

ภาคผนวกที่ 4

เอกสารการสอบเทียบความถูกต้องของเครื่องมือ



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

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3095

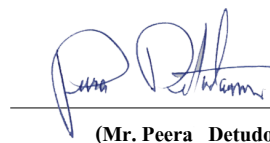
Calibration Data

| High Volume Air Sampler Data | | Calibration Data | | |
|------------------------------|------------|------------------|--|----------------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft ³ /min) | R ² |
| 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 |

Calibrated by :

Phakhinai Khongkomnerd
(Mr. Phakhinai Khongkomnerd)

Approved by :


(Mr. Peera Detudom)



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| CALIBRATION REPORT | | | | | |
|--|--------------------------------------|-------------------|--------------------------------|--------------------------------|------------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 17 April 2022 | BRAND : | API | MODEL : | 100E |
| NO. | SO ₂ -R02 | | | SERIAL NO. | 3431 |
| Calibrator (Dilution System) | | | | | |
| Brand | : API | | | Model | : 700 |
| Last Cal. Date | : 05 August 2021 | | | Serial No. | : 911 |
| Reference Standard Gas | | | | | |
| Standard Gas | : Sulphur Dioxide (SO ₂) | | | 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 | 0.11 | - | 0 | - |
| SO ₂ Span | 400.0 | 399.8 | -0.050 | 400.0 | 1.008 |
| API Model 100E SO ₂ 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 | 674 | 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 ₂ Span Conc | 400 | PPB | 20-20,000 | | |
| SO ₂ Slope | 1.008 | - | 1.0 ± 0.3 | | |
| SO ₂ 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) | | |

Calibrated by : Phakhinai Khongkomnerd
(Mr.Phakhinai Khongkomnerd)

Approved by : Peera Detudom
(Mr.Peera Detudom)



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CALIBRATION REPORT

SO₂ FLUORESCENT ANALYZER

DATE : 17 April 2022

BRAND : API

MODEL : 100E

NO. SO₂-R04

SERIAL NO. 3489

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 05 August 2021

Serial No. : 911

Reference Standard Gas

Standard Gas : Sulphur Dioxide (SO₂)

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 | 0.11 | - | 0 | - |
| SO ₂ Span | 400.0 | 399.7 | -0.075 | 400.0 | 1.005 |

API Model 100E SO₂ 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 | 3022.1 | mV | 1000-4900 |
| STR. LGT | 61.5 | PPB | <100 |
| DRK PMT | 63.1 | mV | -50 - 200 |
| DRK LMP | 57.9 | 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 ₂ Span Conc | 400 | PPB | 20-20,000 |
| SO ₂ Slope | 1.005 | - | 1.0 ± 0.3 |
| SO ₂ 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) |

Calibrated by : Phakhinai Khongkomnerd
(Mr.Phakhinai Khongkomnerd)

Approved by : Peera Detudom
(Mr.Peera Detudom)



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CALIBRATION REPORT

SO₂ FLUORESCENT ANALYZER

DATE : 17 April 2022

BRAND : TELEDYNE

MODEL : TML-60

NO. SO₂-R07

SERIAL NO. TRS1068

Calibrator (Dilution System)

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

Reference Standard Gas

| | | | |
|----------------|--------------------------------------|----------------|----------------|
| Standard Gas | : Sulphur Dioxide (SO ₂) | 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

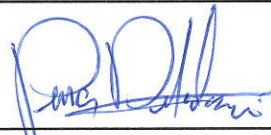
CALIBRATION SETTING

| 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 ₂ Span | 400.0 | 400.3 | 0.075 | 400.0 | 1.012 |

API Model TML-60 SO₂ 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 | 669 | 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 ₂ Span Conc | 400 | PPB | 20-20,000 |
| SO ₂ Slope | 1.012 | - | 1.0 ± 0.3 |
| SO ₂ 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) |

Calibrated by : Phakhinai Khongkomnerd
(Mr.Phakhinai Khongkomnerd)

Approved by : 
(Mr.Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 17 April 2022

BRAND : API

MODEL : 200E

NO. NOX-B16

SERIAL NO. 249

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 | |
|----------------------|-----------------------------------|-------------------|--------|--------------------------------|-------|
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | 0.11 | - | 0 | - |
| NO Span | 400 | 399.8 | -0.050 | 400.0 | 1.005 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.010 |

