TISCH Environmental

| RECALIBRATION DUE DATE: |
|---|
| July 8, 2020 |

# Certificate of Calibration

| Calibration Certification Information | | | | |
|---|---|---|---|---|
| **Cal. Date:** | July 8, 2019 | **Rootsmeter S/N:** 438320 | **Ta:** 297 | °K |
| **Operator:** | Jim Tisch | | **Pa:** 751.8 | mm Hg |
| **Calibration Model #:** | TE-5025A | **Calibrator S/N:** **3166** | | |

| Run | Vol. Init (m3) | Vol. Final (m3) | ΔVol. (m3) | ΔTime (min) | ΔP (mm Hg) | ΔH (in H2O) |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 1.4190 | 3.2 | 2.00 |
| 2 | 3 | 4 | 1 | 1.0080 | 6.4 | 4.00 |
| 3 | 5 | 6 | 1 | 0.9040 | 7.9 | 5.00 |
| 4 | 7 | 8 | 1 | 0.8630 | 8.8 | 5.50 |
| 5 | 9 | 10 | 1 | 0.7150 | 12.8 | 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) | $\sqrt{\Delta H\left(Ta/Pa\right)}$ (y-axis) |
|---|---|---|---|---|---|
| 0.9884 | 0.6965 | 1.4090 | 0.9957 | 0.7017 | 0.8889 |
| 0.9841 | 0.9763 | 1.9926 | 0.9915 | 0.9836 | 1.2570 |
| 0.9822 | 1.0865 | 2.2278 | 0.9895 | 1.0946 | 1.4054 |
| 0.9810 | 1.1367 | 2.3365 | 0.9883 | 1.1452 | 1.4740 |
| 0.9757 | 1.3646 | 2.8179 | 0.9830 | 1.3748 | 1.7777 |
| **QSTD** | **m=** | **2.11024** | **QA** | **m=** | **1.32140** |
| | **b=** | **-0.06349** | | **b=** | **-0.04005** |
| | **r=** | **0.99999** | | **r=** | **0.99999** |

**Calculations**

| | | | |
|---|---|---|---|
| **Vstd=** | ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta) | **Va=** | ΔVol((Pa-ΔP)/Pa) |
| **Qstd=** | Vstd/ΔTime | **Qa=** | Va/ΔTime |

**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=** $1/m\left(\left(\sqrt{\Delta H\left(Ta/Pa\right)}\right)-b\right)$

| 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 |


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TISCH Environmental

| RECALIBRATION DUE DATE: |
|---|
| January 11, 2020 |

# Certificate of Calibration

| Calibration Certification Information | | | | | |
|---|---|---|---|---|---|
| **Cal. Date:** | January 11, 2019 | **Rootsmeter S/N:** 438320 | **Ta:** 293 | °K | |
| **Operator:** | Jim Tisch | | **Pa:** 760.7 | mm Hg | |
| **Calibration Model #:** | TE-5025A | **Calibrator S/N:** **0005** | | | |

| Run | Vol. Init (m3) | Vol. Final (m3) | ΔVol. (m3) | ΔTime (min) | ΔP (mm Hg) | ΔH (in H2O) |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 1.4090 | 3.2 | 2.00 |
| 2 | 3 | 4 | 1 | 0.9980 | 6.4 | 4.00 |
| 3 | 5 | 6 | 1 | 0.8900 | 7.8 | 5.00 |
| 4 | 7 | 8 | 1 | 0.8450 | 8.7 | 5.50 |
| 5 | 9 | 10 | 1 | 0.6990 | 12.6 | 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) | $\sqrt{\Delta H\left(Ta/Pa\right)}$ (y-axis) |
|---|---|---|---|---|---|
| 1.0138 | 0.7195 | 1.4269 | 0.9958 | 0.7067 | 0.8777 |
| 1.0095 | 1.0115 | 2.0180 | 0.9916 | 0.9936 | 1.2412 |
| 1.0076 | 1.1321 | 2.2561 | 0.9897 | 1.1121 | 1.3877 |
| 1.0064 | 1.1910 | 2.3663 | 0.9886 | 1.1699 | 1.4555 |
| 1.0012 | 1.4323 | 2.8538 | 0.9834 | 1.4069 | 1.7553 |
| **QSTD** | **m=** | **1.99861** | **QA** | **m=** | **1.25149** |
| | **b=** | **-0.00882** | | **b=** | **-0.00543** |
| | **r=** | **0.99997** | | **r=** | **0.99997** |

**Calculations**

| | | | |
|---|---|---|---|
| **Vstd=** | ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta) | **Va=** | ΔVol((Pa-ΔP)/Pa) |
| **Qstd=** | Vstd/ΔTime | **Qa=** | Va/ΔTime |

**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=** $1/m\left(\left(\sqrt{\Delta H\left(Ta/Pa\right)}\right)-b\right)$

| 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


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Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA1b | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS001 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 1.9 | 1.9 | 3.8 | 0.9942 | 24 | 24.3552 |
| **2** | 2.4 | 2.4 | 4.8 | 1.1168 | 31 | 31.4587 |
| **3** | 3.1 | 3.1 | 6.2 | 1.2687 | 36 | 36.5327 |
| **4** | 4.4 | 4.4 | 8.8 | 1.5106 | 48 | 48.7103 |
| **5** | 5.0 | 5.0 | 10.0 | 1.6101 | 54 | 54.7991 |

By Linear Regression of Y on X

Slope, m = 47.9646 Intercept, b = -23.1872

Correlation Coefficient* = 0.9973

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks :

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA1b | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS001 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 1.7 | 1.7 | 3.4 | 0.9162 | 28 | 28.3935 |
| **2** | 2.7 | 2.7 | 5.4 | 1.1468 | 36 | 36.5059 |
| **3** | 4.0 | 4.0 | 8.0 | 1.3893 | 46 | 46.6464 |
| **4** | 5.0 | 5.0 | 10.0 | 1.5497 | 52 | 52.7307 |
| **5** | 6.4 | 6.4 | 12.8 | 1.7493 | 58 | 58.8151 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 37.3061 | Intercept, b | = | -5.7536 |
| Correlation Coefficient* | = | 0.9987 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

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# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA2a | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS002 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 2.3 | 2.3 | 4.6 | 1.0934 | 28 | 28.4144 |
| **2** | 2.7 | 2.7 | 5.4 | 1.1843 | 34 | 34.5031 |
| **3** | 3.6 | 3.6 | 7.2 | 1.3669 | 40 | 40.5919 |
| **4** | 4.2 | 4.2 | 8.4 | 1.4760 | 46 | 46.6807 |
| **5** | 4.9 | 4.9 | 9.8 | 1.5939 | 51 | 51.7547 |

By Linear Regression of Y on X

Slope, m = 45.1480 Intercept, b = -20.2407

Correlation Coefficient* = 0.9957

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

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# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA2a | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS002 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 1.7 | 1.7 | 3.4 | 0.9162 | 26 | 26.3654 |
| **2** | 2.3 | 2.3 | 4.6 | 1.0607 | 30 | 30.4216 |
| **3** | 3.2 | 3.2 | 6.4 | 1.2458 | 38 | 38.5340 |
| **4** | 4.4 | 4.4 | 8.8 | 1.4556 | 44 | 44.6183 |
| **5** | 5.2 | 5.2 | 10.4 | 1.5798 | 52 | 52.7307 |

By Linear Regression of Y on X

Slope, m = 38.6538 Intercept, b = -9.8452

Correlation Coefficient* = 0.9925

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

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# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA3a | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS012 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 1.6 | 1.6 | 3.2 | 0.9127 | 27 | 27.3996 |
| **2** | 2.4 | 2.4 | 4.8 | 1.1168 | 34 | 34.5031 |
| **3** | 3.3 | 3.3 | 6.6 | 1.3089 | 38 | 38.5623 |
| **4** | 3.8 | 3.8 | 7.6 | 1.4042 | 43 | 43.6363 |
| **5** | 4.5 | 4.5 | 9.0 | 1.5277 | 48 | 48.7103 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 33.5341 | Intercept, b | = | -3.4912 |
| Correlation Coefficient* | = | 0.9913 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

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# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA3a | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS012 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 1.8 | 1.8 | 3.6 | 0.9418 | 30 | 30.4216 |
| **2** | 2.6 | 2.6 | 5.2 | 1.1259 | 38 | 38.5340 |
| **3** | 3.8 | 3.8 | 7.6 | 1.3548 | 44 | 44.6183 |
| **4** | 5.2 | 5.2 | 10.4 | 1.5798 | 49 | 49.6886 |
| **5** | 6.3 | 6.3 | 12.6 | 1.7358 | 54 | 54.7588 |

By Linear Regression of Y on X

Slope, m = 29.2098 Intercept, b = 4.2401

Correlation Coefficient* = 0.9932

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA4a | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS004 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** (up) | (down) | (difference) | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) **Y-axis** |
| **1** | 2.1 | 2.1 | 4.2 | 1.0450 | 25 | 25.3700 |
| **2** | 2.6 | 2.6 | 5.2 | 1.1623 | 31 | 31.4587 |
| **3** | 3.2 | 3.2 | 6.4 | 1.2889 | 36 | 36.5327 |
| **4** | 3.7 | 3.7 | 7.4 | 1.3856 | 40 | 40.5919 |
| **5** | 4.3 | 4.3 | 8.6 | 1.4934 | 46 | 46.6807 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 46.1620 | Intercept, b | = | -22.7324 |
| Correlation Coefficient* | = | 0.9981 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA4a | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS004 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 2.1 | 2.1 | 4.2 | 1.0149 | 31 | 31.4356 |
| **2** | 2.6 | 2.6 | 5.2 | 1.1259 | 35 | 35.4918 |
| **3** | 3.6 | 3.6 | 7.2 | 1.3195 | 42 | 42.5902 |
| **4** | 4.1 | 4.1 | 8.2 | 1.4061 | 46 | 46.6464 |
| **5** | 4.8 | 4.8 | 9.6 | 1.5190 | 51 | 51.7167 |

