

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัด

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

| รายการตรวจวัด | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|---|---|-------------------------|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| คุณภาพอากาศในบรรยากาศ | | |
| - Total Suspended Particulate | - High Volume Air Sampler No. R01, R18 | - Digital Balance |
| - PM ₁₀ | - High Volume PM ₁₀ Air Sampler No. R03, R06 | - Digital Balance |
| - Nitrogen Dioxide (NO ₂) | - NOx Analyzer No. R04, R07 | - Spectrophotometer |
| คุณภาพอากาศจากปล่อง | | |
| - Total Suspended Particulate | - Console No. R03 - Pitot Tube No. R30, R33, R38 | - Digital Balance |
| - P-Xylene | - Personal Pump SKC No. B66, B70, B71, B72, R72 - Rotameter No. L-R01, R06 | - GC/FID |
| - Methyl Acetate | - Personal Pump SKC No. B66, B70, B71, B72, R72 - Rotameter No. L-R01, R06 | - GC/FID |
| - Methyl Bromide | - Personal Pump SKC No. B66, B70, R70 - Rotameter No. L-R01, R06 | - GC/FID |
| - Acetic Acid | - Personal Pump SKC No. B29, B35, B66, B70, R70 - Rotameter No. L-R01, R06 | - GC/FID |
| - Oxides of Nitrogen | - Vacuum Gauge | - Spectrophotometer |
| - Benzene | - Personal Pump SKC No. B66, B71 - Rotameter No. L-R03, R06 | - GC/FID |
| คุณภาพน้ำ | | |
| - Temperature | - | - Thermometer |
| - pH | - | - pH Meter |
| - Total Dissolved Solids | - | - Digital Balance |
| - Total Suspended Solids | - | - Digital Balance |
| - BOD ₅ | - | - BOD Analyzer |
| - COD | - | - COD Reactor |
| - Grease & Oil | - | - Digital Balance |
| - Xylene | - | - GC/MS |
| - Manganese | - | - ICP |
| - p-Xylene | - | - GC/MS |
| ระดับเสียง | | |
| - L _{eq} 24 hr, L ₉₀ และ L _{max} | - Sound Level Calibrator - Integrated Sound Level Meter No. ACO-R08, R21, R26, R31 | - |

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)**

| รายการตรวจวัด | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|--|--|-------------------------|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| คุณภาพอากาศในสถานประกอบการ - Acetic Acid | - Personal Pump SKC No. B33, B39, B44, B48, B51, B58, B65, B77, B93, R05, R07, R18, R21, R25, R32, R39, R40, R42 - Rotameter No. L-B01, R02 | - GC/FID |
| - Total Dust | - Personal Pump SKC No. B39, B58, B93, R02, R07, R25 - Rotameter No. H-B01, R02 | - Digital Balance |
| - Xylene | - Personal Pump SKC No. B49, B58, B93, R07, R21, - Rotameter No. L- B01, R02 | - GC/FID |
| - p-Xylene | - Personal Pump SKC No. B33, B48, R32, R42 - Rotameter No. L-B01, R02 | - GC/FID |
| ระดับเสียงในสถานประกอบการ - Noise Dose | - Sound Level Calibrator - Noise Dose Meter No. NMD-R05, R13, R27 | - |
| - L_{eq} 12 hr | - Sound Level Calibrator - Integrated Sound Level Meter No. ACO-R25, R28, R37, R38, R39 | - |

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 | 03/11/2022 | y = 1.306x-9.466 | 0.997 |
| B36 | B36 | 02/11/2022 | y = 1.213x-5.932 | 0.996 |
| B37 | B37 | 01/11/2022 | y = 1.253x-5.209 | 0.999 |
| B38 | B38 | 01/11/2022 | y = 1.228x-5.530 | 0.995 |
| B39 | B39 | 01/11/2022 | y = 1.319x-9.149 | 0.998 |
| B40 | B40 | 01/11/2022 | y = 1.196x-4.045 | 0.999 |
| B41 | B41 | 07/11/2022 | y = 1.179x-2.611 | 0.999 |
| B42 | B42 | 01/11/2022 | y = 1.209x-3.713 | 0.995 |
| B43 | B43 | 02/11/2022 | y = 1.187x-3.331 | 0.998 |
| B44 | B44 | 07/11/2022 | y = 1.298x-8.171 | 0.996 |
| R01 | R01 | 02/11/2022 | y = 1.289x-8.287 | 0.998 |
| R02 | R02 | 07/11/2022 | y = 1.307x-10.165 | 0.999 |
| R03 | R03 | 03/11/2022 | y = 1.259x-7.634 | 0.995 |
| R04 | R04 | 04/11/2022 | y = 1.157x-2.287 | 0.995 |
| R05 | R05 | 03/11/2022 | y = 1.273x-8.311 | 0.999 |
| R06 | R06 | 01/11/2022 | y = 1.297x-8.271 | 0.999 |
| R07 | R07 | 02/11/2022 | y = 1.071x+1.468 | 0.995 |
| R08 | R08 | 01/11/2022 | y = 1.206x-5.068 | 0.997 |
| R09 | R09 | 01/11/2022 | y = 1.252x-7.084 | 0.995 |
| R10 | R10 | 03/11/2022 | y = 1.246x-5.817 | 0.999 |
| R11 | R11 | 03/11/2022 | y = 1.117x-1.156 | 0.998 |
| R12 | R12 | 02/11/2022 | y = 1.351x-12.068 | 0.996 |
| R13 | R13 | 03/11/2022 | y = 1.118x-0.601 | 0.999 |
| R14 | R14 | 03/11/2022 | y = 1.164x-2.415 | 0.996 |
| R15 | R15 | 03/11/2022 | y = 1.134x-1.793 | 0.998 |
| R16 | R16 | 04/11/2022 | y = 1.182x-4.717 | 0.996 |
| R17 | R17 | 07/11/2022 | y = 1.218x-5.356 | 0.998 |
| R18 | R18 | 04/11/2022 | y = 1.233x-5.977 | 0.996 |
| R19 | R19 | 07/11/2022 | y = 1.277x-7.752 | 0.997 |
| R20 | R20 | 04/11/2022 | y = 1.327x-10.628 | 0.997 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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

High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

| High Volume PM-10 Data | | Calibration Data | | |
|------------------------|------------|------------------|--|-------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft^3/min) | R^2 |
| R01 | R01 | 02/11/2022 | $y = 1.257x - 6.210$ | 0.998 |
| R02 | R02 | 07/11/2022 | $y = 1.240x - 5.054$ | 0.996 |
| R03 | R03 | 03/11/2022 | $y = 1.199x - 4.666$ | 0.996 |
| R04 | R04 | 04/11/2022 | $y = 1.215x - 6.193$ | 0.999 |
| R05 | R05 | 04/11/2022 | $y = 1.210x - 5.386$ | 0.998 |
| R06 | R06 | 02/11/2022 | $y = 1.270x - 6.263$ | 0.995 |
| R07 | R07 | 07/11/2022 | $y = 1.227x - 5.259$ | 0.998 |
| R08 | R08 | 03/11/2022 | $y = 1.258x - 7.271$ | 0.998 |
| R09 | R09 | 07/11/2022 | $y = 1.202x - 6.317$ | 0.999 |
| R10 | R10 | 03/11/2022 | $y = 1.196x - 4.622$ | 0.997 |
| R11 | R11 | 02/11/2022 | $y = 1.284x - 7.142$ | 0.996 |
| R12 | R12 | 02/11/2022 | $y = 1.253x - 7.460$ | 0.996 |
| R13 | R13 | 04/11/2022 | $y = 1.262x - 6.240$ | 0.998 |
| R14 | R14 | 04/11/2022 | $y = 1.254x - 6.659$ | 0.999 |
| R15 | R15 | 03/11/2022 | $y = 1.299x - 9.065$ | 0.998 |
| R16 | R16 | 09/11/2022 | $y = 1.263x - 7.053$ | 0.995 |
| R17 | R17 | 07/11/2022 | $y = 1.224x - 4.966$ | 0.997 |
| R18 | R18 | 07/11/2022 | $y = 1.235x - 5.907$ | 0.999 |
| R19 | R19 | 03/11/2022 | $y = 1.302x - 9.454$ | 0.995 |
| R20 | R20 | 04/11/2022 | $y = 1.244x - 8.211$ | 0.999 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 13 November 2022

BRAND : API

MODEL : 200E

NO. NOX-R04

SERIAL NO. 4411

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 48

CALIBRATION SETTING

| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
|----------------------|-----------------------------------|-------------------|--------|--------------------------------|-------|
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 399.7 | -0.075 | 400.0 | 1.004 |
| NO _x Span | 400 | 400.1 | 0.025 | 400.0 | 1.008 |

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 | 504 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.1 | mV | -20 - 150 |
| AZERO | 93.9 | mV | -20 - 150 |
| HVPS | 674 | V | 420 - 900 constant |
| RCELL TEMP | 50.4 | °C | 50 ± 1 |
| BOX TEMP | 29.2 | °C | 8 - 48 |
| PMT TEMP | 7.1 | °C | 7 ± 2 |
| MOLY TEMP | 315.1 | °C | 315 ± 5 |
| RCELL PRESS | 8.3 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.5 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.004 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.008 | - | 1.0 ± 0.3 |
| NO Offset | 1.2 | mV | -20 to +150 |
| NO _x Offset | 0.8 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 13 November 2022

BRAND : API

MODEL : 200E

NO. NOX-R07

SERIAL NO. 4468

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 48

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 | 1.008 |
| NO _x Span | 400 | 400.3 | 0.075 | 400.0 | 1.011 |

API Model 200E NO_x Analyzer Check List

| Test Values | Observed Value | Units | Nominal Range |
|---------------------------|----------------|---------|----------------------------|
| RANGE | 500 | PPB | 500 standard |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air |
| SAMPLE FLOW | 511 | cc/min | 500 ± 50 |
| OZONE FLOW | 79 | cc/min | 80 ± 15 |
| PMT | 103.2 | mV | -20 - 150 |
| AZERO | 94.3 | mV | -20 - 150 |
| HVPS | 672 | V | 420 - 900 constant |
| RCELL TEMP | 50.3 | °C | 50 ± 1 |
| BOX TEMP | 29.4 | °C | 8 - 48 |
| PMT TEMP | 7.2 | °C | 7 ± 2 |
| MOLY TEMP | 315.2 | °C | 315 ± 5 |
| RCELL PRESS | 8.2 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.4 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.008 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.011 | - | 1.0 ± 0.3 |
| NO Offset | 1.5 | mV | -20 to +150 |
| NO _x Offset | 1.0 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

(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 : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905


ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

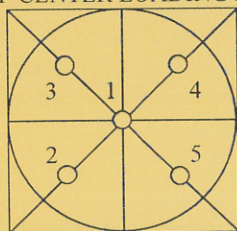
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g
5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

