

MTR Corporation Limited

**East Rail Extensions -
Tai Wai to Ma On Shan**

Train Operational Noise Monitoring for
8-car Train Operation

Monthly Noise Monitoring Report No. 5

(June 2017)

Verified by: Fredrick Leong



Position: Independent Environmental Checker




Date: 23 Jun 17

MTR Corporation Limited

Consultancy Agreement No. C11033

Ma On Shan Line**Train Operational Noise Monitoring for
8-car Train Operation****Monthly Noise Monitoring Report No. 5**

June 2017

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Version: A Date: 22 June 2017

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1 INTRODUCTION

1.1 Background

- 1.1.1 Ma On Shan Line (MOL), previously known as East Rail Extensions – Tai Wai to Ma On Shan (the Project), provides a railway system connecting Tai Wai and Ma On Shan. The Environmental Impact Assessment (EIA) Report (AEIAR-028/1999), which was prepared based upon the construction and operation of 8-car electric train mode, was approved by the Director of Environmental Protection (DEP) and the Environmental Permit (EP-039/2000) was granted to the Kowloon Canton Railway Corporation (KCRC) on 15 January 2000.
- 1.1.2 Subsequent to the issuance of the first EP, a number of Variation of Environmental Permits (VEPs) and Further Environmental Permits (FEPs) have been applied for and the latest Further Environmental Permit (FEP-05/039/2000/F) was granted on 1 June 2012 to transfer the responsibility of the MOL construction and operation from KCRC to MTR Corporation (MTRC).
- 1.1.3 MOL in 4-car train operation commenced in December 2004 and the Project Proponent conducted operational noise monitoring for 4-car train operation from December 2004 to July 2006. Monitoring results showed that the train operational noise continuously complies with the noise limit levels over the reporting period without any trend to cause exceedance. Field observations indicated that the major noise source contributed to the ambient noise were heavy vehicles (i.e. bus and public light bus) travelling along Sai Sha Road and Ma On Shan Road. Assessment and analysis of noise results collected throughout the operational noise monitoring periods also demonstrated the environmental acceptability of the Project. Therefore, the implemented mitigation measures were effective and efficient in controlling noise impacts during the train operation.
- 1.1.4 Modification works at MOL have been completed to allow the transition of current 4-car train operation to 8-car train operation. MOL will be joined with the Shatin to Central Link and West Rail Line to form the “East-West Corridor” in 8-car train operation. Beginning from early 2017, 4-car trains on the MOL will start being converted to 8-car trains by a mix of 4-car and 8-car trains in operation. The number of 8-car train will gradually increase and the conversion period is expected to last for around 9 months. It is therefore anticipated that the full 8-car train operation will be achieved in approximately end 2017.
- 1.1.5 Considering the conversion of 4-car trains to 8-car train operation, MTRC proposes to conduct additional operational noise monitoring for 8-car train configuration to demonstrate the environmental acceptability of the 8-car train operation. A Train Operational Noise Monitoring Plan for 8-car Train Operation (NMP) was prepared and submitted to Environmental Protection Department (EPD) on 23 December 2016.
- 1.1.6 AECOM Asia Co. Ltd (AECOM) was commissioned by MTRC to conduct operational noise monitoring for 8-car train operation of MOL according to the NMP.

1.2 Purpose of the Report

- 1.2.1 The 8-car train operation on MOL commenced on 15 January 2017. This is the 5th monthly operational noise monitoring report, summarising the monitoring results obtained between 15 May 2017 and 14 June 2017.

2 TRAIN OPERATIONAL NOISE MONITORING

2.1 Monitoring Equipment

- 2.1.1 In accordance with Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM), sound level meters in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications were used for carrying out the noise monitoring. Immediately prior to and following each noise measurement, the accuracy of each sound level meter was checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements are considered to be valid with the calibration level from before and after the noise measurement within 1.0 dB. **Table 2.1** summarizes the noise monitoring equipment model used for monitoring.

Table 2.1 Noise Monitoring Equipment

Equipment	Model
Integrating Sound Level Meter	<ul style="list-style-type: none"> • B&K Brand Type 2270 (Serial No. 3007965) • B&K Brand Type 2250-L (Serial No. 2681366) • B&K Brand Type 2250 (Serial No. 3001291)
Calibrator	<ul style="list-style-type: none"> • Rion NC-73 (Serial No. 10307223) • MVI CAL21 (Serial No. 34113610)

2.2 Monitoring Parameters

- 2.2.1 Night-time operation of 8-car train commenced in May 2017, and therefore weekly monitoring with noise parameter of six consecutive $L_{eq\ 5min}$ (i.e. one set of $L_{eq\ 30min}$) was taken during the reporting period according to NMP.
- 2.2.2 Given that the daytime noise monitoring results in the 1st and 2nd month of monitoring demonstrated full compliance with statutory noise limit, monthly monitoring was carried out for daytime noise monitoring since the 3rd monitoring month and continued this reporting period. During the daytime noise monitoring period, one set of $L_{eq\ 30min}$ as six consecutive $L_{eq\ 5min}$ was taken once every month within the period of 8-car train operation.

2.3 Monitoring Locations and Dates

- 2.3.1 Two monitoring stations as shown in **Figure C11033/C/MOL/ACM/M62/001** were selected for noise monitoring.
- 2.3.2 Summary of the monitoring locations and monitoring dates during the reporting period are shown in **Table 2.2**.

