

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม

คุณภาพอากาศในบรรยากาศ



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 : 3611

Calibration Data

| High Volume Air Sampler Data | | Calibration Data | | |
|------------------------------|------------|------------------|--|----------------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft ³ /min) | R ² |
| B35 | B35 | 01/05/2023 | $y = 1.310x - 9.363$ | 0.996 |
| B36 | B36 | 02/05/2023 | $y = 1.201x - 4.686$ | 0.999 |
| B37 | B37 | 02/05/2023 | $y = 1.239x - 4.586$ | 0.998 |
| B38 | B38 | 02/05/2023 | $y = 1.304x - 9.606$ | 0.997 |
| B39 | B39 | 01/05/2023 | $y = 1.240x - 5.469$ | 0.998 |
| B40 | B40 | 03/05/2023 | $y = 1.196x - 4.045$ | 0.999 |
| B41 | B41 | 03/05/2023 | $y = 1.179x - 2.611$ | 0.999 |
| B42 | B42 | 02/05/2023 | $y = 1.246x - 7.813$ | 0.996 |
| B43 | B43 | 02/05/2023 | $y = 1.206x - 3.694$ | 0.999 |
| B44 | B44 | 02/05/2023 | $y = 1.302x - 9.108$ | 0.999 |
| R01 | R01 | 02/05/2023 | $y = 1.268x - 7.113$ | 0.995 |
| R02 | R02 | 01/05/2023 | $y = 1.235x - 6.759$ | 0.997 |
| R03 | R03 | 03/05/2023 | $y = 1.247x - 7.848$ | 0.996 |
| R04 | R04 | 02/05/2023 | $y = 1.161x - 1.778$ | 0.999 |
| R05 | R05 | 02/05/2023 | $y = 1.288x - 9.494$ | 0.999 |
| R06 | R06 | 02/05/2023 | $y = 1.277x - 6.891$ | 0.997 |
| R07 | R07 | 02/05/2023 | $y = 1.046x + 2.772$ | 1.000 |
| R08 | R08 | 02/05/2023 | $y = 1.206x - 5.068$ | 0.997 |
| R09 | R09 | 02/05/2023 | $y = 1.296x - 8.463$ | 0.999 |
| R10 | R10 | 02/05/2023 | $y = 1.244x - 6.477$ | 0.999 |
| R11 | R11 | 02/05/2023 | $y = 1.097x - 0.462$ | 0.998 |
| R12 | R12 | 02/05/2023 | $y = 1.210x - 5.084$ | 0.998 |
| R13 | R13 | 01/05/2023 | $y = 1.149x - 1.965$ | 1.000 |
| R14 | R14 | 01/05/2023 | $y = 1.189x - 3.035$ | 0.998 |
| R15 | R15 | 02/05/2023 | $y = 1.161x - 3.437$ | 0.998 |
| R16 | R16 | 01/05/2023 | $y = 1.158x - 4.330$ | 0.997 |
| R17 | R17 | 02/05/2023 | $y = 1.218x - 5.356$ | 0.998 |
| R18 | R18 | 02/05/2023 | $y = 1.234x - 5.546$ | 0.999 |
| R19 | R19 | 02/05/2023 | $y = 1.267x - 7.058$ | 0.999 |
| R20 | R20 | 01/05/2023 | $y = 1.264x - 8.743$ | 0.999 |

Calibrated by :



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CALIBRATION REPORT

SO₂ FLUORESCENT ANALYZER

DATE : 15 May 2023

BRAND : API

MODEL : 100E

NO. SO₂-R02

SERIAL NO. 3431

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

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. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span | Initial Reading (Before Adj.), PPB | | | Final Reading (After Adj.), PPB | |
|----------------------|------------------------------------|-------------------|-------|---------------------------------|-------|
| | Expected Concentration | Analyzer Response | % Dif | Analyzer Response | Slope |
| Zero | 0 | 0.11 | - | 0 | - |
| SO ₂ Span | 400.0 | 400.2 | 0.050 | 400.0 | 1.011 |

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 | 655 | cc/min | 650 ± 10% |
| PMT | 103.2 | mV | -20-150 with Zero Air |
| UV LAMP | 3027.5 | mV | 1000-4900 |
| STR. LGT | 61.8 | PPB | <100 |
| DRK PMT | 63.3 | mV | -50 - 200 |
| DRK LMP | 58.2 | mV | -50 - 200 |
| HVPS | 671 | V | 550-900 constant |
| DCPS | 2520 | mV | 2500 ± 200 |
| RCELL TEMP | 50.4 | °C | 50 ± 1 |
| BOX TEMP | 29.3 | °C | 5-40 |
| PMT TEMP | 7.1 | °C | 7 ± 2.0 |
| SO ₂ Span Conc | 400 | PPB | 20-20,000 |
| SO ₂ Slope | 1.011 | - | 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 :



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CALIBRATION REPORT

SO₂ FLUORESCENT ANALYZER

DATE : 15 May 2023

BRAND : API

MODEL : 100E

NO. SO₂-R09

SERIAL NO. 76

Calibrator (Dilution System)

Brand : API Model : 700
Last Cal. Date : 04 August 2022 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. 24.5 °C % RH 49

CALIBRATION SETTING

| Span | Initial Reading (Before Adj.), PPB | | | Final Reading (After Adj.), PPB | |
|----------------------|------------------------------------|-------------------|--------|---------------------------------|-------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | 0.10 | - | 0 | - |
| SO ₂ Span | 400.0 | 399.7 | -0.075 | 400.0 | 1.008 |

API Model 100E SO₂ 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 | 656 | cc/min | 650 ± 10% |
| PMT | 103.1 | mV | -20-150 with Zero Air |
| UV LAMP | 3020.8 | mV | 1000-4900 |
| STR. LGT | 61.4 | PPB | <100 |
| DRK PMT | 63.1 | mV | -50 - 200 |
| DRK LMP | 57.8 | mV | -50 - 200 |
| HVPS | 672 | V | 550-900 constant |
| DCPS | 2524 | mV | 2500 ± 200 |
| RCELL TEMP | 50.2 | °C | 50 ± 1 |
| BOX TEMP | 29.1 | °C | 5-40 |
| PMT TEMP | 7.3 | °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 | 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) |

Calibrated by :

(Mr.Adul Dangklom)

(Mr.Peera Detudom)



CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 15 May 2023

BRAND : API

MODEL : 200E

NO. NOX-R03

SERIAL NO. 4410

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span 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 | - |
| NO Span | 400 | 400.1 | 0.025 | 400.0 | 1.007 |
| NO _x Span | 400 | 400.3 | 0.075 | 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 | 503 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.4 | mV | -20 - 150 |
| AZERO | 94.2 | mV | -20 - 150 |
| HVPS | 673 | V | 420 - 900 constant |
| RCELL TEMP | 50.3 | °C | 50 ± 1 |
| BOX TEMP | 29.1 | °C | 8 - 48 |
| PMT TEMP | 7.5 | °C | 7 ± 2 |
| MOLY TEMP | 315.2 | °C | 315 ± 5 |
| RCELL PRESS | 8.5 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.7 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.007 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.010 | - | 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 :

Approved by :



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 15 May 2023

BRAND : API

MODEL : 200E

NO. NOX-R06

SERIAL NO. 4466

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span 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 | 399.9 | -0.025 | 400.0 | 1.005 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.009 |

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 | 506 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.1 | mV | -20 - 150 |
| AZERO | 93.8 | mV | -20 - 150 |
| HVPS | 672 | V | 420 - 900 constant |
| RCELL TEMP | 50.4 | °C | 50 ± 1 |
| BOX TEMP | 29.2 | °C | 8 - 48 |
| PMT TEMP | 7.3 | °C | 7 ± 2 |
| MOLY TEMP | 314.8 | °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 | 1.005 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.009 | - | 1.0 ± 0.3 |
| NO Offset | 1.1 | mV | -20 to +150 |
| NO _x Offset | 0.7 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 nph @ 400 nph span gas |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

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

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

5. OFF CENTER LOADING ERROR



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

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

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

END OF CALIBRATION REPORT

คุณภาพอากาศจากแหล่งกำเนิด



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Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

| Console Data | | Calibration Data | | |
|--------------|------------|------------------|-------|--------------------------------------|
| No. | Serial No. | Date | y | DH _@ (mmH ₂ O) |
| B01 | 1563 | 02/03/2023 | 0.998 | 50.11 |
| B02 | 8002514 | 03/03/2023 | 1.004 | 49.25 |
| B03 | 1503016 | 03/03/2023 | 1.002 | 50.62 |
| B04 | 00006659 | 02/03/2023 | 1.004 | 50.14 |
| B05 | 00007428 | 03/03/2023 | 1.001 | 49.76 |
| R01 | 1561 | 01/03/2023 | 0.997 | 49.86 |
| R02 | 8002513 | 03/03/2023 | 0.996 | 49.93 |
| R03 | 1570 | 02/03/2023 | 1.003 | 49.57 |
| R04 | 8002519 | 01/03/2023 | 1.002 | 48.90 |
| R05 | 1503015 | 01/03/2023 | 0.998 | 50.20 |

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 :

[Signature]

Approved by :

[Signature]



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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 |
| B03 | S | 0.99 | 02/05/2023 | 0.85 | 0.84 |
| B04 | S | 0.99 | 02/05/2023 | 0.84 | 0.84 |
| B05 | S | 0.99 | 02/05/2023 | 0.84 | 0.83 |
| B07 | S | 0.99 | 02/05/2023 | 0.83 | 0.84 |
| B08 | S | 0.99 | 03/05/2023 | 0.84 | 0.85 |
| B09 | S | 0.99 | 04/05/2023 | 0.85 | 0.84 |
| B11 | S | 0.99 | 04/05/2023 | 0.84 | 0.83 |
| B16 | S | 0.99 | 04/05/2023 | 0.84 | 0.85 |
| B18 | S | 0.99 | 02/05/2023 | 0.84 | 0.84 |
| B19 | S | 0.99 | 02/05/2023 | 0.85 | 0.84 |
| B21 | S | 0.99 | 03/05/2023 | 0.84 | 0.85 |
| B24 | S | 0.99 | 03/05/2023 | 0.84 | 0.83 |
| B27 | S | 0.99 | 02/05/2023 | 0.83 | 0.84 |
| B30 | S | 0.99 | 04/05/2023 | 0.84 | 0.84 |
| B31 | S | 0.99 | 02/05/2023 | 0.83 | 0.84 |
| B33 | S | 0.99 | 03/05/2023 | 0.85 | 0.84 |
| B35 | S | 0.99 | 02/05/2023 | 0.84 | 0.83 |

Remark : Accept value of Cp (test) is 0.84 ± 0.01

Calibrated by :

(Mr. Adul Dangklom)

Approved by :



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

Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

| Pitot Tube Data | | | Calibration Data | | |
|-----------------|---------------|----------------------------------|------------------|-------------------|--------|
| No. | Type of Pitot | Coefficient of Standard Pitot | Date | Avg. of Cp (test) | |
| | | | | Side A | Side B |
| B36 | S | 0.99 | 02/05/2023 | 0.84 | 0.84 |
| B37 | S | 0.99 | 02/05/2023 | 0.83 | 0.84 |
| B38 | S | 0.99 | 03/05/2023 | 0.85 | 0.84 |
| B39 | S | 0.99 | 03/05/2023 | 0.84 | 0.83 |
| B40 | S | 0.99 | 02/05/2023 | 0.84 | 0.83 |
| B41 | S | 0.99 | 02/05/2023 | 0.84 | 0.84 |
| B44 | S | 0.99 | 03/05/2023 | 0.85 | 0.84 |
| B45 | S | 0.99 | 03/05/2023 | 0.85 | 0.84 |
| B46 | S | 0.99 | 04/05/2023 | 0.84 | 0.83 |
| B47 | S | 0.99 | 03/05/2023 | 0.84 | 0.85 |
| B48 | S | 0.99 | 03/05/2023 | 0.83 | 0.84 |
| B49 | S | 0.99 | 03/05/2023 | 0.85 | 0.84 |
| B54 | S | 0.99 | 03/05/2023 | 0.83 | 0.84 |
| B56 | S | 0.99 | 02/05/2023 | 0.84 | 0.85 |
| B57 | S | 0.99 | 02/05/2023 | 0.84 | 0.83 |
| B58 | S | 0.99 | 02/05/2023 | 0.85 | 0.84 |

Remark : Accept value of Cp (test) is 0.84 ± 0.01

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-1]
CLID. NO. : 212201112
JOB CONTROL NO. : 220720073201

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

DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

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

Calibrated By : Sittipong Pimdee
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
22 July 2022



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

Certificate No. Q22073201

F3-011-04/01-12

page 1 of 3



@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-1]
DATE OF CALIBRATION : 21 July 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. **CLC-CPPP-05** according to **DKD-R 6-1** as calibration guidelines.

