

15 December 2017

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Re: Quarter 4 - 2017: East Guyong Quarry noise and blast monitoring

1 Introduction

EMM Consulting Pty Ltd (EMM) has been commissioned by Hanson Construction Materials Pty Ltd (NSW) (Hanson) to complete quarterly noise monitoring for the East Guyong Quarry, as required by the site's approved Noise Management Plan. The quarry is located approximately 22 km southeast of Orange, NSW.

The following material was referenced as part of this assessment:

- Environment Protection Authority (EPA), *Industrial Noise Policy* (INP) 2000;
- Environment Protection Authority (EPA), *Noise Policy for Industry* (NPI) 2017;
- R. W. Corkery & Co Pty Limited (RWC), *Noise Management Plan for the East Guyong Quarry* (NMP) 2013;
- Department of Planning and Infrastructure (DP&I), *East Guyong Quarry Project Modification (06_0193 MOD 1) approval* (PA) 2012; and
- Australian and New Zealand Environment Council (ANZEC) 1990, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*.

Analysis of data from two blast events that occurred on 9 November and 28 November 2017 has also been included in this report.

Several technical terms are discussed in this report and are explained in Appendix A.

2 Methodology

2.1 Site operations

At the time of the attended noise monitoring on Thursday 7 December 2017, the quarry's activities comprised of the following:

- extraction of basalt using standard drill, load and haul techniques;
- processing of extracted basalt and stockpiling of material; and
- transportation of quarry products.

The quarry's approved hours of operation are:

- Monday to Friday (non-daylight savings) from 6 am to 6 pm;
- Monday to Friday (daylight savings) from 6 am to 8 pm; and
- Saturdays from 7 am to 1 pm.

Material crushing and screening currently occurs on site from Monday to Thursday. This restriction to approved hours is an operational decision by the quarry and aids in the planning for maintenance and repairs.

2.2 Noise monitoring

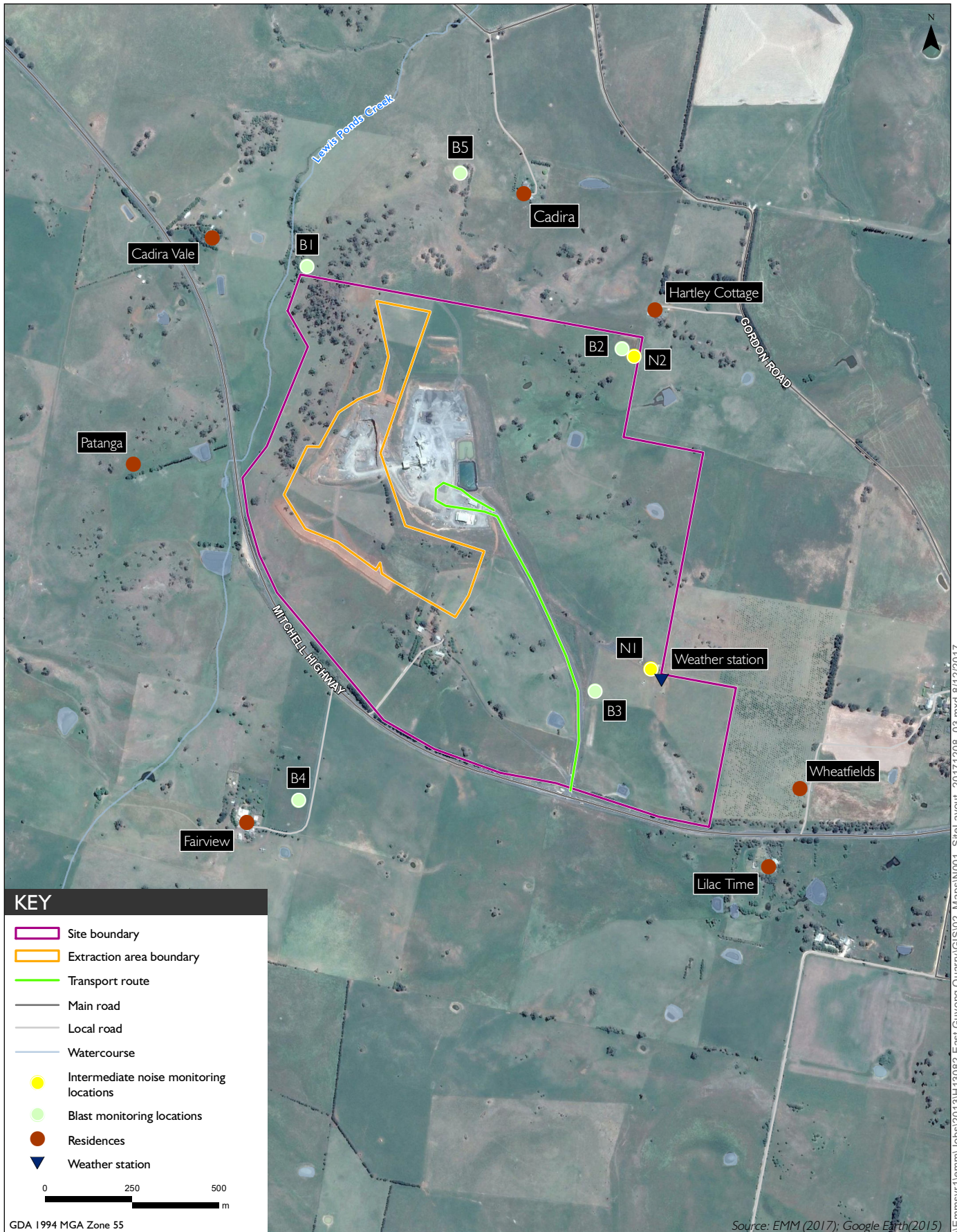
Operator-attended 15 minute noise measurements were conducted at locations N1 and N2, as shown in Figure 1, when the quarry was in full operation. The operator quantified the contribution of each significant quarry noise source where possible. Noise monitoring was conducted in general accordance with the INP and Australian Standard AS 1055.1-1997 *Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