Table 2.2 Monitoring Locations and Schedule of Noise Monitoring

Monitoring Location	ASR	Monitoring Dates
Villa Athena Block 5	B	- Daytime (0700 – 2300): 18 May 2017 - Night-time (2300 – 0700): 18 May, 26 May, 31 May, 8 Jun and 14 Jun 2017
Ma On Shan Centre Block 2	B	- Daytime (0700 – 2300): 18 May 2017 - Night-time ((2300 – 0700): 18 May, 26 May, 31 May, 8 Jun and 14 Jun 2017

- 2.3.3 The daytime noise monitoring frequency has been further reviewed in accordance with the NMP submitted to EPD on 23 December 2016. Given that the daytime noise monitoring

results demonstrated full compliance with statutory noise limit since the 1st month of monitoring, daytime noise monitoring will be ceased starting from 6th month of monitoring while night-time monitoring will be continued.

2.3.4 Tentative monitoring schedule for the upcoming reporting period is presented in **Appendix A**. The monitoring schedule is subject to change due to 8-car train service as and when necessary and weather condition.

2.4 Monitoring Procedures

2.4.1 Field Monitoring Procedures are summarised as below:

- All measurements were made in facade type. The microphone of the sound level meter was positioned 1m exterior of the sensitive receivers and lowered sufficiently so that the external wall of the building acts as a reflecting surface.
- Parameters such as frequency weighting, the time weighting and the duration of measurement were set as follows:
 - frequency weighting : A
 - time weighting : Fast
 - time measurement : Six consecutive five-minutes duration (with data being logged at every one second)
- Prior to and after each noise measurement, the 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 would be considered invalid and repeat of noise measurement would be required after repair or re-calibration of the equipment.
- Details were recorded when intrusive noise was observed. Noise sources and duration were also recorded during the monitoring process.
- All the monitoring 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 monitoring period was recorded by the monitoring staff. Wind speed was regularly checked using the anemometer.
- Noise monitoring would be suspended in the presence of fog, rain, and wind with a steady speed exceeding 5 m/s, or wind with gusts exceeding 10 m/s.

2.4.2 Maintenance and calibration of sound level meter is stated below:

- The microphone of the sound level meter and calibrator were cleaned with a soft cloth at quarterly interval.
- The meter was sent to the supplier for checking and calibration at yearly interval.

2.4.3 Calibration certificates for the equipment employed for monitoring (**Table 2.1** refers) are presented in **Appendix B**.

2.5 Data Analysis

2.5.1 Ambient noise levels were evaluated by discarding logged data for the period when the train passed in front of the monitoring stations. The ambient noise level for each of the six five-minute noise data was averaged to appraise the overall ambient noise level, L_{Aeq} 30mins (ambient).

2.5.2 The noise level contributed by train pass-by, L_{Aeq} 30mins (event) was calculated by subtracting the ambient noise level L_{Aeq} 30mins (ambient) from the overall noise level L_{Aeq} 30mins (overall) (average of six five-minute noise data).

2.5.3 In the event of L_{Aeq} 30mins (overall) is lower than L_{Aeq} 30mins (ambient), L_{Aeq} 30mins (event) would be evaluated by applying a correction of -12 dB(A) to L_{Aeq} 30mins (overall), following same approach as adopted during 4-car train operation noise monitoring conducted between 2004 and 2006.

2.5.4 **Appendix C** is the Action and Limit Levels, and the Event/Action Plan extracted from Tables 2.3 and 2.4, Appendix A of NMP respectively.

2.6 Results and Observations

2.6.1 All monitoring data and graphical presentation of the monitoring results are provided in **Appendix D**, with summary of monitoring levels during daytime and night-time periods presented in **Tables 2.3** and **Table 2.4** respectively.

Table 2.3 Summary of Daytime Impact Noise Monitoring Results

Monitoring Date	Monitoring Location	No. of 8-car train passby ⁽¹⁾	Noise Level, L_{eq} , 30 min dB(A)			
			L_{Aeq} 30min (event)	ASR	Limit Level	Compliance
18 May 2017	Villa Athena Block 5	8	62	B	65	Yes
	Ma On Shan Centre Block 2	8	55	B	65	Yes

Note:

(1) The number of 8-car train passby during the monitoring period.

Table 2.4 Summary of Night-time Impact Noise Monitoring Results

Monitoring Date	Monitoring Location	No. of 8-car train passby ⁽¹⁾	ASR	Noise Level, L_{eq} , 30 min dB(A)			Noise Level, L_{max} dB(A)		
				L_{Aeq} 30min (event)	Limit Level	Compliance	L_{max} (event)	Limit Level	Compliance
18 May 2017	Villa Athena Block 5	4	B	53	55	Yes	70	85	Yes
	Ma On Shan Centre Block 2	4	B	51	55	Yes	69	85	Yes
26 May 2017	Villa Athena Block 5	4	B	52	55	Yes	70	85	Yes
	Ma On Shan Centre Block 2	4	B	53	55	Yes	78	85	Yes
31 May 2017	Villa Athena Block 5	4	B	53	55	Yes	68	85	Yes
	Ma On Shan Centre Block 2	4	B	51	55	Yes	69	85	Yes
8 Jun 2017	Villa Athena Block 5	4	B	53	55	Yes	69	85	Yes
	Ma On Shan Centre Block 2	4	B	50	55	Yes	69	85	Yes
14 Jun 2017	Villa Athena Block 5	4	B	52	55	Yes	70	85	Yes
	Ma On Shan	4	B	50	55	Yes	69	85	Yes

Monitoring Date	Monitoring Location	No. of 8-car train passby ⁽¹⁾	ASR	Noise Level, $L_{eq, 30 \text{ min}}$ dB(A)			Noise Level, L_{max} dB(A)		
				$L_{Aeq, 30 \text{ min}}$ (event)	Limit Level	Compliance	L_{max} (event)	Limit Level	Compliance
	Centre Block 2								

Note:

(1) The number of 8-car train passby during the monitoring period.