API Model 200E NO_x Analyzer Check List

| Test Values | Observed Value | Units | Nominal Range |
|---------------------------|----------------|---------|----------------------------|
| RANGE | 500 | PPB | 500 standard |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air |
| SAMPLE FLOW | 505 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.0 | mV | -20 - 150 |
| AZERO | 93.8 | mV | -20 - 150 |
| HVPS | 669 | V | 420 - 900 constant |
| RCELL TEMP | 50.2 | °C | 50 ± 1 |
| BOX TEMP | 29.5 | °C | 8 - 48 |
| PMT TEMP | 7.3 | °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 _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.005 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.010 | - | 1.0 ± 0.3 |
| NO Offset | 1.2 | mV | -20 to +150 |
| NO _x Offset | 0.8 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

Phakhinai Khongkomnerd
(Mr.Phakhinai Khongkomnerd)

Approved by :

Peera Detudom
(Mr.Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 17 April 2022

BRAND : API

MODEL : 200E

NO. NOX-R03

SERIAL NO. 4410

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 | 400.2 | 0.050 | 400.0 | 1.009 |
| NO _x Span | 400 | 400.4 | 0.100 | 400.0 | 1.014 |

API Model 200E NO_x Analyzer Check List

| Test Values | Observed Value | Units | Nominal Range |
|---------------------------|----------------|---------|----------------------------|
| RANGE | 500 | PPB | 500 standard |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air |
| SAMPLE FLOW | 512 | cc/min | 500 ± 50 |
| OZONE FLOW | 79 | cc/min | 80 ± 15 |
| PMT | 103.3 | mV | -20 - 150 |
| AZERO | 94.1 | mV | -20 - 150 |
| HVPS | 671 | V | 420 - 900 constant |
| RCELL TEMP | 50.4 | °C | 50 ± 1 |
| BOX TEMP | 29.3 | °C | 8 - 48 |
| PMT TEMP | 7.1 | °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 _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.009 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.014 | - | 1.0 ± 0.3 |
| NO Offset | 1.7 | mV | -20 to +150 |
| NO _x Offset | 1.0 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

Phakhinai Khongkomnerd

(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom

(Mr. Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 17 April 2022

BRAND : API

MODEL : 200E

NO. NOX-R05

SERIAL NO. 4413

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 | 1.007 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.011 |

API Model 200E NO_x 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 | 510 | cc/min | 500 ± 50 |
| OZONE FLOW | 79 | cc/min | 80 ± 15 |
| PMT | 103.1 | mV | -20 - 150 |
| AZERO | 94.2 | mV | -20 - 150 |
| HVPS | 674 | V | 420 - 900 constant |
| RCELL TEMP | 50.3 | °C | 50 ± 1 |
| BOX TEMP | 29.4 | °C | 8 - 48 |
| PMT TEMP | 7.5 | °C | 7 ± 2 |
| MOLY TEMP | 315.2 | °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 _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.007 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.011 | - | 1.0 ± 0.3 |
| NO Offset | 1.5 | mV | -20 to +150 |
| NO _x Offset | 0.9 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by : Phakhinai Khongkomnerd
(Mr.Phakhinai Khongkomnerd)

Approved by : Peera Detudom
(Mr.Peera Detudom)

**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 : 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 : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



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

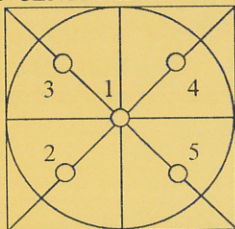
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

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



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 ₂ 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 ± 6.4 (mmH₂O)

Calibrated by :

Phakhinai Khongkomnerd

(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom

(Mr. Peera Detudom)



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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 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 ± 0.01

Calibrated by :

Phakhinai Khongkomnerd

(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom

(Mr. Peera Detudom)

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

| ID No. | Cert. No. | Due Date | Traceability |
|--------|------------|-------------|--|
| 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) |

Approved by :



(Surachai Promthong)

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 (in Hg) | UUC Reading (in Hg) | Correction (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 ± 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 -

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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 | 510920 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,493 | 1,994 | 0.999x – 3.705 | 1.000 |

Calibrated by :