6. OFF CENTER LOADING ERROR



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

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

END OF CALIBRATION REPORT

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 ± 5) °C
Relative Humidity : (60.1 ± 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

| Material | Ref. type | Cell serial No. | Cert. No. | Due Date |
|--------------------------------|---------------|-----------------|------------|------------|
| 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)

| Material | Certified Values of Reference Material (nm) | UUC* Reading (nm) | Error (nm) | Uncertainty ± (nm) | k Factor |
|----------|--|----------------------|---------------|-----------------------|-------------|
| 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

คุณภาพอากาศจากปล่องระบาย



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High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

| High Volume Air Sampler Data | | Calibration Data | | |
|------------------------------|------------|------------------|--|----------------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft ³ /min) | R ² |
| B35 | B35 | 03/11/2022 | $y = 1.306x - 9.466$ | 0.997 |
| B36 | B36 | 02/11/2022 | $y = 1.213x - 5.932$ | 0.996 |
| B37 | B37 | 01/11/2022 | $y = 1.253x - 5.209$ | 0.999 |
| B38 | B38 | 01/11/2022 | $y = 1.228x - 5.530$ | 0.995 |
| B39 | B39 | 01/11/2022 | $y = 1.319x - 9.149$ | 0.998 |
| B40 | B40 | 01/11/2022 | $y = 1.196x - 4.045$ | 0.999 |
| B41 | B41 | 07/11/2022 | $y = 1.179x - 2.611$ | 0.999 |
| B42 | B42 | 01/11/2022 | $y = 1.209x - 3.713$ | 0.995 |
| B43 | B43 | 02/11/2022 | $y = 1.187x - 3.331$ | 0.998 |
| B44 | B44 | 07/11/2022 | $y = 1.298x - 8.171$ | 0.996 |
| R01 | R01 | 02/11/2022 | $y = 1.289x - 8.287$ | 0.998 |
| R02 | R02 | 07/11/2022 | $y = 1.307x - 10.165$ | 0.999 |
| R03 | R03 | 03/11/2022 | $y = 1.259x - 7.634$ | 0.995 |
| R04 | R04 | 04/11/2022 | $y = 1.157x - 2.287$ | 0.995 |
| R05 | R05 | 03/11/2022 | $y = 1.273x - 8.311$ | 0.999 |
| R06 | R06 | 01/11/2022 | $y = 1.297x - 8.271$ | 0.999 |
| R07 | R07 | 02/11/2022 | $y = 1.071x + 1.468$ | 0.995 |
| R08 | R08 | 01/11/2022 | $y = 1.206x - 5.068$ | 0.997 |
| R09 | R09 | 01/11/2022 | $y = 1.252x - 7.084$ | 0.995 |
| R10 | R10 | 03/11/2022 | $y = 1.246x - 5.817$ | 0.999 |
| R11 | R11 | 03/11/2022 | $y = 1.117x - 1.156$ | 0.998 |
| R12 | R12 | 02/11/2022 | $y = 1.351x - 12.068$ | 0.996 |
| R13 | R13 | 03/11/2022 | $y = 1.118x - 0.601$ | 0.999 |
| R14 | R14 | 03/11/2022 | $y = 1.164x - 2.415$ | 0.996 |
| R15 | R15 | 03/11/2022 | $y = 1.134x - 1.793$ | 0.998 |
| R16 | R16 | 04/11/2022 | $y = 1.182x - 4.717$ | 0.996 |
| R17 | R17 | 07/11/2022 | $y = 1.218x - 5.356$ | 0.998 |
| R18 | R18 | 04/11/2022 | $y = 1.233x - 5.977$ | 0.996 |
| R19 | R19 | 07/11/2022 | $y = 1.277x - 7.752$ | 0.997 |
| R20 | R20 | 04/11/2022 | $y = 1.327x - 10.628$ | 0.997 |

Calibrated by :

(Mr. Abdul Dangklom)

Approved by :

(Mr. Peera Detudom)



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Pitot Tube Calibration Report



Calibration Method

Standard Pitot Tube

Calibration Data

| Pitot Tube Data | | | Calibration Data | | |
|-----------------|---------------|-------------------------------|------------------|-------------------|--------|
| No. | Type of Pitot | Coefficient of Standard Pitot | Date | Avg. of Cp (test) | |
| | | | | Side A | Side B |
| B03 | S | 0.99 | 02/11/2022 | 0.84 | 0.85 |
| B04 | S | 0.99 | 04/11/2022 | 0.84 | 0.85 |
| B05 | S | 0.99 | 04/11/2022 | 0.84 | 0.84 |
| B07 | S | 0.99 | 02/11/2022 | 0.84 | 0.83 |
| B08 | S | 0.99 | 03/11/2022 | 0.84 | 0.84 |
| B09 | S | 0.99 | 02/11/2022 | 0.83 | 0.84 |
| B11 | S | 0.99 | 04/11/2022 | 0.84 | 0.84 |
| B16 | S | 0.99 | 02/11/2022 | 0.83 | 0.84 |
| B18 | S | 0.99 | 02/11/2022 | 0.84 | 0.84 |
| B19 | S | 0.99 | 04/11/2022 | 0.83 | 0.84 |
| B21 | S | 0.99 | 02/11/2022 | 0.84 | 0.85 |
| B24 | S | 0.99 | 04/11/2022 | 0.84 | 0.84 |
| B27 | S | 0.99 | 03/11/2022 | 0.84 | 0.85 |
| B30 | S | 0.99 | 03/11/2022 | 0.84 | 0.85 |
| B31 | S | 0.99 | 03/11/2022 | 0.83 | 0.84 |
| B33 | S | 0.99 | 01/11/2022 | 0.84 | 0.84 |
| B35 | S | 0.99 | 01/11/2022 | 0.84 | 0.83 |

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

| | |
|--|---|
| Calibrated by :  (Mr. Adul Dangklom) | Approved by :  (Mr. Peera Detudom) |
|--|---|



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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

| Pitot Tube Data | | | Calibration Data | | |
|-----------------|---------------|----------------------------------|------------------|-------------------|--------|
| No. | Type of Pitot | Coefficient of Standard Pitot | Date | Avg. of Cp (test) | |
| | | | | Side A | Side B |
| B36 | S | 0.99 | 02/11/2022 | 0.83 | 0.84 |
| B37 | S | 0.99 | 01/11/2022 | 0.84 | 0.83 |
| B38 | S | 0.99 | 02/11/2022 | 0.84 | 0.85 |
| B39 | S | 0.99 | 04/11/2022 | 0.84 | 0.84 |
| B40 | S | 0.99 | 02/11/2022 | 0.85 | 0.84 |
| B41 | S | 0.99 | 02/11/2022 | 0.84 | 0.85 |
| B44 | S | 0.99 | 02/11/2022 | 0.84 | 0.83 |
| B45 | S | 0.99 | 01/11/2022 | 0.84 | 0.83 |
| B46 | S | 0.99 | 01/11/2022 | 0.84 | 0.85 |
| B47 | S | 0.99 | 03/11/2022 | 0.84 | 0.84 |
| B48 | S | 0.99 | 03/11/2022 | 0.83 | 0.84 |
| B49 | S | 0.99 | 04/11/2022 | 0.85 | 0.84 |
| B54 | S | 0.99 | 01/11/2022 | 0.83 | 0.84 |
| B56 | S | 0.99 | 01/11/2022 | 0.84 | 0.85 |
| B57 | S | 0.99 | 04/11/2022 | 0.85 | 0.84 |
| B58 | S | 0.99 | 04/11/2022 | 0.84 | 0.84 |

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

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| B41 | SKC | 224-PCXR4 | 612669 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,990 | 0.994x + 3.271 | 1.000 |
| B42 | SKC | 224-PCXR4 | 626041 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,498 | 1,994 | 0.988x + 15.619 | 1.000 |
| B43 | SKC | 224-PCXR4 | 034636 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,501 | 1,992 | 0.991x + 10.565 | 1.000 |
| B44 | SKC | 224-PCXR8 | 529341 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,502 | 2,002 | 1.011x - 21.418 | 0.999 |
| B45 | SKC | 224-PCXR8 | 529594 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,989 | 0.993x + 5.959 | 1.000 |
| B46 | SKC | 224-PCXR8 | 566743 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,504 | 2,002 | 1.016x - 32.885 | 0.999 |
| B47 | SKC | 224-PCXR8 | 566747 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.013x - 24.960 | 0.999 |
| B48 | SKC | 224-PCXR8 | 566753 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,998 | 0.999x - 2.114 | 1.000 |
| B49 | SKC | 224-PCXR8 | 566780 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,502 | 2,003 | 1.012x - 22.706 | 0.999 |
| B50 | SKC | 224-PCXR8 | 500400 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,495 | 2,002 | 1.001x - 3.737 | 1.000 |
| B51 | SKC | 224-PCXR8 | 500363 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,504 | 1,999 | 1.011x - 25.590 | 0.999 |
| B52 | SKC | 224-PCXR8 | 093186 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,496 | 1,994 | 0.997x - 1.161 | 1.000 |
| B53 | SKC | 224-PCXR8 | 707670 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,002 | 1.010x - 20.668 | 0.999 |
| B54 | SKC | 224-PCXR3 | 509821 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,500 | 2,001 | 1.017x - 34.516 | 0.999 |
| B55 | SKC | 224-PCXR3 | 510710 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,994 | 0.995x + 2.521 | 1.000 |
| B56 | SKC | 224-PCXR3 | 511450 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,001 | 1.004x - 7.562 | 1.000 |
| B57 | SKC | 224-PCXR3 | 510798 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,492 | 1,998 | 0.996x +1.109 | 1.000 |
| B58 | SKC | 224-PCXR3 | 509852 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,999 | 1.007x - 19.113 | 0.999 |
| B59 | SKC | 224-PCXR3 | 509862 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 1,994 | 0.997x + 2.955 | 1.000 |
| B60 | SKC | 224-PCXR3 | 512655 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,500 | 2,003 | 1.010x - 19.862 | 0.999 |
| B61 | SKC | 224-PCXR3 | 503915 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,489 | 1,998 | 1.004x - 11.786 | 1.000 |
| B62 | SKC | 224-PCXR3 | 505975 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,996 | 0.997x - 0.064 | 1.000 |
| B63 | SKC | 224-PCXR3 | 511432 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,501 | 1,999 | 1.017x - 35.461 | 0.999 |
| B64 | SKC | 224-PCXR3 | 508302 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,492 | 1,989 | 0.992x + 6.266 | 1.000 |
| B65 | SKC | 224-PCXR3 | 508310 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,003 | 1.011x - 21.992 | 0.999 |
| B66 | SKC | 224-PCXR3 | 509861 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,991 | 0.988x + 13.904 | 1.000 |
| B67 | SKC | 224-PCXR3 | 506295 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,508 | 2,004 | 1.017x - 32.785 | 0.999 |
| B68 | SKC | 224-PCXR3 | 505872 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,997 | 0.994x + 5.237 | 1.000 |
| B69 | SKC | 224-PCXR3 | 508375 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,499 | 2,000 | 1.010x - 21.330 | 0.999 |
| B70 | SKC | 224-PCXR3 | 510623 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,503 | 1,997 | 1.002x - 6.054 | 1.000 |
| B71 | SKC | 224-PCXR3 | 508367 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 990 | 1,506 | 2,002 | 1.018x - 37.025 | 0.999 |
| B72 | SKC | 224-PCXR3 | 505977 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,498 | 1,993 | 0.993x + 5.731 | 1.000 |
| B73 | SKC | 224-PCXR3 | 512606 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,005 | 1.014x - 24.397 | 0.999 |
| B74 | SKC | 224-PCXR3 | 505993 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,495 | 1,994 | 0.999x - 4.284 | 1.000 |
| B75 | SKC | 224-PCXR3 | 509820 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,498 | 1,990 | 0.995x + 2.987 | 1.000 |
| B76 | SKC | 224-PCXR3 | 509811 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,498 | 1,998 | 1.006x - 14.003 | 1.000 |
| B77 | SKC | 224-PCXR3 | 508301 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,501 | 2,003 | 1.014x - 25.845 | 0.999 |
| B78 | SKC | 224-PCXR3 | 510677 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 1,999 | 1.012x - 27.321 | 0.999 |
| B79 | SKC | 224-PCXR3 | 510920 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,493 | 1,994 | 0.999x - 3.905 | 1.000 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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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 | R² |
| L-R01 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 50.2 | 101.0 | 203.9 | 0.987x + 2.546 | 1.000 |
| L-R02 | Dwyer | VFA-21 | 05/10/2022 | 50 | 100 | 200 | 50.1 | 101.3 | 200.5 | 1.007x – 0.870 | 0.999 |
| L-R03 | Dwyer | VFA-21 | 06/10/2022 | 50 | 100 | 200 | 50.1 | 99.8 | 202.3 | 1.017x – 1.042 | 1.000 |
| L-R04 | Dwyer | VFA-21 | 06/10/2022 | 50 | 100 | 200 | 50.2 | 100.9 | 201.0 | 1.008x – 1.004 | 0.999 |
| L-R05 | Dwyer | VFA-21 | 05/10/2022 | 50 | 100 | 200 | 50.2 | 100.8 | 203.0 | 0.990x + 1.973 | 1.000 |
| L-R06 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 50.2 | 99.1 | 201.5 | 1.004x – 0.364 | 1.000 |

