Summary

Preliminary inspection	**Passed**
Environmental conditions, Prior to calibration	**Passed**
Reference information	**Passed**
Indication at the calibration check frequency	**Passed**
Acoustical signal tests of a frequency weighting, C weighting	**Passed**
Self-generated noise, Microphone installed	**Passed**
Self-generated noise, Electrical	**Passed**
Electrical signal tests of frequency weightings, A weighting	**Passed**
Electrical signal tests of frequency weightings, C weighting	**Passed**
Electrical signal tests of frequency weightings, Z weighting	**Passed**
Frequency and time weightings at 1 kHz	**Passed**
Long-term stability, Reference	**Passed**
Level linearity on the reference level range, Upper	**Passed**
Level linearity on the reference level range, Lower	**Passed**
Toneburst response, Time-weighting Fast	**Passed**
Toneburst response, Time-weighting Slow	**Passed**
Toneburst response, Leq	**Passed**
C-weighted peak sound level, 8 kHz	**Passed**
C-weighted peak sound level, 500 Hz	**Passed**
Overload indication	**Passed**
Long-term stability, 1. relative	**Passed**
High-level stability	**Passed**
Long-term stability, 2. relative	**Passed**
Environmental conditions, Following calibration	**Passed**

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1:2013 for the same coverage probability of 95 %.

Instruments

Category:	Type:	Manufacturer:	Serial No.:
Voltmeter	DMM34461A	Keysight / Agilent	MY60055667
Generator	Pulse Generator	Bruel & Kjaer	BK3161-105338
Calibrator	4226	Bruel & Kjaer	3222931
AmplifierDivider	WB-3630 Output Module	Bruel & Kjaer	3330940
Adaptor	WA0302B, 15 pF	Bruel & Kjaer	2747050

Preliminary inspection

Visually inspect instrument, and operate all relevant controls. (clause 5)

	Result
Visual inspection	OK

Environmental conditions, Prior to calibration

Actual environmental conditions prior to calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured [Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	24.10
Air pressure	101.30	-21.30	3.70	101.50
Relative humidity	50.00	-25.00	20.00	51.20

Reference information

Information about reference range, level and channel. (clause 22.h + 22.m)

	Value [dB SPL]
Reference sound pressure level	94
Reference level range	140
Channel number	1

Indication at the calibration check frequency

Measure and adjust sound level meter using the supplied calibrator. (clause 10 + 22.m)

	Expected [dB SPL / Hz]	Measured [dB SPL / Hz]	Uncertainty [dB]
Calibration check frequency (in-house calibrator)	1000.00	1000.00	1.00
Initial indication (in-house calibrator)	93.89	93.96	0.29
Adjusted indication (in-house calibrator)	93.89	93.93	0.29

Acoustical signal tests of a frequency weighting, C weighting

Frequency weightings measured acoustically with a calibrated multi-frequency sound calibrator. Averaging time is 10 seconds, and the result is the average of 2 measurements. (clause 12)

	Coupler Pressure Lc	Mic. Correction C4226	Body Influence	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref. (1st)	93.96	0.06	0.01	93.89	93.91	-0.7	0.7	0.02	0.29
1000Hz, Ref. (2nd)	93.96	0.06	0.01	93.89	93.91	-0.7	0.7	0.02	0.29
1000Hz, Ref. (Average)	93.96	0.06	0.01	93.89	93.91	-0.7	0.7	0.02	0.29
125.89Hz (1st)	94.04	0.00	0.00	93.85	93.86	-1.0	1.0	0.01	0.26
125.89Hz (2nd)	94.04	0.00	0.00	93.85	93.83	-1.0	1.0	-0.02	0.26
125.89Hz (Average)	94.04	0.00	0.00	93.85	93.84	-1.0	1.0	-0.01	0.26
7943.3Hz (1st)	93.69	2.88	-0.03	87.85	87.58	-2.5	1.5	-0.27	0.47
7943.3Hz (2nd)	93.69	2.88	-0.03	87.85	87.58	-2.5	1.5	-0.27	0.47
7943.3Hz (Average)	93.69	2.88	-0.03	87.85	87.58	-2.5	1.5	-0.27	0.47

Self-generated noise, Microphone installed

Self-generated noise measured with microphone submitted for periodic testing. Averaging time is 30 seconds. An anechoic chamber is used to isolate environmental noise.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.1)

	Max	Measured	Uncertainty
	[dB SPL]	[dB SPL]	[dB]
A weighted	17.30	16.81	0.50

Self-generated noise, Electrical

Self-generated noise measured in most sensitive range, with electrical substitution for microphone, according to manufactures specifications.
The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. (clause 11.2)

