

## ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

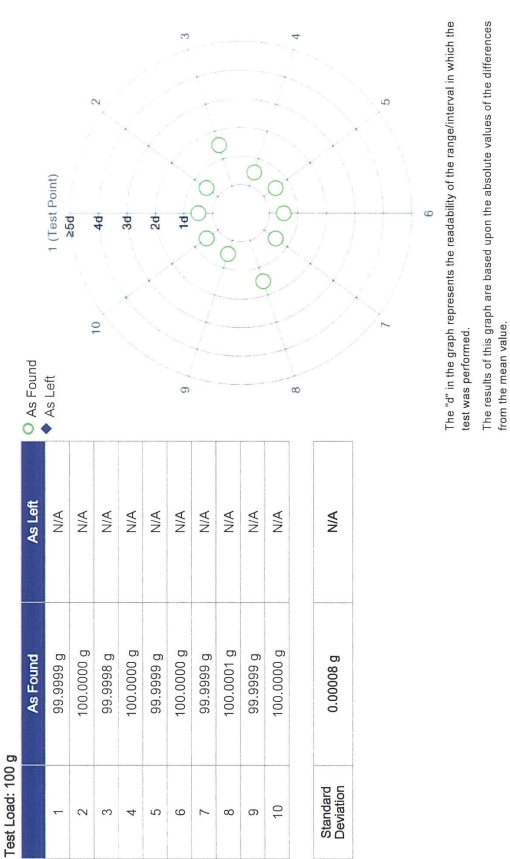
รายการใบรับรองสอบเทียบเครื่องมือหลักประจำห้องปฏิบัติการสำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

| No.  | Instrument/Equipment                       | Parameter  | Manufacturer   | Model/Serial No.             | Calibrator                     | Certification No.            | Date of Calibration | Due date of Calibration * | Remark |
|--|--|------------|----------------|------------------------------|--------------------------------|------------------------------|---------------------|---------------------------|--------|
| Laboratory Instrument/Equipments. (Air Quality Analysis) |  |            |                |                              |                                |                              |                     |                           |        |
| 1  | Analytical Balance<br>(Readability 0.1 mg) | TSP, PM-10 | Mettler-Toledo | AB204-S /<br>1128312528      | Mettler-Toledo (Thailand) Ltd. | TH2058-097-040722-<br>ACC-TH | 7 Apr 22            | 6 Apr 23                  | -      |
| 2  | Analytical Balance<br>(Readability 0.1 mg) |            | Mettler-Toledo | AB204-S/FACT /<br>B108115858 | Mettler-Toledo (Thailand) Ltd. | TH2058-098-040722-<br>ACC-TH | 7 Apr 22            | 6 Apr 23                  | -      |

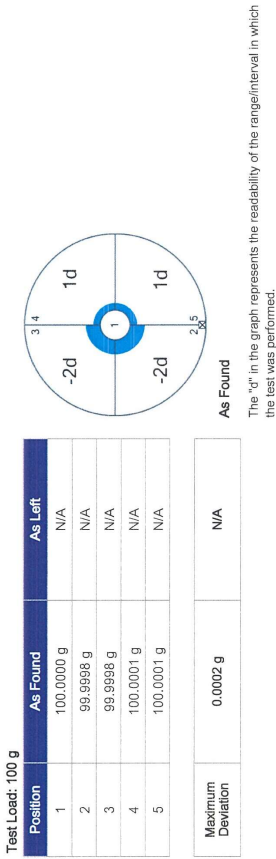
Due Date of Calibration\* : Schedule the program once a year at least once a year.

## Measurement Results

### Repeatability




### Eccentricity



Mettler-Toledo (Thailand) Ltd.  
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH.ServiceSupport@mt.com

## Accuracy Calibration Certificate

### Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Phra Khanong  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number:  0 3 3 2 4 3 9 0 6 \*

Contact: Suwit Chotnok

### Weighing Device

Manufacturer: Mettler Toledo  
Model: AB204-S  
Serial No.: 1128312528  
Building: N/A  
Floor: 2  
Room: Balance Room 2 (206)

Instrument Type: Weighing Instrument  
Asset Number: UAE-AIR 019/2550  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

| Range | Max. Capacity | Readability (g) |
|-------|---------------|-----------------|
| 1     | 220 g         | 0.0001 g        |


### Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
Mettler Toledo Work Instruction: CP/W002/20  
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.  
The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.  
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

|          | Temperature                 | Humidity                  |
|----------|-----------------------------|---------------------------|
| As Found | Start: 22.5 °C End: 21.4 °C | Start: 56.1 % End: 63.2 % |

As Found Calibration Date: 07-Apr-2022  
As Left Calibration Date: N/A  
Issue Date: 08-Apr-2022

Calibrator:   
Sriwit Chamchan

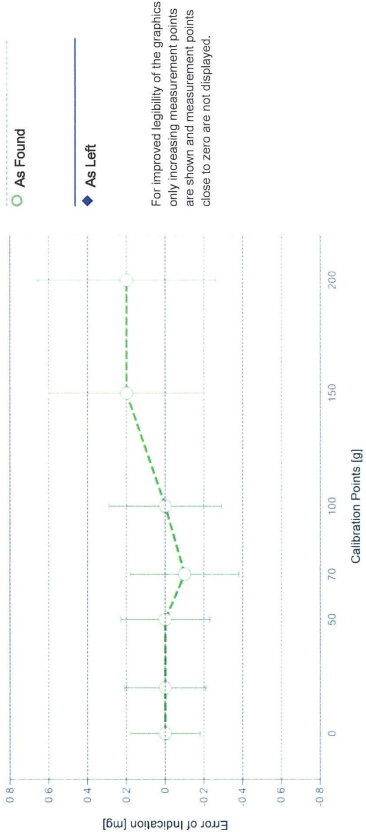
Approved Signatory:   
Kassakorn Tassanachaisakul  
☒ Santi Jitinyom  
☐ Surachet Sukkate

Remarks

Equipment condition: Good  
Next calibration according to customer's procedure  
Calibration data not decide by calibration laboratory  
Test weight by Filler pan : 1 g = 0.9999 g, 3 g = 3.0000 g, 5 g = 5.0000 g  
  
End of Accredited Section  
  
The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Error of Indication

| As Found |                 |            |                     |                      |
|----------|-----------------|------------|---------------------|----------------------|
|          | Reference Value | Indication | Error of Indication | Expanded Uncertainty |
| 1        | 0.0000 g        | 0.0000 g   | 0.0000 g            | 0.18 mg              |
| 2        | 0.1000 g        | 0.1000 g   | 0.0000 g            | 0.19 mg              |
| 3        | 1.0000 g        | 0.9999 g   | -0.0001 g           | 0.19 mg              |
| 4        | 5.0000 g        | 5.0000 g   | 0.0000 g            | 0.19 mg              |
| 5        | 10.0000 g       | 9.9999 g   | -0.0001 g           | 0.20 mg              |
| 6        | 20.0000 g       | 20.0000 g  | 0.0000 g            | 0.21 mg              |
| 7        | 50.0000 g       | 50.0000 g  | 0.0000 g            | 0.23 mg              |
| 8        | 70.0001 g       | 70.0000 g  | -0.0001 g           | 0.28 mg              |
| 9        | 100.0000 g      | 100.0000 g | 0.0000 g            | 0.29 mg              |
| 10       | 150.0000 g      | 150.0002 g | 0.0002 g            | 0.40 mg              |
| 11       | 200.0001 g      | 200.0003 g | 0.0002 g            | 0.46 mg              |



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

|                     |            |                       |             |
|---------------------|------------|-----------------------|-------------|
| Weight Set No.:     | WS80       | Date of Issue:        | 23-Feb-2022 |
| Certificate Number: | C208581631 | Calibration Due Date: | 14-Aug-2023 |

Thermo Hygrometer

|                     |         |                       |             |
|---------------------|---------|-----------------------|-------------|
| Equipment No.:      | IN161   | Date of Issue:        | 14-Jun-2021 |
| Certificate Number: | 21H1220 | Calibration Due Date: | 01-Jun-2022 |



Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

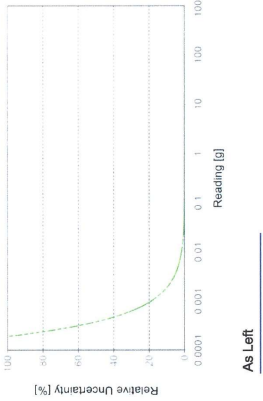
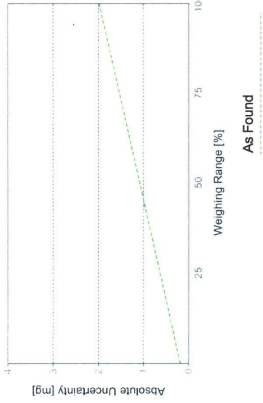
Linearization of Uncertainty Equation

| Range |          | As Found | As Left |
|-------|----------|----------|---------|
| d     | Max      |          |         |
| 1     | 0.0001 g | 220 g    | N/A     |

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

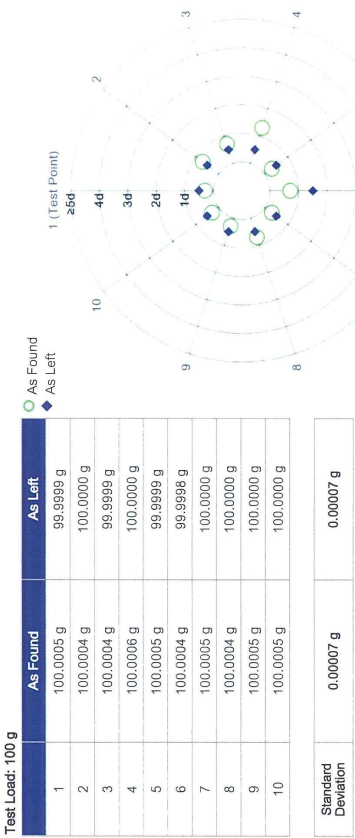
Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

| Net Indication | As Found |          | As Left |     |
|----------------|----------|----------|---------|-----|
|                |          |          |         |     |
| 0.0220 g       | 0.19 mg  | 0.86%    | N/A     | N/A |
| 0.2200 g       | 0.19 mg  | 0.087%   | N/A     | N/A |
| 2.2000 g       | 0.21 mg  | 0.0095%  | N/A     | N/A |
| 22.0000 g      | 0.37 mg  | 0.0017%  | N/A     | N/A |
| 220.0000 g     | 2.0 mg   | 0.00090% | N/A     | N/A |



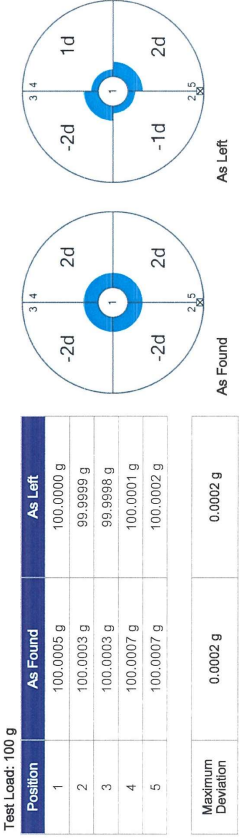
## Measurement Results

### Repeatability



The "g" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### Eccentricity




The "g" in the graph represents the readability of the range/interval in which the test was performed.