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

REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 S/N. 9226007 with Pressure Module Model 700PV4 S/N. 19298401.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0196-21, Due Date 17 November 2022.

UNCERTAINTY :

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

Certificate No. Q22073201

F3-011-04/01-12

page 2 of 3



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

CORRECTION OF PRESSURE

| DUC Test point (inHg) | STD Reading (inHg) | | Correction (inHg) | |
|-------------------------|----------------------|-------|---------------------|------|
| | Up | Down | Up | Down |
| 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| -5 | -4.6 | -4.7 | +0.4 | +0.3 |
| -10 | -9.5 | -9.6 | +0.5 | +0.4 |
| -15 | -14.4 | -14.5 | +0.6 | +0.5 |
| -20 | -19.4 | -19.5 | +0.6 | +0.5 |
| -25 | -24.5 | -24.5 | +0.5 | +0.5 |
| -30 | -29.5 | -29.5 | +0.5 | +0.5 |

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. k factor 1 kPa = 0.2952998 inHg

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

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

End of Certificate

Certificate No. Q22073201

F3-011-04/01-12

page 3 of 3



@clccalibration



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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 $^{\circ}\text{C}$
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 | R ² |
| B41 | SKC | 224-PCXR4 | 612669 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,496 | 1,991 | 0.998x - 1.396 | 1.000 |
| B42 | SKC | 224-PCXR4 | 626041 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,006 | 1,496 | 1,992 | 0.988x + 14.223 | 1.000 |
| B43 | SKC | 224-PCXR4 | 034636 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,503 | 1,993 | 0.992x + 8.810 | 1.000 |
| B44 | SKC | 224-PCXR8 | 529341 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,499 | 2,005 | 1.008x - 14.358 | 1.000 |
| B45 | SKC | 224-PCXR8 | 529594 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,506 | 1,987 | 0.990x + 12.580 | 1.000 |
| B46 | SKC | 224-PCXR8 | 566743 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,502 | 2,000 | 1.012x - 26.902 | 0.999 |
| B47 | SKC | 224-PCXR8 | 566747 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,501 | 2,002 | 1.014x - 27.552 | 0.999 |
| B48 | SKC | 224-PCXR8 | 566753 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,493 | 1,996 | 0.997x - 0.359 | 1.000 |
| B49 | SKC | 224-PCXR8 | 566780 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 1,007 | 1,501 | 2,007 | 1.011x - 19.156 | 0.999 |
| B50 | SKC | 224-PCXR8 | 500400 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,495 | 2,004 | 1.000x - 1.663 | 1.000 |
| B51 | SKC | 224-PCXR8 | 500363 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,502 | 1,998 | 1.008x - 21.322 | 0.999 |
| B52 | SKC | 224-PCXR8 | 093186 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,493 | 1,995 | 1.000x - 6.106 | 1.000 |
| B53 | SKC | 224-PCXR8 | 707670 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 2,002 | 1.009x - 18.883 | 0.999 |
| B54 | SKC | 224-PCXR3 | 509821 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,500 | 2,001 | 1.016x - 32.482 | 0.999 |
| B55 | SKC | 224-PCXR3 | 510710 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,992 | 0.996x - 0.191 | 1.000 |
| B56 | SKC | 224-PCXR3 | 511450 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,003 | 1.005x - 8.081 | 1.000 |
| B57 | SKC | 224-PCXR3 | 510798 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,490 | 2,000 | 1.001x - 2.920 | 1.000 |
| B58 | SKC | 224-PCXR3 | 509852 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,496 | 1,998 | 1.004x - 15.922 | 0.999 |
| B59 | SKC | 224-PCXR3 | 509862 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,501 | 1,996 | 0.996x + 4.471 | 1.000 |
| B60 | SKC | 224-PCXR3 | 512655 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,004 | 1.005x - 9.971 | 1.000 |
| B61 | SKC | 224-PCXR3 | 503915 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,488 | 1,999 | 1.007x - 15.934 | 1.000 |
| B62 | SKC | 224-PCXR3 | 505975 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,495 | 1,997 | 1.000x - 4.802 | 1.000 |
| B63 | SKC | 224-PCXR3 | 511432 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,500 | 2,000 | 1.015x - 32.709 | 0.999 |
| B64 | SKC | 224-PCXR3 | 508302 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,987 | 0.989x + 9.855 | 1.000 |
| B65 | SKC | 224-PCXR3 | 508310 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,502 | 2,005 | 1.012x - 20.596 | 1.000 |
| B66 | SKC | 224-PCXR3 | 509861 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,492 | 1,992 | 0.990x + 10.912 | 1.000 |
| B67 | SKC | 224-PCXR3 | 506295 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,506 | 2,002 | 1.007x - 13.999 | 1.000 |
| B68 | SKC | 224-PCXR3 | 505872 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,488 | 1,997 | 0.998x - 1.743 | 1.000 |
| B69 | SKC | 224-PCXR3 | 508375 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,502 | 2,002 | 1.009x - 18.897 | 0.999 |
| B70 | SKC | 224-PCXR3 | 510623 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,505 | 1,998 | 1.004x - 8.846 | 1.000 |
| B71 | SKC | 224-PCXR3 | 508367 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,503 | 2,003 | 1.011x - 23.544 | 0.999 |
| B72 | SKC | 224-PCXR3 | 505977 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,005 | 1,493 | 1,992 | 0.988x + 13.309 | 1.000 |
| B73 | SKC | 224-PCXR3 | 512606 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,504 | 2,004 | 1.008x - 14.506 | 1.000 |
| B74 | SKC | 224-PCXR3 | 505993 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,497 | 1,996 | 1.001x - 7.514 | 1.000 |
| B75 | SKC | 224-PCXR3 | 509820 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,496 | 1,992 | 0.997x + 0.195 | 1.000 |
| B76 | SKC | 224-PCXR3 | 509811 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,498 | 1,999 | 1.004x - 11.212 | 1.000 |
| B77 | SKC | 224-PCXR3 | 508301 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,502 | 2,004 | 1.013x - 23.811 | 0.999 |
| B78 | SKC | 224-PCXR3 | 510677 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,505 | 2,000 | 1.007x - 16.113 | 0.999 |
| B79 | SKC | 224-PCXR3 | 510920 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,495 | 1,993 | 0.998x - 1.232 | 1.000 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Pichai Lachumong)



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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 | R ² |
| R01 | SKC | 224-PCXR4 | 602467 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,507 | 2,005 | 1.009x - 15.491 | 1.000 |
| R02 | SKC | 224-PCXR4 | 626450 | 10/04/2023 | 1,000 | 2,000 | 3,000 | 997 | 1,497 | 1,989 | 0.990x + 10.155 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,005 | 1,498 | 2,003 | 1.010x - 19.567 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,997 | 0.998x - 1.962 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 1,998 | 1.012x - 28.038 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,497 | 1,995 | 1.004x - 10.749 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,492 | 1,998 | 1.005x - 11.766 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,010 | 1,503 | 2,003 | 0.988x + 3.526 | 1.000 |
| R09 | SKC | 224-PCXR4 | 034650 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,505 | 2,003 | 1.017x - 33.985 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,492 | 1,996 | 1.000x - 3.929 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,497 | 2,003 | 1.012x - 23.883 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,503 | 1,998 | 1.002x - 7.698 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,005 | 1,497 | 1,993 | 0.989x + 13.679 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,503 | 1,998 | 1.015x - 32.167 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,005 | 1.005x - 9.429 | 1.000 |
| R16 | SKC | 224-PCXR8 | 529643 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,496 | 1,995 | 0.999x - 3.290 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,511 | 2,001 | 1.012x - 23.233 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,497 | 1,999 | 1.002x - 7.359 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 1,999 | 1.009x - 19.671 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,501 | 2,004 | 1.015x - 28.270 | 1.000 |
| R21 | SKC | 224-PCXR8 | 665728 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,494 | 1,997 | 1.001x - 7.797 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,003 | 1.003x - 6.218 | 1.000 |
| R23 | SKC | 224-PCXR8 | 761067 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,495 | 1,993 | 0.995x + 0.263 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,506 | 2,002 | 1.009x - 17.713 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,009 | 1,497 | 1,992 | 0.983x + 22.945 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,502 | 2,005 | 1.008x - 14.326 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,502 | 2,002 | 1.007x - 16.361 | 1.000 |
| R28 | SKC | 224-PCXR8 | 707481 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,006 | 1,501 | 2,003 | 1.009x - 18.291 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,494 | 1,989 | 0.987x + 14.566 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,494 | 1,996 | 0.997x + 0.646 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,502 | 2,004 | 1.004x - 5.652 | 1.000 |
| R32 | SKC | 224-PCXR8 | 671950 | 05/04/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,501 | 1,993 | 0.994x + 7.163 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,504 | 2,001 | 1.015x - 30.192 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 04/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,498 | 2,004 | 1.004x - 9.377 | 1.000 |
| R35 | SKC | 224-PCXR8 | 707460 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,996 | 0.996x + 3.677 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,498 | 2,002 | 1.010x - 20.668 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 2,000 | 0.999x - 0.873 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,497 | 2,001 | 1.003x - 8.747 | 1.000 |
| R39 | SKC | 224-PCXR8 | 761095 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,497 | 1,997 | 0.999x + 0.140 | 1.000 |

Calibrated by :

Approved by :

(Mr. P'era 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 |
| R40 | SKC | 224-PCXR4 | 612753 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,503 | 2,004 | 1.014x - 25.279 | 0.999 |
| R41 | SKC | 224-PCXR4 | 626140 | 07/04/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,511 | 2,002 | 1.016x - 31.245 | 0.999 |
| R42 | SKC | 224-PCXR4 | 626463 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,495 | 2,001 | 1.003x - 5.636 | 1.000 |
| R43 | SKC | 224-PCXR4 | 626129 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,006 | 1,503 | 2,005 | 1.008x - 15.834 | 0.999 |
| R44 | SKC | 224-PCXR4 | 602753 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,496 | 1,994 | 0.997x - 0.383 | 1.000 |
| R45 | SKC | 224-PCXR4 | 626137 | 10/04/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,505 | 2,004 | 1.015x - 29.231 | 0.999 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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@spicon.com, www.spicon.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 | 05/04/2023 | 500 | 1,000 | 2,000 | 502.1 | 993.6 | 1981.1 | 1.000x – 3.647 | 0.999 |
| H-R02 | Dwyer | VFB-65 | 10/04/2023 | 500 | 1,000 | 2,000 | 500.4 | 998.7 | 1988.7 | 1.001x – 3.457 | 1.000 |
| H-R03 | Dwyer | VFB-65 | 07/04/2023 | 500 | 1,000 | 2,000 | 502.1 | 990.3 | 1997.7 | 0.993x + 4.022 | 1.000 |
| H-R04 | Dwyer | VFB-65 | 10/04/2023 | 500 | 1,000 | 2,000 | 497.2 | 992.2 | 2016.9 | 1.007x – 11.203 | 1.000 |
| H-R05 | Dwyer | VFB-65 | 05/04/2023 | 500 | 1,000 | 2,000 | 499.2 | 988.5 | 1990.7 | 1.003x – 7.136 | 1.000 |
| H-R06 | Dwyer | VFB-65 | 10/04/2023 | 500 | 1,000 | 2,000 | 504.8 | 994.6 | 1982.6 | 0.999x – 1.961 | 0.999 |

Calibrated by :

(Mr. Abdul Dangklom)

Approved by :

(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 : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

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



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

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

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

5. OFF CENTER LOADING ERROR



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

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

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

END OF CALIBRATION REPORT

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP22018

Pages 1 of 3

Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 25
Serial No.: 501S14123010
ID No.: SP03/58
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY

Condition As Found : GOOD

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPHON, CHATUCHAK,
BANGKOK 10900, THAILAND.