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



@clccalibration



CLC
Accredited
ISO/IEC 17025

CALIBRATION LABORATORY Co., LTD.

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



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

CORRECTION OF PRESSURE

| DUC Test point (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

**QUALITY CALIBRATION CO.,LTD.**

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

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

www.qcalibration.com

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905


ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

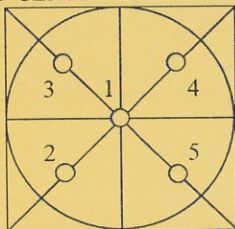
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g
5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

6. OFF CENTER LOADING ERROR



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

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

END OF CALIBRATION REPORT



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 : Suwarot Trikainut

Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

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 | 10/08/2022 | |



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



VARIAN



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 |



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 ± 5) °C
Relative Humidity : (60.1 ± 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

| Material | Ref. type | Cell serial No. | Cert. No. | Due Date |
|--------------------------------|---------------|-----------------|------------|------------|
| 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)

| Material | Certified Values of Reference Material (nm) | UUC* Reading (nm) | Error (nm) | Uncertainty ± (nm) | k Factor |
|----------|--|----------------------|---------------|-----------------------|-------------|
| 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

คุณภาพน้ำ

Certificate of Calibration

Certificate No. : 65-400210-1

Page : 1 of 2

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

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

Equipment : Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : TM21/59

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

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

Date of Received : 19 April 2022

Date of Calibration : 23 April 2022

Date of Issue : 23 April 2022

Calibrated by : Chortip Samchusri

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

The temperature scale used was based on ITS-90

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

1. Platinum Resistance Thermometer (PRT)

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

2. Standard Digital Thermometer

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

Approved by :

(Bunjerd Masri)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 65-400210-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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

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

Remark

UUC : Unit Under Calibration

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

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

- o0o -

3/





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



Cert.No.: 21CH1216

Page.: 1 of 2

Certificate of Calibration

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

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

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

Issue Date : 22 September 2021

The Uncertainties are for a confidence probability of approximately 95%

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

A 0032410



Cert. No.: 21CH1216

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

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

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

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

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

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

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

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

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

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

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

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

-o0o-

maku.

a 1072797

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

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



CERTIFICATE No : 22E9693

REFERENCE No : 66476-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER

MANUFACTURER : HANNA

MODEL : HI 3512

SERIAL No : TH118035


ID No : pH 04/56

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 : 15-Sep-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 15-Sep-22

RECEIVED DATE : 14-Sep-22

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

**QUALITY CALIBRATION CO.,LTD.**

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

CERTIFICATE No : 22E9693

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : HANNA
ID No : pH 04/56
RECEIVED DATE : 14-Sep-22
AMBIENT TEMPERATURE : 20 ° C ± 1 ° C

MODEL : HI 3512
SERIAL NUMBER : TH118035
CALIBRATION DATE : 15-Sep-22
RELATIVE HUMIDITY : 50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062 AND WI-TQ-063. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER
2. REFERENCE STANDARD INSTRUMENTS :-

| <u>INSTRUMENT</u> | <u>MODEL</u> | <u>SERIAL No/ LOT No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|---------------------------|--------------|------------------------------|-----------------------|-----------------|
| 1) pH STANDARD SOLUTION | 00651-06 | CC719181 | 4880-12119147 | 05-Apr-23 |
| 2) pH STANDARD SOLUTION | 00651-08 | CC718727 | 4881-12110709 | 31-Mar-23 |
| 3) pH STANDARD SOLUTION | 00651-10 | CC717045 | 4882-12065386 | 17-Mar-23 |
| 4) PROCESS CALIBRATOR | CA150 | 91S6079 | 22E1145 | 31-Mar-23 |
| 5) BATH | 260014 | 1247 48074 | 22T9870 | 13-Sep-23 |
| 6) THERMOMETER WITH PROBE | 421504 | 55000379 | 22T9904 | 13-Sep-23 |

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

RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR $k = 2.303 RT/F = 59 \text{ mV/pH}$

| mV APPLIED | UUC READING (mV) | CORRECTION (mV) | UUC READING (pH) | UNCERTAINTY OF MEASUREMENT (± mV) | COVERAGE FACTOR k |
|---------------|---------------------|--------------------|---------------------|---|-------------------------|
| 414.11 | 414.8 | -0.69 | -0.171 | 0.14 | 2.0 |
| 354.95 | 355.6 | -0.65 | 0.860 | 0.14 | 2.0 |
| 295.80 | 296.4 | -0.60 | 1.892 | 0.14 | 2.0 |
| 236.64 | 237.2 | -0.56 | 2.922 | 0.14 | 2.0 |
| 177.48 | 178.0 | -0.52 | 3.954 | 0.14 | 2.0 |
| 118.32 | 118.8 | -0.48 | 4.985 | 0.14 | 2.0 |
| 59.16 | 59.7 | -0.54 | 6.016 | 0.14 | 2.0 |
| 0.00 | 0.5 | -0.50 | 7.049 | 0.14 | 2.0 |
| -59.16 | -58.8 | -0.36 | 8.136 | 0.14 | 2.0 |
| -118.32 | -117.9 | -0.42 | 9.223 | 0.14 | 2.0 |
| -177.48 | -177.1 | -0.38 | 10.311 | 0.14 | 2.0 |
| -236.64 | -236.3 | -0.34 | 11.399 | 0.14 | 2.0 |
| -295.80 | -295.5 | -0.30 | 12.487 | 0.14 | 2.0 |
| -354.95 | -354.7 | -0.25 | 13.575 | 0.14 | 2.0 |
| -414.11 | -413.9 | -0.21 | 14.662 | 0.14 | 2.0 |

END OF CALIBRATION REPORT PAGE 2 OF 3

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CERTIFICATE No : 22E9693

PAGE : 3 OF 3

Calibration Report**RESULT OF CALIBRATION (CONTINUE) :****2. DISPLAY UNIT WITH pH ELECTRODE S/N: 09081C6M**

| STANDARD pH BUFFER SOLUTION (pH) | UUC READING (pH) | CORRECTION (pH) | VALUE BEFORE ADJUSTMENT | UNCERTAINTY OF MEASUREMENT (\pm pH) | COVERAGE FACTOR k |
|--|---------------------|--------------------|-------------------------------|--|-------------------------|
| 4.007 | 4.007 | 0.000 | 3.996 | 0.012 | 2.0 |
| 7.004 | 7.006 | -0.002 | 6.944 | 0.012 | 2.0 |
| 10.016 | 10.012 | 0.004 | 10.194 | 0.014 | 2.0 |

3. DISPLAY UNIT WITH TEMPERATURE

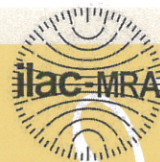
| STANDARD READING ($^{\circ}$ C) | UUC READING ($^{\circ}$ C) | CORRECTION ($^{\circ}$ C) | VALUE BEFORE ADJUSTMENT | UNCERTAINTY OF MEASUREMENT (\pm $^{\circ}$ C) | COVERAGE FACTOR k |
|--|--------------------------------|-------------------------------|-------------------------------|--|-------------------------|
| 25.003 | 25.0 | 0.003 | --- | 0.0085 | 2.0 |

4. PERCENT SLOPE 100%

UUC : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT



CERTIFICATE No : 22M2569

REFERENCE No : 64386-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843

ID No : BA 09/61

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22



CERTIFICATE No : 22M2569

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW
MANUFACTURER : SARTORIUS S/N : 36591843
ID No : BA 09/61 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 51 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT**MODEL****SERIAL No****CERTIFICATE No****DUE DATE**

1) STANDARD WEIGHT SET

E2

QK-I-151

C02210415

09-Feb-23

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

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

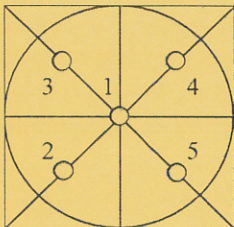
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000048 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

