

15 March 2016

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Re: Quarter 1 - 2016: 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 R. W. Corkery & Co Pty Limited, *Noise Management Plan for the East Guyong Quarry 2013*. 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*;
- 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*.

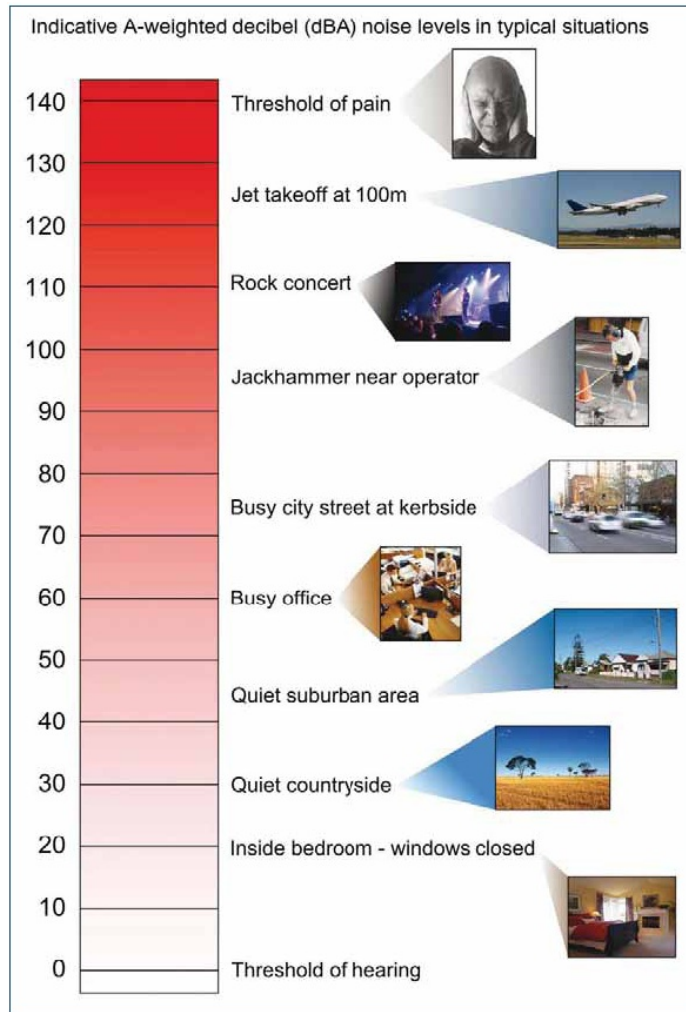
Analysis of data from four blast events that occurred between December 2015 and March 2016 has also been included in this report.

1.1 Technical terms

Several technical terms are discussed in this report. These are explained in Appendix A. It is also useful to have an appreciation of decibels, the unit of noise measurement. Table 1 provides an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure 1.

Table 1 Perceived change in noise

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



Source: NSW Road Noise Policy (DECCW, 2011).

Figure 1 Common noise levels

2 Methodology

2.1 Site operations

Operator-attended noise monitoring was conducted at two locations within the site's boundary as well as an additional location south of the quarry.

At the time of the attended noise monitoring on 10 March 2016, 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.

Material crushing and screening currently occurs on site from Monday to Thursday. 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.

2.2 Noise monitoring

The monitoring assessment quantified noise levels when the quarry was in full operation by undertaking 15 minute operator-attended noise measurements at each location. The operator quantified the contribution of each significant quarry noise source where possible throughout each survey. Noise monitoring was conducted in 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. 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 five 15 minute operator-attended noise measurements during the daytime period on 10 March 2016 to quantify emissions from the quarry at on-site locations N1 and N2, and at an additional location south of the quarry (refer to Figure 2). Noise monitoring was not conducted prior to 7 am as the quarry was not in operation.

Locations N1 and N2 are located 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" situated north-east of the quarry. These monitoring locations were selected so as to not inconvenience residents and are consistent with the 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.

Noise monitoring was completed at an additional location south of the quarry (refer to Figure 2), to quantify site noise levels at the south of the quarry and was representative of the potentially worst affected residences to the south.

3 Criteria

3.1 Operational noise

Condition 3(5) of PA 06_0193 states that the noise assessment criteria are 35 dB $L_{Aeq(15-min)}$, at any residence for all assessment periods. The exception is the "Fairview" residence which has an 36 dB $L_{Aeq(15-min)}$, daytime criterion. 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 - 43 dB, $L_{Aeq(15-min)}$; and
- N2 - 50 dB, $L_{Aeq(15-min)}$.

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. Attended monitoring was completed at an additional location for this quarter. The location was chosen to represent the worst affected receiver under the wind conditions at the time.

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.

Section 4 of the INP (EPA 2000) provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The INP states that where there is a difference of 15 decibels or more between site 'C' weighted and site 'A' weighted levels, a correction factor of 5 dB is added to site noise contribution before comparison to the relevant noise criteria. Where relevant, this guideline has been applied to this assessment as presented in Section 4.

