

# ภาคผนวกที่ 5

## เอกสารการสอบเทียบเครื่องมือ

- |        |     |   |
|--------|-----|---|
| เอกสาร | 5-1 | เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในบรรยากาศ                                     |
| เอกสาร | 5-2 | เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศจากปล่อง                                       |
| เอกสาร | 5-3 | เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศในสถานประกอบการ<br>(Working Area)                 |
| เอกสาร | 5-4 | เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียงโดยทั่วไปและเสียงในสถานประกอบการ<br>(Working Area) |
| เอกสาร | 5-5 | เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อนในสถานประกอบการ<br>(Working Area)                 |

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| รายการตรวจวัด  | เครื่องมือเก็บตัวอย่าง   | เครื่องมือตรวจวิเคราะห์                     |
|--|--|---|
|  | ชื่อเครื่องมือ   | ชื่อเครื่องมือ                              |
| คุณภาพอากาศในบรรยากาศ  |  |   |
| TSP  | - High Volume Air Sampler No. B01, B11, B18  | - Digital Balance                           |
| PM <sub>10</sub>   | - High Volume PM-10 Air Sampler No. B11, B14, B21                                  | - Digital Balance                           |
| SO <sub>2</sub>  | - Gas Sampler Box No. B09, B15, B16  | - Spectrophotometer                         |
| NO <sub>2</sub>  | - NO <sub>2</sub> Analyzer No. B10, B17, B20                                       | - NO <sub>2</sub> Analyzer No.B10, B17, B20 |
| คุณภาพอากาศจากปล่อง  |  |   |
| TSP  | - Console No. B04<br>- Pitot Tube No. B35  | - Digital Balance                           |
| SO <sub>2</sub>  | - Personal Pump SKC No. B76<br>- Rotameter No. H-B07                               | -   |
| NO <sub>x</sub>  | - Vacuum Gauge   | - Spectrophotometer                         |
| คุณภาพอากาศในสถานประกอบการ   |  |   |
| Total Dust   | - Personal Pump SKC No. B09, B36, B56, B70, B78, B81<br>- Rotameter No. H-B01, B03 | - Digital Balance                           |
| ระดับเสียงในบรรยากาศ   |  |   |
| L <sub>eq</sub> 24 hr, L <sub>eq</sub> 1 hr,<br>L <sub>max</sub> และ L <sub>90</sub> | - Acoustic Calibrator<br>- Sound Level Meter No. B11, B13, B22, B26, B29, B33, B37 | -   |
| ระดับเสียงในสถานประกอบการ  |  |   |
| L <sub>eq</sub> 8 hr   | - Acoustic Calibrator<br>- Sound Level Meter No. B11, B13, B18, B29, B33, B38      | -   |
| ระดับความร้อนในสถานประกอบการ   |  |   |
| WBGT   | - Digital Thermometer with Probe No. B11, B21, B24, B26, B32                       | -   |

## เอกสารที่ 5-1

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในบรรยากาศ



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## High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

| High Volume Air Sampler Data |            | Calibration Data |  |                |
|------------------------------|------------|------------------|--|----------------|
| Recorder No.                 | Blower No. | Date             | Actual Flowrate (ft <sup>3</sup> /min) | R <sup>2</sup> |
| B01                          | B01        | 01/08/2023       | y = 1.289x-5.689                       | 0.999          |
| B02                          | B02        | 02/08/2023       | y = 1.106x+2.666                       | 0.999          |
| B03                          | B03        | 01/08/2023       | y = 1.126x-0.852                       | 0.997          |
| B04                          | B04        | 01/08/2023       | y = 1.294x-8.235                       | 0.998          |
| B05                          | B05        | 04/08/2023       | y = 1.279x-7.416                       | 0.996          |
| B06                          | B06        | 01/08/2023       | y = 1.280x-7.015                       | 0.999          |
| B07                          | B07        | 01/08/2023       | y = 1.220x-6.249                       | 0.998          |
| B08                          | B08        | 01/08/2023       | y = 1.268x-7.621                       | 0.999          |
| B09                          | B09        | 01/08/2023       | y = 1.258x-5.982                       | 1.000          |
| B10                          | B10        | 04/08/2023       | y = 1.142x+0.294                       | 0.999          |
| B11                          | B11        | 04/08/2023       | y = 1.165x-3.050                       | 0.998          |
| B12                          | B12        | 04/08/2023       | y = 1.227x-5.594                       | 0.999          |
| B13                          | B13        | 04/08/2023       | y = 1.282x-7.522                       | 0.998          |
| B14                          | B14        | 04/08/2023       | y = 1.298x-7.713                       | 0.999          |
| B15                          | B15        | 02/08/2023       | y = 1.176x-3.322                       | 0.997          |
| B16                          | B16        | 02/08/2023       | y = 1.316x-9.126                       | 0.997          |
| B17                          | B17        | 02/08/2023       | y = 1.235x-5.694                       | 1.000          |
| B18                          | B18        | 02/08/2023       | y = 1.323x-10.629                      | 0.998          |
| B19                          | B19        | 02/08/2023       | y = 1.277x-8.109                       | 0.997          |
| B20                          | B20        | 02/08/2023       | y = 1.297x-8.466                       | 0.998          |
| B21                          | B21        | 03/08/2023       | y = 1.186x-3.582                       | 1.000          |
| B22                          | B22        | 03/08/2023       | y = 1.274x-8.729                       | 0.998          |
| B23                          | B23        | 03/08/2023       | y = 1.224x-5.880                       | 0.995          |
| B24                          | B24        | 03/08/2023       | y = 1.185x-3.773                       | 0.999          |
| B25                          | B25        | 01/08/2023       | y = 1.075x+1.295                       | 0.998          |
| B26                          | B26        | 01/08/2023       | y = 1.282x-7.798                       | 0.997          |
| B27                          | B27        | 01/08/2023       | y = 1.248x-7.408                       | 0.997          |
| B28                          | B28        | 01/08/2023       | y = 1.279x-8.370                       | 0.999          |
| B29                          | B29        | 04/08/2023       | y = 1.292x-7.541                       | 0.999          |
| B30                          | B30        | 04/08/2023       | y = 1.270x-8.142                       | 0.995          |
| B31                          | B31        | 04/08/2023       | y = 1.284x-8.212                       | 0.999          |
| B32                          | B32        | 04/08/2023       | y = 1.294x-6.759                       | 0.999          |
| B33                          | B33        | 04/08/2023       | y = 1.252x-5.024                       | 0.999          |
| B34                          | B34        | 04/08/2023       | y = 1.262x-7.362                       | 0.998          |

Calibrated by :



Approved by :







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## High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

| High Volume PM-10 Data |            | Calibration Data |  |                |
|------------------------|------------|------------------|--|----------------|
| Recorder No.           | Blower No. | Date             | Actual Flowrate (ft <sup>3</sup> /min) | R <sup>2</sup> |
| B01                    | B01        | 03/08/2023       | y = 1.268x-3.132                       | 0.995          |
| B02                    | B02        | 01/08/2023       | y = 1.046x+2.277                       | 0.999          |
| B03                    | B03        | 01/08/2023       | y = 1.277x-6.485                       | 0.998          |
| B04                    | B04        | 01/08/2023       | y = 1.287x-8.164                       | 0.999          |
| B05                    | B05        | 01/08/2023       | y = 1.229x-5.276                       | 0.998          |
| B06                    | B06        | 01/08/2023       | y = 1.270x-6.448                       | 0.997          |
| B07                    | B07        | 03/08/2023       | y = 1.285x-6.916                       | 0.998          |
| B08                    | B08        | 01/08/2023       | y = 1.286x-6.261                       | 0.998          |
| B09                    | B09        | 03/08/2023       | y = 1.257x-5.694                       | 0.997          |
| B10                    | B10        | 03/08/2023       | y = 1.292x-8.553                       | 0.996          |
| B11                    | B11        | 03/08/2023       | y = 1.250x-6.659                       | 0.998          |
| B12                    | B12        | 02/08/2023       | y = 1.292x-8.553                       | 0.996          |
| B13                    | B13        | 02/08/2023       | y = 1.285x-7.847                       | 1.000          |
| B14                    | B14        | 02/08/2023       | y = 1.279x-5.782                       | 0.999          |
| B15                    | B15        | 02/08/2023       | y = 1.144x-0.631                       | 0.999          |
| B16                    | B16        | 02/08/2023       | y = 1.228x-0.850                       | 0.995          |
| B17                    | B17        | 01/08/2023       | y = 1.279x-7.056                       | 0.997          |
| B18                    | B18        | 01/08/2023       | y = 1.220x-3.845                       | 0.998          |
| B19                    | B19        | 01/08/2023       | y = 1.123x-0.193                       | 0.999          |
| B20                    | B20        | 03/08/2023       | y = 1.216x-5.924                       | 0.999          |
| B21                    | B21        | 03/08/2023       | y = 1.182x-1.600                       | 0.996          |
| B22                    | B22        | 03/08/2023       | y = 1.298x-8.251                       | 0.998          |
| B23                    | B23        | 02/08/2023       | y = 1.227x-4.062                       | 0.999          |
| B24                    | B24        | 02/08/2023       | y = 1.246x-4.841                       | 0.999          |
| B25                    | B25        | 02/08/2023       | y = 1.224x-5.771                       | 1.000          |
| B26                    | B26        | 01/08/2023       | y = 1.277x-6.994                       | 0.998          |
| B27                    | B27        | 04/08/2023       | y = 1.258x-8.288                       | 0.999          |
| B28                    | B28        | 04/08/2023       | y = 1.226x-6.184                       | 0.998          |
| B29                    | B29        | 04/08/2023       | y = 1.275x-8.861                       | 0.999          |
| B30                    | B30        | 03/08/2023       | y = 1.308x-9.003                       | 0.999          |
| B31                    | B31        | 03/08/2023       | y = 1.205x-1.680                       | 0.995          |
| B32                    | B32        | 03/08/2023       | y = 1.229x-4.453                       | 0.998          |
| B33                    | B33        | 03/08/2023       | y = 1.273x-7.576                       | 0.996          |
| B34                    | B34        | 03/08/2023       | y = 1.268x-3.565                       | 0.997          |

Calibrated by :





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## Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Dry Cal DCL-ML

S/N : 136164

### Calibration Data

| Gas Sampler |           | Calibration Data |  |                           |                    |                  |                    |
|-------------|-----------|------------------|--|---------------------------|--------------------|------------------|--------------------|
| No.         | Rotameter | Date             | Setting<br>(Constant Flow)<br>(ml/min) | Actual Flow Rate (ml/min) |                    |                  |                    |
|             |           |                  |  | Sampling Line A           |                    | Sampling Line B  |                    |
|             |           |                  |  | Normal Condition          | Standard Condition | Normal Condition | Standard Condition |
| B01         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.5                     | 199.1              | 200.7            | 199.2              |
| B02         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.7                     | 199.3              | 200.4            | 199.0              |
| B03         | 2 (A&B)   | 06/09/2023       | 200                                    | 200.4                     | 199.0              | 200.9            | 199.4              |
| B04         | 2 (A&B)   | 07/09/2023       | 200                                    | 200.6                     | 199.2              | 200.7            | 199.3              |
| B05         | 2 (A&B)   | 07/09/2023       | 200                                    | 200.5                     | 199.0              | 200.9            | 199.4              |
| B06         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.8                     | 199.4              | 200.5            | 199.1              |
| B07         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.5                     | 199.0              | 200.8            | 199.3              |
| B08         | 2 (A&B)   | 06/09/2023       | 200                                    | 200.7                     | 199.2              | 200.5            | 199.1              |
| B09         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.5                     | 199.0              | 200.9            | 199.5              |
| B10         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.6                     | 199.2              | 200.6            | 199.2              |
| B11         | 2 (A&B)   | 06/09/2023       | 200                                    | 200.7                     | 199.3              | 200.5            | 199.0              |
| B12         | 2 (A&B)   | 06/09/2023       | 200                                    | 200.6                     | 199.1              | 200.8            | 199.3              |
| B13         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.4                     | 199.0              | 200.5            | 199.1              |
| B14         | 2 (A&B)   | 08/09/2023       | 200                                    | 200.5                     | 199.1              | 200.7            | 199.2              |
| B15         | 2 (A&B)   | 08/09/2023       | 200                                    | 200.6                     | 199.2              | 200.5            | 199.1              |
| B16         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.8                     | 199.3              | 200.6            | 199.2              |
| B17         | 2 (A&B)   | 05/09/2023       | 200                                    | 200.5                     | 199.1              | 200.8            | 199.3              |

Calibrated by :







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## CALIBRATION REPORT

### CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE : 19 September 2023

BRAND : API

MODEL : 200E

NO. NOX-B10

SERIAL NO. 4465

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 08 August 2023

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

#### CALIBRATION SETTING

| Span                 | Initial Reading (Before Adj.), PPB |                   |        | Final Reading (After Adj.), PPB |       |
|----------------------|------------------------------------|-------------------|--------|---------------------------------|-------|
|                      | Expected Concentration             | Analyzer Response | %Dif   | Analyzer Response               | Slope |
| Zero                 | 0                                  | 0.10              | -      | 0                               | -     |
| NO Span              | 400                                | 399.9             | -0.025 | 400.0                           | 1.007 |
| NO <sub>x</sub> Span | 400                                | 400.2             | 0.050  | 400.0                           | 1.009 |

#### API Model 200E NO<sub>x</sub> Analyzer Check List

| Test Values               | Observed Value | Units   | Nominal Range              |
|---------------------------|----------------|---------|----------------------------|
| RANGE                     | 500            | PPB     | 500 standard               |
| STABILITY (Zero Gas)      | 0.1            | PPB     | < 2 with zero air          |
| SAMPLE FLOW               | 509            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 78             | cc/min  | 80 ± 15                    |
| PMT                       | 103.2          | mV      | -20 - 150                  |
| AZERO                     | 94.0           | mV      | -20 - 150                  |
| HVPS                      | 675            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.1           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.4           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.5            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 314.7          | °C      | 315 ± 5                    |
| RCELL PRESS               | 8.3            | IN-Hg-A | 2 - 10 constant            |
| SAMPLE PRESS              | 28.5           | IN-Hg-A | 25 - 30 constant           |
| NO Span Conc              | 400            | PPB     | 20 - 20,000                |
| NO <sub>x</sub> Span Conc | 400            | PPB     | 20 - 20,000                |
| NO Slope                  | 1.007          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.009          | -       | 1.0 ± 0.3                  |
| NO Offset                 | 1.4            | mV      | -20 to +150                |
| NO <sub>x</sub> Offset    | 0.9            | mV      | -20 to 150                 |
| Stability at Zero         | 0.1            | PPB     | < 0.2                      |
| Stability at Span         | 0.2            | PPB     | < 2 ppb @ 400 ppb span gas |

