

## ภาคผนวกที่ 4

### เอกสารการสอบเทียบความถูกต้องของเครื่องมือ

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

| รายการตรวจวัด                          | เครื่องมือเก็บตัวอย่าง   | เครื่องมือตรวจวิเคราะห์                         |
|--|--|---|
|  | ชื่อเครื่องมือ   | ชื่อเครื่องมือ                                  |
| <b>คุณภาพอากาศในบรรยากาศ</b>           |  |   |
| TSP                                    | High Volume Air Sampler No. R02, R11, R12, R13   | Digital Balance                                 |
| PM <sub>10</sub>                       | High Volume PM <sub>10</sub> Air Sampler No. R07, R10, R12, R13                                  | Digital Balance                                 |
| HCl                                    | Gas Sampler Box No. B08, B09, B15, B17   | Ion Chromatography (IC)                         |
| H <sub>2</sub> SO <sub>4</sub>         | Gas Sampler Box No. B08, B09, B15, B17   | Ion Chromatography (IC)                         |
| NO <sub>2</sub>                        | NO <sub>2</sub> Analyzer No. B06, B08, B09, B13  | NO <sub>2</sub> Analyzer No. B06, B08, B09, B13 |
| SO <sub>2</sub>                        | SO <sub>2</sub> Analyzer No. B03, B05, B06, B07  | SO <sub>2</sub> Analyzer No. B03, B05, B06, B07 |
| <b>คุณภาพอากาศจากปล่อง</b>             |  |   |
| TSP                                    | Console No. R04<br>Pitot Tube No. B47, B58   | Digital Balance                                 |
| SO <sub>2</sub>                        | Personal Pump No. B71, B72<br>Rotameter No. H-R02, R03   | -   |
| NO <sub>x</sub>                        | Vacuum Gauge   | Spectrophotometer                               |
| H <sub>2</sub> SO <sub>4</sub>         | Console No. R04, R05<br>Pitot Tube No. B47, B48  | -   |
| HCl                                    | Console No. R04, R05<br>Pitot Tube No. B47, B48  | Ion Chromatography (IC)                         |
| <b>ระดับเสียงในบรรยากาศ</b>            |  |   |
| L <sub>eq</sub> 24 hr, L <sub>90</sub> | Acoustic Calibrator<br>Integrated Sound Level Meter No. ACO-R23, R27, R33,<br>R34, R39, R49, R50 | -   |
| <b>คุณภาพน้ำ</b>                       |  |   |
| pH                                     | -  | pH Meter  |
| Temperature                            | -  | Thermometer                                     |
| TDS                                    | -  | Digital Balance                                 |
| Conductivity                           | -  | Conductivity Meter                              |
| BOD <sub>5</sub>                       | -  | BOD Analyzer                                    |
| COD                                    | -  | COD Reactor                                     |
| SS                                     | -  | Digital Balance                                 |
| Grease & Oil                           | -  | Digital Balance                                 |
| Zn                                     | -  | Inductive Coupled Plasma (ICP)                  |
| Al                                     | -  | Inductive Coupled Plasma (ICP)                  |
| Iron                                   | -  | Inductive Coupled Plasma (ICP)                  |

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)**

| รายการตรวจวัด   | เครื่องมือเก็บตัวอย่าง   | เครื่องมือตรวจวิเคราะห์        |
|---|--|--------------------------------|
|   | ชื่อเครื่องมือ   | ชื่อเครื่องมือ                 |
| ระดับความร้อน<br>WBGT   | Heat Stress WBGT Meter No. R13, R14  | -                              |
| คุณภาพอากาศในสถานประกอบการ<br>Total Dust  | Personal Pump No. B07, B65<br>Rotameter No. H-R02                                  | Digital Balance                |
| HCl   | Personal Pump No. B56<br>Rotameter No. L-R02                                       | Ion Chromatography (IC)        |
| H <sub>2</sub> SO <sub>4</sub>  | Personal Pump No. B42<br>Rotameter No. L-R02                                       | Ion Chromatography (IC)        |
| Zinc Oxide Fume   | Personal Pump No. R40<br>Rotameter No. H-R02                                       | Inductive Coupled Plasma (ICP) |
| ระดับเสียงในสถานประกอบการ<br>L <sub>eq</sub> 8 hr, L <sub>eq</sub> 12 hr, L <sub>90</sub> | Acoustic Calibrator<br>Integrated Sound Level Meter No. ACO- B02,<br>B03, B14, B19 | -                              |
| Noise Dose  | Noise Dose Meter No.NMD-B04, B05, B13, B18,<br>B20, R06, R13, R20, R26, R27        | -                              |

คุณภาพอากาศในบรรยากาศ





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## High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3095

### 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> |
| B35                          | B35        | 16/02/2022       | y = 1.274x-9.241                       | 0.999          |
| B36                          | B36        | 15/02/2022       | y = 1.132x-3.625                       | 0.996          |
| B37                          | B37        | 04/02/2022       | y = 1.157x+2.640                       | 0.999          |
| B38                          | B38        | 15/02/2022       | y = 1.1432x-2.720                      | 0.999          |
| B39                          | B39        | 07/02/2022       | y = 1.256x-7.614                       | 1.000          |
| B40                          | B40        | 15/02/2022       | y = 1.175x-4.385                       | 0.998          |
| B41                          | B41        | 07/02/2022       | y = 1.133x-1.951                       | 0.998          |
| B42                          | B42        | 04/02/2022       | y = 1.127x-1.985                       | 1.000          |
| B43                          | B43        | 16/02/2022       | y = 1.089x+0.223                       | 0.996          |
| B44                          | B44        | 03/02/2022       | y = 1.339x-11.636                      | 0.997          |
| R01                          | R01        | 02/02/2022       | y = 1.196x-5.960                       | 0.996          |
| R02                          | R02        | 09/02/2022       | y = 1.175x-5.572                       | 1.000          |
| R03                          | R03        | 02/02/2022       | y = 1.187x-6.283                       | 0.995          |
| R04                          | R04        | 07/02/2022       | y = 1.100x-1.352                       | 0.997          |
| R05                          | R05        | 09/02/2022       | y = 1.238x-8.500                       | 0.997          |
| R06                          | R06        | 01/02/2022       | y = 1.328x-11.118                      | 0.996          |
| R07                          | R07        | 07/02/2022       | y = 1.039x+1.507                       | 0.995          |
| R08                          | R08        | 04/02/2022       | y = 1.141x-3.942                       | 0.997          |
| R09                          | R09        | 01/02/2022       | y = 1.192x-5.710                       | 0.997          |
| R10                          | R10        | 09/02/2022       | y = 1.194x-5.807                       | 1.000          |
| R11                          | R11        | 01/02/2022       | y = 1.054x+0.098                       | 0.996          |
| R12                          | R12        | 04/02/2022       | y = 1.171x-5.349                       | 0.996          |
| R13                          | R13        | 04/02/2022       | y = 1.114x-1.755                       | 0.999          |
| R14                          | R14        | 07/02/2022       | y = 1.100x-0.965                       | 0.997          |
| R15                          | R15        | 14/02/2022       | y = 1.047x+1.073                       | 0.995          |
| R16                          | R16        | 09/02/2022       | y = 1.129x-3.642                       | 0.999          |
| R17                          | R17        | 03/02/2022       | y = 1.198x-5.739                       | 1.000          |
| R18                          | R18        | 02/02/2022       | y = 1.268x-9.241                       | 0.998          |
| R19                          | R19        | 03/02/2022       | y = 1.216x-5.626                       | 0.999          |
| R20                          | R20        | 01/02/2022       | y = 1.197x-5.676                       | 0.997          |



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## High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3095

### 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> |
| R01                    | R01        | 04/02/2022       | y = 1.238x-7.598                       | 0.995          |
| R02                    | R02        | 11/02/2022       | y = 1.161x-3.899                       | 0.996          |
| R03                    | R03        | 04/02/2022       | y = 1.154x+2.827                       | 0.998          |
| R04                    | R04        | 06/02/2022       | y = 1.116x-1.752                       | 0.995          |
| R05                    | R05        | 07/02/2022       | y = 1.125x-2.487                       | 0.995          |
| R06                    | R06        | 10/02/2022       | y = 1.321x-9.065                       | 0.998          |
| R07                    | R07        | 04/02/2022       | y = 1.138x-1.986                       | 0.996          |
| R08                    | R08        | 03/02/2022       | y = 1.160x-3.759                       | 0.996          |
| R09                    | R09        | 10/02/2022       | y = 1.209x-6.918                       | 0.995          |
| R10                    | R10        | 04/02/2022       | y = 1.114x-1.889                       | 0.995          |
| R11                    | R11        | 03/02/2022       | y = 1.272x-7.597                       | 1.000          |
| R12                    | R12        | 03/02/2022       | y = 1.153x-3.385                       | 0.995          |
| R13                    | R13        | 02/02/2022       | y = 1.207x-4.913                       | 0.996          |
| R14                    | R14        | 01/02/2022       | y = 1.183x-3.660                       | 0.996          |
| R15                    | R15        | 02/02/2022       | y = 1.247x-7.741                       | 0.999          |
| R16                    | R16        | 02/02/2022       | y = 1.238x-6.677                       | 0.996          |
| R17                    | R17        | 01/02/2022       | y = 1.203x-5.310                       | 0.998          |
| R18                    | R18        | 04/02/2022       | y = 1.148x-3.211                       | 0.998          |
| R19                    | R19        | 04/02/2022       | y = 1.220x-6.839                       | 0.997          |
| R20                    | R20        | 03/02/2022       | y = 1.161x-5.047                       | 0.997          |



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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 Data |           | 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)   | 03/03/2022       | 200                                    | 200.5                     | 199.0              | 200.4            | 199.0              |
| B02              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.3                     | 198.9              | 200.5            | 199.1              |
| B03              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.1              | 200.5            | 199.0              |
| B04              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.4                     | 198.9              | 200.6            | 199.2              |
| B05              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.1              | 200.5            | 199.1              |
| B06              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.6                     | 199.2              | 200.4            | 199.0              |
| B07              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.0              | 200.5            | 199.1              |
| B08              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.1              | 200.5            | 199.0              |
| B09              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.6                     | 199.2              | 200.5            | 199.1              |
| B10              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.4                     | 198.9              | 200.5            | 199.0              |
| B11              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.6                     | 199.2              | 200.6            | 199.1              |
| B12              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.1              | 200.6            | 199.2              |
| B13              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.1              | 200.5            | 199.1              |
| B14              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.6                     | 199.1              | 200.6            | 199.2              |
| B15              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.6                     | 199.1              | 200.5            | 199.0              |
| B16              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.4                     | 199.0              | 200.5            | 199.1              |
| B17              | 2 (A&B)   | 03/03/2022       | 200                                    | 200.5                     | 199.0              | 200.5            | 199.1              |



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### CALIBRATION REPORT

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

DATE : 21 April 2022

BRAND : API

MODEL : 200E

NO. NOX-B06

SERIAL NO. 2286

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00917SK

Certified Date : 01 June 2020

Expired Date : 01 June 2022

Cylinder Conc. : 49.9 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### 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                                | 399.8             | -0.050 | 400.0                           | 1.003 |
| NO <sub>x</sub> Span | 400                                | 400.1             | 0.025  | 400.0                           | 1.006 |

#### 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               | 504            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 78             | cc/min  | 80 ± 15                    |
| PMT                       | 103.0          | mV      | -20 - 150                  |
| AZERO                     | 93.7           | mV      | -20 - 150                  |
| HVPS                      | 671            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.2           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.1           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.0            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 314.7          | °C      | 315 ± 5                    |
| RCELL PRESS               | 8.3            | IN-Hg-A | 2 - 10 constant            |
| SAMPLE PRESS              | 28.4           | 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                  | 1.003          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.006          | -       | 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 |



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## CALIBRATION REPORT

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

DATE : 21 April 2022

BRAND : API

MODEL : 200E

NO. NOX-B08

SERIAL NO. 4336

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00917SK

Certified Date : 01 June 2020

Expired Date : 01 June 2022

Cylinder Conc. : 49.9 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

| Span                 | Initial Reading (Before Adj.),PPB |                   |       | Final Reading (After Adj.),PPB |       |
|----------------------|-----------------------------------|-------------------|-------|--------------------------------|-------|
|                      | Expected Concentration            | Analyzer Response | %Dif  | Analyzer Response              | Slope |
| Zero                 | 0                                 | 0.11              | -     | 0                              | -     |
| NO Span              | 400                               | 400.1             | 0.025 | 400.0                          | 1.008 |
| NO <sub>x</sub> Span | 400                               | 400.4             | 0.100 | 400.0                          | 1.012 |

#### 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               | 511            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 79             | cc/min  | 80 ± 15                    |
| PMT                       | 103.3          | mV      | -20 - 150                  |
| AZERO                     | 94.0           | mV      | -20 - 150                  |
| HVPS                      | 675            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.4           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.3           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.2            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 315.1          | °C      | 315 ± 5                    |
| RCELL PRESS               | 8.2            | 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                  | 1.008          | -       | 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 |





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## CALIBRATION REPORT

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

DATE : 21 April 2022

BRAND : API

MODEL : 200E

NO. NOX-B09

SERIAL NO. 4412

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00917SK

Certified Date : 01 June 2020

Expired Date : 01 June 2022

Cylinder Conc. : 49.9 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### 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                                | 399.6             | -0.100 | 400.0                           | 0.999 |
| NO <sub>x</sub> Span | 400                                | 399.8             | -0.050 | 400.0                           | 1.004 |

#### 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                | 79             | cc/min  | 80 ± 15                    |
| PMT                       | 103.2          | mV      | -20 - 150                  |
| AZERO                     | 93.9           | mV      | -20 - 150                  |
| HVPS                      | 672            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.5           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.4           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.3            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 314.9          | °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                  | 0.999          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.004          | -       | 1.0 ± 0.3                  |
| NO Offset                 | 1.1            | mV      | -20 to +150                |
| NO <sub>x</sub> Offset    | 0.7            | mV      | -20 to 150                 |
| Stability at Zero         | 0.1            | PPB     | < 0.2                      |
| Stability at Span         | 0.2            | PPB     | < 2 ppb @ 400 ppb span gas |



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## CALIBRATION REPORT

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

DATE : 21 April 2022

BRAND : API

MODEL : 200A

NO. NOX-B13

SERIAL NO. 1983

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00917SK

Certified Date : 01 June 2020

Expired Date : 01 June 2022

Cylinder Conc. : 49.9 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### 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                                | 400.1             | 0.025 | 400.0                           | 1.006 |
| NO <sub>x</sub> Span | 400                                | 400.2             | 0.050 | 400.0                           | 1.010 |

#### 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               | 507            | cc/min  | 500 ± 50                   |
| OZONE FLOW                | 78             | cc/min  | 80 ± 15                    |
| PMT                       | 102.9          | mV      | -20 - 150                  |
| AZERO                     | 93.6           | mV      | -20 - 150                  |
| HVPS                      | 669            | V       | 420 - 900 constant         |
| RCELL TEMP                | 50.1           | °C      | 50 ± 1                     |
| BOX TEMP                  | 29.5           | °C      | 8 - 48                     |
| PMT TEMP                  | 7.4            | °C      | 7 ± 2                      |
| MOLY TEMP                 | 315.3          | °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                  | 1.006          | -       | 1.0 ± 0.3                  |
| NO <sub>x</sub> Slope     | 1.010          | -       | 1.0 ± 0.3                  |
| NO Offset                 | 1.5            | 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 |





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## CALIBRATION REPORT

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 21 April 2022

BRAND : API

MODEL : 100A

NO. SO<sub>2</sub>-B03

SERIAL NO. 1846

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO<sub>2</sub>)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### 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                               | -     |
| SO <sub>2</sub> Span | 400.0                              | 400.3             | 0.075 | 400.0                           | 1.014 |