Location : ORGANIC LABORATORY IV

Ambient Temperature : (24.4 \pm 5) °C
Relative Humidity : (60.1 \pm 25) %

Received Date : 30 AUGUST 2022
Calibration Date : 30 AUGUST 2022
Date of Issue : 31 AUGUST 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

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

Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 2 of 3

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Certified reference materials

| <u>Material</u> | <u>Ref. type</u> | <u>Cell serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|------------------|------------------------|------------------|-----------------|
| Holmium liquid | RM-HL | 29706 | 87569 | 13/10/2022 |
| Didymium liquid | RM-DL | 28912 | 87588 | 15/10/2022 |
| Neutral density filter | RM-1N2N3N | 13877 | 87600 | 15/10/2022 |
| Potassium dichromate solutions | RM-0204060810 | 14204 | 87614 | 16/10/2022 |
| Potassium Iodide solution | - | KI-0701-001 | CI-0090-22 | 08/04/2024 |

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

| <u>Material</u> | <u>Certified Values of Reference Material (nm)</u> | <u>UUC* Reading (nm)</u> | <u>Error (nm)</u> | <u>Uncertainty ± (nm)</u> | <u>k Factor</u> |
|-----------------|--|------------------------------|-----------------------|-------------------------------|---------------------|
| RM-HL | 278.13 | 278.3 | 0.17 | 0.16 | 2.00 |
| | 361.25 | 361.4 | 0.15 | 0.16 | 2.00 |
| | 467.82 | 467.8 | -0.02 | 0.16 | 2.00 |
| | 536.56 | 536.5 | -0.06 | 0.16 | 2.00 |
| | 640.50 | 640.5 | 0.00 | 0.16 | 2.00 |
| RM-DL | 740.09 | 740.0 | -0.09 | 0.16 | 2.00 |
| | 864.94 | 865.2 | 0.26 | 0.16 | 2.00 |

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018
Job No. : VC65SP0008
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

| Material | Wavelength (nm) | Filter: S/N | Nominal Absorbance (A) | Certified Absorbance (A) | UUC* Reading Absorbance (A) | Error (A) | Uncertainty ± (A) | k Factor |
|------------------------------|-----------------|-----------------|--------------------------|-----------------------------|-----------------------------|-------------------|-------------------|----------|
| Neutral Density glass filter | 440.0 | 29360 | 1.0 | 1.0524 | 1.0539 | 0.0015 | 0.0028 | 2.00 |
| | | 29914 | 0.7 | 0.7454 | 0.7459 | 0.0005 | 0.0029 | 2.00 |
| | | 29381 | 0.5 | 0.5426 | 0.5426 | 0.0000 | 0.0028 | 2.00 |
| | 546.1 | 29360 | 1.0 | 0.9822 | 0.9810 | -0.0012 | 0.0028 | 2.00 |
| | | 29914 | 0.7 | 0.6962 | 0.6960 | -0.0002 | 0.0028 | 2.00 |
| | | 29381 | 0.5 | 0.5076 | 0.5070 | -0.0006 | 0.0029 | 2.00 |
| | 590.0 | 29360 | 1.0 | 1.0221 | 1.0202 | -0.0019 | 0.0028 | 2.00 |
| | | 29914 | 0.7 | 0.7238 | 0.7230 | -0.0008 | 0.0029 | 2.00 |
| | | 29381 | 0.5 | 0.5364 | 0.5360 | -0.0004 | 0.0031 | 2.00 |
| | 635.0 | 29360 | 1.0 | 0.9751 | 0.9732 | -0.0019 | 0.0028 | 2.00 |
| | | 29914 | 0.7 | 0.6912 | 0.6902 | -0.0010 | 0.0029 | 2.00 |
| | | 29381 | 0.5 | 0.5214 | 0.5210 | -0.0004 | 0.0032 | 2.00 |
| Material | Wavelength (nm) | Solution (mg/l) | Certified Absorbance (A) | UUC* Reading Absorbance (A) | Error (A) | Uncertainty ± (A) | k Factor | |
| RM-0204060810 | 235.0 | 20 | 0.2436 | 0.2419 | -0.0017 | 0.0101 | 2.00 | |
| | | 40 | 0.4905 | 0.4855 | -0.0050 | 0.0115 | 2.00 | |
| | | 60 | 0.7453 | 0.7388 | -0.0065 | 0.0067 | 2.00 | |
| | | 80 | 0.9920 | 0.9839 | -0.0081 | 0.0071 | 2.00 | |
| | | 100 | 1.2487 | 1.2414 | -0.0073 | 0.0073 | 2.00 | |

UUC* = Unit Under Calibration

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

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

| Stray Light** UUC* Reading at 220 nm | |
|--------------------------------------|---------------|
| Transmission T(%) | Absorbance(A) |
| 0.0107 | 3.9886 |

**Specific Acceptance :
Transmission ≤ 1.0 T(%), Absorbance ≥ 2.0 A
**Stray light not TISI Accredited

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

End of Calibration Certificate



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

| Calibration Report | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|------|
| Non-Dispersive Infrared CO Analyzer | | | | | |
| Date : | 02 May 2023 | Brand : | API | Model : | 300E |
| No. | CO-B02 | | | Serial No. | 965 |
| Calibrator (Dilution System) | | | | | |
| Brand : API | | | Model : 700 | | |
| Last Cal. Date : 06 September 2022 | | | Serial No. : 421 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | | Cylinder No. : D196045 | | |
| Certified Date : 16 April 2022 | | Expired Date : 15 April 2024 | | Cylinder Conc. : 4,570 ppm | |
| Calibrating Condition | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.6 | °C |
| | | | % RH | 50 | |
| 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 | 39.97 | -0.075 | 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 | 4017.1 | mV | 2500-4800 mV | | |
| CO Reference | 3949.4 | mV | 2500-4800 mV | | |
| Measure/Reference Ratio | 1.180 | - | 1.1-1.3 W/Zero Air | | |
| Sample Pressure | 28.7 | In-Hg-A | ~2" < Ambient Absolute Pressure | | |
| Sample Flow | 812 | CC/Min | 800 ± 10% | | |
| Sample Temperature | 48.3 | °C | 48 ± 4 | | |
| Bench Temperature | 48.1 | °C | 48 ± 2 | | |
| Wheel Temperature | 68.2 | °C | 68 ± 2 | | |
| Box Temperature | 30.6 | °C | Ambient Temp + 7 ± 10 | | |
| Photo-Drive | 3023.8 | mV | 250 mV to 4750 mV | | |
| Slope | 1.017 | - | 1.0 ± 0.3 | | |
| Offset | 0.2 | - | 0 ± 0.3 | | |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|---|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>January 11, 2023</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>July 11, 2023</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>July 11, 2022</u> | |
| User Name: <u>K.Phenpha Vipasthawatt</u> | Visit Number: <u>2 of 2</u> | |
| Phone: <u>083-9269252</u> | PerkinElmer Phone: <u>02-719-6420 ext 206</u> | |
| Fax: <u>02-513-4221</u> | PerkinElmer Fax: <u>02-318-5597</u> | |

| CONFIGURATION TESTED | | ACCESSORIES/COMPONENT NOT INCLUDED |
|------------------------------|---------------------------|------------------------------------|
| MODEL | SERIAL NUMBER | |
| <u>OPTIMA 5300DV</u> | <u>077C7042401</u> | |
| TESTED EQUIPMENT | CALIBRATION NUMBER | EXPIRATION |
| <u>IPV Methods</u> | | |
| TEST STANDARD USED | PART NUMBER | EXPIRATION DATE |
| <u>Multielement Standard</u> | <u>N069-1579</u> | <u>May 30, 2023</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>February 28, 2023</u> |
| <u>VIS Wavecal solution</u> | <u>N930-2946</u> | <u>August 30, 2023</u> |
| <u>Instrument Cal. STD4</u> | <u>N930-0221</u> | <u>November 30, 2023</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401
DATE TESTED January 11, 2023
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 : 077C7042401
DATE TESTED : January 11, 2023

| PARAMETER | | SPECIFICATION | | FINAL VALUE | |
|---|----------------------|---------------|-------|------------------|-----|
| Spectral Resolution : UV | As 193.696 nm | ≤ 0.007 | | <u>0.00504</u> | |
| | Ni 231.604 nm | ≤ 0.008 | | <u>0.00646</u> | |
| | Ni 341.476 nm | ≤ 0.012 | | <u>0.00768</u> | |
| Spectral Resolution : VIS | La 408.672 nm | ≤ 0.020 | | <u>0.01597</u> | |
| | Ba 455.403 nm | ≤ 0.025 | | <u>0.02185</u> | |
| Precision | | | | | |
| | As 193.656 nm | % RSD | < 1.0 | <u>0.89</u> | % |
| | Zn 213.856 nm | % RSD | < 1.0 | <u>0.77</u> | % |
| | Mn 257.610 nm | % RSD | < 1.0 | <u>0.51</u> | % |
| | La 379.478 nm | % RSD | < 1.0 | <u>0.44</u> | % |
| | Ba 455.403 nm | % RSD | < 1.0 | <u>0.44</u> | % |
| | Ba 493.408 nm | % RSD | < 1.0 | <u>0.46</u> | % |
| Detection Limits : Axial | Tl 190.080 nm | 3(sd) | | <u>4.04</u> | ppb |
| | As 193.696 nm | 3(sd) | | <u>3.58</u> | ppb |
| | Pb 220.353 nm | 3(sd) | | <u>1.90</u> | ppb |
| Detection Limits : Radial | As 193.696 nm | 3(sd) | | <u>47.72</u> | ppb |
| | Zn 213.856 nm | 3(sd) | | <u>1.02</u> | ppb |
| | Mn 257.610 nm | 3(sd) | | <u>0.68</u> | ppb |
| | La 379.478 nm | 3(sd) | | <u>1.43</u> | ppb |
| | Ba 455.403 nm | 3(sd) | | <u>0.10</u> | ppb |
| | Ba 493.408 nm | 3(sd) | | <u>0.36</u> | ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd 226.502 nm | ≤ 150 ppb | | <u>58.36</u> | |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn 257.610 nm | ≤ 45 ppb | | <u>104142.80</u> | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED January 11, 2023**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:




(Mr. Wiphan Promlumda)