Calibrated by :



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## CALIBRATION REPORT

### CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE : 19 September 2023

BRAND : API

MODEL : 200A

NO. NOX-B17

SERIAL NO. 1977

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 08 August 2023

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

#### CALIBRATION SETTING

| Span<br>Set Point    | Initial Reading (Before Adj.),PPB |                   |       | Final Reading (After Adj.),PPB |       |
|----------------------|-----------------------------------|-------------------|-------|--------------------------------|-------|
|                      | Expected Concentration            | Analyzer Response | %Dif  | Analyzer Response              | Slope |
| Zero                 | 0                                 | -0.10             | -     | 0                              | -     |
| NO Span              | 400                               | 400.1             | 0.025 | 400.0                          | 1.009 |
| NO <sub>x</sub> Span | 400                               | 400.2             | 0.050 | 400.0                          | 1.012 |

#### API Model 200A NO<sub>x</sub> Analyzer Check List

| Test Values               | Observed Value | Units   | Nominal Range              |
|---------------------------|----------------|---------|----------------------------|
| RANGE                     | 500            | PPB     | 500 standard               |
| STABILITY (Zero Gas)      | 0.1            | PPB     | < 2 with zero air          |
| SAMPLE FLOW               | 512            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 79             | cc/min  | 80 ± 15                    |
| PMT                       | 103.4          | mV      | -20 - 150                  |
| AZERO                     | 94.2           | mV      | -20 - 150                  |
| HVPS                      | 673            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.4           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.2           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.1            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 315.2          | °C      | 315 ± 5                    |
| RCELL PRESS               | 8.5            | IN-Hg-A | 2 - 10 constant            |
| SAMPLE PRESS              | 28.7           | IN-Hg-A | 25 - 30 constant           |
| NO Span Conc              | 400            | PPB     | 20 - 20,000                |
| NO <sub>x</sub> Span Conc | 400            | PPB     | 20 - 20,000                |
| NO Slope                  | 1.009          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.012          | -       | 1.0 ± 0.3                  |
| NO Offset                 | 1.6            | mV      | -20 to +150                |
| NO <sub>x</sub> Offset    | 1.0            | mV      | -20 to 150                 |
| Stability at Zero         | 0.1            | PPB     | < 0.2                      |
| Stability at Span         | 0.2            | PPB     | < 2 ppb @ 400 ppb span gas |

Calibrated by : \_\_\_\_\_





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72 Fax : (662) 513-4221 E-mail : sale@spscon.com, www.spscon.com

## CALIBRATION REPORT

### CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE : 19 September 2023

BRAND : API

MODEL : TML-41M

NO. NOX-B20

SERIAL NO. N02782

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 08 August 2023

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

#### CALIBRATION SETTING

| Span<br>Set Point    | Initial Reading (Before Adj.), PPB |                   |        | Final Reading (After Adj.), PPB |       |
|----------------------|------------------------------------|-------------------|--------|---------------------------------|-------|
|                      | Expected Concentration             | Analyzer Response | %Dif   | Analyzer Response               | Slope |
| Zero                 | 0                                  | 0.10              | -      | 0                               | -     |
| NO Span              | 400                                | 399.7             | -0.075 | 400.0                           | 1.005 |
| NO <sub>x</sub> Span | 400                                | 400.1             | 0.025  | 400.0                           | 1.008 |

#### API Model TML-41M NO<sub>x</sub> Analyzer Check List

| Test Values               | Observed Value | Units   | Nominal Range              |
|---------------------------|----------------|---------|----------------------------|
| RANGE                     | 500            | PPB     | 500 standard               |
| STABILITY (Zero Gas)      | 0.1            | PPB     | < 2 with zero air          |
| SAMPLE FLOW               | 505            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 78             | cc/min  | 80 ± 15                    |
| PMT                       | 103.1          | mV      | -20 - 150                  |
| AZERO                     | 93.7           | mV      | -20 - 150                  |
| HVPS                      | 672            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.2           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.1           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.3            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 315.1          | °C      | 315 ± 5                    |
| RCELL PRESS               | 8.4            | IN-Hg-A | 2 - 10 constant            |
| SAMPLE PRESS              | 28.6           | IN-Hg-A | 25 - 30 constant           |
| NO Span Conc              | 400            | PPB     | 20 - 20,000                |
| NO <sub>x</sub> Span Conc | 400            | PPB     | 20 - 20,000                |
| NO Slope                  | 1.005          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.008          | -       | 1.0 ± 0.3                  |
| NO Offset                 | 1.2            | mV      | -20 to +150                |
| NO <sub>x</sub> Offset    | 0.8            | mV      | -20 to 150                 |
| Stability at Zero         | 0.1            | PPB     | < 0.2                      |
| Stability at Span         | 0.2            | PPB     | < 2 ppb @ 400 ppb span gas |

Calibrated by :



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

[www.qcalibration.com](http://www.qcalibration.com)

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : METTLER TOLEDO

**MODEL** : XS105DU

**SERIAL No** : 1126422905

**ID No** : BA 05/50

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,  
JOMPOL, CHATUCHAK, BANGKOK 10900

**CALIBRATED BY** : ATSAWIN Y.

**CALIBRATION DATE** : 10-Mar-23

**APPROVED BY** : 

**ISSUED DATE** : 16-Mar-23

**RECEIVED DATE** : 10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.





CERTIFICATE No : 23M2441

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23  
AIR PRESSURE : 1010mbar  $\pm$  1mbar CALIBRATION DATE : 10-Mar-23  
AMBIENT TEMPERATURE : 23° C  $\pm$  1° C RELATIVE HUMIDITY : 49 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT             | MODEL | SERIAL No | CERTIFICATE No | DUE DATE  |
|------------------------|-------|-----------|----------------|-----------|
| 1) STANDARD WEIGHT SET | E2    | QK-I-151  | M2302013S      | 02-Feb-25 |
| 2) STANDARD WEIGHT     | E2    | 15843     | M2302014S      | 02-Feb-25 |

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

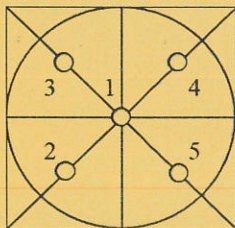
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000039               |
| 0.02              | 0.02000             | 0.00000        | 0.000039               |
| 0.10              | 0.10000             | 0.00000        | 0.000039               |
| 0.20              | 0.20001             | -0.00001       | 0.000040               |
| 0.50              | 0.50001             | -0.00001       | 0.000040               |
| 1.00              | 1.00000             | 0.00000        | 0.000041               |
| 2.00              | 2.00003             | -0.00003       | 0.000042               |
| 5.00              | 5.00001             | -0.00001       | 0.000046               |
| 10.00             | 10.00003            | -0.00003       | 0.000053               |
| 20.00             | 20.00005            | -0.00005       | 0.000067               |
| 50.00             | 50.00001            | -0.00001       | 0.00011                |
| 100.00            | 100.00001           | -0.00001       | 0.00019                |
| 200.00            | 200.00001           | -0.00001       | 0.00032                |

5. OFF CENTER LOADING ERROR



| POINT              | READING (g) |
|--------------------|-------------|
| 1                  | 50.0000     |
| 2                  | 50.0001     |
| 3                  | 50.0000     |
| 4                  | 50.0000     |
| 5                  | 49.9999     |
| OFF-CENTER LOADING | 0.0001      |

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.  
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com <http://www.sithiphorn.com>

NSC-TISI-TIS 17025  
CALIBRATION 0394

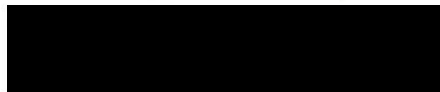
Cert. No. : SP23016

Pages : 1 of 3

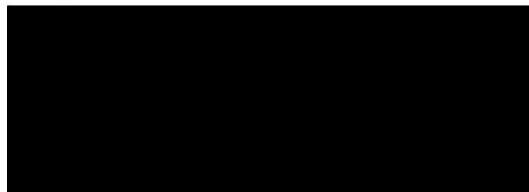
## Calibration Certificate

**Equipment :** UV-VIS SPECTROPHOTOMETER  
**Manufacturer :** PERKINELMER  
**Model :** LAMBDA 25  
**Serial No.:** 501S14123010  
**ID No.:** SP03/58  
**Calibration Mode :** WAVELENGTH ACCURACY  
PHOTOMETRIC ACCURACY  
**Condition As Found :** GOOD  
**Customer :** S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,  
CHOMPHON, CHATUCHAK,  
BANGKOK 10900, THAILAND.  
**Location :** ORGANIC LABORATORY IV  
**Ambient Temperature :** ( 25.0 ± 5 ) °C  
**Relative Humidity :** ( 48.4 ± 25 ) %  
**Received Date :** 30 AUGUST 2023  
**Calibration Date :** 30 AUGUST 2023  
**Date of Issue :** 31 AUGUST 2023

**Calibrated by :**



**Approved by :**



This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.



## Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

**Calibration Method :**

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01, ASTM E925-02

**Condition of this result of calibration :**

## 1. Certified reference materials

| <u>Material</u>                | <u>Ref. type</u> | <u>Cell serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|------------------|------------------------|------------------|-----------------|
| Holmium liquid                 | RM-HL            | 29706                  | 106864           | 01/11/2024      |
| Didymium liquid                | RM-DL            | 28912                  | 106905           | 02/11/2024      |
| Neutral density filter         | RM-1N2N3N        | 13877                  | 106918           | 03/11/2024      |
| Potassium dichromate solutions | RM-0204060810    | 14204                  | 106902           | 02/11/2024      |
| Potassium Iodide solution      | -                | KI-0701-001            | CI-0090-22       | 08/04/2024      |

2. This result of calibration was found accurate as shown on date and place of calibration only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

**Result of calibration : Wavelength Accuracy**

(Without adjustment)

| <u>Material</u> | <u>Certified Values of<br/>Reference Material (nm)</u> | <u>UUC* Reading<br/>(nm)</u> | <u>Error<br/>(nm)</u> | <u>Uncertainty<br/>± (nm)</u> | <u>k<br/>Factor</u> |
|-----------------|--|------------------------------|-----------------------|-------------------------------|---------------------|
| RM-HL           | 278.13   | 278.3                        | 0.17                  | 0.16                          | 2.00                |
|                 | 361.25   | 361.3                        | 0.05                  | 0.16                          | 2.00                |
|                 | 467.82   | 468.0                        | 0.18                  | 0.16                          | 2.00                |
|                 | 536.56   | 536.6                        | 0.04                  | 0.16                          | 2.00                |
|                 | 640.50   | 640.4                        | -0.10                 | 0.16                          | 2.00                |
| RM-DL           | 740.09   | 740.0                        | -0.09                 | 0.16                          | 2.00                |
|                 | 864.94   | 865.0                        | 0.06                  | 0.16                          | 2.00                |

UUC\* = Unit Under Calibration



Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 3 of 3

**Result of calibration : Photometric Accuracy**

(Without adjustment)

| Material                     | Wavelength<br>(nm) | Filter S/N         | Nominal<br>Absorbance (A)   | Certified<br>Absorbance (A)    | UUC* Reading<br>Absorbance (A) | Error<br>(A)         | Uncertainty<br>± (A) | k<br>Factor |
|------------------------------|--------------------|--------------------|-----------------------------|--------------------------------|--------------------------------|----------------------|----------------------|-------------|
| Neutral Density glass filter | 440.0              | 29360              | 1.0                         | 1.0517                         | 1.0564                         | 0.0047               | 0.0031               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.7445                         | 0.7460                         | 0.0015               | 0.0032               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5416                         | 0.5429                         | 0.0013               | 0.0032               | 2.00        |
|                              | 546.1              | 29360              | 1.0                         | 0.9821                         | 0.9849                         | 0.0028               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.6961                         | 0.6961                         | 0.0000               | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5073                         | 0.5073                         | 0.0000               | 0.0030               | 2.00        |
|                              | 590.0              | 29360              | 1.0                         | 1.0222                         | 1.0244                         | 0.0022               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.7237                         | 0.7234                         | -0.0003              | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5361                         | 0.5360                         | -0.0001              | 0.0031               | 2.00        |
|                              | 635.0              | 29360              | 1.0                         | 0.9753                         | 0.9775                         | 0.0022               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.6910                         | 0.6910                         | 0.0000               | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5211                         | 0.5210                         | -0.0001              | 0.0032               | 2.00        |
| Material                     | Wavelength<br>(nm) | Solution<br>(mg/l) | Certified<br>Absorbance (A) | UUC* Reading<br>Absorbance (A) | Error<br>(A)                   | Uncertainty<br>± (A) | k<br>Factor          |             |
| RM-0204060810                | 235.0              | 20                 | 0.2422                      | 0.2462                         | 0.0040                         | 0.0101               | 2.00                 |             |
|                              |                    | 40                 | 0.4866                      | 0.4900                         | 0.0034                         | 0.0115               | 2.00                 |             |
|                              |                    | 60                 | 0.7414                      | 0.7390                         | -0.0024                        | 0.0068               | 2.00                 |             |
|                              |                    | 80                 | 0.9858                      | 0.9871                         | 0.0013                         | 0.0093               | 2.00                 |             |
|                              |                    | 100                | 1.2442                      | 1.2480                         | 0.0038                         | 0.0087               | 2.00                 |             |