2.6.2 According to site observation, apart from the operational train noise, the major noise source identified was heavy vehicles (i.e. bus and public light bus) travelling along Sai Sha Road and Ma On Shan Road.

2.6.3 All recorded noise levels during the reporting period complied with the limit levels.

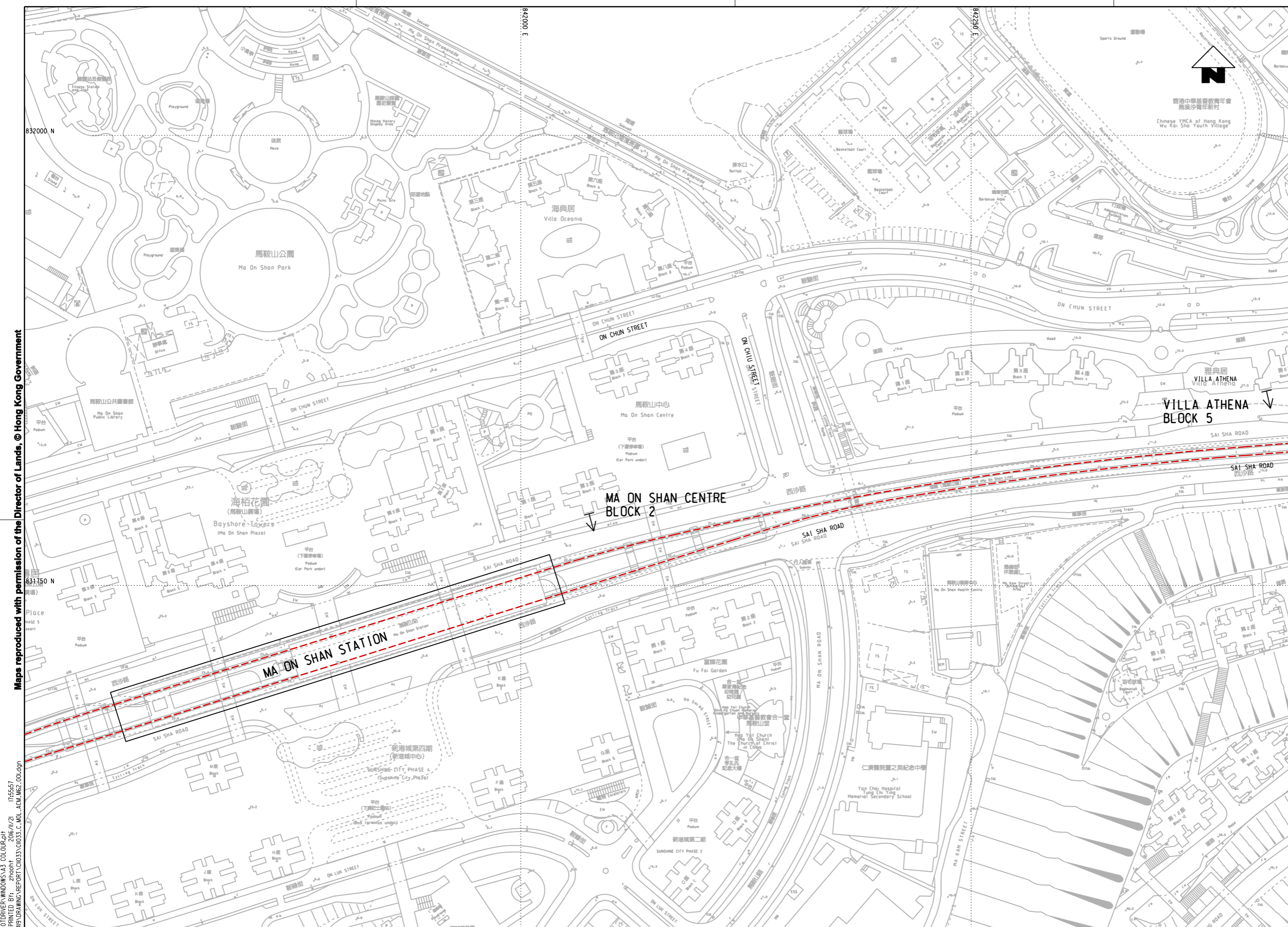
2.7 Record of Noise Complaints

2.7.1 No noise complaint was received during the reporting period and therefore no action was required.

3 CONCLUSION

- 3.1.1 Night-time 8-car train operation commenced in May 2017. Monthly Daytime and weekly night-time noise monitoring were conducted according to NMP. Background noise levels without train pass-by were derived from the monitoring data for the two monitoring stations. By comparing the noise levels with and without pass-by, all recorded daytime and night-time noise levels for train operation noise monitoring complied with the respective limit level. It was observed that noise generated from road traffic along Sai Sha Road and Ma On Shan Road was the dominant noise source during the monitoring period.
- 3.1.2 According to the NMP, the daytime noise monitoring frequency has been reviewed. Considering the daytime monitoring results at the designated monitoring stations comply with the limit level since 1st month of monitoring, daytime noise monitoring will be ceased starting from 6th month of monitoring in accordance with the NMP, while night-time noise monitoring will be continued.