Phakhinai Khongkomnerd
(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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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 |
| R01 | SKC | 224-PCXR4 | 602467 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,508 | 2,004 | 1.020x – 38.784 | 0.999 |
| R02 | SKC | 224-PCXR4 | 626450 | 04/04/2022 | 1,000 | 2,000 | 3,000 | 999 | 1,499 | 1,990 | 0.989x + 12.627 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,004 | 1.012x – 22.479 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,493 | 1,993 | 0.998x – 2.561 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 1,999 | 1.015x – 30.635 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,498 | 1,994 | 1.002x – 7.438 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,490 | 2,000 | 1.008x – 16.831 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,502 | 2,005 | 1.015x – 26.627 | 0.999 |
| R09 | SKC | 224-PCXR4 | 034650 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,504 | 2,002 | 1.018x – 36.538 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,512 | 1,993 | 1.000x + 0.219 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 12/04/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,499 | 2,002 | 1.012x – 23.923 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 12/04/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,501 | 1,999 | 1.001x – 4.986 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 1,993 | 0.991x + 10.793 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,502 | 1,998 | 1.013x – 29.256 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.013x – 24.345 | 0.999 |
| R16 | SKC | 224-PCXR8 | 529643 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,994 | 0.997x + 0.060 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,509 | 2,000 | 1.015x – 30.571 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,496 | 1,998 | 1.002x – 7.678 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,000 | 1.010x – 20.189 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 990 | 1,501 | 2,003 | 1.020x – 40.036 | 0.999 |
| R21 | SKC | 224-PCXR8 | 665728 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,493 | 1,999 | 1.000x – 5.364 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,001 | 1.011x – 21.215 | 0.999 |
| R23 | SKC | 224-PCXR8 | 761067 | 11/04/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,494 | 1,992 | 0.994x + 3.095 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,505 | 2,001 | 1.014x – 29.040 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,500 | 1,992 | 0.992x + 7.630 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 12/04/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.013x – 24.417 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 2,001 | 1.013x – 28.725 | 0.999 |
| R28 | SKC | 224-PCXR8 | 707481 | 11/04/2022 | 1,000 | 1,500 | 2,000 | 1,004 | 1,500 | 2,003 | 1.010x – 19.368 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,491 | 1,991 | 0.988x + 14.326 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,994 | 0.998x – 1.268 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,001 | 1.012x – 23.001 | 0.999 |
| R32 | SKC | 224-PCXR8 | 671950 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,994 | 0.994x + 7.762 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 12/04/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,502 | 1,999 | 1.016x – 34.141 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 2,004 | 1.012x – 24.294 | 0.999 |
| R35 | SKC | 224-PCXR8 | 707460 | 04/04/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,995 | 0.994x + 5.672 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,001 | 1.010x – 19.192 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,499 | 1,998 | 0.999x + 0.554 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 01/04/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,500 | 2,002 | 1.015x – 31.640 | 0.999 |
| R39 | SKC | 224-PCXR8 | 761095 | 12/04/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,496 | 1,994 | 0.997x + 2.652 | 1.000 |

Calibrated by :

Phakhinai Khongkomnerd
(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature . 25 \pm 3 °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 |

Calibrated by :

Phakhinai Khongkomnerd
(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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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 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 |

Calibrated by :

Phakhinai Khongkomnerd
(Mr. Phakhinai Khongkomnerd)

Approved by :

Peera Detudom
(Mr. Peera Detudom)

**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 : 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 : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



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 |

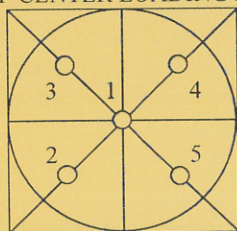
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL 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

Lambda UV Preventive Maintenance (PM)

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

| Part Number | Release | Publication Date |  |
|--------------------|----------------|-------------------------|---|
| 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 ₂ @ 340 nm | 2963 | -0.1296 | < 0.02 %T |
| NaNO ₂ @ 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>This Lambda UV Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</p> | |
| <p>Review of Preventive Maintenance:</p> | |
| <p>Authorized PerkinElmer Representative:</p> <p>Anon Leenthawonkit </p> | <p>Date:</p> <p>25-Jan-2022 (DD-MM-YYYY)</p> |
| <p>Authorized Customer Representative:</p> | <p>Date:</p> <p>25-Jan-2022 (DD-MM-YYYY)</p> |