UUC\* = Unit Under Calibration

**Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230**

|                                |                        |
|--------------------------------|------------------------|
| Resolution of Wavelength Mode  | 0.1 nm                 |
| Resolution of Photometric Mode | 0.0001 A               |
| Parameter Setting              |                        |
| Measurement Mode               | Wavelength, Absorbance |
| Wavelength Scan                | 1100 nm-190 nm         |
| Scanning Speed                 | 7.5 nm/min             |
| Data Pitch                     | 0.1 nm                 |
| Band width(Wavelength)         | 1.0 nm                 |
| Band width(Vis)                | 1.0 nm                 |
| Band width(Uv)                 | 1.0 nm                 |

| Stray Light** UUC* Reading at 220 nm |               |
|--------------------------------------|---------------|
| Transimission T(%)                   | Absorbance(A) |
| 0.0111                               | 3.9564        |

\*\*Specific Acceptance :

Transmission  $\leq$  1.0 T(%), Absorbance  $\geq$  2.0 A

\*\*Stray light not TISI Accredited

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95%

**End of Calibration Certificate**

## เอกสารที่ 5-2

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศจากปล่อง



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

## Console Calibration Report

Calibration Method

Critical Orifices

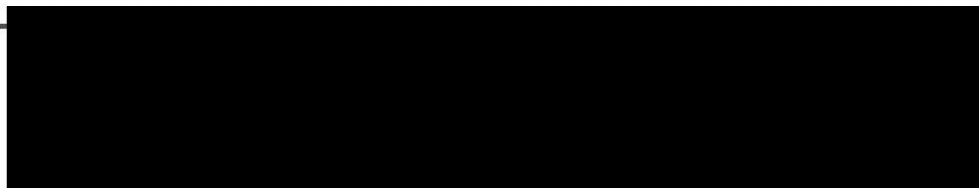
### Calibration Data

| Console Data |            | Calibration Data |       |                                      |
|--------------|------------|------------------|-------|--------------------------------------|
| No.          | Serial No. | Date             | y     | DH <sub>g</sub> (mmH <sub>2</sub> O) |
| B01          | 1563       | 04/09/2023       | 0.997 | 50.11                                |
| B02          | 8002514    | 06/09/2023       | 1.002 | 49.25                                |
| B03          | 1503016    | 05/09/2023       | 0.998 | 50.44                                |
| B04          | 00006659   | 05/09/2023       | 1.004 | 49.37                                |
| B05          | 00007428   | 05/09/2023       | 0.996 | 49.77                                |
| R01          | 1561       | 06/09/2023       | 1.004 | 49.86                                |
| R02          | 8002513    | 08/09/2023       | 1.005 | 50.36                                |
| R03          | 1570       | 07/09/2023       | 0.997 | 49.55                                |
| R04          | 8002519    | 04/09/2023       | 1.004 | 49.69                                |
| R05          | 1503015    | 07/09/2023       | 0.999 | 50.08                                |

Remark : Accept Value of y (test) is  $0.97 < y < 1.03$

Accept Value of DH<sub>g</sub> (test) is  $46.7 \pm 6.4$  (mmH<sub>2</sub>O)

Calibrated by :







บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

## Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

### Calibration Data

| Pitot Tube Data |               |                                  | Calibration Data |                   |        |
|-----------------|---------------|----------------------------------|------------------|-------------------|--------|
| No.             | Type of Pitot | Coefficient of Standard<br>Pitot | Date             | Avg. of Cp (test) |        |
|                 |               |                                  |                  | Side A            | Side B |
| B03             | S             | 0.99                             | 02/08/2023       | 0.84              | 0.84   |
| B04             | S             | 0.99                             | 02/08/2023       | 0.85              | 0.84   |
| B05             | S             | 0.99                             | 02/08/2023       | 0.84              | 0.83   |
| B07             | S             | 0.99                             | 02/08/2023       | 0.84              | 0.84   |
| B08             | S             | 0.99                             | 03/08/2023       | 0.84              | 0.85   |
| B09             | S             | 0.99                             | 01/08/2023       | 0.85              | 0.84   |
| B11             | S             | 0.99                             | 04/08/2023       | 0.84              | 0.85   |
| B16             | S             | 0.99                             | 02/08/2023       | 0.84              | 0.85   |
| B18             | S             | 0.99                             | 02/08/2023       | 0.83              | 0.84   |
| B19             | S             | 0.99                             | 01/08/2023       | 0.84              | 0.84   |
| B21             | S             | 0.99                             | 03/08/2023       | 0.84              | 0.85   |
| B24             | S             | 0.99                             | 03/08/2023       | 0.84              | 0.84   |
| B27             | S             | 0.99                             | 02/08/2023       | 0.84              | 0.84   |
| B30             | S             | 0.99                             | 01/08/2023       | 0.85              | 0.84   |
| B31             | S             | 0.99                             | 03/08/2023       | 0.83              | 0.84   |
| B33             | S             | 0.99                             | 03/08/2023       | 0.84              | 0.84   |
| B35             | S             | 0.99                             | 01/08/2023       | 0.84              | 0.85   |

Remark : Accept value of Cp (test) is  $0.84 \pm 0.01$

Calibrated by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com... www.spscon.com

### Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

#### Environmental Conditions

Temperature : 25  $\pm$  3  $^{\circ}$ C  
Pressure : 1010  $\pm$  15 mmbar

| Personal Pump Data |       |           |            | Calibration Data |                    |       |       |                 |       |       |                              |                |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No.                | Brand | Model     | Serial No. | Date             | Flow Rate (mL/min) |       |       |                 |       |       | Value From Calibration Curve |                |
|                    |       |           |            |                  | Setting            |       |       | Actual (Q std.) |       |       |                              |                |
|                    |       |           |            |                  | 1                  | 2     | 3     | 1               | 2     | 3     | y                            | R <sup>2</sup> |
| B41                | SKC   | 224-PCXR4 | 612669     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,495 | 1,989 | 0.995x + 1.833               | 1.000          |
| B42                | SKC   | 224-PCXR4 | 626041     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,003           | 1,496 | 1,989 | 0.985x + 18.950              | 1.000          |
| B43                | SKC   | 224-PCXR4 | 034636     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,500 | 1,990 | 0.990x + 11.352              | 1.000          |
| B44                | SKC   | 224-PCXR8 | 529341     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,000 | 1.003x - 8.128               | 1.000          |
| B45                | SKC   | 224-PCXR8 | 529594     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,500 | 1,985 | 0.988x + 13.443              | 1.000          |
| B46                | SKC   | 224-PCXR8 | 566743     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,504 | 2,000 | 1.006x - 14.882              | 1.000          |
| B47                | SKC   | 224-PCXR8 | 566747     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,002 | 1.012x - 24.217              | 0.999          |
| B48                | SKC   | 224-PCXR8 | 566753     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,491 | 1,996 | 1.002x - 11.236              | 1.000          |
| B49                | SKC   | 224-PCXR8 | 566780     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,004 | 1.012x - 23.640              | 0.999          |
| B50                | SKC   | 224-PCXR8 | 500400     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,506 | 2,000 | 0.997x + 1.566               | 1.000          |
| B51                | SKC   | 224-PCXR8 | 500363     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,502 | 1,998 | 1.010x - 25.405              | 0.999          |
| B52                | SKC   | 224-PCXR8 | 093186     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,494 | 1,990 | 0.995x + 0.992               | 1.000          |
| B53                | SKC   | 224-PCXR8 | 707670     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,499 | 2,000 | 1.007x - 16.304              | 0.999          |
| B54                | SKC   | 224-PCXR3 | 509821     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,500 | 2,000 | 1.017x - 35.039              | 0.999          |
| B55                | SKC   | 224-PCXR3 | 510710     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,493 | 1,990 | 0.993x + 2.638               | 1.000          |
| B56                | SKC   | 224-PCXR3 | 511450     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,999 | 1.004x - 9.108               | 1.000          |
| B57                | SKC   | 224-PCXR3 | 510798     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,490 | 1,997 | 1.005x - 13.675              | 1.000          |
| B58                | SKC   | 224-PCXR3 | 509852     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,497 | 1,997 | 1.006x - 19.133              | 0.999          |
| B59                | SKC   | 224-PCXR3 | 509862     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,501 | 1,993 | 1.001x - 5.136               | 1.000          |
| B60                | SKC   | 224-PCXR3 | 512655     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 2,015 | 1.017x - 25.660              | 1.000          |
| B61                | SKC   | 224-PCXR3 | 503915     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,488 | 1,997 | 1.004x - 13.766              | 1.000          |
| B62                | SKC   | 224-PCXR3 | 505975     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,493 | 1,994 | 0.996x + 0.183               | 1.000          |
| B63                | SKC   | 224-PCXR3 | 511432     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 989             | 1,499 | 1,998 | 1.010x - 24.150              | 1.000          |
| B64                | SKC   | 224-PCXR3 | 508302     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 997             | 1,491 | 1,987 | 0.990x + 8.411               | 1.000          |
| B65                | SKC   | 224-PCXR3 | 508310     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,011           | 1,499 | 2,000 | 0.998x + 0.263               | 0.999          |
| B66                | SKC   | 224-PCXR3 | 509861     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,489 | 1,990 | 0.987x + 13.691              | 1.000          |
| B67                | SKC   | 224-PCXR3 | 506295     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,506 | 2,009 | 1.012x - 20.281              | 1.000          |
| B68                | SKC   | 224-PCXR3 | 505872     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,489 | 1,996 | 0.994x + 3.757               | 1.000          |
| B69                | SKC   | 224-PCXR3 | 508375     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,998 | 1.008x - 19.635              | 0.999          |
| B70                | SKC   | 224-PCXR3 | 510623     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,502 | 1,994 | 1.001x - 5.451               | 1.000          |
| B71                | SKC   | 224-PCXR3 | 508367     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,504 | 2,000 | 1.016x - 35.155              | 0.999          |
| B72                | SKC   | 224-PCXR3 | 505977     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,498 | 1,992 | 0.992x + 7.080               | 1.000          |
| B73                | SKC   | 224-PCXR3 | 512606     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,499 | 2,002 | 1.000x - 7.240               | 0.999          |
| B74                | SKC   | 224-PCXR3 | 505993     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,992 | 0.996x - 2.446               | 1.000          |
| B75                | SKC   | 224-PCXR3 | 509820     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,989 | 0.995x + 1.829               | 1.000          |
| B76                | SKC   | 224-PCXR3 | 509811     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,497 | 1,997 | 1.005x - 14.428              | 1.000          |
| B77                | SKC   | 224-PCXR3 | 508301     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,499 | 2,001 | 1.008x - 21.556              | 0.999          |
| B78                | SKC   | 224-PCXR3 | 510677     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,502 | 1,997 | 1.012x - 28.449              | 0.999          |
| B79                | SKC   | 224-PCXR3 | 510920     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,492 | 1,992 | 1.000x - 5.853               | 1.000          |

Calibrated by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data |       |        | Calibration Data |                     |       |       |                 |        |        |                              |                |
|----------------|-------|--------|------------------|---------------------|-------|-------|-----------------|--------|--------|------------------------------|----------------|
| No.            | Brand | Model  | Date             | Flow Rate (ml/min)  |       |       |                 |        |        | Value From Calibration Curve |                |
|                |       |        |                  | Flow Rate (Reading) |       |       | Actual (Q std.) |        |        |                              |                |
|                |       |        |                  | 1                   | 2     | 3     | 1               | 2      | 3      | y                            | R <sup>2</sup> |
| H-B01          | Dwyer | VFB-65 | 04/07/2023       | 500                 | 1,000 | 2,000 | 503.2           | 990.1  | 1974.7 | 0.990x + 7.225               | 1.000          |
| H-B02          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 495.6           | 994.6  | 1994.1 | 0.995x + 2.972               | 1.000          |
| H-B03          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 497.1           | 989.8  | 2007.6 | 1.002x - 12.719              | 0.999          |
| H-B04          | Dwyer | VFB-65 | 06/07/2023       | 500                 | 1,000 | 2,000 | 500.3           | 999.5  | 2004.4 | 0.996x - 0.709               | 1.000          |
| H-B05          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 499.3           | 990.7  | 1972.3 | 0.982x + 17.213              | 0.999          |
| H-B06          | Dwyer | VFB-65 | 06/07/2023       | 500                 | 1,000 | 2,000 | 504.0           | 991.4  | 1982.0 | 0.988x + 8.755               | 1.000          |
| H-B07          | Dwyer | VFB-65 | 04/07/2023       | 500                 | 1,000 | 2,000 | 501.3           | 989.4  | 2014.7 | 0.999x - 0.490               | 1.000          |
| H-B08          | Dwyer | VFB-65 | 05/07/2023       | 500                 | 1,000 | 2,000 | 499.2           | 996.1  | 1977.8 | 0.993x + 2.247               | 0.999          |
| H-B09          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 504.0           | 1006.4 | 2008.7 | 0.991x + 16.313              | 1.000          |
| H-B10          | Dwyer | VFB-65 | 10/07/2023       | 500                 | 1,000 | 2,000 | 495.7           | 993.0  | 2011.6 | 1.000x - 1.820               | 1.000          |

Calibrated by :



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : HI-LIGHT  
MODEL / TYPE : N/A  
SERIAL NO. : N/A[64-220066-4]  
CLID. NO. : 212201115  
JOB CONTROL NO. : 230725081568

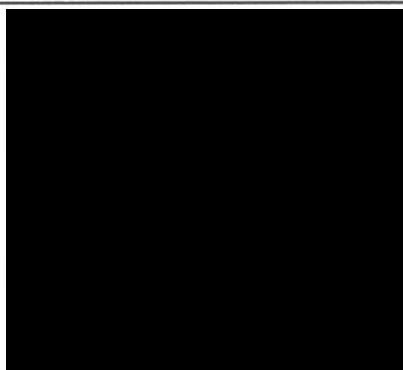
CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 25 July 2023

DATE OF ISSUED : 31 July 2023

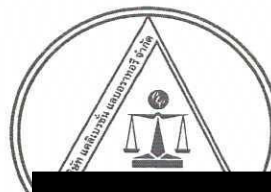
Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :



Approved By :

Authorized Signatory  
31 July 2023



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23081568

F3-011-04/01-12

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@clccalibration



## REPORT OF CALIBRATION FOR

|                         |   |                  |
|-------------------------|---|------------------|
| NOMENCLATURE            | : | VACUUM GAUGE     |
| MANUFACTURER            | : | HI-LIGHT         |
| MODEL / TYPE            | : | N/A              |
| SERIAL NO.              | : | N/A[64-220066-4] |
| DATE OF CALIBRATION     | : | 26 July 2023     |
| DUE DATE OF CALIBRATION | : | 26 July 2024     |

### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(55 \pm 10) \% \text{RH}$

### PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPPP-05** according to **DKD-R 6-1** as calibration guidelines.

The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

### REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 741B S/N. 8295020 with Pressure Module Model 700PD5 S/N. 89404505.

### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).  
Certificate No. MP-0035-23, Due Date 02 February 2024.

### UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of  $k = 2$ . It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. **Q23081568**

**F3-011-04/01-12**

page 2 of 3



@clccalibration



**CLC**  
Accredited  
ISO/IEC 17025

# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



## CONDITION OF CALIBRATION ITEM : GOOD

## MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the means value were reported in the table below.

### CALIBRATION DATA

#### CORRECTION OF PRESSURE

| DUC Test point<br>( inHg ) | STD Reading ( kPa ) |         | Conversion to inHg |       | Correction ( inHg ) |      |
|----------------------------|---------------------|---------|--------------------|-------|---------------------|------|
|                            | Up                  | Down    | Up                 | Down  | Up                  | Down |
| 0                          | 0.00                | 0.00    | 0.0                | 0.0   | 0.0                 | 0.0  |
| -5                         | -17.61              | -17.95  | -5.2               | -5.3  | -0.2                | -0.3 |
| -10                        | -34.54              | -34.54  | -10.2              | -10.2 | -0.2                | -0.2 |
| -15                        | -51.13              | -51.47  | -15.1              | -15.2 | -0.1                | -0.2 |
| -20                        | -67.72              | -68.06  | -20.0              | -20.1 | 0.0                 | -0.1 |
| -25                        | -84.31              | -84.31  | -24.9              | -24.9 | +0.1                | +0.1 |
| -30                        | -101.24             | -101.24 | -29.9              | -29.9 | +0.1                | +0.1 |

Uncertainty of measurement  $\pm 0.2$  inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 inHg

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 36 of 54

**This report is valid for the above stated instrument/s only.**

### End of Certificate ###

Certificate No. Q23081568

F3-011-04/01-12

page 3 of 3



@clccalibration





# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

[www.qcalibration.com](http://www.qcalibration.com)



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,  
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY :

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.





CERTIFICATE No : 23M2441

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23  
AIR PRESSURE : 1010mbar  $\pm$  1mbar CALIBRATION DATE : 10-Mar-23  
AMBIENT TEMPERATURE : 23° C  $\pm$  1° C RELATIVE HUMIDITY : 49 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT             | MODEL | SERIAL No | CERTIFICATE No | DUE DATE  |
|------------------------|-------|-----------|----------------|-----------|
| 1) STANDARD WEIGHT SET | E2    | QK-I-151  | M2302013S      | 02-Feb-25 |
| 2) STANDARD WEIGHT     | E2    | 15843     | M2302014S      | 02-Feb-25 |

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

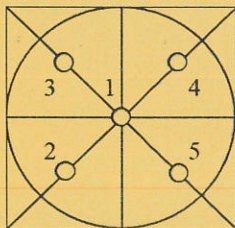
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000039               |
| 0.02              | 0.02000             | 0.00000        | 0.000039               |
| 0.10              | 0.10000             | 0.00000        | 0.000039               |
| 0.20              | 0.20001             | -0.00001       | 0.000040               |
| 0.50              | 0.50001             | -0.00001       | 0.000040               |
| 1.00              | 1.00000             | 0.00000        | 0.000041               |
| 2.00              | 2.00003             | -0.00003       | 0.000042               |
| 5.00              | 5.00001             | -0.00001       | 0.000046               |
| 10.00             | 10.00003            | -0.00003       | 0.000053               |
| 20.00             | 20.00005            | -0.00005       | 0.000067               |
| 50.00             | 50.00001            | -0.00001       | 0.00011                |
| 100.00            | 100.00001           | -0.00001       | 0.00019                |
| 200.00            | 200.00001           | -0.00001       | 0.00032                |

5. OFF CENTER LOADING ERROR



| POINT              | READING (g) |
|--------------------|-------------|
| 1                  | 50.0000     |
| 2                  | 50.0001     |
| 3                  | 50.0000     |
| 4                  | 50.0000     |
| 5                  | 49.9999     |
| OFF-CENTER LOADING | 0.0001      |

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.  
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com <http://www.sithiphorn.com>

NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : SP23016

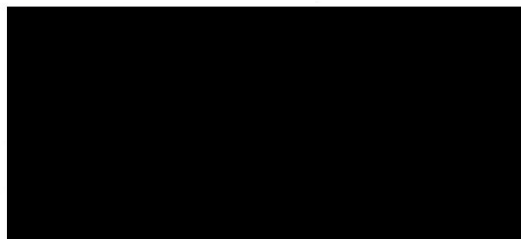
Pages : 1 of 3

## Calibration Certificate

**Equipment :** UV-VIS SPECTROPHOTOMETER  
**Manufacturer :** PERKINELMER  
**Model :** LAMBDA 25  
**Serial No.:** 501S14123010  
**ID No.:** SP03/58  
**Calibration Mode :** WAVELENGTH ACCURACY  
PHOTOMETRIC ACCURACY  
**Condition As Found :** GOOD  
**Customer :** S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,  
CHOMPHON, CHATUCHAK,  
BANGKOK 10900, THAILAND.  
**Location :** ORGANIC LABORATORY IV  
**Ambient Temperature :** ( 25.0  $\pm$  5 ) °C  
**Relative Humidity :** ( 48.4  $\pm$  25 ) %  
**Received Date :** 30 AUGUST 2023  
**Calibration Date :** 30 AUGUST 2023  
**Date of Issue :** 31 AUGUST 2023

**Calibrated by :**

**Approved by :**



This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

## Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

**Calibration Method :**

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01,ASTM E925-02

**Condition of this result of calibration :**

## 1. Certified reference materials

| <u>Material</u>                | <u>Ref. type</u> | <u>Cell serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|------------------|------------------------|------------------|-----------------|
| Holmium liquid                 | RM-HL            | 29706                  | 106864           | 01/11/2024      |
| Didymium liquid                | RM-DL            | 28912                  | 106905           | 02/11/2024      |
| Neutral density filter         | RM-1N2N3N        | 13877                  | 106918           | 03/11/2024      |
| Potassium dichromate solutions | RM-0204060810    | 14204                  | 106902           | 02/11/2024      |
| Potassium Iodide solution      | -                | KI-0701-001            | CI-0090-22       | 08/04/2024      |

2. This result of calibration was found accurate as shown on date and place of calibration only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

**Result of calibration : Wavelength Accuracy**

(Without adjustment)

| <u>Material</u> | <u>Certified Values of<br/>Reference Material (nm)</u> | <u>UUC* Reading<br/>(nm)</u> | <u>Error<br/>(nm)</u> | <u>Uncertainty<br/>± (nm)</u> | <u>k<br/>Factor</u> |
|-----------------|--|------------------------------|-----------------------|-------------------------------|---------------------|
| RM-HL           | 278.13   | 278.3                        | 0.17                  | 0.16                          | 2.00                |
|                 | 361.25   | 361.3                        | 0.05                  | 0.16                          | 2.00                |
|                 | 467.82   | 468.0                        | 0.18                  | 0.16                          | 2.00                |
|                 | 536.56   | 536.6                        | 0.04                  | 0.16                          | 2.00                |
|                 | 640.50   | 640.4                        | -0.10                 | 0.16                          | 2.00                |
| RM-DL           | 740.09   | 740.0                        | -0.09                 | 0.16                          | 2.00                |
|                 | 864.94   | 865.0                        | 0.06                  | 0.16                          | 2.00                |

UUC\* = Unit Under Calibration



Continuation of Calibration Certificate

Cert. No. : SP23016  
Job No. : VC66SP0014  
Pages : 3 of 3

**Result of calibration : Photometric Accuracy**

(Without adjustment)

| Material                     | Wavelength<br>(nm) | Filter S/N         | Nominal<br>Absorbance (A)   | Certified<br>Absorbance (A)    | UUC* Reading<br>Absorbance (A) | Error<br>(A)         | Uncertainty<br>± (A) | k<br>Factor |
|------------------------------|--------------------|--------------------|-----------------------------|--------------------------------|--------------------------------|----------------------|----------------------|-------------|
| Neutral Density glass filter | 440.0              | 29360              | 1.0                         | 1.0517                         | 1.0564                         | 0.0047               | 0.0031               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.7445                         | 0.7460                         | 0.0015               | 0.0032               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5416                         | 0.5429                         | 0.0013               | 0.0032               | 2.00        |
|                              | 546.1              | 29360              | 1.0                         | 0.9821                         | 0.9849                         | 0.0028               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.6961                         | 0.6961                         | 0.0000               | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5073                         | 0.5073                         | 0.0000               | 0.0030               | 2.00        |
|                              | 590.0              | 29360              | 1.0                         | 1.0222                         | 1.0244                         | 0.0022               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.7237                         | 0.7234                         | -0.0003              | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5361                         | 0.5360                         | -0.0001              | 0.0031               | 2.00        |
|                              | 635.0              | 29360              | 1.0                         | 0.9753                         | 0.9775                         | 0.0022               | 0.0030               | 2.00        |
|                              |                    | 29914              | 0.7                         | 0.6910                         | 0.6910                         | 0.0000               | 0.0030               | 2.00        |
|                              |                    | 29381              | 0.5                         | 0.5211                         | 0.5210                         | -0.0001              | 0.0032               | 2.00        |
| Material                     | Wavelength<br>(nm) | Solution<br>(mg/l) | Certified<br>Absorbance (A) | UUC* Reading<br>Absorbance (A) | Error<br>(A)                   | Uncertainty<br>± (A) | k<br>Factor          |             |
| RM-0204060810                | 235.0              | 20                 | 0.2422                      | 0.2462                         | 0.0040                         | 0.0101               | 2.00                 |             |
|                              |                    | 40                 | 0.4866                      | 0.4900                         | 0.0034                         | 0.0115               | 2.00                 |             |
|                              |                    | 60                 | 0.7414                      | 0.7390                         | -0.0024                        | 0.0068               | 2.00                 |             |
|                              |                    | 80                 | 0.9858                      | 0.9871                         | 0.0013                         | 0.0093               | 2.00                 |             |
|                              |                    | 100                | 1.2442                      | 1.2480                         | 0.0038                         | 0.0087               | 2.00                 |             |

UUC\* = Unit Under Calibration

**Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230**

Resolution of Wavelength Mode 0.1 nm  
Resolution of Photometric Mode 0.0001 A  
Parameter Setting  
Measurement Mode Wavelength, Absorbance  
Wavelength Scan 1100 nm-190 nm  
Scanning Speed 7.5 nm/min  
Data Pitch 0.1 nm  
Band width(Wavelength) 1.0 nm  
Band width(Vis) 1.0 nm  
Band width(Uv) 1.0 nm

| Stray Light** UUC* Reading at 220 nm |               |
|--------------------------------------|---------------|
| Transmission T(%)                    | Absorbance(A) |
| 0.0111                               | 3.9564        |

\*\*Specific Acceptance :

Transmission  $\leq$  1.0 T(%), Absorbance  $\geq$  2.0 A

\*\*Stray light not TISI Accredited

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k$ , providing a level of confidence of approximately 95%

End of Calibration Certificate

### เอกสารที่ 5-3

เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศ  
ในสถานประกอบการ (Working Area)





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72. Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature 25  $\pm$  3  $^{\circ}$ C  
Pressure 1010  $\pm$  15 mmbar