A Brüel & Kjær 2250 Type 1 sound analyser (s/n 2759405) was used for the noise monitoring. The sound analyser was calibrated before and after the completion of the surveys using a Brüel & Kjær Type 4230 calibrator (s/n 1276091). The instruments were within a current NATA calibration period at the time of the noise monitoring and relevant certificates are provided in Appendix B.

2.3 Assessment locations

The noise monitoring included four 15 minute operator-attended noise measurements during the daytime period on 7 December 2017 to quantify noise emissions from the quarry at locations N1 and N2. Noise monitoring was not conducted prior to 7 am as the quarry was not in operation.

Locations N1 and N2 are near the south-east and north-east boundaries of the site, respectively. Location N1 is approximately 500 m from "Wheatfields", the closest residence situated south-east of the quarry. Location N2 is approximately 150 m from "Hartley Cottage", the closest residence situated north-east of the quarry. These monitoring locations were selected so as to not inconvenience residents and are consistent with the approved Noise Management Plan for the East Guyong Quarry (RWC, 2013). Monitoring at these locations, rather than at the residences, also provides a better opportunity to quantify site related noise since they are closer to the operations.



Site location and monitoring plan

East Guyong Quarry
East Guyong Quarry noise and blast monitoring

Figure 1

3 Criteria

3.1 Operational noise

Condition 3(5) of PA 06_0193 states that the noise assessment criteria are $L_{Aeq,15 \text{ minute}}$ 35 dB at any residence for all assessment periods. The exception is the "Fairview" residence which has a daytime criterion of $L_{Aeq,15 \text{ minute}}$ 36 dB. In accordance with the PA 06_0193, "Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy."

As per Condition 3(5) of PA_0193, to demonstrate compliance at residential locations, the noise monitoring results are to be assessed against the following (intermediate) noise criteria for monitoring locations N1 and N2:

- N1 - $L_{Aeq,15 \text{ minute}}$ 43 dB; and
- N2 - $L_{Aeq,15 \text{ minute}}$ 50 dB.

