

## Appendix 4.16 Operational Noise of LRT at Tuen Mun South Area

### 1 INTRODUCTION

- 1.1 Pursuant to Section 4.3.2(c) of Appendix C of ESB-332/2020, the assessment shall cover the cumulative rail noise impact associated with the existing and planned railways on existing West Rail Line (WRL) and Light Rail Transit (LRT), committed and planned NSRs within the assessment area.
- 1.2 This Report presents the details and results of noise measurements on the operation noise of LRT in Tuen Mun South Area for the cumulative rail noise impact assessment of the Project.

### 2 DETAILS OF NOISE MEASUREMENT

#### Measurement Location and Date

- 2.1 Noise measurement were conducted at the noise sensitive receivers (NSRs) which were selected as the most representative existing or planned noise NSRs that may affect by the operational noise from the Project and the LRT. The noise measurements were conducted between 2300 and 0000 hours to minimize the influence of background noise. The details of noise measurement are presented in **Table 2.1**. The measurement locations were shown in **Figure C1502/C/TME/ACM/M52/050**. Photographs taken during the measurement are presented in **Appendix A**.

**Table 2.1 Measurement Locations and Dates**

Measurement Point ID	Location	Measurement Condition	Measurement Date	Noise Source under Investigation
M01	Oi Tak House, Yau Oi Estate (NSR OT) (First Floor)	1m from building facade	26 Oct 2021	LRT near Yau Oi Estate
M02	Block 8, Glorious Garden (NSR GG) (Roof Level)	1m from building facade	18 Nov 2021	LRT Depot
M03	Block 8, Glorious Garden (NSR GG) (First level)	1m from building facade	18 Nov 2021	LRT Depot
M04	Promenade area adjacent to HKIC – Tuen Mun Training Ground (i.e. the planned NSR at A16) (Ground level)	Free-field	18 Nov 2021	LRT Depot
M05	Wu Tsui House (NSR WT) (First level)	1m from building facade	6 Oct 2021	LRT near Wu King Road
M06	Tuen Mun Wu Hong Police Quarters (NSR WHPQ) (Podium Level)	1m from building facade	6 Oct 2021	LRT near Wu King Road

#### Measurement Parameter

- 2.2  $L_{Aeq\ 30min}$  was obtained during night-time normal train operation.

## 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 <sup>(1)</sup>
Integrating Sound Level Meter	<ul style="list-style-type: none"><li>• B&amp;K 2250-L (Serial No. 2681366)</li><li>• B&amp;K 2250 (Serial No. 3001291)</li><li>• B&amp;K 2270 (Serial No. 2644597)</li><li>• NTi XL2 (Serial No. A2A-17788-E0)</li><li>• NTi XL2 (Serial No. A2A-17440-E0)</li></ul>
Calibrator	<ul style="list-style-type: none"><li>• Rion NC-74 (Serial No. 34246490)</li><li>• B&amp;K 4231 (Serial No. 3006428)</li></ul>

Note:

(1) Calibration certificates are provided in **Appendix B**.

## 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 :  $L_{Aeq\ 30\ min}$  (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 DATA ANALYSIS AND MEASUREMENT RESULTS**

- 3.1 Overall noise level,  $L_{Aeq\ 30\ min}$  (overall), represents the noise level recorded during the 30-minute Sampling Time Period. Background noise levels,  $L_{Aeq\ 30\ min}$  (background) was evaluated by discarding logged data for the period when noise from LRT

operation observed during the noise measurement. Neither intrusive/extraneous noise nor squeal noise was observed during noise measurement.

3.2 The noise level contributed by LRT operation,  $L_{Aeq\ 30min}$  (event), was calculated by subtracting the background noise level  $L_{Aeq\ 30min}$  (background) from the overall noise level  $L_{Aeq\ 30min}$  (overall) in accordance with standard acoustical principles. In the event of  $L_{Aeq\ 30min}$  (overall) is lower than  $L_{Aeq\ 30min}$  (background),  $L_{Aeq\ 30min}$  (event) would be evaluated by applying a correction of -12 dB(A) to  $L_{Aeq\ 30min}$  (overall), following same approach as adopted in train operation noise measurement for Shatin to Central Link (SCL(TAW-HUH) conducted in 2021.

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

**Table 3.1 Measurement Results for Operational Noise of LRT**

Measurement Point ID	Description	Measurement Time	Measurement Condition (Façade / Free Field)	Sum of Train Passby in both directions	$L_{Aeq\ 30min}$ (overall), dB(A) <sup>(1)</sup>	$L_{Aeq\ 30min}$ (background), dB(A) <sup>(1)</sup>	$L_{Aeq\ 30min}$ (event), dB(A)
M01	Oi Tak House, Yau Oi Estate (NSR OT) (First Floor)	2300 - 2330	Façade	3	55.2	54.6	46.5
		2330 - 0000		3	55.4	54.6	47.6
M02	Block 8, Glorious Garden (NSR GG) (Roof Level)	2300 - 2330	Façade	3	56.0	55.9	44.0
		2330 - 0000		4	55.4	55.2	43.4
M03	Block 8, Glorious Garden (NSR GG) (First level)	2300 - 2330	Façade	3	52.8	52.7	40.8
		2330 - 0000		4	52.2	52.0	40.2
M04	Promenade area adjacent to HKIC – Tuen Mun Training Ground (i.e. the planned NSR at A16) (Ground level)	2300 - 2330	Free Field	3	49.6	49.6	37.6
		2330 - 0000		4	49.3	49.3	37.3
M05	Wu Tsui House (NSR WT) (First level)	2300 - 2330	Façade	14	59.2	59.0	47.2
		2330 - 0000		12	58.9	58.7	46.9
M06	Tuen Mun Wu Hong Police Quarters (NSR WHPQ) (Podium Level)	2300 - 2330	Façade	14	58.3	58.0	46.4
		2330 - 0000		12	57.7	57.5	45.7