	Max	Measured	Uncertainty
	[dB SPL]	[dB SPL]	[dB]
A weighted	12.00	7.05	0.30
C weighted	15.30	12.07	0.30
Z weighted	21.50	18.11	0.30

Electrical signal tests of frequency weightings, A weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level	Expected	Measured	Response Corr.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dBV]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref.	-25.00	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	1.20	95.00	94.95	0.02	-0.01	94.96	-1.0	1.0	-0.04	0.12
125.89Hz	-8.90	95.00	94.96	0.02	-0.01	94.97	-1.0	1.0	-0.03	0.12
251.19Hz	-16.40	95.00	94.96	0.01	0.02	94.99	-1.0	1.0	-0.01	0.12
501.19Hz	-21.80	95.00	94.96	0.01	0.07	95.04	-1.0	1.0	0.04	0.12
1995.3Hz	-26.20	95.00	95.04	-0.03	-0.11	94.90	-1.0	1.0	-0.10	0.12
3981.1Hz	-26.00	95.00	95.09	-0.11	0.12	95.10	-1.0	1.0	0.10	0.12
7943.3Hz	-23.90	95.00	94.90	0.09	-0.04	94.95	-2.5	1.5	-0.05	0.12
15849Hz	-18.40	95.00	94.43	0.57	0.14	95.14	-16.0	2.5	0.14	0.12

Electrical signal tests of frequency weightings, C weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level	Expected	Measured	Response Corr.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dBV]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref.	-25.00	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-24.20	95.00	94.91	0.02	-0.01	94.92	-1.0	1.0	-0.08	0.12
125.89Hz	-24.80	95.00	95.03	0.02	-0.01	95.04	-1.0	1.0	0.04	0.12
251.19Hz	-25.00	95.00	94.99	0.01	0.02	95.02	-1.0	1.0	0.02	0.12
501.19Hz	-25.00	95.00	95.02	0.01	0.07	95.10	-1.0	1.0	0.10	0.12
1995.3Hz	-24.80	95.00	95.07	-0.03	-0.11	94.93	-1.0	1.0	-0.07	0.12
3981.1Hz	-24.20	95.00	95.10	-0.11	0.12	95.11	-1.0	1.0	0.11	0.12
7943.3Hz	-22.00	95.00	94.90	0.09	-0.04	94.95	-2.5	1.5	-0.05	0.12
15849Hz	-16.50	95.00	94.40	0.57	0.14	95.11	-16.0	2.5	0.11	0.12

Electrical signal tests of frequency weightings, Z weighting

Frequency response measured with electrical signal relative to level at 1 kHz in reference range. (clause 13)
Electrical and acoustical response and body influence corrections are adjusted with the respective correction values at the reference frequency, in accordance with clause 13.6

	Input Level	Expected	Measured	Response Corr.	Body Influence	Corr. Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dBV]	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
1000Hz, Ref.	-25.04	95.00	95.00	0.00	0.00	95.00	-0.5	0.5	0.00	0.12
63.096Hz	-25.04	95.00	94.94	0.02	-0.01	94.95	-1.0	1.0	-0.05	0.12
125.89Hz	-25.04	95.00	94.97	0.02	-0.01	94.98	-1.0	1.0	-0.02	0.12
251.19Hz	-25.04	95.00	94.99	0.01	0.02	95.02	-1.0	1.0	0.02	0.12
501.19Hz	-25.04	95.00	95.00	0.01	0.07	95.08	-1.0	1.0	0.08	0.12
1995.3Hz	-25.04	95.00	95.04	-0.03	-0.11	94.90	-1.0	1.0	-0.10	0.12
3981.1Hz	-25.04	95.00	95.12	-0.11	0.12	95.13	-1.0	1.0	0.13	0.12
7943.3Hz	-25.04	95.00	94.92	0.09	-0.04	94.97	-2.5	1.5	-0.03	0.12
15849Hz	-25.04	95.00	94.44	0.57	0.14	95.15	-16.0	2.5	0.15	0.12

Frequency and time weightings at 1 kHz

Frequency and time weighting measured at 1 kHz with electrical signal in reference range. Measured relative to A-weighted and Fast response. (clause 14)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
LAF, Ref.	94.00	94.00	-0.5	0.5	0.00	0.12
LCF	94.00	94.00	-0.2	0.2	0.00	0.12
LZF	94.00	94.04	-0.2	0.2	0.04	0.12
LAS	94.00	94.00	-0.1	0.1	0.00	0.12
LAeq	94.00	94.00	-0.1	0.1	0.00	0.12

Long-term stability, Reference

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Adjusting to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]		[dB]
Reference	94.00	-0.5	0.5	0.00	2024-08-14 12:06:21	0.10