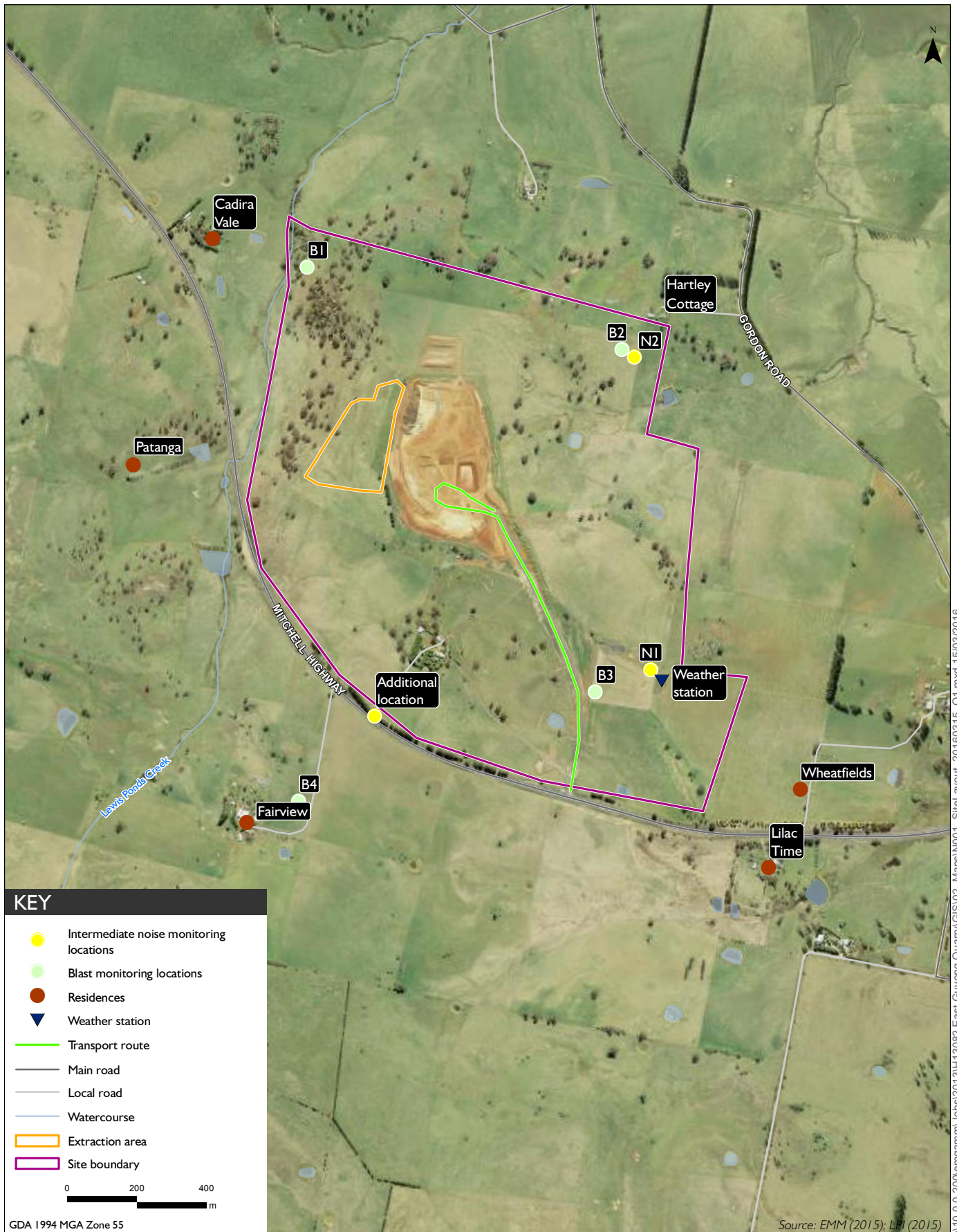
3.3 Blast monitoring

Blast overpressure and vibration monitoring is managed by Hanson for all blast events. Blast overpressure and ground borne vibration are monitored at four locations within or at the site's boundary. The exception is B4, located south of the Mitchell Highway near the Fairview property. Monitoring locations are situated closer to blasting locations than the residential structures (refer to Figure 2), 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)	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%



Site location and monitoring plan

East Guyong Quarry

Quarter 1 – 2016: East Guyong Quarry noise and blast monitoring

Figure 2

4 Results

4.1 Noise monitoring results

Noise monitoring results for locations N1 and N2 and the additional location are presented in Table 3. Data recorded by the site weather station was used to identify weather conditions during the monitoring period and to determine the applicability of noise limits. Wind speed and wind direction are also presented in Table 3.

Wind speed averages were above 3 m/s (at 10 m above ground) during the last measurement, and hence noise limits were not applicable for this measurement. It is noted that winds during this measurement were generally in the direction of source to receiver (ie northerly winds), and therefore would have enhanced site noise levels at these locations.