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## Accuracy Calibration Certificate

### Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Phra Khanong  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number:  20332439062  
Contact: Suwit Chotnok

### Weighing Device

Manufacturer: Mettler Toledo  
Model: AB204-S/FACT  
Serial No.: B108115858  
Building: N/A  
Floor: 2  
Room: Balance Room 2 (206)  
Weighing Instrument: UAE.AIR.016/2555  
Asset Number: N/A  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

### Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
Mettler Toledo Work Instruction: CP/W002/20  
This calibration certificate contains measurements for As Found and As Left calibrations.  
The sensitivity/span of the weighing instrument was adjusted before As Found and As Left calibrations with a built-in weight.  
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

|          | Temperature                    | Humidity                     |
|----------|--------------------------------|------------------------------|
| As Found | Start: 22.6 °C    End: 22.1 °C | Start: 56.0 %    End: 51.9 % |
| As Left  | Start: 22.3 °C    End: 22.4 °C | Start: 46.2 %    End: 55.8 % |

As Found Calibration Date: 07-Apr-2022  
As Left Calibration Date: 07-Apr-2022  
Issue Date: 08-Apr-2022  
Calibrator:   
Approved Signatory:   
Sirawit Chamchan  
Kasakorn Tassanachaisakul  
Santi Jitnyom  
Surachet Sukkate

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.: WS80 Date of Issue: 23-Feb-2022  
Certificate Number: C208581631 Calibration Due Date: 14-Aug-2023

Thermo Hygrometer

Equipment No.: IN161 Date of Issue: 14-Jun-2021  
Certificate Number: 21H1220 Calibration Due Date: 01-Jun-2022

Remarks

FACT adjustment functionality activated

Value of the built-in weight adjusted

Equipment condition: Good

Next calibration according to customer's procedure

Calibration data not decide by calibration laboratory

Test weight by Filter pan : 1 g = 1,0000 g, 3 g = 3,0000 g, 5 g = 5,0000 g

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

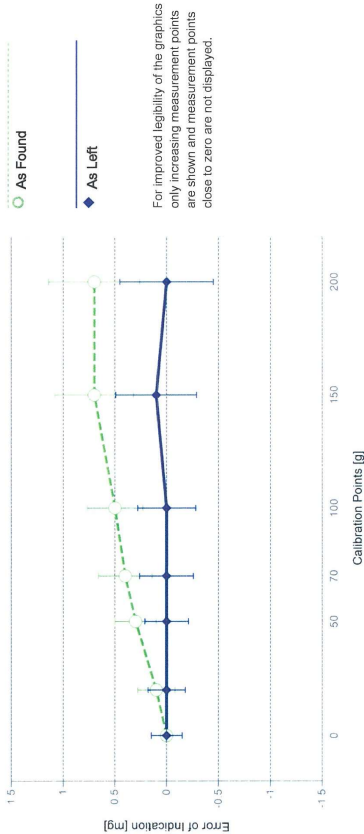
Error of Indication

As Found

|    | Reference Value | Indication | Error of Indication | Expanded Uncertainty | k |
|----|-----------------|------------|---------------------|----------------------|---|
| 1  | 0.0000 g        | 0.0000 g   | 0.0000 g            | 0.15 mg              | 2 |
| 2  | 0.1000 g        | 0.1001 g   | 0.0001 g            | 0.16 mg              | 2 |
| 3  | 1.0000 g        | 0.9999 g   | -0.0001 g           | 0.16 mg              | 2 |
| 4  | 5.0000 g        | 5.0000 g   | 0.0000 g            | 0.16 mg              | 2 |
| 5  | 10.0000 g       | 10.0001 g  | 0.0001 g            | 0.17 mg              | 2 |
| 6  | 20.0000 g       | 20.0001 g  | 0.0001 g            | 0.18 mg              | 2 |
| 7  | 50.0000 g       | 50.0003 g  | 0.0003 g            | 0.20 mg              | 2 |
| 8  | 70.0001 g       | 70.0005 g  | 0.0004 g            | 0.26 mg              | 2 |
| 9  | 100.0000 g      | 100.0005 g | 0.0005 g            | 0.27 mg              | 2 |
| 10 | 150.0000 g      | 150.0007 g | 0.0007 g            | 0.38 mg              | 2 |
| 11 | 200.0001 g      | 200.0008 g | 0.0007 g            | 0.44 mg              | 2 |

As Left

|    | Reference Value | Indication | Error of Indication | Expanded Uncertainty | k |
|----|-----------------|------------|---------------------|----------------------|---|
| 1  | 0.0000 g        | 0.0000 g   | 0.0000 g            | 0.15 mg              | 2 |
| 2  | 0.1000 g        | 0.1000 g   | 0.0000 g            | 0.16 mg              | 2 |
| 3  | 1.0000 g        | 0.9999 g   | -0.0001 g           | 0.17 mg              | 2 |
| 4  | 5.0000 g        | 5.0000 g   | 0.0000 g            | 0.17 mg              | 2 |
| 5  | 10.0000 g       | 10.0000 g  | 0.0000 g            | 0.17 mg              | 2 |
| 6  | 20.0000 g       | 20.0000 g  | 0.0000 g            | 0.18 mg              | 2 |
| 7  | 50.0000 g       | 50.0000 g  | 0.0000 g            | 0.21 mg              | 2 |
| 8  | 70.0001 g       | 70.0001 g  | 0.0000 g            | 0.26 mg              | 2 |
| 9  | 100.0000 g      | 100.0000 g | 0.0000 g            | 0.28 mg              | 2 |
| 10 | 150.0000 g      | 150.0001 g | 0.0001 g            | 0.39 mg              | 2 |
| 11 | 200.0001 g      | 200.0001 g | 0.0000 g            | 0.45 mg              | 2 |



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:

2.5 · 10<sup>-9</sup> / K

Temperature range on site for the evaluation of the measurement uncertainty in use:

3 K

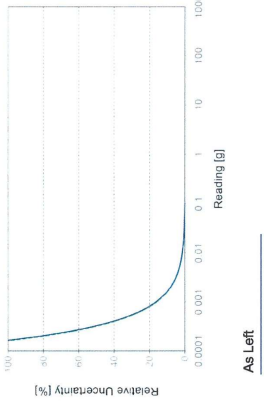
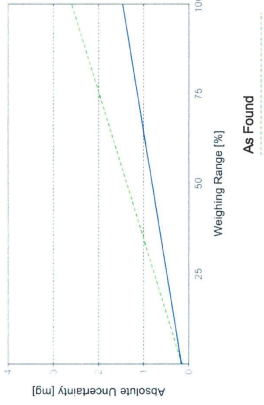
Linearization of Uncertainty Equation

| Range |          | As Found | As Left   |
|-------|----------|----------|---|
| d     | Max      |          |   |
| 1     | 0.0001 g | 220 g    | U <sub>1</sub> = 0.16 mg + 0.0111 mg/g · R<br>U <sub>1</sub> = 0.16 mg + 0.00592 mg/g · R |

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

| Net Indication | As Found   |         | As Left |          |
|----------------|------------|---------|---------|----------|
|                | 0.0220 g   | 0.16 mg | 0.16 mg | 0.73%    |
|                | 0.2200 g   | 0.16 mg | 0.16 mg | 0.073%   |
|                | 2.2000 g   | 0.18 mg | 0.17 mg | 0.0079%  |
|                | 22.0000 g  | 0.40 mg | 0.29 mg | 0.0013%  |
|                | 220.0000 g | 2.6 mg  | 1.5 mg  | 0.00066% |