It is stated in the NMP that by satisfying criteria at these intermediate locations, quarry noise at neighbouring residences would also satisfy residential criteria. This assumes the presence of soil and product stockpiles, bunding and intervening topography between the site and surrounding residences, which provide some degree of attenuation of site noise.

Further to the above, section 11.1.3 of the INP identifies that a development is deemed to be in non-compliance if the monitored noise levels from the development are more than 2 dB above the statutory limit.

3.2 Low frequency noise criteria

Section 11.2.3 of the NMP states that modification factors in Section 4 of the INP (EPA 2000) should be applied to the measured noise levels where applicable. The INP application notes state that Section 4 of the INP has been withdrawn and the modifying factor adjustments outlined in Fact Sheet C of the NPI are to be used when assessing the characteristics of a noise source. Fact sheet C of the NPI (EPA 2017) states that modification factor corrections shall be applied to the measured noise levels.

Fact sheet C of the NPI (EPA 2017) provides guidelines for applying modifying factor corrections to account for annoying noise characteristics, such as tonal and low frequency noise emissions. The NPI specifies that for low frequency noise, a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values in Table C2 of the NPI (EPA 2017), which has been reproduced in Table 1 below.

Table 1 One-third octave low-frequency noise thresholds

HZ/dB(Z)	One-third octave $L_{Zeq,15 \text{ minute}}$ threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB (Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The modifying factor correction to be applied where the site 'C-weighted' and site 'A-weighted' noise emission level is 15 dB or more and:

- where any of the one-third octave noise levels in Table 1 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period; or
- where any of the one-third octave noise levels in Table 1 are exceeded by more than 5 dB and cannot be mitigated, a 5 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB positive adjustment applies for the daytime period.

Hence, where possible throughout each survey the operator has estimated the difference between site 'C-weighted' and site 'A-weighted' noise emission levels by matching audible sounds with the response of the analyser ($L_{Ceq}-L_{Aeq}$). Where this was deemed to be 15 dB or greater, the measured one-third octave frequencies have been compared to the values in Table 1 to identify the relevant modifying factor correction (if applicable). This method has been applied to this assessment as presented in Section 4.

It is of note that the NPI (EPA 2017) states that low-frequency noise corrections only apply under the standard and/or noise-enhancing (ie applicable) meteorological conditions.

3.3 Blast monitoring

Blast overpressure and vibration monitoring is managed by Hanson for all blast events. Blast overpressure and ground vibration are monitored at three locations within or at the site's boundary as well as a fourth location south of the Mitchell Highway near the Fairview property. Monitoring locations are situated closer to blasting locations than the residential structures (refer to Figure 1), and therefore overpressure and vibration levels would likely be lower at the actual residential dwellings than those measured.

Blast emissions criteria for the quarry apply at any residence on privately-owned land surrounding the site and are presented in Table 2.

Table 2 Blast overpressure and vibration criteria

Location	Airblast overpressure criteria (dB (Linear Peak))	Ground vibration criteria (mm/s (Peak velocity))	Allowable exceedance
Any privately-owned residence surrounding the site.	115	5	5% of the total number of blasts in a 12 month period
	120	10	0%

4 Results

4.1 Noise monitoring results

Noise monitoring results for locations N1 and N2 are presented in Table 3. Data recorded by the site's weather station (shown in Figure 1) was used to identify weather conditions during the monitoring period and to determine the applicability of noise limits. Wind speed and direction observations are presented in Table 3.

Wind speed averages were above 3 m/s (at 10 m above ground) during all measurements; hence noise limits were not applicable during any measurement.

Low frequency noise, in accordance with fact sheet C2 of the NPI (EPA 2017), was not applied to any measurements at locations N1 and N2, as low-frequency noise corrections only apply under the standard and/or noise-enhancing (ie applicable) meteorological conditions. It is noted that the crushing plant was in operation for the duration of all measurements.

All quarry contributions measured at locations N1 and N2 satisfied the relevant noise criteria as per the NMP. It is therefore expected that relevant criteria for surrounding residential receivers would also be satisfied.

Based on the preceding information, noise levels from the quarry were expected to satisfy the relevant residential criteria at all assessment locations identified in Condition 3(5) of PA_0193.