Service Engineer

PinAAcle 900T Preventive Maintenance (PM)

| | | | |
|--|--|--|--------------|
| Company Name: | SPS CONSULTING SERVICE CO.,LTD. | | |
| Address (Instrument Location): | 7 SOI PHAHOLYOTHIN 24,PHAHOLYOTHIN RD. JOMPOL,CHATUCHAK, BANGKOK | | |
| Serial Number: | PTCS14111103 | PM Number: | 1-2 |
| Customer Name (if applicable): | K. PHENPHA | Telephone Number: | 083-926-9252 |
| Customer Support Engineer Name: | K. DUANG | Service Order Number: | WO-02044564 |
| Date PM Performed: (DD-MMM-YYYY) | 06-Jan-2023 | Next PM Due Date: (DD-MMM-YYYY) | 06-Jul-2023 |
| Standard Labor Hours to Complete PM : | | 5 hours | |

| Part Number | Release | Publication Date |  |
|----------------|---------|------------------|---|
| 09370143 Rev.9 | A | January 2018 | |

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T 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 or calibration, including a current back-up of system software and/or data files. The completed document 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 # | Configuration Notes |
|----------------------------|-------------|---------------------|
| AS900 | AS9S14B1002 | WINLAB 32 |
| | | |
| | | |
| | | |

Parts Lists

| Parts Included with the PM | | |
|--------------------------------|---|----------|
| Part Number (if applicable) | Description | Quantity |
| B0501696 | Fan Filters | 2 |
| B3002013 | THGA Contact Cylinders | 1 |
| B3141064 | Glycerol for THGA Cooling | N/A |
| N3160156 | O-Ring Kits for Sampling Introduction (Stainless Steels Nebulizer) | N/A |
| N3160157 | O-Ring Kits for Sampling Introduction (Plastic Nebulizer) | 2 |
| N9301714 | Replacement Acetylene Filter Cartridge | 1 |
| TH001022 | Replacement Air Filter Cartridge | 2 |

| Additional Reagents and Standards Required for PM | | | | |
|---|---------------------------|---------|-------------|-------------------------|
| Part Number (if applicable) | Description | Quality | Batch/Lot # | Expired Date (MM/YY) |
| N9300183 | 1000 mg/L Copper Standard | AR | 26-87CUY1 | 30-Jan-2024 |
| N9300244 | GFAAS Mixed Standard | AR | 56-021CRY1 | 30-Jun-2023 |

| Additional Reagents and Standards Required for PM (Customer Support Solution) | | | | |
|---|-----------------------|----------|-------------|----------------------------|
| Part Number (if applicable) | Description | Quantity | Batch/Lot # | Expiration Date (MM/YY) |
| N/A | DI Water | 250 ml. | AR | AR |
| N/A | 0.5% HNO ₃ | 250 ml. | AR | AR |

| Additional Tools Required for PM | | | |
|----------------------------------|-----------------------------|----------|---------------|
| Part Number (if applicable) | Description | Quantity | Serial # |
| N1013000 | 0.2A Neutral density filter | 1 | MG0-252 |
| N1013002 | 1.0A Neutral density filter | 1 | MG2-358 |
| B3100652 Or N9307029 | Electronic Flow Meter | 1 | NA |
| B0505495 | Test Jig | 1 | NA |
| 03030997 | System 2 EDL Driver | 1 | 03030997 |
| N3050605 | As System 2 EDL | 1 | 16148 |
| N3050121 | Cu Lumina HCL | 1 | 092216-010130 |
| N3050109 | Ba Lumina HCL | 1 | 102416-040160 |
| N3050139 | K Lumina HCL | 1 | 110716-010060 |
| N3050152 | Ni Lumina HCL | 1 | 100516-030190 |
| N3050119 | Cr Lumina HCL | 1 | 091911-020150 |

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. PC Instrument Software:

- ✓ Instrument Software user files/databases archived, packed, and/or deleted as needed.

3. Mechanical:

- ✓ Inspect and clean all fans and filters. Replace filters if necessary
- ✓ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector, P/N 09921079, if needed.
- ✓ Clean exterior of the instrument.

3.1 Flame Technique

- ✓ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ✓ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ✓ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ✓ Check the drain system for signs of wear. Replace worn or damaged parts.
- ✓ Visually check for proper flame conditions when igniting the Air-C₂H₂ and N₂O-C₂H₂ flames (if applicable).

3.2 THGA Technique

- ✓ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed, P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease, P/N 09905148
- ✓ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ✓ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ✓ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ✓ Check furnace open/close function.
- ✓ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ✓ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ✓ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ✓ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN

- ✓ Perform Cooling System maintenance if needed per SDB# COSY005.STN.
- ✓ Check auto sampler operation.
- ✓ Perform an auto sampler check valve test as described in the Service Manual.
- ✓ Lubricate the spindles of the auto sampler pumps and all moving parts of the tray mechanics as described in the Service Manual.
- ✓ Inspect the auto sampler sampling capillary as described in the Service Manual. Replace if necessary.

4. Electrical:

- ✓ Inspect PC boards. Clean if necessary.
- ✓ Carefully check all internal and external cable connections.
- ✓ Check instrument firmware revisions upgrade to current levels (if necessary)
- ✓ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

- ✓ Inspect and clean the sample compartment windows, if needed.
- ✓ Inspect and clean the furnace windows, if needed.
- ✓ Inspect and clean the GFTV camera lens, if needed.
- ✓ Inspect optics. Clean or replace if necessary,

6. Gasses:

- ✓ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SDB.
- ✓ Verify that the air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

| Parameter | Specification | Test Results | Pass/Fail |
|---|--|--------------|-----------|
| Flame Sensor | Air/C ₂ H ₂ Flame correctly shuts down | Active | Passed |
| Drain Sensor | Air/C ₂ H ₂ Flame correctly shuts down | Active | Passed |
| Nebulizer Sensor | Air/C ₂ H ₂ Flame correctly shuts down | Active | Passed |
| C ₂ H ₂ Pressure Sensor | Air/C ₂ H ₂ Flame correctly shuts down | Active | Passed |
| Air Pressure Sensor | Air/C ₂ H ₂ Flame correctly shuts down | Active | Passed |
| Burner Head Sensor | Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down | Active | Passed |

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

| Parameter | Specification | Certificate Value at 553.6 nm (Abs.) | Test Results | Pass/Fail |
|-----------------|-----------------|---|--------------|-----------|
| 1.0 A ND Filter | ± 5% from Cert. | 0.9798 | 0.1982 | Passed |
| 0.2 A ND Filter | ± 5% from Cert. | 0.2042 | 0.9942 | Passed |

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0014 | Passed |

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.001 | 0.0001 | Passed |

8.4 D₂ Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0083 | Passed |

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.005 | 0.0002 | Passed |

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.005 | 0.0021 | Passed |

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

| Standard Copper Sensitivity | Specification | Results (Abs.) | Pass/Fail |
|---|----------------|----------------|----------------|
| 5 mg/L Sensitivity SS Neb (if applicable) | > 0.250 Abs. | NA | Not Applicable |
| 2 mg/L Sensitivity HS Neb (if applicable) | > 0.250 Abs. | 0.3281 | Passed |

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

| Parameter | Specification | Test Results | Pass/Fail |
|--------------------|----------------------------|--------------|-----------|
| Internal Flow Rate | 250 mL/min \pm 25 mL/min | 255 | Passed |
| External Flow Rate | 100 mL/min \pm 10 mL/min | 105 | Passed |

9.2 Chromium Baseline Noise

Description: Signal to noise check.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|-------------------|---------|-----------|
| Baseline Noise | ≤ 0.005 Abs. | 0.0000 | Passed |
| Standard Deviation | ≤ 0.005 | 0.0002 | Passed |

9.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

| Parameter | Specification | Results | Pass/Fail |
|---------------------------|--------------------------|---------|-----------|
| Cr m ₀ Results | ≤ 7.0 pg/0.0044 A-s | 5.7 | Passed |
| Precision | ≤ 2.0 % | 0.74 | Passed |

9.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

| Parameter | Specification | Results | Pass/Fail |
|--------------------------|----------------------|---------|-----------|
| Cu m ₀ Result | ≤ 16.5 pg/0.0044 A-s | 12.3 | Passed |
| Zeeman Ratio | 0.52 ± 0.04 | 0.54 | Passed |

10. 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.

Additional Comments

| Additional Comments Regarding the PM | |
|--------------------------------------|--|
| <p>Zeeman Ratio</p> | $= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1855}{0.1855 + 0.1563}$ $= 0.54$ |
| <p>REPLACE PM KIT</p> | |

Review

| | | |
|---|---|---|
| <p><i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.</i></p> | | |
| <p><i>This PinAAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i></p> | | |
| Review of Preventive Maintenance: | | |
| <p>Authorized PerkinElmer Representative:</p> | <div style="background-color: #cccccc; width: 100px; height: 100px;"></div> | <p>Date: 06-Jan-2023 <small>(DD-MMM-YYYY)</small></p> |
| <p>Authorized Customer Representative:</p> | <div style="background-color: #cccccc; width: 100px; height: 100px;"></div> | <p>Date: 06-Jan-2023 <small>(DD-MMM-YYYY)</small></p> |

คุณภาพน้ำเสีย

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 <u>31/12/2022</u> | |
| Performed by : <u> </u> | | Approved By : <u> </u> |
| Date : <u> </u> | | Date : <u> </u> |

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:

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

| | |
|--|---|
| $u_{\text{characterisation}}$: | is the uncertainty in accordance with DIN EN ISO/IEC 17025 which includes the contributions of the primary reference material and the measuring system. |
| $u_{\text{homogeneity}}$: | 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. |
| $u_{\text{stability}}$: | 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 dependence¹:

| Temperature [°C] | Δ pH |
|------------------|-------------|
| 0 | + 0.26 |
| 5 | + 0.17 |
| 10 | + 0.11 |
| 15 | + 0.05 |
| 20 | \pm 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 |





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DOC. NUMBER

CMV-S23-0034

SERVICE REPORT

REPORT DATE

June 21, 2023

| | | |
|--|--|---|
| EQUIPMENT: Multi Water Quality Checker, U-5000G | SERIAL NUMBER / TAG NUMBER RAAGSEN3 | BRAND / MANUFACTURER HORIBA |
| CUSTOMER NAME: IRPC PUBLIC COMPANY LIMITED | LACATION: rayong | JOB NUMBER / REQUESTED NUMBER JID2300281-002 |

SCOPE OF WORK / REASON FOR VISIT

Repair and Calibration

FOUND FAILURE & CORRECTIVE ACTION DETAILS

1. ตรวจสอบสภาพเครื่อง Multi Water Quality Checker

- Meter Model: U-5000G S/N: RAAGSEN3 สามารถใช้งานได้ปกติ
- Probe Model: U-53 S/N: V39CGM6U พบว่า **Sensor Turbidity** ไม่สามารถใช้งานได้
- Sensor pH,COND,ORP,DO ใช้งานได้ปกติ

2. ทำการ Cleaning sensor ทุก parameter

- เติมน Internal Solution (KCl) ใน Reference sensor

3. ปรับเทียบ Auto Calibration ด้วย Buffer pH 4

- พบว่าสามารถปรับเทียบค่าผ่าน คือ pH , COND, ORP, Temp, DO and Depth

4. ปรับเทียบ Manual Calibration 2 จุด (zero , span)

- พบว่าสามารถปรับเทียบค่าผ่าน คือ pH , COND,ORP, Temp, DO and Depth

สรุป : เครื่อง Multi Water Quality Checker Meter Model: U-5000G S/N: RAAGSEN3 และ

Sensor Model: U-53 S/N: V39CGM6U สามารถใช้งานได้ตามปกติ ยกเว้น Sensor Turbidity

WORK CONCLUSION

| <input checked="" type="checkbox"/> COMPLETED | | <input type="checkbox"/> IN COMPLETED | PARTS REPLACEMENT | | |
|---|---|---|-------------------|-----|------|
| <input checked="" type="checkbox"/> CHARGE | <input type="checkbox"/> NO CHARGE | | PARTS NAME | P/N | QTY. |
| <input checked="" type="checkbox"/> Service Fee | <input type="checkbox"/> Project Warranty | <input type="checkbox"/> Take to Office | | | |
| <input type="checkbox"/> Travelling | <input type="checkbox"/> Service Warranty | <input type="checkbox"/> Wait for Parts | | | |
| <input type="checkbox"/> Spare Parts | <input type="checkbox"/> Spare Parts Warranty | <input type="checkbox"/> In Progress | | | |
| <input type="checkbox"/> Other | <input type="checkbox"/> Service Contract | <input type="checkbox"/> Other | | | |