#### API Model 100A SO<sub>2</sub> Analyzer Check list

| Test Values               | Observed Value | Units  | Nominal Range                  |
|---------------------------|----------------|--------|--------------------------------|
| RANGE                     | 500            | PPB    | 0-500                          |
| SAMPLE PRESS              | 28.7           | in-Hg  | 25-35                          |
| SAMPLE FLOW               | 655            | cc/min | 650 ± 10%                      |
| PMT                       | 103.4          | mV     | -20-150 with Zero Air          |
| UV LAMP                   | 3017.8         | mV     | 1000-4900                      |
| STR. LGT                  | 61.9           | PPB    | <100                           |
| DRK PMT                   | 63.4           | mV     | -50 - 200                      |
| DRK LMP                   | 58.2           | mV     | -50 - 200                      |
| HVPS                      | 674            | V      | 550-900 constant               |
| DCPS                      | 2520           | mV     | 2500 ± 200                     |
| RCELL TEMP                | 50.5           | °C     | 50 ± 1                         |
| BOX TEMP                  | 29.4           | °C     | 5-40                           |
| PMT TEMP                  | 7.2            | °C     | 7 ± 2.0                        |
| SO <sub>2</sub> Span Conc | 400            | PPB    | 20-20,000                      |
| SO <sub>2</sub> Slope     | 1.014          | -      | 1.0 ± 0.3                      |
| SO <sub>2</sub> Offset    | 21.7           | mV     | <250                           |
| Stability at Zero         | 0.1            | PPB    | <0.2                           |
| Stability at Span         | 0.2            | PPB    | 0.5% of reading (above 50 ppb) |





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## CALIBRATION REPORT

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 21 April 2022

BRAND : API

MODEL : 100E

NO. SO<sub>2</sub>-B05

SERIAL NO. 3270

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO<sub>2</sub>)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### 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                                  | 0.11              | -      | 0                               | -     |
| SO <sub>2</sub> Span | 400.0                              | 399.7             | -0.075 | 400.0                           | 1.005 |

#### API Model 100E SO<sub>2</sub> Analyzer Check list

| Test Values               | Observed Value | Units  | Nominal Range                  |
|---------------------------|----------------|--------|--------------------------------|
| RANGE                     | 500            | PPB    | 0-500                          |
| SAMPLE PRESS              | 28.4           | in-Hg  | 25-35                          |
| SAMPLE FLOW               | 657            | cc/min | 650 ± 10%                      |
| PMT                       | 103.1          | mV     | -20-150 with Zero Air          |
| UV LAMP                   | 3022.8         | mV     | 1000-4900                      |
| STR. LGT                  | 61.5           | PPB    | <100                           |
| DRK PMT                   | 63.1           | mV     | -50 - 200                      |
| DRK LMP                   | 57.7           | mV     | -50 - 200                      |
| HVPS                      | 673            | V      | 550-900 constant               |
| DCPS                      | 2515           | mV     | 2500 ± 200                     |
| RCELL TEMP                | 50.2           | °C     | 50 ± 1                         |
| BOX TEMP                  | 29.5           | °C     | 5-40                           |
| PMT TEMP                  | 7.1            | °C     | 7 ± 2.0                        |
| SO <sub>2</sub> Span Conc | 400            | PPB    | 20-20,000                      |
| SO <sub>2</sub> Slope     | 1.005          | -      | 1.0 ± 0.3                      |
| SO <sub>2</sub> Offset    | 22.2           | mV     | <250                           |
| Stability at Zero         | 0.1            | PPB    | <0.2                           |
| Stability at Span         | 0.2            | PPB    | 0.5% of reading (above 50 ppb) |



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## CALIBRATION REPORT

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 21 April 2022

BRAND : API

MODEL : 100E

NO. SO<sub>2</sub>-B06

SERIAL NO. 3430

#### Calibrator (Dilution System)

|                |                  |            |       |
|----------------|------------------|------------|-------|
| Brand          | : API            | Model      | : 700 |
| Last Cal. Date | : 05 August 2021 | Serial No. | : 911 |

#### Reference Standard Gas

|                |                                      |                |                |
|----------------|--------------------------------------|----------------|----------------|
| Standard Gas   | : Sulphur Dioxide (SO <sub>2</sub> ) | Cylinder No.   | : A00814SK     |
| Certified Date | : 21 June 2021                       | Expired Date   | : 21 June 2029 |
|                |                                      | Cylinder Conc. | : 50.0 ppm     |

#### CALIBRATING CONDITION

Pressure 1011 mmbar Temp. 24.6 °C % RH 48

#### CALIBRATION SETTING

| Span                 | Initial Reading (Before Adj.),PPB |                   |        | Final Reading (After Adj.),PPB |       |
|----------------------|-----------------------------------|-------------------|--------|--------------------------------|-------|
| Set Point            | Expected Concentration            | Analyzer Response | %Dif   | Analyzer Response              | Slope |
| Zero                 | 0                                 | -0.10             | -      | 0                              | -     |
| SO <sub>2</sub> Span | 400.0                             | 399.6             | -0.100 | 400.0                          | 1.008 |

#### API Model 100E SO<sub>2</sub> Analyzer Check list

| Test Values               | Observed Value | Units  | Nominal Range                  |
|---------------------------|----------------|--------|--------------------------------|
| RANGE                     | 500            | PPB    | 0-500                          |
| SAMPLE PRESS              | 28.5           | in-Hg  | 25-35                          |
| SAMPLE FLOW               | 659            | cc/min | 650 ± 10%                      |
| PMT                       | 103.0          | mV     | -20-150 with Zero Air          |
| UV LAMP                   | 3010.4         | mV     | 1000-4900                      |
| STR. LGT                  | 61.6           | PPB    | <100                           |
| DRK PMT                   | 63.2           | mV     | -50 - 200                      |
| DRK LMP                   | 58.0           | mV     | -50 - 200                      |
| HVPS                      | 671            | V      | 550-900 constant               |
| DCPS                      | 2526           | mV     | 2500 ± 200                     |
| RCELL TEMP                | 50.1           | °C     | 50 ± 1                         |
| BOX TEMP                  | 29.3           | °C     | 5-40                           |
| PMT TEMP                  | 7.4            | °C     | 7 ± 2.0                        |
| SO <sub>2</sub> Span Conc | 400            | PPB    | 20-20,000                      |
| SO <sub>2</sub> Slope     | 1.008          | -      | 1.0 ± 0.3                      |
| SO <sub>2</sub> Offset    | 22.1           | mV     | <250                           |
| Stability at Zero         | 0.1            | PPB    | <0.2                           |
| Stability at Span         | 0.2            | PPB    | 0.5% of reading (above 50 ppb) |





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## CALIBRATION REPORT

### SO<sub>2</sub> FLUORESCENT ANALYZER

DATE : 21 April 2022

BRAND : API

MODEL : 100E

NO. SO<sub>2</sub>-B07

SERIAL NO. 1706

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO<sub>2</sub>)

Cylinder No. : A00814SK

Certified Date : 21 June 2021

Expired Date : 21 June 2029

Cylinder Conc. : 50.0 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

| Span                 | Initial Reading (Before Adj.),PPB |                   |       | Final Reading (After Adj.),PPB |       |
|----------------------|-----------------------------------|-------------------|-------|--------------------------------|-------|
|                      | Expected Concentration            | Analyzer Response | %Dif  | Analyzer Response              | Slope |
| Zero                 | 0                                 | 0.11              | -     | 0                              | -     |
| SO <sub>2</sub> Span | 400.0                             | 400.4             | 0.100 | 400.0                          | 1.016 |

#### API Model 100E SO<sub>2</sub> Analyzer Check list

| Test Values               | Observed Value | Units  | Nominal Range                  |
|---------------------------|----------------|--------|--------------------------------|
| RANGE                     | 500            | PPB    | 0-500                          |
| SAMPLE PRESS              | 28.6           | in-Hg  | 25-35                          |
| SAMPLE FLOW               | 653            | cc/min | 650 ± 10%                      |
| PMT                       | 102.9          | mV     | -20-150 with Zero Air          |
| UV LAMP                   | 2996.1         | mV     | 1000-4900                      |
| STR. LGT                  | 61.4           | PPB    | <100                           |
| DRK PMT                   | 62.9           | mV     | -50 - 200                      |
| DRK LMP                   | 57.6           | mV     | -50 - 200                      |
| HVPS                      | 669            | V      | 550-900 constant               |
| DCPS                      | 2518           | mV     | 2500 ± 200                     |
| RCELL TEMP                | 50.3           | °C     | 50 ± 1                         |
| BOX TEMP                  | 29.2           | °C     | 5-40                           |
| PMT TEMP                  | 7.0            | °C     | 7 ± 2.0                        |
| SO <sub>2</sub> Span Conc | 400            | PPB    | 20-20,000                      |
| SO <sub>2</sub> Slope     | 1.016          | -      | 1.0 ± 0.3                      |
| SO <sub>2</sub> Offset    | 21.8           | mV     | <250                           |
| Stability at Zero         | 0.1            | PPB    | <0.2                           |
| Stability at Span         | 0.2            | PPB    | 0.5% of reading (above 50 ppb) |





CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

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 : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY :

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22





CERTIFICATE No : 22M2567

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22  
AIR PRESSURE : 1008mbar  $\pm$  1mbar CALIBRATION DATE : 11-Mar-22  
AMBIENT TEMPERATURE : 22° 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  | C02210415      | 09-Feb-23 |

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

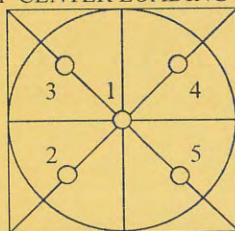
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000058               |
| 0.02              | 0.01999             | 0.00001        | 0.000058               |
| 0.10              | 0.09999             | 0.00001        | 0.000059               |
| 0.20              | 0.19999             | 0.00001        | 0.000059               |
| 0.50              | 0.50001             | -0.00001       | 0.000058               |
| 1.00              | 1.00001             | -0.00001       | 0.000059               |
| 2.00              | 2.00000             | 0.00000        | 0.000059               |
| 5.00              | 5.00001             | -0.00001       | 0.000061               |
| 10.00             | 10.00005            | -0.00005       | 0.000063               |
| 20.00             | 20.00006            | -0.00006       | 0.000069               |
| 50.00             | 50.0000             | 0.0000         | 0.00011                |
| 100.00            | 100.0001            | -0.0001        | 0.00019                |
| 120.00            | 120.0001            | -0.0001        | 0.00022                |

6. OFF CENTER LOADING ERROR



| POINT              | READING (g) |         |
|--------------------|-------------|---------|
| 1                  | 10.00001    | 50.0000 |
| 2                  | 10.00002    | 50.0000 |
| 3                  | 10.00001    | 50.0000 |
| 4                  | 10.00001    | 50.0000 |
| 5                  | 10.00002    | 50.0001 |
| OFF-CENTER LOADING | 0.00001     | 0.0001  |

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





## Certificate of Calibration

### Aquion : Anion (ID#894)

This certificate is to verify that instrument below are calibrated  
by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

S.P.S. Consulting Service Co., Ltd.

Operator Sign

Jan 5, 2022

Test Engineer

คุณภาพอากาศจากปล่อง



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     | $\Delta H_{@}$ (mmH <sub>2</sub> O) |
| B01          | 1563       | 02/03/2022       | 0.998 | 50.11                               |
| B02          | 8002514    | 02/03/2022       | 0.996 | 49.25                               |
| B03          | 1503016    | 03/03/2022       | 0.998 | 50.20                               |
| B04          | 00006659   | 03/03/2022       | 1.005 | 49.64                               |
| B05          | 00007428   | 03/03/2022       | 1.002 | 49.80                               |
| R01          | 1561       | 02/03/2022       | 1.003 | 50.18                               |
| R02          | 8002513    | 03/03/2022       | 0.999 | 49.38                               |
| R03          | 1570       | 04/03/2022       | 1.003 | 49.14                               |
| R04          | 8002519    | 04/03/2022       | 0.999 | 49.52                               |
| R05          | 1503015    | 01/03/2022       | 1.007 | 50.08                               |

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

Accept Value of  $\Delta H_{@}$  (test) is  $46.7 \pm 6.4$  (mmH<sub>2</sub>O)





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## 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 |
| B36             | S             | 0.99                             | 03/02/2022       | 0.83              | 0.84   |
| B37             | S             | 0.99                             | 03/02/2022       | 0.83              | 0.84   |
| B38             | S             | 0.99                             | 02/02/2022       | 0.84              | 0.84   |
| B39             | S             | 0.99                             | 02/02/2022       | 0.85              | 0.84   |
| B40             | S             | 0.99                             | 01/02/2022       | 0.84              | 0.84   |
| B41             | S             | 0.99                             | 01/02/2022       | 0.85              | 0.84   |
| B44             | S             | 0.99                             | 01/02/2022       | 0.83              | 0.84   |
| B45             | S             | 0.99                             | 02/02/2022       | 0.84              | 0.84   |
| B46             | S             | 0.99                             | 02/02/2022       | 0.83              | 0.84   |
| B47             | S             | 0.99                             | 03/02/2022       | 0.84              | 0.84   |
| B48             | S             | 0.99                             | 03/02/2022       | 0.83              | 0.84   |
| B49             | S             | 0.99                             | 03/02/2022       | 0.84              | 0.84   |
| B54             | S             | 0.99                             | 02/02/2022       | 0.84              | 0.85   |
| B56             | S             | 0.99                             | 02/02/2022       | 0.84              | 0.85   |
| B57             | S             | 0.99                             | 04/02/2022       | 0.84              | 0.84   |
| B58             | S             | 0.99                             | 04/02/2022       | 0.84              | 0.83   |