By Linear Regression of Y on X

Slope, m = 39.9174 Intercept, b = -9.4017

Correlation Coefficient* = 0.9985

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA5b | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS010 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 1.7 | 1.7 | 3.4 | 0.9407 | 27 | 27.3996 |
| **2** | 2.3 | 2.3 | 4.6 | 1.0934 | 35 | 35.5179 |
| **3** | 3.0 | 3.0 | 6.0 | 1.2481 | 39 | 39.5771 |
| **4** | 3.6 | 3.6 | 7.2 | 1.3669 | 44 | 44.6511 |
| **5** | 4.1 | 4.1 | 8.2 | 1.4584 | 49 | 49.7251 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 40.8780 | Intercept, b | = | -10.5581 |
| Correlation Coefficient* | = | 0.9935 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | CMA5b | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS010 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 1.9 | 1.9 | 3.8 | 0.9668 | 26 | 26.3654 |
| **2** | 2.8 | 2.8 | 5.6 | 1.1672 | 32 | 32.4497 |
| **3** | 3.6 | 3.6 | 7.2 | 1.3195 | 40 | 40.5621 |
| **4** | 4.5 | 4.5 | 9.0 | 1.4717 | 47 | 47.6605 |
| **5** | 5.3 | 5.3 | 10.6 | 1.5946 | 55 | 55.7729 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 46.9281 | Intercept, b | = | -20.6312 |
| Correlation Coefficient* | = | 0.9917 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | MA1e | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS007 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 1.8 | 1.8 | 3.6 | 0.9678 | 23 | 23.3404 |
| **2** | 2.6 | 2.6 | 5.2 | 1.1623 | 31 | 31.4587 |
| **3** | 3.2 | 3.2 | 6.4 | 1.2889 | 39 | 39.5771 |
| **4** | 3.8 | 3.8 | 7.6 | 1.4042 | 46 | 46.6807 |
| **5** | 4.4 | 4.4 | 8.8 | 1.5106 | 51 | 51.7547 |

By Linear Regression of Y on X

Slope, m = 53.8569 Intercept, b = -29.6619

Correlation Coefficient* = 0.9966

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | MA1e | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS007 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 2.0 | 2.0 | 4.0 | 0.9912 | 23 | 23.3232 |
| **2** | 2.6 | 2.6 | 5.2 | 1.1259 | 28 | 28.3935 |
| **3** | 3.1 | 3.1 | 6.2 | 1.2266 | 33 | 33.4637 |
| **4** | 4.5 | 4.5 | 9.0 | 1.4717 | 39 | 39.5481 |
| **5** | 5.2 | 5.2 | 10.4 | 1.5798 | 45 | 45.6324 |

By Linear Regression of Y on X

Slope, m = 36.0361 Intercept, b = -12.0191

Correlation Coefficient* = 0.9928

Calibration Accepted = Yes/~~No~~**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | MA1w | **Calbration Date** | : | 10-Dec-19 |
| **Equipment no.** | : | HVS008 | **Calbration Due Date** | : | 9-Feb-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 291 | Kelvin | **Pressure, $P_a$** | 1019 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **0005** | **Slope, $m_c$** | 1.99861 | **Intercept, bc** | -0.00882 |
| **Last Calibration Date** | 11-Jan-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 11-Jan-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) **X-axis** | **Continuous Flow Recorder, W** (CFM) | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ **Y-axis** |
| | (up) | (down) | (difference) | | | |
| **1** | 1.5 | 1.5 | 3.0 | 0.8839 | 25 | 25.3700 |
| **2** | 2.1 | 2.1 | 4.2 | 1.0450 | 34 | 34.5031 |
| **3** | 2.8 | 2.8 | 5.6 | 1.2060 | 42 | 42.6215 |
| **4** | 3.6 | 3.6 | 7.2 | 1.3669 | 49 | 49.7251 |
| **5** | 4.3 | 4.3 | 8.6 | 1.4934 | 54 | 54.7991 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 48.1833 | Intercept, b | = | -16.3691 |
| Correlation Coefficient* | = | 0.9978 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 10-Dec-19 | **Date** | : | 10-Dec-19 |

Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

| | | | | | |
|---|---|---|---|---|---|
| **Location** | : | MA1w | **Calbration Date** | : | 07-Feb-20 |
| **Equipment no.** | : | HVS008 | **Calbration Due Date** | : | 08-Apr-20 |

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

| **Ambient Condition** | | | | | |
|---|---|---|---|---|---|
| **Temperature, $T_a$** | 292 | Kelvin | **Pressure, $P_a$** | 1021 | mmHg |

| **Orifice Transfer Standard Information** | | | | | |
|---|---|---|---|---|---|
| **Equipment No.** | **3166** | **Slope, $m_c$** | 2.11024 | **Intercept, bc** | -0.06349 |
| **Last Calibration Date** | 08-Jul-19 | $(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ | | | |
| **Next Calibration Date** | 07-Jul-20 | $= m_c \times Q_{std} + b_c$ | | | |

| **Calibration of TSP** | | | | | | |
|---|---|---|---|---|---|---|
| **Calibration Point** | **Manometer Reading H (inches of water)** | | | **$Q_{std}$** ($m^3$ / min.) | **Continuous Flow Recorder, W** | **IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ |
| | (up) | (down) | (difference) | **X-axis** | (CFM) | **Y-axis** |
| **1** | 2.5 | 2.5 | 5.0 | 1.1046 | 28 | 28.3935 |
| **2** | 3.2 | 3.2 | 6.4 | 1.2458 | 36 | 36.5059 |
| **3** | 4.1 | 4.1 | 8.2 | 1.4061 | 40 | 40.5621 |
| **4** | 4.9 | 4.9 | 9.8 | 1.5344 | 46 | 46.6464 |
| **5** | 5.7 | 5.7 | 11.4 | 1.6526 | 53 | 53.7448 |

By Linear Regression of Y on X

| | | | | | |
|---|---|---|---|---|---|
| Slope, m | = | 43.6905 | Intercept, b | = | -19.5025 |
| Correlation Coefficient* | = | 0.9914 | | | |
| Calibration Accepted | = | Yes/~~No~~** | | | |

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

| | | | | | |
|---|---|---|---|---|---|
| **Calibrated by** | : | Laurance Yung | **Checked by** | : | James Chu |
| **Date** | : | 07-Feb-20 | **Date** | : | 07-Feb-20 |