TIME SPENT (HOURS)

| | | | | | | | | | | |
|----------------|------|--|--|--|--|--|--|----------------|-------------------|---|
| YEAR | 2023 | | | | | | | TOTAL HOURS | TRAVELING DETAILS | |
| MONTH | 6 | | | | | | | | | |
| DATE | 21 | | | | | | | | TRAVEL BY | - |
| SERVICE TIME | 4 | | | | | | | 4 | FROM | - |
| OVERTIME | - | | | | | | | - | TO | - |
| TRAVELING TIME | - | | | | | | | - | TOTAL ROUND TRIP | - |
| TOTAL HOURS | 4 | | | | | | | 4 | DISTANCE (KM.) | - |

SERVICE CREW

| NAME | | NAME | |
|--------------------------|--|------|--|
| 1. Chamaiporn Vongchalee | | 3. | |
| 2. | | 4. | |

| | | |
|-----------------|----------------------|------|
| CUSTOMER'S NAME | CUSTOMER'S SIGNATURE | DATE |
| | | |



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http://www.pico.co.th E-mail-address : pico@pico.co.th

TEST REPORT OF CALIBRATION

We hereby certify that the equipment mentioned below have been maintained and have duly performed in accordance with HORIBA specifications.

| | | |
|------------------|---|-----------------------------|
| Equipment | : | Multi Water Quality Checker |
| Model | : | U-5000G |
| Manufacture | : | HORIBA |
| Serial No. | : | RAAGSEN3 |
| Job No. | : | JID2300281-002 |
| Customer | : | IRPC Public Company Limited |
| Calibration date | : | June 21, 2023 |
| Calibration due | : | June 21, 2024 |

Petro-Instruments Corp., Ltd.

Calibrated by

(Ms.Chamaiporn Vongchaee)

Chemist

Approved by

(Mr. Rattapong Kanchanasakul)

Assistant Section Manager

Scientific Product Business Unit



บริษัท เพทโร-อินสตรูเมนต์ จำกัด
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<http://www.pico.co.th> E-mail-address : pico@pico.co.th

CALIBRATION REPORT

Equipment : Multi Water Quality Checker
Manufacturer : HORIBA
Model : U-53
Serial No. : V39CGM6U
Date of Calibration : June 21, 2023
Customer Name : IRPC Public Company Limited

HORIBA, Multi Water Quality Checker model U-53 was tested according to service manual.

Auto Calibration (1- point)

| Check function | Calibration | Before Calibrate | After Calibrate |
|----------------|--------------------------------------|------------------|-----------------|
| pH | 1- point auto (Zero) (4.01 pH) | 4.05 pH | 4.01 pH |
| CONDUCTIVITY | 1- point auto (Span) (4.49 mS/cm) | 4.45 mS/cm | 4.49 mS/cm |
| DO | 1- point auto (Span) (8.92 mg/L) | 8.87 mg/L | 8.92 mg/L |
| Depth | (0 m) | 0 m | 0 m |

Reference Standard

- Standard Solution of HORIBA, pH 4 Lot No. S3316/03



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PETRO-INSTRUMENTS CORP., LTD.

7/409 ซ.วิภาวดีรังสิต 36 ถ.วิภาวดีรังสิต แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900

7/409 Soi Vibhavadi-Rangsit 36, Vibhavadi-Rangsit Rd., Chatuchak, Chatuchak, Bangkok 10900, Thailand.

TEL : (662) 9395711 (12 Lines), 5132333 (12 Lines), 5139575-9 FAX : (662) 9394207, 9394208

<http://www.pico.co.th> E-mail-address : pico@pico.co.th

Manual Calibration (2- point)

A. pH Measurement.

| Check item | pH Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|------------------|-------------------------|---------------------|--------------------|-------|----------|
| Zero Calibration | 6.86 | 6.86 | 6.86 | 0.00 | PASS |
| Span Calibration | 4.01 | 4.01 | 4.01 | 0.00 | PASS |

Measure at temperature 25 °C Within ± 0.1 pH

B. Conductivity Measurement.

| Check item | Conductivity Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|------------------|---|---------------------|--------------------|-------------|----------|
| Zero Calibration | 0.00 mS/cm | 0.000 mS/cm | 0.00 mS/cm | 0.000 mS/cm | PASS |
| Span Calibration | Range 1 (0.100-0.999 S/m) 0.718 mS/cm | 0.728 mS/cm | 0.718 mS/cm | 0.01 mS/cm | PASS |
| | Range 2 (1.00-10.00 S/m) 6.67 mS/cm | 6.70 mS/cm | 6.67 mS/cm | 0.003 mS/cm | PASS |
| | Range 3 (0.0-99.9 mS/m) 58.7 mS/cm | 59.0 mS/cm | 58.7 mS/cm | 0.3 mS/cm | PASS |

Measure at temperature 25 °C Within $\pm 1\%$ /F.S.



บริษัท เพทโร-อินสตรูเมนต์ จำกัด
PETRO-INSTRUMENTS CORP., LTD.

7/409 ซ.วิภาวดีรังสิต 36 ถ.วิภาวดีรังสิต แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900

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http://www.pico.co.th E-mail-address : pico@pico.co.th

C. DO Measurement.

| Check item | DO Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|---------------------|--|---------------------|--------------------|-----------|----------|
| Zero Calibration | (Solution of NaSO ₃) 0.00 mg/l | 0.00 mg/l | 0.00 mg/l | 0.00 mg/l | PASS |
| Span Calibration | (Saturated with oxygen in air) 8.11 mg/l | 8.15 mg/l | 8.11 mg/l | 0.04 mg/l | PASS |

Measure at temperature 25 °C With in 0 to 20 mg/L :± 0.2 mg/l, 20 to 50 mg/L :± 0.5 mg/l

Calibrated by : Chamaiporn Vongchalee

Approved by : Athitphong Kanchanasathian

ระดับเสียงในบรรยากาศ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

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

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Ambient Environment

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

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

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

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

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

Date of Receipt : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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
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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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E-mail : mtc@tistr.or.th

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Thailand
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E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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 μ Pa at 1000 Hz

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

1. Sound Pressure Level

| Standard Microphone Type | Measured Sound Pressure Level (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|------------------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 93.93 | -0.07 | ± 0.10 | ± 0.40 dB |

2. Frequency

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

3. Total Distortion

| Standard Microphone Type | Measured Total Distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------------|-----------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 1.44 | ± 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 :

(Mr. [Redacted])

(Mr. T [Redacted])

Approved by :

(Mr. Prawate Kluaypa)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Ref : 2011265042601787001

2 / 2

End of Certificate

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.BLMTC.002 Rev.4

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

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Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

การตรวจวัดระดับความร้อน



Certificate of Calibration

Certificate Number : SPR23030505-8

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 32

Serial Number : TPE070001

ID. Number : R12

Environmental Conditions

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

Received Date : 30 Mar 2023

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

Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 01 Apr 2023

Method of Calibration

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

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

Calibrated by : Mr. Sarawut Khitmai

Approved by

Calibration Officer

Authorized Signatory



Calibration Report

Certificate Number : SPR23030505-8

Page : 2 of 3

Reference Standards

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

Traceability

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

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

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23030505-8

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|--------|-------------------|
| 30.0 | 30.013 | 30.0 | -0.013 | 0.50 |
| 35.0 | 35.010 | 35.0 | -0.010 | 0.50 |
| 40.0 | 40.015 | 40.0 | -0.015 | 0.50 |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|--------|-------------------|
| 30.0 | 30.013 | 30.0 | -0.013 | 0.50 |
| 35.0 | 35.010 | 35.0 | -0.010 | 0.50 |
| 40.0 | 40.015 | 40.0 | -0.015 | 0.50 |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

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

Note:

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

Measurement Uncertainty

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

- End of Certificate -

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSI0100006

CLID. NO. : 232000793

JOB CONTROL NO. : 220505044316

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
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
12 May 2022



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

Certificate No. Q22044316

F3-011-04/01-12

page 1 of 3



REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMOHYGRO METER**
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : **3M**

MODEL / TYPE : **QUESTemp° 46**

SERIAL NO. : **TSI010006**

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. **Q22044316**

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 (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty ± (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0 | 29.99 | 31.5 | -1.51 | 0.40 |
| 35.0 | 35.01 | 36.5 | -1.49 | |
| 40.0 | 39.99 | 41.5 | -1.51 | |

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

2. CORRECTION OF TEMPERATURE [DRY]

| Test point (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty ± (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0 | 29.99 | 30.1 | -0.11 | 0.40 |
| 35.0 | 35.01 | 35.0 | +0.01 | |
| 40.0 | 39.99 | 40.1 | -0.11 | |

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

| Test point (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty ± (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|--------------------------|
| 30.0 | 29.99 | 30.1 | -0.11 | 0.40 |
| 35.0 | 35.01 | 35.0 | +0.01 | |
| 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. Q22044316

F3-011-04/01-12

page 3 of 3



แสงสว่างในสถานที่ทำงาน

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 :

Approved By :

Date :

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.
Resp.
(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:

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

| | |
|--|---|
| $u_{\text{characterisation}}$: | is the uncertainty in accordance with DIN EN ISO/IEC 17025 which includes the contributions of the primary reference material and the measuring system. |
| $u_{\text{homogeneity}}$: | 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. |
| $u_{\text{stability}}$: | 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 dependence¹:

| 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 |





PETRO-INSTRUMENTS CORP., LTD.

7/409 Soi Vibhavadi-Rangsit 36, Vibhavadi-Rangsit Rd., Chatuchak, Chatuchak Bangkok 10900 Thailand

Tel. : (+66) 2939 5711 (12 Lines), (+66) 2513 2333 (12 Lines), Fax. : (+66) 939 4207, (+66) 2939 4207

Website : <http://www.pico.co.th> email-address: pico@pico.co.th , service@pico.co.th

DOC. NUMBER

CMV-S23-0034

SERVICE REPORT

REPORT DATE

June 21, 2023

| | | |
|--|--|---|
| EQUIPMENT: Multi Water Quality Checker, U-5000G | SERIAL NUMBER / TAG NUMBER RAAGSEN3 | BRAND / MANUFACTURER HORIBA |
| CUSTOMER NAME: IRPC PUBLIC COMPANY LIMITED | LACATION: rayong | JOB NUMBER / REQUESTED NUMBER JID2300281-002 |

SCOPE OF WORK / REASON FOR VISIT

Repair and Calibration

FOUND FAILURE & CORRECTIVE ACTION DETAILS

1. ตรวจเช็คสภาพเครื่อง Multi Water Quality Checker

- Meter Model: U-5000G S/N: RAAGSEN3 สามารถใช้งานได้ปกติ
- Probe Model: U-53 S/N: V39CGM6U พบว่า **Sensor Turbidity** ไม่สามารถใช้งานได้
- Sensor pH,COND,ORP,DO ใช้งานได้ปกติ

2. ทำการ Cleaning sensor ทุก parameter

- เติมน Internal Solution (KCl) ใน Reference sensor

3. ปรับเทียบ Auto Calibration ด้วย Buffer pH 4

- พบว่าสามารถปรับเทียบค่าผ่าน คือ pH , COND, ORP, Temp, DO and Depth

4. ปรับเทียบ Manual Calibration 2 จุด (zero , span)