| Personal Pump Data |       |           |            | Calibration Data |                    |       |       |                 |       |       |                              |                |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No.                | Brand | Model     | Serial No. | Date             | Flow Rate (mL/min) |       |       |                 |       |       | Value From Calibration Curve |                |
|                    |       |           |            |                  | Setting            |       |       | Actual (Q std.) |       |       |                              |                |
|                    |       |           |            |                  | 1                  | 2     | 3     | 1               | 2     | 3     | y                            | R <sup>2</sup> |
| B01                | SKC   | 224-PCXR4 | 262101     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,495 | 1,996 | 1.001x - 4.542               | 1.000          |
| B02                | SKC   | 224-PCXR4 | 626166     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,504 | 1,999 | 1.009x - 20.101              | 0.999          |
| B03                | SKC   | 224-PCXR4 | 612968     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,493 | 1,999 | 1.005x - 12.388              | 1.000          |
| B04                | SKC   | 224-PCXR4 | 602804     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,501 | 1,992 | 0.998x - 0.040               | 1.000          |
| B05                | SKC   | 224-PCXR4 | 612693     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,498 | 2,000 | 1.010x - 21.803              | 0.999          |
| B06                | SKC   | 224-PCXR4 | 262188     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,506 | 2,004 | 1.011x - 20.811              | 1.000          |
| B07                | SKC   | 224-PCXR4 | 626262     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 997             | 1,490 | 1,993 | 0.992x + 6.399               | 1.000          |
| B08                | SKC   | 224-PCXR4 | 626100     | 07/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,498 | 2,005 | 1.013x - 26.473              | 0.999          |
| B09                | SKC   | 224-PCXR4 | 626479     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,489 | 1,991 | 0.993x + 1.797               | 1.000          |
| B10                | SKC   | 224-PCXR4 | 091950     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,501 | 1,999 | 1.017x - 36.784              | 0.999          |
| B11                | SKC   | 224-PCXR8 | 564315     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,489 | 1,997 | 1.003x - 8.260               | 1.000          |
| B12                | SKC   | 224-PCXR4 | 034656     | 07/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,003 | 1.004x - 7.152               | 1.000          |
| B13                | SKC   | 224-PCXR4 | 602073     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,499 | 1,996 | 1.000x - 3.092               | 1.000          |
| B14                | SKC   | 224-PCXR4 | 626313     | 07/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,491 | 1,987 | 0.991x + 8.312               | 1.000          |
| B15                | SKC   | 224-PCXR4 | 626474     | 07/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,500 | 2,003 | 1.009x - 17.930              | 0.999          |
| B16                | SKC   | 224-PCXR4 | 626477     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,502 | 1,999 | 1.014x - 31.373              | 0.999          |
| B17                | SKC   | 224-PCXR4 | 626860     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,493 | 1,989 | 0.996x - 0.944               | 1.000          |
| B18                | SKC   | 224-PCXR4 | 691484     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,499 | 1,999 | 1.008x - 17.894              | 0.999          |
| B19                | SKC   | 224-PCXR4 | 691599     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,501 | 1,997 | 1.005x - 10.491              | 1.000          |
| B20                | SKC   | 224-PCXR4 | 691587     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 990             | 1,502 | 1,998 | 1.009x - 21.898              | 1.000          |
| B21                | SKC   | 224-PCXR4 | 691531     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,476 | 1,993 | 1.000x - 11.272              | 1.000          |
| B22                | SKC   | 224-PCXR4 | 691654     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,002 | 1.011x - 21.141              | 0.999          |
| B23                | SKC   | 224-PCXR4 | 798393     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,505 | 2,000 | 1.017x - 33.720              | 0.999          |
| B24                | SKC   | 224-PCXR4 | 626363     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,501 | 1,997 | 1.003x - 8.933               | 1.000          |
| B25                | SKC   | 224-PCXR4 | 798489     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,491 | 1,998 | 0.996x + 1.689               | 1.000          |
| B26                | SKC   | 224-PCXR4 | 798479     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,498 | 1,991 | 0.993x + 6.351               | 1.000          |
| B27                | SKC   | 224-PCXR4 | 691673     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,502 | 2,000 | 1.015x - 32.306              | 0.999          |
| B28                | SKC   | 224-PCXR4 | 691570     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,498 | 1,999 | 1.005x - 12.188              | 1.000          |
| B29                | SKC   | 224-PCXR4 | 626472     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,496 | 1,998 | 1.002x - 6.471               | 1.000          |
| B30                | SKC   | 224-PCXR4 | 691489     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,508 | 2,004 | 1.002x - 7.722               | 0.999          |
| B31                | SKC   | 224-PCXR4 | 691509     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,475 | 1,995 | 0.999x - 10.348              | 1.000          |
| B32                | SKC   | 224-PCXR4 | 091567     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 990             | 1,501 | 1,998 | 1.011x - 24.321              | 1.000          |
| B33                | SKC   | 224-PCXR4 | 091756     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,496 | 1,990 | 0.991x + 4.498               | 1.000          |
| B34                | SKC   | 224-PCXR4 | 612962     | 07/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,499 | 2,000 | 1.006x - 14.460              | 0.999          |
| B35                | SKC   | 224-PCXR4 | 602682     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,497 | 1,994 | 1.002x - 9.742               | 1.000          |
| B36                | SKC   | 224-PCXR4 | 626164     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,496 | 1,999 | 1.000x - 6.056               | 1.000          |
| B37                | SKC   | 224-PCXR4 | 626256     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,505 | 1,997 | 1.005x - 13.443              | 1.000          |
| B38                | SKC   | 224-PCXR4 | 626167     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,496 | 1,996 | 1.001x - 3.347               | 1.000          |
| B39                | SKC   | 224-PCXR4 | 034637     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,004           | 1,499 | 1,999 | 1.009x - 18.599              | 0.999          |
| B40                | SKC   | 224-PCXR4 | 798349     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,504 | 1,997 | 1.013x - 29.094              | 0.999          |

Calibrated by :



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### Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

#### Environmental Conditions

Temperature : 25  $\pm$  3  $^{\circ}$ C  
Pressure : 1010  $\pm$  15 mmbar

| Personal Pump Data |       |           |            | Calibration Data |                    |       |       |                 |       |       |                              |                |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No.                | Brand | Model     | Serial No. | Date             | Flow Rate (ml/min) |       |       |                 |       |       | Value From Calibration Curve |                |
|                    |       |           |            |                  | Setting            |       |       | Actual (Q std.) |       |       |                              |                |
|                    |       |           |            |                  | 1                  | 2     | 3     | 1               | 2     | 3     | y                            | R <sup>2</sup> |
| B41                | SKC   | 224-PCXR4 | 612669     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,495 | 1,989 | 0.995x + 1.833               | 1.000          |
| B42                | SKC   | 224-PCXR4 | 626041     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,003           | 1,496 | 1,989 | 0.985x + 18.950              | 1.000          |
| B43                | SKC   | 224-PCXR4 | 034636     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,500 | 1,990 | 0.990x + 11.352              | 1.000          |
| B44                | SKC   | 224-PCXR8 | 529341     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,000 | 1.003x - 8.128               | 1.000          |
| B45                | SKC   | 224-PCXR8 | 529594     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,500 | 1,985 | 0.988x + 13.443              | 1.000          |
| B46                | SKC   | 224-PCXR8 | 566743     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,504 | 2,000 | 1.006x - 14.882              | 1.000          |
| B47                | SKC   | 224-PCXR8 | 566747     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,002 | 1.012x - 24.217              | 0.999          |
| B48                | SKC   | 224-PCXR8 | 566753     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,491 | 1,996 | 1.002x - 11.236              | 1.000          |
| B49                | SKC   | 224-PCXR8 | 566780     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,004 | 1.012x - 23.640              | 0.999          |
| B50                | SKC   | 224-PCXR8 | 500400     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,506 | 2,000 | 0.997x + 1.566               | 1.000          |
| B51                | SKC   | 224-PCXR8 | 500363     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,502 | 1,998 | 1.010x - 25.405              | 0.999          |
| B52                | SKC   | 224-PCXR8 | 093186     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,494 | 1,990 | 0.995x + 0.992               | 1.000          |
| B53                | SKC   | 224-PCXR8 | 707670     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,499 | 2,000 | 1.007x - 16.304              | 0.999          |
| B54                | SKC   | 224-PCXR3 | 509821     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,500 | 2,000 | 1.017x - 35.039              | 0.999          |
| B55                | SKC   | 224-PCXR3 | 510710     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,493 | 1,990 | 0.993x + 2.638               | 1.000          |
| B56                | SKC   | 224-PCXR3 | 511450     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,999 | 1.004x - 9.108               | 1.000          |
| B57                | SKC   | 224-PCXR3 | 510798     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,490 | 1,997 | 1.005x - 13.675              | 1.000          |
| B58                | SKC   | 224-PCXR3 | 509852     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,497 | 1,997 | 1.006x - 19.133              | 0.999          |
| B59                | SKC   | 224-PCXR3 | 509862     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,501 | 1,993 | 1.001x - 5.136               | 1.000          |
| B60                | SKC   | 224-PCXR3 | 512655     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 2,015 | 1.017x - 25.660              | 1.000          |
| B61                | SKC   | 224-PCXR3 | 503915     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,488 | 1,997 | 1.004x - 13.766              | 1.000          |
| B62                | SKC   | 224-PCXR3 | 505975     | 06/07/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,493 | 1,994 | 0.996x + 0.183               | 1.000          |
| B63                | SKC   | 224-PCXR3 | 511432     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 989             | 1,499 | 1,998 | 1.010x - 24.150              | 1.000          |
| B64                | SKC   | 224-PCXR3 | 508302     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 997             | 1,491 | 1,987 | 0.990x + 8.411               | 1.000          |
| B65                | SKC   | 224-PCXR3 | 508310     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,011           | 1,499 | 2,000 | 0.998x + 0.263               | 0.999          |
| B66                | SKC   | 224-PCXR3 | 509861     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,489 | 1,990 | 0.987x + 13.691              | 1.000          |
| B67                | SKC   | 224-PCXR3 | 506295     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,506 | 2,009 | 1.012x - 20.281              | 1.000          |
| B68                | SKC   | 224-PCXR3 | 505872     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,489 | 1,996 | 0.994x + 3.757               | 1.000          |
| B69                | SKC   | 224-PCXR3 | 508375     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,998 | 1.008x - 19.635              | 0.999          |
| B70                | SKC   | 224-PCXR3 | 510623     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,502 | 1,994 | 1.001x - 5.451               | 1.000          |
| B71                | SKC   | 224-PCXR3 | 508367     | 10/07/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,504 | 2,000 | 1.016x - 35.155              | 0.999          |
| B72                | SKC   | 224-PCXR3 | 505977     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,498 | 1,992 | 0.992x + 7.080               | 1.000          |
| B73                | SKC   | 224-PCXR3 | 512606     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,499 | 2,002 | 1.000x - 7.240               | 0.999          |
| B74                | SKC   | 224-PCXR3 | 505993     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,992 | 0.996x - 2.446               | 1.000          |
| B75                | SKC   | 224-PCXR3 | 509820     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,989 | 0.995x + 1.829               | 1.000          |
| B76                | SKC   | 224-PCXR3 | 509811     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,497 | 1,997 | 1.005x - 14.428              | 1.000          |
| B77                | SKC   | 224-PCXR3 | 508301     | 04/07/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,499 | 2,001 | 1.008x - 21.556              | 0.999          |
| B78                | SKC   | 224-PCXR3 | 510677     | 05/07/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,502 | 1,997 | 1.012x - 28.449              | 0.999          |
| B79                | SKC   | 224-PCXR3 | 510920     | 03/07/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,492 | 1,992 | 1.000x - 5.853               | 1.000          |

Calibrated by :





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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
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### Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

#### Environmental Conditions

Temperature : 25  $\pm$  3  $^{\circ}$ C  
Pressure : 1010  $\pm$  15 mmbar

| Personal Pump Data |       |           |            | Calibration Data |                    |       |       |                 |       |       |                              |                |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No.                | Brand | Model     | Serial No. | Date             | Flow Rate (mL/min) |       |       |                 |       |       | Value From Calibration Curve |                |
|                    |       |           |            |                  | Setting            |       |       | Actual (Q std.) |       |       | y                            | R <sup>2</sup> |
|                    |       |           |            |                  | 1                  | 2     | 3     | 1               | 2     | 3     |                              |                |
| B41                | SKC   | 224-PCXR4 | 612669     | 10/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,491 | 1,993 | 0.994x + 2.802               | 1.000          |
| B42                | SKC   | 224-PCXR4 | 626041     | 10/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,490 | 1,989 | 0.995x - 1.759               | 1.000          |
| B43                | SKC   | 224-PCXR4 | 034636     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,488 | 1,989 | 0.991x + 2.866               | 1.000          |
| B44                | SKC   | 224-PCXR8 | 529341     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,503 | 1,998 | 1.009x - 23.051              | 0.999          |
| B45                | SKC   | 224-PCXR8 | 529594     | 10/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,495 | 1,989 | 0.989x + 10.094              | 1.000          |
| B46                | SKC   | 224-PCXR8 | 566743     | 02/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,500 | 1,998 | 1.008x - 19.564              | 0.999          |
| B47                | SKC   | 224-PCXR8 | 566747     | 02/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,502 | 1,996 | 1.011x - 27.787              | 0.999          |
| B48                | SKC   | 224-PCXR8 | 566753     | 03/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,495 | 2,000 | 1.005x - 13.577              | 1.000          |
| B49                | SKC   | 224-PCXR8 | 566780     | 02/10/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,498 | 2,000 | 1.010x - 21.853              | 0.999          |
| B50                | SKC   | 224-PCXR8 | 500400     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,495 | 1,989 | 0.991x + 5.640               | 1.000          |
| B51                | SKC   | 224-PCXR8 | 500363     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,501 | 1,996 | 1.009x - 24.941              | 0.999          |
| B52                | SKC   | 224-PCXR8 | 093186     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,500 | 1,991 | 0.996x + 2.910               | 1.000          |
| B53                | SKC   | 224-PCXR8 | 707670     | 06/10/2023       | 1,000              | 1,500 | 2,000 | 990             | 1,498 | 1,996 | 1.014x - 33.838              | 0.999          |
| B54                | SKC   | 224-PCXR3 | 509821     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,499 | 1,995 | 1.012x - 30.494              | 0.999          |
| B55                | SKC   | 224-PCXR3 | 510710     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,493 | 1,996 | 0.999x - 2.301               | 1.000          |
| B56                | SKC   | 224-PCXR3 | 511450     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,487 | 1,996 | 1.006x - 16.797              | 1.000          |
| B57                | SKC   | 224-PCXR3 | 510798     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 989             | 1,493 | 1,994 | 1.001x - 9.175               | 1.000          |
| B58                | SKC   | 224-PCXR3 | 509852     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,497 | 1,997 | 1.009x - 21.172              | 0.999          |
| B59                | SKC   | 224-PCXR3 | 509862     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,988 | 0.993x + 2.723               | 1.000          |
| B60                | SKC   | 224-PCXR3 | 512655     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,498 | 1,997 | 1.013x - 31.979              | 0.999          |
| B61                | SKC   | 224-PCXR3 | 503915     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,502 | 1,997 | 1.007x - 20.065              | 0.999          |
| B62                | SKC   | 224-PCXR3 | 505975     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,489 | 1,991 | 0.990x + 6.791               | 1.000          |
| B63                | SKC   | 224-PCXR3 | 511432     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,500 | 1,995 | 1.003x - 8.208               | 1.000          |
| B64                | SKC   | 224-PCXR3 | 508302     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 991             | 1,496 | 1,988 | 0.998x - 5.262               | 1.000          |
| B65                | SKC   | 224-PCXR3 | 508310     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,492 | 1,991 | 0.999x - 4.884               | 1.000          |
| B66                | SKC   | 224-PCXR3 | 509861     | 06/10/2023       | 1,000              | 1,500 | 2,000 | 996             | 1,493 | 1,985 | 0.992x + 2.675               | 1.000          |
| B67                | SKC   | 224-PCXR3 | 506295     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,498 | 1,998 | 1.009x - 21.534              | 0.999          |
| B68                | SKC   | 224-PCXR3 | 505872     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,493 | 1,987 | 0.993x + 3.176               | 1.000          |
| B69                | SKC   | 224-PCXR3 | 508375     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,495 | 1,996 | 1.005x - 19.592              | 0.999          |
| B70                | SKC   | 224-PCXR3 | 510623     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,486 | 1,995 | 1.002x - 11.762              | 1.000          |
| B71                | SKC   | 224-PCXR3 | 508367     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,497 | 1,996 | 1.008x - 21.646              | 0.999          |
| B72                | SKC   | 224-PCXR3 | 505977     | 03/10/2023       | 1,000              | 1,500 | 2,000 | 993             | 1,490 | 1,990 | 0.997x - 4.295               | 1.000          |
| B73                | SKC   | 224-PCXR3 | 512606     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,495 | 1,989 | 0.994x + 1.210               | 1.000          |
| B74                | SKC   | 224-PCXR3 | 505993     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 997             | 1,496 | 1,986 | 0.987x + 12.602              | 1.000          |
| B75                | SKC   | 224-PCXR3 | 509820     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,490 | 1,991 | 0.998x - 5.143               | 1.000          |
| B76                | SKC   | 224-PCXR3 | 509811     | 06/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,497 | 1,999 | 1.010x - 23.063              | 0.999          |
| B77                | SKC   | 224-PCXR3 | 508301     | 06/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,501 | 1,998 | 1.013x - 32.023              | 0.999          |
| B78                | SKC   | 224-PCXR3 | 510677     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,997 | 1.007x - 18.549              | 0.999          |
| B79                | SKC   | 224-PCXR3 | 510920     | 03/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,509 | 1,997 | 0.996x + 4.999               | 1.000          |