Level linearity on the reference level range, Upper

Level linearity in reference range, measured at 8 kHz until overload. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.5	0.5	0.00	0.13
99 dB	99.00	99.00	-0.8	0.8	0.00	0.13
104 dB	104.00	104.00	-0.8	0.8	0.00	0.13
109 dB	109.00	109.00	-0.8	0.8	0.00	0.13
114 dB	114.00	114.00	-0.8	0.8	0.00	0.13
119 dB	119.00	119.00	-0.8	0.8	0.00	0.13
124 dB	124.00	124.00	-0.8	0.8	0.00	0.13
129 dB	129.00	129.00	-0.8	0.8	0.00	0.13
134 dB	134.00	134.00	-0.8	0.8	0.00	0.13
135 dB	135.00	135.00	-0.8	0.8	0.00	0.13
136 dB	136.00	136.00	-0.8	0.8	0.00	0.13
137 dB	137.00	137.00	-0.8	0.8	0.00	0.13
138 dB	138.00	138.00	-0.8	0.8	0.00	0.13
139 dB	139.00	139.00	-0.8	0.8	0.00	0.13
140 dB	140.00	140.00	-0.8	0.8	0.00	0.13

Level linearity on the reference level range, Lower

Level linearity in reference range, measured at 8 kHz down to lower limit, or until underrange. (clause 16)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
94 dB	94.00	94.00	-0.5	0.5	0.00	0.13
89 dB	89.00	89.00	-0.8	0.8	0.00	0.13
84 dB	84.00	84.00	-0.8	0.8	0.00	0.13
79 dB	79.00	79.00	-0.8	0.8	0.00	0.13
74 dB	74.00	74.00	-0.8	0.8	0.00	0.13
69 dB	69.00	69.00	-0.8	0.8	0.00	0.13
64 dB	64.00	64.00	-0.8	0.8	0.00	0.13
59 dB	59.00	59.00	-0.8	0.8	0.00	0.13
54 dB	54.00	54.00	-0.8	0.8	0.00	0.13
49 dB	49.00	49.00	-0.8	0.8	0.00	0.13
44 dB	44.00	44.00	-0.8	0.8	0.00	0.13
39 dB	39.00	39.00	-0.8	0.8	0.00	0.24
34 dB	34.00	34.01	-0.8	0.8	0.01	0.24
29 dB	29.00	29.03	-0.8	0.8	0.03	0.24
28 dB	28.00	28.04	-0.8	0.8	0.04	0.24
27 dB	27.00	27.05	-0.8	0.8	0.05	0.24
26 dB	26.00	26.04	-0.8	0.8	0.04	0.24
25 dB	25.00	25.09	-0.8	0.8	0.09	0.24
24 dB	24.00	24.08	-0.8	0.8	0.08	0.24
23 dB	23.00	23.11	-0.8	0.8	0.11	0.24

Toneburst response, Time-weighting Fast

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	136.00	136.02	-0.5	0.5	0.02	0.12
2 ms Burst	119.00	118.95	-1.5	1.0	-0.05	0.12
0.25 ms Burst	110.00	109.83	-3.0	1.0	-0.17	0.12

Toneburst response, Time-weighting Slow

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	129.60	129.58	-0.5	0.5	-0.02	0.12
2 ms Burst	110.00	109.97	-3.0	1.0	-0.03	0.12

Toneburst response, Leq

Response to 4 kHz toneburst measured in reference range, relative to continuous signal. (clause 18)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	137.00	137.00	-0.5	0.5	0.00	0.12
200 ms Burst	120.00	120.01	-0.5	0.5	0.01	0.12
2 ms Burst	100.00	99.98	-1.5	1.0	-0.02	0.12
0.25 ms Burst	91.00	90.85	-3.0	1.0	-0.15	0.12

C-weighted peak sound level, 8 kHz

Peak-response to a 8 kHz single-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	132.00	132.00	-0.5	0.5	0.00	0.09
Single Sine	135.40	135.32	-2.0	2.0	-0.08	0.20

C-weighted peak sound level, 500 Hz

Peak-response to a 500 Hz half-cycle sine measured in least-sensitive range, relative to continuous signal. (clause 19)

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous, Ref.	135.00	135.00	-0.5	0.5	0.00	0.09
Half-sine, Positive	137.40	137.14	-1.0	1.0	-0.26	0.12
Half-sine, Negative	137.40	137.14	-1.0	1.0	-0.26	0.12

Overload indication

Overload indication in the least sensitive range determined with a 4 kHz positive/negative half-cycle signal. (clause 20)

	Measured / Input Level	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
Continuous	140.00	-0.5	0.5	0.00	0.25
Half-sine, Positive	142.00	-10.0	10.0	2.00	0.25
Half-sine, Negative	142.00	-10.0	10.0	2.00	0.25
Difference	142.00	-1.5	1.5	0.00	0.25