### List of Instruments Certification for Air & Noise Quality Analysis

| No.            | Instrument/Equipment                            | Parameter   | Manufacturer               | Model/Serial No.    | Calibrator   | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|----------------|---|---|----------------------------|---------------------|--|-------------------|---------------------|-------------------------|--------|
| <b>Ambient</b> |   |   |                            |                     |  |                   |                     |                         |        |
| 1              | Orifice Transfer Standard Calibrator            | Total Suspended Particulate (TSP)<br>Particulate Matter < 10 µm (PM <sub>10</sub> ) | Andersen Instruments, Inc. | G25A<br>11MX        | Tisch Environmental, Inc.                            | 28062022          | 28 Jun 21           | 27 Jun 23               | -      |
| 2              | U-Tube Manometer                                | Total Suspended Particulate (TSP)<br>Particulate Matter < 10 µm (PM <sub>10</sub> ) | Dwyer                      | 1221-36-W/M<br>-    | Technology Promotion Association<br>(Thailand-Japan) | 22P800            | 12 Mar 22           | 11 Mar 23               | -      |
| 3              | Aneroid Barometer                               | Total Suspended Particulate (TSP)<br>Particulate Matter < 10 µm (PM <sub>10</sub> ) | Barigo, Germany            | -                   | Technology Promotion Association<br>(Thailand-Japan) | 21P2502           | 21 Jul 21           | 20 Jul 22               | -      |
| 4              | Dial Thermo-Hygrometer                          | Total Suspended Particulate (TSP)<br>Particulate Matter < 10 µm (PM <sub>10</sub> ) | Barigo, Germany            | -                   | Technology Promotion Association<br>(Thailand-Japan) | 22H770            | 5 Apr 22            | 4 Apr 23                | -      |
| 5              | Wind Speed/Wind Direction                       | WS/WD   | Scarlet Tech Ltd.          | WL-21<br>2111DT0004 | Scarlet Tech Ltd.                                    | 22022022          | 22 Feb 22           | 21 Feb 23               | -      |
| 6              | Wind Speed/Wind Direction                       | WS/WD   | Scarlet Tech Ltd.          | WL-21<br>2111DT0041 | Scarlet Tech Ltd.                                    | 25032022          | 25 Mar 22           | 24 Mar 23               | -      |
| 7              | Wind Speed/Wind Direction                       | WS/WD   | Scarlet Tech Ltd.          | WL-21<br>2111DT0052 | Scarlet Tech Ltd.                                    | 25032022          | 25 Mar 22           | 24 Mar 23               | -      |
| 8              | Wind Speed/Wind Direction                       | WS/WD   | Scarlet Tech Ltd.          | WL-21<br>2111DT0058 | Scarlet Tech Ltd.                                    | 25032022          | 25 Mar 22           | 24 Mar 23               | -      |
| 9              | Sound Level Calibrator<br>(Acoustic Calibrator) | Calibrate Sound Level Meter   | Svantek                    | SV36<br>107224      | Innovative Instrument<br>Co.,Ltd.                    | 21-ACT-326        | 24 Aug 21           | 23 Aug 22               | -      |
| 10             | Sound Level Meter                               | L <sub>Aeq</sub> 24 hr, L <sub>Amax</sub> , L <sub>A1hr</sub> , L <sub>A90</sub>    | Larson Davis               | LxT2<br>0006614     | Innovative Instrument<br>Co.,Ltd.                    | 22-ACT-104        | 11 Feb 22           | 10 Feb 23               | -      |
| 11             | Sound Level Meter                               | L <sub>Aeq</sub> 24 hr, L <sub>Amax</sub> , L <sub>A1hr</sub> , L <sub>A90</sub>    | Larson Davis               | LxT2<br>0006615     | Innovative Instrument<br>Co.,Ltd.                    | 22-ACT-102        | 11 Feb 22           | 10 Feb 23               | -      |
| 12             | Sound Level Meter                               | L <sub>Aeq</sub> 24 hr, L <sub>Amax</sub> , L <sub>A1hr</sub> , L <sub>A90</sub>    | Larson Davis               | LxT2<br>0006616     | Innovative Instrument<br>Co.,Ltd.                    | 22-ACT-113        | 15 Feb 22           | 14 Feb 23               | -      |

### List of Instruments Certification for Air & Noise Quality Analysis

| No.            | Instrument/Equipment | Parameter  | Manufacturer | Model/Serial No. | Calibrator                        | Certification No. | Date of Calibration | Due date of Calibration | Remark |
|----------------|----------------------|--|--------------|------------------|-----------------------------------|-------------------|---------------------|-------------------------|--------|
| <b>Ambient</b> |                      |  |              |                  |                                   |                   |                     |                         |        |
| 13             | Sound Level Meter    | L <sub>Aeq</sub> 24 hr, L <sub>Amax</sub> , L <sub>A1hr</sub> , L <sub>A90</sub> | Larson Davis | LxT2<br>0006617  | Innovative Instrument<br>Co.,Ltd. | 22-ACT-100        | 11 Feb 22           | 10 Feb 23               | -      |





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250  
TEL: 0-2717-5000-24 FAX: 0-2719-9484

## Certificate of Calibration

Certificate No.: 22P800  
Page: 1 of 2

Equipment: U-Tube Manometer  
Manufacturer: Dwyer  
Model: 1221-36-W/M  
Serial No.:  
ID No.: UAE.EFM.022/2560  
Condition As-Received: Used Item  
Received Date: 03 March 2022  
Calibration Date: 12 March 2022  
Reference: 2203-0131WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1010 mbar

Submitted by: United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,  
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using "DKD-R 6-1" ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration  
1. Reference standards instruments :  
1) Pressure Calibrator  
Model PC106P  
Serial No. 1189  
Certificate No. MP-0110-21  
Due Date 09 Aug 2022

2. This result of calibration was made on requested at the point specified by customer.  
3. Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O  
4. This instrument was used clean air as pressure media.  
5. This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.  
6. This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.  
7. The certificate is valid only to the item calibrated on date and place of calibration.  
8. This Certification is traceable to the International System of Unit maintained at:-  
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Suwit Aussarree  
Issue Date: 14 March 2022  
Approved Signatory: *Attapol P.*  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwanasri  
[x] Attapol Panurach

เอกสารไม่ควบคุม

B 0282413



RECALIBRATION  
DUE DATE:  
June 28, 2022

## Certificate of Calibration

Calibration Certification Information  
Cal. Date: June 28, 2021  
Operator: Jim Tisch  
Calibration Model #: G25A  
Rootsmeier S/N: 438320  
Pa: 753.6 mm Hg  
Calibrator S/N: 11MX

| Run | Vol. Init<br>(m3) | Vol. Final<br>(m3) | ΔVol.<br>(m3) | ΔTime<br>(min) | ΔP<br>(mm Hg) | ΔH<br>(in H <sub>2</sub> O) |
|-----|-------------------|--------------------|---------------|----------------|---------------|-----------------------------|
| 1   | 1                 | 2                  | 1             | 1.3910         | 3.3           | 2.00                        |
| 2   | 3                 | 4                  | 1             | 0.9890         | 6.4           | 4.00                        |
| 3   | 5                 | 6                  | 1             | 0.8850         | 8.0           | 5.00                        |
| 4   | 7                 | 8                  | 1             | 0.8430         | 9.0           | 5.50                        |
| 5   | 9                 | 10                 | 1             | 0.6970         | 12.9          | 8.00                        |

### Data Tabulation

| Vstd<br>(m3) | Qstd<br>(x-axis)                        | $\sqrt{\frac{\Delta H}{P_{std}}} \left( \frac{P_a}{T_{std}} \right) \left( \frac{T_a}{P_a} \right)$<br>(y-axis) | Va<br>(x-axis)                          | Qa<br>(y-axis) | $\sqrt{\frac{\Delta H}{P_a}} \left( \frac{T_a}{P_a} \right)$<br>(y-axis) |
|--------------|---|---|---|----------------|--|
| 0.9906       | 0.7121                                  | 1.4106  | 0.9956                                  | 0.7158         | 0.8878   |
| 0.9865       | 0.9975                                  | 1.9949  | 0.9915                                  | 1.0025         | 1.2555   |
| 0.9844       | 1.1123                                  | 2.2304  | 0.9894                                  | 1.1179         | 1.4037   |
| 0.9831       | 1.1661                                  | 2.3393  | 0.9881                                  | 1.1721         | 1.4723   |
| 0.9779       | 1.4030                                  | 2.8213  | 0.9829                                  | 1.4102         | 1.7756   |
| QSTD         | m= 2.04215<br>b= -0.04258<br>r= 1.00000 | QA  | m= 1.27876<br>b= -0.02680<br>r= 1.00000 |                |  |

### Calculations

|  |   |
|--|---|
| Vstd= $\Delta Vol / (P_a - \Delta P) / P_{std} (T_{std} / T_a)$  | Va= $\Delta Vol / (P_a - \Delta P) / P_a$   |
| Qstd= $V_{std} / \Delta Time$  | Qa= $V_a / \Delta Time$   |
| For subsequent flow rate calculations:   |   |
| Qstd= $1/m \left( \sqrt{\frac{\Delta H}{P_a}} \left( \frac{P_a}{T_{std}} \right) \left( \frac{T_{std}}{P_a} \right) - b \right)$ | Qa= $1/m \left( \sqrt{\frac{\Delta H}{P_a}} \left( \frac{T_a}{P_a} \right) - b \right)$ |

### Standard Conditions

|       |  |
|-------|--|
| Tstd: | 298.15 °K  |
| Pstd: | 760 mm Hg  |
| Key   |  |
| ΔH:   | calibrator manometer reading (in H <sub>2</sub> O) |
| ΔP:   | rootsmeier 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

Tisch Environmental, Inc.  
145 South Miami Avenue  
Village of Cleves, OH 45002  
www.tisch-env.com  
TOLL FREE: (877)263-7610  
FAX: (513)467-9009

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 21P2502  
Page : 1 of 2

Equipment : Aneroid Barometer  
Manufacturer: Barigo  
Model :  
Serial No.:  
ID No.: UAE.ANV.151/2550  
Condition As-Received: Used Item  
Received Date: 20 July 2021  
Calibration Date: 21 July 2021

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2107-0570WSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1009 mbar  
Submitted by: United Analyst and Engineering Consultant Co., Ltd.  
81 Soi Udonsuk 41, Sukhumvit Road, Bangkok,  
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments  
Standard according to in-house calibration procedure CP-P10, using "DKD-R 6-1 ; Calibration of Pressure  
Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1. Reference standards instruments :

| Instrument            | Model  | Serial No. | Certificate No. | Due Date    |
|-----------------------|--------|------------|-----------------|-------------|
| 1) Standard Barometer | DP1142 | 1422505046 | MP-0053-21      | 08 Apr 2022 |

2. This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3. This result of calibration was made on requested at the point specified by customer.