綜合試驗有限公司
SOILS & MATERIALS ENGINEERING CO., LTD.
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Fax: (852) 2555 7533

HOKLAS 028
CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0222 02 **Page** 1 **of** 2

## Item tested

| | | Microphone | Preamp |
|---|---|---|---|
| Description: | Sound Level Meter (Type 1) | | |
| Manufacturer: | B & K | B & K | B & K |
| Type/Model No.: | 2250 | 4950 | ZC0032 |
| Serial/Equipment No.: | 2701778 | 2755097 | 19223 |
| Adaptors used: | - | - | - |

## Item submitted by

Customer Name: Lam Geotechnics Limited.
Address of Customer: -
Request No.: -
Date of receipt: 22-Feb-2019

## Date of test: 25-Feb-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Multi function sound calibrator | B&K 4226 | 2288444 | 23-Aug-2019 | CIGISMEC |
| Signal generator | DS 360 | 33873 | 24-Apr-2019 | CEPREI |
| Signal generator | DS 360 | 61227 | 26-Dec-2019 | CEPREI |

## Ambient conditions

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

## Test specifications

1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess 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:** 26-Feb-2019 **Company Chop:** SOILS AND MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

綜合試驗有限公司
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# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 19CA0222 02 **Page** 2 **of** 2

## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | |
| | Lin | Pass | 1.6 | |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| Frequency weightings | A | Pass | 0.3 | |
| | C | Pass | 0.3 | |
| | Lin | Pass | 0.3 | |
| Time weightings | Single Burst Fast | Pass | 0.3 | |
| | Single Burst Slow | Pass | 0.3 | |
| Peak response | Single 100μs rectangular pulse | Pass | 0.3 | |
| R.M.S. accuracy | Crest factor of 3 | Pass | 0.3 | |
| Time weighting I | Single burst 5 ms at 2000 Hz | Pass | 0.3 | |
| | Repeated at frequency of 100 Hz | Pass | 0.3 | |
| Time averaging | 1 ms burst duty factor $1/10^3$ 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:** Fong Chun Wai **Date:** 25-Feb-2019

**Checked by:** Fung Chi Yip **Date:** 26-Feb-2019

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.

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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 20CA0123 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.: | 2250L | 4950 | ZC0032 |
| Serial/Equipment No.: | 3002695 | 2940839 | 18582 |
| Adaptors used: | - | - | - |

## Item submitted by

| | |
|---|---|
| Customer Name: | Lam Geotechnics Limited. |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 23-Jan-2020 |

**Date of test:** 24-Jan-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-2020 | CIGISMEC |
| Signal generator | DS 360 | 33873 | 10-Apr-2020 | CEPREI |

## Ambient conditions

| | |
|---|---|
| Temperature: | 21 ± 1 °C |
| Relative humidity: | 55 ± 10 % |
| Air pressure: | 1005 ± 5 hPa |

## Test specifications

1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.

2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.

3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess 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:** 29-Jan-2020 **Company Chop:** SOILS & MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

綜合試驗有限公司
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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 20CA0123 01 **Page** 2 **of** 2

## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | |
| | Lin | Pass | 1.6 | |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| Frequency weightings | A | Pass | 0.3 | |
| | C | Pass | 0.3 | |
| | Lin | Pass | 0.3 | |
| Time weightings | Single Burst Fast | Pass | 0.3 | |
| | Single Burst Slow | Pass | 0.3 | |
| Peak response | Single 100μs rectangular pulse | Pass | 0.3 | |
| R.M.S. accuracy | Crest factor of 3 | Pass | 0.3 | |
| Time weighting I | Single burst 5 ms at 2000 Hz | Pass | 0.3 | |
| | Repeated at frequency of 100 Hz | Pass | 0.3 | |
| Time averaging | 1 ms burst duty factor $1/10^3$ 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:** 24-Jan-2020

**Checked by:** Shek Kwong Tat **Date:** 29-Jan-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.

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| | | | | | |
|---|---|---|---|---|---|
| Sound level meter type: | 2250L | Serial No. | 3002695 | Date | 24-Jan-2020 |
| Microphone type: | 4950 | Serial No. | 2940839 | | |
| Preamp type: | ZC0032 | Serial No. | 18582 | Report: | 20CA0123 01 |

## SELF GENERATED NOISE TEST

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

| | | |
|---|---|---|
| Noise level in A weighting | 13.5 | dB |
| Noise level in C weighting | 14.0 | dB |
| Noise level in Lin | 18.8 | dB |