Note:

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

## 4 PREDICTED RAILWAY NOISE LEVELS FROM LRT OPERATION

4.1 The measured noise levels from LRT operation are proposed to be used for the cumulative rail noise impact assessment for the Project. The highest measured noise levels ( $L_{Aeq\ 30min}$ ) at each measurement point during 2300 – 0000 would be adopted. Since some of the noise measurements were not performed during the peak operation of LRT, a correction factor was added to calculate the operational noise level at peak train frequency of LRT based on the standard acoustical principle.

Correction factors of +2.5 dB(A) was also included to account for the free-field measurement where applicable.

The measured rail noise level at the roof level of Block 8, Glorious Garden is higher than that measured on ground level, thus only the measured noise levels at roof level would be adopted for cumulative rail noise assessment as conservative approach. The predicted railway noise levels from LRT operation during daytime and evening and night-time periods for cumulative rail noise impact assessment are presented in **Table 4.1** and **Table 4.2** respectively.

**Table 4.1 Predicted Railway Noise Levels from LRT Operation for Cumulative Rail Noise Impact Assessment during Daytime and Evening**

Measurement Point ID	Description	Highest Measured Noise Levels, $L_{Aeq\ 30min}$ dB(A)	Sum of Train Passby in both directions (per 30 min)		Correction, dB(A)		Predicted Rail Noise Levels from LRT Operation, dB(A)	Applicable to the NAPs for Cumulative Rail Noise Impact Assessment <sup>(6)</sup>
			During the Measurement Period	Peak Operation <sup>(1)</sup>	Train Frequency	Facade		
M01	Oi Tak House, Yau Oi Estate (NSR OT) (First Floor)	47.6	3	8	4.3	0	51.9	OT3 & OM2
M02	Block 8, Glorious Garden <sup>(2)</sup> (NSR GG) (Roof Level)	44.0	4	4	0	0	44.0 <sup>(2)</sup>	LMO2, LMO3, GG1, GG2, STM1 & STM2
M04	Promenade area adjacent to HKIC – Tuen Mun Training Ground (i.e. the planned NSR at A16) (Ground level)	37.6	4	4	0	2.5	40.1	A16PH1, A16PH1a <sup>(4)</sup> , A16PH2, A16PH6, A16PH10 & A16PH11
M05	Wu Tsui House (NSR WT) (First level)	47.2	14	26	2.7	0	49.9	A16PH1a <sup>(4)</sup> , OM1 <sup>(5)</sup> , WT0b, WT1, WT2, WF1 & WF2, WHPQ1 & WHPQ2, LCCS1, LCCS2, SHDC1, WK1, WK2, TCC, NH1, WB0, WB1, WB2, PG1 <sup>(7)</sup> , RG1 <sup>(7)</sup>
M06	Tuen Mun Wu Hong Police Quarters (NSR WHPQ) (Podium Level)	46.4	14	26	2.7	0	49.1	<sup>(3)</sup>

Notes:

- (1) Peak train frequencies were provided by MTRCL based on the operation timetable. The peak normal train frequency during day-time, evening and night-time periods are same, while a maximum of 2 additional non-service trains per 30 min would be operated daytime and evening period.
- (2) The measured rail noise level at the roof level of Block 8, Glorious Garden is higher than that measured on ground level, thus only the measured noise levels at roof level would be adopted for cumulative rail noise assessment as conservative approach.
- (3) With consideration of potential screening effect provided by the podium of WHPQ, measurement results at M05 would be adopted for cumulative rail noise assessment as conservative approach.
- (4) Since A16PH1a would be affected by both LRT Depot and LRT operation along Hoi Wang Road, noise impacts from both sources were assessed. The total operation noise from LRT is equal to log sum of operational noise from LRT Depot (i.e. 40.1dB(A)) and LRT operation noise (i.e. 49.9 dB(A)). The overall noise level from LRT Depot and LRT operation along Hoi Wang Road at A16PH1a is hence conservatively calculated as 50.3 dB(A) during daytime and evening period.
- (5) OM1 would be subject to rail noise from the LRT operation of 5 LRT routes (505, 507, 614, 614P & 751) along Tuen Mun Heung Sze Wui Road while the measurement point M05 recorded the rail noise from 3 LRT Routes (507, 614 & 614P). The

total peak train frequency of the 5 LRT routes is 45 trains per 30min during daytime and evening period (i.e. 43 per 30mins for normal operation + 2 additional non-service trains per 30 min). The total peak train frequency was confirmed by MTRCL. With 45 trains per 30min, the LRT operation noise at OM1 would not be higher than 52.3 dB(A) during daytime/evening period.

