

Appendix 4.12 Fixed Plant Noise Measurement at Existing Kam Sheung Road (KSR) Station

1 INTRODUCTION

- 1.1 Pursuant to Section 4.3.2(b) of Appendix C of ESB-346/2021, the assessment shall cover the cumulative fixed plant noise impact associated with the operation of the Project on existing, committed and planned NSRs within the assessment area.
- 1.2 This Report presents the details and results of noise measurements on the fixed plant noise of existing Kam Sheung Road (KSR) Station on Tuen Ma Line (TML) for the cumulative fixed plant noise impact assessment of the Project.

2 DETAILS OF FIXED SOURCES AND MEASUREMENT

Measurement Location and Date

- 2.1 Site inspections were conducted on 22 to 23 August 2022 and 11 to 12 September 2023 during night-time period. Based on the site observation, three ventilation louvres (i.e. Fixed Plant ID: A1, A2 & A3) at the southwest façade of the station and air-cooled chillers at the rooftop of the station were identified. Therefore on-site noise measurements were conducted and the measured noise data was used for cumulative noise assessment under the EIA Study. The noise measurements were conducted between 2300 and 0100 hours to minimize the influence of background noise. All measurements were conducted under free-field condition. The measurement locations were shown in **Annex A**. Photographs taken during the measurement are presented in **Annex B**.

Details of Fixed Plant Noise Source

- 2.2 Details of the three identified louvres provided in **Table 2.1** below and the locations of these louvres are shown in **Annex A**.

Table 2.1 Description of Identified Louvres

Fixed Plant ID	Louvre Size, m		Height from Ground Level, m	Louvre Facing Direction
	Length	Width		
A1	1.6	1	6	Southwest of KSR Station
A2	2.5	1	2.8	Southwest of KSR Station
A3	1	1	2.8	Southwest of KSR Station

Measurement Equipment

- 2.3 In accordance with the *Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites* (IND-TM), sound level meter in compliance with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) specifications was used for carrying out the noise measurement. Immediately prior to and following each noise measurement, the accuracy of sound level meter was checked using an acoustic calibrator generating 94dB at 1000 Hz. Measurement was considered to be valid with the calibration level from before and after the noise measurement within 1.0 dB. **Table 2.2** summarizes the equipment used in the noise measurement.

Table 2.2 Noise Measurement Equipment

Equipment	Model ⁽¹⁾
Integrating Sound Level Meter	• NTi XL2 (Serial No. A2A-1788-E0)
Calibrator	• B&K 4231 (Serial No. 3006428)

Note:

(1) Calibration certificates are provided in **Annex C**.

Measurement Procedures

2.4 During the noise measurement, the following procedures were followed:

- Parameters such as frequency weighting, the time weighting and the duration of measurement were set as follows:
 - Frequency weighting : A
 - Time weighting : Fast
 - Duration of measurement : L_{Aeq} (with data being logged at every one second)
- Prior to and after each noise measurement, the sound level meter was calibrated using the Calibrator for 94 dB at 1000 Hz. If the difference in the calibration level before and after measurement was more than 1 dB (A), the measurement is considered invalid and repeat of noise measurement should be required after repair or re-calibration of the equipment.
- Train passby events and their durations were also recorded during the measurement process.
- All the measurement data within the sound level meter system were downloaded through the computer software. All these data were then checked and reviewed properly.
- The weather condition during the measurement period was recorded by the measurement staff.
- Noise measurement was conducted in the absence of fog, rain, and wind with a steady speed lower than 5 m/s, or wind with gusts lower than 10 m/s.

3 MEASUREMENT RESULTS AND CALCULATION OF SOUND POWER LEVEL

3.1 Fixed plant noise levels were recorded in term of $L_{Aeq (1 \text{ min})}$. Background noise levels were evaluated by discarding the logged data for the period when noise from train operation and intrusive/extraneous noise observed during the noise measurements. The noise levels contributed by the fixed plants at the existing KSR Station were calculated by subtracting the background noise level from the measured noise level in accordance with standard acoustical principles.

3.2 The measurement results are presented in **Table 3.1** below.

Table 3.1 Measurement Results of Fixed Plant Noise from Existing KSR Station

Measure ment Point ID	Measurement Distance from the Source, m	Measured Noise Level $L_{Aeq \text{ 1min,}}$ dB(A) ⁽¹⁾	Background Noise Level $L_{Aeq \text{ 1min,}}$ dB(A) ⁽¹⁾	Background Corrected Noise Level $L_{Aeq \text{ 1min,}}$ dB(A) ^{(1), (2)}
M1	8	56	47	55
M2	9	60	48	60
M3	2.5	50	47	48

Note:

(1) The measured noise levels were rounded up to integer.