## LINEARITY TEST

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

| Reference/Expected level | Actual level | | Tolerance | Deviation | |
|---|---|---|---|---|---|
| | non-integrated | integrated | | non-integrated | integrated |
| dB | dB | dB | +/- dB | dB | dB |
| 94.0 | 94.0 | 94.0 | 0.7 | 0.0 | 0.0 |
| 99.0 | 99.0 | 99.0 | 0.7 | 0.0 | 0.0 |
| 104.0 | 104.0 | 104.0 | 0.7 | 0.0 | 0.0 |
| 109.0 | 109.0 | 109.0 | 0.7 | 0.0 | 0.0 |
| 114.0 | 114.0 | 114.0 | 0.7 | 0.0 | 0.0 |
| 119.0 | 119.1 | 119.1 | 0.7 | 0.1 | 0.1 |
| 124.0 | 124.1 | 124.1 | 0.7 | 0.1 | 0.1 |
| 129.0 | 129.1 | 129.1 | 0.7 | 0.1 | 0.1 |
| 134.0 | 134.1 | 134.1 | 0.7 | 0.1 | 0.1 |
| 135.0 | 135.1 | 135.1 | 0.7 | 0.1 | 0.1 |
| 136.0 | 136.1 | 136.1 | 0.7 | 0.1 | 0.1 |
| 137.0 | 137.1 | 137.1 | 0.7 | 0.1 | 0.1 |
| 138.0 | 138.1 | 138.1 | 0.7 | 0.1 | 0.1 |
| 139.0 | 139.0 | 139.0 | 0.7 | 0.0 | 0.0 |
| 140.0 | 140.0 | 140.0 | 0.7 | 0.0 | 0.0 |
| 89.0 | 89.0 | 89.0 | 0.7 | 0.0 | 0.0 |
| 84.0 | 84.0 | 84.0 | 0.7 | 0.0 | 0.0 |
| 79.0 | 79.0 | 79.0 | 0.7 | 0.0 | 0.0 |
| 74.0 | 74.0 | 74.0 | 0.7 | 0.0 | 0.0 |
| 69.0 | 69.0 | 69.0 | 0.7 | 0.0 | 0.0 |
| 64.0 | 64.0 | 64.0 | 0.7 | 0.0 | 0.0 |
| 59.0 | 59.0 | 59.0 | 0.7 | 0.0 | 0.0 |
| 54.0 | 54.0 | 54.0 | 0.7 | 0.0 | 0.0 |
| 49.0 | 49.0 | 49.0 | 0.7 | 0.0 | 0.0 |
| 44.0 | 44.0 | 44.0 | 0.7 | 0.0 | 0.0 |
| 39.0 | 39.0 | 39.0 | 0.7 | 0.0 | 0.0 |

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| | | | | | |
|---|---|---|---|---|---|
| Sound level meter type: | 2250L | Serial No. | 3002695 | Date | 24-Jan-2020 |
| Microphone type: | 4950 | Serial No. | 2940839 | | |
| Preamp type: | ZC0032 | Serial No. | 18582 | Report: | 20CA0123 01 |

| | | | | | |
|---|---|---|---|---|---|
| 34.0 | 34.0 | 34.0 | 0.7 | 0.0 | 0.0 |
| 33.0 | 33.0 | 33.0 | 0.7 | 0.0 | 0.0 |
| 32.0 | 32.0 | 32.0 | 0.7 | 0.0 | 0.0 |
| 31.0 | 31.0 | 31.0 | 0.7 | 0.0 | 0.0 |
| 30.0 | 30.0 | 30.0 | 0.7 | 0.0 | 0.0 |

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

| Other ranges | Expected level | Actual level | Tolerance | Deviation |
|---|---|---|---|---|
| dB | dB | dB | +/- dB | dB |
| 20-140 | 94.0 | 94.0 | 0.7 | 0.0 |

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

| Ranges | Reference/Expected level | Actual level | Tolerance | Deviation |
|---|---|---|---|---|
| dB | dB | dB | +/- dB | dB |
| 20-140 | 30.0 | 30.0 | 0.7 | 0.0 |
| | 138.0 | 138.1 | 0.7 | 0.1 |

## FREQUENCY WEIGHTING TEST

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

Frequency weighting A:

| Frequency | Ref. level | Expected level | Correction of electrical response | Actual level | Tolerance(dB) | | Deviation * |
|---|---|---|---|---|---|---|---|
| Hz | dB | dB | dB | dB | + | - | dB |
| 1000.0 | 94.0 | 94.0 | 0.0 | 94.0 | 0.0 | 0.0 | 0.0 |
| 31.6 | 94.0 | 54.6 | 0.0 | 54.5 | 1.5 | 1.5 | -0.1 |
| 63.1 | 94.0 | 67.8 | 0.0 | 67.8 | 1.5 | 1.5 | 0.0 |
| 125.9 | 94.0 | 77.9 | 0.0 | 77.9 | 1.0 | 1.0 | 0.0 |
| 251.2 | 94.0 | 85.4 | 0.0 | 85.4 | 1.0 | 1.0 | 0.0 |
| 501.2 | 94.0 | 90.8 | 0.0 | 90.8 | 1.0 | 1.0 | 0.0 |
| 1995.0 | 94.0 | 95.2 | 0.0 | 95.2 | 1.0 | 1.0 | 0.0 |
| 3981.0 | 94.0 | 95.0 | -0.1 | 94.9 | 1.0 | 1.0 | 0.0 |
| 7943.0 | 94.0 | 92.9 | -0.3 | 92.6 | 1.5 | 3.0 | 0.0 |
| 12590.0 | 94.0 | 89.7 | -0.3 | 89.4 | 3.0 | 6.0 | 0.0 |

Frequency weighting C:

| Frequency | Ref. level | Expected level | Correction of electrical response | Actual level | Tolerance(dB) | | Deviation * |
|---|---|---|---|---|---|---|---|
| Hz | dB | dB | dB | dB | + | - | dB |
| 1000.0 | 94.0 | 94.0 | 0.0 | 94.0 | 0.0 | 0.0 | 0.0 |
| 31.6 | 94.0 | 91.0 | 0.0 | 91.1 | 1.5 | 1.5 | 0.1 |
| 63.1 | 94.0 | 93.2 | 0.0 | 93.2 | 1.5 | 1.5 | 0.0 |
| 125.9 | 94.0 | 93.8 | 0.0 | 93.8 | 1.0 | 1.0 | 0.0 |

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Sound level meter type: 2250L Serial No. 3002695 Date 24-Jan-2020
Microphone type: 4950 Serial No. 2940839
Preamp type: ZC0032 Serial No. 18582 Report: 20CA0123 01

