

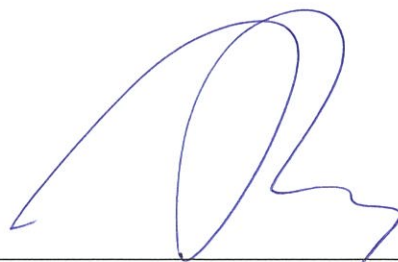
MTR Corporation Limited

HONG KONG SECTION OF GUANGZHOU –
SHENZHEN – HONG KONG EXPRESS RAIL LINK
(No. EP-349/2009/M)

**Commissioning Test Report
for the Fixed Plant Noise at Kwai Chung
Ventilation Building (KCV)**

Verified by

:



(Eric Ching)

Position

:

Independent Environmental Checker

Date

:

10 July 2018

MTR Corporation Limited

HONG KONG SECTION OF GUANGZHOU –
SHENZHEN – HONG KONG EXPRESS RAIL LINK
(No. EP-349/2009/M)

**Commissioning Test Report
for the Fixed Plant Noise at Kwai Chung
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Certified by : 
(Raymond Wong)

Position : Environmental Team Leader

Date : 10 July 2018

Hong Kong Section of Guangzhou-Shenzhen- Hong Kong Express Rail Link (XRL)

Commissioning Test Report for
the Fixed Plant Noise at Kwai
Chung Ventilation Building (KCV)

MTR Corporation

May 2018

Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL)

Commissioning Test Report for the Fixed Plant Noise at Kwai Chung Ventilation Building (KCV)

1 Introduction

The Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) Project (hereinafter known as “XRL”) covers a 26km long underground rail line on dedicated tracks that run between the terminus in West Kowloon and the boundary at Huanggang, where connects with the XRL Mainland section. XRL Project also includes the construction of ventilation buildings, emergency access points, stabling sidings and maintenance facilities and an emergency rescue siding (ERS) (formerly known as rescue emergency station).

The Environmental Impact Assessment (EIA) Report (Register No.: AEIA-143/2009) was approved on 28 September 2009 by the Director of Environmental Protection (DEP) under the Environmental Impact Assessment Ordinance (EIAO). Following the approval of the EIA Report, an environmental permit (EP) was granted on 16 October 2009 (EP No: EP-349/2009) for the construction and operation of the Project. Variations of environmental permit (VEP) were subsequently applied and the latest Environmental Permit (EP No: EP-349/2009/M) (hereinafter known as “the EP”) was issued by Director of Environmental Protection (DEP) on 25 June 2018.

This report is prepared with reference to EP Condition 2.36, *“The Permit Holder shall, no later than two weeks before the commencement of the operation of the Project, deposit with the Director a Commissioning Test Report to confirm the compliance of the operational airborne and ground-borne noise levels in accordance with the EIA Report and the application for variation of an environmental permit No. VEP-377/2012 and its attached documents”*.

MTR Corporation has prepared the Commissioning Test Report for Fixed Plant Noise for the noise measurement to show the compliance of noise criteria in accordance with the EIA Report and the EP; also the noise measurement for investigation of any tonal, impulsive and intermittent characteristics from the fixed plant noise sources. This report presents the noise measurement methodology, calculated Sound Power Levels from noise measurements, results of noise measurement for the fixed plant noise sources installed at Kwai Chung Ventilation Building (KCV) and confirming any characteristics of tonality, impulsiveness and intermittency. For the fixed plant noise verification at the other ventilation buildings and West Kowloon Terminal (WKT) areas, separate reports would be submitted.

2 Noise Criteria

2.1 Fixed Plant Noise Criteria in EIA

With reference to the IND-TM under the Noise Control Ordinance (NCO), the relevant acceptable noise levels (ANL) were determined based on the area sensitivity rating (ASR). The fixed plant noise criteria for the representative noise sensitive receivers (NSRs) were determined in EIA as follow (whichever is lower):

- 5dB(A) below the appropriate ANL set out in the IND-TM (the ANL-5dB(A) criterion);
or

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- The prevailing background noise levels where the prevailing background noise level is 5dB(A) below the appropriate ANL (i.e. ANL-5dB(A))

The noise criteria above were determined for planning purpose. While for operation, the fixed plant noise is controlled by a Noise Abatement Notices system governed by the NCO.

The fixed plant noise criteria for the NSR along the XRL alignment in KCV area, with the latest status of representative NSR, are presented in **Table 2.1** below. Appropriate corrections in tonal, impulsive or intermittent characteristics should be applied, where applicable, in accordance with IND-TM during the commissioning test.

Table 2.1 Summary of Fixed Plant Noise Criteria

NSR	Description	Area Sensitivity Rating (ASR) ^(a)	Noise Criteria, dB(A) ^(a)	
			Day and Evening Time	Night-time
Kwai Chung Ventilation Building (KCV) (Figure 2.1)				
KC1	Kwai Oi House, Kwai Fong Estate	B	60	50

Note:

- (a) ASR and noise criteria either follow that defined in the EIA Report or relevant application for variation of environmental permit (VEP-377/2012) where appropriate.

Fixed plant noise sources include: ventilation fans for building services, and plenum for tunnel ventilation, which are generally located inside plant rooms. Noise generated from indoor fixed plants would be emitted through louvres. The worst case scenario is when all eligible fixed plants at the same location operating concurrently under “normal scenario” for XRL operation during daytime and evening time periods; and night-time period, respectively. The worst case scenario was considered for compliance check against the fixed plant noise criteria and the noise measurement to confirm any characteristics of tonality, impulsiveness and intermittency at the identified NSRs.

Table 2.2 below summarised the information of the fixed plant noise sources and the layout plan is shown in **Figure 2.2**

Table 2.2 Summary of Fixed Plant Noise Sources

Source Location	Direction Facing	Louvre ID
<i>Kwai Chung Ventilation Building (KCV) (Figure 2.2)</i>		
Tunnel ventilation shaft	North	N1
FS control room/Corridor/Irrigation pump room	North	N2
UPS room	North	N3
LV switch room	North	N4
Air compression receiver room	North	N5
Smoke extraction fan	North	N6
Fresh air louvre	East	E1

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Source Location	Direction Facing	Louvre ID
<i>Kwai Chung Ventilation Building (KCV) (Figure 2.2)</i>		
Exhaust air louvre	East	E2
Staircase pressurization fan room	East	E3
Tunnel ventilation shaft	South	S1
P&D pump and tank room	South	S2
MCC room	South	S3
TECS control room	South	S4
Tunnel ventilation shaft	West	W1
Tunnel ventilation shaft	West	W2
Staircase pressurization fan room	West	W3
Smoke extraction make-up room	West	W4

3 Methodology

3.1 Noise Measurement for the Fixed Plants

Noise measurements to obtain the noise levels of the fixed plants were undertaken by Supreme Acoustics Research Limited, GAS Joint Venture and ATAL Building Services Engineering Ltd. The commissioning tests were carried out by qualified persons possessing at least 7 years of noise control experience and a corporate member of Hong Kong Institute of Acoustics or equivalent in accordance with S3.22 of the XRL EM&A Manual.

3.1.1 Methodology

Three measurement methods, namely Method 1 (at or near NSR), Method 2 (Far Field) and Method 3 (Near Field), have been developed based on NCO-TM, basic acoustic principles and *ISO 3746-2010: Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*, respectively. Given the fixed plant noise sources are steady, all proposed methods could be adopted for all types of fixed plant source depending on the site environment/constraints that might affect the possibility to obtain valid results, considerations including but not limited to:

- Background noise with less influence to the measured noise levels
- Free of obstacles between measurement location and noise source
- Accessibility and Safety Concerns

Considering the reliability of data collection, i.e., results not influenced by the above-mentioned considerations, and the measurement efficiency on site, the selection of methodology was prioritized based on efficient measurement as Method 1 (at or near NSR) > Method 2 (Far Field) > Method 3 (Near Field). For Kwai Chung Ventilation Building (KCV), considering there are other building structures between the NSR and noise sources, also the heavily trafficked Kwai Chung Road was immediately in front of the NSR; obtaining valid results using Method 1 was considered unlikely. As such, only Method 2 and Method 3 were

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considered applicable. Method used for each louvre is presented in Appendix A3. Details of the measurement methodology are shown in **Appendix A1**.

Method 1 – Measuring Sound Pressure Level at NSR or Near NSR

- Measurement at NSR or near NSR at distance D away from the louvre, where D was at least two times the largest dimension b of the louvre and rounded up to integer, i.e.: $D \geq 2b$
- The microphone was pointing toward the louvre and three measurements were taken when the noise source from the louvre was switched ON
- Background noise level was taken when the noise source from louvre was switched OFF
- The sound pressure level (SPL) at NSR or near NSR was determined by the following equation:

$$\text{Background corrected } L_p = L_p + BG - [20\log D + 8] \text{ (if applicable) + façade correction (if applicable)}$$

Where

L_p is the average $L_{eq,1min}$ of all measurements, in dB(A);

BG is the background correction factor, in dB(A);

D is separation between the center of louvre or surface of the plant and the microphone, in metres.

Method 2 – Measuring Sound Power Level by Far Field Method for Louvres or for Plants

- The microphone was positioned at the perpendicular distance D away from the center of the louvre or the surface of the plant, where D was at least two times the largest dimension b of the louvre or plant and rounded up to integer, i.e.: $D \geq 2b$
- The microphone was pointing toward the center of the louvre/combined louvre area or the center the plant; and three measurements were taken when the noise source from the louvre was switched ON
- Background noise level was taken when the noise source from the louvre or plant was switched OFF
- The sound power level (SWL) of the louvre or the plant was determined, based on basic acoustic principles, by the following equation:

$$L_w = L_p + 20\log D_{center} + 8 + BG$$

Where

L_p is the average $L_{eq,1min}$ of all measurements, in dB(A);

D_{center} is separation between the center of louvre or plant and the microphone, in metres;

BG is the background correction factor, in dB(A).

Method 3 – Measuring Sound Power Level by Near Field Method for Louvres or for Plants

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- A right parallelepiped hypothetical measurement box for each louvre or each surface of a plant was determined according to ISO 3746, with each side being spaced a distance D from the corresponding side of the louvre or plant
- Each of the 5 planes of the measurement box was subdivided into equal-sized rectangular grids, the length of each side of the grids should be less than or equal to 3 times of distance D , i.e. grid length $\leq 3D$
- The microphone was pointing toward the center of each grid, and a measurement was taken for each grid during the noise source from the louvre was switched ON
- Background noise level was taken when the noise source from louvre or plant was switched OFF
- The SWL of the louvre or the plant was determined by the following equation:

$$L_w = L_p + 10\log(S) - K_{1A} - K_{2A}$$

Where

L_p is the averaged measured L_{eq} of all measurement points, in dB(A);

S is the total surface area over the measurement box (total 5 planes), in m^2 ;

K_{1A} is the background correction factor as described in *ISO 3746:2010*, in dB(A);

K_{2A} is the environmental correction for sound absorption and reflection as described in *ISO 3746:2010*, in dB(A).

