

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม

| | |
|------------|------------------------------|
| ลำดับที่ 1 | คุณภาพอากาศจากปล่อง |
| ลำดับที่ 2 | คุณภาพอากาศในบรรยากาศ |
| ลำดับที่ 3 | คุณภาพน้ำใต้ดิน |
| ลำดับที่ 4 | ระดับเสียงในบรรยากาศ |
| ลำดับที่ 5 | ระดับเสียงในสถานประกอบการ |
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| ลำดับที่ 7 | ระดับความร้อนในสถานประกอบการ |

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| รายการตรวจวัด | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|--|--|---|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| 1. คุณภาพอากาศจากปล่องระบาย | | |
| Total Suspended Particulate | Console No. R03, R04 Pitot Tube No. B08, B54 | Digital Balance |
| Oxides of Nitrogen | Vacuum Gauge | Spectrophotometer |
| Carbon Monoxide | Personal Pump SKC No. R23, R24 Rotameter No. H-R03, R04 | CO Analyzer No. R02 |
| Copper | Console No. R03, R04 Pitot Tube No. B08, B54 | ICP |
| 2. คุณภาพอากาศในบรรยากาศ | | |
| Total Suspended Particulate | High Volume Air Sampler No. R10, R16, R17, R18 | Digital Balance |
| Particulate Matter less than 10 microns | High Volume PM-10 Air Sampler No. R04, R05, R08, R16 | Digital Balance |
| Copper | High Volume Air Sampler No. R10, R16, R17, R18 | ICP |
| Carbon Monoxide | CO Analyzer No. B02, B04, R02, R03 | CO Analyzer No. B02, B04, R02, R03 |
| Nitrogen Dioxide | NO ₂ Analyzer No. B06, B21, R02, R04 | NO ₂ Analyzer No. B06, B21, R02, R04 |
| 3. คุณภาพน้ำใต้ดิน | | |
| pH | - | pH Meter |
| Conductivity | - | Conductivity Meter |
| Total Dissolved Solids | - | Digital Balance |
| Total Suspended Solids | - | Digital Balance |
| Nitrate Nitrogen | - | Spectrophotometer |
| Total Coliform Bacteria | - | Incubator |
| | | Water Bath |
| Fecal Coliform Bacteria | - | Incubator |
| | | Water Bath |
| Calcium | - | ICP |
| Magnesium | - | ICP |
| Total Iron | - | ICP |
| Manganese | - | ICP |
| Aluminium | - | ICP |
| Lead | - | ICP |
| Mercury | - | AAS |
| Nickel | - | ICP |
| Copper | - | ICP |
| Arsenic | - | AAS |

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)

| รายการตรวจวัด | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|--|---|-------------------------|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| 4. ระดับเสียงในบรรยากาศ L_{eq} 24 hr, L_{90} , L_{max} และระดับเสียงรบกวน | Acoustic Calibrator Sound Level Meter No. ACO-R20, R25, R44, R48 Sound Level Meter No. CR-B10 | - |
| 5. ระดับเสียงในสถานประกอบการ L_{eq} 8 hr และ L_{max} | Acoustic Calibrator Sound Level Meter No. ACO-B43, R29, R32, R34, R40, R41, R50, R51 | - |
| TWA | Acoustic Calibrator Sound Level Meter No. NMD-B03, B04, B05, B08, B10, R02, R13, R20, R35 | - |
| 6. คุณภาพอากาศในสถานประกอบการ Copper Dust | Personal Pump SKC No. R03, R08, R22, R35, R40 Rotameter No. H-R02 | ICP |
| Copper Fume | Personal Pump SKC No. B21, R13, R19, R32, R44 Rotameter No. H-R02 | ICP |
| CO | Personal Pump SKC No. R12, R19, R21, R22 Rotameter No. H-R02 | CO Analyzer No. R02 |
| 7. ระดับความร้อน WBGT | Digital Thermometer Heat Stress WBGT Meter No. R04, R05, R06 | - |