4. This instrument was used clean air as pressure media.

5. The certificate is valid only to the item calibrated on date and place of calibration.

6. This Certificate is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussamee  
Issue Date : 22 July 2021

Approved Signatory : Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwanmasri  
✓ Attapol Panurach

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Cert.No.: 22P800  
Page: 2 of 2

Result of calibration:- Without adjustment  
Function:- Pressure Measurement  
Increasing Pressure  
Range : 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O  
Scale Interval : 0.1 inH<sub>2</sub>O ( The Fifth Estimate )

| UUC Indication                           |  |                                       |                            |
|--|--|---------------------------------------|----------------------------|
| Applied Pressure<br>(inH <sub>2</sub> O) | High-port side<br>(inH <sub>2</sub> O) | Low-port side<br>(inH <sub>2</sub> O) | ΔP<br>(inH <sub>2</sub> O) |
| 0.00                                     | 0.00                                   | 0.00                                  | 0.00                       |
| 2.00                                     | 1.00                                   | -1.00                                 | 2.00                       |
| 4.00                                     | 2.00                                   | -2.00                                 | 4.00                       |
| 6.00                                     | 3.00                                   | -3.00                                 | 6.00                       |
| 8.00                                     | 4.00                                   | -4.00                                 | 8.00                       |
| 10.00                                    | 5.00                                   | -5.02                                 | 10.02                      |
| 12.00                                    | 6.00                                   | -6.02                                 | 12.02                      |
| 14.00                                    | 7.00                                   | -7.04                                 | 14.04                      |
| 16.00                                    | 8.00                                   | -8.04                                 | 16.04                      |
| 18.00                                    | 9.00                                   | -9.04                                 | 18.04                      |
| 20.00                                    | 10.00                                  | -10.04                                | 20.04                      |
| 22.00                                    | 11.00                                  | -11.02                                | 22.02                      |
| 24.00                                    | 12.00                                  | -12.02                                | 24.02                      |
| 26.00                                    | 13.00                                  | -13.02                                | 26.02                      |
| 28.00                                    | 14.00                                  | -14.04                                | 28.04                      |
| 30.00                                    | 15.00                                  | -15.04                                | 30.04                      |
| 32.00                                    | 16.00                                  | -16.04                                | 32.04                      |
| 34.00                                    | 16.98                                  | -17.06                                | 34.04                      |
| 35.80                                    | 17.98                                  | -18.00                                | 35.98                      |

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

The reported uncertainty of measurement was based on a standard uncertainty multiplied  
by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 %.

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CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, BANGKOK 10250

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NSC-TS1-TIS17025  
CALIBRATION 0008

## Certificate of Calibration

Certificate No. : 22H770

Page : 1 of 2

**Equipment :** Dial Thermo-Hygrometer  
**Manufacturer:** Barigo  
**Model :** -  
**Serial No.:** -  
**ID No.:** UAE.ANV.003/2545  
**Condition As-Received:** Used Item  
**Received Date:** 30 March 2022  
**Calibration Date:** 01 April 2022  
**Reference:** to 05 April 2022  
**Ambient Temperature:** 2203-1124WSC  
**Relative Humidity:** ( 25 ± 3 ) °C ( 50 ± 20 ) %

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

**Submitted by:** United Analyst and Engineering Consultant Co.,Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-H02 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

1.Reference standards instruments :

| Instrument                                   | Model        | Serial No. | Certificate No. | Due Date    |
|--|--------------|------------|-----------------|-------------|
| 1) Standard Chilled Mirror Hygrometer Sensor | Dew Prime II | 31863      | 19714           | 17 Sep 2022 |
| 2) Standard Humidity/Temperature Meter       | 400          | 10203027   | TH-0063-21      | 01 Jul 2022 |

2.The certificate is valid only to the item calibrated on date and place of calibration.

3.This Certification is traceable to the International System of Unit maintained at:-  
-National Institute of Standards and Technology (NIST) , The United States of America  
-National Institute of Metrology Thailand (NIMT)

**Calibrated by :** Somchai Dumwor  
**Issue Date :** 08 April 2022

**Approved Signatory :**

[✓] Chakrit Waewanjua  
[ ] Pornthippa Tameyakul  
[ ] Viporn Tantiyawutti

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B 0285422



Cert.No.: 21P2502  
Page: 2 of 2

**Result of calibration:- Without adjustment**  
**Function:- Absolute Pressure Measurement**  
**Scale Interval: 1 hPa (The Fifth Estimate)**

| Applied Pressure (hPa) | 959.18 | 970.39 | 980.57 | 990.77 | 1000.79 | 1010.71 | 1020.54 | 1030.39 |
|------------------------|--------|--------|--------|--------|---------|---------|---------|---------|
| UUC* Indication (hPa)  | 960.0  | 970.0  | 980.0  | 990.0  | 1000.0  | 1010.0  | 1020.0  | 1030.0  |
| Error (hPa)            | 0.82   | -0.39  | -0.57  | -0.77  | -0.79   | -0.71   | -0.54   | -0.39   |

### Decreasing Pressure

| Applied Pressure (hPa) | 1030.46 | 1020.42 | 1010.54 | 1000.67 | 990.64 | 980.74 | 970.54 | 959.39 |
|------------------------|---------|---------|---------|---------|--------|--------|--------|--------|
| UUC* Indication (hPa)  | 1030.0  | 1020.0  | 1010.0  | 1000.0  | 990.0  | 980.0  | 970.0  | 960.0  |
| Error (hPa)            | -0.46   | -0.42   | -0.54   | -0.67   | -0.64  | -0.74  | -0.54  | 0.61   |

The uncertainty of measurement was ± 0.30 hPa

\* UUC = Unit Under Calibration

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 %.

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# Certificate of Calibration

## WL-21 Wireless Anemometer

Scarlet Tech Ltd, hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (st-wl-21) and is within manufacturer's specification at the time when the calibration is done.

**Client:** Envir Service Co., Ltd.

**Serial No.:** 2111DT0004

**Calibration Date:** 2022/2/22

**Calibration Expiry Date:** 2023/2/21

### The Result of Calibration

| Velocity             |  | Actual Value (m/s) | Deviation | Tolerance   | Result |
|----------------------|--|--------------------|-----------|-------------|--------|
| Measured Value (m/s) |  |                    |           |             |        |
| 1.0                  |  | 0.9                | 0.1       | 0.9 - 1.1   | Pass   |
| 2.0                  |  | 2                  | 0         | 1.8 - 2.2   | Pass   |
| 5.0                  |  | 4.8                | 0.2       | 4.7 - 5.3   | Pass   |
| 7.0                  |  | 7.1                | 0.1       | 6.0 - 8.0   | Pass   |
| 10.0                 |  | 9.7                | 0.3       | 9.5 - 10.5  | Pass   |
| 20.0                 |  | 20                 | 0         | 19.0 - 21.0 | Pass   |

| Wind Direction |  | Actual Value | Deviation | Tolerance | Result |
|----------------|--|--------------|-----------|-----------|--------|
| Measured Value |  |              |           |           |        |
| 45°            |  | 48           | 3         | 42 - 48   | Pass   |
| 135°           |  | 134          | 1         | 132 - 138 | Pass   |
| 225°           |  | 227          | 2         | 222 - 228 | Pass   |
| 315°           |  | 315          | 0         | 312 - 318 | Pass   |
| 0°             |  | 1            | 1         | 357 - 3   | Pass   |

| Inspection | Actual Value | Deviation | Tolerance | Result |
|------------|--------------|-----------|-----------|--------|
| Room Temp  | 22.1         | 0.4       | 21.5-23.5 | Pass   |

| Atmospheric Pressure | Actual Value | Deviation | Tolerance | Result |
|----------------------|--------------|-----------|-----------|--------|
| Inspection           | 998          | 2         | 994-1002  | Pass   |

Environment conditions :

Air temperature: 24 °C  
Relative humidity: 58 %  
Static pressure: 118.3 kPa

Performed by:

Jim Lin

Certified by  
Head of Engineering department

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Cert. No.: 22H770  
Page.: 2 of 2

| Result of Calibration:- |  | Humidity measurement       |                           | Without Adjustment   |                               |
|-------------------------|--|----------------------------|---------------------------|----------------------|-------------------------------|
| Function:               |  | Reference Temperature (°C) | Standard Humidity (%R.H.) | UUC* Reading (%R.H.) | Error of Measurement (±%R.H.) |
|                         |  | 25.0                       | 40.1                      | 56.0                 | 1.5                           |
|                         |  | 25.0                       | 60.0                      | 60.5                 | 1.7                           |
|                         |  | 25.0                       | 80.0                      | 63.0                 | 1.7                           |

| Result of Calibration:- |  | Temperature measurement    |                           | Without Adjustment |                            |
|-------------------------|--|----------------------------|---------------------------|--------------------|----------------------------|
| Function:               |  | Reference Temperature (°C) | Standard Temperature (°C) | UUC* Reading (°C)  | Error of Measurement (±°C) |
|                         |  | 20.02                      | 20.02                     | 20.0               | 0.72                       |
|                         |  | 29.98                      | 29.98                     | 30.0               | 0.72                       |
|                         |  | 35.02                      | 35.02                     | 35.5               | 0.72                       |
|                         |  | 40.03                      | 40.03                     | 41.0               | 0.97                       |

UUC\* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor k = 2.00, providing confidence level approximately 95%.

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a 1104142

# Certificate of Calibration

## WL-21 Wireless Anemometer

Scarlet Tech Ltd, hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (st-wl-21) and is within manufacturer's specification at the time when the calibration is done.

**Client:** Envir Service Co., Ltd.

**Serial No.:** 2111DT0052

**Calibration Date:** 2022/3/25

**Calibration Expiry Date:** 2023/3/24

### The Result of Calibration

| Velocity             |  | Actual Value (m/s) | Deviation | Tolerance   | Result |
|----------------------|--|--------------------|-----------|-------------|--------|
| Measured Value (m/s) |  |                    |           |             |        |
| 1.0                  |  | 0.9                | 0.1       | 0.9 - 1.1   | Pass   |
| 2.0                  |  | 1.9                | 0.1       | 1.8 - 2.2   | Pass   |
| 5.0                  |  | 4.8                | 0.2       | 4.7 - 5.3   | Pass   |
| 7.0                  |  | 7.0                | 0         | 6.0 - 8.0   | Pass   |
| 10.0                 |  | 9.9                | 0.1       | 9.5 - 10.5  | Pass   |
| 20.0                 |  | 20.0               | 0         | 19.0 - 21.0 | Pass   |

| Wind Direction |  | Actual Value | Deviation | Tolerance | Result |
|----------------|--|--------------|-----------|-----------|--------|
| Measured Value |  |              |           |           |        |
| 45°            |  | 45           | 0         | 42 - 48   | Pass   |
| 135°           |  | 137          | 2         | 132 - 138 | Pass   |
| 225°           |  | 223          | 2         | 222 - 228 | Pass   |
| 315°           |  | 316          | 2         | 312 - 318 | Pass   |
| 0°             |  | 1            | 1         | 357 - 3   | Pass   |

| Inspection | Actual Value | Deviation | Tolerance | Result |
|------------|--------------|-----------|-----------|--------|
| Room Temp  | 24.0         | 0.2       | 23.2-25.2 | Pass   |

| Atmospheric Pressure Inspection | Actual Value | Deviation | Tolerance | Result |
|---------------------------------|--------------|-----------|-----------|--------|
| 998                             | 1000         | 2         | 994-1002  | Pass   |

Environment conditions :

Air temperature: 22 °C

Relative humidity: 62 %

Static pressure: 102.2 kPa

**Performed by:**

*Jim Lin*

Certified by  
Head of Engineering department

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# Certificate of Calibration

## WL-21 Wireless Anemometer

Scarlet Tech Ltd, hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (st-wl-21) and is within manufacturer's specification at the time when the calibration is done.

