

# Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 7, 2021	Rootsmeter S/N: 438320	Ta: 294	°K
Operator: Jim Tisch		Pa: 756.4	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: <b>0843</b>		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3970	4.2	2.00
2	3	4	1	0.9930	6.4	4.00
3	5	6	1	0.8790	8.0	5.00
4	7	8	1	0.8420	8.7	5.50
5	9	10	1	0.6950	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H (Ta/Pa)}$ (y-axis)
1.0032	0.7181	1.4204	0.9944	0.7118	0.8817
1.0003	1.0073	2.0088	0.9915	0.9985	1.2469
0.9982	1.1356	2.2459	0.9894	1.1256	1.3941
0.9972	1.1843	2.3555	0.9885	1.1740	1.4621
0.9919	1.4272	2.8409	0.9832	1.4147	1.7634
<b>QSTD</b>	m=	<b>1.99914</b>	<b>QA</b>	m=	<b>1.25183</b>
	b=	<b>-0.01375</b>		b=	<b>-0.00854</b>
	r=	<b>0.99991</b>		r=	<b>0.99991</b>

Calculations			
Vstd= $\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va= $\Delta Vol((Pa-\Delta P)/Pa)$		
Qstd= $Vstd/\Delta Time$	Qa= $Va/\Delta Time$		
For subsequent flow rate calculations:			
Qstd= $1/m \left( \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} \right) - b \right)$	Qa= $1/m \left( \left( \sqrt{\Delta H (Ta/Pa)} \right) - b \right)$		

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmeter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

## AECOM Asia Company Limited Tisch TSP Mass Flow Controlled High Volume Air Sampler Field Calibration Report

Station: <u>Block B, Merit Industrial Centre ( E-A14a )</u>	Operator: <u>Choi Wing Ho</u>
Cal. Date: <u>16/7/2021</u>	Next Due Date: <u>16/9/2021</u>
Model No.: <u>TE-5170</u>	Serial No.: <u>10380</u>
Equipment No.: <u>A-001-15T</u>	

Ambient Condition			
Temperature, Ta (K)	304	Pressure, Pa (mmHg)	755.1

Orifice Transfer Standard Information					
Serial No:	843	Slope, mc	1.99914	Intercept, bc	-0.1375
Last Calibration Date:	7-Jan-21	$mc \times Qstd + bc = [H \times (Pa/760) \times (298/Ta)]^{1/2}$			
Next Calibration Date:	7-Jan-22				

Calibration of TSP Sampler					
Resistance Plate No.	Orifice			HVS Flow Recorder	
	DH (orifice), in. of water	$[DH \times (Pa/760) \times (298/Ta)]^{1/2}$	Qstd (m <sup>3</sup> /min) X-axis	Flow Recorder Reading (CFM)	Continuous Flow Recorder Reading IC (CFM) Y-axis
18	7.0	2.61	1.37	44.0	43.42
13	6.0	2.42	1.28	40.0	39.48
10	5.0	2.21	1.17	35.0	34.54
7	4.2	2.02	1.08	30.0	29.61
5	3.0	1.71	0.92	23.0	22.70

By Linear Regression of Y on X  
 Slope, mw = 46.6345 Intercept, bw = -20.4247  
 Correlation Coefficient\* = 0.9986

\*If Correlation Coefficient < 0.990, check and recalibrate.

Set Point Calculation
From the TSP Field Calibration Curve, take Qstd = 1.30m <sup>3</sup> /min From the Regression Equation, the "Y" value according to
$mw \times Qstd + bw = IC \times [(Pa/760) \times (298/Ta)]^{1/2}$
Therefore, Set Point; IC = $(mw \times Qstd + bw) \times [(760 / Pa) \times (Ta / 298)]^{1/2} =$ <u>40.73</u>

Remarks: \_\_\_\_\_

QC Reviewer: WS CHAN Signature:  Date: 16/07/21



## EQUIPMENT CALIBRATION RECORD

Type: Laser Dust Monitor  
 Manufacturer/Brand: SIBATA  
 Model No.: LD-3  
 Equipment No.: A.005.09a  
 Sensitivity Adjustment Scale Setting: 797 CPM

Operator: Mike Shek (MSKM)

### Standard Equipment

Equipment: High Volume Sampler  
 Venue: Fanling Government Secondary School  
 Model No.: TE-5170  
 Serial No.: 3154  
 Last Calibration Date: 23-Apr-21

### Calibration Result

Sensitivity Adjustment Scale Setting (Before Calibration): 797 CPM  
 Sensitivity Adjustment Scale Setting (After Calibration): 797 CPM

Hour	Date (dd/mm/yy)	Time	Ambient Condition		Concentration <sup>①</sup> (mg/m3) Y-axis	Total Count <sup>②</sup>	Count/ Minute <sup>③</sup> X-axis
			Temp (°C)	R.H.(%)			
1	30/04/21	9:30-10:30	28.0	78	0.04950	1980	33.00
2	30/04/21	10:30-11:30	28.0	78	0.05045	2030	33.83
3	30/04/21	11:30-12:30	28.0	78	0.05250	2120	35.33
4	30/04/21	12:30-13:30	28.0	78	0.05520	2310	38.50

Note: ① Monitoring data was measured by High Volume Sampler  
 ② Total Count was logged by Laser Dust Monitor  
 ③ Count/minute was calculated by (Total Count/60)

By Linear Regression of Y on X  
 Slope (K-factor): 0.0015  
 Correlation coefficient: 0.9997

Validity of Calibration Record: 30-Apr-22

Remarks:

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QC Reviewer: Y W Fung      Signature: [Signature]      Date: 3-May-21



## EQUIPMENT CALIBRATION RECORD

Type: Laser Dust Monitor  
 Manufacturer/Brand: SIBATA  
 Model No.: LD-3  
 Equipment No.: A.005.10a  
 Sensitivity Adjustment Scale Setting: 753 CPM

Operator: Mike Shek (MSKM)

### Standard Equipment

Equipment: High Volume Sampler  
 Venue: Fanling Government Secondary School  
 Model No.: TE-5170  
 Serial No.: 3154  
 Last Calibration Date: 23-Apr-21

### Calibration Result

Sensitivity Adjustment Scale Setting (Before Calibration): 753 CPM  
 Sensitivity Adjustment Scale Setting (After Calibration): 753 CPM

Hour	Date (dd/mm/yy)	Time	Ambient Condition		Concentration <sup>①</sup> (mg/m <sup>3</sup> ) Y-axis	Total Count <sup>②</sup>	Count/ Minute <sup>③</sup> X-axis
			Temp (°C)	R.H.(%)			
1	30/04/21	9:30-10:30	28.0	78	0.04950	1945	32.42
2	30/04/21	10:30-11:30	28.0	78	0.05045	2010	33.50
3	30/04/21	11:30-12:30	28.0	78	0.05250	2110	35.17
4	30/04/21	12:30-13:30	28.0	78	0.05520	2310	38.50

Note: ① Monitoring data was measured by High Volume Sampler  
 ② Total Count was logged by Laser Dust Monitor  
 ③ Count/minute was calculated by (Total Count/60)

By Linear Regression of Y on X  
 Slope (K-factor): 0.0015  
 Correlation coefficient: 0.9994

Validity of Calibration Record: 30-Apr-22

Remarks:

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QC Reviewer: Ywiny

Signature: Y

Date: 3-May-21



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA1019 02-01

Page 1 of 2

### Item tested

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

### Item submitted by

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

Date of test: 22-Oct-2020

### Reference equipment used in the calibration

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

### Ambient conditions

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

### Test specifications

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

### Test results

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

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

Actual Measurement data are documented on worksheets.

Approved Signatory:

Feng Junqi

Date: 23-Oct-2020

Company Chop:



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



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 20CA1019 02-01

Page 2 of 2

### 1, Electrical Tests

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

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

### 2, Acoustic tests

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

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

### 3, Response to associated sound calibrator

N/A

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

Calibrated by:

Date:

Fung Chi Yip  
22-Oct-2020

- End -

Checked by:

Date:

Feng Junqi  
23-Oct-2020

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



## CERTIFICATE OF CALIBRATION

Certificate No.: 21CA0309 02 Page 1 of 2

### Item tested

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

### Item submitted by

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

Date of test: 22-Mar-2021

### Reference equipment used in the calibration

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

### Ambient conditions

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

### Test specifications

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

### Test results

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

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

Actual Measurement data are documented on worksheets.

Approved Signatory:



Feng Junqi

Date: 24-Mar-2021

Company Chop:



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





## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 21CA0309 02 Page 2 of 2

### 1, Electrical Tests

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

Test:	Subtest:	Status:	Uncertainty (dB) / Coverage Factor	
Self-generated noise	A	Pass	0.3	
	C	Pass	1.0	2.1
	Lin	Pass	2.0	2.2
Linearity range for Leq	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	Frequency weightings	A	Pass	0.3
Time weightings	C	Pass	0.3	
	Lin	Pass	0.3	
	Single Burst Fast	Pass	0.3	
Peak response	Single Burst Slow	Pass	0.3	
	Single 100µs rectangular pulse	Pass	0.3	
R.M.S. accuracy	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

### 2, Acoustic tests

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

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

### 3, Response to associated sound calibrator

N/A

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

- End -

Calibrated by:

Date:

Fung Chi Yip

22-Mar-2021

Checked by:

Date:

Chan Yuk Yiu

24-Mar-2021

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



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA1006 03

Page: 1 of 2

### Item tested

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

### Item submitted by

Customer: AECOM ASIA CO LIMITED  
Address of Customer: -  
Request No.: -  
Date of receipt: 06-Oct-2020

Date of test: 12-Oct-2020

### Reference equipment used in the calibration

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

### Ambient conditions

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

### Test specifications

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

### Test results

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

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

Approved Signatory:



Feng Junqi

Date: 12-Oct-2020

Company Chop:

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





## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA1019 02-02

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### Item tested

Description: Acoustical Calibrator (Class 1)  
 Manufacturer: B & K  
 Type/Model No.: 4231  
 Serial/Equipment No.: 3014024 / N004.04  
 Adaptors used: -

### Item submitted by

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

Date of test: 22-Oct-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2341427	11-May-2021	SCL
Preamplifier	B&K 2673	2743150	03-Jun-2021	CEPREI
Measuring amplifier	B&K 2610	2346941	03-Jun-2021	CEPREI
Signal generator	DS 360	33873	19-May-2021	CEPREI
Digital multi-meter	34401A	US36087050	19-May-2021	CEPREI
Audio analyzer	8903B	GB41300350	18-May-2021	CEPREI
Universal counter	53132A	MY40003662	18-May-2021	CEPREI

### Ambient conditions

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

### Test specifications

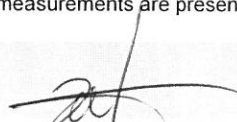
- The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- The results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

### Test results

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

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

Approved Signatory:

  
 Feng Junqi

Date: 23-Oct-2020

Company Chop:



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