Except for Method 3, which was adopted with reference to ISO 3746; the noise sources measured using Method 1 or Method 2 were considered steady if the difference between the maximum and minimum L_{eq} is less than or equal to 1dB(A), ie, $\leq 1\text{dB(A)}$; average L_{eq} was therefore considered. Otherwise, the maximum L_{eq} would be adopted for SWL determination as a conservative approach.

3.1.2 Measurement Equipment

The sound level meters and calibrators used for noise measurements are listed in **Table 3.1**. The instruments complied with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) or equivalent international standards. Calibration certificates are shown in **Appendix A2a**.

Table 3.1 Noise Measurement Equipment

Equipment	Model	Serial Number
Sound Level Meter	NTi XL2	5011
	NTi XL2	5617
	NTi XL2	6240
	Casella CEL-63X	5044655
Calibrator	BSWA TECH CA111	320248
	Casella CEL-120/1	5060836

Before and after each series of measurements, a calibration check was carried out on the sound level meter by the calibrator. The difference between the readings made before and after each series of measurements shall be less than or equal to 1.0 dB.

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3.1.3 Measurement Schedule

The noise measurements were carried out during daytime, evening time and night-time periods, where the fixed plant items were operated steadily and continuously at their noisiest operating mode under normal scenario. The noise measurement schedule is shown in **Table 3.2**.

Table 3.2 Measurement Schedule

Location	Date	Time
KCV	25 - 26 April 2017	22:00 – 04:00
	22 September 2017	18:00 – 21:30
	6 October 2017	15:30 – 16:00

3.2 Noise Measurement to Confirm Any Characteristics of Tonality, Impulsiveness and Intermittency at NSRs

3.2.1 Measurement Equipment

The sound level meters and calibrators used for noise measurements are listed in **Table 3.3**. The instruments complied with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) or equivalent international standards. Calibration certificates are shown in **Appendix A2b**.

Table 3.3 Noise Measurement Equipment

Equipment	Model	Serial Number
Sound Level Meter	Larson Davis 831	0002594
Calibrator	B&K 4231	2084888

3.2.2 Measurement Parameters

With reference to the IND-TM, the noise measurement was conducted at the representative NSR for $L_{Aeq(30min)}$ in one-third octave band under the worst case scenario, ie, “normal scenario” during daytime and evening time periods; and night-time period, respectively.

The fixed plant noise sources will be operated steadily and continuously, and therefore no intermittency and impulsiveness are expected at the NSR. However, the characteristics of intermittency and impulsiveness will be recorded, if any, based on observation during measurement.

2 sets of background noise level, $L_{Aeq(5min)}$, and in one-third octave band, were measured at each measurement location when all fixed plant noise sources were not in operation.

3.2.3 Measurement Location

The noise measurement was carried out at the first layer of NSRs for the concerned area. For KCV, the representative NSR is Kwai Oi House, Kwai Fong Estate (KC1). The measurement location is shown in **Figure 2.1**.

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3.2.4 Measurement Schedule

The noise measurements were carried out at the monitoring location for KCV, where the fixed plant items were operated steadily and continuously at their noisiest operating mode under normal scenario. The noise measurement schedule is shown in **Table 3.4**.

Table 3.4 Measurement Schedule

Location	Date
KCV	13 - 14 February 2018

4 Measurement Results

4.1 The Noise Levels of Fixed Plant Noise Sources

The noise levels measured under the worst case scenario are determined and presented in **Table 4.1**. Details of the measurement results are shown in **Appendix A3**.

Table 4.1 Summary of Sound Power Levels for Fixed Plants

Works Area	Direction Facing/ Elevation	Calculated SWL L_{Aeq} , dB(A)
KCV	North N1	95
	North N2	78
	North N3	72
	North N4	89
	North N5	81
	North N6 ^(a)	99
	East E1	71
	East E2	67
	East E3 ^(a)	89
	South S1	94
	South S2	77
	South S3	87
	South S4 ^(a)	100
	West W1	91
	West W2	89
	West W3 ^(a)	85
	West W4 ^(a)	110

Note:

- (a) The plant would be operated during day and evening time only under normal scenario.

A compliance check against the fixed plant noise criteria at NSR was conducted. The cumulative noise levels from noise sources were assessed to ensure the compliance with the noise criterion. **Table 4.2** shows the results, details of the calculation are also given in **Appendix A3**.

Table 4.2 Cumulative Fixed Plant Noise at NSR

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NSR	Source Location	Cumulative SPL, dB(A)		Noise Criteria, dB(A)		Compliance (Y/N)	
		Day and Evening Time	Night-time	Day and Evening Time	Night-time	Day and Evening Time	Night-time
KC1	Ventilation Shaft for N/B ^(a) and Building Service	46	33	60	50	Y	Y
KC1	Ventilation Shaft for S/B ^(a) and Building Service	46	33	60	50	Y	Y

Note:

- (a) Tunnel ventilation would only be operated for either northbound (N/B) or southbound (S/B) direction under normal scenario.

4.2 The Characteristics of Tonality, Impulsiveness and Intermittency at NSRs

Noise measurement to confirm any characteristics of tonality, impulsiveness and intermittency at the identified NSRs were conducted under the normal scenarios during daytime and evening, and during night-time, respectively and summarised in **Table 4.3** below. In each scenario, two sets of noise measurements, $L_{Aeq(30min)}$, in one-third octave band, were carried out to confirm that the difference in the measured noise levels with and without operation of fixed plant noise sources were less than 3.0 dB(A). That means the fixed plant noise sources from the ventilation building are not considered as significant noise sources at the NSR. Noise measurements at NSR KC1 (Kwai Oi House, Kwai Fong Estate) were dominated by road traffic noise; characteristics of tonality, impulsiveness and intermittency due to the fixed plant noise sources from KCV was not noticeable during the measurement. Detailed results of noise measurements are shown in **Appendix A4**.

Table 4.3 Noise measurement Results at NSR

NSR	Scenario	Measured Noise Level $L_{Aeq(30min)}$, dB(A), (measurement time)	Averaged Background Level $L_{Aeq(5min)}$, dB(A), (measurement time)	Difference between Measured Noise Level and Background Level, dB(A), (< 3 or >= 3)
KC1	Day and Evening Time	63.8 (22:01 – 22:31) 63.7 (22:31 – 23:01)	63.5 (21:12 – 22:28)	< 3
	Night-time	63.1 (23:39 – 00:09) 62.5 (00:10 – 00:40)	61.2 (00:46 – 01:02)	< 3

As the differences between measured noise levels and background levels are all less than 3.0 dB(A), it was unable to obtain reliable corrected noise levels at the NSRs and corrections for tonality, impulsiveness or intermittency were therefore not applicable.

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5 Conclusions

To fulfil the XRL EP condition 2.36, the fixed plant noise verification were undertaken and the measurement results indicated all the fixed plant noise levels in KCV are in compliance with the fixed plant noise criteria.

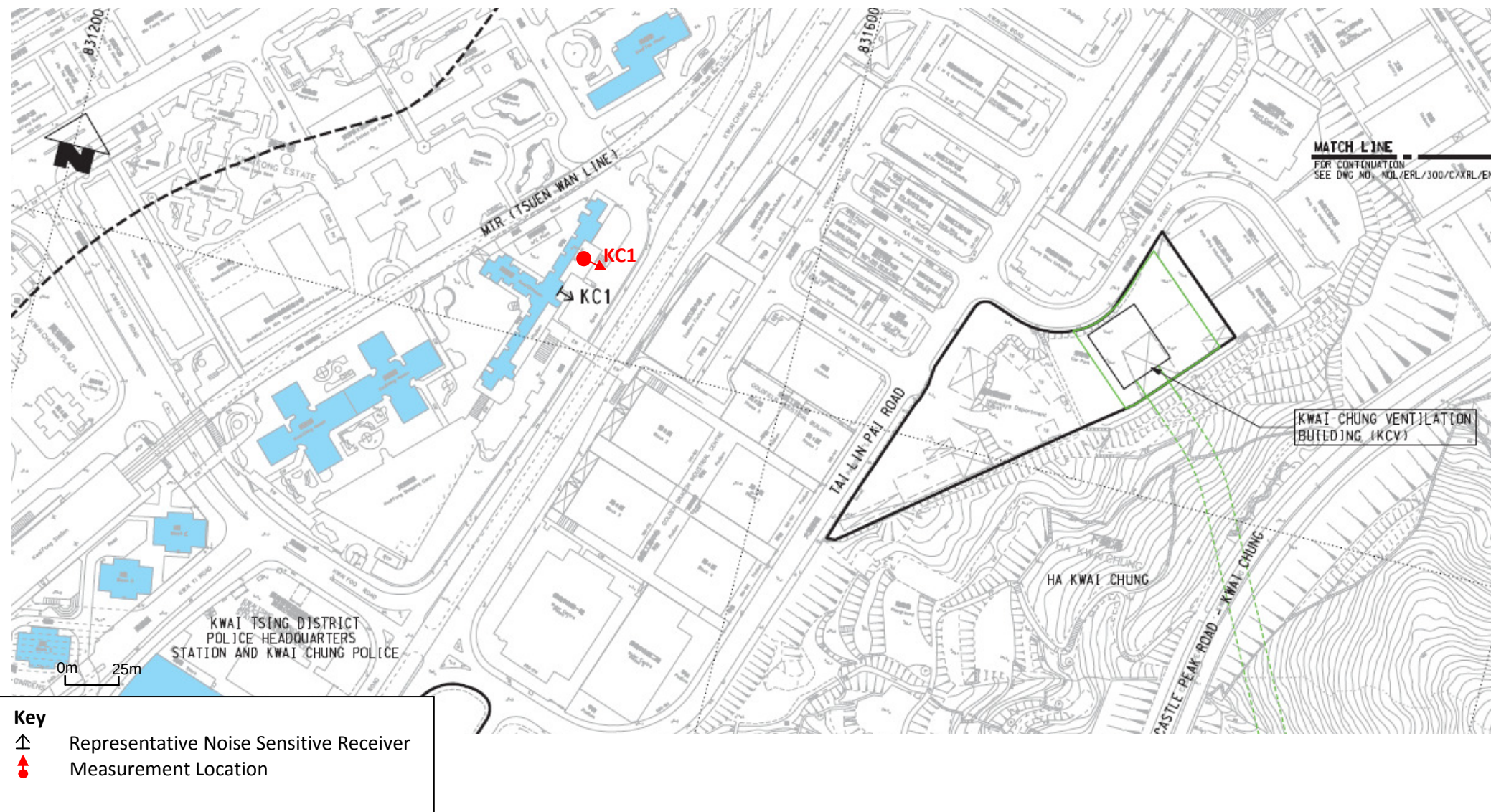


Figure 2.1 – Representative Noise Sensitive Receiver (NSR) and Noise Measurement Location for KCV