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



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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                            | R²    |
| B41                | SKC   | 224-PCXR4 | 612669     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,496 | 1,989 | 0.994x + 3.829               | 1.000 |
| B42                | SKC   | 224-PCXR4 | 626041     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,498 | 1,993 | 0.990x + 12.348              | 1.000 |
| B43                | SKC   | 224-PCXR4 | 034636     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,501 | 1,992 | 0.990x + 12.839              | 1.000 |
| B44                | SKC   | 224-PCXR8 | 529341     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,002 | 1.011x – 21.577              | 0.999 |
| B45                | SKC   | 224-PCXR8 | 529594     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,498 | 1,992 | 0.995x + 2.928               | 1.000 |
| B46                | SKC   | 224-PCXR8 | 566743     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,504 | 2,002 | 1.016x – 33.204              | 0.999 |
| B47                | SKC   | 224-PCXR8 | 566747     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,004 | 1.013x – 24.202              | 0.999 |
| B48                | SKC   | 224-PCXR8 | 566753     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 999             | 1,494 | 1,997 | 0.999x + 1.795               | 1.000 |
| B49                | SKC   | 224-PCXR8 | 566780     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,502 | 2,003 | 1.011x – 21.031              | 0.999 |
| B50                | SKC   | 224-PCXR8 | 500400     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,495 | 2,002 | 1.001x + 2.900               | 1.000 |
| B51                | SKC   | 224-PCXR8 | 500363     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,504 | 2,000 | 1.012x – 26.268              | 0.999 |
| B52                | SKC   | 224-PCXR8 | 093186     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,498 | 1,994 | 0.997x – 1.240               | 1.000 |
| B53                | SKC   | 224-PCXR8 | 707670     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,499 | 2,004 | 1.012x – 22.742              | 0.999 |
| B54                | SKC   | 224-PCXR3 | 509821     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,501 | 2,001 | 1.016x – 33.718              | 0.999 |
| B55                | SKC   | 224-PCXR3 | 510710     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,494 | 1,994 | 0.994x + 4.635               | 1.000 |
| B56                | SKC   | 224-PCXR3 | 511450     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,001 | 1.011x – 20.684              | 0.999 |
| B57                | SKC   | 224-PCXR3 | 510798     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,493 | 1,998 | 1.001x + 3.398               | 1.000 |
| B58                | SKC   | 224-PCXR3 | 509852     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 2,000 | 1.007x – 19.631              | 0.999 |
| B59                | SKC   | 224-PCXR3 | 509862     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,503 | 1,995 | 0.998x + 2.916               | 1.000 |
| B60                | SKC   | 224-PCXR3 | 512655     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,004 | 1.013x – 23.891              | 0.999 |
| B61                | SKC   | 224-PCXR3 | 503915     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,489 | 1,999 | 1.004x – 11.786              | 1.000 |
| B62                | SKC   | 224-PCXR3 | 505975     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 999             | 1,494 | 1,995 | 0.997x – 0.503               | 1.000 |
| B63                | SKC   | 224-PCXR3 | 511432     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 991             | 1,501 | 2,000 | 1.017x – 36.139              | 0.999 |
| B64                | SKC   | 224-PCXR3 | 508302     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,493 | 1,990 | 0.994x + 3.992               | 1.000 |
| B65                | SKC   | 224-PCXR3 | 508310     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,003 | 1.012x – 23.109              | 0.999 |
| B66                | SKC   | 224-PCXR3 | 509861     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,491 | 1,991 | 0.987x + 14.701              | 1.000 |
| B67                | SKC   | 224-PCXR3 | 506295     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,507 | 2,004 | 1.017x – 33.104              | 0.999 |
| B68                | SKC   | 224-PCXR3 | 505872     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,491 | 1,997 | 0.994x + 5.556               | 1.000 |
| B69                | SKC   | 224-PCXR3 | 508375     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,000 | 1.010x – 21.689              | 0.999 |
| B70                | SKC   | 224-PCXR3 | 510623     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,503 | 1,997 | 1.002x – 6.693               | 1.000 |
| B71                | SKC   | 224-PCXR3 | 508367     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 991             | 1,506 | 2,002 | 1.018x – 36.227              | 0.999 |
| B72                | SKC   | 224-PCXR3 | 505977     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,993 | 0.992x + 7.087               | 1.000 |
| B73                | SKC   | 224-PCXR3 | 512606     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,501 | 2,005 | 1.014x – 24.517              | 0.999 |
| B74                | SKC   | 224-PCXR3 | 505993     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,495 | 1,994 | 0.999x – 4.363               | 1.000 |
| B75                | SKC   | 224-PCXR3 | 509820     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,499 | 1,992 | 0.995x + 2.429               | 1.000 |
| B76                | SKC   | 224-PCXR3 | 509811     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,498 | 1,998 | 1.007x – 15.040              | 1.000 |
| B77                | SKC   | 224-PCXR3 | 508301     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,501 | 2,003 | 1.014x – 26.643              | 0.999 |
| B78                | SKC   | 224-PCXR3 | 510677     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,503 | 1,999 | 1.012x – 27.520              | 0.999 |
| B79                | SKC   | 224-PCXR3 | 510880     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,498 | 1,994 | 0.998x – 2.765               | 1.000 |



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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                            | R²    |
| H-R01          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 503.1           | 992.4 | 1979.1 | 0.999x + 3.360               | 0.999 |
| H-R02          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 500.8           | 995.3 | 1986.1 | 1.002x + 5.536               | 1.000 |
| H-R03          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 502.1           | 987.7 | 1997.3 | 0.994x + 1.910               | 1.000 |
| H-R04          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 496.4           | 989.6 | 2019.5 | 1.009x - 13.763              | 1.000 |
| H-R05          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 496.8           | 987.7 | 1987.7 | 1.004x - 9.632               | 1.000 |
| H-R06          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 505.2           | 992.4 | 1979.4 | 0.999x + 2.749               | 0.999 |



## Certificate of Calibration

**Certificate No. :** 64-220066-1

**Page : 1 of 2**

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

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

**Equipment :** Vacuum Gauge

**Manufacturer :** HI-LIGHT **Model :** N/A

**ID No. :** 1/60

**Range :** 0 in Hg to -30 in Hg **Resolution :** 1 in Hg

**Environment :** Ambient Temperature :  $(20 \pm 2) ^\circ \text{C}$

Relative Humidity :  $(50 \pm 10) \%$

**Date of Received :** 02 July 2021

**Date of Calibration :** 05 July 2021

**Date of Issue :** 05 July 2021

**Calibrated by :** Satja Sangkhum

**Calibration Method :** In-house method CAL-M2201 based on BS EN 837-1:2016 with Pressure Calibrator

**Reference Standard Instruments :** This certification is traceable to the International System of Units

Pressure Calibrator & Pressure Sensors Modules

| <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> | <u>Traceability</u>                                |
|---------------|------------------|-----------------|--|
| 220007        | MP-0036-20       | 11 Mar 2022     | National Institute of Metrology (Thailand), (NIMT) |
| 220001        | MP-0036-20       | 11 Mar 2022     | National Institute of Metrology (Thailand), (NIMT) |

A

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 64-220066-1

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**Function :** Vacuum measurement

**Condition of calibration :**

- 1 Scale and conversion factor is 1 kPa = 0.295 in Hg
- 2 Angle of mounting from horizontal at 90 °
- 3 UUC reading after lightly tapped
- 4 Reference plane of UUC at center of Gauge
- 5 UUC calibrated by using clean air as pressure media
6. UUC Condition As-Received : Good

| Standard Reading<br>( in Hg ) | UUC Reading<br>( in Hg ) | Correction<br>( in Hg ) |
|-------------------------------|--------------------------|-------------------------|
| 0.00                          | 0                        | 0.0                     |
| -4.69                         | -5                       | 0.3                     |
| -9.57                         | -10                      | 0.4                     |
| -14.67                        | -15                      | 0.3                     |
| -19.71                        | -20                      | 0.3                     |
| -29.93                        | -30                      | 0.1                     |
| -29.92                        | -30                      | 0.1                     |
| -19.69                        | -20                      | 0.3                     |
| -14.69                        | -15                      | 0.3                     |
| -9.58                         | -10                      | 0.4                     |
| -4.69                         | -5                       | 0.3                     |
| 0.00                          | 0                        | 0.0                     |

Remark

UUC : Unit Under Calibration

The uncertainty is combined hysteresis

The uncertainty of measurement was with in  $\pm 0.39$  in Hg

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

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

- o0o -





CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

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 : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY :

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22





CERTIFICATE No : 22M2567

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22  
AIR PRESSURE : 1008mbar  $\pm$  1mbar CALIBRATION DATE : 11-Mar-22  
AMBIENT TEMPERATURE : 22° 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  | C02210415      | 09-Feb-23 |

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

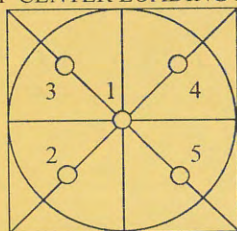
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000058               |
| 0.02              | 0.01999             | 0.00001        | 0.000058               |
| 0.10              | 0.09999             | 0.00001        | 0.000059               |
| 0.20              | 0.19999             | 0.00001        | 0.000059               |
| 0.50              | 0.50001             | -0.00001       | 0.000058               |
| 1.00              | 1.00001             | -0.00001       | 0.000059               |
| 2.00              | 2.00000             | 0.00000        | 0.000059               |
| 5.00              | 5.00001             | -0.00001       | 0.000061               |
| 10.00             | 10.00005            | -0.00005       | 0.000063               |
| 20.00             | 20.00006            | -0.00006       | 0.000069               |
| 50.00             | 50.00000            | 0.00000        | 0.00011                |
| 100.00            | 100.00001           | -0.00001       | 0.00019                |
| 120.00            | 120.00001           | -0.00001       | 0.00022                |

6. OFF CENTER LOADING ERROR



| POINT              | READING (g) |          |
|--------------------|-------------|----------|
| 1                  | 10.00001    | 50.0000  |
| 2                  | 10.00002    | 50.0000  |
| 3                  | 10.00001    | 50.0000  |
| 4                  | 10.00001    | 50.0000  |
| 5                  | 10.00002    | 50.00001 |
| OFF-CENTER LOADING | 0.00001     | 0.0001   |

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



## ***Lambda UV Preventive Maintenance (PM)***

|  |   |   |             |
|--|---|---|-------------|
| <b>Company Name:</b>                       | S.P.S. CONSULTING SERVICE CO., LTD.             |   |             |
| <b>Address:</b>                            | 7, Soi Phaholyothin24, Ladyao, Jatujak, Bangkok |   |             |
| <b>User Name:</b>                          | K. Benjawan                                     | <b>WO Number:</b>                         | WO-01550999 |
| <b>Telephone Number:</b>                   | 086-141-2523                                    | <b>PM Number:</b>                         | 6 of 6 P    |
| <b>Customer Support Engineer:</b>          | K. Anon   | <b>Certificate Number:</b>                | UV2004-2022 |
| <b>Date PM Performed:</b><br>(DD-MMM-YYYY) | 25-Jan-2022                                     | <b>Next PM Due Date:</b><br>(DD-MMM-YYYY) | 25-Jul-2022 |

| <b>Part Number</b> | <b>Release</b> | <b>Publication Date</b> |  |
|--------------------|----------------|-------------------------|---|
| 09370504           | B              | March 2013              |   |

### **Scope**

The purpose of this PM is to ensure the continued functionality of the PerkinElmer Lambda UV/Vis Spectrophotometer by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer. The customer should save their method before the PM begins.

### **General Instructions:**

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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## Component List

| Component Specific Model | Serial #     | Software Version |     | Configuration Notes |
|--------------------------|--------------|------------------|-----|---------------------|
| Lambda 25                | 501S14123010 | 6.2.0.0741       | STD | 1.27                |
| NA                       | NA           | NA               | NA  | NA                  |

## Parts Lists

| Parts Included with the PM  |  |          |               |                         |
|-----------------------------|--|----------|---------------|-------------------------|
| Part Number (if applicable) | Description  | Quantity | Serial Number | Expiration Date (MM/YY) |
| B250 0099                   | Stray Light standard   |          |               |                         |
|                             | Nal cell   | 1        | 1943          | Jan-22                  |
|                             | NaNO2 cell   | 1        | 2963          |                         |
|                             | KCl cell   | 1        | 31030         |                         |
|                             | H2O  | 1        | 71497         |                         |
| B050 7805                   | Secondary Standards for calibration of wavelength and photometric accuracy or use NBS/NIST 390 standards |          |               |                         |
|                             | Gray Glass G1  | 1        | 2926          | Jan-22                  |
|                             | Gray Glass G2  | 1        | 3501          |                         |
|                             | Gray Glass G3  | 1        | 2552          |                         |
|                             | Holmium Glass  | 1        | 1085          |                         |

| Additional Tools Required for PM                  |             |          |             |   |                         |
|---|-------------|----------|-------------|---|-------------------------|
| Part Number (if applicable)                       | Description | Quantity | Serial #    |   | Remark                  |
| -   | -           | -        | -           | - | -                       |
| -   | -           | -        | -           | - | -                       |
| -   | -           | -        | -           | - | -                       |
| Additional Reagents and Standards Required for PM |             |          |             |   |                         |
| Part Number (if applicable)                       | Description | Quantity | Batch/Lot # |   | Expiration Date (MM/YY) |
| -   | -           | -        | -           | - | -                       |
| -   | -           | -        | -           | - | -                       |
| -   | -           | -        | -           | - | -                       |

## Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

### 1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

### 2. Optical checks:

- ☒ Lamp Alignment/Energy
- ☒ Sample Compartment Windows/Monochromator
- ☒ Mirror and Grating Alignment
- ☒ Cell Holder Alignment

### 3. Mechanical:

- ☒ Physical inspection – Please write any comments in the additional comments section.
- ☒ Grating Drive Mechanism.
- ☒ Lamp Change Mechanism.
- ☐ Slit Drive Manual Servo.

### 4. Test:

Refer to Appendix A for the specifications of the instrument being tested.

- ☒ D2 Wavelength accuracy

|                      | Actual Value | Specification |
|----------------------|--------------|---------------|
| Accuracy at 656.1 nm | 656.16       | ± 0.1         |

☒ Holmium Oxide wavelength accuracy

| Filter ID # |                   | 1085         |           |               |
|-------------|-------------------|--------------|-----------|---------------|
| Test        | Calibration Value | Actual Value | Deviation | Specification |
| 279.3 nm    | 279.3             | 279.39       | -0.09     | ± 0.5         |
| 360.8 nm    | 360.9             | 360.93       | -0.03     | ± 0.5         |
| 459.9 nm    | 460.0             | 460.07       | -0.07     | ± 0.5         |
| 536.4 nm    | 536.2             | 536.40       | -0.20     | ± 0.5         |

☒ Scattered Light.

| Test                       | Filter ID # | Result  | Specification |
|----------------------------|-------------|---------|---------------|
| NaI @ 220 nm               | 1943        | 0.0133  | < 0.02 %T     |
| NaNO <sub>2</sub> @ 340 nm | 2963        | -0.1296 | < 0.02 %T     |
| NaNO <sub>2</sub> @ 370 nm | 2963        | -0.0002 | < 0.02 %T     |
| KCl @ 200 nm               | 31030       | 2.4808  | ≥ 2 A         |

☒ Baseline Flatness.

| Corrected Baseline | Specification |
|--------------------|---------------|
| 0.000163           | ± 0.001 A     |

☒ Noise Test @ 500 nm.

| Actual Value | Specification |
|--------------|---------------|
| 0.0000240    | ± 0.00008 A   |

☒ Photometric Accuracy.

| Filter 1 ID # |                  | 2926         |           |               |
|---------------|------------------|--------------|-----------|---------------|
| Test          | Calibrated Value | Actual Value | Deviation | Specification |
| 440 nm        | 0.3483           | 0.3493       | -0.0010   | ± 0.006 A     |
| 546 nm        | 0.3029           | 0.3046       | -0.0017   | ± 0.006 A     |
| 635 nm        | 0.3200           | 0.3232       | -0.0032   | ± 0.006 A     |
| Filter 2 ID # |                  | 3501         |           |               |
| Test          | Calibrated Value | Actual Value | Deviation | Specification |
| 440 nm        | 1.001            | 1.0024       | -0.0014   | ± 0.006 A     |
| 546 nm        | 0.9797           | 0.9813       | -0.0016   | ± 0.006 A     |
| 635 nm        | 1.0285           | 1.0325       | -0.0040   | ± 0.006 A     |
| Filter 3 ID # |                  | 2552         |           |               |
| Test          | Calibrated Value | Actual Value | Deviation | Specification |
| 440 nm        | 0.489            | 0.4935       | -0.0045   | ± 0.006 A     |
| 546 nm        | 0.4582           | 0.4595       | -0.0013   | ± 0.006 A     |
| 635 nm        | 0.5046           | 0.5075       | -0.0029   | ± 0.006 A     |

**5. Accessory (where applicable):**

- ☐ Integrating Sphere
- ☐ Reflecting Attachment
- ☐ Cell Changer
- ☐ Sipper
- ☐ Auto Sampler


**6. Review:**

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach PM sticker.
- ☒ Update Logbook.