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

| Calibration Report | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|------|
| Non-Dispersive Infrared CO Analyzer | | | | | |
| Date : | 01 April 2022 | Brand : | API | Model : | 300E |
| No. | CO-R01 | | | Serial No. | 704 |
| Calibrator (Dilution System) | | | | | |
| Brand : API | | | Model : 700 | | |
| Last Cal. Date : 20 September 2021 | | | Serial No. : 421 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | | Cylinder No. : D824478 | | |
| Certified Date : 15 April 2020 | | Expired Date : 14 April 2022 | | Cylinder Conc. : 4,740 ppm | |
| Calibrating Condition | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.6 | °C |
| | | | % RH | 49 | |
| Calibration Setting | | | | | |
| Span | Initial Reading (Before Adj.), PPM | | | Final Reading (After Adj.), PPM | |
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | |
| Zero | 0 | -0.10 | - | 0 | |
| CO Span | 40.00 | 40.13 | 0.325 | 40.00 | |
| API Model 300E CO Analyzer Check List | | | | | |
| Parameter | Observed Value | Units | Nominal Range | | |
| Range | 50 | PPM | 0-1000 ppm | | |
| Stability | 0.10 | PPM | < 1 ppm With Zero Air | | |
| CO Measure | 4013.6 | mV | 2500-4800 mV | | |
| CO Reference | 3948.5 | mV | 2500-4800 mV | | |
| Measure/Reference Ratio | 1.179 | - | 1.1-1.3 W/Zero Air | | |
| Sample Pressure | 28.4 | In-Hg-A | ~2" < Ambient Absolute Pressure | | |
| Sample Flow | 808 | CC/Min | 800 ± 10% | | |
| Sample Temperature | 48.2 | °C | 48 ± 4 | | |
| Bench Temperature | 48.0 | °C | 48 ± 2 | | |
| Wheel Temperature | 68.5 | °C | 68 ± 2 | | |
| Box Temperature | 30.6 | °C | Ambient Temp + 7 ± 10 | | |
| Photo-Drive | 3024.3 | mV | 250 mV to 4750 mV | | |
| Slope | 1.016 | - | 1.0 ± 0.3 | | |
| Offset | 0.2 | - | 0 ± 0.3 | | |

Phakhinai Khongkomnerd

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Peera Detudom)

DATA SHEET FOR CALIBRATION / VERIFICATION AND INSPECTION


Calibration

Verification

Inspection
เครื่องมือ / อุปกรณ์ ที่สอบเทียบหรือทวนสอบ

Equipment / Tools : Multimeter (pH , DO) Tag No. / I.D. No. : L09-AT-SP003-A2 Serial No. : 130500088588

Cal. / Ver. date : 4/4/2022
เครื่องมือ / อุปกรณ์ที่เป็น Master

| Equipment / Tools : | I.D. No. | Model /Serial No. | Cert. No. | Expired date |
|---------------------|----------|-------------------|-----------|--------------|
| | | | | |
| | | | | |

Reference Materials ที่ใช้

| Chemical | Grade | Assay (%) | Cert. No. | Expired date |
|--------------------------------------|-------|-------------|-----------|--------------|
| Buffer pH 4.00 ; Lot No. HC99677935 | | | | 31/7/2022 |
| Buffer pH 7.00 ; Lot No. HC04269139 | | | | 31/10/2023 |
| Buffer pH 10.00 ; Lot No. HC02905338 | | | | 30/6/2023 |


| Calibration / verification item | Result | Error | Acceptance Criteria | Pass / Fail |
|--------------------------------------|--------|-------|---------------------|-------------|
| 1.การสอบเทียบ Observed Slope (slope) | 98 | - | 95 to 105% | Pass |
| 2.verification pH6.86 | 6.85 | -0.01 | ± 0.05 | Pass |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| Inspection item | Result | Correction |
|---------------------------|--------|------------|
| 1.ตรวจเช็คสภาพพร้อมใช้งาน | ปกติ | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Next Due date 31/5/2022

Performed by : 

Date : 4/4/2022

Approved By : 

Date : 4/4/2022

Certificate of Analysis – Certified Reference Material

Certipur® Buffer solution pH 10.00 (20°C)

Certified Reference Material for pH measurement

Product no.: 1.09438.1000
Lot no.: HC02905338
Description of CRM: Certipur® Buffer solution pH 10.00 (20°C)
Certified Reference Material for pH measurement
Expiry date: 2023/06/30
Storage: +15°C to +25°C tightly closed in the original container
Composition: boric acid / potassium chloride / sodium hydroxide



Certified value

Associated uncertainty, $U=k \cdot u$
($k=2$)

pH value 10.01

± 0.03 (20°C)

Metrological traceability:

The pH value of this certified buffer solution is directly traceable to primary certified reference materials characterised by PTB and verified by SRMs from NIST.