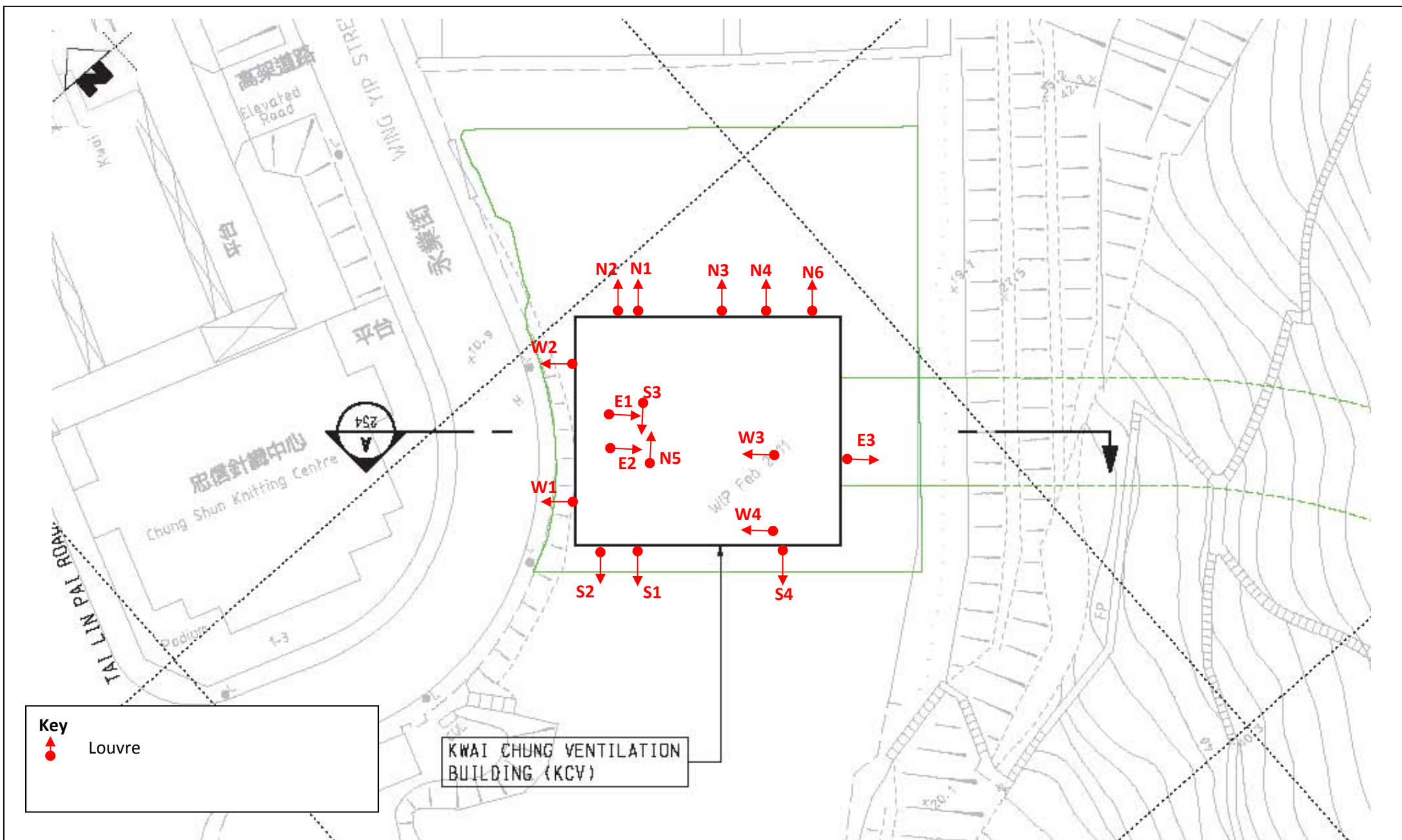


Figure 2.2 – Site layout and Fixed Plant Sources at KCV

Appendix A1 –Measurement Methodology



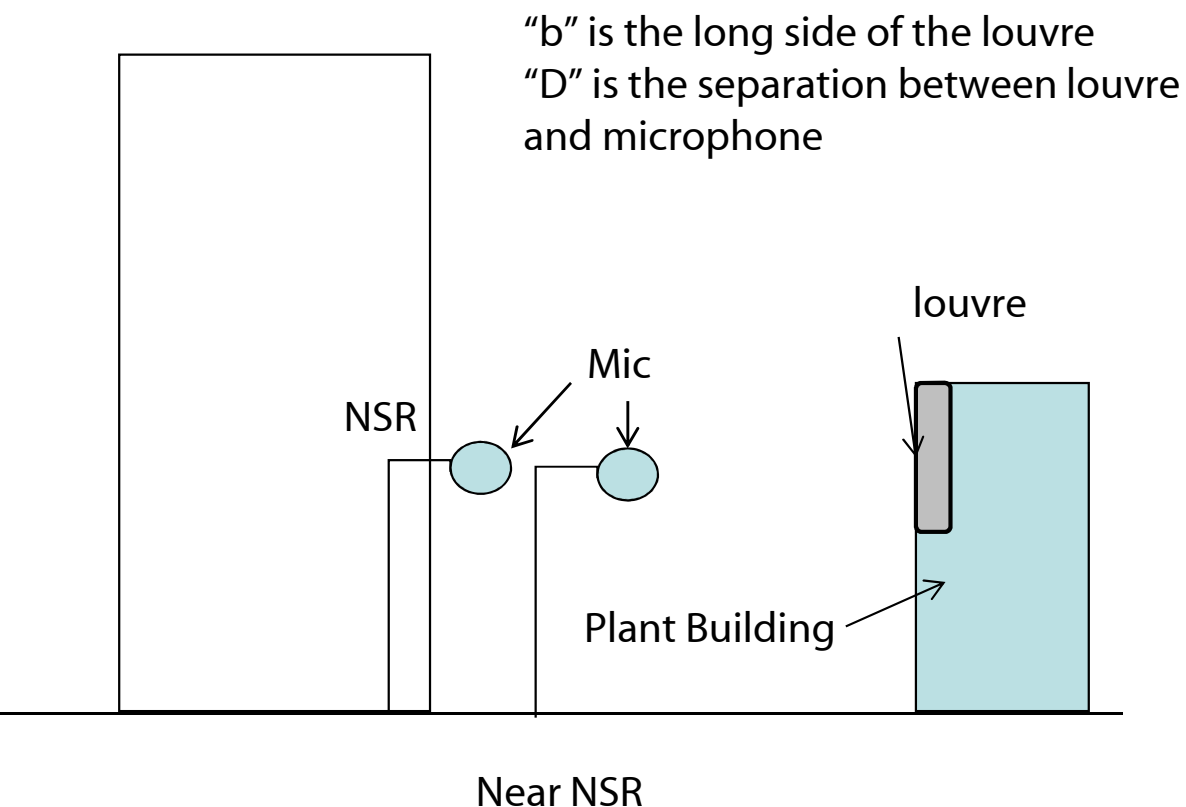
XRL Fixed Plant Noise Test Plan

BY : MTR XRL Env Team

Summary of Testing Methodology

Method	Standard	No of repeated measurement	No of measurement point	Measurement distance, D	To Verify
Method 1 (NSR Method)	NCO - TM	3 sets of Leq 1min	Depend on number of NSRs nearby	At the most affected NSR or near NSR	ANL-5 or Background Prevailing
Method 2 (Far Field Method)	Basic Acoustic Principle	3 sets of Leq 1min	1 (for louvre/plant with uniform plane source)	$D \geq 2b$ and roundup to integer	ANL-5 or Background Prevailing
Method 3 (Near Field Method)	Developed based on ISO3746:2010	1 set of Leq 10s ^(a) /1min	Depend on the size of the louvre/plant and the measurement distance should follow guideline in ISO3746	At least 1m from the louvre opening/plant (unless otherwise specified)	ANL-5 or Background Prevailing
Note : (a) If fixed plant items are operated at their noisiest operating modes and are steady during measurement, 10-second will be adopted for the duration of measurement.					