## Additional Comments

| Additional Comments Regarding the PM |
|--------------------------------------|
|                                      |
|                                      |
|                                      |
|                                      |
|                                      |
|                                      |
|                                      |
|                                      |

## Review

|  |   |
|--|---|
| <p><i>The preventive maintenance checks and if applicable performance tests for Lambda UV have been completed.</i></p>                           |   |
| <p><b>This Lambda UV Passes</b> <input checked="" type="checkbox"/> <b>Fails</b> <input type="checkbox"/> <i>the preventive maintenance.</i></p> |   |
| <p><b>Review of Preventive Maintenance:</b></p>  |   |
| <p>Authorized </p>  | <p>Date:<br/>25-Jan-2022<br/>(DD-MM-YYYY)</p> |
| <p>Authorized Customer Representative:</p>   | <p>Date:<br/>25-Jan-2022<br/>(DD-MM-YYYY)</p> |



## Certificate of Calibration

**Aquion : Anion (ID#894)**

This certificate is to verify that instrument below are calibrated  
by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

**S.P.S. Consulting Service Co., Ltd.**



Operator Sign

: Jan 5, 2022

Test Engineer



ระดับเสียงในบรรยากาศ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

**Request No.** 21-64/0528

**MTC No.** EEL. BP. 17/0564

## CALIBRATION CERTIFICATE

**Submitted by** : S.P.S. Consulting Services 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 generated by sound calibrator under test shall be 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** : 6 May 2021

**Date of Calibration** : 15 May 2021

1 / 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**

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. 21-64/0528

MTC No. EEL. BP. 17/0564

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   | 93.96                                 | -0.04                  | $\pm 0.10$          | $\pm 0.40$ 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

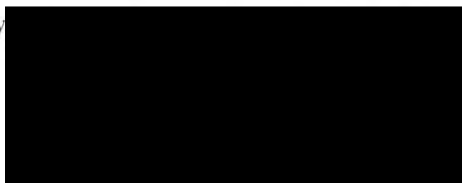
| Standard Microphone<br>Type | Measured Total Distortion<br>(%) | Uncertainty<br>(%) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 1.26                             | $\pm 0.50$         | $\pm 3.0\%$                              |

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by



Approved



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 15 May 2021

Date of Issue : 18 May 2021

Ref : 2011264050601894002

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

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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 R\_218/22

## 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 | 15 May 2021 |
|                   |                | Due Date         | 15 May 2022 |

### Calibration Data

| Sound Level Meter Data   |       |       |            | Calibration Data |                     |                  |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand | Model | Serial No. | Date             | Actual Reading [dB] |                  |
|  |       |       |            |                  | Before Adjustment   | After Adjustment |
| ACO-R23  | ACO   | 6236  | 00192035   | 21 April 2022    | 94.1                | 94.0             |
| ACO-R27  | ACO   | 6236  | 00192039   | 21 April 2022    | 94.0                | 94.0             |
| ACO-R33  | ACO   | 6236  | 00192045   | 21 April 2022    | 94.0                | 94.0             |
| ACO-R34  | ACO   | 6236  | 00192046   | 21 April 2022    | 94.1                | 94.0             |
| ACO-R39  | ACO   | 6236  | 00192051   | 21 April 2022    | 94.0                | 94.0             |
| ACO-R49  | ACO   | 6236  | 00192061   | 21 April 2022    | 94.0                | 94.0             |
| ACO-R50  | ACO   | 6236  | 00192062   | 21 April 2022    | 94.1                | 94.0             |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |       |       |            |                  | 93.96 ± 0.40 dB     |                  |

คุณภาพน้ำเสีย



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH1216

Page.: 1 of 2

## Certificate of Calibration

|                         |   |
|-------------------------|---|
| Equipment :             | pH Meter  |
| Manufacturer :          | HANNA   |
| Model :                 | HI 3512   |
| Serial No. :            | 08685754  |
| ID No. :                | -   |
| Condition As-Received:  | Used Item   |
| Received Date :         | 14 September 2021   |
| Calibration Date :      | 16 September 2021   |
| Reference :             | 2109-0508WN-1   |
| Submitted by :          | S.P.S. Consulting Service Co.,Ltd.<br>7 Phaholyothin 24, Phaholyothin Road,<br>Jompol, Chatuchak, Bangkok10900  |
| Ambient Temperature :   | (25 ± 2.5) °C   |
| Relative Humidity :     | (50 ± 15) %   |
| Calibration Procedure : | In - house method :<br>- CP-CH5 by direct measurement with standard<br>voltage calibrator and direct measurement<br>with certified reference material (CRM) |

Calibrated by : Walalak Sirithean

Approved by :

(✓) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lernagtrakul

Issue Date : 22 September 2021

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0032410





Cert. No.: 21CH1216

Page.: 2 of 2

**Condition of this calibration result**

1. Reference Standard Instrument : -

| <u>Instrument</u>              | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 46530031          | 130RC098      | 20E3666          | 14 Oct 2021     |

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

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.008               | CPA chem            | 754028         | 28 June 2023     |
| pH 6.985               | CPA chem            | 725927         | 12 Jan 2022      |
| pH 10.015              | CPA chem            | 761018         | 02 Aug 2022      |

3. This certificate is valid only to the item calibrated on date and place of calibration.

**Calibration Results****Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

| Unit Under Calibration     | Nominal Value | Standard Voltage Input | Actual Reading |        | Uncertainty of Measurement<br>( $\pm$ mV) | Coverage factor<br><i>k</i> |
|----------------------------|---------------|------------------------|----------------|--------|---|-----------------------------|
|                            | pH            | mV                     | mV             | pH     |   |                             |
| pH Meter<br>S/N.: 08685754 | 4.000         | 177.48                 | 177.9          | 4.000  | 0.058                                     | 2.00                        |
|                            | 7.000         | 0.00                   | 0.4            | 7.000  | 0.058                                     | 2.00                        |
|                            | 10.000        | -177.48                | -177.2         | 10.000 | 0.058                                     | 2.00                        |

**Function : pH Measurement****Performing three buffers standard curve by using buffer nominal pH (4,7,10)**

| Unit Under Calibration         | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading<br>(mV) | Uncertainty of pH measurement<br>( $\pm$ ) | Coverage factor<br><i>k</i> |
|--------------------------------|-----------------------------|-------------------|---------------------------|--|-----------------------------|
| pH Electrode<br>S/N.: 061416CM | 4.008                       | 4.008             | 169.2                     | 0.0046                                     | 2.00                        |
|                                | 6.985                       | 6.985             | -4.4                      | 0.0075                                     | 2.00                        |
|                                | 10.015                      | 10.013            | -178.9                    | 0.013                                      | 2.05                        |

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

-o0o-

malu.

a 1072797



**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 : 21T3943

REFERENCE No : 60857-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : DIGITAL THERMOMETER WITH PROBE

**MANUFACTURER** : HANNA

**MODEL** : HI 3512

**SERIAL No** : TH118035

**ID No** : PH 04/56

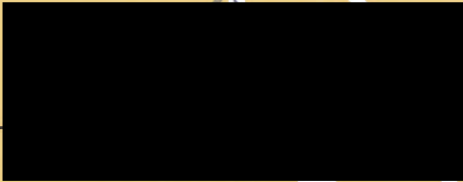
**PROBE TYPE** : THERMOCOUPLE

**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** : CHARUKIT L.

**CALIBRATION DATE** : 20-Apr-21

**APPROVED BY** : 

**ISSUED DATE** : 20-Apr-21

**RECEIVED DATE** : 09-Apr-21

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





# 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

CERTIFICATE No : 21T3943

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL THERMOMETER WITH PROBE  
MANUFACTURER : HANNA  
MODEL : HI 3512  
ID No : PH 04/56  
RECEIVED DATE : 09-Apr-21  
AMBIENT TEMPERATURE : 23 °C ± 3 °C

SERIAL NUMBER : TH118035  
PROBE TYPE : THERMOCOUPLE  
CALIBRATION DATE : 20-Apr-21  
RELATIVE HUMIDITY : 50 %RH ± 20 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BASED ON WI-TQ-017 BY COMPARISON WITH STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT) INTO LIQUID BATH TEMPERATURE CONTROLLER. THE TEMPERATURE SCALE USED WAS BASED ON ITS-90.
2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT              | MODEL | SERIAL No | CERTIFICATE No | DUE DATE  |
|-------------------------|-------|-----------|----------------|-----------|
| 1) STANDARD THERMOMETER | 1529  | A22167    | 20T12169       | 10-Dec-21 |
| 2) SPRT PROBE           | 5612  | 587312    | 20T12169       | 10-Dec-21 |
| 3) MICRO-BATH           | 7103  | A14258    | 20T12167       | 08-Dec-21 |
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).

### RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

| STANDARD<br>READING<br>(°C) | UUC*<br>READING<br>(°C) | IMMERSION<br>DEPTH<br>(mm) | CORRECTION<br>(°C) | UNCERTAINTY<br>OF MEASUREMENT<br>(±°C) |
|-----------------------------|-------------------------|----------------------------|--------------------|--|
| 25.0035                     | 24.8                    | 80                         | 0.2035             | 0.21                                   |

USER SHOULD EVALUATE THE UUC ERROR IF IT IS USED OUTSIDE THE AMBIENT TEMPERATURE RANGE DURING CALIBRATION.  
UUC\* : UNIT UNDER CALIBRATION  
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



## Certificate of Calibration

**Certificate No. :** 65-400210-1

**Page : 1 of 2**

**Submitted by :** S. P. S Consulting Service Co.,Ltd.  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

**Equipment :** Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : TM21/59

**Environment :** Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

**Date of Received :** 19 April 2022

**Date of Calibration :** 23 April 2022

**Date of Issue :** 23 April 2022

**Calibrated by :** Chortip Samchusri

**Calibration Method :** This instrument was calibrated by In-house method comparison technique CAL-M4001 based on ASTM E77-07 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

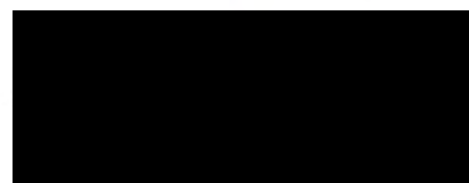
**Reference Standard Instruments :** This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

| ID No. | Cert. No.  | Due Date    | Traceability                                    |
|--------|------------|-------------|---|
| 400001 | TT-0016-22 | 07 Feb 2024 | National Institute of Metrology Thailand (NIMT) |

2. Standard Digital Thermometer

| ID No. | Cert. No. | Due Date    | Traceability                                    |
|--------|-----------|-------------|---|
| 400003 | 21E1850   | 14 Jun 2023 | National Institute of Metrology Thailand (NIMT) |
| 400004 | 21E1850   | 14 Jun 2023 | National Institute of Metrology Thailand (NIMT) |



The Uncertainties are for a confidence probability of approximately 95%

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## Certificate of Calibration

**Certificate No. :** 65-400210-1

**Page : 2 of 2**

**Result of Calibration :** Without Adjustment

**UUC Condition As-Received :** Good

**Function :** Temperature measurement

Ice point check : UUC\* reading 0 °C Standard reading 0.6439 °C

| Standard Reading<br>( °C ) | UUC Reading<br>( °C ) | Correction<br>( °C ) | Uncertainty<br>( ± °C ) |
|----------------------------|-----------------------|----------------------|-------------------------|
| 20.6690                    | 20                    | 0.7                  | 0.31                    |

### Remark

UUC : Unit Under Calibration

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

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

- o0o -



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**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 : 21M3167  
REFERENCE No : 60627-3

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : SARTORIUS

**MODEL** : BSA224S-CW

**SERIAL No** : 36591843


**ID No** : BA 09/61

**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** : 19-Mar-21

**APPROVED BY** : 

**ISSUED DATE** : 20-Mar-21

**RECEIVED DATE** : 19-Mar-21

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



**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 : 21M3167

PAGE : 2 OF 2

**Calibration Report**

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW  
MANUFACTURER : SARTORIUS S/N : 36591843  
ID No : BA 09/61 RECEIVED DATE : 19-Mar-21  
AIR PRESSURE : 1009mbar  $\pm$  1mbar CALIBRATION DATE : 19-Mar-21  
AMBIENT TEMPERATURE : 24°C  $\pm$  1°C RELATIVE HUMIDITY : 52 %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 ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. 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  | C02210415      | 09-Feb-23 |
| 2) STANDARD WEIGHT     | E2    | 15843     | C02210419      | 10-Feb-23 |
| 3) STANDARD WEIGHT     | E2    | QK-I-349  | M2103235S      | 26-Mar-23 |

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**

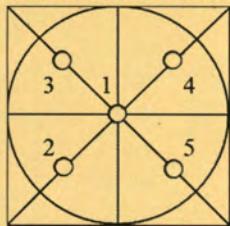
1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000045 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.0               | 0.0000              | 0.0000         | 0.000075               |
| 0.1               | 0.1000              | 0.0000         | 0.000075               |
| 0.2               | 0.2000              | 0.0000         | 0.000076               |
| 0.5               | 0.5000              | 0.0000         | 0.000076               |
| 1.0               | 1.0000              | 0.0000         | 0.000077               |
| 2.0               | 2.0000              | 0.0000         | 0.000077               |
| 5.0               | 5.0000              | 0.0000         | 0.000079               |
| 10.0              | 10.0000             | 0.0000         | 0.000082               |
| 20.0              | 20.0000             | 0.0000         | 0.000086               |
| 50.0              | 50.0000             | 0.0000         | 0.00013                |
| 100.0             | 100.0001            | -0.0001        | 0.00019                |
| 200.0             | 199.9997            | 0.0003         | 0.00032                |

**5. OFF CENTER LOADING ERROR**

| POINT              | READING (g) |
|--------------------|-------------|
| 1                  | 100.0000    |
| 2                  | 100.0000    |
| 3                  | 100.0001    |
| 4                  | 100.0000    |
| 5                  | 99.9999     |
| 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





CERTIFICATE No : 22M2569

REFERENCE No : 64386-3

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843

ID No : BA 09/61

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 : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY :

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22





CERTIFICATE No : 22M2569

PAGE : 2 OF 2

## Calibration Report

|                     |   |                      |                   |   |                      |
|---------------------|---|----------------------|-------------------|---|----------------------|
| EQUIPMENT           | : | DIGITAL BALANCE      | MODEL             | : | BSA224S-CW           |
| MANUFACTURER        | : | SARTORIUS            | S/N               | : | 36591843             |
| ID No               | : | BA 09/61             | RECEIVED DATE     | : | 11-Mar-22            |
| AIR PRESSURE        | : | 1008mbar $\pm$ 1mbar | CALIBRATION DATE  | : | 11-Mar-22            |
| AMBIENT TEMPERATURE | : | 22° C $\pm$ 1° C     | RELATIVE HUMIDITY | : | 51 %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 ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. 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 :-

| <u>INSTRUMENT</u>      | <u>MODEL</u> | <u>SERIAL No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|------------------------|--------------|------------------|-----------------------|-----------------|
| 1) STANDARD WEIGHT SET | E2           | QK-I-151         | C02210415             | 09-Feb-23       |

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

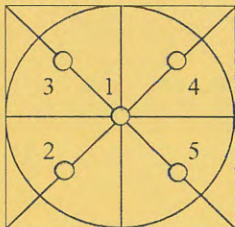
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000048 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.0000              | 0.0000         | 0.000078               |
| 0.10              | 0.1000              | 0.0000         | 0.000078               |
| 0.20              | 0.2000              | 0.0000         | 0.000078               |
| 0.50              | 0.5000              | 0.0000         | 0.000079               |
| 1.00              | 1.0000              | 0.0000         | 0.000079               |
| 2.00              | 2.0000              | 0.0000         | 0.000080               |
| 5.00              | 5.0000              | 0.0000         | 0.000081               |
| 10.00             | 10.0000             | 0.0000         | 0.000084               |
| 20.00             | 20.0000             | 0.0000         | 0.000089               |
| 50.00             | 50.0000             | 0.0000         | 0.00011                |
| 100.00            | 100.0000            | 0.0000         | 0.00019                |
| 200.00            | 199.9999            | 0.0001         | 0.00032                |

5. OFF CENTER LOADING ERROR



| POINT              | READING (g) |
|--------------------|-------------|
| 1                  | 99.9999     |
| 2                  | 99.9999     |
| 3                  | 100.0000    |
| 4                  | 99.9999     |
| 5                  | 99.9998     |
| OFF-CENTER LOADING | 0.0001      |

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



**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



CERTIFICATE No : 21E3592  
REFERENCE No : 60760-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : CONDUCTIVITY METER  
**MANUFACTURER** : EUTECH  
**MODEL** : CON 150  
**SERIAL No** : 2746308  
**ID No** : CD 04/61  
**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** : 02-Apr-21