Low frequency noise was identified for both measurements at location N2 and a penalty of 5 dB was added to the respective quarry $L_{Aeq(15-min)}$ contributions in accordance with Chapter 4 of the INP (EPA 2000). It is noted that the crushing plant was in operation for the duration of both measurements.

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

An additional monitoring location was also chosen to confirm that satisfying relevant criteria at monitoring locations N1 and N2 would satisfy relevant criteria at other surrounding residential locations. This location was south of the quarry and was selected due to northerly source to receiver wind present at the time and little intervening topography between the quarry activity and monitoring location. The measured quarry $L_{Aeq(15-min)}$ contribution at the additional location was estimated at 35 dB which satisfies the $L_{Aeq(15-min)}$ 35 dB residential criterion.

Based on the preceding information, noise levels from the quarry are 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 – 10 March 2016

Location	Start time (hrs)	Attended noise monitoring results dB					Criteria dB	Meteorological conditions ¹		Comments
		Total measured			Site contribution			Wind speed (m/s)	Wind direction (degrees from North)	
		L _{Aeq}	L _{Amax}	L _{A90}	Est. L _{C-A}	L _{Aeq}				
N1	8:11	46	57	43	12	41	43	1.0	181	Site audible (predominantly FEL and haul truck revs and alarms). Other sources included dominant road traffic noise from Mitchell Highway (45-48 dB) and intermittent bird noise (35-38 dB).
N2	8:40	39	60	36	20	42 ² (37+5)	50	1.1	15	Site audible (predominantly crushing plant, FEL and haul truck revs and alarms). Other sources include occasional bird/insect noise (40-45 dB).
N2	8:59	38	53	35	21	41 ² (36+5)	50	1.9	16	Site audible (predominantly crushing plant, FEL and haul truck revs and alarms). Other sources included consistent insect noise (35-40 dB) and occasional bird noise (40-45 dB).
N1	9:27	53	74	35	11	36	43	1.7	348	Site audible (predominantly FEL and haul truck revs and alarms). Other sources included occasional road traffic noise from Mitchell highway (35-40 dB), occasional wind/foilage noise and frequent bird noise (40-45 dB).
Additional location ³	10:10	69	86	41	10	<35	35 ⁴	3.6	337	Site barely audible to inaudible. Other sources included consistent car/truck pass-bys on Mitchell Highway (70-80 dB), frequent wind/foilage noise and occasional bird/insect noise (35 dB).

- Notes:
1. Meteorological data was obtained from the site weather station at a height of 10 m above ground.
 2. Modifying factor for low frequency noise applicable in accordance with section 4 of the INP (difference of 15 decibels or more between site 'C-weighted' and site 'A-weighted' noise levels).
 3. Additional monitoring location south of the quarry (refer to Figure 2).
 4. Limits were not applicable during this measurement due to the presence of winds above 3m/s.

4.2 Blast overpressure and ground vibration

Four blast events occurred at the quarry since the last quarterly monitoring in December 2015. The blast overpressure and vibration monitoring results are presented in Table 4, which satisfy the relevant criteria at all monitoring locations (refer to Figure 2).

Table 4 Blasting and vibration monitoring results

Date	Monitoring location	Airblast overpressure level (dB(Linear Peak))		Ground vibration - Peak particle velocity (mm/s)	
		Measured	Criteria	Measured	Criteria
16/12/15	B1	103	115	2.51	5
	B2	107	115	1.14	5
	B3	112	115	0.84	5
	B4	112	115	0.78	5
13/1/16	B1	106	115	2.67	5
	B2	107	115	1.34	5
	B3	105	115	0.90	5
	B4	109	115	0.72	5
27/1/16	B1	108	115	1.86	5
	B2	106	115	0.74	5
	B3	110	115	0.82	5
	B4	114	115	0.99	5
2/3/16	B1	101	115	1.58	5
	B2	106	115	0.82	5
	B3	96	115	0.80	5
	B4	110	115	0.52	5

5 Conclusion

EMM has completed a noise assessment of East Guyong Quarry operations at two monitoring locations within the site's boundary on 10 March 2016. Attended monitoring was also completed at an additional location to quantify site noise at residences south of the quarry.

The results demonstrate that the received site noise levels at all monitoring locations satisfy 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 satisfy 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 three blast events relevant to Quarter 1, 2016 and an additional blast in December which occurred subsequent to the Q4 2015 noise and blast monitoring report.

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'L. Adamson' with a stylized flourish at the end.

Lucas Adamson
Acoustic Consultant
ladamson@emmconsulting.com.au
Review: DW

Appendix A

Glossary of acoustic terms

Table A1 **Glossary of acoustic terms**

Term	Description
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L_{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' 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_{Amax}	The maximum root mean squared 'A-weighted' 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.

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.

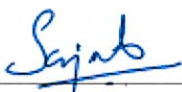
RESULTS:

	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