Method 1 – Sound Pressure Level at NSR or Near NSR for louvre or Plant

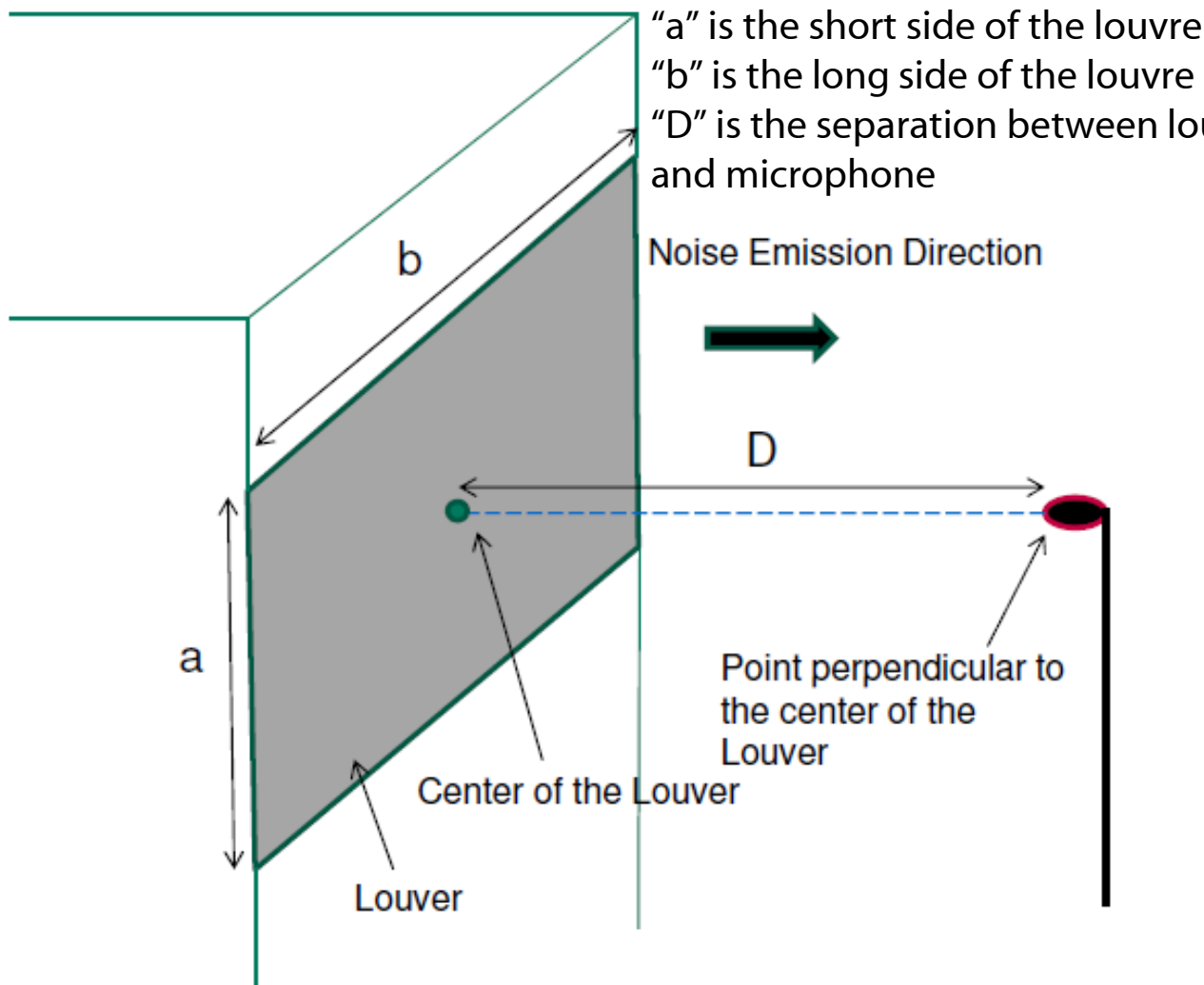


- Based on NCO - TM
- The locations of measurement points are depended on the site situation
- 3.0 dB façade correction should be considered if the location of measurement point is not at assessment point as defined in NCO-TM
- "D" must be greater than 2b and roundup to integer
- Detail calculation of the SPL should refer to the NCO-TM.
- Background noise level (BGL) should be taken for determination of background correction (BG)
- If the difference between the BGL and measured noise level (MNL) is less than 3.0 dB, BG should be capped to 3.0 dB

$$\text{Background corrected SPL} = \text{Mean } L_{Aeq1min} + BG - [20\log(D) + 8] \text{ (if applicable) + façade correction (if applicable)}$$

if the difference between the maximum and minimum $L_{eq} > 1\text{dB(A)}$; maximum L_{eq} would be adopted as a conservative approach

Method 2 – Far Field Sound Power Testing Method for louvre



"a" is the short side of the louvre
"b" is the long side of the louvre
"D" is the separation between louvre
and microphone

Noise Emission Direction

- Based on basic acoustic principle
- "D" must be greater than 2b and roundup to integer, i.e.: $D \geq 2b$
- The microphone must point to the center of the louvre.
- At least 3 sets of L_{Aeq} , 1 min should be obtained
- Background noise level (BGL) should be taken for determination of background correction (BG)
- If the difference between the BGL and measured noise level (MNL) is less than 3.0 dB, BG should be capped to 3.0 dB

$$SWL \text{ (Sound Power Level)} = \text{Mean measured } L_{Aeq1min} + 20 \log (D, \text{center}) + 8 + BG$$

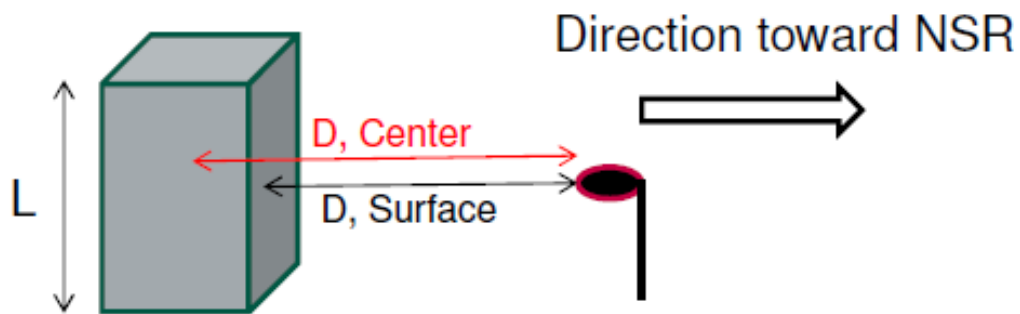
if the difference between the maximum and minimum $L_{eq} > 1 \text{ dB(A)}$; maximum L_{eq} would be adopted as a conservative approach

Method 2 – Far Field Sound Power Testing Method for Plant

“L” is the longest side of the plant item

“D, Center” is the separation between center of the plant item and microphone

“D, Surface” is the separation between surface of the plant item and microphone

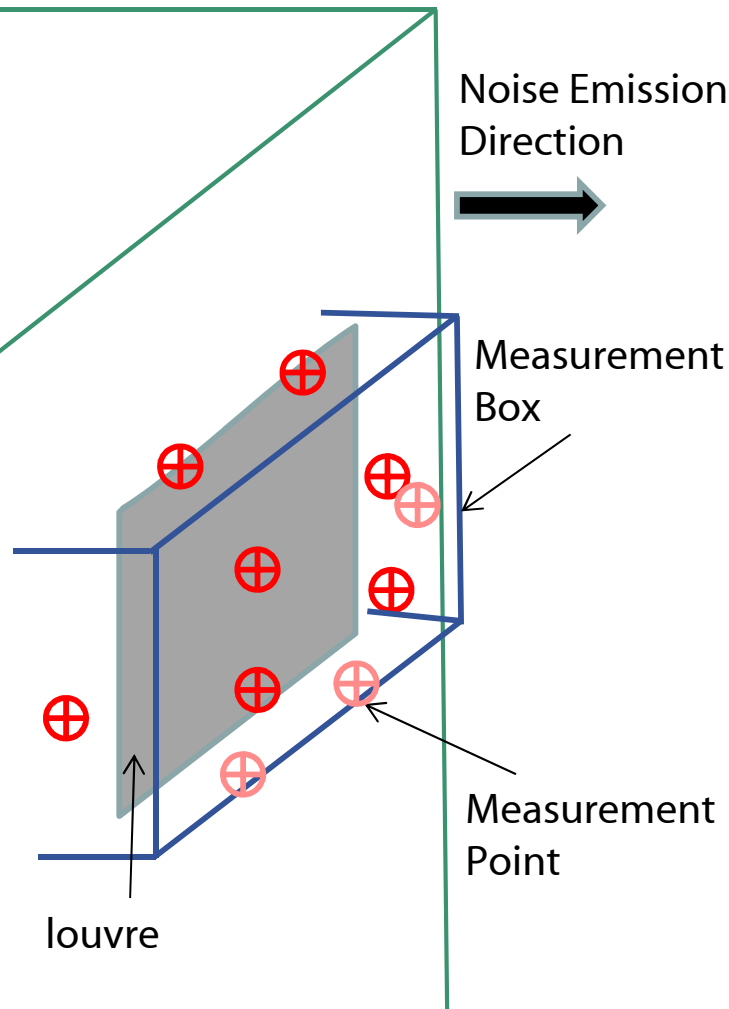


- “D, Surface” must be greater than twice of L (2L) and roundup to integer
- The microphone must be pointing to the center of the plant
- At least 3 sets of LAeq, 1min should be obtained at each measurement point.
- Background noise level (BGL) should be taken for determination of background correction (BG)
- If the difference between the BGL and measured noise level (MNL) is less than 3.0 dB, BG should be capped to 3.0 dB

$$\text{SWL (Sound Power Level)} = \text{Mean measured } L_{\text{Aeq}1\text{min}} + 20 \log (D, \text{center}) + 8 + \text{BG}$$

if the difference between the maximum and minimum Leq > 1dB(A); maximum Leq would be adopted as a conservative approach

Method 3 – Near Field Sound Power Testing Method for louvre



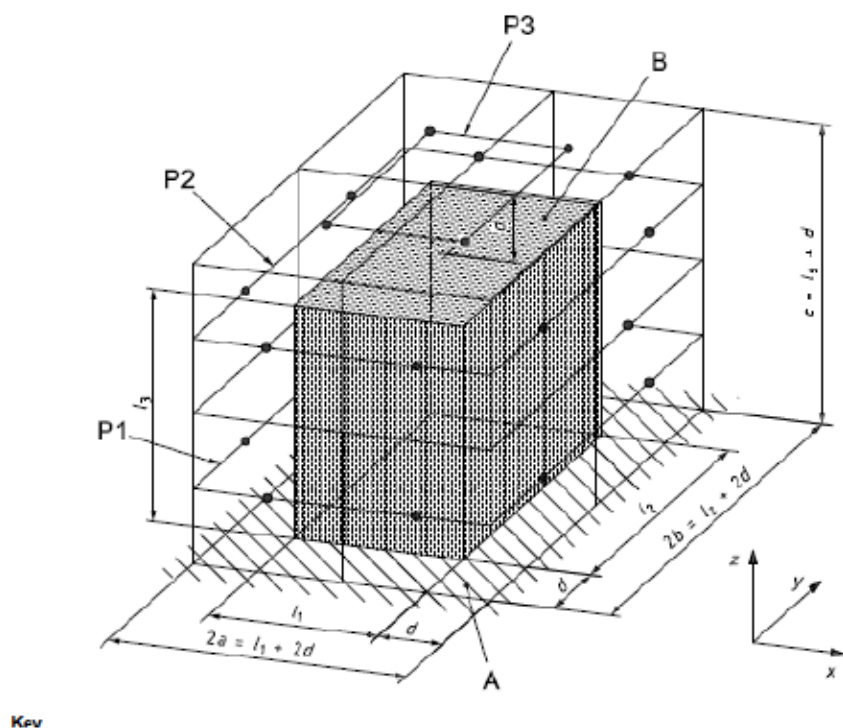
- Based on the principle of ISO3746 – 2010
- First step is to determine a hypothetical measurement surface /box with not less than 1m separation from the louvre.
- Second, determine the location of measurement point in accordance with the latest edition of ISO3746.
- Background noise level (BGL) should be taken at each measurement point for determination of background correction (K1A)
- At least 1 set of Leq, 10s/1min should be obtained at each measurement point
- Extra localized microphone positions on the measurement surface in the region of high noise radiation would be considered following relevant procedures in ISO 3744
- If the difference between the BGL and measured noise level (MNL) is less than 3.0 dB, K1A should be capped to 3.0 dB
- The measurement distance would be reduced if necessary to obtain higher MNL for valid measurement results
- Details calculation of the SWL should refer to the latest edition of ISO3746.