**APPROVED BY** : 

**ISSUED DATE** : 02-Apr-21

**RECEIVED DATE** : 31-Mar-21

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





# 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

CERTIFICATE No : 21E3592

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : CONDUCTIVITY METER  
MANUFACTURER : EUTECH  
SERIAL NUMBER : 2746308  
RECEIVED DATE : 31-Mar-21  
AMBIENT TEMPERATURE : 20 °C ± 1 °C  
MODEL : CON 150  
ID No : CD 04/61  
CALIBRATION DATE : 02-Apr-21  
RELATIVE HUMIDITY : 50 % RH ± 15% RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD. THE DISPLAY AND ELECTROD WAS CALIBRATED BY USING STANDARD CONDUCTIVITY BUFFER SOLUTION IN CONTROLLED TEMPERATURE BATH.
2. REFERENCE STANDARD INSTRUMENTS :-

| <u>INSTRUMENT</u>       | <u>MODEL</u> | <u>LOT No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|-------------------------|--------------|---------------|-----------------------|-----------------|
| 1) REFERENCE MATERIAL   | 00652-26     | CC20562       | 4066-11793752         | 09-Dec-21       |
| 2) REFERENCE MATERIAL   | 00652-30     | CC20458       | 4173-11692041         | 04-Nov-21       |
| 3) REFERENCE MATERIAL   | 00652-32     | CC20466       | 4068-11695401         | 05-Nov-21       |
| 4) REFERENCE MATERIAL   | 00652-34     | CC20523       | 4069-11762897         | 01-Dec-21       |
| 5) BATH                 | 260014       | 1247 48074    | 20T9392               | 10-Sep-21       |
| 6) STANDARD THERMOMETER | 421504       | 55000379      | 20T9616               | 10-Sep-21       |

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 :-
  - NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST), USA.
  - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

### RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

#### 1. DISPLAY UNIT WITH ELECTROD S/N CONSEN91W

| CONDUCTIVITY<br>BUFFER<br>SOLUTION | UUC READING | CORRECTION | VALUE<br>BEFORE<br>ADJUSTMENT | UNIT  | UNCERTAINTY<br>OF<br>MEASUREMENT (±) | COVERAGE<br>FACTOR<br>k |
|------------------------------------|-------------|------------|-------------------------------|-------|--------------------------------------|-------------------------|
| 99.0                               | 99.4        | -0.40      | N/A                           | µS/cm | 3.0                                  | 2.0                     |
| 1413.0                             | 1413        | 0.00       | N/A                           | µS/cm | 30                                   | 2.0                     |
| 9.992                              | 9.55        | 0.44       | N/A                           | mS/cm | 0.21                                 | 2.0                     |
| 99.915                             | 80.3        | 19.62      | N/A                           | mS/cm | 2.1                                  | 2.0                     |

#### 2. DISPLAY UNIT WITH TEMPERATURE

| STANDARD<br>READING<br>(°C) | UUC READING<br>(°C) | CORRECTION | VALUE<br>BEFORE<br>ADJUSTMENT | UNCERTAINTY<br>OF<br>MEASUREMENT (±°C) | COVERAGE<br>FACTOR<br>k |
|-----------------------------|---------------------|------------|-------------------------------|--|-------------------------|
| 25.003                      | 25.0                | 0.0        | N/A                           | 0.0085                                 | 2.0                     |

UUC : UNIT UNDER CALIBRATION

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR SHOWN IN THE TABLE, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH140

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** Conductivity Meter  
**Manufacturer :** Mettler Toledo  
**Model :** SevenCompact  
**Serial No. :** C141708983  
**ID No. :** -  
**Condition As-Received:** Used Item  
**Received Date :** 31 January 2022  
**Calibration Date :** 02 February 2022  
**Reference :** 2201-0954WSC-1  
**Submitted by :** S.P.S. Consulting Service Co.,Ltd.  
7 Soi Phahonyothin 24, Phahonyothin Rd.,  
Chom Phon, Chatuchak, Bangkok 10900  
**Ambient Temperature :**  $(25 \pm 2.5) ^\circ\text{C}$   
**Relative Humidity :**  $(50 \pm 15) \%$   
**Calibration Procedure:** In -house method :  
- CP-CH6 : based on direct measurement by  
using certified reference material (CRM)

**Calibrated by :**

Warakorn Lerngagtrakul

**Approved by :**

- ( ✓ ) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lerngagtrakul

**Issue Date :**

10 February 2022

**The Uncertainties are for a confidence probability of approximately 95%**

This certificate may not be reproduced other than in full, except with the prior written  
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0037795



Cert.No.: 22CH140

Page.: 2 of 2

**Condition of this result of calibration**

## 1. Reference Standard Instrument :-

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due date</u> |
|-------------------|-------------------|---------------|------------------------|-----------------|
| 1) Thermometer    | 1963878           | 130RC095      | 21I977                 | 17 Sep 2022     |

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

- Traceable to National Institute of Metrology (Thailand), NIMT

## 2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Conductivity Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------------|---------------------|----------------|------------------|
| 147.0 $\mu\text{S/cm}$       | CPA Chem            | 761020         | 02 Aug 2022      |
| 1413.0 $\mu\text{S/cm}$      | CPA Chem            | 761021         | 02 Aug 2022      |
| 12.880 mS/cm                 | CPA Chem            | 761022         | 02 Aug 2022      |
| 111.3 mS/cm                  | CPA Chem            | 768164         | 12 Sep 2022      |

- Control Conductivity calibration solution temperature by Water bath ( $25 \pm 0.1$ )  $^{\circ}\text{C}$

## 3. This certificate is valid only to the item calibrated on date and place of calibration.

**Calibration results****Function : Conductivity Measurement**

(\*) After Adjustment at 0.147, 1.413, 12.880, 111.3 mS/cm

Conductivity Electrode Serial No.: 5821320179

| <b>Standard<br/>Conductivity Solution</b> | <b>Before Adjustment<br/>UUC* Reading</b> | <b>After Adjustment<br/>UUC* Reading</b> | <b>Uncertainty<br/>of Measurement<br/>(<math>\pm</math>)</b> | <b>Coverage<br/>factor<br/>k</b> |
|---|---|--|--|----------------------------------|
| 147.0 $\mu\text{S/cm}$                    | 148.1 $\mu\text{S/cm}$                    | 147.0 $\mu\text{S/cm}$                   | 0.99 $\mu\text{S/cm}$  | 2.00                             |
| 1413.0 $\mu\text{S/cm}$                   | 1413 $\mu\text{S/cm}$                     | 1413 $\mu\text{S/cm}$                    | 9.2 $\mu\text{S/cm}$   | 2.00                             |
| 12.880 mS/cm                              | 12.61 mS/cm                               | 12.88 mS/cm                              | 0.086 mS/cm  | 2.00                             |
| 111.3 mS/cm                               | 105.7 mS/cm                               | 111.4 mS/cm                              | 0.76 mS/cm   | 2.00                             |

**Remark**

- UUC\* = Unit Under Calibration

- 147.0  $\mu\text{S/cm}$  Adjustment Cell constant =  $0.550585 \text{ cm}^{-1}$ - 1413.0  $\mu\text{S/cm}$  Adjustment Cell constant =  $0.554585 \text{ cm}^{-1}$ - 12.880 mS/cm Adjustment Cell constant =  $0.562585 \text{ cm}^{-1}$ - 111.3 mS/cm Adjustment Cell constant =  $0.578585 \text{ cm}^{-1}$ 

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





**TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)**  
**CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES**

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484

**Cert.No.:** 21TW92

**Page.:** 1 of 2

## Certificate of Testing

|                               |  |
|-------------------------------|--|
| <b>Equipment :</b>            | DO Meter   |
| <b>Manufacturer :</b>         | YSI  |
| <b>Model :</b>                | 5100   |
| <b>Serial No. :</b>           | 01H1079 AB   |
| <b>ID No. :</b>               | -  |
| <b>Received Date :</b>        | 19 April 2021  |
| <b>Test Date :</b>            | 21 April 2021  |
| <b>Reference :</b>            | 2104-0372WN-1  |
| <b>Submitted by :</b>         | S.P.S. Consulting Service Co.,Ltd.<br>7 Soi Phaholyothin 24, Phaholyothin Rd.,<br>Jompol, Chatuchak, Bangkok 10900 |
| <b>Laboratory Condition :</b> | Temperature ( $25 \pm 5$ ) °C<br>Humidity ( $50 \pm 20$ ) %  |
| <b>Test Procedure :</b>       | In - house method : CP-CH9<br>by Comparison Technique with Azide Modification Method                               |
| <b>Tested by :</b>            | Walalak Sirithean  |

**Approved by :**

- ( ) Malee Butkruea
- ( ) Saithip Meangmai
- ( ☒ ) Warakorn Lerngagtrakul

**Issue Date :**

26 April 2021





Cert.No.: 21TW92

Page.: 2 of 2

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14J100195

| Titration Method<br>(Azide Modification Method)<br>(mg/L) | DO Meter<br>Reading<br>(mg/L) | Standard Deviation<br>(mg/L) |
|---|-------------------------------|------------------------------|
| 8.00  | 7.99                          | 0.0055                       |

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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**TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)**  
**CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES**

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484

**Cert.No.:** 22TW98

**Page.:** 1 of 2

## Certificate of Testing

**Equipment :** DO Meter  
**Manufacturer :** YSI  
**Model :** 5000-230V  
**Serial No. :** 15B100751  
**ID No. :** -  
**Received Date :** 20 April 2022  
**Test Date :** 21 April 2022  
**Reference :** 2204-0429WC-1  
**Submitted by :** S.P.S. Consulting Service Co.,Ltd.  
7 Phaholyothin 24, Phaholyothin Road.,  
Jompol, Chatuchak, Bangkok 10900  
**Laboratory Condition :** Temperature (  $25 \pm 5$  ) °C  
Humidity (  $50 \pm 20$  ) %  
**Test Procedure :** In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
**Tested by :** Walalak Sirithean

**Approved by :**

- ( ☒ ) Malee Butkruea  
( ☐ ) Saithip Meangmai  
( ☐ ) Warakorn Lernagatrakul

**Issue Date :** 25 April 2022



Cert.No.: 22TW98

Page.: 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

| <u>Instruments</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--------------------|-------------------|---------------|------------------------|-----------------|
| 1) Burette         | -                 | 130BU10       | 21CG1389               | 25 Mar 2023     |
| 2) Balance         | 1126143764        | 140RC004      | 21MM430                | 21 Sep 2022     |

2. Standard Material :-

| <u>Material</u>                 | <u>Manufacturer</u> | <u>Lot.No.</u> | <u>Assay</u> |
|---------------------------------|---------------------|----------------|--------------|
| Sodium Thiosulfate pentahydrate | Merck               | AM1763316      | 100.2%       |

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14J100195

| <b>Titration Method<br/>(Azide Modification Method)</b><br>(mg/L) | <b>DO Meter<br/>Reading</b><br>(mg/L) | <b>Standard Deviation</b><br>(mg/L) |
|---|---------------------------------------|-------------------------------------|
| 8.12  | 8.14                                  | 0.0084                              |

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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# 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

CERTIFICATE No : 21T0599

REFERENCE No : 59852-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0235

ID No : DRB 02/59

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

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 21-Jan-21

APPROVED BY : 

ISSUED DATE : 25-Jan-21

RECEIVED DATE : 20-Jan-21





CERTIFICATE No : 21T0599

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : COD REACTOR  
MANUFACTURER : HACH  
ID NUMBER : DRB 02/59  
RECEIVED DATE : 20-Jan-21  
AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200  
SERIAL NUMBER : 15110C0235  
CALIBRATION DATE : 21-Jan-21  
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

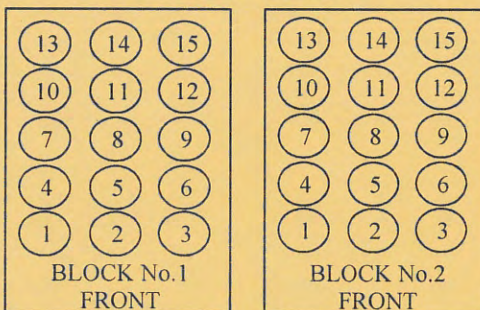
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 19 POINTS AND LOCATED AS THE PICTURE BELOW AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE TENTH THERMOCOUPLE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

| <u>INSTRUMENT</u>             | <u>MODEL</u> | <u>SERIAL No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|-------------------------------|--------------|------------------|-----------------------|-----------------|
| 1) DATA LOGGER WITH TC TYPE K | HYDRA 2635A  | 8009008          | 20T7223               | 11-Jul-21       |

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 QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



### TEMPERATURE MEASUREMENT ACCURACY TEST

| Block No.                                     | 1    | 2     |
|---|------|-------|
| Controller temperature (°C)                   | 150  | 150   |
| Indicating Temperature                        | 150  | 150   |
| Measured Temperature (°C) at Spread Locations | 1    | 150.4 |
|   | 2    | 150.8 |
|   | 3    | 150.7 |
|   | 4    | 151.1 |
|   | 5    | 151.0 |
|   | 6    | 150.8 |
|   | 7    | 150.9 |
|   | 8    | 151.2 |
|   | 9    | 150.9 |
|   | 10   | 150.6 |
|   | 11   | 150.4 |
|   | 12   | 149.6 |
|   | 13   | 149.3 |
|   | 14   | 149.4 |
|   | 15   | 149.9 |
| Uncertainty of Measurement(± °C)              | 0.86 | 0.86  |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY. THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





# 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 : 22T0570

REFERENCE No : 63773-2

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : COD REACTOR

**MANUFACTURER** : HACH

**MODEL** : DRB 200

**SERIAL No** : 15110C0498

**ID No** : DRB 06/59

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

**CALIBRATED BY** : CHAICHARN CH.

**CALIBRATION DATE** : 21-Jan-22

**APPROVED BY** : 

**ISSUED DATE** : 21-Jan-22

**RECEIVED DATE** : 19-Jan-22





# 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

CERTIFICATE No : 22T0570

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : COD REACTOR  
MANUFACTURER : HACH  
ID NUMBER : DRB 06/59  
RECEIVED DATE : 19-Jan-22  
AMBIENT TEMPERATURE : 23° C ± 1° C  
MODEL : DRB 200  
SERIAL NUMBER : 15110C0498  
CALIBRATION DATE : 21-Jan-22  
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

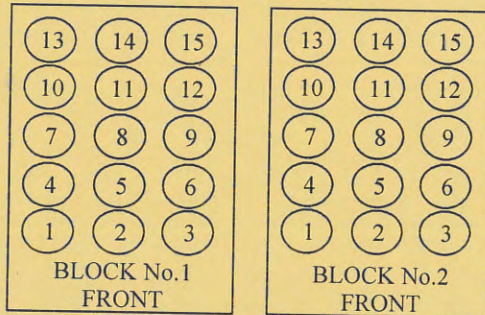
1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT                    | MODEL       | SERIAL No | CERTIFICATE No | DUE DATE  |
|-------------------------------|-------------|-----------|----------------|-----------|
| 1) DATA LOGGER WITH TC TYPE K | HYDRA 2635A | 8009008   | 21T6767        | 10-Jul-22 |

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 QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



### TEMPERATURE MEASUREMENT ACCURACY TEST

| Block No.                                     | 1    | 2     |
|---|------|-------|
| Controller temperature (°C)                   | 145  | 145   |
| Indicating Temperature                        | 145  | 145   |
| Measured Temperature (°C) at Spread Locations | 1    | 150.5 |
|   | 2    | 150.6 |
|   | 3    | 149.7 |
|   | 4    | 150.2 |
|   | 5    | 149.9 |
|   | 6    | 150.1 |
|   | 7    | 150.1 |
|   | 8    | 149.7 |
|   | 9    | 150.6 |
|   | 10   | 149.6 |
|   | 11   | 149.9 |
|   | 12   | 149.6 |
|   | 13   | 149.7 |
|   | 14   | 149.8 |
|   | 15   | 149.6 |
| Uncertainty of Measurement(± °C)              | 0.86 | 0.86  |

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY. THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





## MAINTENANCE REPORT

### OPTIMA 5300DV

|  |  |
|--|--|
| <b>Customer :</b> S.P.S. CONSULTING SERVICE CO., LTD.<br><hr/> <b>Address :</b> 7 Soi Phaholyothin 24<br><hr/> Phaholyothin Road., Jompol,<br><hr/> Chatuchak, Bangkok 10900<br><hr/> <b>User Name:</b> Phenpha Vipasthawatt<br><hr/> <b>Phone:</b> 0-2939-4370-72<br><hr/> <b>Fax:</b> 0-2513-4221<br><hr/> | <b>Date Tested:</b> January 18, 2021<br><hr/> <b>Recommendation Recertification</b><br><b>Period</b> 6 <b>Months</b><br><hr/> <b>Recertification Due:</b> July 18, 2021<br><hr/> <b>Date Last Certified:</b> July 21, 2020<br><hr/> <b>Visit Number:</b> 2 of 2<br><hr/> <b>PerkinElmer Phone:</b> 02-719-6420 ext 206<br><hr/> <b>PerkinElmer Fax:</b> 02-318-5597<br><hr/> |
|--|--|

| CONFIGURATION TESTED      |                           | ACCESSORIES/COMPONENT NOT INCLUDED |
|---------------------------|---------------------------|------------------------------------|
| <b>MODEL</b>              | <b>SERIAL NUMBER</b>      |                                    |
| OPTIMA 5300DV             | 077C7042401               |                                    |
| <b>TESTED EQUIPMENT</b>   | <b>CALIBRATION NUMBER</b> | <b>EXPIRATION</b>                  |
| IPV Methods               |                           |                                    |
| <b>TEST STANDARD USED</b> | <b>PART NUMBER</b>        | <b>EXPIRATION DATE</b>             |
| Multielement Standard     | N069-1579                 | February 28, 2022                  |
| Wavecal Solution          | N058-2152                 | January 30, 2022                   |
| VIS Wavecal solution      | N930-2946                 | December 30, 2021                  |
| Instrument Cal. STD4      | N930-0221                 | June 30, 2021                      |
| <b>CUSTOMER SUPPLIED</b>  | <b>COMMENTS</b>           | <b>CUSTOMER INITIALS</b>           |
| 2 % HNO3                  |                           |                                    |
| 10 % HNO3                 |                           |                                    |



## MAINTENANCE REPORT

### OPTIMA 5300DV

SERIAL NUMBER 077C7042401

DATE TESTED

January 18, 2021**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

B. Inspect and replace as necessary, all torch components including the RF coil.

☐ OK

C. Inspect all tubing for sign of clacking or leaking.

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every six months.