**Client:** Envir Service Co., Ltd.

**Serial No.:** 2111DT0041

**Calibration Date:** 2022/3/25

**Calibration Expiry Date:** 2023/3/24

### The Result of Calibration

| Velocity             |  | Actual Value (m/s) | Deviation | Tolerance   | Result |
|----------------------|--|--------------------|-----------|-------------|--------|
| Measured Value (m/s) |  |                    |           |             |        |
| 1.0                  |  | 1                  | 0         | 0.9 - 1.1   | Pass   |
| 2.0                  |  | 1.8                | 0.2       | 1.8 - 2.2   | Pass   |
| 5.0                  |  | 5                  | 0         | 4.7 - 5.3   | Pass   |
| 7.0                  |  | 7.2                | 0.2       | 6.0 - 8.0   | Pass   |
| 10.0                 |  | 9.9                | 0.1       | 9.5 - 10.5  | Pass   |
| 20.0                 |  | 20                 | 0         | 19.0 - 21.0 | Pass   |

| Wind Direction |  | Actual Value | Deviation | Tolerance | Result |
|----------------|--|--------------|-----------|-----------|--------|
| Measured Value |  |              |           |           |        |
| 45°            |  | 43           | 2         | 42 - 48   | Pass   |
| 135°           |  | 135          | 0         | 132 - 138 | Pass   |
| 225°           |  | 227          | 2         | 222 - 228 | Pass   |
| 315°           |  | 318          | 3         | 312 - 318 | Pass   |
| 0°             |  | 0            | 0         | 357 - 3   | Pass   |

| Inspection | Actual Value | Deviation | Tolerance | Result |
|------------|--------------|-----------|-----------|--------|
| Room Temp  | 24.8         | 0.6       | 23.2-25.2 | Pass   |

| Atmospheric Pressure Inspection | Actual Value | Deviation | Tolerance | Result |
|---------------------------------|--------------|-----------|-----------|--------|
| 998                             | 1001         | 3         | 994-1002  | Pass   |

Environment conditions :

Air temperature: 22 °C

Relative humidity: 62 %

Static pressure: 102.2 kPa

**Performed by:**

*Jim Lin*

Certified by  
Head of Engineering department

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1. Indication at the calibration check frequency

| UUC Setting        | Nominal       |  | Before Adjust |             | Adjust      |             | Acceptance Limit<br>(± dB) |
|--------------------|---------------|--|---------------|-------------|-------------|-------------|----------------------------|
|                    | Level<br>(dB) |  | UUC<br>(dB)   | ERR<br>(dB) | UUC<br>(dB) | ERR<br>(dB) |                            |
| FAST / A / 37-139  |               |  |               |             |             |             |                            |
| Calibrator Setting |               |  |               |             |             |             |                            |
| 1000 Hz 114.00 dB  | 113.85        |  | 114.0         | +0.15       | 113.9       | 0.05        | 0.3                        |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN:58079

2. Self-generated noise, Microphone installed

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 28.7     | 0.10        |

3. Self-generated noise, Microphone replaced by the electrical input signal device

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 28.6     | 0.10        |
| C             | 28.8     | 0.10        |
| Z             | 34.7     | 0.10        |

4. Acoustic signal test of frequency weightings (Without Windscreen)

| UUC Setting   | Deviation from various Frequency Weighting Response curve |      |      |                       | Acceptance Limit<br>(± dB) |
|---------------|---|------|------|-----------------------|----------------------------|
|               | A   | C    | Z    | UNCERTAINTY<br>(± dB) |                            |
| FAST / 37-139 |   |      |      |                       |                            |
| STD Setting   | (dB)  | (dB) | (dB) | (± dB)                |                            |
| 125 Hz        | 0.0   | 0.1  | 0.1  | 0.50                  | 2.0                        |
| 1000 Hz       | 0.0   | 0.0  | 0.0  | 0.60                  | 1.0                        |
| 4000 Hz       | 0.7   | 0.7  | 0.7  | 0.60                  | 3.0                        |
| 8000 Hz       | 1.0   | 0.9  | 0.8  | 0.70                  | 5.0                        |

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

| UUC Setting   | Deviation from various Frequency Weighting Response curve |        |        |  | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|---------------|---|--------|--------|--|-----------------------|----------------------------|
|               | A (dB)  | C (dB) | Z (dB) |  |                       |                            |
| FAST / 37-139 |   |        |        |  |                       |                            |
| STD Setting   |   |        |        |  |                       |                            |
| 63 Hz         | -0.2  | 0.0    | 0.0    |  |                       | 2.0                        |
| 125 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 250 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 500 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 1000 Hz       | 0.0   | 0.0    | 0.0    |  | 0.2                   | 1.0                        |
| 2000 Hz       | 0.0   | 0.1    | 0.0    |  |                       | 2.0                        |
| 4000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 3.0                        |
| 8000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 5.0                        |
| 16000 Hz      | -0.1  | -0.1   | -0.1   |  |                       | +5, -INF.                  |

6. Frequency and time weightings at 1kHz

| UUC Setting   | STD    | Measured          | Acceptance Limit<br>(± dB) |
|---------------|--------|-------------------|----------------------------|
| FAST / 37-139 | REF    |                   |                            |
| UUC Weighting | (dB)   | UUC (dB) ERR (dB) |                            |
| A             | 114.00 | 114.0 0.0         | 0.2                        |
| C             | 114.00 | 114.0 0.0         | 0.2                        |
| Z             | 114.00 | 114.0 0.0         | 0.2                        |

| UUC Setting       | STD    | Measured          | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|-------------------|--------|-------------------|-----------------------|----------------------------|
| 37-139 / A        | REF    | UUC (dB) ERR (dB) |                       |                            |
| UUC Time Response | (dB)   |                   |                       |                            |
| Fast              | 114.00 | 114.0 0.0         |                       | 0.1                        |
| Slow              | 114.00 | 114.0 0.0         | 0.2                   | 0.1                        |
| Leq               | 114.00 | 114.0 0.0         |                       | 0.1                        |



7. Long Term Stability

| UUC Setting       | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------|----------|-------------|------------------|
| FAST / A / 37-139 | UUC      | (± dB)      | (± dB)           |
| STD Setting       |          |             |                  |
| Initial           | 114.0    |             |                  |
| Final             | 114.0    |             |                  |
| Deviated          | 0.0      | 0.1         | 0.3              |

8. Level linearity on the reference level range

| UUC Setting       | Anticipated | Deviation | UNCERTAINTY | Acceptance Limit |
|-------------------|-------------|-----------|-------------|------------------|
| FAST / A / 37-139 | REF         | UUC       | ERR         | (± dB)           |
| STD dB            | (dB)        | (dB)      | (dB)        | (± dB)           |
| 140.00            | 140         | 140.0     | 0.0         | 1.1              |
| 139.00            | 139         | 139.0     | 0.0         | 1.1              |
| 134.00            | 134         | 134.0     | 0.0         | 1.1              |
| 129.00            | 129         | 129.0     | 0.0         | 1.1              |
| 124.00            | 124         | 124.0     | 0.0         | 1.1              |
| 119.00            | 119         | 119.0     | 0.0         | 1.1              |
| 114.00            | 114         | 114.0     | 0.0         | 1.1              |
| 109.00            | 109         | 109.0     | 0.0         | 1.1              |
| 104.00            | 104         | 104.0     | 0.0         | 1.1              |
| 99.00             | 99          | 99.0      | 0.0         | 1.1              |
| 94.00             | 94          | 94.0      | 0.0         | 1.1              |
| 89.00             | 89          | 89.0      | 0.0         | 1.1              |
| 84.00             | 84          | 84.0      | 0.0         | 1.1              |
| 79.00             | 79          | 79.0      | 0.0         | 1.1              |
| 74.00             | 74          | 74.0      | 0.0         | 1.1              |
| 69.00             | 69          | 69.0      | 0.0         | 1.1              |
| 64.00             | 64          | 64.0      | 0.0         | 1.1              |
| 59.00             | 59          | 59.0      | 0.0         | 1.1              |
| 54.00             | 54          | 54.0      | 0.0         | 1.1              |
| 49.00             | 49          | 49.0      | 0.0         | 1.1              |
| 44.00             | 44          | 44.1      | 0.1         | 1.1              |
| 39.00             | 39          | 39.3      | 0.3         | 1.1              |

9. Level linearity including the level range control

| UUC Setting | STD   | Measured | UNCERTAINTY | Acceptance Limit |
|-------------|-------|----------|-------------|------------------|
| FAST / A    | REF   | UUC      | (± dB)      | (± dB)           |
| UUC Range   | (dB)  |          |             |                  |
| 44.1        | 43.7  | -0.4     | 0.3         | 1.1              |
| 114         | 114.0 | 0.0      |             | 1.1              |

10. Tone burst response

| UUC Setting       | STD       | Anticipated | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------|-----------|-------------|----------|-------------|------------------|
| A / 37-139        | Toneburst | Ref         | UUC      | ERR         | (± dB)           |
| UUC Time Response | (ms)      | (dB)        | (dB)     | (dB)        | (± dB)           |
| Fast              | 200       | 135.0       | 135.0    | 0.0         | 1.0              |
|                   | 2         | 118.0       | 117.9    | -0.1        | +1.0, -2.5       |
|                   | 0.25      | 109.0       | 108.7    | -0.3        | +1.5, -5.0       |
| Slow              | 200       | 128.6       | 128.5    | -0.1        | 1.0              |
|                   | 2         | 109.0       | 108.8    | -0.2        | +1.0, -5.0       |
|                   | 200       | 129.0       | 129.0    | 0.0         | 1.0              |
| SEL               | 2         | 109.0       | 109.1    | +0.1        | +1.0, -2.5       |
|                   | 0.25      | 100.0       | 99.7     | -0.3        | +1.5, -5.0       |