NIST 189c, 188, 185i, 186 Ig, 186 IIg, 187f
PTB OX-405/18, TA-442/19, PHT-340/16, PHO-346/16, BO-373/17
PTB: Physikalisch Technische Bundesanstalt, Braunschweig, Germany
NIST: National Institute of Standards and Technology, Gaithersburg, USA.

Measurement method:

pH value is measured with a combined glass electrode after 5-point calibration according to DIN 19268 with reference buffer solutions according to DIN 19266, IUPAC, NIST, Ph.Eur. and USP.

Accreditation:

Merck KGaA, Darmstadt, Germany is accredited by the German accreditation authority DAkkS as registered reference material producer D-RM-15185-01-00 in accordance with ISO 17034 and registered calibration laboratory D-K-15185-01-00 according to DIN EN ISO/IEC 17025.

Certificate issue date:

2020/06/24



ISO 17034



ISO/IEC 17025

CRM released by Approving Officer
or delegate LS-OII-QS3

Dipl.-Ing. Ayfer Yildirim
Responsible Manager of LS-OII-QS3
(Calibration Laboratory D-K-15185-01)



| | |
|---|--|
| Intended use: | This reference material is intended for use as a calibration standard for pH instruments or pH electrodes or as a control sample for measuring the pH value. |
| Instructions for handling and correct use: | The pH value is strongly dependent on the temperature. It is therefore necessary to keep the temperature constant within the measurement. |
| Health and safety information: | Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken. |
| Preparation: | This reference material is prepared gravimetrically from boric acid, potassium chloride, sodium hydroxide and high purity water. |

Associated uncertainty:

The expanded uncertainty U_{CRM} is calculated as $U_{CRM} = k \cdot u_{CRM}$, where $k = 2$ is the coverage factor for a 95% coverage probability and u_{CRM} is the combined standard uncertainty in accordance to ISO 17034.

The combined uncertainty u_{CRM} is derived from combination of the squared uncertainty contributions:

$$u_{CRM} = \sqrt{u^2_{Characterisation} + u^2_{Homogeneity} + u^2_{Stability}}$$

| | |
|---|---|
| $u_{characterisation}$: | is the uncertainty in accordance with DIN EN ISO/IEC 17025 which includes the contributions of the primary reference material and the measuring system. |
| $u_{homogeneity}$: | is the between-bottle variation in accordance with ISO 17034. The assessment of homogeneity is performed by analysis of a representative number of systematically chosen sample units. |
| $u_{stability}$: | is the uncertainty obtained from short-term and long-term stability in accordance with ISO 17034. The stability studies are the basis for the quantification of the expiry date of this reference material for the unopened bottle. |

Informative values:

| | | |
|---------------------------------------|------------------|--------|
| Temperature dependence ¹ : | Temperature [°C] | Δ pH |
| | 0 | + 0.26 |
| | 5 | + 0.17 |
| | 10 | + 0.11 |
| | 15 | + 0.05 |
| | 20 | ± 0 |
| | 25 | - 0.06 |
| | 30 | - 0.11 |
| | 35 | - 0.16 |
| | 40 | - 0.18 |
| | 50 | - 0.26 |

¹Temperature deviation data provided for reference only. Values are not batch-specific and should not be considered certified values.

For more detailed information please read the certification report on our website.

Certificate of analysis revision history:

| Certificate version | Date | Reason for version |
|---------------------|------------|--------------------|
| 01 | 2020/06/24 | Initial version |





Certificate of Calibration

Equipment: pH METER
Model: HQ40d
Serial No. (or ID.): 130500088588 (201000002308)
Manufacturer: Hach
Electrode Serial No.: 210362614404
Condition: In Condition

Certificate No.: C07220217
Issued Date: 27 April 2022
Job No.: KSPR2205346
Page: 1 of 3
Model: PHC201 Brand: Hach

Customer: IRPC PUBLIC CO., LTD.
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Environment Condition: Temperature 25.7 °C ± 0.8 °C
Humidity 66.5 %RH ± 2.4 %RH


Calibration Place: IRPC PUBLIC CO., LTD.(Gc Lab 207)
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Calibration By: Mr. Dumrong Boonsopon

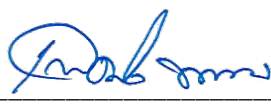
Calibration Date: 27 April 2022

The Method used: In house method, SPCC-WI-58, base on ASTM E 70-07

Traceability: This certificate is traceable to SI Units, Sample Test is assured through primary measurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 794132, 794134, 794133 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20210028EA


(Mr. Dumrong Boonsopon)