5. OFF CENTER LOADING ERROR



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

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

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

END OF CALIBRATION REPORT



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

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

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

Cert.No.: 22TW98

Page.: 1 of 2

Certificate of Testing

| | |
|--|--|
| Equipment : | DO Meter |
| Manufacturer : | YSI |
| Model : | 5000-230V |
| Serial No. : | 15B100751 |
| ID No. : | - |
| Received Date : | 20 April 2022 |
| Test Date : | 21 April 2022 |
| Reference : | 2204-0429WC-1 |
| Submitted by : | S.P.S. Consulting Service Co.,Ltd. 7 Phaholyothin 24, Phaholyothin Road., Jompol, Chatuchak, Bangkok 10900 |
| Laboratory Condition : | Temperature (25 ± 5) °C Humidity (50 ± 20) % |
| Test Procedure : | In - house method : CP-CH9 by Comparison Technique with Azide Modification Method |
| Tested by : | Walalak Sirithean |
| Approved by : | <div style="background-color: gray; width: 150px; height: 30px; margin: 0 auto;"></div> Approved Signatory |
| <input checked="" type="checkbox"/> Malee Butkruea <input type="checkbox"/> Saithip Meangmai <input type="checkbox"/> Warakorn Lerngagtrakul | |
| Issue Date : | 25 April 2022 |



Cert.No.: 22TW98

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

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

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14J100195

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

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

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www.qcalibration.com

CERTIFICATE No : 22T0570

REFERENCE No : 63773-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200


SERIAL No : 15110C0498

ID No : DRB 06/59

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

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 21-Jan-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 21-Jan-22

RECEIVED DATE : 19-Jan-22



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

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

CERTIFICATE No : 22T0570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
ID NUMBER : DRB 06/59
RECEIVED DATE : 19-Jan-22
AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200
SERIAL NUMBER : 15110C0498
CALIBRATION DATE : 21-Jan-22
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

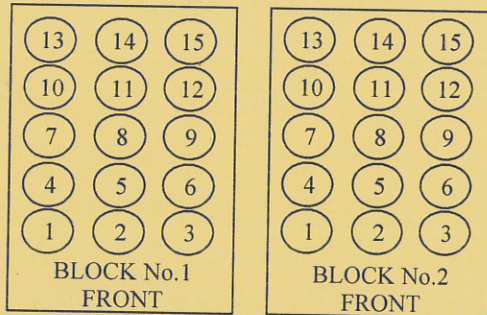
1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



TEMPERATURE MEASUREMENT ACCURACY TEST

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

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

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

END OF CALIBRATION REPORT

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: CN10925120
Organization Name: S.P.S Consulting service
Organization Location: 7 Soi Phaholyothin Road, Ladyao, Khet Jatujak, Bangkok 10900
Date: March 29, 2022 3:56:41 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Back SSL

Setpoint Status:

Pass

Pressure:

25.0 psi

Pressure Change:

-0.2 psi /5 minutes

Agilent Recommended:

>= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Back SSL

Date: March 29, 2022 3:56:41 PM
System ID: CN10925120

Setpoint Status:

Pass

| | Setpoint | | Actual | |
|----------------------|----------|-----|--------|-----|
| Inlet Pressure: | 25.0 | psi | 25.0 | psi |
| Accuracy: | | | 0.0 | psi |
| Agilent Recommended: | | | <= 1.2 | |

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Accuracy

Name:

7890

Front

SSL

Setpoint Status:

Pass

| | Setpoint | | Actual | |
|----------------------|----------|-----|--------|-----|
| Inlet Pressure: | 25.0 | psi | 25.0 | psi |
| Accuracy: | | | 0.0 | psi |
| Agilent Recommended: | | | <= 1.2 | |

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name:

7890

Front

FID

Setpoint Status:

Pass

Flow Type:

Fuel

Setpoint:

30.0

mL/min

Measured Flow:

30.4

mL/min

Accuracy:

0.4

mL/min

Agilent Recommended:

<=

10.0

% setpoint

(

3.0

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Date:

March 29, 2022 3:56:41 PM

System ID:

CN10025120

Setpoint Status:

Pass

Flow Type:

Oxidizer

Setpoint:

400.0

mL/min

Measured Flow:

392.6

mL/min

Accuracy:

7.4

mL/min

Agilent Recommended:

<=

10.0

% setpoint

(

40.0

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status:

Pass

Flow Type:

Makeup

Setpoint:

25.0

mL/min

Measured Flow:

25.4

mL/min

Accuracy:

0.4

mL/min

Agilent Recommended:

<=

10.0

% setpoint

(

2.5

mL/min

)

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name:

7890

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0

230.6

°C

Accuracy:

0.6

°C

Agilent Recommended:

>=

-1.0

% setpoint in K

(

-5.0

°C

)

<=

1.0

% setpoint in K

(

5.0

°C

)

Date:

March 29, 2022 3:56:41 PM

System ID:

CN10025120

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0 100.3 °C

Accuracy:

0.3 °C

Agilent Recommended:

>= -1.0 % setpoint in K

(-3.7 °C)

<= 1.0 % setpoint in K

(3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:

7890

Setpoint Status:

Pass

Setpoint/Average

Temperature:

100.0 100.2333 °C

Stability:

0.1 °C

Agilent Recommended:

<= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1

Back

SSL

/ Front

FID

Manual Injection

Name:

Not applicable

Setpoint Status:

Completed

Injection Volume on Column:

1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1

Back

SSL

/ Front

FID

Date:

March 29, 2022 3:56:41 PM

System ID:

CN10025120

Name: 7890

Setpoint Status: Pass

Base Signal: 12.1 pA

ASTM Noise

counts

712.29

<= 768.00

Agilent Recommended:

Status: Pass

Drift

counts/Hr

275.82

<= 19200.00

Pass

Overall Noise and Drift Test Status

Pass

Signal to Noise

Tested Combination1 Back SSL / Front FID

Manual Injection

Name: 7890

Setpoint Status: Pass

Signal to Noise: 874687

Agilent Recommended: >= 300000

Overall Signal to Noise Test Status

Pass

Log Amp

Tested Combination2 Front SSL / External SQ

Name: 5975C Inert XL with TAD

Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Date: March 29, 2022 3:56:41 PM
System ID: CN10025120

| Tested Combination2 | Front | SSL | / External | SQ |
|--------------------------|-------------------------|------|---------------------------|---------------|
| Name: | 5975C inert XL with TAD | | | |
| Setpoint Status: | Pass | | | |
| Amu: | 1050 | m/z | Drift After Five Minutes: | RFPA Voltage: |
| | | | 4 | 485 |
| | | | mV | mV |
| Agilent Recommended: | >= | -100 | and | <= 100 |
| | | | | <= 1100 |
| Overall RFPA Test Status | | | | |
| Pass | | | | |

Tune EI

| Tested Combination2 | Front | SSL | / External | SQ |
|-----------------------------|-------------------------|-----|------------|----|
| Name: | 5975C inert XL with TAD | | | |
| Setpoint Status: | Pass | | | |
| Filament: | 1 | | | |
| Setpoint Status: | Pass | | | |
| Filament: | 2 | | | |
| Overall Tune EI Test Status | | | | |
| Pass | | | | |

Signal to Noise EI

| Tested Combination2 | Front | SSL | / External | SQ |
|----------------------|-------------------------|-----------|------------|----|
| Name: | 5975C inert XL with TAD | | | |
| Source: | EI - Inert | Filament: | 1 | |
| Setpoint Status: | Pass | | | |
| Signal to Noise: | 332 | | | |
| Agilent Recommended: | >= 320 | | | |

Source: EI - Inert Filament: 2

Setpoint Status: Pass

Signal to Noise: 422

Agilent Recommended: \geq 320

Overall Signal to Noise EI Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

| | |
|--------------|----------------------|
| System ID | CN10925120 |
| Manufacturer | Agilent Technologies |
| Name | 7890 |

Tested Combination1

| | |
|---------------------|------------------|
| Injection Technique | Manual Injection |
| Sampler Identifier | Sampler 1 |
| Inlet | Back |
| Detector | Front |
| LTM Included? | No |

Tested Combination2

| | |
|---------------------|------------------|
| Injection Technique | Manual Injection |
| Sampler Identifier | Sampler 2 |
| Inlet | Front |
| Detector | External |
| LTM Included? | No |

Sampler 1

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Manual Injection |
| Usage | Sample Injection |
| Syringe Volume (µL) | 10 |

Sampler 2

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Type | Manual Injection |
| Usage | Sample Injection |
| Syringe Volume (µL) | 10 |

Date: March 29, 2022 3:56:41 PM
System ID: CN10925120

Mainframe 1

| | |
|-------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Model Number | G3440A |
| Serial Number | CN10925120 |
| Firmware Revision | A.01.10.3 |
| Oven Type | Standard |

Inlet 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Front |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Inlet 2

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | SSL |
| Location | Back |
| Carrier Gas | Helium |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes |

Detector 1

| | |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies |
| Name | 7890 |
| Type | FID |
| Adapter | Capillary |
| Control Type | Electronic Pressure Control (EPC) |
| Location | Front |
| Makeup Gas | Nitrogen |

Detector 2

| | |
|--------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name | Mass Spectrometer |
| Type | Mass Spectrometer |
| Location | External |

Mass Spectrometer 1

| | |
|-----------------------|-------------------------|
| Manufacturer | Agilent Technologies |
| Type | SQ |
| Name | 5975C inert XL with TAD |
| Serial Number | US91732743 |
| Firmware Revision | 5975 5.02.07 |
| High Vacuum System | Turbo Pump |
| Scouting Run Standard | OFN Std |

MS EI Source 1

| | |
|---------------------|----------------------|
| Manufacturer | Agilent Technologies |
| Source Type | EI - Inert |
| Number of filaments | 2 |

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

| | |
|--------------------------|---|
| Full Name of Signer: | Saenguthai Tarak |
| Logged On User Name: | saenguthai.tarak@non.agilent.com |
| Signature Creation Date: | March 29, 2022 |
| Reason for Signature: | Executed protocol and published this original version of document |

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| | |
|------------|---------------------------|
| Date: | March 29, 2022 3:56:41 PM |
| System ID: | CN10925120 |

User Name: saenguthai.tarak
 Hostname: LAPTOP-CQ3\$KOMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| March 29, 2022 1:45:41 PM | Audit | SessionCreated | Session | None |
| March 29, 2022 1:45:41 PM | Start | Configuration | Session | None |
| March 29, 2022 1:45:41 PM | Audit | Entitlement | Licensing | User is Nonpaying and does not require an unlock code |
| March 29, 2022 1:46:18 PM | Audit | EqpLoaded | Session | EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.50/Gc.02.50.eqp], EQP File Name: [Gc.02.50.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.50/GcMs.02.50.eqp], EQP File Name: [GcMs.02.50.eqp], EQP Name: [AgilentRecommended] |
| March 29, 2022 1:46:20 PM | End | Configuration | Session | None |
| March 29, 2022 1:46:24 PM | Start | Qualification | Session | OQ |
| March 29, 2022 1:46:24 PM | Start | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | None |
| March 29, 2022 1:47:33 PM | End | Execution | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | Run Count : 1 |