(2) Background noise correction has been limited to maximum 10 dB(A)

3.3 Based on the measured noise levels, the Sound Power Levels (SWLs) were predicted in accordance with the standard acoustic principles which is presented in **Table 3.2**. The predicted SWLs were adopted in the cumulative fixed plant noise assessment in the EIA Study.

Table 3.2 Predicted SWLs of Fixed Sources at Existing KSR Station

Fixed Plant ID	Distance from the Source, m	Background Corrected Noise Level $L_{Aeq\ 1min}$, dB(A)	Distance Correction, dB(A) ⁽¹⁾	SWL, dB(A)
A1	8	55	+26	81
A2	9	60	+27	87
A3	2.5	48	+16	64

Note:

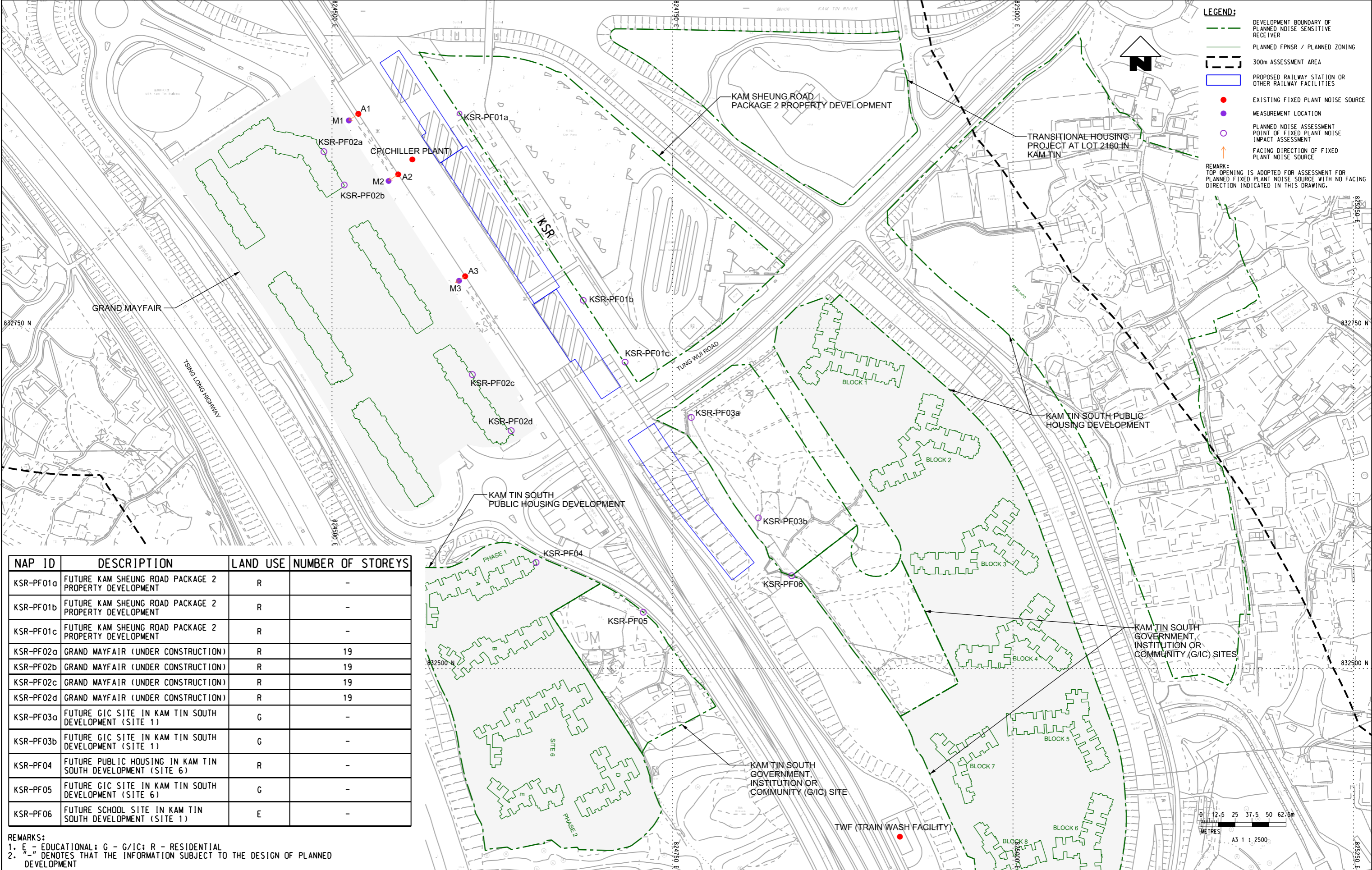
(1) Distance Correction was calculated based on the formula: $20 \log D + 8$, where D is the distance in metres