ลำดับที่ 1

คุณภาพอากาศจากปล่อง



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

Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

| Console Data | | Calibration Data | | |
|--------------|------------|------------------|-------|--|
| No. | Serial No. | Date | y | ΔH_{g} (mmH ₂ O) |
| B01 | 1563 | 01/03/2024 | 1.003 | 50.38 |
| B02 | 8002514 | 04/03/2024 | 1.002 | 49.73 |
| B03 | 1503016 | 02/03/2024 | 0.997 | 50.45 |
| B04 | 00006659 | 01/03/2024 | 1.004 | 49.97 |
| B05 | 00007428 | 02/03/2024 | 0.996 | 49.65 |
| R01 | 1561 | 02/03/2024 | 0.999 | 50.18 |
| R02 | 8002513 | 01/03/2024 | 1.005 | 50.04 |
| R03 | 1570 | 03/03/2024 | 0.998 | 49.82 |
| R04 | 8002519 | 02/03/2024 | 1.004 | 49.58 |
| R05 | 1503015 | 03/03/2024 | 1.002 | 50.33 |

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

Accept Value of ΔH_{g} (test) is 46.7 ± 6.4 (mmH₂O)



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Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

| Console Data | | Calibration Data | | |
|--------------|------------|------------------|-------|--|
| No. | Serial No. | Date | y | ΔH_{g} (mmH ₂ O) |
| B01 | 1563 | 03/06/2024 | 0.996 | 50.07 |
| B02 | 8002514 | 04/06/2024 | 0.995 | 49.98 |
| B03 | 1503016 | 04/06/2024 | 0.994 | 50.19 |
| B04 | 00006659 | 03/06/2024 | 0.995 | 50.28 |
| B05 | 00007428 | 03/06/2024 | 0.997 | 49.75 |
| R01 | 1561 | 05/06/2024 | 0.994 | 50.23 |
| R02 | 8002513 | 04/06/2024 | 0.993 | 50.35 |
| R03 | 1570 | 03/06/2024 | 0.994 | 50.12 |
| R04 | 8002519 | 05/06/2024 | 0.993 | 49.89 |
| R05 | 1503015 | 04/06/2024 | 0.996 | 49.92 |

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

Accept Value of ΔH_{g} (test) is 46.7 ± 6.4 (mmH₂O)



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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 | 06/05/2024 | 0.84 | 0.84 |
| B04 | S | 0.99 | 06/05/2024 | 0.84 | 0.85 |
| B05 | S | 0.99 | 07/05/2024 | 0.84 | 0.83 |
| B07 | S | 0.99 | 07/05/2024 | 0.84 | 0.84 |
| B08 | S | 0.99 | 07/05/2024 | 0.84 | 0.85 |
| B09 | S | 0.99 | 07/05/2024 | 0.83 | 0.84 |
| B11 | S | 0.99 | 07/05/2024 | 0.84 | 0.85 |
| B16 | S | 0.99 | 08/05/2024 | 0.84 | 0.84 |
| B18 | S | 0.99 | 08/05/2024 | 0.85 | 0.84 |
| B19 | S | 0.99 | 08/05/2024 | 0.84 | 0.85 |
| B21 | S | 0.99 | 07/05/2024 | 0.84 | 0.84 |
| B24 | S | 0.99 | 07/05/2024 | 0.84 | 0.84 |
| B27 | S | 0.99 | 06/05/2024 | 0.85 | 0.84 |
| B30 | S | 0.99 | 09/05/2024 | 0.84 | 0.84 |
| B31 | S | 0.99 | 09/05/2024 | 0.84 | 0.84 |
| B33 | S | 0.99 | 09/05/2024 | 0.83 | 0.84 |
| B35 | S | 0.99 | 07/05/2024 | 0.84 | 0.84 |

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



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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 | 07/05/2024 | 0.84 | 0.84 |
| B37 | S | 0.99 | 07/05/2024 | 0.84 | 0.83 |
| B38 | S | 0.99 | 07/05/2024 | 0.85 | 0.84 |
| B39 | S | 0.99 | 09/05/2024 | 0.84 | 0.84 |
| B40 | S | 0.99 | 09/05/2024 | 0.84 | 0.83 |
| B41 | S | 0.99 | 09/05/2024 | 0.84 | 0.84 |
| B44 | S | 0.99 | 08/05/2024 | 0.83 | 0.84 |
| B45 | S | 0.99 | 08/05/2024 | 0.84 | 0.84 |
| B46 | S | 0.99 | 08/05/2024 | 0.84 | 0.84 |
| B47 | S | 0.99 | 08/05/2024 | 0.85 | 0.84 |
| B48 | S | 0.99 | 10/05/2024 | 0.84 | 0.84 |
| B49 | S | 0.99 | 06/05/2024 | 0.84 | 0.84 |
| B54 | S | 0.99 | 06/05/2024 | 0.85 | 0.84 |
| B56 | S | 0.99 | 07/05/2024 | 0.83 | 0.84 |
| B57 | S | 0.99 | 10/05/2024 | 0.84 | 0.84 |
| B58 | S | 0.99 | 10/05/2024 | 0.85 | 0.84 |