User Name: saenguthai.tarak
 Hostname: LAPTOP-CQ3SKOMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|----------------------|
| March 29, 2022 1:47:36 PM | Start | Execution | Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | None |
| March 29, 2022 1:47:47 PM | End | Execution | Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi | Run Count : 1 |
| March 29, 2022 1:47:48 PM | Start | Execution | Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| March 29, 2022 1:47:53 PM | End | Execution | Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| March 29, 2022 1:47:54 PM | Start | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | None |
| March 29, 2022 1:48:02 PM | End | Execution | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi | Run Count : 1 |
| March 29, 2022 1:48:04 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | None |
| March 29, 2022 1:48:18 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| March 29, 2022 1:48:20 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | None |
| March 29, 2022 1:48:26 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |

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Date: March 29, 2022 3:56:41 PM
 System ID: CN10925120

User Name: saenguthai.tarak
 Hostname: LAPTOP-CQ3SKOMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|----------------------|
| March 29, 2022 1:48:27 PM | Start | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | None |
| March 29, 2022 1:48:40 PM | End | Execution | Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint | Run Count : 1 |
| March 29, 2022 1:48:42 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| March 29, 2022 1:49:00 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| March 29, 2022 1:49:03 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| March 29, 2022 1:49:06 PM | Start | Execution | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None |
| March 29, 2022 1:49:30 PM | Audit | Data | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry |
| March 29, 2022 1:49:31 PM | End | Execution | GC Oven Temperature Accuracy - 7890: - Temperature ; Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1 |
| March 29, 2022 1:49:33 PM | Start | Execution | GC Oven Temperature Stability - 7890: - Temperature ; Oven - S: 100.0°C - L: <= 0.5°C | None |

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Date: March 29, 2022 3:56:41 PM
 System ID: CN10925120

User Name: saenguthai.tarak
 Hostname: LAPTOP-CQ3SKOMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|---|--|
| March 29, 2022 1:50:29 PM | Audit | Data | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Manual Data Entry |
| March 29, 2022 1:50:30 PM | End | Execution | GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C | Run Count : 1 |
| March 29, 2022 3:15:23 PM | Start | Execution | GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated | None |
| March 29, 2022 3:15:26 PM | Start | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |
| March 29, 2022 3:15:39 PM | Start | Execution | GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated | None |
| March 29, 2022 3:16:02 PM | Audit | Data | GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated | Data files Path : F:\PMOQ2022\SC_FID.D\FID 1A.ch |
| March 29, 2022 3:16:37 PM | End | Execution | GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated | Run Count : 1 |
| March 29, 2022 3:16:39 PM | Start | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |
| March 29, 2022 3:25:39 PM | Start | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | None |

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Date: March 29, 2022 3:56:41 PM
 System ID: CN10925120

User Name: saenguthal.tarak
 Hostname: LAPTOP-CQ3SKOMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|--|---|
| March 29, 2022 3:26:13 PM | Audit | Data | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Data files Path : F:\PMOQ2022\IND_FID.D\FID1A.ch |
| March 29, 2022 3:26:19 PM | End | Execution | Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour | Run Count : 1 |
| March 29, 2022 3:27:37 PM | Start | Execution | Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000 | None |
| March 29, 2022 3:27:49 PM | Audit | Data | Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000 | Data files Path : F:\PMOQ2022\SN_FID.D\FID1A.ch |
| March 29, 2022 3:28:18 PM | End | Execution | Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000 | Run Count : 1 |
| March 29, 2022 3:29:49 PM | Audit | AcqRestarted | Session | None |
| March 29, 2022 3:30:44 PM | Audit | SessionReloaded | Session | None |
| March 29, 2022 3:30:47 PM | Start | Qualification | Session | OQ |
| March 29, 2022 3:30:53 PM | Start | Execution | Log Amp - 5975C Inert XL with TAD SQ: - Source: EI - Inert | None |
| March 29, 2022 3:31:02 PM | End | Execution | Log Amp - 5975C Inert XL with TAD SQ: - Source: EI - Inert | Run Count : 1 |
| March 29, 2022 3:31:05 PM | Start | Execution | RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert | None |
| March 29, 2022 3:33:09 PM | End | Execution | RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert | Run Count : 1 |
| March 29, 2022 3:33:11 PM | Start | Execution | Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated) | None |

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Date: March 29, 2022 3:56:41 PM
 System ID: CN10925120

User Name: saenguthai.tarak
 Hostname: LAPTOP-CQ3SKQMV

System Id: CN10925120
 Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|--|--|
| March 29, 2022 3:33:43 PM | End | Execution | Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated) | Run Count : 1 |
| March 29, 2022 3:33:45 PM | Start | Execution | Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated) | None |
| March 29, 2022 3:34:05 PM | End | Execution | Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated) | Run Count : 1 |
| March 29, 2022 3:34:37 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 1 - L: >= 320 | None |
| March 29, 2022 3:34:51 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 1 - L: >= 320 | Data files Path : F:\PMOQ2022\SN_F1_05.D\ DATASIM.MS |
| March 29, 2022 3:35:27 PM | End | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 1 - L: >= 320 | Run Count : 1 |
| March 29, 2022 3:35:30 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 2 - L: >= 320 | None |
| March 29, 2022 3:35:58 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 2 - L: >= 320 | None |

User Name: saenguthai.tarak
Hostname: LAPTOP-CQ3SKOMV


System Id: CN10925120
Print Date: March 29, 2022 3:56:43 PM

OQ_GCMS_SPS CN10925120 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---------------------------|-------------------|--------------------|--|---|
| March 29, 2022 3:36:32 PM | Start | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 2 - L: >= 320 | None |
| March 29, 2022 3:36:46 PM | Audit | Data | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 2 - L: >= 320 | Data files Path : F:\PMOQ2022\SN_F2_05.D\ DATASIM.MS |
| March 29, 2022 3:36:53 PM | End | Execution | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Inert using Filament 2 - L: >= 320 | Run Count : 1 |
| March 29, 2022 3:36:58 PM | End' | Qualification | Session | OQ |
| March 29, 2022 3:36:58 PM | Start | Reporting | Session | None |
| March 29, 2022 3:50:19 PM | Audit | Reporting | Session | Report Generated : Certificate |

GC Clarus 600/680 Preventive Maintenance (PM)

| | | | |
|---|--|--|-------------|
| Company Name: | S.P.S. Consulting Service Co.,Ltd | | |
| Address (Instrument Location): | 7 Soi Phaholyothin24 Phaholyothin Road, Jompol, Chatuchak, Bangkok, 10900. | | |
| Serial Number: | 680S14042502 | Service Tag: | N68APSSFXMP |
| Customer Name (if applicable): | Ms.Sujinda | PM number: | 2 of 2 |
| Service Engineer Name: | Pramote Chaisorn | Service Order Number: | WO-01841730 |
| Date PM Performed: (DD-MMM-YYYY) | 02-Sep-2022 | Next PM Due Date: (DD-MMM-YYYY) | 02-Mar-2023 |

| Part Number | Release | Publication Date |  PerkinElmer® |
|--------------------|----------------|-------------------------|--|
| TH09370070 | C | August 2016 | |

Scope

The purpose of this PM is to ensure the continued functionality of the Clarus 600 and Clarus 680 GC 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 # | Software Version | Configuration Notes |
|----------------------------|--------------|------------------|---------------------|
| Clarus680 | 680S14042502 | Totalchrom6.3.2 | |
| Clarus SQ8T | 648N4050804 | Turbomass 6.4 | |
| AtomX | US14113002 | Tekma AtomX | |
| | | | |

Parts Lists

| Additional Tools Required for PM | | | | |
|---|---------------------|----------|-------------|------------------------------|
| Part Number (if applicable) | Description | Quantity | Serial # | Calibration Due Date (MM/YY) |
| LF21-0503 | Fluke179 multimeter | 1 | 22460228 | 04-Nov-2022 |
| | | | | |
| Additional Reagents and Standards Required for PM | | | | |
| Part Number (if applicable) | Description | Quantity | Batch/Lot # | Expiration Date (MM/YY) |
| N/A | | | | |
| | | | | |

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.

- ☒ Check incoming AC line voltage for proper levels and grounding.

L-N 220 Volt

L-G 220 Volt

N-G 0.35 Volt

**Neutral to ground not more than 0.5 volts peak to peak*

- ☒ Inspect all gas line filters and traps; Replace if necessary with customer supplied spares.

Carrier gas ☒ Helium ☐ Nitrogen ☐ Hydrogen

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

Detector gas ☒ Air Zero ☒ Hydrogen ☐ Nitrogen ☐ Helium

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

- ☒ Inspect the customer log book and make any appropriate PM entries.

- ☒ Leak check all fittings from the gas source to instrument.

Gas leakage ☒ Pass ☐ Fail Comment _____

- ☒ Perform general inspection of system for cleanliness.

- ☒ Inspect for functional and clean electronic cooling and oven vent fans

Electronic cooling fan ☒ Yes ☐ No

Oven cooling fan ☒ Yes ☐ No

2. Electronic :

- ☒ Check oven temperature. Calibrate if necessary.

Oven temperature set point 150 °C ☒ Pass ☐ Fail

- ☐ Check sub-ambient option. (If installed).

Oven temperature set point 5 °C ☐ Pass ☐ Fail

- ☒ Perform routine maintenance on detector/injector. Replace parts as necessary with customer supplied spares.