11. Peak C Sound level

| UUC Setting         | Anticipated | Measured | UNCERTAINTY | Acceptance Limit |
|---------------------|-------------|----------|-------------|------------------|
| FAST / C / 95-142   | REF         | UUC      | ERR         | (± dB)           |
| STD Setting         | (dB)        | (dB)     | (dB)        | (± dB)           |
| Complete cycle      | 137.4       | 136.7    | -0.70       | 3.0              |
| Positive half cycle | 136.4       | 136.2    | -0.20       | 2.0              |
| Negative half cycle | 136.4       | 136.2    | -0.20       | 2.0              |

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1. Indication at the calibration check frequency

| UUC Setting        | Nominal Level | Before Adjust |          | Adjust   |          | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|--------------------|---------------|---------------|----------|----------|----------|-----------------------|----------------------------|
|                    |               | UUC (dB)      | ERR (dB) | UUC (dB) | ERR (dB) |                       |                            |
| FAST / A / 37-139  |               |               |          |          |          |                       |                            |
| Calibrator Setting |               |               |          |          |          |                       |                            |
| 1000 Hz 114.00 dB  | 113.85        | 113.9         | +0.05    | 113.9    | 0.05     | 0.20                  | 0.3                        |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN.58079

2. Self-generated noise, Microphone installed

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 27.8     | 0.10        |

3. Self-generated noise, Microphone replaced by the electrical input signal device

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 27.7     | 0.10        |
| C             | 27.5     | 0.10        |
| Z             | 34.0     | 0.10        |

4. Acoustic signal test of frequency weightings (Without Windscreen)

| UUC Setting  | Deviation from various Frequency Weighting Response curve |           |           |  | UNCERTAINTY<br>( ± dB) | Acceptance Limit<br>( ± dB) |
|--------------|---|-----------|-----------|--|------------------------|-----------------------------|
|              | Weighting Response curve                                  |           |           |  |                        |                             |
|              | A<br>(dB)   | C<br>(dB) | Z<br>(dB) |  |                        |                             |
| FAST /37-139 |   |           |           |  |                        |                             |
| STD Setting  |   |           |           |  |                        |                             |
| 125 Hz       | -0.1  | 0.1       | 0.1       |  | 0.50                   | 2.0                         |
| 1000 Hz      | 0.0   | 0.0       | 0.0       |  | 0.60                   | 1.0                         |
| 4000 Hz      | 0.5   | 0.5       | 0.6       |  | 0.60                   | 3.0                         |
| 8000 Hz      | 0.3   | 0.3       | 0.4       |  | 0.70                   | 5.0                         |

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

| UUC Setting   | Deviation from various Frequency Weighting Response curve |        |        |  | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|---------------|---|--------|--------|--|-----------------------|----------------------------|
|               | A (dB)  | C (dB) | Z (dB) |  |                       |                            |
| FAST / 37-139 |   |        |        |  |                       |                            |
| STD Setting   |   |        |        |  |                       |                            |
| 63 Hz         | -0.2  | 0.0    | 0.0    |  |                       | 2.0                        |
| 125 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 250 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 500 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                        |
| 1000 Hz       | 0.0   | 0.0    | 0.0    |  | 0.2                   | 1.0                        |
| 2000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 2.0                        |
| 4000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 3.0                        |
| 8000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 5.0                        |
| 16000 Hz      | -0.1  | -0.1   | -0.1   |  |                       | +5, -INF.                  |

6. Frequency and time weightings at 1kHz

| UUC Setting   | STD REF | Measured |          | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|---------------|---------|----------|----------|-----------------------|----------------------------|
|               |         | UUC (dB) | ERR (dB) |                       |                            |
| FAST / 37-139 |         |          |          |                       |                            |
| UUC Weighting | (dB)    |          |          |                       |                            |
| A             | 114.00  | 114.0    | 0.0      |                       | 0.2                        |
| C             | 114.00  | 114.0    | 0.0      | 0.2                   | 0.2                        |
| Z             | 114.00  | 114.0    | 0.0      |                       | 0.2                        |

| UUC Setting       | STD REF | Measured |          | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|-------------------|---------|----------|----------|-----------------------|----------------------------|
|                   |         | UUC (dB) | ERR (dB) |                       |                            |
| 37-139 / A        |         |          |          |                       |                            |
| UUC Time Response | (dB)    |          |          |                       |                            |
| Fast              | 114.00  | 114.0    | 0.0      |                       | 0.1                        |
| Slow              | 114.00  | 114.0    | 0.0      | 0.2                   | 0.1                        |
| Leq               | 114.00  | 114.0    | 0.0      |                       | 0.1                        |

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7. Long Term Stability

| UUC Setting | Measured          |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|-------------|-------------------|-------------|-----------------------|-------------------------------|
|             | FAST / A / 37-139 | UUC<br>(dB) |                       |                               |
| STD Setting |                   |             |                       |                               |
|             | Initial           | 114.0       |                       |                               |
|             | Final             | 114.0       |                       |                               |
| Deviated    |                   | 0.0         | 0.1                   | 0.3                           |

8. Level linearity on the reference level range

| UUC Setting       | Anticipated<br>REF<br>(dB) | Deviation   |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|-------------------|----------------------------|-------------|-------------|-----------------------|-------------------------------|
|                   |                            | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| FAST / A / 37-139 |                            |             |             |                       |                               |
| STD dB            |                            |             |             |                       |                               |
| 140.00            | 140                        | 140.0       | 0.0         |                       | 1.1                           |
| 139.00            | 139                        | 139.0       | 0.0         |                       | 1.1                           |
| 134.00            | 134                        | 134.0       | 0.0         |                       | 1.1                           |
| 129.00            | 129                        | 129.0       | 0.0         |                       | 1.1                           |
| 124.00            | 124                        | 124.0       | 0.0         |                       | 1.1                           |
| 119.00            | 119                        | 119.0       | 0.0         |                       | 1.1                           |
| 114.00            | 114                        | 114.0       | 0.0         |                       | 1.1                           |
| 109.00            | 109                        | 109.0       | 0.0         |                       | 1.1                           |
| 104.00            | 104                        | 104.0       | 0.0         |                       | 1.1                           |
| 99.00             | 99                         | 99.0        | 0.0         |                       | 1.1                           |
| 94.00             | 94                         | 93.9        | -0.1        |                       | 1.1                           |
| 89.00             | 89                         | 88.9        | -0.1        |                       | 1.1                           |
| 84.00             | 84                         | 83.9        | -0.1        |                       | 1.1                           |
| 79.00             | 79                         | 78.9        | -0.1        |                       | 1.1                           |
| 74.00             | 74                         | 73.9        | -0.1        |                       | 1.1                           |
| 69.00             | 69                         | 68.9        | -0.1        |                       | 1.1                           |
| 64.00             | 64                         | 63.9        | -0.1        |                       | 1.1                           |
| 59.00             | 59                         | 58.9        | -0.1        |                       | 1.1                           |
| 54.00             | 54                         | 53.9        | -0.1        |                       | 1.1                           |
| 49.00             | 49                         | 48.9        | -0.1        |                       | 1.1                           |
| 44.00             | 44                         | 44.0        | 0.0         |                       | 1.1                           |
| 39.00             | 39                         | 39.2        | 0.2         |                       | 1.1                           |
| 38.00             | 38                         | 38.3        | 0.3         |                       | 1.1                           |

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9. Level linearity including the level range control

| UUC Setting | STD<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|-------------|--------------------|-------------|-------------|-----------------------|-------------------------------|
|             |                    | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| 37-139      | 43.2               | 42.9        | -0.3        |                       | 1.1                           |
|             | 114                | 114.0       | 0.0         | 0.3                   | 1.1                           |

10. Tone burst response

| UUC Setting | STD<br>Toneburst<br>(ms) | Anticipated<br>Ref<br>(dB) | Measured    |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|-------------|--------------------------|----------------------------|-------------|-------------|-----------------------|-------------------------------|
|             |                          |                            | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| Fast        | 200                      | 135.0                      | 135.0       | 0.0         |                       | 1.0                           |
|             | 2                        | 118.0                      | 117.8       | -0.2        |                       | +1.0, -2.5                    |
|             | 0.25                     | 109.0                      | 108.6       | -0.4        |                       | +1.5, -5.0                    |
| Slow        | 200                      | 128.6                      | 128.5       | -0.1        |                       | 1.0                           |
|             | 2                        | 109.0                      | 108.9       | -0.1        |                       | +1.0, -5.0                    |
|             | 200                      | 129.0                      | 129.0       | 0.0         |                       | 1.0                           |
| SEL         | 2                        | 109.0                      | 109.0       | 0.0         |                       | +1.0, -2.5                    |
|             | 0.25                     | 100.0                      | 99.8        | -0.2        |                       | +1.5, -5.0                    |

11. Peak C Sound level

| UUC Setting         | Anticipated<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|---------------------|----------------------------|-------------|-------------|-----------------------|-------------------------------|
|                     |                            | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| FAST / C / 95-142   |                            |             |             |                       |                               |
| STD Setting         |                            |             |             |                       |                               |
| Complete cycle      | 137.4                      | 136.8       | -0.60       |                       | 3.0                           |
| Positive half cycle | 136.4                      | 136.2       | -0.20       |                       | 2.0                           |
| Negative half cycle | 136.4                      | 136.2       | -0.20       |                       | 2.0                           |

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Certificate No : 22-ACT-102

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| 12. Overload indication |          |             |                  |
|-------------------------|----------|-------------|------------------|
| UUC Setting             | Measured | UNCERTAINTY | Acceptance Limit |
| FAST / A / 37-139       | UUC      | (± dB)      | (± dB)           |
| STD Setting             | (dB)     |             |                  |
| Positive one-half cycle | 141.7    |             |                  |
| Negative one-half cycle | 141.7    |             |                  |
| Deviated                | 0.0      | 0.2         | 1.5              |

| 13. High Level Stability |          |             |                  |
|--------------------------|----------|-------------|------------------|
| UUC Setting              | Measured | UNCERTAINTY | Acceptance Limit |
| FAST / A / 37-139        | UUC      | (± dB)      | (± dB)           |
| STD Setting              | (dB)     |             |                  |
| Initial                  | 138.0    |             |                  |
| Final                    | 138.0    |             |                  |
| Deviated                 | 0.0      | 0.1         | 0.3              |