- (6) As a conservative approach, distance correction was not considered in rail noise levels from LRT operation for prediction of cumulative rail noise impact.
- (7) NAP PG1 and RG1 are primarily affected by the noise from the LRT running along Wu Chui Road (i.e. Route 610, 615 and 615P). The total peak frequency of these three routes is lower than the 3 LRT Routes (i.e. 507, 614 & 614P) near Wu Tsui House. Therefore, it is considered conservative to adopt the total peak frequency of 26 train per 30 min for the calculation of LRT noise at PG1 and RG1 during daytime and evening period.

**Table 4.2 Predicted Railway Noise Levels from LRT Operation for Cumulative Rail Noise Impact Assessment during Night-time**

Measurement Point ID	Description	Highest Measured Noise Levels, $L_{Aeq\ 30min}$ dB(A)	Sum of Train Passby in both directions (per 30 min)		Correction, dB(A)		Predicted Rail Noise Levels from LRT Operation, dB(A)	Applicable to the NAPs for Cumulative Rail Noise Impact Assessment <sup>(6)</sup>
			During the Measurement Period	Peak Operation <sup>(1)</sup>	Train Frequency	Facade		
M01	Oi Tak House, Yau Oi Estate (NSR OT) (First Floor)	47.6	3	6	3	0	50.6	OT3 & OM2
M02	Block 8, Glorious Garden <sup>(2)</sup> (NSR GG) (Roof Level)	44.0	4	4	0	0	44.0 <sup>(2)</sup>	LMO2, LMO3, GG1, GG2, STM1 & STM2
M04	Promenade area adjacent to HKIC – Tuen Mun Training Ground (i.e. the planned NSR at A16) (Ground level)	37.6	4	4	0	2.5	40.1	A16PH1, A16PH1a <sup>(4)</sup> , A16PH2, A16PH6, A16PH10 & A16PH11
M05	Wu Tsui House (NSR WT) (First level)	47.2	14	24	2.3	0	49.5	A16PH1a <sup>(4)</sup> , OM1 <sup>(6)</sup> , WT0b, WT1, WT2, WF1 & WF2, WHPQ1 & WHPQ2, LCCS1, LCCS2, SHDC1, WK1, WK2, TCC, NH1, WB0, WB1, WB2, PG1 <sup>(7)</sup> , RG1 <sup>(7)</sup>
M06	Tuen Mun Wu Hong Police Quarters (NSR WHPQ) (Podium Level)	46.4	14	24	2.3	0	48.7	- <sup>(3)</sup>

Notes:

- (1) Peak train frequencies were provided by MTRCL based on the operation timetable. The peak train frequency during daytime and night-time periods are same, while a maximum of 2 additional non-service trains per 30 min would be operated daytime and evening period.
- (2) The measured rail noise level at the roof level of Block 8, Glorious Garden is higher than that measured on ground level, thus only the measured noise levels at roof level were adopted for cumulative rail noise assessment as conservative approach.
- (3) With consideration of potential screening effect provided by the podium of WHPQ, measurement results at M05 were adopted for cumulative rail noise assessment as conservative approach.
- (4) Since A16PH1a would be affected by both LRT Depot and LRT operation along Hoi Wang Road, noise impacts from both sources were assessed. The total operation noise from LRT is equal to log sum of operational noise from LRT Depot (i.e. 40.1dB(A)) and LRT operation noise (i.e. 49.5 dB(A)). The overall noise level from LRT Depot and LRT operation along Hoi Wang Road at A16PH1a is hence conservatively calculated as 50.0 dB(A) during night-time period.
- (5) OM1 would be subject to rail noise from the LRT operation of 5 LRT routes (505, 507, 614, 614P & 751) along Tuen Mun Heung Sze Wui Road while the measurement point M05 recorded the rail noise from 3 LRT Routes (507, 614 & 614P). The total peak train frequency of the 5 LRT routes is 43 trains per 30min during night-time period. The total peak train frequency

was confirmed by MTRCL. With 43 trains per 30min, the LRT operation noise at OM1 would not be higher than 52.1 dB(A) during night-time.

- (6) As a conservative approach, distance correction was not considered in rail noise levels from LRT operation for prediction of cumulative rail noise impact.
- (7) NAP PG1 and RG1 are primarily affected by the noise from the LRT running along Wu Chui Road (i.e. Route 610, 615 and 615P). The total peak frequency of these three routes is lower than the 3 LRT Routes (i.e. 507, 614 & 614P) near Wu Tsui House. Therefore, it is considered conservative to adopt the total peak frequency of 24 train per 30 min for the calculation of LRT noise at PG1 and RG1 during night-time period.