- ☒ Check flows, including split flows if applicable. Calibrate if necessary.

| | |
|--------------|------|
| Carrier flow | Pass |
| Split flow | Pass |
- ☒ Check detector gas flows and adjust if necessary.

| | |
|---------------|------|
| Detector flow | Pass |
|---------------|------|
- ☒ Autosampler installed ☒ Yes ☐ No

| | |
|---|------|
| Check autosampler sensor for wear and replace if necessary. | |
| Vial sensor | Pass |
| Door sensor | Pass |
| Tower sensor | Pass |
| Plunger sensor | Pass |
| Elevator sensor | Pass |
- ☒ Remove syringe, manually flush. Replace with customer supplied spare if necessary.
- ☒ Check firmware version. Upgrade to current levels if necessary.

| | |
|------------------|------------|
| Firmware version | <u>6.5</u> |
|------------------|------------|
- ☒ Measure all accessible power supply voltages.

| | |
|----------|------|
| 5 Volt | Pass |
| +15 Volt | Pass |
| -15 Volt | Pass |
| 24 Volt | Pass |
- ☒ Record all detector voltage signal.

| | |
|--------------------|-----------------|
| Detector Channel A | <u>0.89</u> mV. |
| Detector Channel B | <u>NA</u> mV. |

3. Diagnostics Tests:

- ☒ Run instrument diagnostics.

| | |
|---|------|
| <input checked="" type="checkbox"/> BRAM | Pass |
| <input checked="" type="checkbox"/> EPROM | Pass |
- ☒ Run Autosampler diagnostics.

| | |
|---|------|
| <input checked="" type="checkbox"/> BRAM | Pass |
| <input checked="" type="checkbox"/> EPROM | Pass |

4. Review:

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

Additional Comments

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

Review

| | |
|--|---------------------------------------|
| <i>The preventive maintenance checks and if applicable performance tests for Clarus600/680 GC have been completed.</i> | |
| <i>This Clarus600/680 GC</i> | <i>Pass</i> |
| <i>the preventive maintenance.</i> | |
| Review of Preventive Maintenance: | |
| Authorized PerkinElmer Representative: Pramote Chaisorn | Date: 02-Sep-2022 (DD-MMM-YYYY) |
| Authorized Customer Representative: | Date: 02-Sep-2022 (DD-MMM-YYYY) |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|--|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>July 11, 2022</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>January 11, 2023</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>January 12, 2022</u> | |
| User Name: <u>K.Phenpha Vipasthawatt</u> | Visit Number: <u>1 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>August 30, 2022</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>November 30, 2022</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>August 30, 2022</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 11, 2022**1. MECHANICAL CHECKS**

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

2. OPTICAL CHECKS

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

3. COOLING SYSTEM CHECKS

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

4. PERFORMANCE CHECKS

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



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : July 11, 2022

| PARAMETER | SPECIFICATION | | | FINAL VALUE |
|----------------------------------|---------------|-------------|--|-----------------|
| Spectral Resolution : UV | As 193.696 nm | ≤ 0.007 | | <u>0.00544</u> |
| | Ni 231.604 nm | ≤ 0.008 | | <u>0.00709</u> |
| | Ni 341.476 nm | ≤ 0.012 | | <u>0.00757</u> |
| Spectral Resolution : VIS | La 408.672 nm | ≤ 0.020 | | <u>0.01638</u> |
| | Ba 455.403 nm | ≤ 0.025 | | <u>0.02391</u> |
| Precision | | | | |
| | As 193.656 nm | % RSD < 1.0 | | <u>0.91</u> % |
| | Zn 213.856 nm | % RSD < 1.0 | | <u>0.87</u> % |
| | Mn 257.610 nm | % RSD < 1.0 | | <u>0.76</u> % |
| | La 379.478 nm | % RSD < 1.0 | | <u>0.59</u> % |
| | Ba 455.403 nm | % RSD < 1.0 | | <u>0.53</u> % |
| | Ba 493.408 nm | % RSD < 1.0 | | <u>0.55</u> % |
| Detection Limits : Axial | Tl 190.080 nm | 3(sd) | | <u>5.51</u> ppb |
| | As 193.696 nm | 3(sd) | | <u>8.59</u> ppb |
| | Pb 220.353 nm | 3(sd) | | <u>0.50</u> ppb |
| Detection Limits : Radial | As 193.696 nm | 3(sd) | | <u>2.17</u> ppb |
| | Zn 213.856 nm | 3(sd) | | <u>0.03</u> ppb |
| | Mn 257.610 nm | 3(sd) | | <u>0.01</u> ppb |
| | La 379.478 nm | 3(sd) | | <u>0.04</u> ppb |
| | Ba 455.403 nm | 3(sd) | | <u>0.01</u> ppb |
| | Ba 493.408 nm | 3(sd) | | <u>0.00</u> ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd 226.502 nm | ≤ 150 ppb | | <u>12.46</u> |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn 257.610 nm | ≤ 45 ppb | | <u>30.82</u> |



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 11, 2022**Remarks :**

Commissioning follow as commissioning performance sheets.

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

☒

meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

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

Service Department PerkinElmer Ltd.

Authorized Representative:

(Mr. Wiphan Promlumda)

Service Engineer

ระดับเสียง

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

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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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

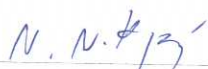
| Standard Microphone Type | Measured Frequency (Hz) | Deviated value (Hz) | Uncertainty (Hz) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 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. Nuttapong Niljrusvanit)


(Mr. Tawikiat Iamsamran)

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Approved by :


(Mr. Prawate Kluaypa)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

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.BL.MTC.002 Rev.4

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E-mail : sumalee@tistr.or.th



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

Noise R_589/22

Sound Level Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|----------------|------------------|---------------|
| Brand | ACO | Number | AC 03/56 |
| Model | 2127 | Serial No. | 130006 |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 28 April 2022 |
| | | Due Date | 28 April 2023 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-R08 | ACO | 6236 | 00152082 | 13 November 2022 | 94.0 | 94.0 |
| ACO-R21 | ACO | 6236 | 00182004 | 13 November 2022 | 94.1 | 94.0 |
| ACO-R26 | ACO | 6236 | 00192038 | 13 November 2022 | 94.1 | 94.0 |
| ACO-R31 | ACO | 6236 | 00192043 | 13 November 2022 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.93 ± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)

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, Chaluchak, 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 | R² |
| R01 | SKC | 224-PCXR4 | 602467 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,508 | 2,004 | 1.020x - 38.744 | 0.998 |
| R02 | SKC | 224-PCXR4 | 626450 | 01/07/2022 | 1,000 | 2,000 | 3,000 | 998 | 1,499 | 1,990 | 0.989x + 12.348 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,004 | 1.012x - 22.080 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,493 | 1,993 | 0.997x - 1.763 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 1,999 | 1.013x - 30.077 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,498 | 1,994 | 1.002x - 7.319 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,490 | 2,000 | 1.008x - 17.031 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 05/07/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,502 | 2,005 | 1.015x - 26.148 | 0.999 |
| R09 | SKC | 224-PCXR4 | 034650 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,504 | 2,002 | 1.018x - 36.777 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,512 | 1,994 | 1.000x + 0.100 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,499 | 2,002 | 1.013x - 25.598 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,501 | 1,999 | 1.001x - 4.866 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 1,993 | 0.991x + 10.115 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,502 | 1,999 | 1.013x - 29.654 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,500 | 2,004 | 1.013x - 25.263 | 0.999 |
| R16 | SKC | 224-PCXR8 | 529643 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,994 | 0.997x - 0.379 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,509 | 2,000 | 1.014x - 30.173 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,496 | 1,998 | 1.001x - 6.880 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,000 | 1.010x - 19.831 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 990 | 1,500 | 2,003 | 1.020x - 40.235 | 0.999 |
| R21 | SKC | 224-PCXR8 | 665728 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,493 | 1,999 | 1.001x - 5.604 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,001 | 1.011x - 21.494 | 0.999 |
| R23 | SKC | 224-PCXR8 | 761067 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,494 | 1,992 | 0.994x + 2.896 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,505 | 2,000 | 1.013x - 27.843 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,500 | 1,993 | 0.993x + 6.633 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.013x - 24.298 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 2,001 | 1.013x - 28.844 | 0.999 |
| R28 | SKC | 224-PCXR8 | 707481 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,004 | 1,500 | 2,003 | 1.010x - 19.727 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,491 | 1,991 | 0.988x + 13.928 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,994 | 0.998x - 1.149 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,001 | 1.012x - 23.161 | 0.999 |
| R32 | SKC | 224-PCXR8 | 671950 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,994 | 0.993x + 7.961 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,502 | 1,999 | 1.017x - 34.540 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,498 | 2,004 | 1.013x - 25.091 | 0.999 |
| R35 | SKC | 224-PCXR8 | 707460 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,995 | 0.994x + 5.472 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,001 | 1.009x - 19.272 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,499 | 1,998 | 0.998x + 0.243 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,500 | 2,002 | 1.015x - 32.039 | 0.999 |
| R39 | SKC | 224-PCXR8 | 761095 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,496 | 1,994 | 0.997x + 2.333 | 1.000 |

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Feera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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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 $^{\circ}$ 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 |
| R40 | SKC | 224-PCXR4 | 612753 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,003 | 1.012x – 22.926 | 0.999 |
| R41 | SKC | 224-PCXR4 | 626140 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,509 | 2,002 | 1.018x – 34.715 | 0.999 |
| R42 | SKC | 224-PCXR4 | 626463 | 01/07/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,493 | 2,000 | 1.004x – 7.949 | 1.000 |
| R43 | SKC | 224-PCXR4 | 626129 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,003 | 1.012x – 22.176 | 0.999 |
| R44 | SKC | 224-PCXR4 | 602753 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,495 | 1,993 | 0.996x + 1.332 | 1.000 |
| R45 | SKC | 224-PCXR4 | 626137 | 04/07/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,505 | 2,002 | 1.019x – 37.527 | 0.999 |

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Teera Detudom)



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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 | 04/07/2022 | 50 | 100 | 200 | 50.2 | 101.0 | 203.5 | 0.988x + 2.342 | 1.000 |
| L-R02 | Dwyer | VFA-21 | 04/07/2022 | 50 | 100 | 200 | 50.1 | 101.3 | 200.5 | 1.006x - 0.768 | 0.999 |
| L-R03 | Dwyer | VFA-21 | 04/07/2022 | 50 | 100 | 200 | 50.5 | 99.8 | 202.3 | 1.016x - 0.811 | 1.000 |
| L-R04 | Dwyer | VFA-21 | 01/07/2022 | 50 | 100 | 200 | 50.2 | 100.9 | 200.6 | 1.009x - 1.208 | 0.999 |
| L-R05 | Dwyer | VFA-21 | 01/07/2022 | 50 | 100 | 200 | 50.2 | 100.4 | 203.0 | 0.991x + 1.666 | 1.000 |
| L-R06 | Dwyer | VFA-21 | 04/07/2022 | 50 | 100 | 200 | 50.6 | 99.1 | 201.5 | 1.002x - 0.007 | 1.000 |

Calibrated by :

(Mr.Phakhinai Khongkomnerd)

Approved by :

(Mr. Peera Detudom)



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Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

| Calibration Data | | | | | | | | | | | |
|------------------|-------|--------|------------------|---------------------|-------|-------|-----------------|-------|--------|------------------------------|----------------|
| Rotameter Data | | | Calibration Data | | | | | | | | |
| No. | Brand | Model | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | Flow Rate (Reading) | | | Actual (Q std.) | | | | |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| H-R01 | Dwyer | VFB-65 | 04/07/2022 | 500 | 1,000 | 2,000 | 503.3 | 992.4 | 1978.7 | 0.999x - 3.250 | 0.999 |
| H-R02 | Dwyer | VFB-65 | 04/07/2022 | 500 | 1,000 | 2,000 | 501.2 | 995.3 | 1985.7 | 1.002x - 4.979 | 1.000 |
| H-R03 | Dwyer | VFB-65 | 04/07/2022 | 500 | 1,000 | 2,000 | 502.5 | 989.9 | 1996.9 | 0.993x + 3.105 | 1.000 |
| H-R04 | Dwyer | VFB-65 | 01/07/2022 | 500 | 1,000 | 2,000 | 496.4 | 989.6 | 2019.5 | 1.009x - 13.684 | 1.000 |
| H-R05 | Dwyer | VFB-65 | 01/07/2022 | 500 | 1,000 | 2,000 | 497.2 | 990.3 | 1988.1 | 1.003x - 8.079 | 1.000 |
| H-R06 | Dwyer | VFB-65 | 04/07/2022 | 500 | 1,000 | 2,000 | 504.6 | 992.4 | 1979.4 | 1.000x - 3.305 | 0.999 |