4 AIR-COOLED CHILLERS

- 4.1 Three air-cooled chillers (Fixed Plant ID: CP) were identified on the northern rooftop of the existing Kam Sheung Road Station. As advised by MTR, improvement works would be carried out for the chillers to enhance its performance and allow for better environment. It is anticipated that the provision of enhancement measures would be completed in 2024 tentatively (i.e. before operation of NOL). MTR confirmed that the total sound power level of the chillers after the improvement works would not be higher than 92 dB(A).

Annex A

Measurement Locations & Identified FPN Locations



NAP ID	DESCRIPTION	LAND USE	NUMBER OF STOREYS
KSR-PF01a	FUTURE KAM SHEUNG ROAD PACKAGE 2 PROPERTY DEVELOPMENT	R	-
KSR-PF01b	FUTURE KAM SHEUNG ROAD PACKAGE 2 PROPERTY DEVELOPMENT	R	-
KSR-PF01c	FUTURE KAM SHEUNG ROAD PACKAGE 2 PROPERTY DEVELOPMENT	R	-
KSR-PF02a	GRAND MAYFAIR (UNDER CONSTRUCTION)	R	19
KSR-PF02b	GRAND MAYFAIR (UNDER CONSTRUCTION)	R	19
KSR-PF02c	GRAND MAYFAIR (UNDER CONSTRUCTION)	R	19
KSR-PF02d	GRAND MAYFAIR (UNDER CONSTRUCTION)	R	19
KSR-PF03a	FUTURE G/C SITE IN KAM TIN SOUTH DEVELOPMENT (SITE 1)	G	-
KSR-PF03b	FUTURE G/C SITE IN KAM TIN SOUTH DEVELOPMENT (SITE 1)	G	-
KSR-PF04	FUTURE PUBLIC HOUSING IN KAM TIN SOUTH DEVELOPMENT (SITE 6)	R	-
KSR-PF05	FUTURE G/C SITE IN KAM TIN SOUTH DEVELOPMENT (SITE 6)	G	-
KSR-PF06	FUTURE SCHOOL SITE IN KAM TIN SOUTH DEVELOPMENT (SITE 1)	E	-

REMARKS:
 1. E - EDUCATIONAL; G - G/IC; R - RESIDENTIAL
 2. "-" DENOTES THAT THE INFORMATION SUBJECT TO THE DESIGN OF PLANNED DEVELOPMENT

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	YFB
DESIGNED	---
CHECKED	---
APPROVED	---
DATE	15/OCT/2022

NORTHERN LINK

 ORIGINATOR
 CADD REF. C1603_C.NOL_ACM_M52_523.dgn

TITLE
C1603
 ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR NORTHERN LINK
 LOCATION OF FIXED PLANT NOISE SOURCES AT EXISTING
 KAM SHEUNG ROAD STATION
 SCALE 1 : 2500 (A3)
 DRAWING NO. C1603/C/NOL/ACM/M52/523
 REV. -

Annex B

Measurement Photos



Photo 1: Noise Measurement at the Existing KSR Station



Photo 2: Noise Measurement at the Existing KSR Station

Annex C
Calibration Certificates



SOILS & MATERIALS ENGINEERING CO., LTD.

香港新界葵涌永基路22-24號好爸爸創科大廈

Good Ba Ba Hitech Building, Nos. 22-24 Wing Kei Road, Kwai Chung, New Territories, Hong Kong

Tel: (852) 2873 6860 Fax: (852) 2555 7533 E-mail: smec@cigismec.com Website: www.cigismec.com



CERTIFICATE OF CALIBRATION

Certificate No.: 23CA0427 01-02 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	,	Microphone	Preamp
Manufacturer:	Nti	,	Nti Andio	Nti Andio
Type/Model No.:	XL2	,	MC230A	MA220
Serial/Equipment No.:	A2A-17788-EO	,	A18398	9065
Adaptors used:	-	,		

Item submitted by

Customer Name: AECOM
 Address of Customer: -
 Request No.: -
 Date of receipt: 27-Apr-2023