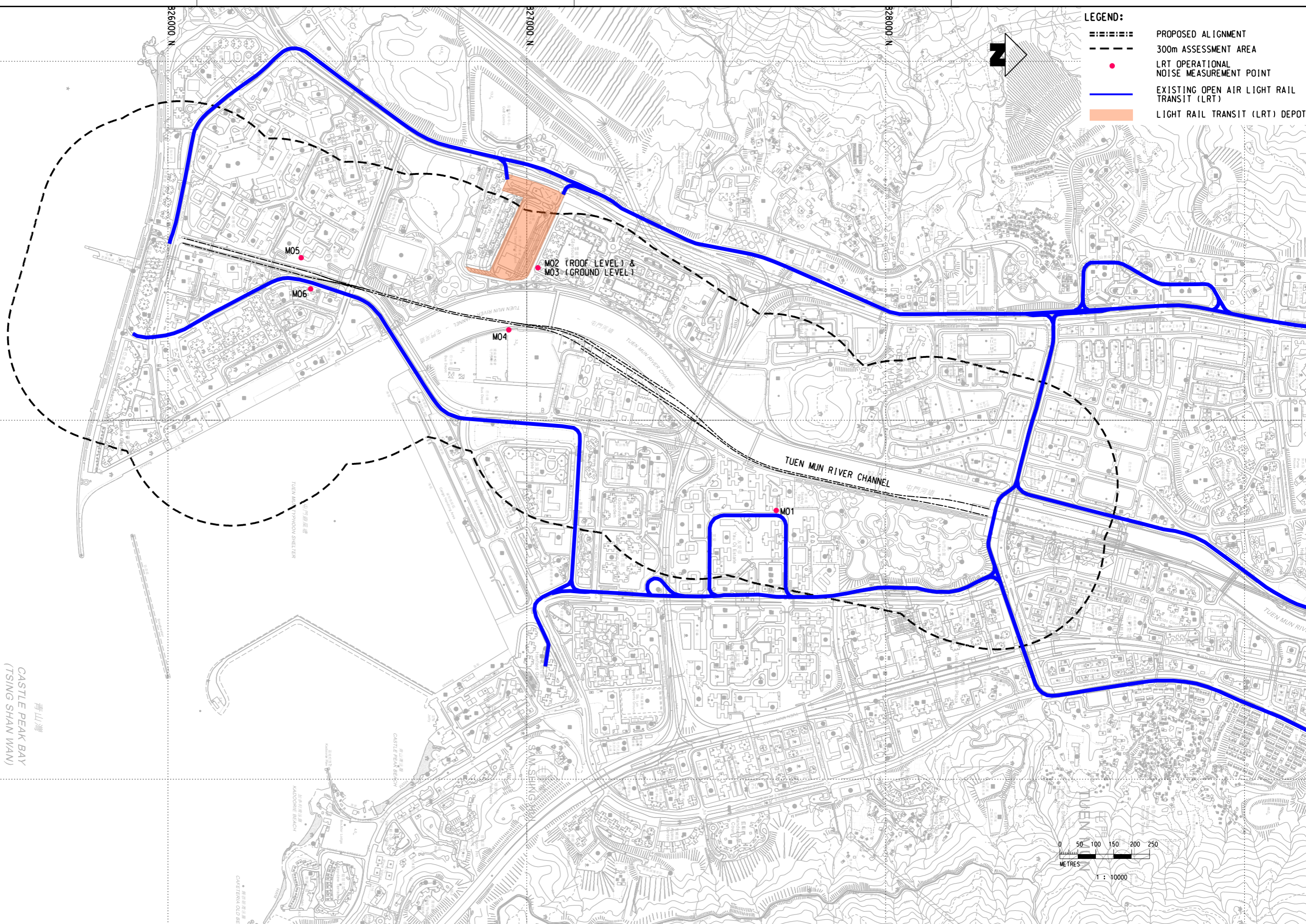
## **5 FIXED PLANT NOISE FROM LRT DEPOT**

- 5.1 The major fixed plant noise sources in LRT Depot are the chiller plants and ventilation fans which operate during daytime only. These major fixed plant sources are located away from A16 Station at more than 300m from the station. The activities within LRT Depot are conducted within enclosed workshop, thus the potential fixed plant noise from the operation of LRT Depot to the A16 planned property development would not have significant contribution with the operation noise from A16 Station. In addition, based on observation of site inspections, the operational noise from LRT Depot was inaudible at the locations near Lung Mun Oasis and planned A16 property development in Area 16. Therefore, adverse cumulative fixed plant noise impact is not anticipated at the NSRs.

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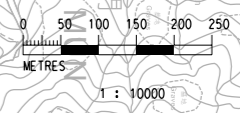
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REV DESCRIPTION BY DATE APPROVED REV DESCRIPTION BY DATE APPROVED



**LEGEND:**

- ==:==:==: PROPOSED ALIGNMENT
- - - - - 300m ASSESSMENT AREA
- LRT OPERATIONAL NOISE MEASUREMENT POINT
- EXISTING OPEN AIR LIGHT RAIL TRANSIT (LRT)
- LIGHT RAIL TRANSIT (LRT) DEPOT



DRAWN	
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	18/MAY/2009
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**MTR**