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

CERTIFICATE OF CALIBRATION FOR

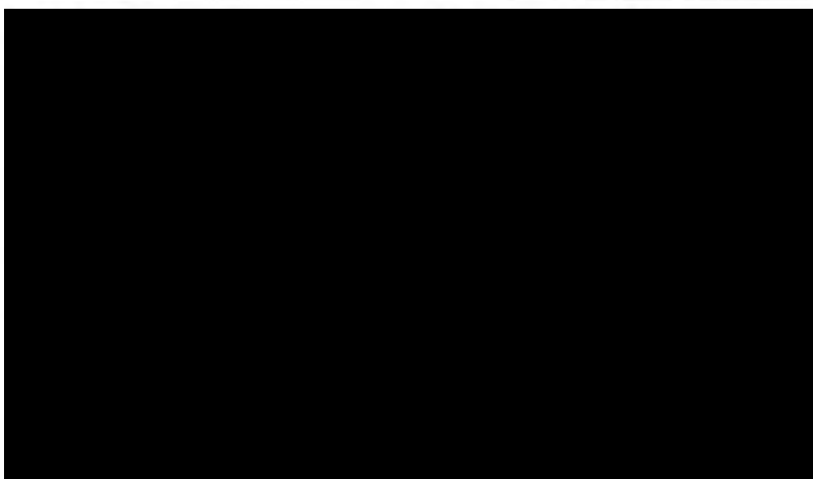
NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220088-1]
CLID. NO. : 212301419
JOB CONTROL NO. : 230725081570

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

DATE OF RECEIVED : 25 July 2023

DATE OF ISSUED : 31 July 2023

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



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. Q23081570

F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

| | | |
|-------------------------|---|------------------|
| NOMENCLATURE | : | VACUUM GAUGE |
| MANUFACTURER | : | HI-LIGHT |
| MODEL / TYPE | : | N/A |
| SERIAL NO. | : | N/A[64-220088-1] |
| DATE OF CALIBRATION | : | 26 July 2023 |
| DUE DATE OF CALIBRATION | : | 26 July 2024 |

ENVIRONMENT CONDITIONS :

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

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

PROCEDURE USED :

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

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

REFERENCE STANDARD USED :

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

TRACEABILITY :

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

UNCERTAINTY :

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

Certificate No. Q23081570

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@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 (kPa) | | Conversion to inHg | | Correction (inHg) | |
|----------------------------|---------------------|---------|--------------------|-------|---------------------|------|
| | Up | Down | Up | Down | Up | Down |
| 0 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 |
| -5 | -15.07 | -15.10 | -4.5 | -4.5 | +0.5 | +0.5 |
| -10 | -32.10 | -32.13 | -9.5 | -9.5 | +0.5 | +0.5 |
| -15 | -49.20 | -49.23 | -14.5 | -14.5 | +0.5 | +0.5 |
| -20 | -66.26 | -66.26 | -19.6 | -19.6 | +0.4 | +0.4 |
| -25 | -83.30 | -83.33 | -24.6 | -24.6 | +0.4 | +0.4 |
| -30 | -100.39 | -100.39 | -29.6 | -29.6 | +0.4 | +0.4 |

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 inHg

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

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

End of Certificate

Certificate No. Q23081570

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@clccalibration



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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 ± 3 °C
Pressure : 1010 ± 15 mmbar