Date of test: 29-Apr-2023

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2023	CIGISMEC
Signal generator	DS 360	61227	08-Jun-2023	CEPREI

Ambient conditions

Temperature: 22 ± 1 °C
 Relative humidity: 55 ± 10 %
 Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:

Feng Junqi

Date: 02-May-2023

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument. The results apply to the item as received.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 23CA0427 01-02

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1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	2.1
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	2.2
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Time weightings	Lin	Pass	0.3	
	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
R.M.S. accuracy	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2, Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3, Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date:

Fung Chi Yip
29-Apr-2023

Checked by:

Date:

Chan Yuk Yiu
02-May-2023

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

SELF GENERATED NOISE TEST

The noise test is performed in the most sensitive range of the SLM with the microphone replaced by an equivalent impedance.

Noise level in A weighting	10.3	dB
Noise level in C weighting	14.6	dB
Noise level in Lin	21.6	dB

LINEARITY TEST

The linearity is tested relative to the reference sound pressure level using a continuous sinusoidal signal of frequency 4 kHz. The measurement is made on the reference range for indications at 5 dB intervals starting from the 94 dB reference sound pressure level. And until within 5 dB of the upper and lower limits of the reference range, the measurements shall be made at 1 dB intervals. (SLM set to LEQ/SPL)

Reference/Expected level	Actual level		Tolerance	Deviation	
	non-integrated	integrated		non-integrated	integrated
dB	dB	dB	+/- dB	dB	dB
94.0	94.0	94.0	0.7	0.0	0.0
99.0	99.0	99.0	0.7	0.0	0.0
104.0	104.0	104.0	0.7	0.0	0.0
109.0	109.0	109.0	0.7	0.0	0.0
114.0	114.0	114.0	0.7	0.0	0.0
115.0	115.0	115.0	0.7	0.0	0.0
116.0	116.0	116.0	0.7	0.0	0.0
117.0	117.0	117.0	0.7	0.0	0.0
118.0	118.0	118.0	0.7	0.0	0.0
119.0	119.0	119.0	0.7	0.0	0.0
120.0	120.0	120.0	0.7	0.0	0.0
89.0	89.0	89.0	0.7	0.0	0.0
84.0	84.0	84.0	0.7	0.0	0.0
79.0	79.0	79.0	0.7	0.0	0.0
74.0	74.0	74.0	0.7	0.0	0.0
69.0	69.0	69.0	0.7	0.0	0.0
64.0	64.0	64.0	0.7	0.0	0.0
59.0	59.0	59.0	0.7	0.0	0.0
54.0	54.0	54.0	0.7	0.0	0.0
49.0	49.0	49.0	0.7	0.0	0.0
44.0	44.0	44.0	0.7	0.0	0.0
39.0	39.0	39.0	0.7	0.0	0.0
34.0	34.1	34.1	0.7	0.1	0.1
33.0	33.1	33.1	0.7	0.1	0.1



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

32.0	32.1	32.1	0.7	0.1	0.1
31.0	31.2	31.2	0.7	0.2	0.2
30.0	30.2	30.2	0.7	0.2	0.2

Measurements for an indication of the reference SPL on all other ranges which include it

Other ranges	Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
40-140	94.0	94.0	0.7	0.0
20-120	94.0	94.0	0.7	0.0
0-100	94.0	94.0	0.7	0.0

Measurements on all level ranges for indications 2 dB below the upper limit and 2 dB above the lower limit

Ranges	Reference/Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
40-140	50.0	50.7	0.7	0.7
	138.0	138.0	0.7	0.0
20-120	30.0	30.2	0.7	0.2
	118.0	118.0	0.7	0.0
0-100	30.0	30.0	0.7	0.0
	98.0	98.0	0.7	0.0

FREQUENCY WEIGHTING TEST

The frequency response of the weighting networks are tested at octave intervals over the frequency ranges 31.5 Hz to 12500 Hz. The signal level at 1000 Hz is set to give an indication of the reference SPL.