- พบว่าสามารถปรับเทียบค่าผ่าน คือ pH , COND,ORP, Temp, DO and Depth

สรุป : เครื่อง Multi Water Quality Checker Meter Model: U-5000G S/N: RAAGSEN3 และ

Sensor Model: U-53 S/N: V39CGM6U สามารถใช้งานได้ตามปกติ ยกเว้น Sensor Turbidity

WORK CONCLUSION

| <input checked="" type="checkbox"/> COMPLETED | | <input type="checkbox"/> IN COMPLETED | PARTS REPLACEMENT | | |
|---|---|---|-------------------|-----|------|
| <input checked="" type="checkbox"/> CHARGE | <input type="checkbox"/> NO CHARGE | | PARTS NAME | P/N | QTY. |
| <input checked="" type="checkbox"/> Service Fee | <input type="checkbox"/> Project Warranty | <input type="checkbox"/> Take to Office | | | |
| <input type="checkbox"/> Travelling | <input type="checkbox"/> Service Warranty | <input type="checkbox"/> Wait for Parts | | | |
| <input type="checkbox"/> Spare Parts | <input type="checkbox"/> Spare Parts Warranty | <input type="checkbox"/> In Progress | | | |
| <input type="checkbox"/> Other | <input type="checkbox"/> Service Contract | <input type="checkbox"/> Other | | | |

TIME SPENT (HOURS)

| YEAR | 2023 | | | | | | | TOTAL HOURS | TRAVELING DETAILS | |
|----------------|------|--|--|--|--|--|--|----------------|-------------------|---|
| MONTH | 6 | | | | | | | | | |
| DATE | 21 | | | | | | | | TRAVEL BY | - |
| SERVICE TIME | 4 | | | | | | | 4 | FROM | - |
| OVERTIME | - | | | | | | | - | TO | - |
| TRAVELING TIME | - | | | | | | | - | TOTAL ROUND TRIP | - |
| TOTAL HOURS | 4 | | | | | | | 4 | DISTANCE (KM.) | - |

SERVICE CREW

| NAME | | NAME | |
|--------------------------|--|------|--|
| 1. Chamaiporn Vongchalee | | 3. | |
| 2. | | 4. | |

| CUSTOMER'S NAME | CUSTOMER'S SIGNATURE | DATE |
|-----------------|----------------------|------|
| | | |



บริษัท เพทโร-อินสตรูเมนต์ จำกัด
PETRO-INSTRUMENTS CORP., LTD.

7/409 ซ.วิภาวดีรังสิต 36 ถ.วิภาวดีรังสิต แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900

7/409 Soi Vibhavadi-Rangsit 36, Vibhavadi-Rangsit Rd., Chatuchak, Chatuchak, Bangkok 10900, Thailand.

TEL : (662) 9395711 (12 Lines), 5132333 (12 Lines), 5139575-9 FAX : (662) 9394207, 9394208

http://www.pico.co.th E-mail-address : pico@pico.co.th

TEST REPORT OF CALIBRATION

We hereby certify that the equipment mentioned below have been maintained and have duly performed in accordance with HORIBA specifications.

Equipment : Multi Water Quality Checker
Model : U-5000G
Manufacture : HORIBA
Serial No. : RAAGSEN3
Job No. : JID2300281-002
Customer : IRPC Public Company Limited
Calibration date : June 21, 2023
Calibration due : June 21, 2024

Petro-Instruments Corp., Ltd.

Calibrated by 

(Ms.Chamaiporn Vongchalee)

Chemist

Approved by

(Mr 

Assistant Section Manager

Scientific Product Business Unit



บริษัท เพทโร-อินสตรูเมนต์ จำกัด
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TEL : (662) 9395711 (12 Lines), 5132333 (12 Lines), 5139575-9 FAX : (662) 9394207, 9394208

<http://www.pico.co.th> E-mail-address : pico@pico.co.th

CALIBRATION REPORT

Equipment : Multi Water Quality Checker
Manufacturer : HORIBA
Model : U-53
Serial No. : V39CGM6U
Date of Calibration : June 21, 2023
Customer Name : IRPC Public Company Limited

HORIBA, Multi Water Quality Checker model U-53 was tested according to service manual.

Auto Calibration (1- point)

| Check function | Calibration | Before Calibrate | After Calibrate |
|----------------|--------------------------------------|------------------|-----------------|
| pH | 1- point auto (Zero) (4.01 pH) | 4.05 pH | 4.01 pH |
| CONDUCTIVITY | 1- point auto (Span) (4.49 mS/cm) | 4.45 mS/cm | 4.49 mS/cm |
| DO | 1- point auto (Span) (8.92 mg/L) | 8.87 mg/L | 8.92 mg/L |
| Depth | (0 m) | 0 m | 0 m |

Reference Standard

- Standard Solution of HORIBA, pH 4 Lot No. S3316/03



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<http://www.pico.co.th> E-mail-address : pico@pico.co.th

Manual Calibration (2- point)

A. pH Measurement.

| Check item | pH Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|------------------|-------------------------|---------------------|--------------------|-------|----------|
| Zero Calibration | 6.86 | 6.86 | 6.86 | 0.00 | PASS |
| Span Calibration | 4.01 | 4.01 | 4.01 | 0.00 | PASS |

Measure at temperature 25 °C Within ± 0.1 pH

B. Conductivity Measurement.

| Check item | Conductivity Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|------------------|---|---------------------|--------------------|-------------|----------|
| Zero Calibration | 0.00 mS/cm | 0.000 mS/cm | 0.00 mS/cm | 0.000 mS/cm | PASS |
| Span Calibration | Range 1 (0.100-0.999 S/m) 0.718 mS/cm | 0.728 mS/cm | 0.718 mS/cm | 0.01 mS/cm | PASS |
| | Range 2 (1.00-10.00 S/m) 6.67 mS/cm | 6.70 mS/cm | 6.67 mS/cm | 0.003 mS/cm | PASS |
| | Range 3 (0.0-99.9 mS/m) 58.7 mS/cm | 59.0 mS/cm | 58.7 mS/cm | 0.3 mS/cm | PASS |

Measure at temperature 25 °C Within $\pm 1\%$ /F.S.



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PETRO-INSTRUMENTS CORP., LTD.

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http://www.pico.co.th E-mail-address : pico@pico.co.th

C. DO Measurement.

| Check item | DO Standard Solution | Before Calibrate | After Calibrate | Error | Judgment |
|---------------------|--|---------------------|--------------------|-----------|----------|
| Zero Calibration | (Solution of NaSO ₃) 0.00 mg/l | 0.00 mg/l | 0.00 mg/l | 0.00 mg/l | PASS |
| Span Calibration | (Saturated with oxygen in air) 8.11 mg/l | 8.15 mg/l | 8.11 mg/l | 0.04 mg/l | PASS |

Measure at temperature 25 °C With in 0 to 20 mg/L :± 0.2 mg/l, 20 to 50 mg/L :± 0.5 mg/l

Calibrated by : Chamaiporn Vongchalee

Approved by : Athitphong Kanchanasathian

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : LUX METER
MANUFACTURER : EXTECH INSTRUMENTS
MODEL / TYPE : 407026
SERIAL NO. : A.055623/A.055623[LUX-R09]
CLID. NO. : 252300055
JOB CONTROL NO. : 230112003738

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

DATE OF RECEIVED : 12 January 2023

DATE OF ISSUED : 16 January 2023

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

Calibrated By : Suwit Phuanbusabong
Calibration Engineer

Approved By : Mongkol Yotsoontorn
Authorized Signatory
16 January 2023



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

Certificate No. Q23003738

F3-011-04/01-12

page 1 of 3



REPORT OF CALIBRATION

FOR

| | | |
|---------------------|---|----------------------------|
| NOMENCLATURE | : | LUX METER |
| MANUFACTURER | : | EXTECH INSTRUMENTS |
| MODEL / TYPE | : | 407026 |
| SERIAL NO. | : | A.055623/A.055623[LUX-R09] |
| DATE OF CALIBRATION | : | 14 January 2023 |

ENVIRONMENT CONDITIONS :

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

Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPEE-18** by comparison with Illuminance Sensor which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Illuminance Sensor, Bentham Model ORM400/DH400VL S/N. 27710/1/27585/3.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Optical Test and Calibration Ltd.
Certificate No. 131916/ABU/1. Due Date 25 February 2023.

UNCERTAINTY :

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

Certificate No. Q23003738

F3-011-04/01-12

page 2 of 3



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

LUX METER RESULT

| STD Applied (lux) | DUC Reading (lux) | Correction (lux) | Uncertainty \pm (% of rdg.) |
|---------------------|---------------------|--------------------|---------------------------------|
| 100 | 103 | -3 | 2.6 |
| 200 | 206 | -6 | 2.6 |
| 300 | 308 | -8 | 2.6 |
| 1000 | 1025 | -25 | 2.6 |
| 2000 | 2000 | 0 | 2.6 |
| 3000 | 3080 | -80 | 3.8 |

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 46 of 54

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

End of Certificate

Certificate No. Q23003738

F3-011-04/01-12

page 3 of 3



ระดับเสียงในสถานประกอบการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

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

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

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

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

Date of Receipt : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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. 21-65/0455

MTC No. EEL. BP. 41/0465

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 μ Pa at 1000 Hz

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

1. Sound Pressure Level

| Standard Microphone Type | Measured Sound Pressure Level (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|------------------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 93.93 | -0.07 | ± 0.10 | ± 0.40 dB |

2. Frequency

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

3. Total Distortion

| Standard Microphone Type | Measured Total Distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------------|-----------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 1.44 | ± 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 :

(Mr.Nuttapong Niljrusvanit)

Approved by :

(Mr.Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Ref : 2011265042601787001

2 / 2

End of Certificate

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FM.BLMTC.002 Rev.4

ระดับเสียงติดตัวบุคคล

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

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

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Date of Receipt : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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 μ Pa at 1000 Hz

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

1. Sound Pressure Level

| Standard Microphone Type | Measured Sound Pressure Level (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|------------------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 93.93 | -0.07 | ± 0.10 | ± 0.40 dB |

2. Frequency

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

3. Total Distortion

| Standard Microphone Type | Measured Total Distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------------|-----------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 1.44 | ± 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 :

(Mr. Tawikiat Iamsamran)

Approved by :