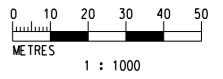
Figure



LEGEND:

→ OPERATIONAL NOISE MONITORING STATION

--- MA ON SHAN RAIL ALIGNMENT



Maps reproduced with permission of the Director of Lands, © Hong Kong Government

PLOT DRW: V:\mst\mtr\p\DRIVER\WINDOWS\3 COLOUR.dwg 2016/11/21 17:55:57
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 FILE NAME:

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	18/MAY/2009

MTR

SHATIN TO CENTRAL LINK

AECOM

ORIGINATOR

CADD REF. C11033_C_MOL_ACM_M62_001.dgn

TITLE	C11033 MOL - MA ON SHAN LINE LOCATIONS OF NOISE MONITORING STATIONS
SCALE	1 : 1000 (A1)
FIGURE NO.	C11033/C/MOL/ACM/M62/001
REV.	A

Appendix A

**Tentative Monitoring Schedule for the Upcoming Reporting
Period**

Tai Wai to Ma On Shan Rail
Tentative Train Noise Monitoring Schedule for 8-car Train Operation (Jun 2017)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28-Jun	29-Jun	30-Jun	1-Jul	1-Jun	2-Jun	3-Jun
4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun
11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun
18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun
				Noise Monitoring (Night time)		
25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul
				Noise Monitoring (Night time)		

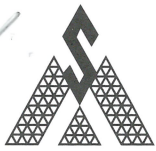
The schedule is subject to change due to unforeseeable circumstances (e.g. adverse weather, etc)

**Tai Wai to Ma On Shan Rail
Tentative Train Noise Monitoring Schedule for 8-car Train Operation (Jul 2017)**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	1-Jul
2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul
				Noise Monitoring (Night time)		
9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul
				Noise Monitoring (Night time)		
16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul
23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul
30-Jul	31-Jul					

The schedule is subject to change due to unforeseeable circumstances (e.g. adverse weather, etc)

Appendix B
Calibration Records of Monitoring Equipment



CERTIFICATE OF CALIBRATION

Certificate No.: 16CA0929 04 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	4189	ZC0032
Serial/Equipment No.:	3001291 (N 001.05)	3005374	23853
Adaptors used:	-	-	-

Item submitted by

Customer Name:	AECOM ASIA CO. LTD.
Address of Customer:	-
Request No.:	-
Date of receipt:	29-Sep-2016

Date of test: 05-Oct-2016

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	18-Jun-2017	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI

Ambient conditions

Temperature:	21 ± 1 °C
Relative humidity:	60 ± 10 %
Air pressure:	1000 ± 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 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.

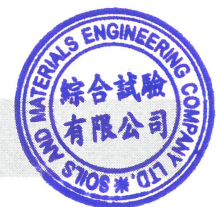
Actual Measurement data are documented on worksheets.

Approved Signatory:

Huang Jian Min/Feng Jun Qi

Date: 06-Oct-2016

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.: 16CA0929 04

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	
	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 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:

Fung Chi Yip

Date: 05-Oct-2016

Checked by:

Lam Tze Wai

Date: 06-Oct-2016

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.: 16CA0606 03 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	,	Microphone
Manufacturer:	B & K	,	B & K
Type/Model No.:	2270	,	4189
Serial/Equipment No.:	3007965 / N.012.02	,	3005374
Adaptors used:	-	,	-

Item submitted by

Customer Name: AECOM ASIA CO. LTD.
Address of Customer: -
Request No.: -
Date of receipt: 06-Jun-2016

Date of test: 07-Jun-2016

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	19-Jun-2016	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	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 $\pm 20\%$.
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:

Huang Jian Min/Feng Jun Qi

Date: 08-Jun-2016

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.: 16CA0606 03 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	
Linearity range for SPL	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	Frequency weightings			
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			
Time averaging	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
Pulse range	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
	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.

Calibrated by:

Date:

Fung Chi Yip
07-Jun-2016

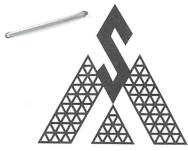
- End -

Checked by:

Date:

Lam Tze Wai
08-Jun-2016

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.: 17CA0303 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: 03-Mar-2017

Date of test: 07-Mar-2017

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	18-Jun-2017	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 60 ± 10 %
Air pressure: 1010 ± 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.

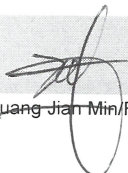
Test results

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.

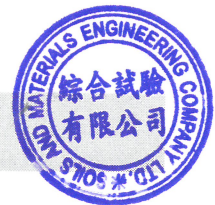
Actual Measurement data are documented on worksheets.

Approved Signatory:


Huang Jian Min/Feng Jun Qi

Date: 08-Mar-2017

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.: 17CA0303 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			
Time weightings	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Peak response	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
R.M.S. accuracy	Single 100µs rectangular pulse	Pass	0.3	
	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	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
07-Mar-2017

Checked by:

Date:

Lam Tze Wai
08-Mar-2017

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.: 16CA1201 01

Page: 1 of 2

Item tested

Description: Acoustical Calibrator (Class 1)
Manufacturer: Rion Co., Ltd.
Type/Model No.: NC-73
Serial/Equipment No.: 10307223 (CN.004.08)
Adaptors used: -

Item submitted by

Customer: AECOM ASIA CO. LTD.
Address of Customer: -
Request No.: -
Date of receipt: 01-Dec-2016

Date of test: 05-Dec-2016

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	14-Apr-2017	SCL
Preamplifier	B&K 2673	2239857	28-Apr-2017	CEPREI
Measuring amplifier	B&K 2610	2346941	26-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI
Digital multi-meter	34401A	US36087050	18-Apr-2017	CEPREI
Audio analyzer	8903B	GB41300350	19-Apr-2017	CEPREI
Universal counter	53132A	MY40003662	19-Apr-2017	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.

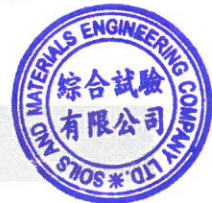
Details of the performed measurements are presented on page 2 of this certificate.