SWL = Mean L_{Aeq} over all measurement points + 10 log (total surface area over the measurement box) - K1A - K2A (sound absorption and reflection correction)

K1A refers to background noise correction factor

K2A refers to environmental correction for sound absorption and reflection

Method 3 – Near Field Sound Power Testing Method for Plant



- Based on ISO 3746
- The locations of measurement points are depended on the size of the plant, which cannot be easily generalised (See figure on the left for example).
- Extra localized microphone positions on the measurement surface in the region of high noise radiation would be considered following relevant procedures in ISO 3744
- If the difference between the BGL and measured noise level (MNL) is less than 3.0 dB, K1A should be capped to 3.0 dB
- The measurement distance would be reduced if necessary to obtain higher MNL for valid measurement results
- Detail calculation of the SWL should refer to the latest edition of ISO 3746.

SWL = Mean L_{Aeq} over all measurement points + 10 log (total surface area over the measurement box) - K1A - K2A (sound absorption and reflection correction)

K1A refers to background noise correction factor

K2A refers to environmental correction for sound absorption and reflection

End

Appendix A2 – Calibration Certificates

**Appendix A2a – Calibration Certificates (Noise Measurement for the
Fixed Plants)**

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **M2230 Measurement Microphone**
consisting of
MA220 Serial Number: 6240
Capsule Serial Number: 9498

- Certificate Issued: **10 January 2017**

- Certificate Number: **42745-6240-M2230**

- Results: **PASSED**
(for detailed report see next page)

Tested by: M.Frick

Signature:

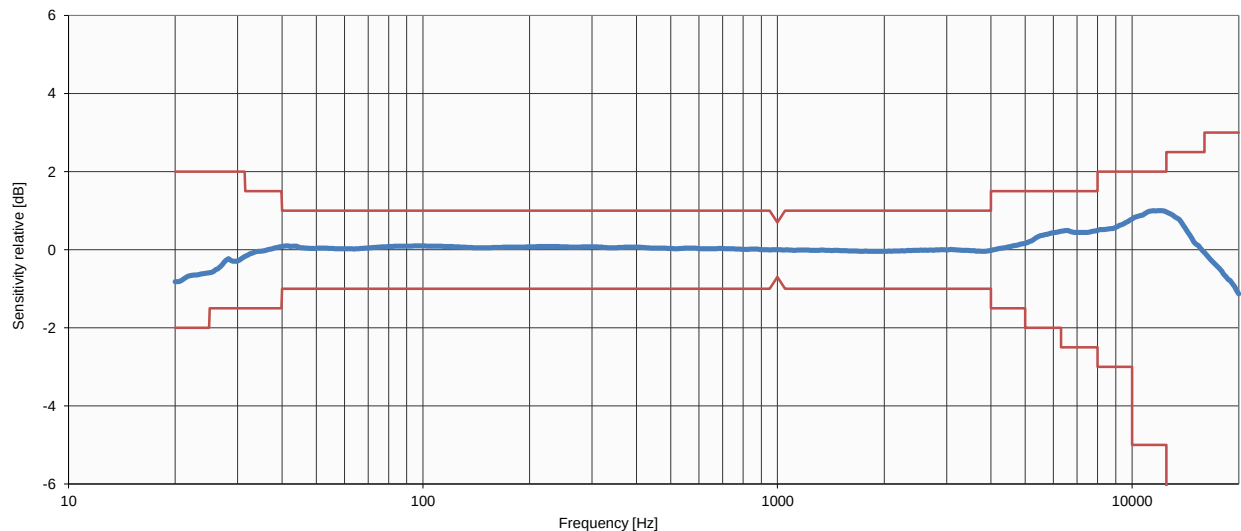
Stamp:

A handwritten signature in black ink is written over a rectangular stamp. The stamp contains the following text: 'NTi Audio AG', 'Im alten Riet 102', 'LI 9494 Schaan', and 'www.nti-audio.com'.

Date: 10 January 2017
Calibration of: M2230 Measurement Microphone
MA220 Serial Number: 6240
Capsule Serial Number: 9498

- Detailed Calibration Test Results:

Frequency response: **Class 1 acc. IEC 61672**



	actual	calibration uncertainty ¹
Sensitivity @ 1 kHz, 114 dB SPL	43.3 mV/Pa	±2.85%

- Test Conditions: Temperature: 27.2 °C ±0.5 °C
 Relative Humidity: 39.5 % ±2%
 Air Pressure: 95.94 kPa ±0.25 kPa

- Calibration Equipment Used:

- Norsonic Sound Calibrator, Type 1251, S/No. 30930
Last Calibration: 05.12.2016, Next Calibration: 05.12.2018
Calibrated by Metas, Switzerland
- NTi Audio FX100, S/No. 11094
Last Calibration: 16.08.2016, Next Calibration: 16.08.2017
Calibrated by NTi Audio meeting product specifications
- MTG MV203, S/No. 0630 / Mic Capsule, MK221 S/No. 16502
Last Calibration: 30.11.2015, Next Calibration: 30.11.2017
Calibrated by MTG, Germany

¹ The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **M2230 Measurement Microphone**
consisting of
MA220 Serial Number: 5011
Capsule Serial Number: 7698

- Certificate Issued: **24 March 2017**
- Certificate Number: **42818-5011-M2230**

- Results: **PASSED**
(for detailed report see next page)

Tested by: M.Frick

Signature:

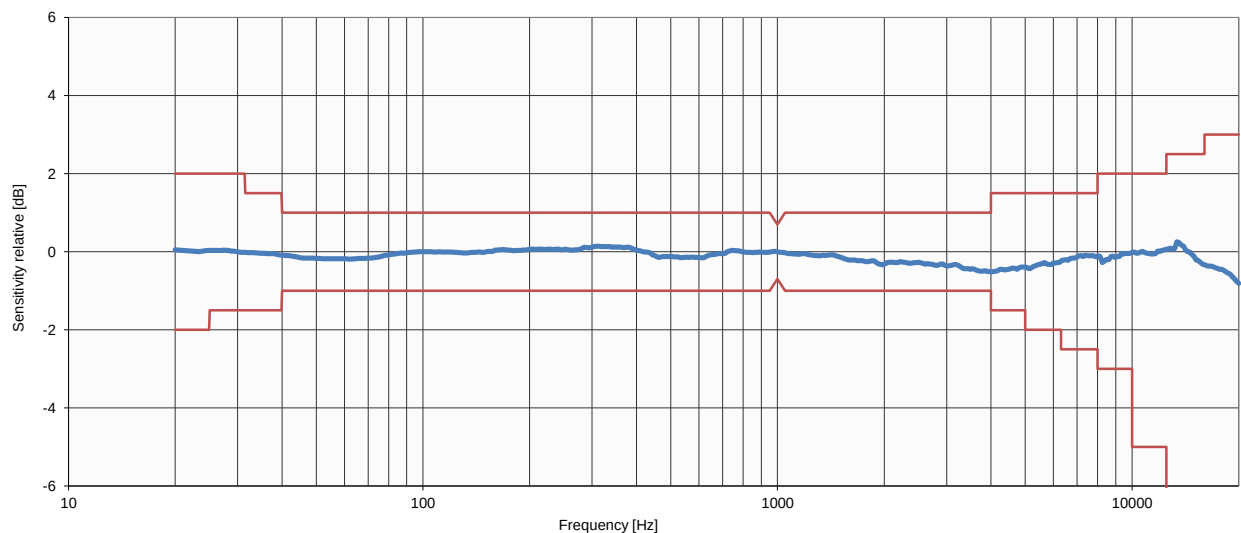
Stamp:

A handwritten signature in black ink is written over a rectangular stamp. The stamp contains the following text: 'NTi Audio AG', 'Im alten Riet 102', 'LI 9494 Schaan', and 'www.nti-audio.com'.

Date: 24 March 2017
Calibration of: M2230 Measurement Microphone
MA220 Serial Number: 5011
Capsule Serial Number: 7698

- Detailed Calibration Test Results:

Frequency response: **Class 1 acc. IEC 61672**



	actual	calibration uncertainty ¹
Sensitivity @ 1 kHz, 114 dB SPL	46.5 mV/Pa	±2.85%

- Test Conditions: Temperature: 21.1 °C ±0.5 °C
Relative Humidity: 47.2 % ±2%
Air Pressure: 97.4 kPa ±0.25 kPa

- Calibration Equipment Used:

- Norsonic Sound Calibrator, Type 1251, S/No. 30930
Last Calibration: 05.12.2016, Next Calibration: 05.12.2018
Calibrated by Metas, Switzerland
- NTi Audio FX100, S/No. 11094
Last Calibration: 16.08.2016, Next Calibration: 16.08.2017
Calibrated by NTi Audio meeting product specifications
- MTG MV203, S/No. 0630 / Mic Capsule, MK221 S/No. 16502
Last Calibration: 30.11.2015, Next Calibration: 30.11.2017
Calibrated by MTG, Germany

¹ The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.

Manufacturer Calibration Certificate

The following instrument has been tested and calibrated to the manufacturer specifications.
The calibration is traceable in accordance with ISO/IEC 17025 covering all instrument functions.

- Device Type: **M2230 Measurement Microphone**
consisting of
MA220 Serial Number: 5617
Capsule Serial Number: 8507

- Certificate Issued: **24 March 2017**
- Certificate Number: **42818-5617-M2230**

- Results: **PASSED**
(for detailed report see next page)

Tested by: M.Frick

Signature:

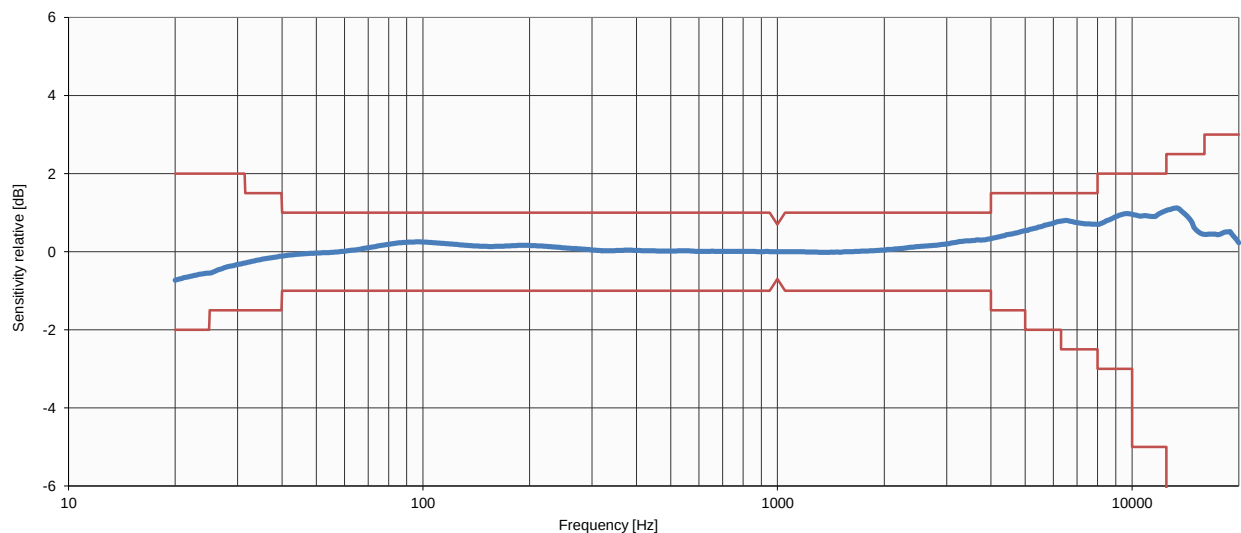
Stamp:

A handwritten signature in black ink is written over a rectangular stamp. The stamp contains the following text: 'NTi Audio AG', 'Im alten Riet 102', 'LI 9494 Schaan', and 'www.nti-audio.com'.