(Mr. Prawate Kluaypa)
Director
TISTR

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Ref : 2011265042601787001

2 / 2

End of Certificate

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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 ² |
| R01 | SKC | 224-PCXR4 | 602467 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,508 | 2,004 | 1.008x - 13.936 | 0.999 |
| R02 | SKC | 224-PCXR4 | 626450 | 06/01/2023 | 1,000 | 2,000 | 3,000 | 998 | 1,499 | 1,990 | 0.989x + 12.268 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 06/01/2023 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,004 | 1.011x - 21.761 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 06/01/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,493 | 1,995 | 0.997x - 1.563 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 06/01/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,505 | 1,999 | 1.014x - 31.752 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 06/01/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,498 | 1,994 | 1.003x - 8.555 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,490 | 1,999 | 1.007x - 16.073 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 1,011 | 1,501 | 2,005 | 0.999x + 3.207 | 1.000 |
| R09 | SKC | 224-PCXR4 | 034650 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 991 | 1,504 | 2,002 | 1.018x - 35.900 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,512 | 1,994 | 0.999x + 0.977 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,499 | 2,002 | 1.013x - 25.119 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 997 | 1,501 | 1,999 | 1.001x - 4.906 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 1,994 | 0.992x + 9.636 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,502 | 1,999 | 1.014x - 30.212 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,500 | 2,004 | 1.006x - 11.941 | 1.000 |
| R16 | SKC | 224-PCXR8 | 529643 | 05/01/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,994 | 1.000x - 4.686 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 05/01/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,509 | 2,000 | 1.015x - 30.731 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 05/01/2023 | 1,000 | 1,500 | 2,000 | 991 | 1,498 | 1,998 | 1.001x - 6.840 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 05/01/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,000 | 1.010x - 21.027 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 991 | 1,501 | 2,003 | 1.020x - 39.916 | 0.999 |
| R21 | SKC | 224-PCXR8 | 665728 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,493 | 1,999 | 1.000x - 5.404 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,002 | 1.004x - 7.135 | 1.000 |
| R23 | SKC | 224-PCXR8 | 761067 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,494 | 1,991 | 0.993x + 4.132 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,505 | 2,000 | 1.008x - 17.553 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 1,010 | 1,499 | 1,993 | 0.984x + 23.464 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.009x - 15.842 | 1.000 |
| R27 | SKC | 224-PCXR8 | 707398 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 2,001 | 1.005x - 13.449 | 1.000 |
| R28 | SKC | 224-PCXR8 | 707461 | 04/01/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,500 | 2,002 | 1.010x - 19.288 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,493 | 1,991 | 0.988x + 14.167 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,495 | 1,994 | 0.996x + 1.922 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,001 | 1.002x - 3.618 | 1.000 |
| R32 | SKC | 224-PCXR8 | 671950 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,994 | 0.995x + 4.970 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,502 | 1,999 | 1.014x - 31.070 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 2,004 | 1.006x - 11.810 | 1.000 |
| R35 | SKC | 224-PCXR8 | 707460 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,498 | 1,995 | 0.994x + 6.669 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,004 | 1,499 | 2,001 | 1.009x - 18.036 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,499 | 1,998 | 1.000x - 2.070 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,500 | 2,001 | 1.004x - 9.345 | 1.000 |
| R39 | SKC | 224-PCXR8 | 761095 | 03/01/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,496 | 1,994 | 0.997x + 2.373 | 1.000 |

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

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

Rotameter Calibration Report (For Personal Pump 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 ² |
| L-R01 | Dwyer | VFA-21 | 04/01/2023 | 50 | 100 | 200 | 50.6 | 100.6 | 203.9 | 0.982x + 2.803 | 1.000 |
| L-R02 | Dwyer | VFA-21 | 04/01/2023 | 50 | 100 | 200 | 49.7 | 101.3 | 200.1 | 1.008x - 1.204 | 0.999 |
| L-R03 | Dwyer | VFA-21 | 04/01/2023 | 50 | 100 | 200 | 50.5 | 99.8 | 202.3 | 1.017x - 0.913 | 1.000 |
| L-R04 | Dwyer | VFA-21 | 03/01/2023 | 50 | 100 | 200 | 49.8 | 100.5 | 201.0 | 1.010x - 1.439 | 0.999 |
| L-R05 | Dwyer | VFA-21 | 03/01/2023 | 50 | 100 | 200 | 50.6 | 100.0 | 203.4 | 0.991x + 1.807 | 1.000 |
| L-R06 | Dwyer | VFA-21 | 03/01/2023 | 50 | 100 | 200 | 50.6 | 99.1 | 201.9 | 1.003x - 0.031 | 1.000 |

Calibrated by :

Approved by :



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

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

Address : 7 Phahonyothin Soi 24 Phahonyothin Rd. Ladyao Chatuchak Bangkok 10900

Date : 10/08/2022

ELECTRONIC TEST

| | | |
|----------------------|--|-------------------------------|
| CPU | <input checked="" type="checkbox"/> PASS | <input type="checkbox"/> FAIL |
| LCD TEST | <input checked="" type="checkbox"/> PASS | <input type="checkbox"/> FAIL |
| VENT TEST | <input checked="" type="checkbox"/> PASS | <input type="checkbox"/> FAIL |
| KEY ECHO TEST | <input checked="" type="checkbox"/> PASS | <input type="checkbox"/> FAIL |
| DESTRUCTION RAM TEST | <input checked="" type="checkbox"/> PASS | <input type="checkbox"/> FAIL |

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

| | |
|---------------|---|
| Column | 80 °C hold 1 min., rate 20 °C/min. to 200 °C hold 1min. |
| Injector | 220 °C |
| Detector | 300 °C |
| Column flow | 5 mL/min |
| Makeup flow | 25 mL/min |
| Air flow | 300 mL/min |
| Hydrogen flow | 30 mL/min |

Column: Capillary Column CP sil 5 CB 0.25 ID x 15 M

Sample: 1 µL Injection FID Test Sample 0.218 g/L C14, C15, C16 in hexane

SENSITIVITY TEST: C15. (Area count) = 118,103 Counts.





Detector Sensitivity (FID)

| Detector Response | Result | Specification |
|----------------------------|--------|---------------|
| Baseline Noise (μ V) | 2.94 | ≤ 50 |
| Baseline Drift (%) | 0.18 | ≤ 1 |
| Sensitivity (S/N for C15) | 4,000 | $\geq 1,024$ |

Temperature Specification

| Temperature | Set | Result | Specification |
|-------------------|-----|--------|---------------|
| Column Oven (° C) | 80 | 80 | ± 5 |
| Injector (° C) | 220 | 220 | ± 5 |
| Detector (° C) | 300 | 300 | ± 5 |
| Incubator (° C) | 60 | N/A | ± 5 |

Relative Standard Deviation % (% RSD)

| Checkout Procedure | Result | Specification |
|------------------------|--------|---------------|
| Area C15 (%) | 1.68 | ≤ 5 |
| Retention Time C15(%) | 0.01 | ≤ 0.5 |

APPROVAL

Signature:

Engineer :

Date : 10/08/2022





Results Integrated System Testing

| Checkout Procedure | FID |
|--------------------|---------------|
| Detector Position | Front |
| Inlet Type | 1079 Injector |
| C15 Area 1 | 117,172 |
| C15 Area 2 | 119,182 |
| C15 Area 3 | 117,982 |
| C15 Area 4 | 118,589 |
| C15 Area 5 | 117,592 |
| C15 Area Average | 118,103 |
| * % RSD (< 5 %) | 1.68 |

* The precision specification should be less than 2.0 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 5 % for Manual injections. To calculate the %RSD, select the C15 peak area for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

| | | |
|----------------|--|-------------------------------|
| Compliance | <input checked="" type="checkbox"/> Pass | <input type="checkbox"/> Fail |
| Performance by | | |
| Date | | |



| | | | |
|-------------|--|------|--|
| Comments | | | |
| Reviewed by | | Date | |





Results Integrated System Testing

| Checkout Procedure | FID |
|---------------------|---------------|
| Detector Position | Front |
| Inlet Type | 1079 Injector |
| C15 RT 1 | 4.048 |
| C15 RT 2 | 4.048 |
| C15 RT 3 | 4.048 |
| C15 RT 4 | 4.048 |
| C15 RT 5 | 4.048 |
| C15 RT Average | 4.000 |
| * % RSD (< 0.5 %) | 0.01 |

* The precision specification should be less than 0.5 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 0.5 % for Manual injections. To calculate the %RSD, select the RT C15 peak for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

| | | |
|----------------|--|-------------------------------|
| Compliance | <input checked="" type="checkbox"/> Pass | <input type="checkbox"/> Fail |
| Performance by | | |
| Date | | |



| | | | |
|-------------|--|------|------------|
| Comments | | | |
| Reviewed by | | | |
| | | Date | 10/08/2022 |



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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

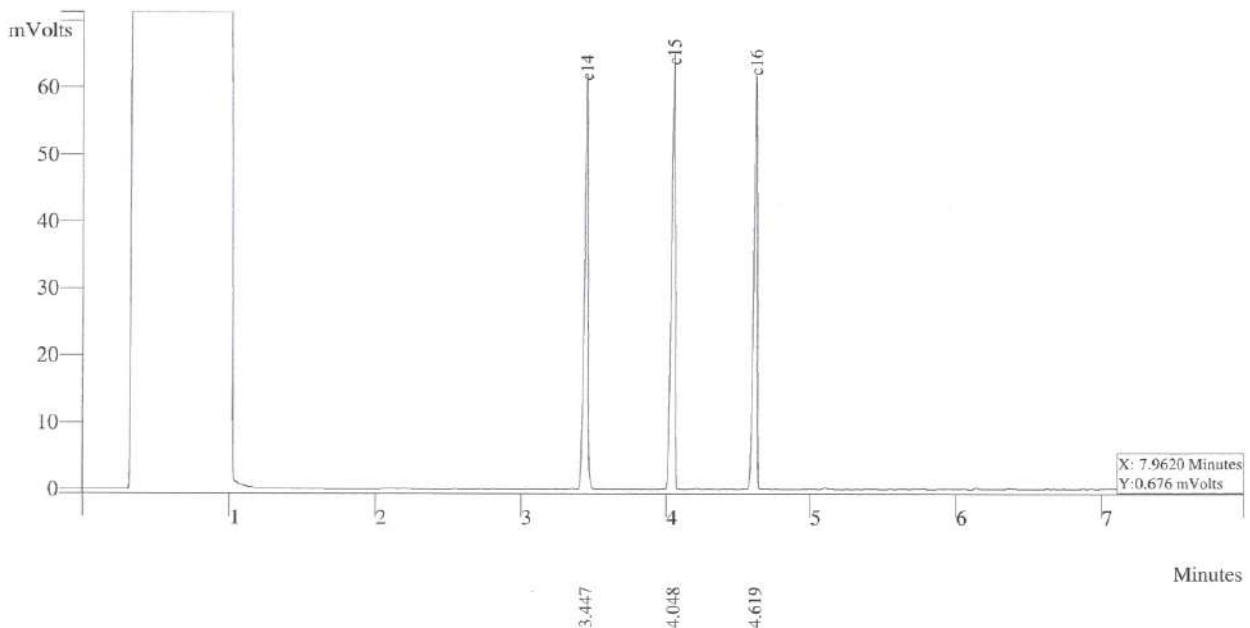
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022001.run

A = FID 10 V RESULTS



| Peak No | Peak Name | Result () | Ret Time (min) | Peak Area (counts) | Sep. Code | Width 1/2 (sec) |
|---------|-----------|-----------|----------------|--------------------|-----------|-----------------|
| 1 | c14 | 32.2988 | 3.477 | 112355 | VP | 1.7 |
| 2 | c15 | 33.6834 | 4.048 | 117172 | VV | 1.5 |
| 3 | c16 | 34.0178 | 4.619 | 118335 | VP | 1.5 |
| Totals | | 100.0000 | | 347862 | | |



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

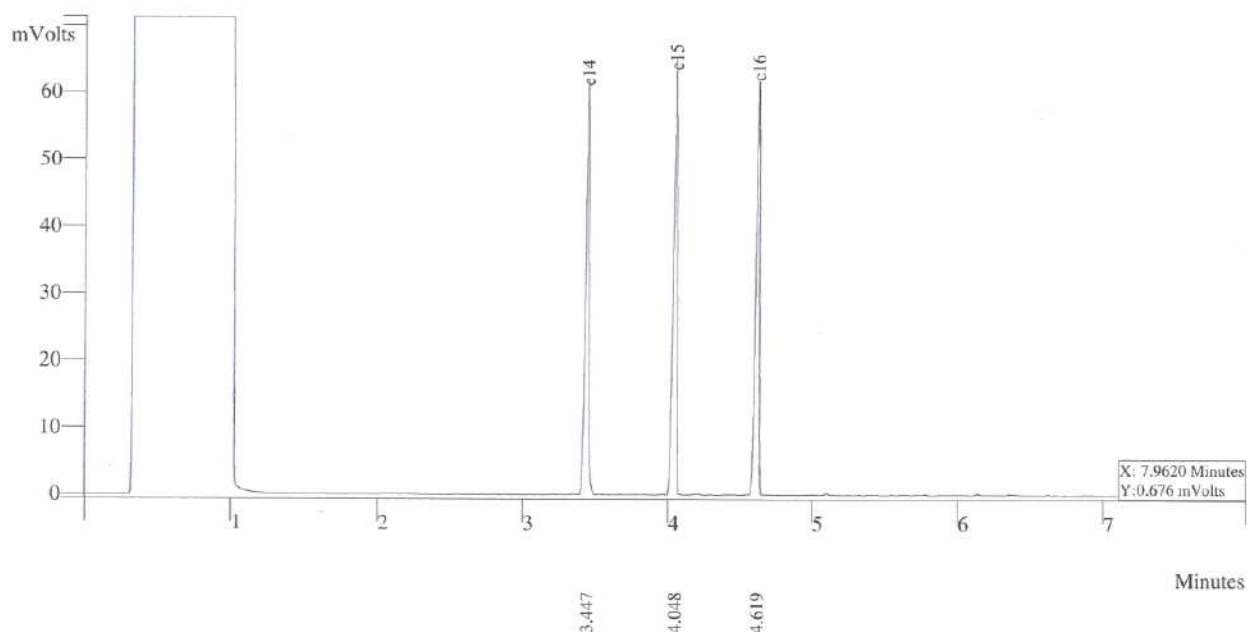
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022002.run