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Peera Detudom)



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| B01 | SKC | 224-PCXR4 | 262101 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,497 | 1,998 | 1.001x - 3.789 | 1.000 |
| B02 | SKC | 224-PCXR4 | 626166 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,505 | 2,001 | 1.009x - 19.707 | 0.999 |
| B03 | SKC | 224-PCXR4 | 612968 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,494 | 2,001 | 1.006x - 12.308 | 1.000 |
| B04 | SKC | 224-PCXR4 | 602804 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,502 | 2,000 | 1.004x - 5.919 | 1.000 |
| B05 | SKC | 224-PCXR4 | 612693 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,003 | 1.012x - 22.622 | 0.999 |
| B06 | SKC | 224-PCXR4 | 262188 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,507 | 1,999 | 1.005x - 11.738 | 1.000 |
| B07 | SKC | 224-PCXR4 | 626262 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,492 | 1,995 | 0.993x + 6.405 | 1.000 |
| B08 | SKC | 224-PCXR4 | 626100 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,003 | 1.013x - 24.18 | 0.999 |
| B09 | SKC | 224-PCXR4 | 626479 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,490 | 1,994 | 0.994x + 1.675 | 1.000 |
| B10 | SKC | 224-PCXR4 | 091950 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,503 | 2,001 | 1.017x - 34.588 | 0.999 |
| B11 | SKC | 224-PCXR8 | 564315 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,490 | 2,003 | 1.007x - 14.438 | 1.000 |
| B12 | SKC | 224-PCXR4 | 034656 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,503 | 2,003 | 1.010x - 19.005 | 0.999 |
| B13 | SKC | 224-PCXR4 | 602073 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,500 | 1,993 | 0.997x + 2.708 | 1.000 |
| B14 | SKC | 224-PCXR4 | 626313 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,988 | 0.992x + 6.007 | 1.000 |
| B15 | SKC | 224-PCXR4 | 626474 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,502 | 2,005 | 1.003x - 10.123 | 0.999 |
| B16 | SKC | 224-PCXR4 | 626477 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,504 | 2,001 | 1.015x - 31.624 | 0.999 |
| B17 | SKC | 224-PCXR4 | 626860 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,494 | 1,991 | 0.997x - 0.239 | 1.000 |
| B18 | SKC | 224-PCXR4 | 691484 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,001 | 1.008x - 16.073 | 0.999 |
| B19 | SKC | 224-PCXR4 | 691599 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,503 | 2,000 | 1.005x - 8.623 | 1.000 |
| B20 | SKC | 224-PCXR4 | 691587 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,504 | 1,999 | 1.016x - 33.631 | 0.999 |
| B21 | SKC | 224-PCXR4 | 691531 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,500 | 1,994 | 1.001x - 6.669 | 1.000 |
| B22 | SKC | 224-PCXR4 | 691654 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,003 | 1.011x - 20.429 | 0.999 |
| B23 | SKC | 224-PCXR4 | 798393 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,505 | 2,002 | 1.018x - 34.843 | 0.999 |
| B24 | SKC | 224-PCXR4 | 626363 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,502 | 2,000 | 1.012x - 23.225 | 0.999 |
| B25 | SKC | 224-PCXR4 | 798489 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,512 | 2,001 | 0.998x + 5.049 | 1.000 |
| B26 | SKC | 224-PCXR4 | 798479 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,499 | 1,993 | 0.996x + 2.892 | 1.000 |
| B27 | SKC | 224-PCXR4 | 691673 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,503 | 1,999 | 1.011x - 22.778 | 0.999 |
| B28 | SKC | 224-PCXR4 | 691570 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,500 | 2,002 | 1.007x - 13.301 | 1.000 |
| B29 | SKC | 224-PCXR4 | 626472 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,496 | 1,998 | 1.002x - 5.261 | 1.000 |
| B30 | SKC | 224-PCXR4 | 691489 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,007 | 1,500 | 2,004 | 1.010x - 18.482 | 0.999 |
| B31 | SKC | 224-PCXR4 | 691509 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,497 | 1,998 | 1.004x - 8.882 | 1.000 |
| B32 | SKC | 224-PCXR4 | 091567 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,504 | 2,001 | 1.007x - 15.930 | 1.000 |
| B33 | SKC | 224-PCXR4 | 091756 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,496 | 1,991 | 0.996x + 0.714 | 1.000 |
| B34 | SKC | 224-PCXR4 | 612962 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,001 | 1.009x - 17.944 | 0.999 |
| B35 | SKC | 224-PCXR4 | 602682 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,498 | 1,995 | 1.001x - 7.331 | 1.000 |
| B36 | SKC | 224-PCXR4 | 626164 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,495 | 1,999 | 1.000x - 4.866 | 1.000 |
| B37 | SKC | 224-PCXR4 | 626256 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 1,999 | 1.013x - 28.214 | 0.999 |
| B38 | SKC | 224-PCXR4 | 626167 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,496 | 1,996 | 1.002x - 6.342 | 1.000 |
| B39 | SKC | 224-PCXR4 | 034637 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,006 | 1,500 | 2,001 | 1.008x - 16.624 | 0.999 |
| B40 | SKC | 224-PCXR4 | 798349 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,505 | 1,998 | 1.014x - 29.642 | 0.999 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|-------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R² |
| B41 | SKC | 224-PCXR4 | 612669 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,990 | 0.994x + 3.271 | 1.000 |
| B42 | SKC | 224-PCXR4 | 626041 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,498 | 1,994 | 0.988x + 15.619 | 1.000 |
| B43 | SKC | 224-PCXR4 | 034636 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,501 | 1,992 | 0.991x + 10.565 | 1.000 |
| B44 | SKC | 224-PCXR8 | 529341 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,502 | 2,002 | 1.011x - 21.418 | 0.999 |
| B45 | SKC | 224-PCXR8 | 529594 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,989 | 0.993x + 5.959 | 1.000 |
| B46 | SKC | 224-PCXR8 | 566743 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,504 | 2,002 | 1.016x - 32.885 | 0.999 |
| B47 | SKC | 224-PCXR8 | 566747 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,004 | 1.013x - 24.960 | 0.999 |
| B48 | SKC | 224-PCXR8 | 566753 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,998 | 0.999x - 2.114 | 1.000 |
| B49 | SKC | 224-PCXR8 | 566780 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,502 | 2,003 | 1.012x - 22.706 | 0.999 |
| B50 | SKC | 224-PCXR8 | 500400 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,495 | 2,002 | 1.001x - 3.737 | 1.000 |
| B51 | SKC | 224-PCXR8 | 500363 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,504 | 1,999 | 1.011x - 25.590 | 0.999 |
| B52 | SKC | 224-PCXR8 | 093186 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 995 | 1,496 | 1,994 | 0.997x - 1.161 | 1.000 |
| B53 | SKC | 224-PCXR8 | 707670 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,002 | 1.010x - 20.668 | 0.999 |
| B54 | SKC | 224-PCXR3 | 509821 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,500 | 2,001 | 1.017x - 34.516 | 0.999 |
| B55 | SKC | 224-PCXR3 | 510710 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,994 | 0.995x + 2.521 | 1.000 |
| B56 | SKC | 224-PCXR3 | 511450 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,001 | 1.004x - 7.562 | 1.000 |
| B57 | SKC | 224-PCXR3 | 510798 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,492 | 1,998 | 0.996x +1.109 | 1.000 |
| B58 | SKC | 224-PCXR3 | 509852 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,999 | 1.007x - 19.113 | 0.999 |
| B59 | SKC | 224-PCXR3 | 509862 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 1,994 | 0.997x + 2.955 | 1.000 |
| B60 | SKC | 224-PCXR3 | 512655 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,005 | 1,500 | 2,003 | 1.010x - 19.862 | 0.999 |
| B61 | SKC | 224-PCXR3 | 503915 | 04/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,489 | 1,998 | 1.004x - 11.786 | 1.000 |
| B62 | SKC | 224-PCXR3 | 505975 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,996 | 0.997x - 0.064 | 1.000 |
| B63 | SKC | 224-PCXR3 | 511432 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 991 | 1,501 | 1,999 | 1.017x - 35.461 | 0.999 |
| B64 | SKC | 224-PCXR3 | 508302 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,492 | 1,989 | 0.992x + 6.266 | 1.000 |
| B65 | SKC | 224-PCXR3 | 508310 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,003 | 1.011x - 21.992 | 0.999 |
| B66 | SKC | 224-PCXR3 | 509861 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,991 | 0.988x + 13.904 | 1.000 |
| B67 | SKC | 224-PCXR3 | 506295 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,508 | 2,004 | 1.017x - 32.785 | 0.999 |
| B68 | SKC | 224-PCXR3 | 505872 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,997 | 0.994x + 5.237 | 1.000 |
| B69 | SKC | 224-PCXR3 | 508375 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,499 | 2,000 | 1.010x - 21.330 | 0.999 |
| B70 | SKC | 224-PCXR3 | 510623 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,503 | 1,997 | 1.002x - 6.054 | 1.000 |
| B71 | SKC | 224-PCXR3 | 508367 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 990 | 1,506 | 2,002 | 1.018x - 37.025 | 0.999 |
| B72 | SKC | 224-PCXR3 | 505977 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,498 | 1,993 | 0.993x + 5.731 | 1.000 |
| B73 | SKC | 224-PCXR3 | 512606 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,005 | 1.014x - 24.397 | 0.999 |
| B74 | SKC | 224-PCXR3 | 505993 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,495 | 1,994 | 0.999x - 4.284 | 1.000 |
| B75 | SKC | 224-PCXR3 | 509820 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,498 | 1,990 | 0.995x + 2.987 | 1.000 |
| B76 | SKC | 224-PCXR3 | 509811 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 993 | 1,498 | 1,998 | 1.006x - 14.003 | 1.000 |
| B77 | SKC | 224-PCXR3 | 508301 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,501 | 2,003 | 1.014x - 25.845 | 0.999 |
| B78 | SKC | 224-PCXR3 | 510677 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 1,999 | 1.012x - 27.321 | 0.999 |
| B79 | SKC | 224-PCXR3 | 510920 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,493 | 1,994 | 0.999x - 3.905 | 1.000 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| B80 | SKC | 224-PCXR3 | 504569 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,002 | 1.011x - 22.072 | 0.999 |
| B81 | SKC | 224-PCXR3 | 503480 | 06/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,499 | 2,000 | 1.014x - 29.407 | 0.999 |
| B82 | SKC | 224-PCXR3 | 505673 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,498 | 1,996 | 1.001x - 4.866 | 1.000 |
| B83 | SKC | 224-PCXR3 | 510785 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,499 | 2,002 | 1.012x - 23.827 | 0.999 |
| B84 | SKC | 224-PCXR3 | 508333 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,495 | 1,991 | 0.996x - 1.819 | 1.000 |
| B85 | SKC | 224-PCXR3 | 505757 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 994 | 1,502 | 1,998 | 1.013x - 28.362 | 0.999 |
| B86 | SKC | 224-PCXR3 | 512625 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,503 | 2,004 | 1.012x - 22.064 | 0.999 |
| B87 | SKC | 224-PCXR3 | 504324 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 2,000 | 1.001x - 2.186 | 1.000 |
| B88 | SKC | 224-PCXR3 | 508307 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 997 | 1,498 | 1,994 | 0.997x + 1.093 | 1.000 |
| B89 | SKC | 224-PCXR3 | 509860 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,500 | 2,003 | 1.014x - 25.885 | 0.999 |
| B90 | SKC | 224-PCXR3 | 508366 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,503 | 1,999 | 1.015x - 31.616 | 0.999 |
| B91 | SKC | 224-PCXR3 | 510919 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,996 | 1.000x - 2.608 | 1.000 |
| B92 | SKC | 224-PCXR3 | 510987 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,003 | 1.013x - 24.030 | 0.999 |
| B93 | SKC | 224-PCXR3 | 509845 | 05/10/2022 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,998 | 1.002x - 6.609 | 1.000 |
| B94 | SKC | 224-PCXR8 | A127871 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,500 | 2,002 | 1.013x - 25.526 | 0.999 |
| B95 | SKC | 224-PCXR8 | A127921 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 992 | 1,502 | 2,001 | 1.015x - 30.265 | 0.999 |
| B96 | SKC | 224-PCXR8 | A127942 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 996 | 1,498 | 1,994 | 1.000x - 3.258 | 1.000 |
| B97 | SKC | 224-PCXR8 | A127955 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,003 | 1.013x - 23.258 | 0.999 |
| B98 | SKC | 224-PCXR8 | A127956 | 03/10/2022 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,997 | 1.002x - 7.256 | 1.000 |