Approved Signatory:


Huang Jian Min/Feng Jun Qi

Date: 08-Dec-2016

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.: 16CA1201 01

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 μ Pa)
			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 = 0.002 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 = 986.6 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 = 0.5 %**

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:

Fung Chi Yip

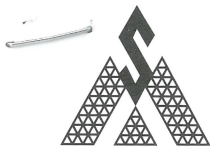
Date: 05-Dec-2016

Checked by:

Lam Tze Wai

Date: 08-Dec-2016

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.: 16CA0830 01

Page: 1 of 2

Item tested

Description: Acoustical Calibrator (Class 1)
Manufacturer: MVI
Type/Model No.: CAL21
Serial/Equipment No.: 34113610(2011) / N.004.11
Adaptors used: Yes (BAC21)

Item submitted by

Customer: AECOM ASIA CO., LTD.
Address of Customer: -
Request No.: -
Date of receipt: 30-Aug-2016

Date of test: 30-Aug-2016

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	14-Apr-2017	SCL
Preamplifier	B&K 2673	2239857	28-Apr-2017	CEPREI
Measuring amplifier	B&K 2610	2346941	26-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI
Digital multi-meter	34401A	US36087050	18-Apr-2017	CEPREI
Audio analyzer	8903B	GB41300350	19-Apr-2017	CEPREI
Universal counter	53132A	MY40003662	19-Apr-2017	CEPREI

Ambient conditions

Temperature: 22 ± 1 °C
Relative humidity: 60 ± 10 %
Air pressure: 1005 ± 5 hPa

Test specifications

- 1, 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.
- 2, The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- 3, 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:


Huang Jian Min/Feng Jun Qi

Date: 31-Aug-2016

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.

Appendix C

**Excerpt of Train Operational Noise Monitoring Plan for 8-car
Train Operation**

Appendix C –

Excerpt of Train Operational Noise Monitoring Plan for 8-car Train Operation

Table 2.3 Train Operational Noise Monitoring Location

Train Operational Noise Monitoring Location	Area Sensitivity Rating (ASR)	Noise Criterion/Limit Level, dB(A)		
		Leq, 30 mins		L _{max}
		Day (0700 – 2300 hrs)	Night (2300 – 0700 hrs)	Night (2300 – 0700 hrs)
Villa Athena Block 5, Rooftop	B	65	55	85
Ma On Shan Centre Block 2, Rooftop	B	65	55	85

Table 2.4 Action and Limit Levels for Train Operational Noise Monitoring

Time Period	Action Level	Limit Level ⁽¹⁾
Day (0700 – 2300 hours)	On receiving one documented valid complaint	L _{eq, 30 mins} = 65dB(A)
Night (2300 – 0700 hours)		L _{eq, 30 mins} = 55dB(A) L _{max} = 85dB(A)

Note:

- (1) Rail Noise is under control of the Noise Control Ordinance and should comply with Acceptable Noise Levels laid down in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites.

Appendix C - Except of Train Operational Noise Monitoring Plan for 8-car Train Operation

Appendix A Event/Action Plans for Train Operational Noise

Event	Monitoring Team Action
Action Level - Complaint received ⁽¹⁾	<ol style="list-style-type: none"> 1) Inform MTRC and IEC; 2) Conduct investigation to identify source(s) of Impact; 3) Check monitoring data and determine the validity of complaint; 4) Conduct follow up action if the complaint is confirmed to be valid. If not, record the investigation findings and close case.
Action Level – Confirmed as Valid Complaint	<ol style="list-style-type: none"> 1) Conduct noise measurement where necessary; 2) Check monitoring data; 3) Investigate and discuss mitigation measures with MTRC; 4) MTRC to implement mitigation measures as appropriate so as not to affect the train services and operation; 5) Conduct noise measurement where necessary to review the adopted measures; 6) Document the event/action and close case.
Limit Level	<ol style="list-style-type: none"> 1) Identify source(s) of Impact; 2) Inform MTRC, IEC and EPD; 3) Repeat measurement to confirm findings; 4) Check monitoring data; 5) Investigate and discuss mitigation measures with MTRC; 6) MTRC to implement mitigation measures as appropriate so as not to affect the train services and operation; 7) Conduct noise measurement where necessary to review the adopted measures; 8) Repeat Steps 3) to 7) if exceedance continues; 9) Document the event/action if exceedance stops.

Note:

- (1) Please refer to the MTR hotline and contact information via http://www.mtr.com.hk/en/customer/main/contact_us.html

Appendix D

Train Operation Noise Monitoring Results

Appendix D Train Operation Noise Monitoring Results

Location : Villa Athena Block 5(Daytime)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Recorded Noise Level, dB(A)		Ambient Noise Level, dB(A)		LAeq Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
			LAeq 30 mins (overall)	LAeq 5mins (overall)	LAeq 30mins (ambient)	LAeq 5mins (ambient)			
18-May-2017	7:00	62	65.3	63.4	62.3	61.5	65	Yes	Yes
				62.9		61.9			
				64.9		62.3			
				65.1		62.8			
				66.7		62.2			
				67.1		62.7			