Table 3 **Attended noise monitoring summary – 7 December 2017**

Location	Start time	Attended noise monitoring results dB					Criteria dB	Meteorological conditions ¹		Criteria Applies? (Y/N)	Exceedance	Comments
		Total measured			Site contribution			Wind speed (m/s)	Wind direction ²			
		L _{Aeq}	L _{Amax}	L _{A90}	LFN mod. factor	L _{Aeq}						
N1	08:12	42	59	40	0 dB	37	43	4.4	304	N	N/A	Site consistently audible including crushing plant, engine revs and reversing alarms. Other sources include frequent bird noise, wind gusts and occasional traffic noise from the Mitchell Highway.
N2	08:36	44	69	40	0 dB	38	50	4.7	302	N	N/A	Site consistently audible including crushing plant, engine revs and reversing alarms. Other sources include frequent bird noise, wind gusts and occasional traffic noise from the Mitchell Highway.
N2	08:51	43	70	40	0 dB	38	50	4.9	314	N	N/A	Site consistently audible including crushing plant, engine revs and reversing alarms. Other sources include frequent traffic noise from the Mitchell Highway, bird noise and a plane.
N1	09:26	45	63	41	0 dB	38	43	6.0	305	N	N/A	Site consistently audible including crushing plant, engine revs and reversing alarms. Other sources include frequent bird noise, wind gusts/wind in trees and a plane.

- Notes:
1. Meteorological data was obtained from the site weather station at a height of 10 m above ground.
 2. Wind direction reported in degrees from north (0°)
 3. N/A = Not Applicable

4.2 Blast overpressure and ground vibration

Two blast events occurred at the quarry since the last quarterly noise monitoring in September 2017. The blast overpressure and vibration monitoring results were provided by Hanson and are presented in Table 4. The monitoring results show the relevant criteria were satisfied at all monitoring locations (refer to Figure 1).

Table 4 Blast emissions monitoring results

Date	Monitoring location	Airblast overpressure level (dB(Linear Peak))		Ground vibration - Peak particle velocity (mm/s)	
		Measured	Criteria ²	Measured	Criteria ²
9/11/17	B1	114	115	4.09	5
	B2	85	115	0.57	5
	B3 ¹	-	115	-	5
	B4	108	115	0.59	5
28/11/17	B1	101	115	2.83	5
	B2 ¹	-	115	-	5
	B3 ¹	-	115	-	5
	B4	83	115	0.82	5
	B5 ¹	-	115	-	5

Notes: 1. There was no trigger for this blasting event.
2. This criteria applies at the nearest residential location and not at the monitoring location.

5 Conclusion

EMM has completed an assessment of noise and blasting emissions from East Guyong Quarry operations. Noise monitoring was undertaken at locations around the site on 7 December 2017 as required by the site's approved NMP.

The results demonstrated that the received site noise levels at all monitoring locations satisfied the relevant noise criteria as per the PA_0193 and in accordance with the NMP for the East Guyong Quarry.

Therefore, it is concluded that noise levels from quarry operations satisfied the relevant criteria at all assessment locations identified in Condition 3(5) of PA_0193.

Blast overpressure and ground vibration monitoring results satisfied the relevant criteria at all monitoring locations for the two blast events that have been assessed and, hence, the criteria was also achieved at the nearest residences.

Yours sincerely,



Lucas Adamson
Acoustic Consultant
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Review: KT (14/12/17)

Appendix A

Glossary of acoustic terms

A number of technical terms are required for the discussion of noise. These are explained in Table A.1.