Date: 24 March 2017
Calibration of: M2230 Measurement Microphone
MA220 Serial Number: 5617
Capsule Serial Number: 8507

- Detailed Calibration Test Results:

Frequency response: **Class 1 acc. IEC 61672**



	actual	calibration uncertainty ¹
Sensitivity @ 1 kHz, 114 dB SPL	48.1 mV/Pa	±2.85%

- Test Conditions: Temperature: 24.6 °C ±0.5 °C
Relative Humidity: 43.6 % ±2%
Air Pressure: 97.65 kPa ±0.25 kPa

- Calibration Equipment Used:

- Norsonic Sound Calibrator, Type 1251, S/No. 30930
Last Calibration: 05.12.2016, Next Calibration: 05.12.2018
Calibrated by Metas, Switzerland
- NTi Audio FX100, S/No. 11094
Last Calibration: 16.08.2016, Next Calibration: 16.08.2017
Calibrated by NTi Audio meeting product specifications
- MTG MV203, S/No. 0630 / Mic Capsule, MK221 S/No. 16502
Last Calibration: 30.11.2015, Next Calibration: 30.11.2017
Calibrated by MTG, Germany

¹ The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the regulations of the GUM.



Calibration Chart

BSWA-IV-C021-03-0048A

Sound Calibrator model CA111
Serial Number 320248
Appearance OK
Power Supply 1.5V LR6 (AA battery) x2
Sound Pressure Level 13.93 / 114.02 dB
Frequency 1000.5 / 1000.5 Hz
THD (@1000Hz) 0.39 / 0.95 %

Copying and using select parts, or tampering with this document without the permission of BSWA is forbidden!

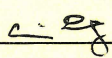
BSWA Technology Ltd.

www.bswa-tech.com

This equipment was calibrated at the following ambient conditions:

Temperature: 23 °C
Humidity: 35 %RH
Pressure: 1025 hPa

This equipment is qualified!


Calibrated

2016-11-15

Date



Appendix A2b – Calibration Certificates (Noise Measurement to Confirm Any Characteristics of Tonality, Impulsiveness and Intermittency at NSRs)



Calibration Certificate

Certificate No. **706817**

Page 1 of 3 Pages

Customer : Supreme Acoustics Research Limited.

Address : Rm3915, Hong Kong Plaza, 188 Connaught Road West, Hong Kong

Order No. : Q72718

Date of receipt : 13-Jul-17

Item Tested

Description : Sound Level Meter

Manufacturer : Larson Davis

Model : 831

I.D. : SLM No.1

Serial No. : 0002594

Test Conditions

Date of Test : 25-Jul-17

Ambient Temperature : $(23 \pm 3)^{\circ}\text{C}$

Supply Voltage : --

Relative Humidity : $(50 \pm 25) \%$

Test Specifications

Calibration check.

Ref. Document/Procedure: Z01, IEC 61672.

Test Results

All results were within the IEC 61672 Type 1 or manufacturer's specification.

The results are shown in the attached page(s).

Main Test equipment used:

<u>Equipment No.</u>	<u>Description</u>	<u>Cert. No.</u>	<u>Traceable to</u>
S017	Multi-Function Generator	C170120	SCL-HKSAR
S240	Sound Level Calibrator	703741	NIM-PRC & SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by : 
Elva Chong

Approved by : 
Alan Chu

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Date: 25-Jul-17



Calibration Certificate

Certificate No. 706817

Page 2 of 3 Pages

Results :

1. Self-generated noise: 20.3 dBA (Mfr's Spec ≤ 19 dBA)

2. Acoustical signal test

UUT Setting			Applied Value (dB)	UUT Reading (dB)
Range (dB)	Frequency Weighting	Time Weighting		
20-140	A	F	94.0	94.0
		S		94.0
	C	F		94.0
	Z	F		94.0
	A	F	114.0	114.1
		S		114.1
	C	F		114.1
	Z	F		114.1

IEC 61672 Class 2 Spec. : ± 1.4 dB

Uncertainty : ± 0.1 dB

3 Electrical signal tests of frequency weightings (A weighting)

Frequency	Attenuation (dB)	IEC 61672 Class 2 Spec.
31.5 Hz	-39.6	- 39.4 dB, ± 3.5 dB
63 Hz	-26.3	- 26.2 dB, ± 2.5 dB
125 Hz	-16.3	- 16.1 dB, ± 2.0 dB
250 Hz	-8.8	- 8.6 dB, ± 1.9 dB
500 Hz	-3.3	- 3.2 dB, ± 1.9 dB
1 kHz	0.0 (Ref)	0 dB, ± 1.4 dB
2 kHz	+1.4	+ 1.2 dB, ± 2.6 dB
4 kHz	+1.9	+ 1.0 dB, ± 3.6 dB
8 kHz	+1.8	- 1.1 dB, ± 5.6 dB
16 kHz	-1.3	- 6.6 dB, + 6.0 dB $\sim \infty$ dB

Uncertainty : ± 0.1 dB



Calibration Certificate

Certificate No. 706817

Page 3 of 3 Pages

4. Frequency & Time weightings at 1 kHz

4.1 Frequency Weighting (Fast)

UUT Setting	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Class 2 Spec.
A	94.0	94.0 (Ref.)	- -	± 0.4 dB
C	94.0	94.0	0.0	

4.2 Time Weighting (A-weighted)

UUT Setting	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Class 2 Spec.
Fast	94.0	94.0 (Ref.)	- -	± 0.3 dB
Slow	94.0	94.0	0.0	

Uncertainty : ± 0.1 dB

Remarks : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1 024 hPa.

4. Power Supply Check: OK

5. Preamplifier model : PRM831 , S/N : 019083

6. Microphone model: 377B02 , S/N : 126167

7. The UUT was adjusted with the laboratory's sound calibrator at the reference sound pressure level before the calibration.

----- END -----



Calibration Certificate

Certificate No. **707077**

Page 1 of 2 Pages

Customer : Supreme Acoustics Research Limited.

Address : Rm3915, Hong Kong Plaza, 188 Connaught Road West, Hong Kong

Order No. : Q72409

Date of receipt : 20-Jul-17

Item Tested

Description : Sound Level Calibrator

Manufacturer : B&K

Model : Type 4231

I.D. : No.003

Serial No. : 2084888

Test Conditions

Date of Test : 24-Jul-17

Ambient Temperature : (23 ± 3)°C

Supply Voltage : --

Relative Humidity : (50 ± 25) %

Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02, IEC 60942.

Test Results

All results were within the IEC 60942 Class 1 specification.

The results are shown in the attached page(s).

Main Test equipment used:

<u>Equipment No.</u>	<u>Description</u>	<u>Cert. No.</u>	<u>Traceable to</u>
S014	Spectrum Analyzer	707126	NIM-PRC & SCL-HKSAR
S240	Sound Level Calibrator	703741	NIM-PRC & SCL-HKSAR
S041	Universal Counter	607883	SCL-HKSAR
S206	Sound Level Meter	605757	SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by :

Elva Chong

Approved by :

Alan Chu

Date: 24-Jul-17

This Certificate is issued by:

Hong Kong Calibration Ltd.

Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.

Tel: 2425 8801 Fax: 2425 8646

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Calibration Certificate

Certificate No. 707077

Page 2 of 2 Pages

Results :

1. Generated Sound Pressure Level

UUT Nominal Value (dB)	Measured Value (dB)	IEC 60942 Class 1 Spec.
94	94.1	± 0.4 dB
114	114.2	

Uncertainty : ± 0.1 dB

2. Short-term Level Fluctuation : 0.0 dB

IEC 60942 Class 1 Spec. : ± 0.1 dB

Uncertainty : ± 0.01 dB

3. Frequency

UUT Nominal Value (kHz)	Measured Value (kHz)	IEC 60942 Class 1 Spec.
1	0.999 9	± 1 %

Uncertainty : ± 3.6 × 10⁻⁶

4. Total Distortion : < 0.6 %

IEC 60942 Class 1 Spec. : < 3 %

Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1 023 hPa.