TUEN MUN SOUTH EXTENSION

**AECOM**

ORIGINATOR

CADD REF. C1502\_C\_TME\_ACM\_M52\_050.dgn

TITLE **C1502**  
**TUEN MUN SOUTH EXTENSION**  
**MEASUREMENT LOCATIONS FOR LRT OPERATIONAL NOISE**

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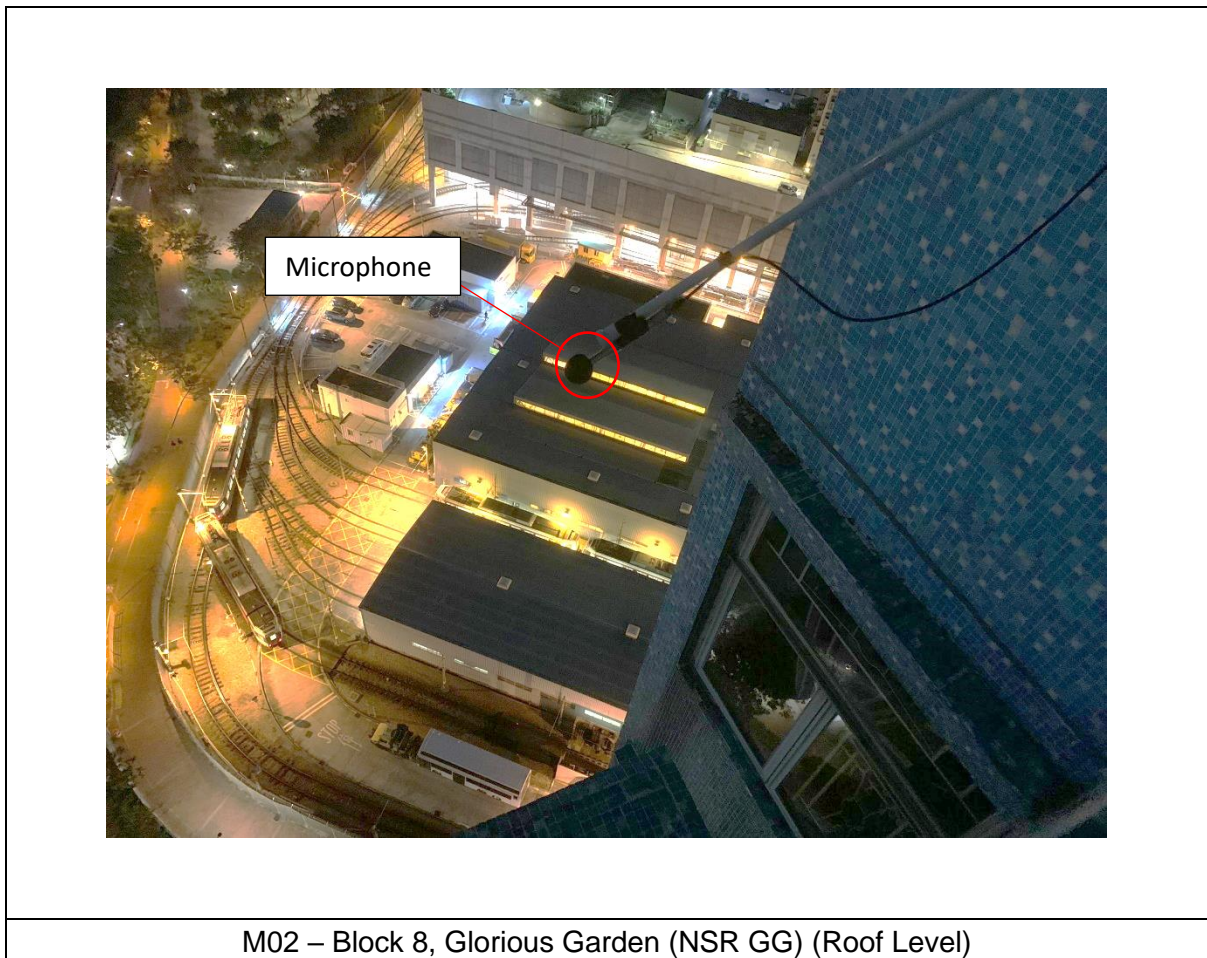
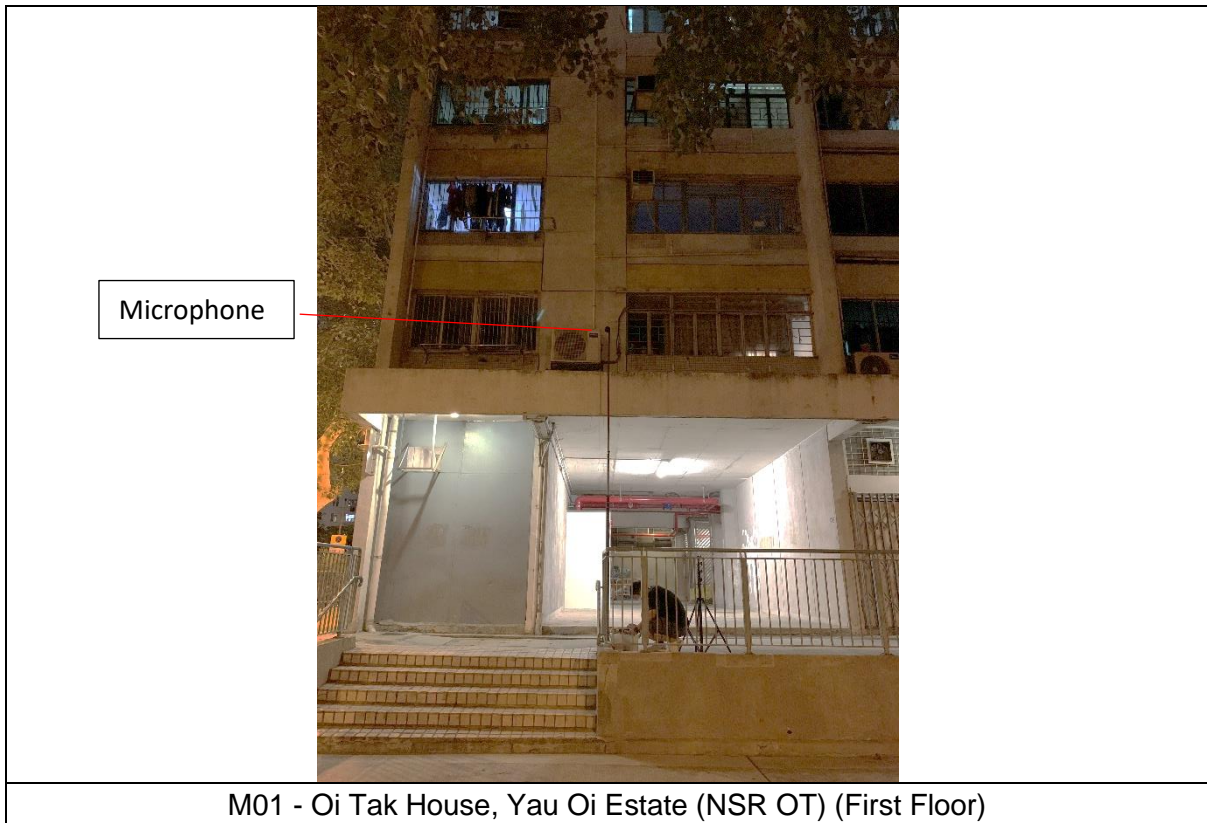
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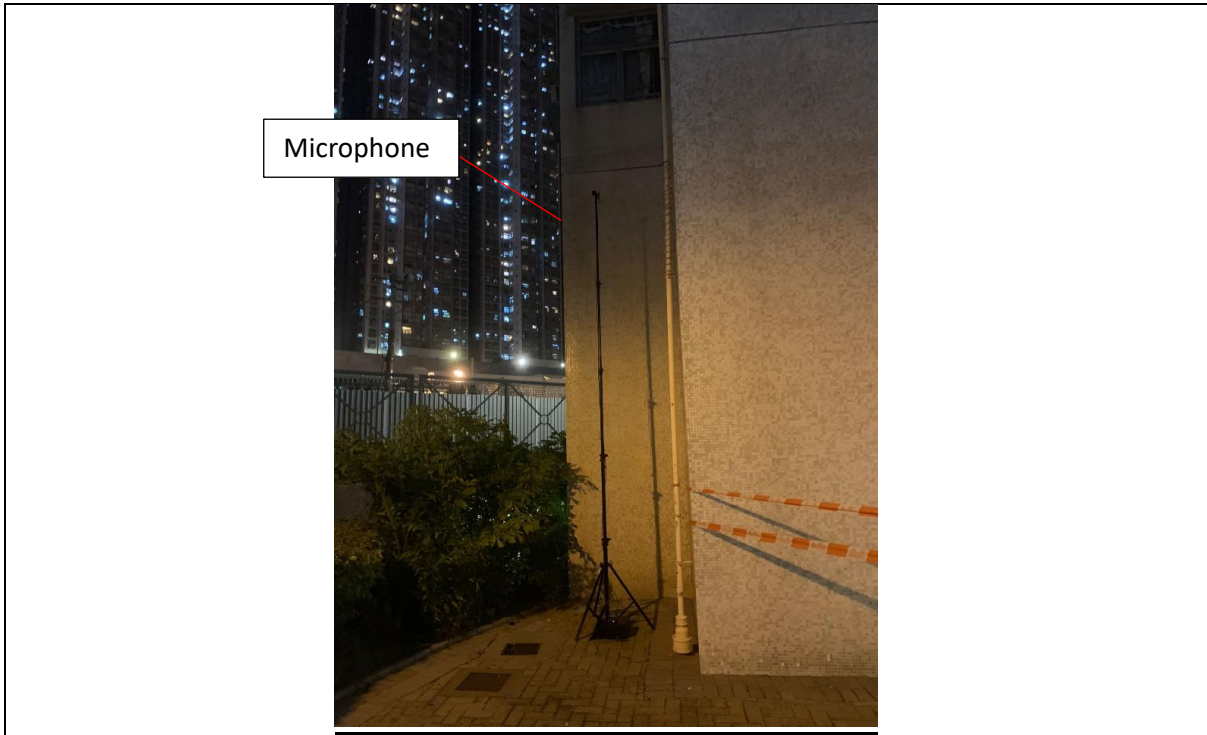
**Appendix A**  
**Measurement Photos**