Long-term stability, 1. relative

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15) Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[dB SPL / Min]	[dB / Min]	[dB / Min]	[dB / Min]		[dB]
Measurement	94.00	-0.1	0.1	0.00	2024-08-14 12:38:01	0.10
Time passed	31.40	0.0	35.0	31.40		0.00

High-level stability

High-level stability over 5 minutes, with steady 1kHz signal, 1dB below upper boundary. (clause 21)

	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty
	[dB SPL]	[dB]	[dB]	[dB]	[dB]
High-level, Ref.	139.00	-0.5	0.5	0.00	0.10
High-level, after 5min	139.00	-0.1	0.1	0.00	0.10

Long-term stability, 2. relative

Long-term stability over 25 to 35 minutes, with steady 1kHz signal at reference level. (clause 15)
Relative to prior adjustment to reference level indication.

	Measured	Accept - Limit	Accept + Limit	Deviation	Timestamp	Uncertainty
	[Min / dB SPL]	[Min / dB]	[Min / dB]	[Min / dB]		[dB]
Wait	37.20	25.0	120.0	37.20		0.00
Measurement	94.00	-0.1	0.1	0.00	2024-08-14 12:44:02	0.10

Environmental conditions, Following calibration

Actual environmental conditions following calibration. (clause 7)

	Expected	Accept - Limit	Accept + Limit	Measured
				[Deg / kPa / %RH]
Air temperature	23.00	-3.00	3.00	24.07
Air pressure	101.30	-21.30	3.70	101.40
Relative humidity	50.00	-25.00	20.00	52.06

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Sound Calibrator

IEC 60942:2017

Calibration Certificate

Calibration Number C25652-V1

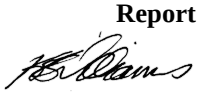
Client Details EMM Consulting
Level 3, 175 Scott Street
Newcastle, NSW, 2300

	Manufacturer	*Model*	*Serial*
Equipment Tested :			
Instrument :	Svantek	SV36	140737

Atmospheric Conditions

Ambient Temperature : 21.8 °C
Relative Humidity : 38 %
Barometric Pressure : 99.58 kPa

Calibration Technician : Peter Elters
Secondary Check: Rhys Gravelle
Calibration Date : 02-Oct-2025
Report Issue Date : 03-Oct-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	94.11	1000.00
	114	1000	114.09	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	*±0.10 dB*	*Temperature*	*±0.1 °C*
Frequency	*±0.07 %*	*Relative Humidity*	*±1.9 %*
Distortion	*±0.20 %*	*Barometric Pressure*	*±0.019 kPa*

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

NATA WORLD RECOGNISED ACCREDITATION

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

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

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

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

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Sound Calibrator
IEC 60942:2017
Calibration Test Report

Calibration Number C25652-V1

Client Details EMM Consulting
Level 3, 175 Scott Street
Newcastle, NSW, 2300

	Manufacturer	*Model*	*Serial*
Equipment Tested : Instrument :	Svantek	SV36	140737

Atmospheric Conditions

Ambient Temperature : 21.8 °C
Relative Humidity : 38 %
Barometric Pressure : 99.58 kPa

Calibration Technician : Peter Elters
Secondary Check: Rhys Gravelle
Calibration Date : 02-Oct-2025
Report Issue Date : 03-Oct-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*	*±0.019 kPa*

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

1. REVISION HISTORY

Revision	Date	Description
1	03-Oct-2025	Original Issue

2. OVERVIEW

This report presents the calibration test results of a SV36 Acoustic Calibrator, and associated equipment. Calibration is carried out in accordance with *IEC 60942-2017, Electroacoustics - Sound Calibrators*.

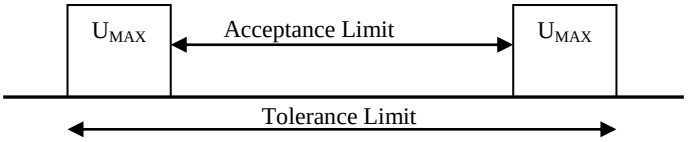
Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

This report was generated using template version identifier of 69876974.

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

	Manufacturer	*Model*	*Serial*
Equipment Tested :			
Instrument :	Svantek	SV36	140737

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 – 3215300) 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 – AH88227) 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)	
94	1000	94.11	0.11	±0.25	P	0.10	0.15	Measured Output
114	1000	114.09	0.09	±0.25	P	0.10	0.15	Measured Output

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)	
94	1000	1000.00	0.00	±7.00	P	0.70	2.00	Measured Output
114	1000	1000.00	0.00	±7.00	P	0.70	2.00	Measured Output

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 (%)	
94	1000	0.32	±2.50	P	0.20	0.50	Measured Output
114	1000	0.87	±2.50	P	0.20	0.50	Measured Output

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