Calibrated by :



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### Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

#### Environmental Conditions

Temperature : 25  $\pm$  3  $^{\circ}$ C  
 Pressure : 1010  $\pm$  15 mmbar

| Personal Pump Data |       |           |            | Calibration Data |                    |       |       |                 |       |       |                              |                |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No.                | Brand | Model     | Serial No. | Date             | Flow Rate (ml/min) |       |       |                 |       |       | Value From Calibration Curve |                |
|                    |       |           |            |                  | Setting            |       |       | Actual (Q std.) |       |       |                              |                |
|                    |       |           |            |                  | 1                  | 2     | 3     | 1               | 2     | 3     | y                            | R <sup>2</sup> |
| B80                | SKC   | 224-PCXR3 | 504569     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,497 | 2,000 | 1.007x - 19.202              | 0.999          |
| B81                | SKC   | 224-PCXR3 | 503480     | 07/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,496 | 1,996 | 1.006x - 17.526              | 1.000          |
| B82                | SKC   | 224-PCXR3 | 505673     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,495 | 1,992 | 1.002x - 11.742              | 1.000          |
| B83                | SKC   | 224-PCXR3 | 510785     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,497 | 1,998 | 1.005x - 15.177              | 1.000          |
| B84                | SKC   | 224-PCXR3 | 508333     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,498 | 1,999 | 1.003x - 16.041              | 0.999          |
| B85                | SKC   | 224-PCXR3 | 505757     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,498 | 1,999 | 1.010x - 23.715              | 0.999          |
| B86                | SKC   | 224-PCXR3 | 512625     | 02/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,493 | 1,989 | 0.994x + 1.568               | 1.000          |
| B87                | SKC   | 224-PCXR3 | 504324     | 09/10/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 1,996 | 1.006x - 16.049              | 0.999          |
| B88                | SKC   | 224-PCXR3 | 508307     | 09/10/2023       | 1,000              | 1,500 | 2,000 | 1,000           | 1,496 | 1,990 | 0.990x + 9.617               | 1.000          |
| B89                | SKC   | 224-PCXR3 | 509860     | 05/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,496 | 1,998 | 0.997x - 5.214               | 0.999          |
| B90                | SKC   | 224-PCXR3 | 508366     | 03/10/2023       | 1,000              | 1,500 | 2,000 | 992             | 1,495 | 1,992 | 0.999x - 5.095               | 1.000          |
| B91                | SKC   | 224-PCXR3 | 510919     | 10/10/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,496 | 1,993 | 0.995x - 1.847               | 1.000          |
| B92                | SKC   | 224-PCXR3 | 510987     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 1,001           | 1,496 | 1,997 | 1.009x - 22.028              | 0.999          |
| B93                | SKC   | 224-PCXR3 | 509845     | 04/10/2023       | 1,000              | 1,500 | 2,000 | 997             | 1,491 | 1,990 | 0.993x + 2.516               | 1.000          |
| B94                | SKC   | 224-PCXR8 | A127871    | 04/10/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,495 | 1,995 | 1.005x - 19.074              | 0.999          |
| B95                | SKC   | 224-PCXR8 | A127921    | 09/10/2023       | 1,000              | 1,500 | 2,000 | 998             | 1,498 | 1,999 | 1.012x - 25.793              | 0.999          |
| B96                | SKC   | 224-PCXR8 | A127942    | 09/10/2023       | 1,000              | 1,500 | 2,000 | 999             | 1,495 | 1,989 | 0.991x + 5.720               | 1.000          |
| B97                | SKC   | 224-PCXR8 | A127955    | 09/10/2023       | 1,000              | 1,500 | 2,000 | 994             | 1,496 | 1,996 | 1.011x - 28.512              | 0.999          |
| B98                | SKC   | 224-PCXR8 | A127956    | 10/10/2023       | 1,000              | 1,500 | 2,000 | 995             | 1,489 | 1,987 | 0.994x + 1.218               | 1.000          |

Calibrated by :



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Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data |       |        | Calibration Data |                     |       |       |                 |        |        |                              |                |
|----------------|-------|--------|------------------|---------------------|-------|-------|-----------------|--------|--------|------------------------------|----------------|
| No.            | Brand | Model  | Date             | Flow Rate (mL/min)  |       |       |                 |        |        | Value From Calibration Curve |                |
|                |       |        |                  | Flow Rate (Reading) |       |       | Actual (Q std.) |        |        |                              |                |
|                |       |        |                  | 1                   | 2     | 3     | 1               | 2      | 3      | y                            | R <sup>2</sup> |
| H-B01          | Dwyer | VFB-65 | 04/07/2023       | 500                 | 1,000 | 2,000 | 503.2           | 990.1  | 1974.7 | 0.990x + 7.225               | 1.000          |
| H-B02          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 495.6           | 994.6  | 1994.1 | 0.995x + 2.972               | 1.000          |
| H-B03          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 497.1           | 989.8  | 2007.6 | 1.002x - 12.719              | 0.999          |
| H-B04          | Dwyer | VFB-65 | 06/07/2023       | 500                 | 1,000 | 2,000 | 500.3           | 999.5  | 2004.4 | 0.996x - 0.709               | 1.000          |
| H-B05          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 499.3           | 990.7  | 1972.3 | 0.982x + 17.213              | 0.999          |
| H-B06          | Dwyer | VFB-65 | 06/07/2023       | 500                 | 1,000 | 2,000 | 504.0           | 991.4  | 1982.0 | 0.988x + 8.755               | 1.000          |
| H-B07          | Dwyer | VFB-65 | 04/07/2023       | 500                 | 1,000 | 2,000 | 501.3           | 989.4  | 2014.7 | 0.999x - 0.490               | 1.000          |
| H-B08          | Dwyer | VFB-65 | 05/07/2023       | 500                 | 1,000 | 2,000 | 499.2           | 996.1  | 1977.8 | 0.993x + 2.247               | 0.999          |
| H-B09          | Dwyer | VFB-65 | 07/07/2023       | 500                 | 1,000 | 2,000 | 504.0           | 1006.4 | 2008.7 | 0.991x + 16.313              | 1.000          |
| H-B10          | Dwyer | VFB-65 | 10/07/2023       | 500                 | 1,000 | 2,000 | 495.7           | 993.0  | 2011.6 | 1.000x - 1.820               | 1.000          |

Calibrated by :





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Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

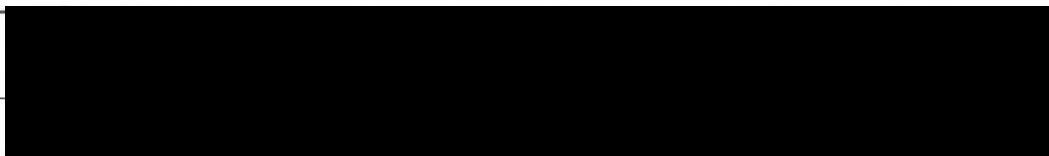
Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data |       |        | Calibration Data |                     |       |       |                 |       |        |                              |                |
|----------------|-------|--------|------------------|---------------------|-------|-------|-----------------|-------|--------|------------------------------|----------------|
| No.            | Brand | Model  | Date             | Flow Rate (mL/min)  |       |       |                 |       |        | Value From Calibration Curve |                |
|                |       |        |                  | Flow Rate (Reading) |       |       | Actual (Q std.) |       |        |                              |                |
|                |       |        |                  | 1                   | 2     | 3     | 1               | 2     | 3      | y                            | R <sup>2</sup> |
| H-B01          | Dwyer | VFB-65 | 02/10/2023       | 500                 | 1,000 | 2,000 | 500.1           | 992.7 | 1979.6 | 0.993x + 4.560               | 1.000          |
| H-B02          | Dwyer | VFB-65 | 03/10/2023       | 500                 | 1,000 | 2,000 | 503.6           | 989.1 | 1983.1 | 0.991x + 6.131               | 1.000          |
| H-B03          | Dwyer | VFB-65 | 02/10/2023       | 500                 | 1,000 | 2,000 | 498.7           | 991.6 | 2006.8 | 0.999x - 9.214               | 0.999          |
| H-B04          | Dwyer | VFB-65 | 04/10/2023       | 500                 | 1,000 | 2,000 | 502.3           | 988.1 | 2003.7 | 1.000x - 2.013               | 1.000          |
| H-B05          | Dwyer | VFB-65 | 03/10/2023       | 500                 | 1,000 | 2,000 | 497.8           | 989.1 | 1971.6 | 0.981x + 16.401              | 0.999          |
| H-B06          | Dwyer | VFB-65 | 05/10/2023       | 500                 | 1,000 | 2,000 | 499.3           | 995.9 | 1979.0 | 0.988x + 11.304              | 1.000          |
| H-B07          | Dwyer | VFB-65 | 04/10/2023       | 500                 | 1,000 | 2,000 | 495.1           | 995.8 | 1991.3 | 0.997x - 1.222               | 1.000          |
| H-B08          | Dwyer | VFB-65 | 05/10/2023       | 500                 | 1,000 | 2,000 | 500.7           | 998.7 | 1975.8 | 0.990x + 5.555               | 0.999          |
| H-B09          | Dwyer | VFB-65 | 03/10/2023       | 500                 | 1,000 | 2,000 | 496.9           | 998.5 | 1979.0 | 0.989x + 10.735              | 1.000          |
| H-B10          | Dwyer | VFB-65 | 07/10/2023       | 500                 | 1,000 | 2,000 | 499.4           | 997.5 | 2004.6 | 0.998x - 1.062               | 1.000          |

Calibrated by :







CERTIFICATE No : 23M2441  
REFERENCE No : 68471-1

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : METTLER TOLEDO

**MODEL** : XS105DU

**SERIAL No** : 1126422905

**ID No** : BA 05/50

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,  
JOMPOL, CHATUCHAK, BANGKOK 10900

**CALIBRATED BY** : ATSAWIN Y.

**CALIBRATION DATE** :

**APPROVED BY** :

**ISSUED DATE** :

16-Mar-23

**RECEIVED DATE** :

10-Mar-23





CERTIFICATE No : 23M2441

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23  
AIR PRESSURE : 1010mbar  $\pm$  1mbar CALIBRATION DATE : 10-Mar-23  
AMBIENT TEMPERATURE : 23° C  $\pm$  1° C RELATIVE HUMIDITY : 49 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT             | MODEL | SERIAL No | CERTIFICATE No | DUE DATE  |
|------------------------|-------|-----------|----------------|-----------|
| 1) STANDARD WEIGHT SET | E2    | QK-I-151  | M2302013S      | 02-Feb-25 |
| 2) STANDARD WEIGHT     | E2    | 15843     | M2302014S      | 02-Feb-25 |

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

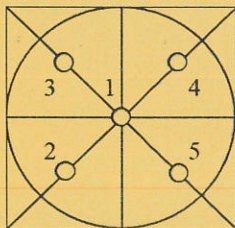
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000039               |
| 0.02              | 0.02000             | 0.00000        | 0.000039               |
| 0.10              | 0.10000             | 0.00000        | 0.000039               |
| 0.20              | 0.20001             | -0.00001       | 0.000040               |
| 0.50              | 0.50001             | -0.00001       | 0.000040               |
| 1.00              | 1.00000             | 0.00000        | 0.000041               |
| 2.00              | 2.00003             | -0.00003       | 0.000042               |
| 5.00              | 5.00001             | -0.00001       | 0.000046               |
| 10.00             | 10.00003            | -0.00003       | 0.000053               |
| 20.00             | 20.00005            | -0.00005       | 0.000067               |
| 50.00             | 50.00001            | -0.00001       | 0.00011                |
| 100.00            | 100.00001           | -0.00001       | 0.00019                |
| 200.00            | 200.00001           | -0.00001       | 0.00032                |

5. OFF CENTER LOADING ERROR



| POINT              | READING (g) |
|--------------------|-------------|
| 1                  | 50.0000     |
| 2                  | 50.0001     |
| 3                  | 50.0000     |
| 4                  | 50.0000     |
| 5                  | 49.9999     |
| OFF-CENTER LOADING | 0.0001      |

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



### เอกสารที่ 5-4

เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียง

โดยทั่วไปและเสียงในสถานประกอบการ

(Working Area)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

## CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.

Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

### Ambient Environment

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

Relative Humidity :  $(50 \pm 15) \%$

Ambient Pressure :  $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.  
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.  
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.  
4. Digital Multimeter Agilent 34401A S/N MY44005560.  
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.  
6. Audio Analyzer Keithley 2015-P S/N 4106495.  
7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

**Calibration Procedure:** CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

#### Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

#### Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

#### Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

Acoustic Output in dB re 20 $\mu$ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0°C and 50 %RH

1. Sound Pressure Level

| Standard Microphone<br>Type | Measured Sound Pressure<br>Level (dB) | Deviated value<br>(dB) | Uncertainty<br>(dB) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 93.94                                 | -0.06                  | $\pm 0.10$          | $\pm 0.40$ dB                            |

2. Frequency

| Standard Microphone<br>Type | Measured Frequency<br>(Hz) | Deviated value<br>(Hz) | Uncertainty<br>(Hz) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|----------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 999.9                      | -0.1                   | $\pm 1.5$           | $\pm 1.0\%$                              |

3. Total distortion

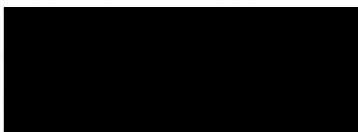
| Standard Microphone<br>Type | Measured Total distortion<br>(%) | Uncertainty<br>(%) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 1.80                             | $\pm 0.50$         | $\pm 3.0\%$                              |