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 251.2 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 501.2 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 1995.0 | 94.0 | 93.8 | 0.0 | 93.8 | 1.0 | 1.0 | 0.0 |
| 3981.0 | 94.0 | 93.2 | -0.1 | 93.1 | 1.0 | 1.0 | 0.0 |
| 7943.0 | 94.0 | 91.0 | -0.3 | 90.7 | 1.5 | 3.0 | 0.0 |
| 12590.0 | 94.0 | 87.8 | -0.3 | 87.4 | 3.0 | 6.0 | -0.1 |

Frequency weighting Lin:

| Frequency | Ref. level | Expected level | Correction of electrical response | Actual level | Tolerance(dB) | | Deviation * |
|---|---|---|---|---|---|---|---|
| Hz | dB | dB | dB | dB | + | - | dB |
| 1000.0 | 94.0 | 94.0 | 0.0 | 94.0 | 0.0 | 0.0 | 0.0 |
| 31.6 | 94.0 | 94.0 | 0.0 | 94.1 | 1.5 | 1.5 | 0.1 |
| 63.1 | 94.0 | 94.0 | 0.0 | 94.0 | 1.5 | 1.5 | 0.0 |
| 125.9 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 251.2 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 501.2 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 1995.0 | 94.0 | 94.0 | 0.0 | 94.0 | 1.0 | 1.0 | 0.0 |
| 3981.0 | 94.0 | 94.0 | -0.1 | 93.9 | 1.0 | 1.0 | 0.0 |
| 7943.0 | 94.0 | 94.0 | -0.3 | 93.7 | 1.5 | 3.0 | 0.0 |
| 12590.0 | 94.0 | 94.0 | -0.3 | 93.7 | 3.0 | 6.0 | 0.0 |

*Deviation = Actual level - ( Expected level + Correction of electrical response)
The correction of electrical response is specified in the Table A.2 of technical documentation of BE 1712-21. The maximum expanded uncertainty of correction of electrical response is 0.29 dB.

## TIME WEIGHTING FAST TEST

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

| Ref. level | Expected level | Actual level | Tolerance(dB) | | Deviation |
|---|---|---|---|---|---|
| dB | dB | dB | + | - | dB |
| 116.0 | 115.0 | 114.9 | 1.0 | 1.0 | -0.1 |

## TIME WEIGHTING SLOW TEST

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

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

## PEAK RESPONSE TEST

The onset time of the peak detector is tested on the reference range by comparing the response to a 100 us rectangular test pulse with the response to a 10 ms reference pulse of the same amplitude. The amplitude of the

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| | | | | | |
|---|---|---|---|---|---|
| Sound level meter type: | 2250L | Serial No. | 3002695 | Date | 24-Jan-2020 |
| Microphone type: | 4950 | Serial No. | 2940839 | | |
| Preamp type: | ZC0032 | Serial No. | 18582 | Report: | 20CA0123 01 |

10 ms reference pulse is such as to produce an indication 1 dB below the upper limit of the primary indicator range.

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

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

Negative polarities:

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

## RMS ACCURACY TEST

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

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

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

## TIME WEIGHTING IMPULSE TEST

Time weighting I is tested on the reference range (Set the SLM to LAImax)
Test frequency: 2000 Hz
Amplitude: The upper limit of the primary indicator range.

Single sinusoidal burst of duration 5 ms:

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

Repeated at 100 Hz

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

## TIME AVERAGING TEST

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

Frequency of tone burst: 4000 Hz
Duration of tone burst: 1 ms

| Repetition Time | Level of tone burst | Expected Leq | Actual Leq | Tolerance | Deviation | Remarks |
|---|---|---|---|---|---|---|
| msec | dB | dB | dB | +/- dB | dB | |
| 1000 | 110.0 | 110.0 | 109.9 | 1.0 | -0.1 | 60s integ. |
| 10000 | 100.0 | 100.0 | 99.9 | 1.0 | -0.1 | 6min. integ. |

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| | | | | | |
|---|---|---|---|---|---|
| Sound level meter type: | 2250L | Serial No. | 3002695 | Date | 24-Jan-2020 |
| Microphone type: | 4950 | Serial No. | 2940839 | | |
| Preamp type: | ZC0032 | Serial No. | 18582 | Report: | 20CA0123 01 |

## PULSE RANGE AND SOUND EXPOSURE LEVEL TEST

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

Test frequency: 4000 Hz

Integration time: 10 sec

The integrating sound level meter set to Leq:

| Duration | Rms level of | Expected | Actual | Tolerance | Deviation |
|---|---|---|---|---|---|
| msec | tone burst (dB) | dB | dB | +/- dB | dB |
| 10 | 88.0 | 58.0 | 57.9 | 1.7 | -0.1 |

The integrating sound level meter set to SEL:

| Duration | Rms level of | Expected | Actual | Tolerance | Deviation |
|---|---|---|---|---|---|
| msec | tone burst (dB) | dB | dB | +/- dB | dB |
| 10.0 | 88.0 | 68.0 | 67.9 | 1.7 | -0.1 |

## OVERLOAD INDICATION TEST

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

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

| Level | Level reduced by | Further reduced | Difference | Tolerance | Deviation |
|---|---|---|---|---|---|
| at overload (dB) | 1 dB | 3 dB | dB | dB | dB |
| 136.8 | 135.8 | 132.8 | 3.0 | 1.0 | 0.0 |

For integrating SLM, with the instrument indicating Leq.