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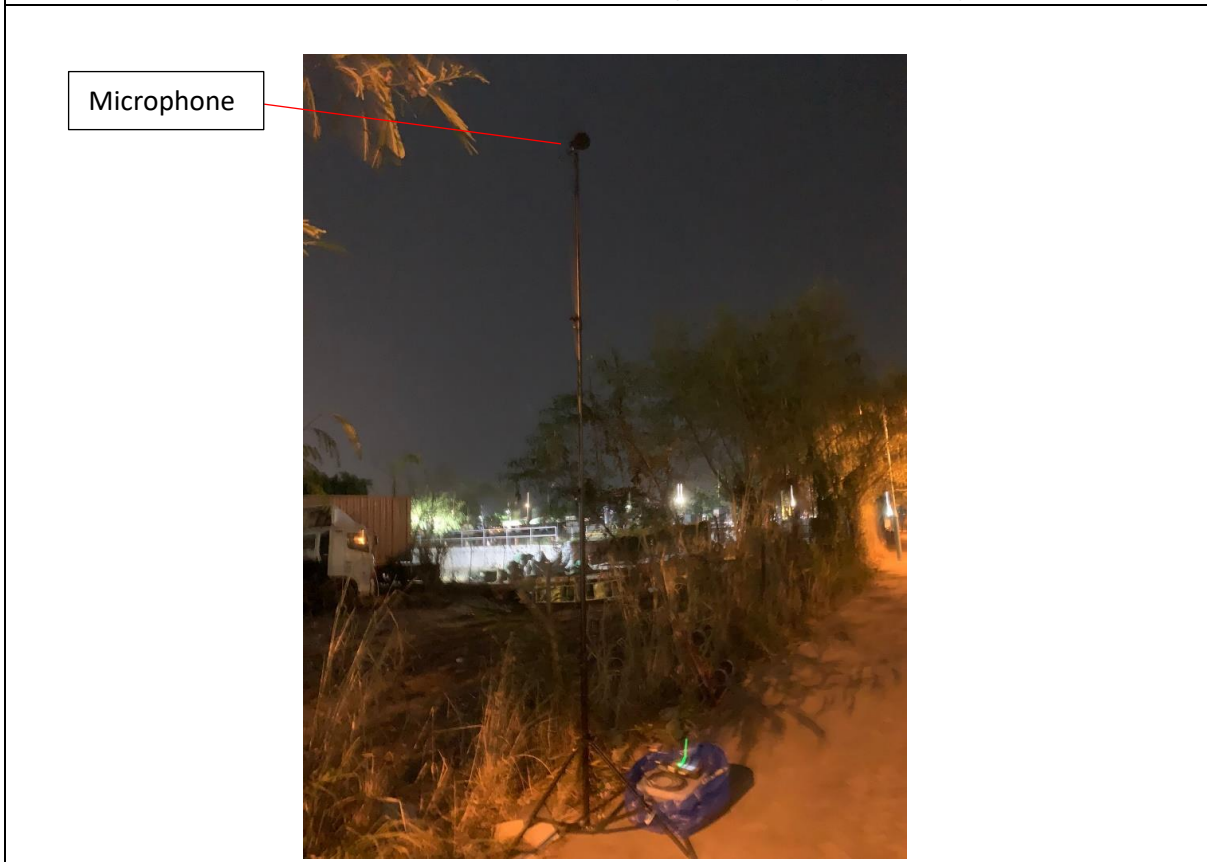