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



(Mr. Prawate Kluaypa)  
Director  
TISTR

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated or value assigned.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Head Office

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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise B\_373/23

## Sound Level Meter Calibration Report

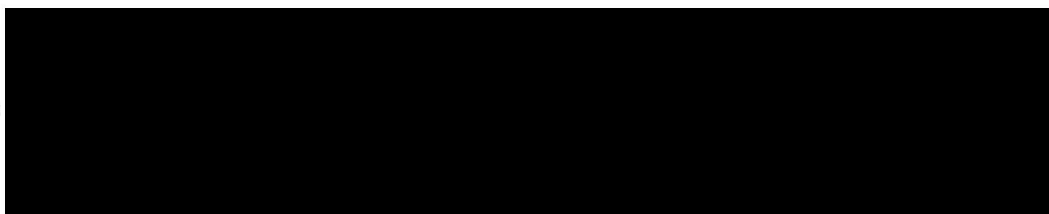
### Acoustic Calibrator Data

|                   |                |                  |               |
|-------------------|----------------|------------------|---------------|
| Brand             | ACO            | Number           | AC 03/56      |
| Model             | 2127           | Serial No.       | 130006        |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 29 March 2023 |
|                   |                | Due Date         | 29 March 2024 |

### Calibration Data

| Sound Level Meter Data   |       |       |            | Calibration Data  |                     |                  |
|--|-------|-------|------------|-------------------|---------------------|------------------|
| SLM No.  | Brand | Model | Serial No. | Date              | Actual Reading [dB] |                  |
|  |       |       |            |                   | Before Adjustment   | After Adjustment |
| ACO-B11  | ACO   | 6236  | 00152079   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B13  | ACO   | 6236  | 00152084   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B22  | ACO   | 6236  | 00172060   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B26  | ACO   | 6236  | 00182007   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B29  | ACO   | 6236  | 00182011   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B33  | ACO   | 6236  | 00182015   | 19 September 2023 | 94.0                | 94.0             |
| ACO-B37  | ACO   | 6236  | 00192028   | 19 September 2023 | 94.0                | 94.0             |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |       |       |            |                   | 93.94 ± 0.10 dB     |                  |

Calibrated by :







บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise B\_378/23

## Sound Level Meter Calibration Report

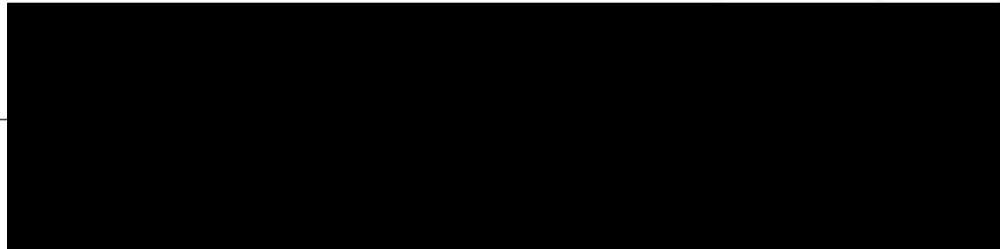
### Acoustic Calibrator Data

|                   |                |                  |               |
|-------------------|----------------|------------------|---------------|
| Brand             | ACO            | Number           | AC 03/56      |
| Model             | 2127           | Serial No.       | 130006        |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 29 March 2023 |
|                   |                | Due Date         | 29 March 2024 |

### Calibration Data

| Sound Level Meter Data   |       |       |            | Calibration Data  |                     |                  |
|--|-------|-------|------------|-------------------|---------------------|------------------|
| SLM No.  | Brand | Model | Serial No. | Date              | Actual Reading [dB] |                  |
|  |       |       |            |                   | Before Adjustment   | After Adjustment |
| ACO-B18  | ACO   | 6236  | 00172048   | 22 September 2023 | 94.0                | 94.0             |
| ACO-B29  | ACO   | 6236  | 00182011   | 22 September 2023 | 94.1                | 94.0             |
| ACO-B33  | ACO   | 6236  | 00182015   | 22 September 2023 | 94.0                | 94.0             |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |       |       |            |                   | 93.94 ± 0.10 dB     |                  |

Calibrated by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise B\_440/23

## Sound Level Meter Calibration Report

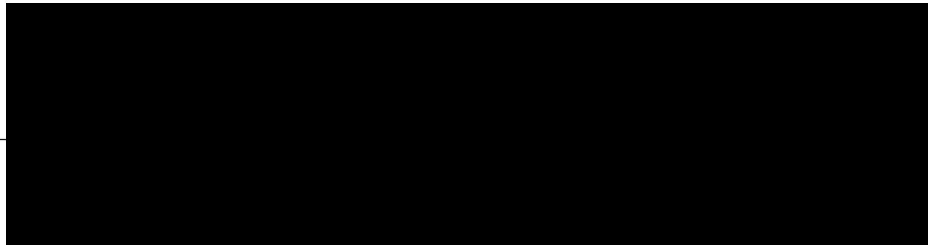
### Acoustic Calibrator Data

|                   |                |                  |               |
|-------------------|----------------|------------------|---------------|
| Brand             | ACO            | Number           | AC 03/56      |
| Model             | 2127           | Serial No.       | 130006        |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 29 March 2023 |
|                   |                | Due Date         | 29 March 2024 |

### Calibration Data

| Sound Level Meter Data   |       |       |            | Calibration Data |                     |                  |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand | Model | Serial No. | Date             | Actual Reading [dB] |                  |
|  |       |       |            |                  | Before Adjustment   | After Adjustment |
| ACO-B11  | ACO   | 6236  | 00152079   | 17 November 2023 | 94.0                | 94.0             |
| ACO-B13  | ACO   | 6236  | 00152084   | 17 November 2023 | 93.9                | 94.0             |
| ACO-B38  | ACO   | 6236  | 00192029   | 17 November 2023 | 93.9                | 94.0             |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |       |       |            |                  | 93.94 ± 0.10 dB     |                  |

Calibrated by :





### เอกสารที่ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อน  
ในสถานประกอบการ (Working Area)

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup>34

SERIAL NO. : TEL080034

CLID. NO. : 231801937

JOB CONTROL NO. : 221028109974

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Calibration Engineer

Approved By :

Authorized Signatory

31 October 2022



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q22109974

F3-011-04/01-12

page 1 of 3



@clccalibration





CLC  
Accredited  
ISO/IEC 17025

# CALIBRATION LABORATORY Co., LTD.

2/10-11,14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230

Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup>34

SERIAL NO. : TEL080034

DATE OF CALIBRATION : 29 October 2022

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(55 \pm 10) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No. 19944, Due Date 26 January 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. **Q22109974**

**F3-011-04/01-12**

page 2 of 3



@clccalibration



**CLC**  
Accredited  
ISO/IEC 17025

# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230

Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



## CONDITION OF CALIBRATION ITEM : GOOD

## MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

### CALIBRATION DATA

#### 1. CORRECTION OF TEMPERATURE : WET

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 30.01                         | 30.0                   | +0.01                 | 0.40                     |
| 35.0                  | 35.00                         | 35.0                   | 0.00                  |                          |
| 40.0                  | 40.01                         | 39.9                   | +0.11                 |                          |

#### 2. CORRECTION OF TEMPERATURE : DRY

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 30.01                         | 30.2                   | -0.19                 | 0.40                     |
| 35.0                  | 35.00                         | 35.1                   | -0.10                 |                          |
| 40.0                  | 40.01                         | 40.1                   | -0.09                 |                          |

#### 3. CORRECTION OF TEMPERATURE : GLOBE BULB

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 30.01                         | 30.0                   | +0.01                 | 0.40                     |
| 35.0                  | 35.00                         | 34.9                   | +0.10                 |                          |
| 40.0                  | 40.01                         | 39.9                   | +0.11                 |                          |

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

**This report is valid for the above stated instrument/s only.**

**### End of Certificate ###**

Certificate No. Q22109974

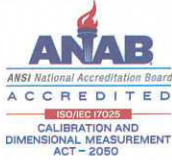
F3-011-04/01-12

page 3 of 3



@clccalibration





## Certificate of Calibration

Certificate Number : SPR23030505-2

Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.

7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,  
Bangkok 10900

Equipment Name : Area Heat Stress Monitor

Manufacturer : Metrosonics

Model : hs-32

Serial Number : MCE030011

ID. Number : B21

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Received Date : 30 Mar 2023

Relative Humidity :  $50\% \pm 15\%$

Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 01 Apr 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

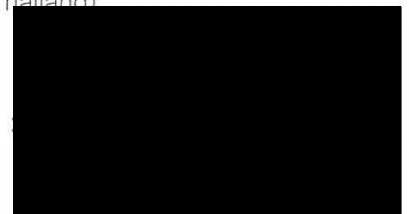
All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand)

Calibrated by



Calibration Officer

Approved by



Authorized Signatory



## Calibration Report

Certificate Number : SPR23030505-2

Page : 2 of 3

### Reference Standards

| Equipment Name    | Model  | Serial No. | Certificate No. | Due. Date   |
|-------------------|--------|------------|-----------------|-------------|
| Humidity Chamber  | TH-80S | N/A        | SPR23010480-5   | 22 Feb 2024 |
| THERMO-HYGROMETER | 5020A  | A47046     | QR23-0176       | 26 Jan 2024 |

### Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd





## Result of Calibration

Certificate No. : SPR23030505-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.4        | 0.387 | 0.50              |
| 35.0                | 35.010           | 35.4        | 0.390 | 0.50              |
| 40.0                | 40.015           | 40.4        | 0.385 | 0.50              |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.5        | 0.487 | 0.50              |
| 35.0                | 35.010           | 35.5        | 0.490 | 0.50              |
| 40.0                | 40.015           | 40.5        | 0.485 | 0.50              |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.4        | 0.387 | 0.50              |
| 35.0                | 35.010           | 35.4        | 0.390 | 0.50              |
| 40.0                | 40.015           | 40.4        | 0.385 | 0.50              |

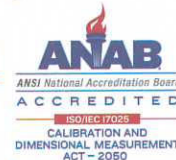
### Note:

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2$ , providing a level of confidence approximately 95%.

- End of Certificate -



## Certificate of Calibration

Certificate Number : SPR23030505-3

Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.

7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,  
Bangkok 10900

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 32

Serial Number : TPH050002

ID. Number : B24

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Received Date : 30 Mar 2023

Relative Humidity :  $50\% \pm 15\%$

Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 01 Apr 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr. Sarawut Khitmai

Approved by :

Calibration Officer

Authorized Signatory





## Calibration Report

Certificate Number : SPR23030505-3

Page : 2 of 3

### Reference Standards

| Equipment Name    | Model  | Serial No. | Certificate No. | Due. Date   |
|-------------------|--------|------------|-----------------|-------------|
| Humidity Chamber  | TH-80S | N/A        | SPR23010480-5   | 22 Feb 2024 |
| THERMO-HYGROMETER | 5020A  | A47046     | QR23-0176       | 26 Jan 2024 |

### Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd



## Result of Calibration

Certificate No. : SPR23030505-3

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.2        | 0.187 | 0.50              |
| 35.0                | 35.010           | 35.2        | 0.190 | 0.50              |
| 40.0                | 40.015           | 40.2        | 0.185 | 0.50              |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.2        | 0.187 | 0.50              |
| 35.0                | 35.010           | 35.2        | 0.190 | 0.50              |
| 40.0                | 40.015           | 40.2        | 0.185 | 0.50              |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.3        | 0.287 | 0.50              |
| 35.0                | 35.010           | 35.3        | 0.290 | 0.50              |
| 40.0                | 40.015           | 40.3        | 0.285 | 0.50              |

### Note:

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2$ , providing a level of confidence approximately 95%.

- End of Certificate -





CLC  
Accredited  
ISO/IEC 17025

# CALIBRATION LABORATORY Co., LTD.

2/10-11,14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230

Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup>32

SERIAL NO. : TPH050041

CLID. NO. : 231801942

JOB CONTROL NO. : 220815082002

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 15 August 2022

DATE OF ISSUED : 20 August 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

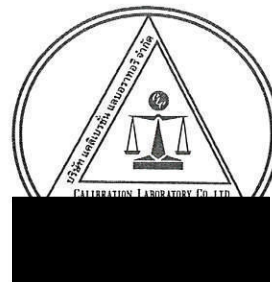
Calibrated By :

Calibration Engineer

Approved By :

Authorized Signatory

20 August 2022



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units ( SI )

Certificate No. Q22082002

F3-011-04/01-12

page 1 of 3



@clccalibration



CLC  
Accredited  
ISO/IEC 17025

# CALIBRATION LABORATORY Co., LTD.

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NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup>32

SERIAL NO. : TPH050041

DATE OF CALIBRATION : 18 August 2022

---

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(55 \pm 10) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No. 19944, Due Date 26 January 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22082002

F3-011-04/01-12

page 2 of 3



@clccalibration





**CLC**  
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# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230

Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment**

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

## CALIBRATION DATA

### **\*1. CORRECTION OF TEMPERATURE [WET]**

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 29.98                         | 30.0                   | -0.02                 | 0.40                     |
| 35.0                  | 34.98                         | 34.7                   | +0.28                 |                          |
| 40.0                  | 40.00                         | 39.7                   | +0.30                 |                          |

Note. \* means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

### **2. CORRECTION OF TEMPERATURE [DRY]**

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 29.98                         | 30.2                   | -0.22                 | 0.40                     |
| 35.0                  | 34.98                         | 34.9                   | +0.08                 |                          |
| 40.0                  | 40.00                         | 39.7                   | +0.30                 |                          |

### **3. CORRECTION OF TEMPERATURE [GLOBE BULB]**

| Test point<br>( ° C ) | Actual Temperature<br>( ° C ) | DUC Reading<br>( ° C ) | Correction<br>( ° C ) | Uncertainty<br>± ( ° C ) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0                  | 29.98                         | 30.2                   | -0.22                 | 0.40                     |
| 35.0                  | 34.98                         | 34.9                   | +0.08                 |                          |
| 40.0                  | 40.00                         | 39.8                   | +0.20                 |                          |

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

**This report is valid for the above stated instrument/s only.**

### End of Certificate ###

Certificate No. Q22082002

F3-011-04/01-12

page 3 of 3



@clccalibration



## Certificate of Calibration

Certificate Number : SPR23030505-4

Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.