End of Certificate

Certificate of Calibration


| Customer |  |
|----------|--|
| Name     | : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.                     |
| Address  | : 81 Soi Udomsuak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260 |


| Unit Under Calibration Details |                     |
|--------------------------------|---------------------|
| Measurement item :             | : Sound Level Meter |
| Manufacturer                   | : LARSON DAVIS      |
| Model                          | : LxT2              |
| Serial Number                  | : 0006616           |
| ID                             | : UAE.EFM.047/2564  |
| Resolution                     | : 0.1 dB            |

| Calibration Environment and Details |  |
|-------------------------------------|--|
| Temperature                         | : 23 °C ± 2 °C   |
| Humidity                            | : 50 %RH ± 20 %RH  |
| Barometric Pressure                 | : 1013 hPa ± 10 hPa  |
| Received Date                       | : 14 February 2022   |
| Calibrated Date                     | : 15 February 2022   |
| Calibration Procedure               | : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests |
| Location of Calibration             | : Lab Acoustic   |

| Reference Standard        |          |           |           |                   |
|---------------------------|----------|-----------|-----------|-------------------|
| Instrument                | Brand    | Model     | SN.       | Due calibration   |
| Standard Microphone       | GRAS     | 40AN      | 188273    | 15 September 2022 |
| Multifrequency Calibrator | Quest    | Quest-cal | EFA000234 | 14 June 2022      |
| Audio Generator           | Svanteck | Svan401   | 131       | 18 October 2022   |

| Note  |  |  |  |  |
|---|--|--|--|--|
| The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$ , providing a level of confidence approximately 95 %. |  |  |  |  |

Calibrated By : 

Approved By : 

Mr. Noppadon Luangart  
Calibration Officer

Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 15 February 2022

1. Indication at the calibration check frequency

| UUC Setting        | Nominal       |  | Before Adjust |             | Adjust      |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|--------------------|---------------|--|---------------|-------------|-------------|-------------|-----------------------|-------------------------------|
|                    | Level<br>(dB) |  | UUC<br>(dB)   | ERR<br>(dB) | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| FAST / A / 37-139  |               |  |               |             |             |             |                       |                               |
| Calibrator Setting |               |  |               |             |             |             |                       |                               |
| 1000 Hz 114.00 dB  | 113.85        |  | 114.1         | +0.25       | 113.8       | -0.05       | 0.20                  | 0.3                           |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN:58079

2. Self-generated noise, Microphone installed

| UUC Setting   | Measured      |  | UNCERTAINTY<br>(± dB) |
|---------------|---------------|--|-----------------------|
|               | Level<br>(dB) |  |                       |
| FAST / 37-139 |               |  |                       |
| UUC Weighting |               |  |                       |
| A             | 28.6          |  | 0.10                  |

3. Self-generated noise, Microphone replaced by the electrical input signal device

| UUC Setting   | Measured      |  | UNCERTAINTY<br>(± dB) |
|---------------|---------------|--|-----------------------|
|               | Level<br>(dB) |  |                       |
| FAST / 37-139 |               |  |                       |
| UUC Weighting |               |  |                       |
| A             | 28.4          |  | 0.10                  |
| C             | 27.8          |  | 0.10                  |
| Z             | 32.4          |  | 0.10                  |

4. Acoustic signal test of frequency weightings (Without Windscreen)

| UUC Setting   | Deviation from various Frequency Weighting Response curve |      |      |      | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|---------------|---|------|------|------|-----------------------|-------------------------------|
|               | A   | C    | Z    |      |                       |                               |
|               |   |      | (dB) | (dB) |                       |                               |
| FAST / 37-139 |   |      |      |      |                       |                               |
| STD Setting   |   |      |      |      |                       |                               |
| 125 Hz        | 0.0   | 0.1  | 0.1  | 0.0  | 0.50                  | 2.0                           |
| 1000 Hz       | 0.0   | 0.0  | 0.0  | 0.0  | 0.60                  | 1.0                           |
| 4000 Hz       | 0.3   | 0.3  | 0.4  | 0.4  | 0.60                  | 3.0                           |
| 8000 Hz       | -0.1  | -0.1 | 0.0  | 0.0  | 0.70                  | 5.0                           |

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

| UUC Setting   | Deviation from various Frequency Weighting Response curve |        |        |  | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|---------------|---|--------|--------|--|-----------------------|-------------------------------|
|               | A (dB)  | C (dB) | Z (dB) |  |                       |                               |
| FAST / 37-139 |   |        |        |  |                       |                               |
| STD Setting   |   |        |        |  |                       |                               |
| 63 Hz         | -0.2  | -0.1   | -0.1   |  |                       | 2.0                           |
| 125 Hz        | -0.1  | 0.0    | -0.1   |  |                       | 1.5                           |
| 250 Hz        | -0.1  | -0.1   | -0.1   |  |                       | 1.5                           |
| 500 Hz        | -0.1  | 0.0    | 0.0    |  |                       | 1.5                           |
| 1000 Hz       | 0.0   | 0.0    | 0.0    |  | 0.2                   | 1.0                           |
| 2000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 2.0                           |
| 4000 Hz       | 0.0   | 0.0    | 0.0    |  |                       | 3.0                           |
| 8000 Hz       | -0.1  | -0.1   | 0.0    |  |                       | 5.0                           |
| 16000 Hz      | -0.1  | -0.1   | -0.1   |  |                       | +5, -INF.                     |

6. Frequency and time weightings at 1kHz

| UUC Setting   | STD<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|---------------|--------------------|-------------|-------------|-----------------------|-------------------------------|
|               |                    | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| FAST / 37-139 |                    |             |             |                       |                               |
| UUC Weighting |                    |             |             |                       |                               |
| A             | 114.00             | 114.0       | 0.0         |                       | 0.2                           |
| C             | 114.00             | 114.0       | 0.0         | 0.2                   | 0.2                           |
| Z             | 114.00             | 114.0       | 0.0         |                       | 0.2                           |

| UUC Setting       | STD<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>(± dB) | Acceptance<br>Limit<br>(± dB) |
|-------------------|--------------------|-------------|-------------|-----------------------|-------------------------------|
|                   |                    | UUC<br>(dB) | ERR<br>(dB) |                       |                               |
| 37-139 / A        |                    |             |             |                       |                               |
| UUC Time Response |                    |             |             |                       |                               |
| Fast              | 114.00             | 114.0       | 0.0         |                       | 0.1                           |
| Slow              | 114.00             | 114.0       | 0.0         | 0.2                   | 0.1                           |
| Leq               | 114.00             | 114.0       | 0.0         |                       | 0.1                           |





Certificate of Calibration

**Customer**

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.      Certificate No : 22-ACT-100

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok      Request No : Req-2022-0234

10260

Unit Under Calibration Details

Measurement item : Sound Level Meter      Microphone Class : 2

Manufacturer : LARSON DAVIS      Microphone Model : 375A04

Model : LxT2      Microphone S/N : 328669

Serial Number : 0006617      Preamplifier Model : PRMLxT2C

ID : UAE.EFM.048/2564      Preamplifier S/N : 071532

Resolution : 0.1 dB      Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C

Humidity : 50 %RH ± 20 %RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 31 January 2022

Calibrated Date : 11 February 2022

Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests

Location of Calibration : Lab Acoustic

Reference Standard

| Instrument                | Brand   | Model     | SN.       | Due calibration   | Traceability |
|---------------------------|---------|-----------|-----------|-------------------|--------------|
| Standard Microphone       | GRAS    | 40AN      | 188273    | 15 September 2022 | GRAS         |
| Multifrequency Calibrator | Quest   | Quest-cal | EFA000234 | 14 June 2022      | TSI          |
| Audio Generator           | Svaneek | Svan401   | 131       | 18 October 2022   | WK Electric  |

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor  $k = 2$ , providing a level of confidence approximately 95 %.

Calibrated By :       Approved By : 

Mr. Noppadon Luangart      Mr. Pacit Maithavorn

Calibration Officer      Calibration Engineer Supervisor

Issue Date : 11 February 2022

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Request No : Req-2022-0330

| 12. Overload indication |          |             |                  |
|-------------------------|----------|-------------|------------------|
| UUC Setting             | Measured | UNCERTAINTY | Acceptance Limit |
| FAST / A / 37-139       | UUC (dB) | (± dB)      | (± dB)           |
| STD Setting             |          |             |                  |
| Positive one-half cycle | 141.9    |             |                  |
| Negative one-half cycle | 141.9    |             |                  |
| Deviated                | 0.0      | 0.2         | 1.5              |

| 13. High Level Stability |          |             |                  |
|--------------------------|----------|-------------|------------------|
| UUC Setting              | Measured | UNCERTAINTY | Acceptance Limit |
| FAST / A / 37-139        | UUC (dB) | (± dB)      | (± dB)           |
| STD Setting              |          |             |                  |
| Initial                  | 138.0    |             |                  |
| Final                    | 138.0    |             |                  |
| Deviated                 | 0.0      | 0.1         | 0.3              |

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1. Indication at the calibration check frequency

| UUC Setting        | Nominal Level | Before Adjust |          | Adjust   |          | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|--------------------|---------------|---------------|----------|----------|----------|-----------------------|----------------------------|
|                    |               | UUC (dB)      | ERR (dB) | UUC (dB) | ERR (dB) |                       |                            |
| FAST / A / 37-139  |               |               |          |          |          |                       |                            |
| Calibrator Setting |               |               |          |          |          |                       |                            |
| 1000 Hz 114.00 dB  | 113.85        | 113.9         | +0.05    | 113.9    | 0.05     | 0.20                  | 0.3                        |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN.58079