Frequency weighting A:

Frequency	Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
				+	-	
Hz	dB	dB	dB			dB
1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	54.6	54.4	1.5	1.5	-0.2
63.1	94.0	67.8	67.7	1.5	1.5	-0.1
125.9	94.0	77.9	77.8	1.0	1.0	-0.1
251.2	94.0	85.4	85.3	1.0	1.0	-0.1
501.2	94.0	90.8	90.8	1.0	1.0	0.0
1995.0	94.0	95.2	95.2	1.0	1.0	0.0
3981.0	94.0	95.0	95.0	1.0	1.0	0.0
7943.0	94.0	92.9	92.9	1.5	3.0	0.0
12590.0	94.0	89.7	89.6	3.0	6.0	-0.1

Frequency weighting C:

Frequency	Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
				+	-	
Hz	dB	dB	dB			dB



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	91.0	90.8	1.5	1.5	-0.2
63.1	94.0	93.2	93.1	1.5	1.5	-0.1
125.9	94.0	93.8	93.8	1.0	1.0	0.0
251.2	94.0	94.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	94.0	1.0	1.0	0.0
1995.0	94.0	93.8	93.8	1.0	1.0	0.0
3981.0	94.0	93.2	93.2	1.0	1.0	0.0
7943.0	94.0	91.0	91.0	1.5	3.0	0.0
12590.0	94.0	87.8	87.6	3.0	6.0	-0.2

Frequency weighting Lin:

Frequency Hz	Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
				+	-	
1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	94.0	93.8	1.5	1.5	-0.2
63.1	94.0	94.0	93.9	1.5	1.5	-0.1
125.9	94.0	94.0	94.0	1.0	1.0	0.0
251.2	94.0	94.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	94.0	1.0	1.0	0.0
1995.0	94.0	94.0	94.0	1.0	1.0	0.0
3981.0	94.0	94.0	94.0	1.0	1.0	0.0
7943.0	94.0	94.0	94.0	1.5	3.0	0.0
12590.0	94.0	94.0	94.0	3.0	6.0	-0.1

Note: No corrections for the frequency response of the microphone, instrument case and windshield are made to the sound level meter.

TIME WEIGHTING FAST TEST

Time weighting F is tested on the reference range with a single sinusoidal burst of duration 200 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
			+	-	
116.0	115.0	115.0	1.0	1.0	0.0

TIME WEIGHTING SLOW TEST

Time weighting S is tested on the reference range with a single sinusoidal burst of duration 500 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
			+	-	
116.0	111.9	111.9	1.0	1.0	0.0



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

PEAK RESPONSE TEST

The onset time of the peak detector is tested on the reference range by comparing the response to a 100 us rectangular test pulse with the response to a 10 ms reference pulse of the same amplitude. The amplitude of the 10 ms reference pulse is such as to produce an indication 1 dB below the upper limit of the primary indicator range.

Positive polarities: (Weighting Z, set the generator signal to single, Lzpeak)

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.3	2.0	0.3

Negative polarities:

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.3	2.0	0.3

RMS ACCURACY TEST

The RMS detector accuracy is tested on the reference range for a crest factor of 3.

Test frequency: 2000 Hz
Amplitude: 2 dB below the upper limit of the primary indicator range.
Burst repetition frequency: 40 Hz
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz. (Set to INT)

	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
Time weighting	dB	dB	indication(dB)	+/- dB	dB
Slow	118.0+6.6	118.0	117.9	0.5	-0.1

TIME WEIGHTING IMPULSE TEST

Time weighting I is tested on the reference range (Set the SLM to LAImax)

Test frequency: 2000 Hz
Amplitude: The upper limit of the primary indicator range.

Single sinusoidal burst of duration 5 ms:

Ref. Level	Single burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	111.2	111.1	2.0	-0.1

Repeated at 100 Hz

Ref. Level	Repeated burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	117.3	117.1	1.0	-0.2

TIME AVERAGING TEST

This test compares the SLM reading for continuous sine signals with readings obtained from a sine tone burst sequence having the same RMS level. The test level is 30 dB below the upper limit of the linearity range and repeated for Type 1 SLM with 40 dB below the upper limit of the linearity.

Frequency of tone burst: 4000 Hz

Duration of tone burst: 1 ms

Repetition Time	Level of tone burst	Expected Leq	Actual Leq	Tolerance	Deviation	Remarks



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

msec	dB	dB	dB	+/- dB	dB	
1000	90.0	90.0	89.9	1.0	-0.1	60s integ.
10000	80.0	80.0	79.9	1.0	-0.1	6min. integ.

PULSE RANGE AND SOUND EXPOSURE LEVEL TEST

The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz

Integration time: 10 sec

The integrating sound level meter set to Leq:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10	88.0	58.0	57.8	1.7	-0.2

The integrating sound level meter set to SEL:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10.0	88.0	68.0	68.0	1.7	0.0

OVERLOAD INDICATION TEST

For SLM capable of operating in a non-integrating mode.