All readings are taken as façade measurement

Appendix D Train Operation Noise Monitoring Results

Location : Villa Athena Block 5(Night-time)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Train Noise Level, dB(A) Lmax (event)	Recorded Noise Level, dB(A)			Ambient Noise Level, dB(A)			LAeq Limit Level, dB(A)	Compliance (Yes/No)	Lmax Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)											
				LAeq 30 mins (overall)	LAeq 5mins (overall)	Lmax 5mins (event)	LAeq 30mins (ambient)	LAeq 5mins (ambient)	Lmax 5mins (ambient)																
18-May-2017	6:30	53	70	61.5	61.5	67.3	60.8	61.1	67.0	55	Yes	85	Yes	Yes											
					60.5	67.2		59.7	64.8																
					61.2	68.2		60.2	66.7																
					62.1	70.4		60.6	66.3																
					61.6	67.7		61.2	68.2																
					62.1	68.2		61.8	73.2																
					61.5	68.8		60.3	64.9																
					60.6	67.8		60.2	69.5																
					63.3	68.4		63.3	79.9																
					60.4	57.8		60.5	68.3																
26-May-2017	23:05	52	70	61.5	61.2	68.2	60.9	60.6	68.3	55	Yes	85	Yes	Yes											
					61.1	69.9		59.5	66.7																
					59.1	67.0		58.2	65.7																
					59.8	67.5		58.5	63.4																
					59.0	65.7		59.0	65.0																
					60.8	67.7		59.5	66.4																
					60.6	67.8		59.6	65.6																
					59.7	67.9		58.7	63.5																
					62.9	67.9		62.5	64.9																
					63.0	66.8		62.8	66.9																
31-May-2017	23:04	53	68	59.9	63.3	67.5	58.9	62.9	66.5	55	Yes	85	Yes	Yes											
					63.5	68.6		62.8	67.5																
					63.2	67.2		62.9	67.7																
					63.7	67.2		63.4	69.2																
					60.8	67.4		60.2	70.9																
					60.1	68.8		59.4	63.7																
					60.5	68.3		59.4	65.9																
					58.5	64.8		58.3	65.6																
					61.2	69.6		60.1	67.3																
					61.5	69.8		61.0	67.2																
8-Jun-2017	6:30	53	69	63.3	63.7	67.2	62.9	63.4	69.2	55	Yes	85	Yes	Yes											
					60.8	67.4		60.2	70.9																
					60.1	68.8		59.4	63.7																
					60.5	68.3		59.4	65.9																
					58.5	64.8		58.3	65.6																
					61.2	69.6		60.1	67.3																
					61.5	69.8		61.0	67.2																
					14-Jun-2017	23:04		52	70						60.5	61.5	69.8	59.8	61.0	67.2	55	Yes	85	Yes	Yes

All readings are taken as façade measurement

Appendix D Train Operation Noise Monitoring Results

Location : Ma On Shan Centre Block 2 (Daytime)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Recorded Noise Level, dB(A)		Ambient Noise Level, dB(A)		LAeq Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
			LAeq 30 mins (overall)	LAeq 5mins (overall)	LAeq 30mins (ambient)	LAeq 5mins (ambient)			
18-May-2017	7:00	55	63.1	62.4	62.4	62.1	65	Yes	Yes
				62.4		61.8			
				62.9		62.7			
				63.8		62.8			
				63.0		62.5			
				63.9		62.5			

All readings are taken as façade measurement

Appendix D Train Operation Noise Monitoring Results

Location : Ma On Shan Centre Block 2 (Night-time)