## Appendix A Measurement Photos





M03 – Block 8, Glorious Garden (NSR GG) (First Level)



M04 – Promenade area adjacent to HKIC – Tuen Mun Training Ground (Ground Floor)  
(Planned NSR at A16)



Microphone

M05 – Wu Tsui House (NSR WT) (First Floor)

Microphone



M06 – Tuen Mun Wu Hong Police Quarters (WHPQ) (Podium Floor)

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**Appendix B**  
**Calibration Certificates**

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## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0319 01-01 Page 1 of 2

## Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250-L	4950	ZC0032
Serial/Equipment No.:	2681366	2665582	17190
Adaptors used:	-	-	-

## Item submitted by

Customer Name:	AECOM ASIA CO LTD
Address of Customer:	-
Request No.:	-
Date of receipt:	19-Mar-2021

Date of test: 23-Mar-2021

## Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2021	CIGISMEC
Signal generator	DS 360	33873	19-May-2021	CEPREI

## Ambient conditions

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

## Test specifications

- 1, 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.
- 2, 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%.
- 3, 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 responses of the Sound Level Meter.

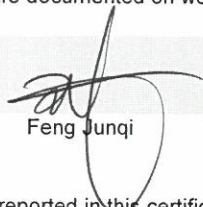
## Test results

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: 24-Mar-2021

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.: 21CA0319 01-01

Page 2 of 2

### 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	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	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	
Frequency weightings	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Time weightings	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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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  
23-Mar-2021

Checked by:

Date:

Chan Yuk Yiu  
24-Mar-2021

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.



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA1019 02-01 Page 1 of 2

### Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250	4950	ZC0032
Serial/Equipment No.:	3001291	3005374	23853
Adaptors used:	-	-	-

### Item submitted by

Customer Name: AECOM ASIA CO LIMITED  
Address of Customer: -  
Request No.: -  
Date of receipt: 19-Oct-2020

Date of test: 22-Oct-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2021	CIGISMEC
Signal generator	DS 360	61227	24-Dec-2020	CEPREI

### Ambient conditions

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

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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: 23-Oct-2020

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.: 20CA1019 02-01

Page 2 of 2

### 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	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	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	
Frequency 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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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  
22-Oct-2020

Checked by:

Date:

Feng Junqi  
23-Oct-2020

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.





## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0309 02 Page 1 of 2

### Item tested

Description:	Sound Level Meter (Type 1)	,	Microphone	Pream
Manufacturer:	B & K	,	B & K	B & K
Type/Model No.:	2270	,	4950	ZC0032
Serial/Equipment No.:	2644597	,	2879980	29398
Adaptors used:	-	,	-	-

### Item submitted by

Customer Name: AECOM ASIA CO LTD  
Address of Customer: -  
Request No.: -  
Date of receipt: 09-Mar-2021

Date of test: 22-Mar-2021

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2021	CIGISMEC
Signal generator	DS 360	33873	19-May-2021	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 response of the Sound Level Meter.