----- END -----

Appendix A3 – Fixed Plant Noise Summary

NSR		Noise Source	Description	Louvre ID	Plant or Louvre? (P/L)	In operation? (Y/N)	Louvre Size (m)		Method ⁽ⁱⁱ⁾	Measure-ment Distance, D_M (m)	Surface Area of Measurement Box, S (m ²)	Measured L_{Aeq} [dB(A)] ⁽ⁱⁱⁱ⁾	Average Background L_{Aeq} [dB(A)]	Difference L_{Aeq} [dB(A)]	Background Corrected Measured $L_{Aeq,mea}$ [dB(A)] ^(iv)	Calculated SWL L_{Aeq} [dB(A)] ^(v)	Distance from Noise Source to NSR, D_N [m]	Correction for line of sight, LoS [dB(A)]	Corrected SPL at NSR [dB(A)]	Cumulative SPL at NSR [dB(A)]	Day and Evening Time Criteria [dB(A)]	Exceedance [dB(A)]
							Width	Height														
KC1	Kwai Oi House, Kwai Fong Estate	Ventilation Shaft for N/B ⁽ⁱ⁾ and Building Service	Tunnel ventilation shaft	N1	L	Y	10.03	12.30	3	3	499.2	67.8	53.6	14.2	67.8	95	309	10	30	46	60	0
			FS control room/Corridor /Irrigation pump room	N2	L	Y	2.00	0.80	2	4	n/a	60.3	57.1	3.2	57.5	78	309	10	13			
			UPS room	N3	L	Y	0.80	1.00	2	2	n/a	60.5	57.1	3.4	57.8	72	309	10	7			
			LV switch room	N4	L	Y	5.00	1.00	2	10	n/a	62.2	57.1	5.1	60.6	89	309	10	24			
			Air compression receiver room	N5	L	Y	1.20	0.80	2	3	n/a	63.9	55.5	8.4	63.2	81	284	10	17			
			Smoke extraction fan	N6	L	Y	4.60	3.60	3	1	61.4	81.6	60.4	21.2	81.6	99	309	10	34			
			Fresh air louvre	E1	L	Y	3.50	3.60	3	0.5	29.8	59.7	57.8	1.9	56.7	71	284	10	7			
			Exhaust air louvre	E2	L	Y	2.80	2.20	3	0.5	19.2	57.5	57.8	-0.3	54.5	67	284	10	3			
			Staircase pressurization fan room	E3	L	Y	2.40	3.00	2	6	n/a	65.2	53.2	12	65.2	89	307	10	24			
			Tunnel ventilation shaft	S1	L	N ⁽ⁱ⁾	11.45	12.30	3	3	533.8	66.4	56.2	10.2	66.4	94	284	-				
			P&D pump and tank room	S2	L	Y	1.00	1.00	2	2	n/a	65.4	61.2	4.2	63.3	77	284	10	13			
			MCC room	S3	L	Y	1.50	1.00	2	3	n/a	69.6	55.5	14.1	69.6	87	284	10	23			
			TECS control room	S4	L	Y	2.00	1.00	2	4	n/a	80.4	60.6	19.8	80.4	100	284	10	36			
			Tunnel ventilation shaft	W1	L	N ⁽ⁱ⁾	7.08	4.70	3	3	282.6	66.1	54.1	12	66.1	91	284	-				
			Tunnel ventilation shaft	W2	L	Y	7.08	2.60	3	3	242.5	65.2	52.3	12.9	65.2	89	299	10	24			
			Staircase pressurization fan room	W3	L	Y	2.40	2.00	2	5	n/a	64.2	58.3	5.9	62.9	85	299	10	20			
			Smoke extraction make-up room	W4	L	Y	2.40	3.00	2	6	n/a	86.4	58.3	28.1	86.4	110	299	10	45			
KC1	Kwai Oi House, Kwai Fong Estate	Ventilation Shaft for S/B ⁽ⁱ⁾ and Building Service	Tunnel ventilation shaft	N1	L	N ⁽ⁱ⁾	10.03	12.30	3	3	499.2	67.8	53.6	14.2	67.8	95	309	-		46	60	0
			FS control room/Corridor /Irrigation pump room	N2	L	Y	2.00	0.80	2	4	n/a	60.3	57.1	3.2	57.5	78	309	10	13			
			UPS room	N3	L	Y	0.80	1.00	2	2	n/a	60.5	57.1	3.4	57.8	72	309	10	7			
			LV switch room	N4	L	Y	5.00	1.00	2	10	n/a	62.2	57.1	5.1	60.6	89	309	10	24			
			Air compression receiver room	N5	L	Y	1.20	0.80	2	3	n/a	63.9	55.5	8.4	63.2	81	284	10	17			
			Smoke extraction fan	N6	L	Y	4.60	3.60	3	1	61.4	81.6	60.4	21.2	81.6	99	309	10	34			
			Fresh air louvre	E1	L	Y	3.50	3.60	3	0.5	29.8	59.7	57.8	1.9	56.7	71	284	10	7			
			Exhaust air louvre	E2	L	Y	2.80	2.20	3	0.5	19.2	57.5	57.8	-0.3	54.5	67	284	10	3			
			Staircase pressurization fan room	E3	L	Y	2.40	3.00	2	6	n/a	65.2	53.2	12.0	65.2	89	307	10	24			
			Tunnel ventilation shaft	S1	L	Y	11.45	12.30	3	3	533.8	66.4	56.2	10.2	66.4	94	284	10	30			
			P&D pump and tank room	S2	L	Y	1.00	1.00	2	2	n/a	65.4	61.2	4.2	63.3	77	284	10	13			
			MCC room	S3	L	Y	1.50	1.00	2	3	n/a	69.6	55.5	14.1	69.6	87	284	10	23			

NSR		Noise Source	Description	Louvre ID	Plant or Louvre? (P/L)	In operation? (Y/N)	Louvre Size (m)		Method ⁽ⁱⁱ⁾	Measurement Distance, D_M (m)	Surface Area of Measurement Box, S (m ²)	Measured L_{Aeq} [dB(A)] ⁽ⁱⁱⁱ⁾	Average Background L_{Aeq} [dB(A)]	Difference L_{Aeq} [dB(A)]	Background Corrected Measured $L_{Aeq,mea}$ [dB(A)] ^(iv)	Calculated SWL L_{Aeq} [dB(A)] ^(v)	Distance from Noise Source to NSR, D_N [m]	Correction for line of sight, LoS [dB(A)]	Corrected SPL at NSR [dB(A)]	Cumulative SPL at NSR [dB(A)]	Day and Evening Time Criteria [dB(A)]	Exceedance [dB(A)]
							Width	Height														
			TECS control room	S4	L	Y	2.00	1.00	2	4	n/a	80.4	60.6	19.8	80.4	100	284	10	36			
			Tunnel ventilation shaft	W1	L	Y	7.08	4.70	3	3	282.6	66.1	54.1	12.0	66.1	91	284	10	27			
			Tunnel ventilation shaft	W2	L	N ⁽ⁱ⁾	7.08	2.60	3	3	242.5	65.2	52.3	12.9	65.2	89	299	-				
			Staircase pressurization fan room	W3	L	Y	2.40	2.00	2	5	n/a	64.2	58.3	5.9	62.9	85	299	10	20			
			Smoke extraction make-up room	W4	L	Y	2.40	3.00	2	6	n/a	86.4	58.3	28.1	86.4	110	299	10	45			

Remarks:

(i) Tunnel ventilation would only be operated for either northbound (N/B) or southbound (S/B) direction under normal scenario.

(ii) Method 2 Far field method for Louvres or Plants

Method 3 Near field method for Louvres or Plants

(iii) Results are averaged from the measured noise levels.

(iv) If the difference between the background and the measured noise level is less than 3.0 dB, background noise correction factor should be capped to 3.0 dB.

(v) The calculation of SWL is in accordance with the methodology described in **Section 3.1.1** and **Appendix A1** of the Report. For Method 3, K2A was not claimed in the calculation.

Night Time Fixed Plant Noise at NSR

NSR		Noise Source	Description	Louvre ID	Plant or Louvre? (P/L)	In operation? (Y/N)	Louvre Size (m)		Method (iii)	Measurement Distance, D_M (m)	Surface Area of Measurement Box, S (m ²)	Measured L_{Aeq} [dB(A)] (iv)	Average Background L_{Aeq} [dB(A)]	Difference L_{Aeq} [dB(A)]	Background Corrected Measured $L_{Aeq,mea}$ [dB(A)] (v)	Calculated SWL L_{Aeq} [dB(A)] (vi)	Distance from Noise Source to NSR, D_N [m]	Correction for line of sight, LoS [dB(A)]	Corrected SPL at NSR [dB(A)]	Cumulative SPL at NSR [dB(A)]	Night-Time Criteria [dB(A)]	Exceedance [dB(A)]
							Width	Height														
KC1	Kwai Oi House, Kwai Fong Estate	Ventilation Shaft for N/B ⁽ⁱ⁾ and Building Service	Tunnel ventilation shaft	N1	L	Y	10.03	12.30	3	3	499.2	67.8	53.6	14.2	67.8	95	309	10	30	33	50	0
			FS control room/Corridor /Irrigation pump room	N2	L	Y	2.00	0.80	2	4	n/a	60.3	57.1	3.2	57.5	78	309	10	13			
			UPS room	N3	L	Y	0.80	1.00	2	2	n/a	60.5	57.1	3.4	57.8	72	309	10	7			
			LV switch room	N4	L	Y	5.00	1.00	2	10	n/a	62.2	57.1	5.1	60.6	89	309	10	24			
			Air compression receiver room	N5	L	Y	1.20	0.80	2	3	n/a	63.9	55.5	8.4	63.2	81	284	10	17			
			Smoke extraction fan	N6	L	N ⁽ⁱⁱ⁾	4.60	3.60	3	1	61.4	81.6	60.4	21.2	81.6	99	309	-				
			Fresh air louvre	E1	L	Y	3.50	3.60	3	0.5	29.8	59.7	57.8	1.9	56.7	71	284	10	7			
			Exhaust air louvre	E2	L	Y	2.80	2.20	3	0.5	19.2	57.5	57.8	-0.3	54.5	67	284	10	3			
			Staircase pressurization fan	E3	L	N ⁽ⁱⁱ⁾	2.40	3.00	2	6	n/a	65.2	53.2	12	65.2	89	307	-				
			Tunnel ventilation shaft	S1	L	N ⁽ⁱ⁾	11.45	12.30	3	3	533.8	66.4	56.2	10.2	66.4	94	284	-				
			P&D pump and tank room	S2	L	Y	1.00	1.00	2	2	n/a	65.4	61.2	4.2	63.3	77	284	10	13			
			MCC room	S3	L	Y	1.50	1.00	2	3	n/a	69.6	55.5	14.1	69.6	87	284	10	23			
			TECS control room	S4	L	N ⁽ⁱⁱ⁾	2.00	1.00	2	4	n/a	80.4	60.6	19.8	80.4	100	284	-				
			Tunnel ventilation shaft	W1	L	N ⁽ⁱ⁾	7.08	4.70	3	3	282.6	66.1	54.1	12	66.1	91	284	-				
			Tunnel ventilation shaft	W2	L	Y	7.08	2.60	3	3	242.5	65.2	52.3	12.9	65.2	89	299	10	24			
			Staircase pressurization fan	W3	L	N ⁽ⁱⁱ⁾	2.40	2.00	2	5	n/a	64.2	58.3	5.9	62.9	85	299	-				
			Smoke extraction make-up room	W4	L	N ⁽ⁱⁱ⁾	2.40	3.00	2	6	n/a	86.4	58.3	28.1	86.4	110	299	-				
KC1	Kwai Oi House, Kwai Fong Estate	Ventilation Shaft for S/B ⁽ⁱ⁾ and Building Service	Tunnel ventilation shaft	N1	L	N ⁽ⁱ⁾	10.03	12.30	3	3	499.2	67.8	53.6	14.2	67.8	95	309	-		33	50	0
			FS control room/Corridor /Irrigation pump room	N2	L	Y	2.00	0.80	2	4	n/a	60.3	57.1	3.2	57.5	78	309	10	13			
			UPS room	N3	L	Y	0.80	1.00	2	2	n/a	60.5	57.1	3.4	57.8	72	309	10	7			
			LV switch room	N4	L	Y	5.00	1.00	2	10	n/a	62.2	57.1	5.1	60.6	89	309	10	24			
			Air compression receiver room	N5	L	Y	1.20	0.80	2	3	n/a	63.9	55.5	8.4	63.2	81	284	10	17			
			Smoke extraction fan	N6	L	N ⁽ⁱⁱ⁾	4.60	3.60	3	1	61.4	81.6	60.4	21.2	81.6	99	309	-				
			Fresh air louvre	E1	L	Y	3.50	3.60	3	0.5	29.8	59.7	57.8	1.9	56.7	71	284	10	7			
			Exhaust air louvre	E2	L	Y	2.80	2.20	3	0.5	19.2	57.5	57.8	-0.3	54.5	67	284	10	3			
			Staircase pressurization fan	E3	L	N ⁽ⁱⁱ⁾	2.40	3.00	2	6	n/a	65.2	53.2	12.0	65.2	89	307	-				
			Tunnel ventilation shaft	S1	L	Y	11.45	12.30	3	3	533.8	66.4	56.2	10.2	66.4	94	284	10	30			
			P&D pump and tank room	S2	L	Y	1.00	1.00	2	2	n/a	65.4	61.2	4.2	63.3	77	284	10	13			
			MCC room	S3	L	Y	1.50	1.00	2	3	n/a	69.6	55.5	14.1	69.6	87	284	10	23			
			TECS control room	S4	L	N ⁽ⁱⁱ⁾	2.00	1.00	2	4	n/a	80.4	60.6	19.8	80.4	100	284	-				