Table A.1 Glossary of acoustic terms

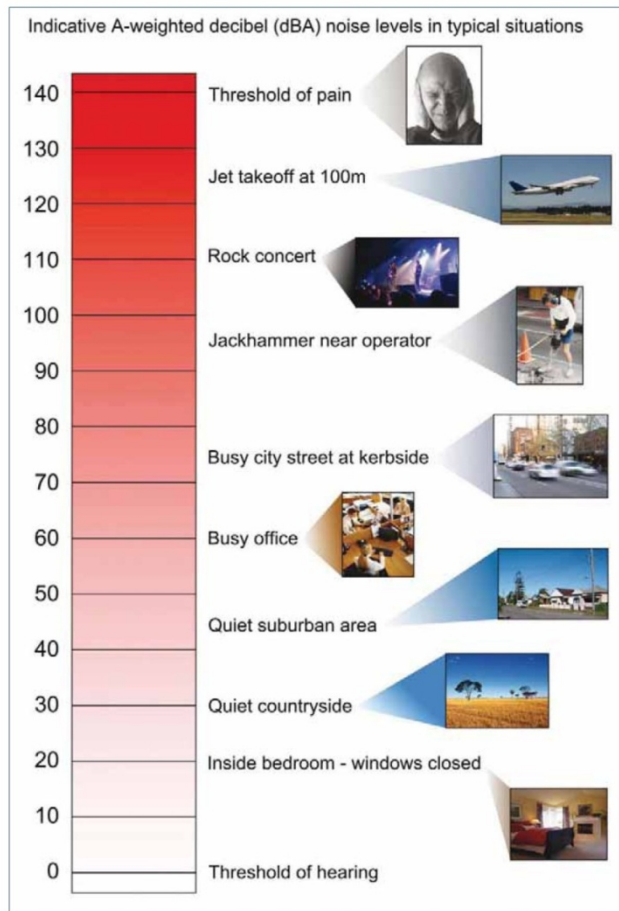
Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This is an adjustment made to sound-level measurement to approximate the response of the human ear.
C-weighting	This is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
L_{90}	Commonly referred to as the background noise level. The noise level exceeded 90% of the time.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{Aeq(15-min)}$ descriptor refers to an L_{Aeq} noise level measured over a 15 minute period.
L_{max}	The maximum root mean squared sound pressure level received during a measuring interval.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table A.2 gives an indication as to what an average person perceives about changes in noise levels:

Table A.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure A.1.



Source: Road Noise Policy (Department of Environment, Climate Change and Water (DECCW) 2011).

Figure A.1 Common noise levels

Appendix B

Calibration certificates

CERTIFICATE OF CALIBRATION

Certificate No: CAU1600070

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CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 2759405
Microphone:	Brüel & Kjær	4189	No: 2888134
Preamplifier:	Brüel & Kjær	ZC-0032	No: 16037
Supplied Calibrator:	Brüel & Kjær	4230	No: 1276091
Software version:	BZ7222 Version 3.5.3	Pattern Approval:	Pending
Instruction manual:	BE1712-18	Identification:	N/A

CUSTOMER:

EMM Consulting
Level 5, 21 Bolton Street
Newcastle NSW 2300

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.

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 5.1 - DB: 5.10) and test procedure 2250-4189.

RESULTS:

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

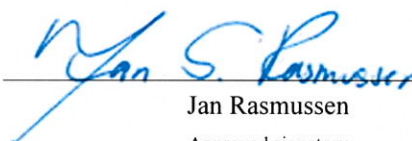
The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method,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

Date of Calibration: 03/02/2016

Certificate issued: 03/02/2016



Sajeeb Tharayil
Calibration Technician



Jan Rasmussen
Approved signatory

CERTIFICATE OF CALIBRATION

No.: CAU1600071

CALIBRATION OF:

Calibrator: Brüel & Kjær 4230 No: 1276091
Identification: Sound Level Calibrator
IEC Class: 2

CUSTOMER:

EMM Consulting
Level 5
21 Bolton Street
Newcastle NSW 2300

CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C
Environment conditions: Air temperature: 24.3 °C
Air pressure: 100.1 kPa
Relative Humidity: 56.3 %RH

SPECIFICATIONS:

The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 using calibration procedure 4230 Complete

RESULTS:

- | | |
|---|---|
| <input type="checkbox"/> Initial Calibration | <input type="checkbox"/> Calibration before repair/adjustment |
| <input checked="" type="checkbox"/> Recalibration without repair/adjustment | <input type="checkbox"/> 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 calibrator under calibration.

Date of Calibration: 03/02/2016

Certificate issued: 03/02/2016


Jan Rasmussen
Approved Signatory