☐ OK**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK





## MAINTENANCE REPORT

### OPTIMA 5300DV

| SERIAL NUMBER : <u>077C7042401</u> |               |             | DATE TESTED : <u>January 18, 2021</u> |             |     |
|------------------------------------|---------------|-------------|---------------------------------------|-------------|-----|
| PARAMETER                          | SPECIFICATION |             |                                       | FINAL VALUE |     |
| Spectral Resolution : UV           | As 193.696 nm | ≤ 0.007     |                                       | 0.00592     |     |
|                                    | Ni 231.604 nm | ≤ 0.008     |                                       | 0.00771     |     |
|                                    | Ni 341.476 nm | ≤ 0.012     |                                       | 0.00792     |     |
| Spectral Resolution : VIS          | La 408.672 nm | ≤ 0.020     |                                       | 0.01605     |     |
|                                    | Ba 455.403 nm | ≤ 0.025     |                                       | 0.02172     |     |
| Precision                          |               |             |                                       |             |     |
|                                    | As 193.656 nm | % RSD < 1.0 |                                       | 0.55 %      |     |
|                                    | Zn 213.856 nm | % RSD < 1.0 |                                       | 0.58 %      |     |
|                                    | Mn 257.610 nm | % RSD < 1.0 |                                       | 0.46 %      |     |
|                                    | La 379.478 nm | % RSD < 1.0 |                                       | 0.36 %      |     |
|                                    | Ba 455.403 nm | % RSD < 1.0 |                                       | 0.6 %       |     |
|                                    | Ba 493.408 nm | % RSD < 1.0 |                                       | 0.74 %      |     |
| Detection Limits : Axial           | Tl 190.800 nm | 3(sd)       |                                       | 1.92        | ppb |
|                                    | As 193.696 nm | 3(sd)       |                                       | 3.64        | ppb |
|                                    | Pb 220.353 nm | 3(sd)       |                                       | 1.20        | ppb |
| Detection Limits : Radial          | As 193.696 nm | 3(sd)       |                                       | 34.30       | ppb |
|                                    | Zn 213.856 nm | 3(sd)       |                                       | 1.66        | ppb |
|                                    | Mn 257.610 nm | 3(sd)       |                                       | 1.87        | ppb |
|                                    | La 379.478 nm | 3(sd)       |                                       | 0.82        | ppb |
|                                    | Ba 455.403 nm | 3(sd)       |                                       | 0.14        | ppb |
|                                    | Ba 493.408 nm | 3(sd)       |                                       | 0.15        | ppb |
| BEC : Axial (IB X 5000)/(IS-IB)    | Cd 226.502 nm | ≤ 150 ppb   |                                       | 28.94       | ppb |
| BEC : Radial (IB X 1000)/(IS-IB)   | Mn 257.610 nm | ≤ 45 ppb    |                                       | 27.84       | ppb |



## MAINTENANCE REPORT

### OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED January 18, 2021**Remarks :**

Commissioning follow as commissioning performance sheets.

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This is to certify that the above tests have been performed and the configuration tested

☒

meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale, including warranty terms.

**Service Department PerkinElmer Ltd.**

Authorized Representative: \_\_\_\_\_

(



)

Service Engineer





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

|   |   |  |
|---|---|--|
| <b>Customer :</b> <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>January 12, 2022</u>          |  |
|   | Recommendation Recertification                |  |
| <b>Address :</b> <u>7 Soi Phaholyothin 24</u>             | Period <u>6</u> Months                        |  |
| <u>Paholyothin Road</u>                                   | Recertification Due: <u>July 12, 2022</u>     |  |
| <u>Jompol Chatuchak, Bangkok 1090</u>                     | Date Last Certified: <u>July 14, 2021</u>     |  |
| <b>User Name:</b> <u>K.Phenpha Viphasathawat</u>          | Visit Number: <u>2 of 2</u>                   |  |
| <b>Phone:</b> <u>083-9269252</u>                          | PerkinElmer Phone: <u>02-719-6420 ext 206</u> |  |
| <b>Fax:</b> <u>02-513-4221</u>                            | PerkinElmer Fax: <u>02-318-5597</u>           |  |

| CONFIGURATION TESTED         |                           | ACCESSORIES/COMPONENT<br>NOT INCLUDED |
|------------------------------|---------------------------|---------------------------------------|
| <b>MODEL</b>                 | <b>SERIAL NUMBER</b>      |                                       |
| <u>OPTIMA 5300DV</u>         | <u>077C7042401</u>        |                                       |
| <b>TESTED EQUIPMENT</b>      | <b>CALIBRATION NUMBER</b> | <b>EXPIRATION</b>                     |
| <u>IPV Methods</u>           |                           |                                       |
| <b>TEST STANDARD USED</b>    | <b>PART NUMBER</b>        | <b>EXPIRATION DATE</b>                |
| <u>Multielement Standard</u> | <u>N069-1579</u>          | <u>August 30, 2022</u>                |
| <u>Wavecal Solution</u>      | <u>N058-2152</u>          | <u>January 30, 2022</u>               |
| <u>VIS Wavecal solution</u>  | <u>N930-2946</u>          | <u>June 30, 2022</u>                  |
| <u>Instrument Cal. STD4</u>  | <u>N930-0221</u>          | <u>August 30, 2022</u>                |
| <b>CUSTOMER SUPPLIED</b>     | <b>COMMENTS</b>           | <b>CUSTOMER INITIALS</b>              |
| <u>2 % HNO3</u>              |                           |                                       |
| <u>10 % HNO3</u>             |                           |                                       |



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER**    077C7042401
**DATE TESTED**    January 12, 2022
**1. MECHANICAL CHECKS**

- |  |                             |
|--|-----------------------------|
| A. Inspect and clean all fans and filters.                                       | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking.                           | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings.                             | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers.                                    | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument.   | <input type="checkbox"/> OK |

**2. OPTICAL CHECKS**

- |   |                             |
|---|-----------------------------|
| A. Inspect and clean all optical components.        | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment.                       | <input type="checkbox"/> OK |

**3. COOLING SYSTEM CHECKS**

- |   |                              |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK  |
| B. Flush out the chiller every year.          | <input type="checkbox"/> N/A |

**4. PERFORMANCE CHECKS**

- |                            |                             |
|----------------------------|-----------------------------|
| A. Torch View Alignment.   | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

SERIAL NUMBER : 077C7042401

DATE TESTED : January 12, 2022

| PARAMETER                        | SPECIFICATION |            |             | FINAL VALUE |     |
|----------------------------------|---------------|------------|-------------|-------------|-----|
| Spectral Resolution : UV         | As            | 193.696 nm | ≤ 0.007     | 0.00554     |     |
|                                  | Ni            | 231.604 nm | ≤ 0.008     | 0.00725     |     |
|                                  | Ni            | 341.476 nm | ≤ 0.012     | 0.00752     |     |
| Spectral Resolution : VIS        | La            | 408.672 nm | ≤ 0.020     | 0.01616     |     |
|                                  | Ba            | 455.403 nm | ≤ 0.025     | 0.02416     |     |
| Precision                        |               |            |             |             |     |
|                                  | As            | 193.656 nm | % RSD < 1.0 | 0.34        | %   |
|                                  | Zn            | 213.856 nm | % RSD < 1.0 | 0.27        | %   |
|                                  | Mn            | 257.610 nm | % RSD < 1.0 | 0.41        | %   |
|                                  | La            | 379.478 nm | % RSD < 1.0 | 0.57        | %   |
|                                  | Ba            | 455.403 nm | % RSD < 1.0 | 0.33        | %   |
|                                  | Ba            | 493.408 nm | % RSD < 1.0 | 0.26        | %   |
| Detection Limits : Axial         | Tl            | 190.080 nm | 3(sd)       | 5.51        | ppb |
|                                  | As            | 193.696 nm | 3(sd)       | 8.59        | ppb |
|                                  | Pb            | 220.353 nm | 3(sd)       | 0.50        | ppb |
| Detection Limits : Radial        | As            | 193.696 nm | 3(sd)       | 21.00       | ppb |
|                                  | Zn            | 213.856 nm | 3(sd)       | 0.32        | ppb |
|                                  | Mn            | 257.610 nm | 3(sd)       | 0.18        | ppb |
|                                  | La            | 379.478 nm | 3(sd)       | 0.44        | ppb |
|                                  | Ba            | 455.403 nm | 3(sd)       | 0.17        | ppb |
|                                  | Ba            | 493.408 nm | 3(sd)       | 0.12        | ppb |
| BEC : Axial (IB X 500)/(IS-IB)   | Cd            | 226.502 nm | ≤ 150 ppb   | 12.46       |     |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn            | 257.610 nm | ≤ 45 ppb    | 30.82       |     |



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER** 077C7042401**DATE TESTED** January 12, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,  
including warranty terms.

**Service Department PerkinElmer Ltd.**

**Authorized Representative:**

Service Engineer



ระดับความร้อนในสถานประกอบการ

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSI010011

CLID. NO. : 232000797

JOB CONTROL NO. : 210403031522

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

DATE OF RECEIVED : 03 April 2021

DATE OF ISSUED : 08 April 2021

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

Calibrated By : Tanawan Seenam-Ngoen  
Calibration Engineer

Approved By :

08 April 2021

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. Q21031522

F3-011-04/01-12

page 1 of 3





## REPORT OF CALIBRATION FOR

|                     |   |  |
|---------------------|---|--|
| NOMENCLATURE        | : | DIGITAL THERMOHYGRO METER<br>(THERMAL ENVIRONMENT MONITOR) |
| MANUFACTURER        | : | 3M   |
| MODEL / TYPE        | : | QUESTemp° 46   |
| SERIAL NO.          | : | TSI010011  |
| DATE OF CALIBRATION | : | 06 April 2021  |

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### 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** as calibration guidelines.

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.18815, Due Date 11 November 2021.

### 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:2013)"

Certificate No. Q21031522

F3-011-04/01-12

page 2 of 3



## 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                         | 30.4                   | -0.42                 | 0.40                     |
| 35.0                  | 34.99                         | 35.4                   | -0.41                 |                          |
| 40.0                  | 40.01                         | 40.3                   | -0.29                 |                          |

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                         | 29.9                   | +0.08                 | 0.40                     |
| 35.0                  | 34.99                         | 34.9                   | +0.09                 |                          |
| 40.0                  | 40.01                         | 39.9                   | +0.11                 |                          |

#### 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                         | 29.9                   | +0.08                 | 0.40                     |
| 35.0                  | 34.99                         | 35.0                   | -0.01                 |                          |
| 40.0                  | 40.01                         | 40.0                   | +0.01                 |                          |

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. Q21031522

F3-011-04/01-12

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@clccalibration

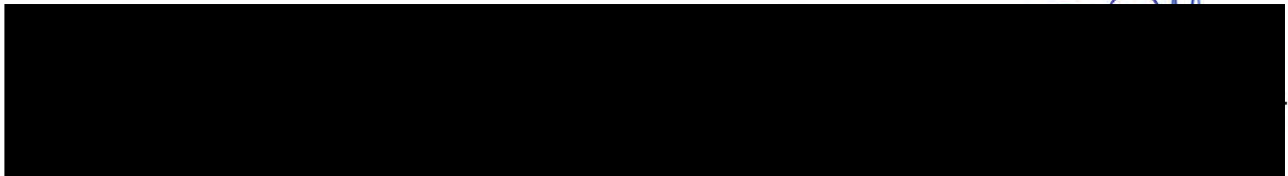




บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com,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

Heat B001\_4/22

| Heat Stress WBGT Meter Verification Report                             |                            |                     |                      |
|--|----------------------------|---------------------|----------------------|
| Verification Data  |                            |                     |                      |
| Heat Stress WBGT Meter No.   | : R13                      | Verification Date   | : 03 March 2022      |
| Brand  | : 3M                       | Ambient Temp.       | : 24.5 °C            |
| Model  | : QUESTemp <sup>o</sup> 46 | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : TSIO10011                | 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   | 47.0                       | 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  |                            |                     |                      |





# 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



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp° 46  
SERIAL NO. : TSH120011  
CLID. NO. : 232000795  
JOB CONTROL NO. : 220505044292

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

DATE OF RECEIVED : 05 May 2022

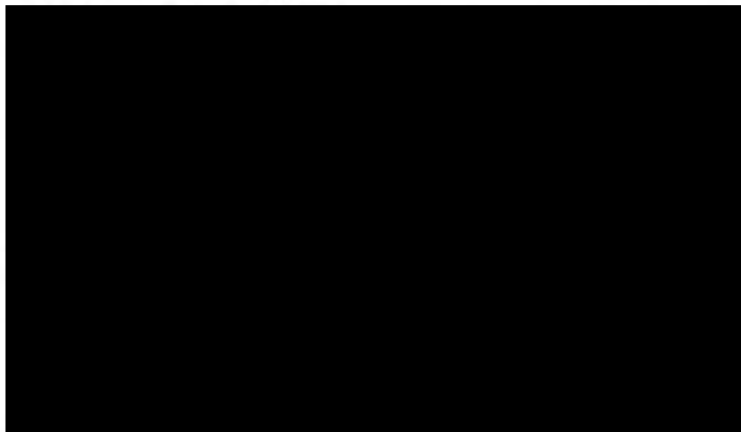
DATE OF ISSUED : 12 May 2022

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

Calibrated By :

Oranut Kamchatphai

Approved By :



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. Q22044292

F3-011-04/01-12

page 1 of 3



@clccalibration



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSH120011

DATE OF CALIBRATION : 05 May 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. 36151.  
Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.  
Certificate No. 19317, Due Date 09 July 2022.