NSR	Noise Source	Description	Louvre ID	Plant or Louvre? (P/L)	In operation? (Y/N)	Louvre Size (m)		Method ⁽ⁱⁱⁱ⁾	Measurement Distance, D_M (m)	Surface Area of Measurement Box, S (m ²)	Measured L_{Aeq} [dB(A)] ^(iv)	Average Background L_{Aeq} [dB(A)]	Difference L_{Aeq} [dB(A)]	Background Corrected Measured $L_{Aeq,mea}$ [dB(A)] ^(v)	Calculated SWL L_{Aeq} [dB(A)] ^(vi)	Distance from Noise Source to NSR, D_N [m]	Correction for line of sight, LoS [dB(A)]	Corrected SPL at NSR [dB(A)]	Cumulative SPL at NSR [dB(A)]	Night-Time Criteria [dB(A)]	Exceedance [dB(A)]
						Width	Height														
		Tunnel ventilation shaft	W1	L	Y	7.08	4.70	3	3	282.6	66.1	54.1	12.0	66.1	91	284	10	27			
		Tunnel ventilation shaft	W2	L	N ⁽ⁱ⁾	7.08	2.60	3	3	242.5	65.2	52.3	12.9	65.2	89	299	-				
		Staircase pressurization fan	W3	L	N ⁽ⁱⁱ⁾	2.40	2.00	2	5	n/a	64.2	58.3	5.9	62.9	85	299	-				
		Smoke extraction make-up room	W4	L	N ⁽ⁱⁱⁱ⁾	2.40	3.00	2	6	n/a	86.4	58.3	28.1	86.4	110	299	-				

Remarks:

(i) Tunnel ventilation would only be operated for either northbound (N/B) or southbound (S/B) direction under normal scenario.

(ii) The plant would be operated during day and evening time only under normal scenario.

(iii) Method 2 Far field method for Louvres or Plants

Method 3 Near field method for Louvres or Plants

(iv) Results are averaged from the measured noise levels.

(v) If the difference between the background and the measured noise level is less than 3.0 dB, background noise correction factor should be capped to 3.0 dB.

(vi) The calculation of SWL is in accordance with the methodology described in **Section 3.1.1** and **Appendix A1** of the Report. For Method 3, K2A was not claimed in the calculation.

KCV - Noise Measurement Result - data

Description	Louvre ID	Scenario	Method	Location / measurement	L _{Aeq} [dB]
Tunnel ventilation shaft	N1	Normal	3	Point 1	65.8
	N1	Normal	3	Point 2	65.7
	N1	Normal	3	Point 3	67.3
	N1	Normal	3	Point 4	68.3
	N1	Normal	3	Point 5	68.9
	N1	Normal	3	Point 6	68.6
	N1	Normal	3	Point 7	68.3
	N1	Normal	3	Point 8	67
	N1	Normal	3	Point 9	68.3
	N1	Normal	3	Point 10	68.4
	N1	Normal	3	Point 11	68.4
	N1	Normal	3	Point 12	68.4
	N1	Normal	3	Point 13	68.4
	N1	Normal	3	Point 14	67.5
	N1	Normal	3	Point 15	67
	N1	Normal	3	Point 16	67.5
	N1	Normal		AVERAGE	67.8
FS control room/Corridor /Irrigation pump room	N2	Normal	2	measurement 1	60.3
	N2	Normal	2	measurement 2	60.3
	N2	Normal	2	measurement 3	60.2
	N2				60.3
UPS room	N3	Normal	2	measurement 1	60.6
	N3	Normal	2	measurement 2	60.6
	N3	Normal	2	measurement 3	60.3
	N3				60.5
LV switch room	N4	Normal	2	measurement 1	62.4
	N4	Normal	2	measurement 2	62.1
	N4	Normal	2	measurement 3	62.1
	N4				62.2
Air compression receiver room	N5	Normal	2	measurement 1	63.8
	N5	Normal	2	measurement 2	63.9
	N5	Normal	2	measurement 3	64.0
	N5				63.9
Smoke extraction fan	N6	Normal	3	Point 1	82.4
	N6	Normal	3	Point 2	81.7
	N6	Normal	3	Point 3	77.8
	N6	Normal	3	Point 4	80.4
	N6	Normal	3	Point 5	82.7
	N6	Normal	3	Point 6	84.1
	N6	Normal	3	Point 7	87
	N6	Normal	3	Point 8	85.1
	N6	Normal	3	Point 9	79.6
	N6	Normal	3	Point 10	80.6
	N6	Normal	3	Point 11	80.3
	N6	Normal	3	Point 12	77.7
	N6	Normal	3	Point 13	76.3
	N6	Normal	3	Point 14	74.8
	N6	Normal	3	Point 15	77.1
	N6	Normal	3	Point 16	77.4
	N6	Normal		AVERAGE	81.6
Fresh air louvre	E1	Normal	3	Point 1	59.8
	E1	Normal	3	Point 2	59.7
	E1	Normal	3	Point 3	59.5
	E1	Normal		AVERAGE	59.7
Exhaust air louvre	E2	Normal	3	Point 1	58.1
	E2	Normal	3	Point 2	57.6
	E2	Normal	3	Point 3	56.7
	E2	Normal		AVERAGE	57.5
Staircase pressurization fan room	E3	Normal	2	measurement 1	65.2
	E3	Normal	2	measurement 2	65.2
	E3	Normal	2	measurement 3	65.1
	E3				65.2
Tunnel ventilation shaft	S1	Normal	3	Point 1	68.2
	S1	Normal	3	Point 2	67.5
	S1	Normal	3	Point 3	66.1
	S1	Normal	3	Point 4	66.7
	S1	Normal	3	Point 5	66.4
	S1	Normal	3	Point 6	65.2
	S1	Normal	3	Point 7	65.4
	S1	Normal	3	Point 8	66.6
	S1	Normal	3	Point 9	65.5
	S1	Normal	3	Point 10	67.1
	S1	Normal	3	Point 11	67
	S1	Normal	3	Point 12	63.5
	S1	Normal		AVERAGE	66.4

P&D pump and tank room	S2	Normal	2	measurement 1	65.5
	S2	Normal	2	measurement 2	65.4
	S2	Normal	2	measurement 3	65.2
	S2				65.4
MCC room	S3	Normal	2	measurement 1	69.6
	S3	Normal	2	measurement 2	69.8
	S3	Normal	2	measurement 3	69.5
	S3				69.6
TECS control room	S4	Normal	2	measurement 1	80.4
	S4	Normal	2	measurement 2	80.4
	S4	Normal	2	measurement 3	80.4
	S4				80.4
Tunnel ventilation shaft	W1	Normal	3	Point 1	66.3
	W1	Normal	3	Point 2	67.2
	W1	Normal	3	Point 3	66
	W1	Normal	3	Point 4	64.1
	W1	Normal	3	Point 5	64
	W1	Normal	3	Point 6	65.4
	W1	Normal	3	Point 7	66.6
	W1	Normal	3	Point 8	66.7
	W1	Normal	3	Point 9	67.4
	W1	Normal	3	Point 10	67
	W1	Normal	3	Point 11	66.2
	W1	Normal	3	Point 12	64.6
	W1	Normal		AVERAGE	66.1
Tunnel ventilation shaft	W2	Normal	3	Point 1	62.6
	W2	Normal	3	Point 2	65.4
	W2	Normal	3	Point 3	66.1
	W2	Normal	3	Point 4	66.5
	W2	Normal	3	Point 5	66.3
	W2	Normal	3	Point 6	66.1
	W2	Normal	3	Point 7	64.5
	W2	Normal	3	Point 8	62
	W2	Normal		AVERAGE	65.2
Staircase pressurization fan room	W3	Normal	2	measurement 1	64.2
	W3	Normal	2	measurement 2	64.1
	W3	Normal	2	measurement 3	64.2
	W3				64.2
Smoke extraction make-up room	W4	Normal	2	measurement 1	86.5
	W4	Normal	2	measurement 2	86.4
	W4	Normal	2	measurement 3	86.4
	W4				86.4

Appendix A4 – Results on Tonality, Impulsiveness and Intermittency

Appendix A4 - Results on Tonality, Impulsiveness and Intermittency

NSR	Scenario	Measurement Type	Start Time	End Time	L _{aeq} dB(A)
KC1	1	Background Noise Levels	13/02/2018 21:12	13/02/2018 21:17	63.3
			13/02/2018 21:23	13/02/2018 21:28	63.6
		Measured Noise Levels	13/02/2018 22:01	13/02/2018 22:31	63.8
			13/02/2018 22:31	13/02/2018 23:01	63.7
	2	Background Noise Levels	14/02/2018 00:46	14/02/2018 00:51	61.6
			14/02/2018 00:57	14/02/2018 01:02	60.8
		Measured Noise Levels	13/02/2018 23:39	14/02/2018 00:09	63.1
			14/02/2018 00:10	14/02/2018 00:40	62.5