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (mL/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| R01 | SKC | 224-PCXR4 | 602467 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 2,006 | 1.009x – 15.012 | 1.000 |
| R02 | SKC | 224-PCXR4 | 626450 | 04/04/2024 | 1,000 | 2,000 | 3,000 | 999 | 1,497 | 1,989 | 0.988x + 13.944 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,006 | 1,498 | 2,005 | 1.011x – 20.963 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,995 | 0.996x + 0.630 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,508 | 1,998 | 1.010x – 23.496 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,500 | 1,997 | 1.001x – 5.085 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,491 | 2,002 | 1.009x – 17.230 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,010 | 1,502 | 2,007 | 1.001x + 0.255 | 1.000 |
| R09 | SKC | 224-PCXR4 | 034650 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,503 | 2,003 | 1.017x – 34.105 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,996 | 1.001x - 3.929 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,001 | 1.010x – 21.251 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,500 | 2,002 | 1.004x – 9.014 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,503 | 1,993 | 0.990x + 13.944 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,501 | 1,998 | 1.013x – 27.899 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,003 | 1.005x – 8.870 | 1.000 |
| R16 | SKC | 224-PCXR8 | 529643 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,497 | 1,995 | 1.000x – 4.367 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,507 | 2,003 | 1.012x – 23.233 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,499 | 1,999 | 1.002x – 7.159 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,497 | 2,002 | 1.011x – 21.211 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,501 | 2,004 | 1.013x – 24.274 | 1.000 |
| R21 | SKC | 224-PCXR8 | 665728 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,496 | 1,998 | 0.999x – 1.264 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,004 | 1.006x – 10.948 | 1.000 |
| R23 | SKC | 224-PCXR8 | 761067 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,493 | 1,992 | 0.994x + 2.840 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,507 | 1,998 | 1.006x – 14.466 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,009 | 1,494 | 1,996 | 0.987x + 17.592 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,004 | 1.009x – 15.934 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,502 | 2,003 | 1.008x – 17.956 | 1.000 |
| R28 | SKC | 224-PCXR8 | 707481 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,003 | 1.012x – 22.471 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,005 | 1,495 | 1,992 | 0.987x + 16.057 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,995 | 0.997x + 0.921 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,504 | 2,001 | 1.001x – 1.723 | 1.000 |
| R32 | SKC | 224-PCXR8 | 671950 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,502 | 1,996 | 0.997x + 3.418 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,499 | 2,001 | 1.010x – 22.367 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,501 | 2,005 | 1.008x – 14.071 | 1.000 |
| R35 | SKC | 224-PCXR8 | 707460 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,496 | 1,996 | 0.997x + 1.671 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,000 | 1.010x – 20.385 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,999 | 0.997x + 1.683 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,499 | 2,000 | 1.000x – 3.701 | 1.000 |
| R39 | SKC | 224-PCXR8 | 761095 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,496 | 1,993 | 0.996x + 2.987 | 1.000 |



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

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 | 02/04/2024 | 500 | 1,000 | 2,000 | 502.7 | 995.4 | 1981.1 | 0.999x - 2.801 | 0.999 |
| H-R02 | Dwyer | VFB-65 | 04/04/2024 | 500 | 1,000 | 2,000 | 501.2 | 1000.7 | 1990.7 | 1.000x - 1.869 | 1.000 |
| H-R03 | Dwyer | VFB-65 | 09/04/2024 | 500 | 1,000 | 2,000 | 502.1 | 993.7 | 1998.1 | 0.992x + 5.811 | 1.000 |
| H-R04 | Dwyer | VFB-65 | 08/04/2024 | 500 | 1,000 | 2,000 | 497.2 | 993.8 | 2015.1 | 1.006x - 10.146 | 1.000 |
| H-R05 | Dwyer | VFB-65 | 05/04/2024 | 500 | 1,000 | 2,000 | 500.1 | 995.3 | 1991.1 | 1.001x - 3.418 | 1.000 |
| H-R06 | Dwyer | VFB-65 | 05/04/2024 | 500 | 1,000 | 2,000 | 503.6 | 996.6 | 1984.2 | 1.000x - 2.517 | 0.999 |



CERTIFICATE No : 24M2227

REFERENCE No : 72448-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA05/50

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 :

CALIBRATION DATE :

08-Mar-24

APPROVED BY :

ISSUED DATE :

14-Mar-24

RECEIVED DATE :

08-Mar-24



CERTIFICATE No : 24M2227

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA05/50 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25°C \pm 1°C RELATIVE HUMIDITY : 53 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE 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

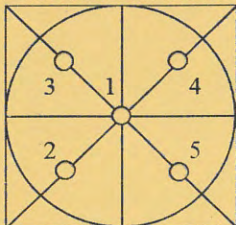
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00 | 0.00000 | 0.00000 | 0.000065 |
| 0.02 | 0.02001 | -0.00001 | 0.000065 |
| 0.10 | 0.10002 | -0.00002 | 0.000066 |
| 0.20 | 0.20001 | -0.00001 | 0.000066 |
| 0.50 | 0.50001 | -0.00001 | 0.000065 |
| 1.00 | 1.00003 | -0.00003 | 0.000066 |
| 2.00 | 2.00001 | -0.00001 | 0.000067 |
| 5.00 | 5.00001 | -0.00001 | 0.000068 |
| 10.00 | 9.99994 | 0.00006 | 0.000070 |
| 20.00 | 20.00008 | -0.00008 | 0.000078 |
| 50.00 | 50.0000 | 0.0000 | 0.00013 |
| 100.00 | 100.0001 | -0.0001 | 0.00019 |
| 120.00 | 120.0001 | -0.0001 | 0.00022 |