A = FID 10 V RESULTS



| Peak No | Peak Name | Result () | Ret Time (min) | Peak Area (counts) | Sep. Code | Width 1/2 (sec) |
|---------|-----------|-----------|----------------|--------------------|-----------|-----------------|
| 1 | c14 | 32.2988 | 3.477 | 112755 | VP | 1.7 |
| 2 | c15 | 33.6834 | 4.048 | 119182 | VV | 1.5 |
| 3 | c16 | 34.0178 | 4.619 | 118265 | VP | 1.5 |
| Totals | | 100.0000 | | 348205 | | |



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

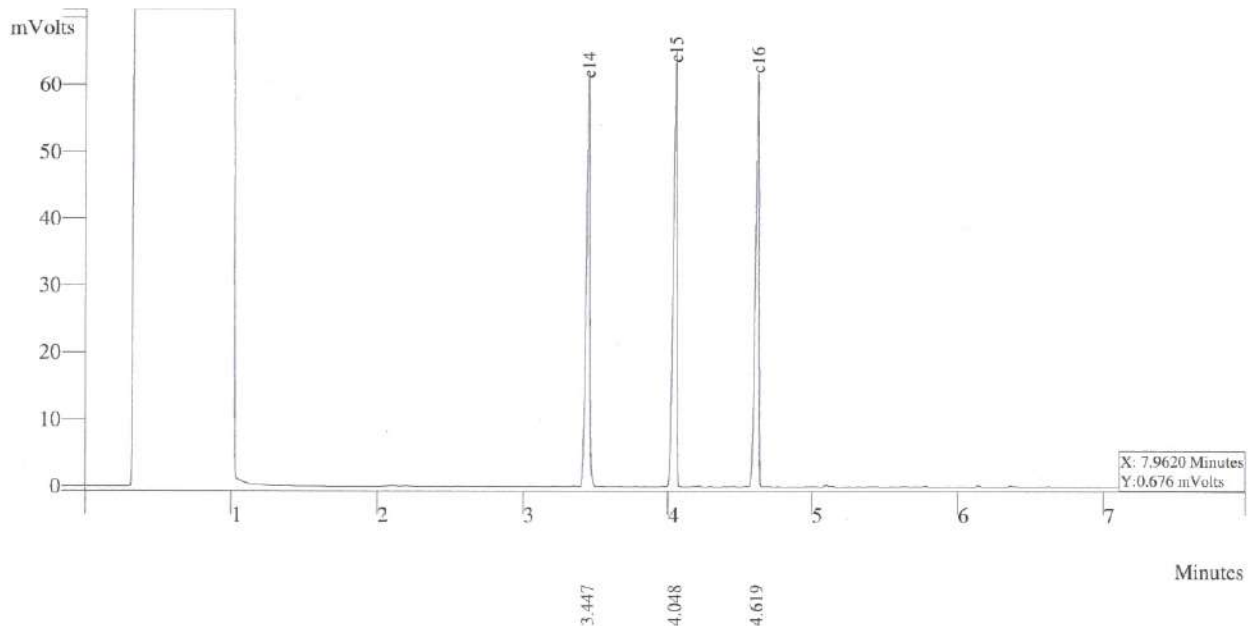
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022003.run

A = FID 10 V RESULTS



| Peak No | Peak Name | Result () | Ret Time (min) | Peak Area (counts) | Sep. Code | Width 1/2 (sec) |
|---------|-----------|-----------|----------------|--------------------|-----------|-----------------|
| 1 | c14 | 32.2988 | 3.477 | 112755 | VP | 1.7 |
| 2 | c15 | 33.6834 | 4.048 | 117982 | VV | 1.5 |
| 3 | c16 | 34.0178 | 4.619 | 118265 | VP | 1.5 |
| Totals | | 100.0000 | | 348205 | | |



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

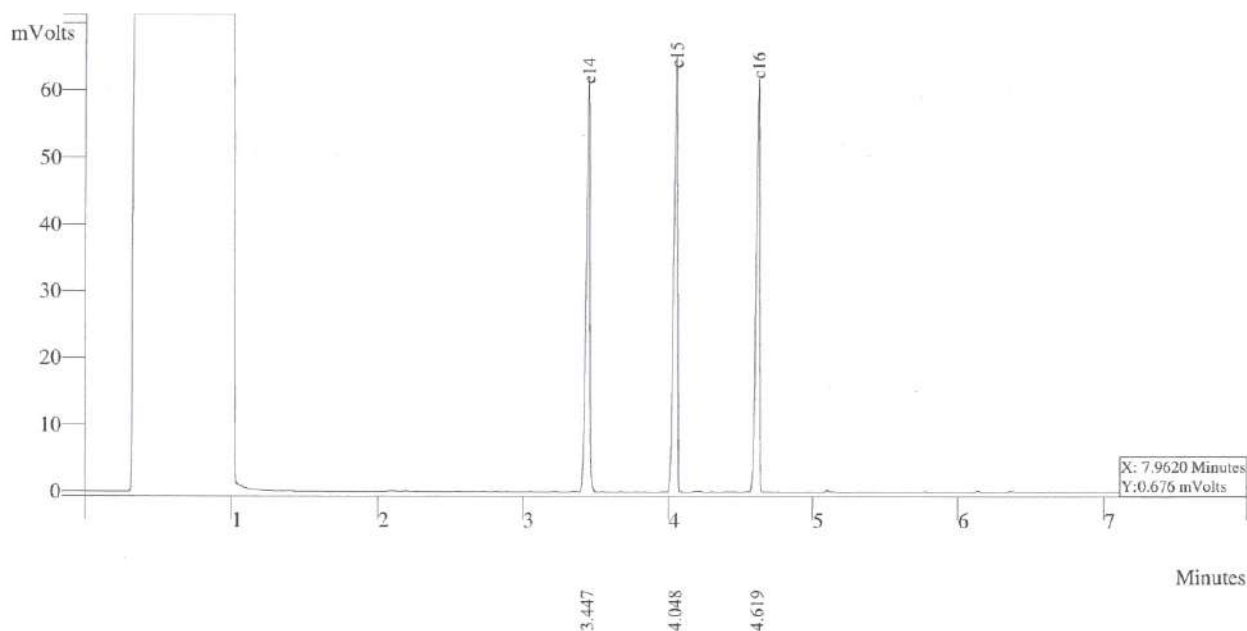
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022004.run

A = FID 10 V RESULTS



| Peak No | Peak Name | Result () | Ret Time (min) | Peak Area (counts) | Sep. Code | Width 1/2 (sec) |
|---------|-----------|-----------|----------------|--------------------|-----------|-----------------|
| 1 | c14 | 32.2988 | 3.377 | 113755 | VP | 1.7 |
| 2 | c15 | 33.6834 | 4.048 | 118589 | VV | 1.5 |
| 3 | c16 | 34.3178 | 4.619 | 128265 | VP | 1.5 |
| Totals | | 100.0000 | | 360202 | | |



THAI UNIQUE CO.,LTD.

1 Of 1

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

Sample ID: **fid std**

Operator (Inj): **suwarot**

Injection Date: **16/08/2022**

Calc Date: **16/08/2022**

Run Time (min): **7.993**

Workstation:

Instrument (Inj): **Varian Star #1**



VARIAN

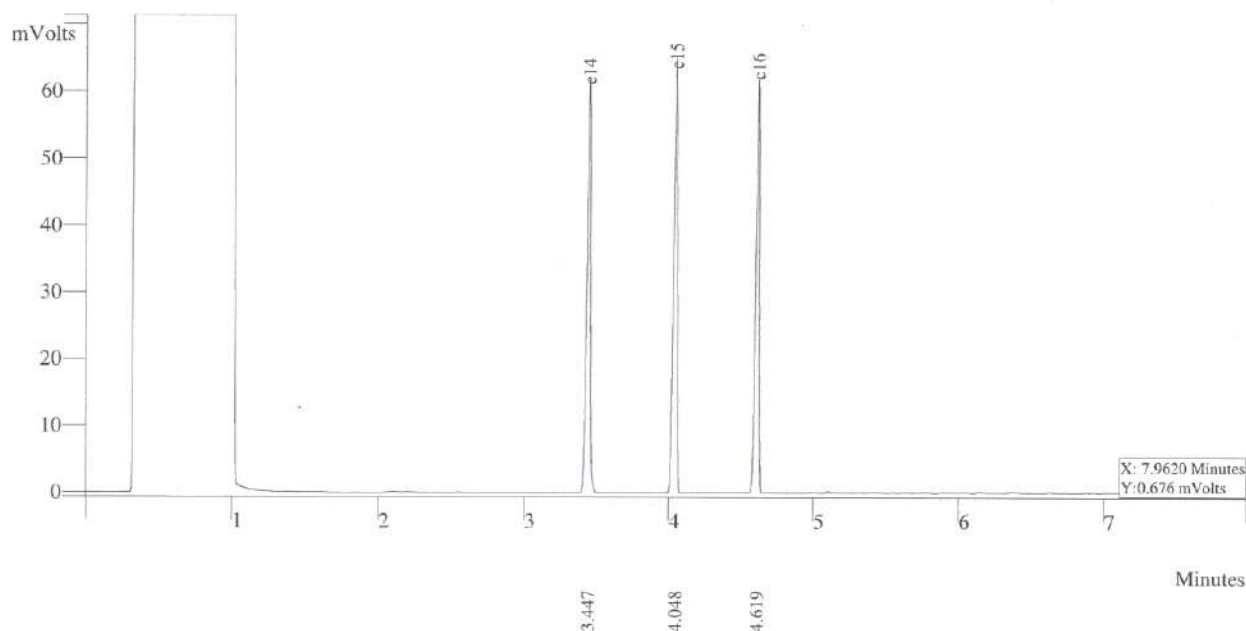
Run Mode: **Analysis**

Peak Measurement: **Peak Area**

Calculation Type: **Percent**

c:\star\data\tu\cal2022\fid2022005.run

A = FID 10 V RESULTS



| Peak No | Peak Name | Result () | Ret Time (min) | Peak Area (counts) | Sep. Code | Width 1/2 (sec) |
|---------|-----------|-----------|----------------|--------------------|-----------|-----------------|
| 1 | c14 | 32.2988 | 3.377 | 115755 | VP | 1.7 |
| 2 | c15 | 33.6834 | 4.048 | 117592 | VV | 1.5 |
| 3 | c16 | 34.3178 | 4.619 | 138265 | VP | 1.5 |
| Totals | | 100.0000 | | 369202 | | |



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1 Of 1