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@spscn.com, www.spscn.com

Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

| Rotameter Data | | | | Calibration Data | | | | | | | |
|----------------|-------|--------|------------|---------------------|-----|-----|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | Flow Rate (Reading) | | | Actual (Q std.) | | | y | R ² |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | | |
| L-B01 | Dwyer | VFA-21 | 05/10/2022 | 50 | 100 | 200 | 50.7 | 99.1 | 198.9 | $0.985x + 1.192$ | 1.000 |
| L-B02 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 49.8 | 99.4 | 198.3 | $1.012x - 2.104$ | 1.000 |
| L-B03 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 50.8 | 99.2 | 198.3 | $1.009x - 1.844$ | 0.999 |
| L-B04 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 49.9 | 101.6 | 201.1 | $0.996x + 1.334$ | 1.000 |
| L-B05 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 50.1 | 98.5 | 200.8 | $0.992x + 0.311$ | 1.000 |
| L-B06 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 50.3 | 100.5 | 203.4 | $1.009x + 0.376$ | 1.000 |
| L-B07 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 49.4 | 100.8 | 199.7 | $1.005x - 1.24$ | 0.999 |
| L-B08 | Dwyer | VFA-21 | 04/10/2022 | 50 | 100 | 200 | 49.8 | 101.3 | 198.1 | $0.998x - 0.116$ | 1.000 |
| L-B09 | Dwyer | VFA-21 | 06/10/2022 | 50 | 100 | 200 | 49.6 | 99.2 | 200.7 | $1.013x - 1.491$ | 1.000 |
| L-B10 | Dwyer | VFA-21 | 06/10/2022 | 50 | 100 | 200 | 50.6 | 100.2 | 202.8 | $0.993x + 2011$ | 1.000 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com., www.spscon.com

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data | | | Calibration Data | | | | | | | | |
|----------------|-------|--------|------------------|---------------------|-------|-------|-----------------|--------|--------|------------------------------|----------------|
| No. | Brand | Model | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | Flow Rate (Reading) | | | Actual (Q std.) | | | | |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| H-B01 | Dwyer | VFB-65 | 05/10/2022 | 500 | 1,000 | 2,000 | 505.3 | 990.7 | 1975.7 | 0.990x + 8.856 | 1.000 |
| H-B02 | Dwyer | VFB-65 | 04/10/2022 | 500 | 1,000 | 2,000 | 495.7 | 997.8 | 1995.3 | 0.994x + 4.025 | 1.000 |
| H-B03 | Dwyer | VFB-65 | 04/10/2022 | 500 | 1,000 | 2,000 | 498.3 | 987.5 | 2010.2 | 1.004x - 14.483 | 0.999 |
| H-B04 | Dwyer | VFB-65 | 05/10/2022 | 500 | 1,000 | 2,000 | 501.2 | 999.9 | 2008.7 | 0.998x - 0.511 | 1.000 |
| H-B05 | Dwyer | VFB-65 | 05/10/2022 | 500 | 1,000 | 2,000 | 499.0 | 997.4 | 1972.3 | 0.987x + 14.507 | 1.000 |
| H-B06 | Dwyer | VFB-65 | 05/10/2022 | 500 | 1,000 | 2,000 | 503.9 | 993.4 | 1981.4 | 1.006x - 9.415 | 0.999 |
| H-B07 | Dwyer | VFB-65 | 05/10/2022 | 500 | 1,000 | 2,000 | 504.1 | 989.0 | 2018.3 | 1.002x - 2.255 | 1.000 |
| H-B08 | Dwyer | VFB-65 | 04/10/2022 | 500 | 1,000 | 2,000 | 499.8 | 999.2 | 1975.8 | 0.997x + 2.922 | 0.999 |
| H-B09 | Dwyer | VFB-65 | 06/10/2022 | 500 | 1,000 | 2,000 | 503.7 | 1006.6 | 2014.3 | 0.993x + 14.424 | 1.000 |
| H-B10 | Dwyer | VFB-65 | 06/10/2022 | 500 | 1,000 | 2,000 | 496.9 | 998.6 | 2012.4 | 0.998x + 1.450 | 1.000 |

Calibrated by :

(Mr. Abdul Dangklom)

Approved by :

(Mr. Peera Detudom)



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 ($^{\circ}$ C) | 80 | 80 | ± 5 |
| Injector ($^{\circ}$ C) | 220 | 220 | ± 5 |
| Detector ($^{\circ}$ C) | 300 | 300 | ± 5 |
| Incubator ($^{\circ}$ 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: Suwarot.Engineer : Suwarot TrikainutDate : 10/08/2022



บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

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 | Samarot. | |
| Date | 10/08/2022 | |



| | | | |
|-------------|-----------|------|------------|
| Comments | - | | |
| Reviewed by | Sashin P. | Date | 10/08/2022 |



VARIAN



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

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 | Sumrat. | |
| Date | 10/08/2022 | |



| | | | |
|-------------|-----------|------|------------|
| Comments | - | | |
| Reviewed by | Sumrat P. | Date | 10/08/2022 |



VARIAN

**QUALITY CALIBRATION CO.,LTD.**

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

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

www.qcalibration.com

CERTIFICATE No : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

SERIAL No : 1126422905


ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

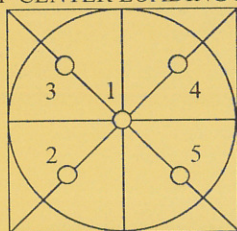
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g
5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

6. OFF CENTER LOADING ERROR



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

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

END OF CALIBRATION REPORT

ระดับเสียงในสถานประกอบการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0841

MTC No. EEL. BP. 46/0964

CALIBRATION CERTIFICATE

Submitted by : S.P.S CONSULTING SERVICE CO.,LTD.

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

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

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : SVANTEK

Model : SV34

Serial No. : 33139

Ambient Environment

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

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

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

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 14 Sep. 2021

Date of Calibration : 17 Sep. 2021

1 / 2

The results relate only to the items tested or calibrated.

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

FM.BL.MTC.002 Rev.3

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Changwat Pathumthani 12120, Thailand
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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

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

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0841

MTC No. EEL. BP. 46/0964

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

Nominal Output of Unit Under Test = 114 dB re 20 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 2 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 113.67 | -0.33 | ± 0.10 | ± 0.75 dB |

2. Frequency

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

3. Total Distortion


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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :


(Mr. Weerachai Deechaiyae)

Approved by :


(Mr. Prawate Kluaypa)
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 17 Sep. 2021

Date of Issue : 20 Sep. 2021

Ref : 2011264091403811002

End of Certificate

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FM.BL.MTC.002 Rev.3

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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Noise Dose R_430/22

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

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

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| NMD-R02 | SVANTEK | SV-104IS | 60152 | 08 August 2022 | 113.6 | 113.6 |
| NMD-R05 | SVANTEK | SV-104IS | 60155 | 08 August 2022 | 113.5 | 113.6 |
| NMD-R13 | SVANTEK | SV-104IS | 63438 | 08 August 2022 | 113.6 | 113.6 |
| NMD-R27 | SVANTEK | SV-104IS | 80837 | 08 August 2022 | 113.6 | 113.6 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 113.67± 0.10 dB | |

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Peera Detudom)

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

N. N. [Signature]

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FM.BL.MTC.002 Rev.4

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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

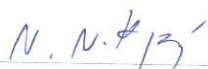
| Standard Microphone Type | Measured Frequency (Hz) | Deviated value (Hz) | Uncertainty (Hz) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 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)


(Mr. Tawikiat Iamsamran)

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Approved by :


(Mr. Prawate Kluaypa)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 2011265042601787001

2 / 2

End of Certificate

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Noise R_429/22

Sound Level Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|----------------|------------------|---------------|
| Brand | ACO | Number | AC 03/56 |
| Model | 2127 | Serial No. | 130006 |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 28 April 2022 |
| | | Due Date | 28 April 2023 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-R25 | ACO | 6236 | 00192037 | 08 August 2022 | 94.1 | 94.0 |
| ACO-R28 | ACO | 6236 | 00192040 | 08 August 2022 | 94.0 | 94.0 |
| ACO-R37 | ACO | 6236 | 00192049 | 08 August 2022 | 94.1 | 94.0 |
| ACO-R38 | ACO | 6236 | 00192050 | 08 August 2022 | 94.0 | 94.0 |
| ACO-R39 | ACO | 6236 | 00192051 | 08 August 2022 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.93 ± 0.10 dB | |

Calibrated by :

(Mr. Phakhinai Khongkomnerd)

Approved by :

(Mr. Peera Detudom)