2. Self-generated noise, Microphone installed

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 28.9     | 0.10        |

3. Self-generated noise, Microphone replaced by the electrical input signal device

| UUC Setting   | Measured | UNCERTAINTY |
|---------------|----------|-------------|
| FAST / 37-139 |          |             |
| UUC Weighting | (dB)     | (± dB)      |
| A             | 28.8     | 0.10        |
| C             | 28.4     | 0.10        |
| Z             | 34.3     | 0.10        |

4. Acoustic signal test of frequency weightings (Without Windscreen)

| UUC Setting   | Deviation from various Frequency Weighting Response curve |      |      |     | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|---------------|---|------|------|-----|-----------------------|----------------------------|
|               | A   | C    | Z    |     |                       |                            |
| FAST / 37-139 | (dB)  | (dB) | (dB) |     | (± dB)                |                            |
| STD Setting   |   |      |      |     |                       |                            |
| 125 Hz        | 0.0   | 0.1  | 0.0  | 0.0 | 0.50                  | 2.0                        |
| 1000 Hz       | 0.0   | 0.0  | 0.0  | 0.0 | 0.60                  | 1.0                        |
| 4000 Hz       | 0.6   | 0.6  | 0.6  | 0.6 | 0.60                  | 3.0                        |
| 8000 Hz       | 0.5   | 0.5  | 0.6  | 0.6 | 0.70                  | 5.0                        |

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5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

| UUC Setting   | Deviation from various Frequency Weighting Response curve |        |        |      | UNCERTAINTY<br>(± dB) | Acceptance Limit<br>(± dB) |
|---------------|---|--------|--------|------|-----------------------|----------------------------|
|               | A (dB)  | C (dB) | Z (dB) |      |                       |                            |
| FAST / 37-139 |   |        |        |      |                       |                            |
| STD Setting   |   |        |        |      |                       |                            |
| 63 Hz         | -0.2  | 0.0    | 0.0    | 0.0  | 0.2                   | 2.0                        |
| 125 Hz        | -0.1  | 0.0    | 0.0    | 0.0  | 0.2                   | 1.5                        |
| 250 Hz        | -0.1  | 0.0    | 0.0    | 0.0  | 0.2                   | 1.5                        |
| 500 Hz        | -0.1  | 0.0    | 0.0    | 0.0  | 0.2                   | 1.5                        |
| 1000 Hz       | 0.0   | 0.0    | 0.0    | 0.0  | 0.2                   | 1.0                        |
| 2000 Hz       | 0.0   | 0.1    | 0.0    | 0.0  | 0.2                   | 2.0                        |
| 4000 Hz       | 0.0   | 0.0    | 0.0    | 0.0  | 0.2                   | 3.0                        |
| 8000 Hz       | -0.1  | 0.0    | 0.0    | 0.0  | 0.2                   | 5                          |
| 16000 Hz      | -0.1  | -0.1   | -0.1   | -0.1 | 0.2                   | +5, -INF.                  |

6. Frequency and time weightings at 1kHz

| UUC Setting   | STD      | Measured          | Acceptance Limit   |
|---------------|----------|-------------------|--------------------|
| FAST / 37-139 | REF (dB) | UUC (dB) ERR (dB) | UNCERTAINTY (± dB) |
| UUC Weighting | (dB)     | (dB) (dB)         | (± dB)             |
| A             | 114.00   | 114.0 0.0         | 0.2                |
| C             | 114.00   | 114.0 0.0         | 0.2                |
| Z             | 114.00   | 114.0 0.0         | 0.2                |

| UUC Setting       | STD      | Measured          | Acceptance Limit   |
|-------------------|----------|-------------------|--------------------|
| 37-139 / A        | REF (dB) | UUC (dB) ERR (dB) | UNCERTAINTY (± dB) |
| UUC Time Response | (dB)     | (dB) (dB)         | (± dB)             |
| Fast              | 114.00   | 114.0 0.0         | 0.1                |
| Slow              | 114.00   | 114.0 0.0         | 0.1                |
| Leq               | 114.00   | 114.0 0.0         | 0.1                |

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7. Long Term Stability

| UUC Setting | Measured          |             | UNCERTAINTY<br>( ± dB) | Acceptance<br>Limit<br>( ± dB) |
|-------------|-------------------|-------------|------------------------|--------------------------------|
|             | FAST / A / 37-139 | UUC<br>(dB) |                        |                                |
| STD Setting | Initial           | 114.0       |                        |                                |
|             | Final             | 114.0       |                        |                                |
| Deviated    |                   | 0.0         | 0.1                    | 0.3                            |

8. Level linearity on the reference level range

| UUC Setting       | Anticipated<br>REF<br>(dB) | Deviation   |             | UNCERTAINTY<br>( ± dB) | Acceptance<br>Limit<br>( ± dB) |
|-------------------|----------------------------|-------------|-------------|------------------------|--------------------------------|
|                   |                            | UUC<br>(dB) | ERR<br>(dB) |                        |                                |
| FAST / A / 37-139 |                            |             |             |                        |                                |
| STD dB            |                            |             |             |                        |                                |
| 140.00            | 140                        | 140.0       | 0.0         | 0.3                    | 1.1                            |
| 139.00            | 139                        | 139.0       | 0.0         |                        | 1.1                            |
| 134.00            | 134                        | 134.0       | 0.0         |                        | 1.1                            |
| 129.00            | 129                        | 129.0       | 0.0         |                        | 1.1                            |
| 124.00            | 124                        | 124.0       | 0.0         |                        | 1.1                            |
| 119.00            | 119                        | 119.0       | 0.0         |                        | 1.1                            |
| 114.00            | 114                        | 114.0       | 0.0         |                        | 1.1                            |
| 109.00            | 109                        | 109.0       | 0.0         |                        | 1.1                            |
| 104.00            | 104                        | 104.0       | 0.0         |                        | 1.1                            |
| 99.00             | 99                         | 99.0        | 0.0         |                        | 1.1                            |
| 94.00             | 94                         | 94.0        | 0.0         |                        | 1.1                            |
| 89.00             | 89                         | 89.0        | 0.0         |                        | 1.1                            |
| 84.00             | 84                         | 84.0        | 0.0         |                        | 1.1                            |
| 79.00             | 79                         | 79.0        | 0.0         |                        | 1.1                            |
| 74.00             | 74                         | 74.0        | 0.0         |                        | 1.1                            |
| 69.00             | 69                         | 69.0        | 0.0         |                        | 1.1                            |
| 64.00             | 64                         | 64.0        | 0.0         |                        | 1.1                            |
| 59.00             | 59                         | 59.0        | 0.0         |                        | 1.1                            |
| 54.00             | 54                         | 54.0        | 0.0         |                        | 1.1                            |
| 49.00             | 49                         | 49.0        | 0.0         |                        | 1.1                            |
| 44.00             | 44                         | 44.1        | 0.1         |                        | 1.1                            |
| 39.00             | 39                         | 39.4        | 0.4         |                        | 1.1                            |

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9. Level linearity including the level range control

| UUC Setting | STD<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>( ± dB) | Acceptance<br>Limit<br>( ± dB) |
|-------------|--------------------|-------------|-------------|------------------------|--------------------------------|
|             |                    | UUC<br>(dB) | ERR<br>(dB) |                        |                                |
| 37-139      | 43.9               | 43.6        | -0.3        | 0.3                    | 1.1                            |
|             | 114                | 114.0       | 0.0         |                        | 1.1                            |

10. Tone burst response

| UUC Setting | STD<br>Toneburst<br>(ms) | Anticipated<br>Ref<br>(dB) | Measured    |             | UNCERTAINTY<br>( ± dB) | Acceptance<br>Limit<br>( ± dB) |
|-------------|--------------------------|----------------------------|-------------|-------------|------------------------|--------------------------------|
|             |                          |                            | UUC<br>(dB) | ERR<br>(dB) |                        |                                |
| A / 37-139  | 200                      | 135.0                      | 134.9       | -0.1        | 0.3                    | 1.0                            |
|             | 2                        | 118.0                      | 117.6       | -0.4        |                        | +1.0, -2.5                     |
|             | 0.25                     | 109.0                      | 108.7       | -0.3        |                        | +1.5, -5.0                     |
| Fast        | 200                      | 128.6                      | 128.5       | -0.1        |                        | 1.0                            |
|             | 2                        | 109.0                      | 108.9       | -0.1        |                        | +1.0, -5.0                     |
| Slow        | 200                      | 129.0                      | 129.0       | 0.0         |                        | 1.0                            |
|             | 2                        | 109.0                      | 109.1       | +0.1        |                        | +1.0, -2.5                     |
| SEL         | 0.25                     | 100.0                      | 99.9        | -0.1        |                        | +1.5, -5.0                     |

11. Peak C Sound level

| UUC Setting         | Anticipated<br>REF<br>(dB) | Measured    |             | UNCERTAINTY<br>( ± dB) | Acceptance<br>Limit<br>( ± dB) |
|---------------------|----------------------------|-------------|-------------|------------------------|--------------------------------|
|                     |                            | UUC<br>(dB) | ERR<br>(dB) |                        |                                |
| FAST / C / 95-142   |                            |             |             |                        |                                |
| STD Setting         |                            |             |             |                        |                                |
| Complete cycle      | 137.4                      | 136.8       | -0.60       | 0.2                    | 3.0                            |
| Positive half cycle | 136.4                      | 136.2       | -0.20       |                        | 2.0                            |
| Negative half cycle | 136.4                      | 136.2       | -0.20       |                        | 2.0                            |

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12. Overload indication

| UUC Setting             | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------------|----------|-------------|------------------|
| FAST / A / 37-139       | UUC      | ( ± dB)     | ( ± dB)          |
| STD Setting             | (dB)     |             |                  |
| Positive one-half cycle | 142.8    |             |                  |
| Negative one-half cycle | 142.7    |             |                  |
| Deviated                | 0.1      | 0.2         | 1.5              |

13. High Level Stability

| UUC Setting       | Measured | UNCERTAINTY | Acceptance Limit |
|-------------------|----------|-------------|------------------|
| FAST / A / 37-139 | UUC      | ( ± dB)     | ( ± dB)          |
| STD Setting       | (dB)     |             |                  |
| Initial           | 138.0    |             |                  |
| Final             | 138.0    |             |                  |
| Deviated          | 0.0      | 0.1         | 0.3              |

End of Certificate