#### 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. **Q22044292**

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

page 2 of 3



## 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                  | 29.99                         | 31.4                   | -1.41                 | 0.40                     |
| 35.0                  | 35.01                         | 36.4                   | -1.39                 |                          |
| 40.0                  | 39.99                         | 41.4                   | -1.41                 |                          |

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                  | 29.99                         | 30.0                   | -0.01                 | 0.40                     |
| 35.0                  | 35.01                         | 35.1                   | -0.09                 |                          |
| 40.0                  | 39.99                         | 40.2                   | -0.21                 |                          |

#### 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                  | 29.99                         | 29.9                   | +0.09                 | 0.40                     |
| 35.0                  | 35.01                         | 34.8                   | +0.21                 |                          |
| 40.0                  | 39.99                         | 39.6                   | +0.39                 |                          |

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. Q22044292

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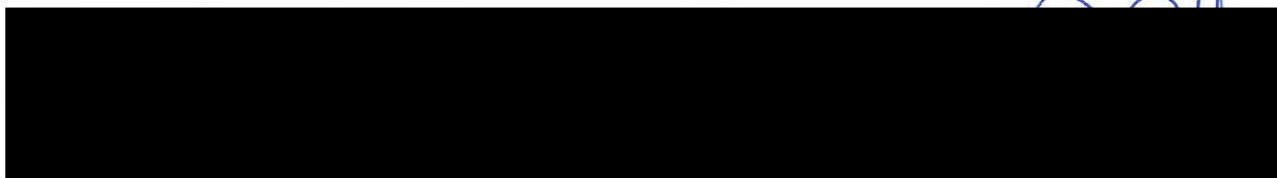




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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Heat B002\_4/22

| Heat Stress WBGT Meter Verification Report                             |                            |                     |                      |
|--|----------------------------|---------------------|----------------------|
| Verification Data  |                            |                     |                      |
| Heat Stress WBGT Meter No.   | : R14                      | Verification Date   | : 03 March 2022      |
| Brand  | : 3M                       | Ambient Temp.       | : 24.5 °C            |
| Model  | : QUESTemp <sup>o</sup> 46 | Barometric Pressure | : 1011 mmbar         |
| Serial No.   | : TSH120011                | 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   | 47.0                       | 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  |                            |                     |                      |



คุณภาพอากาศในสถานประกอบการ





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     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,497 | 1,998 | 1.001x - 3.749               | 1.000          |
| B02                | SKC   | 224-PCXR4 | 626166     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,505 | 2,001 | 1.010x - 20.465              | 0.999          |
| B03                | SKC   | 224-PCXR4 | 612968     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,494 | 2,000 | 1.006x - 12.986              | 1.000          |
| B04                | SKC   | 224-PCXR4 | 602804     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,502 | 1,996 | 1.001x - 2.928               | 1.000          |
| B05                | SKC   | 224-PCXR4 | 612693     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,499 | 2,003 | 1.012x - 23.061              | 0.999          |
| B06                | SKC   | 224-PCXR4 | 262188     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,508 | 1,999 | 1.012x - 25.219              | 0.999          |
| B07                | SKC   | 224-PCXR4 | 626262     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,492 | 1,995 | 0.992x + 6.804               | 1.000          |
| B08                | SKC   | 224-PCXR4 | 626100     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,499 | 2,003 | 1.012x - 22.750              | 0.999          |
| B09                | SKC   | 224-PCXR4 | 626479     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,490 | 1,994 | 0.994x + 3.231               | 1.000          |
| B10                | SKC   | 224-PCXR4 | 091950     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,503 | 2,001 | 1.016x - 32.594              | 0.999          |
| B11                | SKC   | 224-PCXR8 | 564315     | 06/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,490 | 1,998 | 1.003x - 9.054               | 1.000          |
| B12                | SKC   | 224-PCXR4 | 034656     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,503 | 2,003 | 1.011x - 19.603              | 0.999          |
| B13                | SKC   | 224-PCXR4 | 602073     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,500 | 1,999 | 1.001x - 4.072               | 1.000          |
| B14                | SKC   | 224-PCXR4 | 626313     | 05/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,491 | 1,988 | 0.992x + 5.727               | 1.000          |
| B15                | SKC   | 224-PCXR4 | 626474     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,502 | 2,005 | 1.012x - 22.726              | 0.999          |
| B16                | SKC   | 224-PCXR4 | 626477     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,504 | 2,000 | 1.014x - 30.627              | 0.999          |
| B17                | SKC   | 224-PCXR4 | 626860     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,495 | 1,991 | 0.997x + 0.479               | 1.000          |
| B18                | SKC   | 224-PCXR4 | 691484     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,501 | 2,001 | 1.010x - 19.424              | 0.999          |
| B19                | SKC   | 224-PCXR4 | 691599     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,503 | 1,999 | 1.005x - 8.224               | 1.000          |
| B20                | SKC   | 224-PCXR4 | 691587     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,504 | 1,999 | 1.014x - 30.520              | 0.999          |
| B21                | SKC   | 224-PCXR4 | 691531     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,499 | 1,992 | 1.000x - 4.714               | 1.000          |
| B22                | SKC   | 224-PCXR4 | 691654     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,004           | 1,501 | 2,004 | 1.012x - 20.788              | 0.999          |
| B23                | SKC   | 224-PCXR4 | 798393     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,505 | 2,002 | 1.017x - 33.567              | 0.999          |
| B24                | SKC   | 224-PCXR4 | 626363     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,502 | 2,005 | 1.016x - 28.210              | 0.999          |
| B25                | SKC   | 224-PCXR4 | 798489     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,512 | 2,001 | 0.998x + 5.009               | 1.000          |
| B26                | SKC   | 224-PCXR4 | 798479     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,499 | 1,993 | 0.997x + 1.855               | 1.000          |
| B27                | SKC   | 224-PCXR4 | 691673     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,503 | 2,001 | 1.017x - 33.826              | 0.999          |
| B28                | SKC   | 224-PCXR4 | 691570     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,002 | 1.013x - 24.230              | 0.999          |
| B29                | SKC   | 224-PCXR4 | 626472     | 06/04/2022       | 1,000              | 1,500 | 2,000 | 999             | 1,494 | 1,998 | 1.002x - 6.378               | 1.000          |
| B30                | SKC   | 224-PCXR4 | 691489     | 06/04/2022       | 1,000              | 1,500 | 2,000 | 1,004           | 1,500 | 2,004 | 1.012x - 22.431              | 0.999          |
| B31                | SKC   | 224-PCXR4 | 691509     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,495 | 1,995 | 1.002x - 7.965               | 1.000          |
| B32                | SKC   | 224-PCXR4 | 091567     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,504 | 2,001 | 1.015x - 30.208              | 0.999          |
| B33                | SKC   | 224-PCXR4 | 091756     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,496 | 1,991 | 0.996x + 0.475               | 1.000          |
| B34                | SKC   | 224-PCXR4 | 612962     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,002 | 1.011x - 21.135              | 0.999          |
| B35                | SKC   | 224-PCXR4 | 602682     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,498 | 1,996 | 1.001x - 6.493               | 1.000          |
| B36                | SKC   | 224-PCXR4 | 626164     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,497 | 1,999 | 0.999x - 2.393               | 1.000          |
| B37                | SKC   | 224-PCXR4 | 626256     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,506 | 2,002 | 1.016x - 31.285              | 0.999          |
| B38                | SKC   | 224-PCXR4 | 626167     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,497 | 1,996 | 1.001x - 4.387               | 1.000          |
| B39                | SKC   | 224-PCXR4 | 034637     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,500 | 2,002 | 1.012x - 22.527              | 0.999          |
| B40                | SKC   | 224-PCXR4 | 798349     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,505 | 2,000 | 1.017x - 34.109              | 0.999          |





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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     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,496 | 1,989 | 0.994x + 3.829               | 1.000          |
| B42                | SKC   | 224-PCXR4 | 626041     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,498 | 1,993 | 0.990x + 12.348              | 1.000          |
| B43                | SKC   | 224-PCXR4 | 034636     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,501 | 1,992 | 0.990x + 12.839              | 1.000          |
| B44                | SKC   | 224-PCXR8 | 529341     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,002 | 1.011x - 21.577              | 0.999          |
| B45                | SKC   | 224-PCXR8 | 529594     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,498 | 1,992 | 0.995x + 2.928               | 1.000          |
| B46                | SKC   | 224-PCXR8 | 566743     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,504 | 2,002 | 1.016x - 33.204              | 0.999          |
| B47                | SKC   | 224-PCXR8 | 566747     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,004 | 1.013x - 24.202              | 0.999          |
| B48                | SKC   | 224-PCXR8 | 566753     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 999             | 1,494 | 1,997 | 0.999x + 1.795               | 1.000          |
| B49                | SKC   | 224-PCXR8 | 566780     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,502 | 2,003 | 1.011x - 21.031              | 0.999          |
| B50                | SKC   | 224-PCXR8 | 500400     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,495 | 2,002 | 1.001x + 2.900               | 1.000          |
| B51                | SKC   | 224-PCXR8 | 500363     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,504 | 2,000 | 1.012x - 26.268              | 0.999          |
| B52                | SKC   | 224-PCXR8 | 093186     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,498 | 1,994 | 0.997x - 1.240               | 1.000          |
| B53                | SKC   | 224-PCXR8 | 707670     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,499 | 2,004 | 1.012x - 22.742              | 0.999          |
| B54                | SKC   | 224-PCXR3 | 509821     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,501 | 2,001 | 1.016x - 33.718              | 0.999          |
| B55                | SKC   | 224-PCXR3 | 510710     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,494 | 1,994 | 0.994x + 4.635               | 1.000          |
| B56                | SKC   | 224-PCXR3 | 511450     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,001 | 1.011x - 20.684              | 0.999          |
| B57                | SKC   | 224-PCXR3 | 510798     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,493 | 1,998 | 1.001x + 3.398               | 1.000          |
| B58                | SKC   | 224-PCXR3 | 509852     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 2,000 | 1.007x - 19.631              | 0.999          |
| B59                | SKC   | 224-PCXR3 | 509862     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,503 | 1,995 | 0.998x + 2.916               | 1.000          |
| B60                | SKC   | 224-PCXR3 | 512655     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,004 | 1.013x - 23.891              | 0.999          |
| B61                | SKC   | 224-PCXR3 | 503915     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,489 | 1,999 | 1.004x - 11.786              | 1.000          |
| B62                | SKC   | 224-PCXR3 | 505975     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 999             | 1,494 | 1,995 | 0.997x - 0.503               | 1.000          |
| B63                | SKC   | 224-PCXR3 | 511432     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 991             | 1,501 | 2,000 | 1.017x - 36.139              | 0.999          |
| B64                | SKC   | 224-PCXR3 | 508302     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,493 | 1,990 | 0.994x + 3.992               | 1.000          |
| B65                | SKC   | 224-PCXR3 | 508310     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,500 | 2,003 | 1.012x - 23.109              | 0.999          |
| B66                | SKC   | 224-PCXR3 | 509861     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,491 | 1,991 | 0.987x + 14.701              | 1.000          |
| B67                | SKC   | 224-PCXR3 | 506295     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,507 | 2,004 | 1.017x - 33.104              | 0.999          |
| B68                | SKC   | 224-PCXR3 | 505872     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,491 | 1,997 | 0.994x + 5.556               | 1.000          |
| B69                | SKC   | 224-PCXR3 | 508375     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,500 | 2,000 | 1.010x - 21.689              | 0.999          |
| B70                | SKC   | 224-PCXR3 | 510623     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,503 | 1,997 | 1.002x - 6.693               | 1.000          |
| B71                | SKC   | 224-PCXR3 | 508367     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 991             | 1,506 | 2,002 | 1.018x - 36.227              | 0.999          |
| B72                | SKC   | 224-PCXR3 | 505977     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,498 | 1,993 | 0.992x + 7.087               | 1.000          |
| B73                | SKC   | 224-PCXR3 | 512606     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,001           | 1,501 | 2,005 | 1.014x - 24.517              | 0.999          |
| B74                | SKC   | 224-PCXR3 | 505993     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,495 | 1,994 | 0.999x - 4.363               | 1.000          |
| B75                | SKC   | 224-PCXR3 | 509820     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,499 | 1,992 | 0.995x + 2.429               | 1.000          |
| B76                | SKC   | 224-PCXR3 | 509811     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,498 | 1,998 | 1.007x - 15.040              | 1.000          |
| B77                | SKC   | 224-PCXR3 | 508301     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,501 | 2,003 | 1.014x - 26.643              | 0.999          |
| B78                | SKC   | 224-PCXR3 | 510677     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 996             | 1,503 | 1,999 | 1.012x - 27.520              | 0.999          |
| B79                | SKC   | 224-PCXR3 | 510920     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,493 | 1,994 | 0.999x - 3.705               | 1.000          |





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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     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,499 | 2,001 | 1.010x – 20.517              | 0.999          |
| B81                | SKC   | 224-PCXR3 | 503480     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 994             | 1,499 | 2,000 | 1.015x – 31.561              | 0.999          |
| B82                | SKC   | 224-PCXR3 | 505673     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,499 | 1,996 | 1.002x – 7.299               | 1.000          |
| B83                | SKC   | 224-PCXR3 | 510785     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,500 | 2,002 | 1.012x – 23.787              | 0.999          |
| B84                | SKC   | 224-PCXR3 | 508333     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,497 | 1,991 | 0.997x – 0.383               | 1.000          |
| B85                | SKC   | 224-PCXR3 | 505757     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 993             | 1,502 | 1,999 | 1.014x – 30.476              | 0.999          |
| B86                | SKC   | 224-PCXR3 | 512625     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,502 | 2,004 | 1.012x – 22.463              | 0.999          |
| B87                | SKC   | 224-PCXR3 | 504324     | 11/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,496 | 2,000 | 1.001x – 2.305               | 1.000          |
| B88                | SKC   | 224-PCXR3 | 508307     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 997             | 1,498 | 1,993 | 0.996x + 1.212               | 1.000          |
| B89                | SKC   | 224-PCXR3 | 509860     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,501 | 2,003 | 1.014x – 25.646              | 0.999          |
| B90                | SKC   | 224-PCXR3 | 508366     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,502 | 2,001 | 1.017x – 33.850              | 0.999          |
| B91                | SKC   | 224-PCXR3 | 510919     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 998             | 1,498 | 1,996 | 1.000x – 3.765               | 1.000          |
| B92                | SKC   | 224-PCXR3 | 510987     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,003           | 1,501 | 2,004 | 1.012x – 21.916              | 0.999          |
| B93                | SKC   | 224-PCXR3 | 509845     | 12/04/2022       | 1,000              | 1,500 | 2,000 | 1,000           | 1,498 | 1,998 | 1.000x – 2.261               | 1.000          |



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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  $^{\circ}\text{C}$   
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                            | R²    |
| R40                | SKC   | 224-PCXR4 | 612753     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,003 | 1.012x – 23.005              | 0.999 |
| R41                | SKC   | 224-PCXR4 | 626140     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 991             | 1,509 | 2,002 | 1.018x – 35.114              | 0.999 |
| R42                | SKC   | 224-PCXR4 | 626463     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 995             | 1,493 | 2,000 | 1.003x – 7.470               | 1.000 |
| R43                | SKC   | 224-PCXR4 | 626129     | 04/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,501 | 2,003 | 1.012x – 22.495              | 0.999 |
| R44                | SKC   | 224-PCXR4 | 602753     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 1,002           | 1,495 | 1,994 | 0.996x + 1.133               | 1.000 |
| R45                | SKC   | 224-PCXR4 | 626137     | 01/04/2022       | 1,000              | 1,500 | 2,000 | 992             | 1,505 | 2,002 | 1.019x – 37.368              | 0.999 |