Test frequency: 2000 Hz

Amplitude: 2 dB below the upper limit of the primary indicator range.

Burst repetition frequency: 40 Hz

Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz.

Level	Level reduced by	Further reduced	Difference	Tolerance	Deviation
at overload (dB)	1 dB	3 dB	dB	dB	dB
121.3	120.3	117.3	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leq.

For integrating SLM, with the instrument indicating Leq and set to the reference range. The test signal as following:

The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz

Integration time: 10 sec

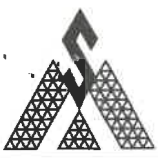
Single burst duration: 1 msec

Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
127.3	126.3	86.3	86.1	2.2	-0.2

ACOUSTIC TEST

The acoustic test of the complete SLM is tested at the frequency 125 Hz and 8000 Hz using a B&K type 4226 Multifunction Acoustic Calibrator. The test is performed in A weighting.

Frequency	Expected level	Actual level	Tolerance (dB)		Deviation
Hz	dB	Measured (dB)	+	-	dB



Test Data for Sound Level Meter

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Sound level meter type: XL2 Serial No. A2A-17788-EO Date 29-Apr-2023
Microphone type: MC230A Serial No. A18398

Report: 23CA0427 01-02

1000	94.0	94.0	0.0	0.0	0.0
125	77.9	77.9	1.0	1.0	0.0
8000	92.9	94.0	1.5	3.0	1.1

-----END-----



SOILS & MATERIALS ENGINEERING CO., LTD.

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CERTIFICATE OF CALIBRATION

Certificate No.: 23CA0427 01-03

Page: 1 of 2

Item tested

Description: Acoustical Calibrator (Class 1)
 Manufacturer: B & K
 Type/Model No.: 4231
 Serial/Equipment No.: 3006428
 Adaptors used: -

Item submitted by

Customer: AECOM
 Address of Customer: -
 Request No.: -
 Date of receipt: 27-Apr-2023

Date of test: 29-Apr-2023

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	23-May-2023	SCL
Preamplifier	B&K 2673	2743150	28-Jun-2023	CEPREI
Measuring amplifier	B&K 2610	2346941	30-Jun-2023	CEPREI
Signal generator	DS 360	61227	08-Jun-2023	CEPREI
Digital multi-meter	34401A	US36087050	30-May-2023	CEPREI
Audio analyzer	8903B	GB41300350	06-Jul-2023	CEPREI
Universal counter	53132A	MY40003662	13-Jun-2023	CEPREI

Ambient conditions

Temperature: 22 ± 1 °C
 Relative humidity: 55 ± 10 %
 Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- The results are rounded to the nearest 0.01 dB and 0.1 Hz and have not been corrected for variations from a reference pressure of 1013.25 hectoPascals as the maker's information indicates that the instrument is insensitive to pressure changes.

Test results

This is to certify that the sound calibrator conforms to the requirements of annex B of IEC 60942: 1997 for the conditions under which the test was performed. This does not imply that the sound calibrator meets IEC 60942 under any other conditions.

Details of the performed measurements are presented on page 2 of this certificate.

Approved Signatory:

Feng Junqi

Date: 02-May-2023

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 23CA0427 01-03

Page: 2 of 2

1, Measured Sound Pressure Level

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	(Output level in dB re 20 µPa)
			Estimated Expanded Uncertainty dB
1000	94.00	94.22	0.10

2, Sound Pressure Level Stability - Short Term Fluctuations

The Short Term Fluctuations was determined by measuring the maximum and minimum of the fast weighted DC output of the B&K 2610 measuring amplifier over a 20 second time interval as required in the standard. The Short Term Fluctuation was found to be:

At 1000 Hz **STF = 0.016 dB**
Estimated expanded uncertainty 0.005 dB

3, Actual Output Frequency

The determination of actual output frequency was made using a B&K 4180 microphone together with a B&K 2673 preamplifier connected to a B&K 2610 measuring amplifier. The AC output of the B&K 2610 was taken to an universal counter which was used to determine the frequency averaged over 20 second of operation as required by the standard. The actual output frequency at 1 KHz was:

At 1000 Hz **Actual Frequency = 1000.0 Hz**
Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

4, Total Noise and Distortion

For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

At 1000 Hz **TND = 0.7 %**
Estimated expanded uncertainty 0.7 %

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date:

Fung Chi Yip
29-Apr-2023

Checked by:

Date:

Chan Yuk Yiu
02-May-2023

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are carry no implication regarding the long-term stability of the instrument. The results apply to the item as received.