7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,  
Bangkok 10900

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 32

Serial Number : TPH050015

ID. Number : B32

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Received Date : 30 Mar 2023

Relative Humidity :  $50\% \pm 15\%$

Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 01 Apr 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

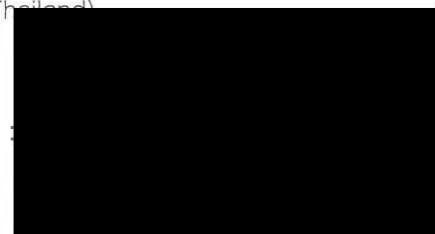
All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand)

Calibrated by



Calibration Officer

Approved by



Authorized Signatory





## Calibration Report

Certificate Number : SPR23030505-4

Page : 2 of 3

### Reference Standards

| Equipment Name    | Model  | Serial No. | Certificate No. | Due. Date   |
|-------------------|--------|------------|-----------------|-------------|
| Humidity Chamber  | TH-80S | N/A        | SPR23010480-5   | 22 Feb 2024 |
| THERMO-HYGROMETER | 5020A  | A47046     | QR23-0176       | 26 Jan 2024 |

### Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd



## Result of Calibration

Certificate No. : SPR23030505-4

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.1        | 0.087 | 0.50              |
| 35.0                | 35.010           | 35.1        | 0.090 | 0.50              |
| 40.0                | 40.015           | 40.1        | 0.085 | 0.50              |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.1        | 0.087 | 0.50              |
| 35.0                | 35.010           | 35.1        | 0.090 | 0.50              |
| 40.0                | 40.015           | 40.1        | 0.085 | 0.50              |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty ( ± ) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0                | 30.013           | 30.2        | 0.187 | 0.50              |
| 35.0                | 35.010           | 35.2        | 0.190 | 0.50              |
| 40.0                | 40.015           | 40.2        | 0.185 | 0.50              |

### Note:

The result of calibration was found accurate as show on date and place of calibration only.  
This Certificate is not certified for any commercial transaction.

### Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2$ , providing a level of confidence approximately 95%.

- End of Certificate -



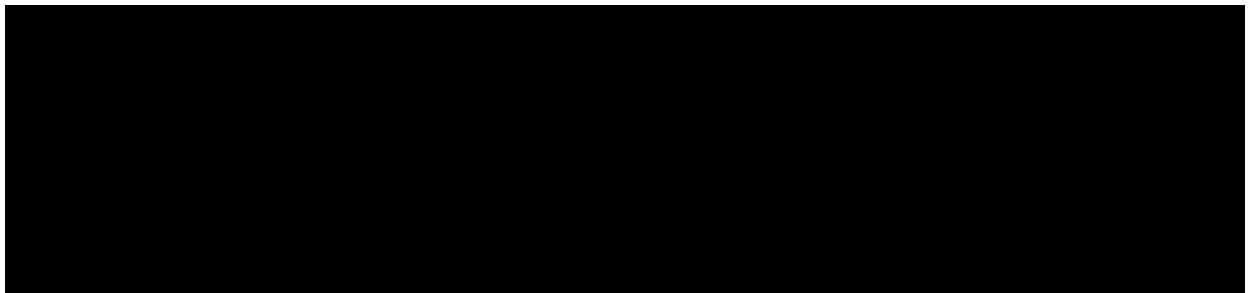


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S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Heat 119\_1

| Heat Stress WBGT Meter Verification Report                           |                            |                     |                      |
|--|----------------------------|---------------------|----------------------|
| Verification Data  |                            |                     |                      |
| Heat Stress WBGT Meter No.   | : B11                      | Verification Date   | : 22 September 2023  |
| Brand  | : 3M                       | Ambient Temp.       | : 24.5 °C            |
| Model  | : QUESTemp <sup>o</sup> 34 | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : TEL080034                | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                      |                            |                     |                      |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C |                            |                     |                      |
| Result of Verification : Without Adjustment                          |                            |                     |                      |
| Wet Probe Temperature Measurement                                    |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 12.5   | 12.5                       | 0.0                 | ± 0.5                |
| Dry Probe Temperature Measurement                                    |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 47.1   | 47.2                       | -0.1                | ± 0.5                |
| Globe Probe Temperature Measurement                                  |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 69.3   | 69.1                       | 0.2                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION  |                            |                     |                      |

Verified by :



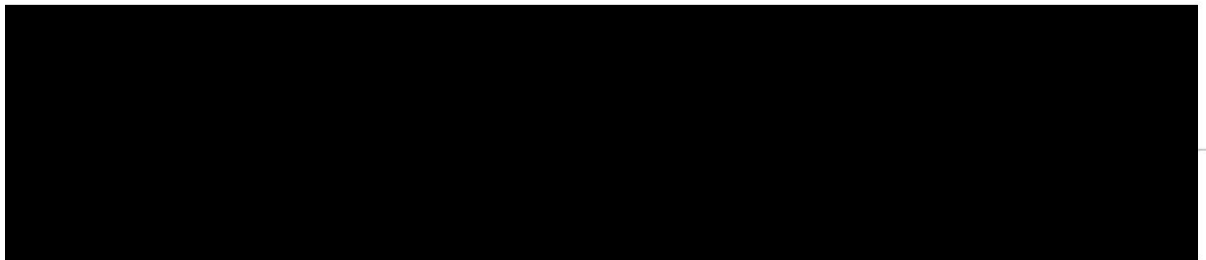


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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Heat 119\_2

| Heat Stress WBGT Meter Verification Report                           |                   |                     |                      |
|--|-------------------|---------------------|----------------------|
| Verification Data  |                   |                     |                      |
| Heat Stress WBGT Meter No.   | : B21             | Verification Date   | : 22 September 2023  |
| Brand  | : METROSNIcs      | Ambient Temp.       | : 24.5 °C            |
| Model  | : hs-32           | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : MCE030011       | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                      |                   |                     |                      |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C |                   |                     |                      |
| Result of Verification : Without Adjustment                          |                   |                     |                      |
| Wet Probe Temperature Measurement                                    |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 12.5   | 12.6              | -0.1                | ± 0.5                |
| Dry Probe Temperature Measurement                                    |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 47.1   | 47.1              | 0.0                 | ± 0.5                |
| Globe Probe Temperature Measurement                                  |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 69.3   | 69.2              | 0.1                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION  |                   |                     |                      |

Verified by :





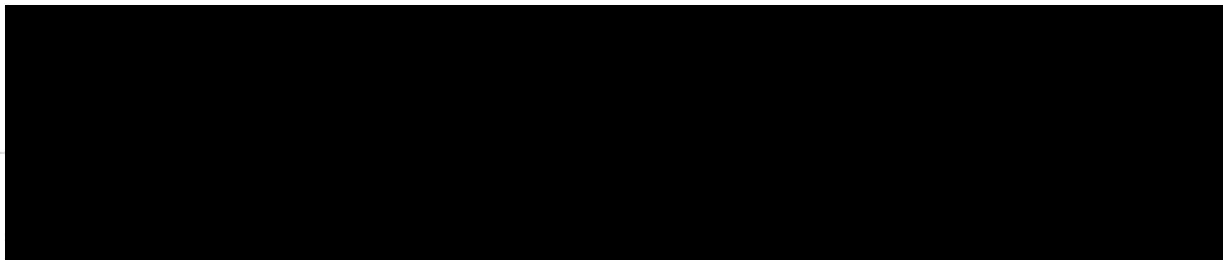


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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Heat 119\_3

| Heat Stress WBGT Meter Verification Report                           |                            |                     |                      |
|--|----------------------------|---------------------|----------------------|
| Verification Data  |                            |                     |                      |
| Heat Stress WBGT Meter No.   | : B26                      | Verification Date   | : 22 September 2023  |
| Brand  | : 3M                       | Ambient Temp.       | : 24.5 °C            |
| Model  | : QUESTemp <sup>o</sup> 32 | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : TPH050041                | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                      |                            |                     |                      |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C |                            |                     |                      |
| Result of Verification : Without Adjustment                          |                            |                     |                      |
| Wet Probe Temperature Measurement                                    |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 12.5   | 12.7                       | -0.2                | ± 0.5                |
| Dry Probe Temperature Measurement                                    |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 47.1   | 47.2                       | -0.1                | ± 0.5                |
| Globe Probe Temperature Measurement                                  |                            |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)          | Correction (°C)     | Tolerance Limit (°C) |
| 69.3   | 69.3                       | 0.0                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION  |                            |                     |                      |

Verified by : \_\_\_\_\_





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

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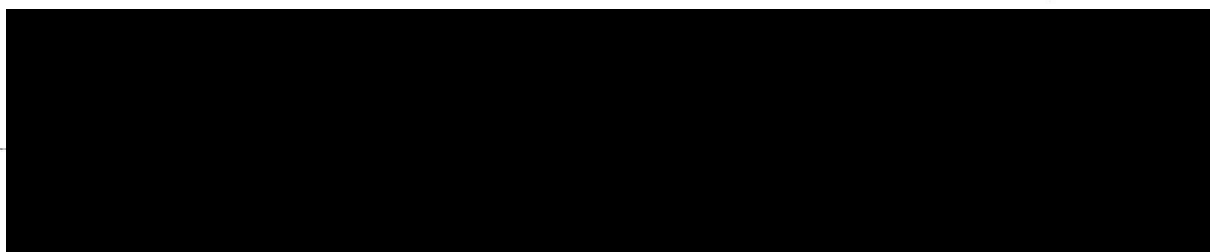
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Heat 134\_2

| Heat Stress WBGT Meter Verification Report                                    |                      |                     |                      |
|---|----------------------|---------------------|----------------------|
| Verification Data   |                      |                     |                      |
| Heat Stress WBGT Meter No.  | : B24                | Verification Date   | : 17 November 2023   |
| Brand   | : Quest Technologies | Ambient Temp.       | : 24.5 °C            |
| Model   | : QUESTemp 32        | Barometric Pressure | : 1011 mmbar         |
| Serial No.  | : TPH050002          | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                               |                      |                     |                      |
| Verification Module No. : 21    WB = 12.5 °C,    DB = 47.1 °C,    G = 69.3 °C |                      |                     |                      |
| Result of Verification : Without Adjustment                                   |                      |                     |                      |
| Wet Probe Temperature Measurement   |                      |                     |                      |
| Verification Module Reading (°C)  | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 12.5  | 12.7                 | -0.2                | ± 0.5                |
| Dry Probe Temperature Measurement   |                      |                     |                      |
| Verification Module Reading (°C)  | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 47.1  | 47.1                 | 0.0                 | ± 0.5                |
| Globe Probe Temperature Measurement   |                      |                     |                      |
| Verification Module Reading (°C)  | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 69.3  | 69.2                 | 0.1                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION   |                      |                     |                      |

Verified by : \_\_\_\_\_





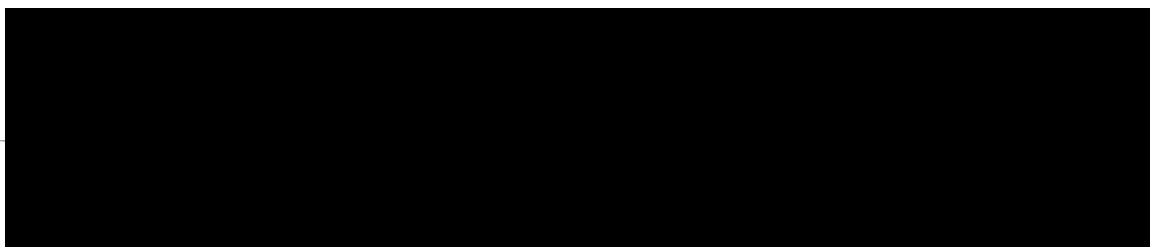


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Heat 134\_1

| Heat Stress WBGT Meter Verification Report                           |                   |                     |                      |
|--|-------------------|---------------------|----------------------|
| Verification Data  |                   |                     |                      |
| Heat Stress WBGT Meter No.   | : B21             | Verification Date   | : 17 November 2023   |
| Brand  | : METROSNIICS     | Ambient Temp.       | : 24.5 °C            |
| Model  | : hs-32           | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : MCE030011       | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                      |                   |                     |                      |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C |                   |                     |                      |
| Result of Verification : Without Adjustment                          |                   |                     |                      |
| Wet Probe Temperature Measurement                                    |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 12.5   | 12.5              | 0.0                 | ± 0.5                |
| Dry Probe Temperature Measurement                                    |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 47.1   | 47.2              | -0.1                | ± 0.5                |
| Globe Probe Temperature Measurement                                  |                   |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C) | Correction (°C)     | Tolerance Limit (°C) |
| 69.3   | 69.2              | 0.1                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION  |                   |                     |                      |

Verified by :





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Heat 134\_3

| Heat Stress WBGT Meter Verification Report                           |                      |                     |                      |
|--|----------------------|---------------------|----------------------|
| Verification Data  |                      |                     |                      |
| Heat Stress WBGT Meter No.   | : B32                | Verification Date   | : 17 November 2023   |
| Brand  | : Quest Technologies | Ambient Temp.       | : 24.5 °C            |
| Model  | : QUESTemp 32        | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : TPH050015          | Relative Humidity   | : 49 %               |
| Verification Module (Electronic Sensor Check) :                      |                      |                     |                      |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C |                      |                     |                      |
| Result of Verification : Without Adjustment                          |                      |                     |                      |
| Wet Probe Temperature Measurement                                    |                      |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 12.5   | 12.4                 | 0.1                 | ± 0.5                |
| Dry Probe Temperature Measurement                                    |                      |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 47.1   | 47.1                 | 0.0                 | ± 0.5                |
| Globe Probe Temperature Measurement                                  |                      |                     |                      |
| Verification Module Reading (°C)                                     | UUC* Reading (°C)    | Correction (°C)     | Tolerance Limit (°C) |
| 69.3   | 69.3                 | 0.0                 | ± 0.5                |
| UUC* = UNIT UNDER CALIBRATION  |                      |                     |                      |

Verified by : \_\_\_\_\_