For integrating SLM, with the instrument indicating Leq and set to the reference range. The test signal as following:
The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz
Integration time: 10 sec
Single burst duration: 1 msec

| Rms level | Level reduced by | Expected level | Actual level | Tolerance | Deviation |
|---|---|---|---|---|---|
| at overload (dB) | 1 dB | dB | dB | dB | dB |
| 143.6 | 142.6 | 102.6 | 102.6 | 2.2 | 0.0 |

## ACOUSTIC TEST

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

| Frequency | Expected level | Actual level | Tolerance (dB) | | Deviation |
|---|---|---|---|---|---|
| Hz | dB | Measured (dB) | + | - | dB |
| 1000 | 94.0 | 94.0 | 0.0 | 0.0 | 0.0 |
| 125 | 77.9 | 78.1 | 1.0 | 1.0 | 0.2 |
| 8000 | 92.9 | 93.2 | 1.5 | 3.0 | 0.3 |

----------END---------

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CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0905 02 **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.: | 3006790 | 2827240 | 21213 |
| Adaptors used: | - | - | - |

## Item submitted by

| | |
|---|---|
| Customer Name: | Lam Geotechnics Limited |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 05-Sep-2019 |

## Date of test: 06-Sep-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Multi function sound calibrator | B&K 4226 | 2288444 | 23-Aug-2020 | CIGISMEC |
| Signal generator | DS 360 | 61227 | 26-Dec-2019 | CEPREI |

## Ambient conditions

| | |
|---|---|
| Temperature: | 21 ± 1 °C |
| Relative humidity: | 55 ± 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 responsess 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:** 06-Sep-2019 **Company Chop:** SOILS & MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

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# CERTIFICATE OF CALIBRATION

(Continuation Page)



## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | |
| | Lin | Pass | 1.6 | |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| Frequency weightings | A | Pass | 0.3 | |
| | C | Pass | 0.3 | |
| | Lin | Pass | 0.3 | |
| Time weightings | Single Burst Fast | Pass | 0.3 | |
| | Single Burst Slow | Pass | 0.3 | |
| Peak response | Single 100μs rectangular pulse | Pass | 0.3 | |
| R.M.S. accuracy | Crest factor of 3 | Pass | 0.3 | |
| Time weighting I | Single burst 5 ms at 2000 Hz | Pass | 0.3 | |
| | Repeated at frequency of 100 Hz | Pass | 0.3 | |
| Time averaging | 1 ms burst duty factor $1/10^3$ 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: 06-Sep-2019

Checked by: Shek Kwong Tat Date: 06-Sep-2019

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.

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SOILS & MATERIALS ENGINEERING CO., LTD.
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E-mail: smec@cigismec.com Website: www.cigismec.com
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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0329 02 **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.: | 2722310 | 2698702 | 13318 |
| Adaptors used: | - | - | - |

## Item submitted by

| | |
|---|---|
| Customer Name: | Lam Geotechnics Ltd. |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 29-Mar-2019 |

## Date of test: 02-Apr-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Multi function sound calibrator | B&K 4226 | 2288444 | 23-Aug-2019 | CIGISMEC |
| Signal generator | DS 360 | 33873 | 24-Apr-2019 | CEPREI |
| Signal generator | DS 360 | 61227 | 26-Dec-2019 | CEPREI |

## Ambient conditions

| | |
|---|---|
| Temperature: | 21 ± 1 °C |
| Relative humidity: | 55 ± 10 % |
| Air pressure: | 1005 ± 5 hPa |

## Test specifications

1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.

2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.

3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess of the Sound Level Meter.

## Test results

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

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

Actual Measurement data are documented on worksheets.

**Approved Signatory:** Feng Junqi **Date:** 02-Apr-2019 **Company Chop:** SOILS AND MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 19CA0329 02 **Page** 2 **of** 2

## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | |
| | Lin | Pass | 1.6 | |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| Frequency weightings | A | Pass | 0.3 | |
| | C | Pass | 0.3 | |
| | Lin | Pass | 0.3 | |
| Time weightings | Single Burst Fast | Pass | 0.3 | |
| | Single Burst Slow | Pass | 0.3 | |
| Peak response | Single 100μs rectangular pulse | Pass | 0.3 | |
| R.M.S. accuracy | Crest factor of 3 | Pass | 0.3 | |
| Time weighting I | Single burst 5 ms at 2000 Hz | Pass | 0.3 | |
| | Repeated at frequency of 100 Hz | Pass | 0.3 | |
| Time averaging | 1 ms burst duty factor $1/10^3$ 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:** Fong Chun Wai **Date:** 02-Apr-2019

**Checked by:** Fung Chi Yip **Date:** 02-Apr-2019

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.

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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0425 02 **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.: | 2722311 | 2698703 | 13321 |
| Adaptors used: | - | - | - |

## Item submitted by

| | |
|---|---|
| Customer Name: | Lam Geotechnics Ltd. |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 25-Apr-2019 |

## Date of test: 02-May-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Multi function sound calibrator | B&K 4226 | 2288444 | 23-Aug-2019 | CIGISMEC |
| Signal generator | DS 360 | 61227 | 26-Dec-2019 | CEPREI |

## Ambient conditions

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

## Test specifications

1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.

2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.