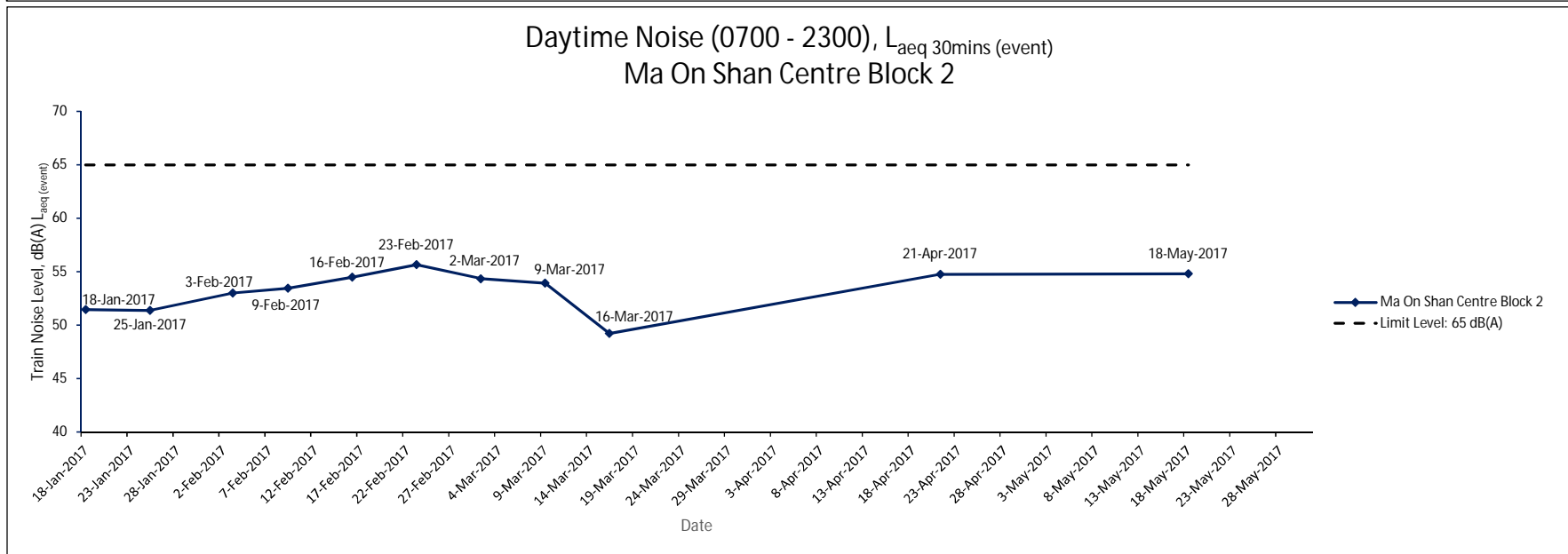
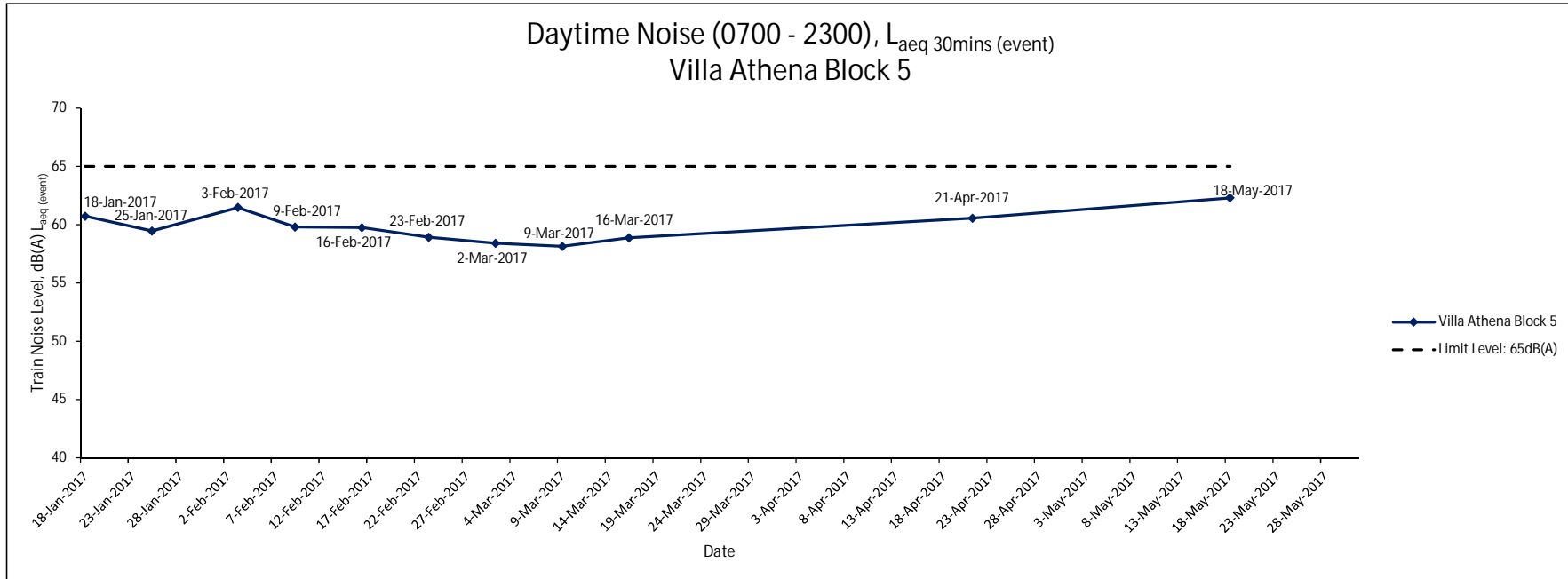
Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Train Noise Level, dB(A) Lmax (event)	Recorded Noise Level, dB(A)			Ambient Noise Level, dB(A)			LAEq Limit Level, dB(A)	Compliance (Yes/No)	Lmax Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
				LAEq 30 mins (overall)	LAEq 5mins (overall)	Lmax 5mins (event)	LAEq 30mins (ambient)	LAEq 5mins (ambient)	Lmax 5mins (ambient)					
18-May-2017	6:30	51	69	61.2	60.8	66.0	60.8	60.4	65.7	55	Yes	85	Yes	Yes
					60.9	68.8		60.2	65.8					
					61.2	66.4		61.0	66.5					
					60.9	67.2		60.5	65.9					
					60.9	66.8		60.7	64.9					
					62.2	67.2		61.7	69.4					
					61.2	67.9		60.4	65.6					
					60.5	69.8		59.8	67.2					
					61.4	77.5		59.5	63.7					
					60.0	66.8		59.9	65.9					
26-May-2017	23:04	53	78	60.9	61.1	68.1	60.0	61.1	66.0	55	Yes	85	Yes	Yes
					61.0	69.0		59.3	65.2					
					59.5	66.9		58.7	64.2					
					60.6	68.2		60.2	66.8					
					59.3	67.0		58.9	65.3					
					60.1	66.8		59.8	65.7					
					60.8	67.3		60.1	66.6					
					59.5	68.9		58.5	63.6					
					61.0	68.7		60.5	66.1					
					61.4	67.9		60.8	69.5					
31-May-2017	23:04	51	69	60.0	60.9	67.4	59.4	60.4	64.2	55	Yes	85	Yes	Yes
					62.2	69.2		62.0	66.1					
					61.3	66.5		61.1	65.7					
					62.6	67.7		62.5	67.0					
					60.1	68.9		59.4	67.4					
					60.0	67.3		59.4	63.2					
					60.3	65.4		60.0	65.1					
					58.5	0 ^[1]		58.5	67.0					
					61.3	65.6		60.9	67.8					
					60.6	66.2		60.3	66.3					
14-Jun-2017	23:04	50	69	60.2	60.1	68.9	59.8	59.4	67.4	55	Yes	85	Yes	Yes
					60.0	67.3		59.4	63.2					
					60.3	65.4		60.0	65.1					
					58.5	0 ^[1]		58.5	67.0					
					61.3	65.6		60.9	67.8					
					60.6	66.2		60.3	66.3					