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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-R01          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 503.1           | 992.4 | 1979.1 | 0.999x + 3.360               | 0.999          |
| H-R02          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 500.8           | 995.3 | 1986.1 | 1.002x + 5.536               | 1.000          |
| H-R03          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 502.1           | 987.7 | 1997.3 | 0.994x + 1.910               | 1.000          |
| H-R04          | Dwyer | VFB-65 | 04/04/2022       | 500                 | 1,000 | 2,000 | 496.4           | 989.6 | 2019.5 | 1.009x - 13.763              | 1.000          |
| H-R05          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 496.8           | 987.7 | 1987.7 | 1.004x - 9.632               | 1.000          |
| H-R06          | Dwyer | VFB-65 | 01/04/2022       | 500                 | 1,000 | 2,000 | 505.2           | 992.4 | 1979.4 | 0.999x + 2.749               | 0.999          |



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

Rotameter Calibration Report (For Personal Pump Low 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> |
| L-R01          | Dwyer | VFA-21 | 04/04/2022       | 50                  | 100 | 200 | 50.2            | 100.6 | 203.5 | 0.983x + 2.458               | 1.000          |
| L-R02          | Dwyer | VFA-21 | 01/04/2022       | 50                  | 100 | 200 | 49.7            | 100.9 | 200.5 | 1.008x - 1.306               | 0.999          |
| L-R03          | Dwyer | VFA-21 | 04/04/2022       | 50                  | 100 | 200 | 50.1            | 99.8  | 202.3 | 1.018x - 1.156               | 1.000          |
| L-R04          | Dwyer | VFA-21 | 04/04/2022       | 50                  | 100 | 200 | 49.8            | 100.9 | 200.6 | 1.009x - 1.349               | 0.999          |
| L-R05          | Dwyer | VFA-21 | 01/04/2022       | 50                  | 100 | 200 | 49.8            | 100.4 | 203.4 | 0.992x + 1.525               | 1.000          |
| L-R06          | Dwyer | VFA-21 | 01/04/2022       | 50                  | 100 | 200 | 50.2            | 99.1  | 201.9 | 1.003x - 0.172               | 1.000          |





CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

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 : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY :

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22





CERTIFICATE No : 22M2567

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU  
MANUFACTURER : METTLER TOLEDO S/N : 1126422905  
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22  
AIR PRESSURE : 1008mbar  $\pm$  1mbar CALIBRATION DATE : 11-Mar-22  
AMBIENT TEMPERATURE : 22° 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  | C02210415      | 09-Feb-23 |

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

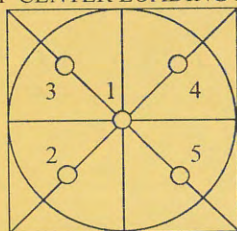
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY ( $\pm$ g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00              | 0.00000             | 0.00000        | 0.000058               |
| 0.02              | 0.01999             | 0.00001        | 0.000058               |
| 0.10              | 0.09999             | 0.00001        | 0.000059               |
| 0.20              | 0.19999             | 0.00001        | 0.000059               |
| 0.50              | 0.50001             | -0.00001       | 0.000058               |
| 1.00              | 1.00001             | -0.00001       | 0.000059               |
| 2.00              | 2.00000             | 0.00000        | 0.000059               |
| 5.00              | 5.00001             | -0.00001       | 0.000061               |
| 10.00             | 10.00005            | -0.00005       | 0.000063               |
| 20.00             | 20.00006            | -0.00006       | 0.000069               |
| 50.00             | 50.0000             | 0.0000         | 0.00011                |
| 100.00            | 100.0001            | -0.0001        | 0.00019                |
| 120.00            | 120.0001            | -0.0001        | 0.00022                |

6. OFF CENTER LOADING ERROR



| POINT              | READING (g) |         |
|--------------------|-------------|---------|
| 1                  | 10.00001    | 50.0000 |
| 2                  | 10.00002    | 50.0000 |
| 3                  | 10.00001    | 50.0000 |
| 4                  | 10.00001    | 50.0000 |
| 5                  | 10.00002    | 50.0001 |
| OFF-CENTER LOADING | 0.00001     | 0.0001  |

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





## Certificate of Calibration

### Aquion : Anion (ID#894)

This certificate is to verify that instrument below are calibrated  
by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

S.P.S. Consulting Service Co., Ltd.

Operator S [Redacted] : Jan 5, 2022

Test Engineer



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

|   |   |  |
|---|---|--|
| <b>Customer :</b> <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>January 12, 2022</u>          |  |
|   | Recommendation Recertification                |  |
| <b>Address :</b> <u>7 Soi Phaholyothin 24</u>             | Period <u>6</u> Months                        |  |
| <u>Paholyothin Road</u>                                   | Recertification Due: <u>July 12, 2022</u>     |  |
| <u>Jompol Chatuchak, Bangkok 1090</u>                     | Date Last Certified: <u>July 14, 2021</u>     |  |
| <b>User Name:</b> <u>K.Phenpha Viphasathawat</u>          | Visit Number: <u>2 of 2</u>                   |  |
| <b>Phone:</b> <u>083-9269252</u>                          | PerkinElmer Phone: <u>02-719-6420 ext 206</u> |  |
| <b>Fax:</b> <u>02-513-4221</u>                            | PerkinElmer Fax: <u>02-318-5597</u>           |  |

| CONFIGURATION TESTED         |                           | ACCESSORIES/COMPONENT<br>NOT INCLUDED |
|------------------------------|---------------------------|---------------------------------------|
| <b>MODEL</b>                 | <b>SERIAL NUMBER</b>      |                                       |
| <u>OPTIMA 5300DV</u>         | <u>077C7042401</u>        |                                       |
| <b>TESTED EQUIPMENT</b>      | <b>CALIBRATION NUMBER</b> | <b>EXPIRATION</b>                     |
| <u>IPV Methods</u>           |                           |                                       |
| <b>TEST STANDARD USED</b>    | <b>PART NUMBER</b>        | <b>EXPIRATION DATE</b>                |
| <u>Multielement Standard</u> | <u>N069-1579</u>          | <u>August 30, 2022</u>                |
| <u>Wavecal Solution</u>      | <u>N058-2152</u>          | <u>January 30, 2022</u>               |
| <u>VIS Wavecal solution</u>  | <u>N930-2946</u>          | <u>June 30, 2022</u>                  |
| <u>Instrument Cal. STD4</u>  | <u>N930-0221</u>          | <u>August 30, 2022</u>                |
| <b>CUSTOMER SUPPLIED</b>     | <b>COMMENTS</b>           | <b>CUSTOMER INITIALS</b>              |
| <u>2 % HNO3</u>              |                           |                                       |
| <u>10 % HNO3</u>             |                           |                                       |





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER**    077C7042401
**DATE TESTED**    January 12, 2022
**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

B. Inspect and replace as necessary, all torch components including the RF coil.

☐ OK

C. Inspect all tubing for sign of clacking or leaking.

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK

**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK

**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A

**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : January 12, 2022

| PARAMETER                        | SPECIFICATION |            |             | FINAL VALUE |     |
|----------------------------------|---------------|------------|-------------|-------------|-----|
| Spectral Resolution : UV         | As            | 193.696 nm | ≤ 0.007     | 0.00554     |     |
|                                  | Ni            | 231.604 nm | ≤ 0.008     | 0.00725     |     |
|                                  | Ni            | 341.476 nm | ≤ 0.012     | 0.00752     |     |
| Spectral Resolution : VIS        | La            | 408.672 nm | ≤ 0.020     | 0.01616     |     |
|                                  | Ba            | 455.403 nm | ≤ 0.025     | 0.02416     |     |
| Precision                        |               |            |             |             |     |
|                                  | As            | 193.656 nm | % RSD < 1.0 | 0.34        | %   |
|                                  | Zn            | 213.856 nm | % RSD < 1.0 | 0.27        | %   |
|                                  | Mn            | 257.610 nm | % RSD < 1.0 | 0.41        | %   |
|                                  | La            | 379.478 nm | % RSD < 1.0 | 0.57        | %   |
|                                  | Ba            | 455.403 nm | % RSD < 1.0 | 0.33        | %   |
|                                  | Ba            | 493.408 nm | % RSD < 1.0 | 0.26        | %   |
| Detection Limits : Axial         | Tl            | 190.080 nm | 3(sd)       | 5.51        | ppb |
|                                  | As            | 193.696 nm | 3(sd)       | 8.59        | ppb |
|                                  | Pb            | 220.353 nm | 3(sd)       | 0.50        | ppb |
| Detection Limits : Radial        | As            | 193.696 nm | 3(sd)       | 21.00       | ppb |
|                                  | Zn            | 213.856 nm | 3(sd)       | 0.32        | ppb |
|                                  | Mn            | 257.610 nm | 3(sd)       | 0.18        | ppb |
|                                  | La            | 379.478 nm | 3(sd)       | 0.44        | ppb |
|                                  | Ba            | 455.403 nm | 3(sd)       | 0.17        | ppb |
|                                  | Ba            | 493.408 nm | 3(sd)       | 0.12        | ppb |
| BEC : Axial (IB X 500)/(IS-IB)   | Cd            | 226.502 nm | ≤ 150 ppb   | 12.46       |     |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn            | 257.610 nm | ≤ 45 ppb    | 30.82       |     |





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER** 077C7042401**DATE TESTED** January 12, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,  
including warranty terms.

**Service Department PerkinElmer Ltd.**

**Authorized Representative**

ระดับเสียงในสถานประกอบการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0841

MTC No. EEL. BP. 46/0964

## 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 : Acoustic Calibrator

Manufacturer : SVANTEK

Model : SV34

Serial No. : 33139

### 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 Panasonic VP-7722A S/N 041477D122.  
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be 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 : 14 Sep. 2021

Date of Calibration : 17 Sep. 2021

1 / 2  
W

The results relate only to the items tested or calibrated.

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.3

#### Head Office

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0841

MTC No. EEL. BP. 46/0964

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 = 114 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 2 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 113.67                                | -0.33                  | $\pm 0.10$          | $\pm 0.75$ dB                            |

2. Frequency

| Standard Microphone<br>Type | Measured Frequency<br>(Hz) | Deviated value<br>(Hz) | Uncertainty<br>(Hz) | Tolerance limit<br>IEC60942:2003 Class 2 |
|-----------------------------|----------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 1000.0                     | 0.0                    | $\pm 1.5$           | $\pm 2.0\%$                              |

3. Total Distortion

| Standard Microphone<br>Type | Measured Total Distortion<br>(%) | Uncertainty<br>(%) | Tolerance limit<br>IEC60942:2003 Class 2 |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 0.24                             | $\pm 0.50$         | $\pm 4.0\%$                              |

- Note : 1. No adjustment.  
2. The calibrator pressure correction was not included.  
3. The microphone volume correction was not included.

Calibrated

Date of Calibration : 17 Sep. 2021

Date of Issue : 20 Sep. 2021

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264091403811002

End of Certificate

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The results relate only to the items tested or calibrated.

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FM.BL.MTC.002 Rev.3

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

Noise Dose R\_213/22

## Noise Dose Meter Calibration Report

### Acoustic Calibrator Data

|                   |                 |                  |                   |
|-------------------|-----------------|------------------|-------------------|
| Brand             | SVANTEK         | Number           | SV 06/62          |
| Model             | SV34            | Serial No.       | 33139             |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 17 September 2021 |
|                   |                 | Due Date         | 17 September 2022 |

### Calibration Data

| Sound Level Meter Data   |         |          |            | Calibration Data |                     |                  |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand   | Model    | Serial No. | Date             | Actual Reading [dB] |                  |
|  |         |          |            |                  | Before Adjustment   | After Adjustment |
| NMD-B02  | SVANTEK | SV-104IS | 80842      | 27 April 2022    | 113.5               | 113.6            |
| NMD-B03  | SVANTEK | SV-104IS | 80852      | 27 April 2022    | 113.6               | 113.6            |
| NMD-B04  | SVANTEK | SV-104IS | 80854      | 27 April 2022    | 113.6               | 113.6            |
| NMD-B05  | SVANTEK | SV-104IS | 80856      | 27 April 2022    | 113.5               | 113.6            |
| NMD-B13  | SVANTEK | SV-104IS | 80834      | 27 April 2022    | 113.6               | 113.6            |
| NMD-B14  | SVANTEK | SV-104IS | 80875      | 27 April 2022    | 113.6               | 113.6            |
| NMD-B18  | SVANTEK | SV-104IS | 106123     | 27 April 2022    | 113.5               | 113.6            |
| NMD-B19  | SVANTEK | SV-104IS | 106124     | 27 April 2022    | 113.6               | 113.6            |
| NMD-B20  | SVANTEK | SV-104IS | 106131     | 27 April 2022    | 113.6               | 113.6            |
| NMD-R10  | SVANTEK | SV-104IS | 60150      | 27 April 2022    | 113.6               | 113.6            |
| NMD-R21  | SVANTEK | SV-104IS | 80800      | 27 April 2022    | 113.5               | 113.6            |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |         |          |            |                  | 113.67± 0.75 dB     |                  |



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Noise Dose R\_259/22

## Noise Dose Meter Calibration Report

### Acoustic Calibrator Data

|                   |                 |                  |                   |
|-------------------|-----------------|------------------|-------------------|
| Brand             | SVANTEK         | Number           | SV 06/62          |
| Model             | SV34            | Serial No.       | 33139             |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 17 September 2021 |
|                   |                 | Due Date         | 17 September 2022 |

### Calibration Data

| Sound Level Meter Data   |         |          |            | Calibration Data |                     |                  |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand   | Model    | Serial No. | Date             | Actual Reading [dB] |                  |
|  |         |          |            |                  | Before Adjustment   | After Adjustment |
| NMD-B04  | SVANTEK | SV-104IS | 80854      | 22 May 2022      | 113.6               | 113.6            |
| NMD-B05  | SVANTEK | SV-104IS | 80856      | 22 May 2022      | 113.5               | 113.6            |
| NMD-B06  | SVANTEK | SV-104IS | 80816      | 22 May 2022      | 113.6               | 113.6            |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |         |          |            |                  | 113.67 ± 0.75 dB    |                  |





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Noise Dose R\_352/22

## Noise Dose Meter Calibration Report

### Acoustic Calibrator Data

|                   |                 |                  |                   |
|-------------------|-----------------|------------------|-------------------|
| Brand             | SVANTEK         | Number           | SV 06/62          |
| Model             | SV34            | Serial No.       | 33139             |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 17 September 2021 |
|                   |                 | Due Date         | 17 September 2022 |

### Calibration Data

| Sound Level Meter Data   |         |          |            | Calibration Data |                     |                  |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand   | Model    | Serial No. | Date             | Actual Reading [dB] |                  |
|  |         |          |            |                  | Before Adjustment   | After Adjustment |
| NMD-R06  | SVANTEK | SV-104IS | 60146      | 28 June 2022     | 113.5               | 113.6            |
| NMD-R13  | SVANTEK | SV-104IS | 63438      | 28 June 2022     | 113.5               | 113.6            |
| NMD-R20  | SVANTEK | SV-104IS | 70035      | 28 June 2022     | 113.6               | 113.6            |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |         |          |            |                  | 113.67+ 0.10 dB     |                  |



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Noise Dose R\_339/22

## Noise Dose Meter Calibration Report

### Acoustic Calibrator Data

|                   |                 |                  |                   |
|-------------------|-----------------|------------------|-------------------|
| Brand             | SVANTEK         | Number           | SV 06/62          |
| Model             | SV34            | Serial No.       | 33139             |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 17 September 2021 |
|                   |                 | Due Date         | 17 September 2022 |

### Calibration Data

| Sound Level Meter Data   |         |          |            | Calibration Data |                     |                  |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No.  | Brand   | Model    | Serial No. | Date             | Actual Reading [dB] |                  |
|  |         |          |            |                  | Before Adjustment   | After Adjustment |
| NMD-R26  | SVANTEK | SV-104IS | 80836      | 23 June 2022     | 113.5               | 113.6            |
| NMD-R27  | SVANTEK | SV-104IS | 80837      | 23 June 2022     | 113.6               | 113.6            |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) |         |          |            |                  | 113.67± 0.10 dB     |                  |