3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess 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:** 03-May-2019 **Company Chop:** SOILS AND MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

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HOKLAS 028 CAL

# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 19CA0425 02 **Page** 2 **of** 2

## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | |
| | Lin | Pass | 1.6 | |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| Frequency weightings | A | Pass | 0.3 | |
| | C | Pass | 0.3 | |
| | Lin | Pass | 0.3 | |
| Time weightings | Single Burst Fast | Pass | 0.3 | |
| | Single Burst Slow | Pass | 0.3 | |
| Peak response | Single 100μs rectangular pulse | Pass | 0.3 | |
| R.M.S. accuracy | Crest factor of 3 | Pass | 0.3 | |
| Time weighting I | Single burst 5 ms at 2000 Hz | Pass | 0.3 | |
| | Repeated at frequency of 100 Hz | Pass | 0.3 | |
| Time averaging | 1 ms burst duty factor $1/10^3$ 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:** 02-May-2019

**Checked by:** Shek Kwong Tat **Date:** 03-May-2019

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.

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HOKLAS 028
CAL

# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0314 01 **Page** 1 **of** 2

## Item tested

| | | | |
|---|---|---|---|
| Description: | Sound Level Meter (Type 1) | , | Microphone |
| Manufacturer: | Larson Davis | , | PCB |
| Type/Model No.: | LxT1 | , | 377B02 |
| Serial/Equipment No.: | 0003737 | , | 171529 |
| Adaptors used: | - | , | - |

## Item submitted by

| | |
|---|---|
| Customer Name: | Lam Geotechnics Ltd. |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 14-Mar-2019 |

## Date of test: 18-Mar-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Multi function sound calibrator | B&K 4226 | 2288444 | 23-Aug-2019 | CIGISMEC |
| Signal generator | DS 360 | 61227 | 26-Dec-2019 | CEPREI |

## Ambient conditions

| | |
|---|---|
| Temperature: | 21 ± 1 °C |
| Relative humidity: | 55 ± 10 % |
| Air pressure: | 1005 ± 5 hPa |

## Test specifications

1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.

2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.

3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess 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:** 19-Mar-2019 **Company Chop:** SOILS AND MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

**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.

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# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 19CA0314 01 **Page** 2 **of** 2

## 1, Electrical Tests

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

| Test: | Subtest: | Status: | Expanded Uncertainty (dB) | Coverage Factor |
|---|---|---|---|---|
| Self-generated noise | A | Pass | 0.3 | |
| | C | Pass | 0.8 | 2.1 |
| | Lin | Pass | 1.6 | 2.2 |
| Linearity range for Leq | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| | Reference SPL on all other ranges | Pass | 0.3 | |
| | 2 dB below upper limit of each range | Pass | 0.3 | |
| | 2 dB above lower limit of each range | Pass | 0.3 | |
| Linearity range for SPL | At reference range , Step 5 dB at 4 kHz | Pass | 0.3 | |
| 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 | N/A | N/A | |
| 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:** Fong Chun Wai **Date:** 18-Mar-2019

**Checked by:** Fung Chi Yip **Date:** 19-Mar-2019

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.

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# CERTIFICATE OF CALIBRATION

**Certificate No.:** 19CA0617 03-02 **Page:** 1 **of** 2

## Item tested

| | |
|---|---|
| Description: | Acoustical Calibrator (Class 1) |
| Manufacturer: | Honglim Co., Ltd. |
| Type/Model No.: | HLES-02 |
| Serial/Equipment No.: | 2016611465 |
| Adaptors used: | - |

## Item submitted by

| | |
|---|---|
| Curstomer: | Lam Environmental Services Limired. |
| Address of Customer: | - |
| Request No.: | - |
| Date of receipt: | 17-Jun-2019 |

## Date of test: 19-Jun-2019

## Reference equipment used in the calibration

| Description: | Model: | Serial No. | Expiry Date: | Traceable to: |
|---|---|---|---|---|
| Lab standard microphone | B&K 4180 | 2341427 | 03-May-2020 | SCL |
| Preamplifier | B&K 2673 | 2239857 | 17-May-2020 | CEPREI |
| Measuring amplifier | B&K 2610 | 2346941 | 05-Jun-2020 | CEPREI |
| Signal generator | DS 360 | 61227 | 10-May-2020 | CEPREI |
| Digital multi-meter | 34401A | US36087050 | 08-May-2020 | CEPREI |
| Audio analyzer | 8903B | GB41300350 | 13-May-2020 | CEPREI |
| Universal counter | 53132A | MY40003662 | 10-May-2020 | CEPREI |

## Ambient conditions

| | |
|---|---|
| Temperature: | 22 ± 1 °C |
| Relative humidity: | 55 ± 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:** Feng Junqi **Date:** 19-Jun-2019 **Company Chop:**

SOILS AND MATERIALS ENGINEERING COMPANY LTD. 綜合試驗有限公司

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

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# CERTIFICATE OF CALIBRATION

(Continuation Page)

**Certificate No.:** 19CA0617 03-02 **Page:** 2 **of** 2

## 1, Measured Sound Pressure Level

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

(Output level in dB re 20 μPa)

| Frequency Shown Hz | Output Sound Pressure Level Setting dB | Measured Output Sound Pressure Level dB | Estimated Expanded Uncertainty dB |
|---|---|---|---|
| 1000 | 94.00 | 93.85 | 0.10 |

## 2, Sound Pressure Level Stability - Short Term Fluctuations

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

**At 1000 Hz** **STF = 0.012 dB**

Estimated expanded uncertainty 0.005 dB

## 3, Actual Output Frequency

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

**At 1000 Hz** **Actual Frequency = 1003.6 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 = 0.3 %**

Estimated expanded uncertainty 0.7 %

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

- End -

**Calibrated by:** Fung Chi Yip **Date:** 19-Jun-2019

**Checked by:** Shek Kwong Tat **Date:** 19-Jun-2019

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.