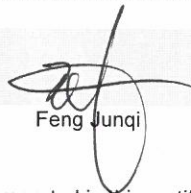
### Test results

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: 24-Mar-2021

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.: 21CA0309 02 Page 2 of 2

### 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:	Uncertainty (dB) / Coverage Factor	
Self-generated noise	A	Pass	0.3	
	C	Pass	1.0	2.1
	Lin	Pass	2.0	2.2
Linearity range for Leq	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	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	
		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	
Frequency weightings	Lin	Pass	0.3	
	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Time weightings	Single 100µs rectangular pulse	Pass	0.3	
	Crest factor of 3	Pass	0.3	
R.M.S. accuracy	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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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	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 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  
22-Mar-2021

Checked by:

Date:

Chan Yuk Yiu  
24-Mar-2021

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.



## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0518 01-01

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-17440-EO	A18423	9087
Adaptors used:	-		

## Item submitted by

Customer Name: AECOM  
Address of Customer: -  
Request No.: -  
Date of receipt: 18-May-2021

Date of test: 21-May-2021

## Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2021	CIGISMEC
Signal generator	DS 360	61227	31-Dec-2020	CEPREI

## Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

## Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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 responses 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: 22-May-2021

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.: 21CA0518 01-01

Page 2 of 2

### 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	
	C	Pass	0.8	2.1
	Lin	Pass	1.6	2.2
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	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	
Frequency weightings	Lin	Pass	0.3	
	Time weightings	Single Burst Fast	Pass	0.3
	Single Burst Slow	Pass	0.3	
Peak response	Single 100 $\mu$ s 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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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.

Calibrated by:


Date:

  
Fung Chi Yip  
21-May-2021

- End -

Checked by:

Date:

  
Chan Yuk Yiu  
22-May-2021



## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0518 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: 18-May-2021

Date of test: 21-May-2021

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2021	CIGISMEC
Signal generator	DS 360	61227	31-Dec-2020	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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.

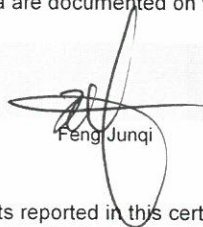
### Test results

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: 22-May-2021

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.: 21CA0518 01-02

Page 2 of 2

### 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	
	C	Pass	0.8	2.1
	Lin	Pass	1.6	2.2
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	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	
	Lin	Pass	0.3	
Time weightings	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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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  
21-May-2021

Checked by:

Date:

Chan Yuk Yiu  
22-May-2021

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.



## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0401 02

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: 01-Apr-2021

Date of test: 05-Apr-2021

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	11-May-2021	SCL
Preamplifier	B&K 2673	2743150	03-Jun-2021	CEPREI
Measuring amplifier	B&K 2610	2346941	03-Jun-2021	CEPREI
Signal generator	DS 360	33873	19-May-2021	CEPREI
Digital multi-meter	34401A	US36087050	19-May-2021	CEPREI
Audio analyzer	8903B	GB41300350	18-May-2021	CEPREI
Universal counter	53132A	MY40003662	18-May-2021	CEPREI

### Ambient conditions

Temperature:  $22 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1010 \pm 5$  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: 07-Apr-2021

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.: 21CA0401 02

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 $\mu$ Pa)
			Estimated Expanded Uncertainty dB
1000	94.00	94.23	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 = 999.95 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 = 0.3 %

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:

Furig Chi Yip  
05-Apr-2021

Checked by:

Date:

Jackie  
Chan Yuk Yiu  
07-Apr-2021

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.





## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA1019 03-02

Page: 1 of 2

### Item tested

Description: Acoustical Calibrator (Class 1)  
Manufacturer: Rion Co., Ltd.  
Type/Model No.: NC-74  
Serial/Equipment No.: 34246490 / N.004.10  
Adaptors used: -

### Item submitted by

Customer: AECOM ASIA CO LIMITED  
Address of Customer: -  
Request No.: -  
Date of receipt: 19-Oct-2021

Date of test: 21-Oct-2021

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2341427	04-May-2022	SCL
Preamplifier	B&K 2673	2239857	31-May-2022	CEPREI
Measuring amplifier	B&K 2610	2346941	01-Jun-2022	CEPREI
Signal generator	DS 360	33873	27-May-2022	CEPREI
Digital multi-meter	34401A	US36087050	27-May-2022	CEPREI
Audio analyzer	8903B	GB41300350	28-May-2022	CEPREI
Universal counter	53132A	MY40003662	02-Jun-2022	CEPREI

### Ambient conditions

Temperature:  $22 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  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: 22-Oct-2021

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.: 21CA1019 03-02

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.

(Output level in dB re 20  $\mu$ Pa)

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	Estimated Expanded Uncertainty dB
1000	94.00	94.00	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 = 0.012 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:

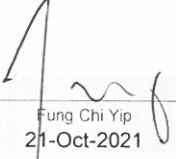
At 1000 Hz    Actual Frequency = 1002.1  
Estimated expanded uncertainty                          0.1 Hz                  Coverage factor k = 2.2

### 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 = 1.7 %  
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.

Calibrated by: 

Date: 21-Oct-2021

- End -

Checked by: 

Date: 22-Oct-2021

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.