Person in charge


บริษัท เอสพีซี อาร์ที จำกัด
SPC RT Co., Ltd.
(Mr. Thalerngkeat Pongngam)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

Calibration Results:**pH Scale**

| Input | pH Meter Reading | | | Uncertainty of Measurement (mV) | Coverage Factor (k) |
|---------|------------------|------------|--------|---------------------------------|---------------------|
| | (mV) | Error (mV) | (pH) | | |
| 414.12 | 414.0 | -0.12 | - | 0.065 | 2.00 |
| 354.96 | 354.8 | -0.16 | 0.999 | 0.065 | 2.00 |
| 295.8 | 295.7 | -0.10 | 1.999 | 0.065 | 2.00 |
| 236.64 | 236.6 | -0.04 | 2.999 | 0.065 | 2.00 |
| 177.48 | 177.4 | -0.08 | 4.000 | 0.065 | 2.00 |
| 118.32 | 118.3 | -0.02 | 5.000 | 0.065 | 2.00 |
| 59.16 | 59.1 | -0.06 | 6.000 | 0.065 | 2.00 |
| 0 | 0.0 | 0.00 | 7.000 | 0.065 | 2.00 |
| -59.16 | -59.2 | -0.04 | 8.000 | 0.065 | 2.00 |
| -118.32 | -118.3 | 0.02 | 9.000 | 0.065 | 2.00 |
| -177.48 | -177.5 | -0.02 | 10.000 | 0.065 | 2.00 |
| -236.64 | -236.6 | 0.04 | 11.001 | 0.065 | 2.00 |
| -295.8 | -295.7 | 0.10 | 12.001 | 0.065 | 2.00 |
| -354.96 | -354.9 | 0.06 | 13.002 | 0.065 | 2.00 |
| -414.12 | -414.0 | 0.12 | - | 0.065 | 2.00 |

Electrode Test Results*

The three-point calibration using three standard buffer solutions; pH 4.008 , pH 6.985 and pH 10.015

The practical slope of the pH electrode; 58.09 (mV/pH), 98.19%

The zero point of the pH electrode; 6.70 (pH)

Sample Test Results

| Standard Buffer Solution (pH) | Unit Under Calibration (pH) | Difference (pH) | Uncertainty of Measurement (pH) | Coverage Factor (k) |
|-------------------------------|-----------------------------|-----------------|---------------------------------|---------------------|
| 4.008 | 4.008 | 0.000 | 0.012 | 2.43 |
| 6.985 | 6.998 | 0.013 | 0.0097 | 2.05 |
| 10.015 | 10.023 | 0.008 | 0.013 | 2.00 |

* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2205346

ชนิดเครื่องมือ: pH METER

รุ่น: HQ40d

หมายเลขเครื่อง: 130500088588

| ตรวจสอบ (รับ) | | รายการตรวจเช็ค | ตรวจสอบ (ส่ง) | | หมายเหตุ |
|-------------------------------------|--------------------------|---|-------------------------------------|--------------------------|----------|
| 27 Apr 2022 | | | 27 Apr 2022 | | |
| ปกติ | ไม่ปกติ | | ปกติ | ไม่ปกติ | |
| | | General | | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. ความสมบูรณ์เครื่อง | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. ปุ่มกด (Keypad) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 5. หน้าจอ (Display, Screen Contrast) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| | | Spectrophotometer | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 8. ความยาวคลื่น (Wavelength Check) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 9. แหล่งกำเนิดแสง (UV < 3,000 hour) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 10. แหล่งกำเนิดแสง (Visible < 5,000 hour) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 11. ช่องวัดหลายตัวอย่าง (Carousel Module) | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | pH Meter and Conductivity Meter | | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 12. อิเล็กโทรด (Electrode and Connection Cable) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 13. ระดับสารละลายใน Electrode (Level KCl) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 14. ฝาปิดกันปลาย Electrode (Dust Protection Hood) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 15. ขาจับอิเล็กโทรด (Stand) | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Turbidimeter | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 16. ค่าความขุ่นที่ต่ำสุด (No Sample) | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0) | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Automatic titrator | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | 18. สภาพ Piston Burettes | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 19. Function Rinsing and Dosing | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> | <input type="checkbox"/> | 20. ระบบท่อสายยางและอุปกรณ์ประกอบ | <input type="checkbox"/> | <input type="checkbox"/> | |

เพิ่มเติม/ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 \pm 0.5°C

Mr. Dumrong Boonsopon
Service Engineer