All readings are taken as façade measurement

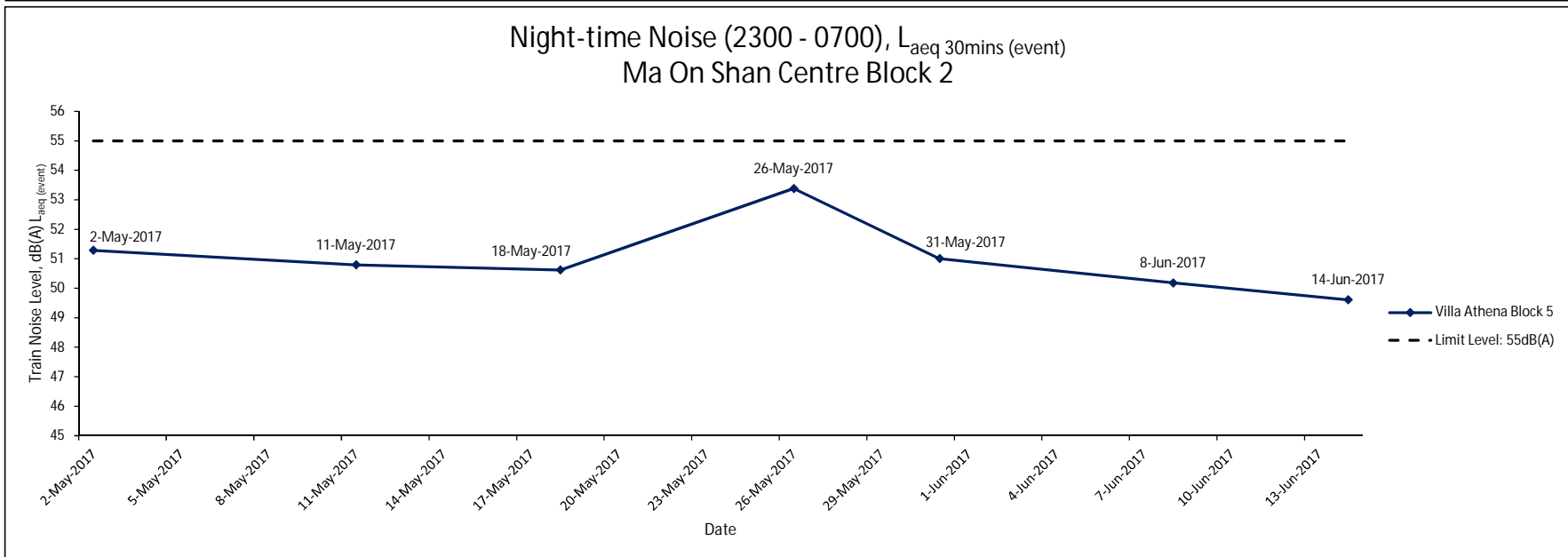
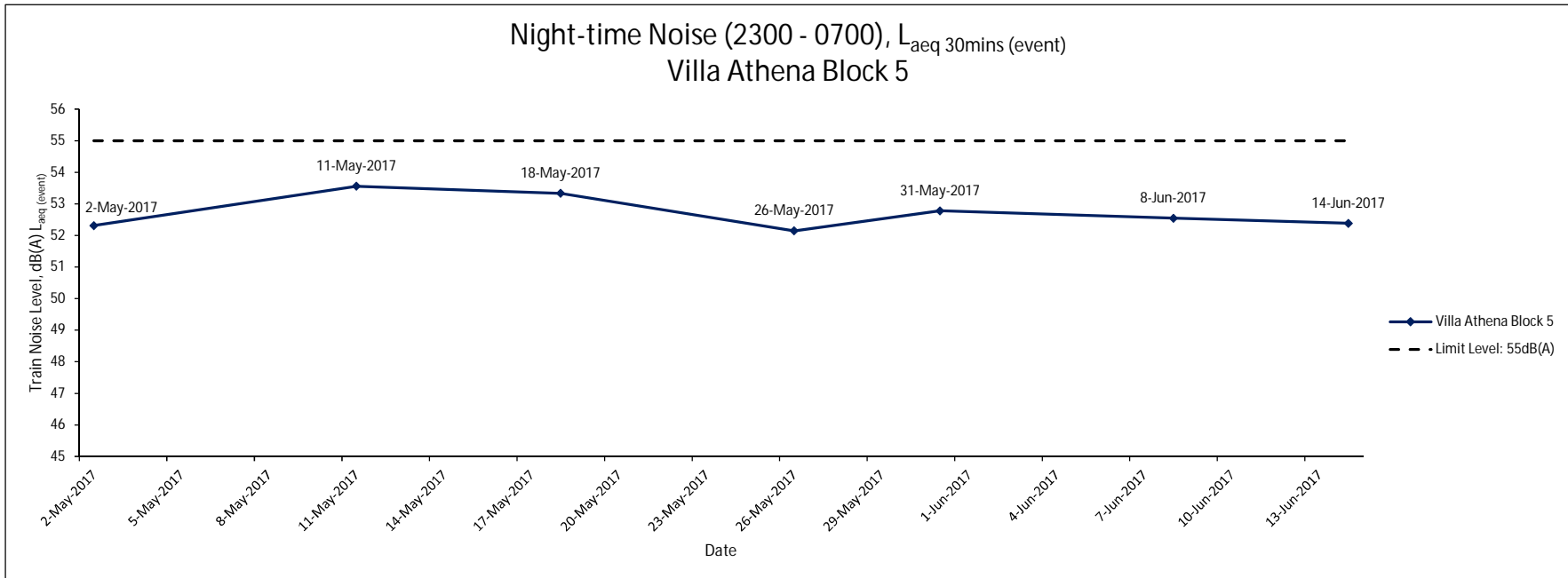
Note:

[1] No train passby during the 4th 5-minutes time slot.

Appendix D Train Operation Noise Monitoring Results



Appendix D Train Operation Noise Monitoring Results



Appendix D Train Operation Noise Monitoring Results