5. OFF CENTER LOADING ERROR



| POINT | READING (g) |
|--------------------|-------------|
| 1 | 50.0000 |
| 2 | 50.0000 |
| 3 | 50.0000 |
| 4 | 50.0000 |
| 5 | 50.0000 |
| OFF-CENTER LOADING | 0.0000 |

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

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

END OF CALIBRATION REPORT

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

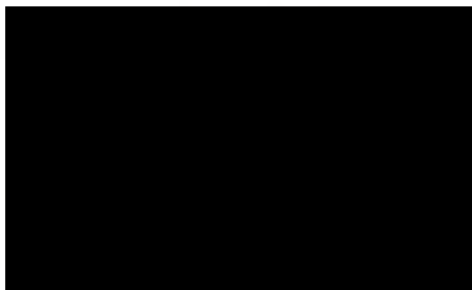
Pages : 1 of 3

Calibration Certificate

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

Calibrated by :

Approved by :



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

Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Certified reference materials

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

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

| 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 | 361.3 | 0.05 | 0.16 | 2.00 |
| | 467.82 | 468.0 | 0.18 | 0.16 | 2.00 |
| | 536.56 | 536.6 | 0.04 | 0.16 | 2.00 |
| | 640.50 | 640.4 | -0.10 | 0.16 | 2.00 |
| RM-DL | 740.09 | 740.0 | -0.09 | 0.16 | 2.00 |
| | 864.94 | 865.0 | 0.06 | 0.16 | 2.00 |

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

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

Result of calibration : Photometric Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

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

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

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

**Specific Acceptance :

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

**Stray light not TISI Accredited

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

End of Calibration Certificate



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

| Calibration Report | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|-------|
| Non-Dispersive Infrared CO Analyzer | | | | | |
| Date : | 09 May 2024 | Brand : | API | Model : | 300E |
| No. | CO-R02 | | | Serial No. | 171-S |
| Calibrator (Dilution System) | | | | | |
| Brand : API | | | Model : 700 | | |
| Last Cal. Date : 08 August 2023 | | | Serial No. : 911 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | | Cylinder No. : D711839 | | |
| Certified Date : 14 March 2024 | | Expired Date : 14 March 2032 | | Cylinder Conc. : 4,580 ppm | |
| Calibrating Condition | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | | | % RH | 48 |
| Calibration Setting | | | | | |
| Span | Initial Reading (Before Adj.), PPM | | | Final Reading (After Adj.), PPM | |
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | |
| Zero | 0 | -0.10 | - | 0 | |
| CO Span | 40.00 | 40.05 | 0.125 | 40.00 | |
| API Model 300E CO Analyzer Check List | | | | | |
| Parameter | Observed Value | Units | Nominal Range | | |
| Range | 50 | PPM | 0-1000 ppm | | |
| Stability | 0.10 | PPM | < 1 ppm With Zero Air | | |
| CO Measure | 4016.2 | mV | 2500-4800 mV | | |
| CO Reference | 3948.8 | mV | 2500-4800 mV | | |
| Measure/Reference Ratio | 1.180 | - | 1.1-1.3 W/Zero Air | | |
| Sample Pressure | 28.5 | In-Hg-A | ~2" < Ambient Absolute Pressure | | |
| Sample Flow | 808 | CC/Min | 800 ± 10% | | |
| Sample Temperature | 48.4 | °C | 48 ± 4 | | |
| Bench Temperature | 48.2 | °C | 48 ± 2 | | |
| Wheel Temperature | 68.3 | °C | 68 ± 2 | | |
| Box Temperature | 30.8 | °C | Ambient Temp + 7 ± 10 | | |
| Photo-Drive | 3045.7 | mV | 250 mV to 4750 mV | | |
| Slope | 1.017 | - | 1.0 ± 0.3 | | |
| Offset | 0.2 | - | 0 ± 0.3 | | |



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

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

| Calibration Report | | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|-------|----|
| Non-Dispersive Infrared CO Analyzer | | | | | | |
| Date : | 05 June 2024 | Brand : | API | Model : | 300E | |
| No. | CO-R02 | | | Serial No. | 171-5 | |
| Calibrator (Dilution System) | | | | | | |
| Brand : API | | | Model : 700 | | | |
| Last Cal. Date : 08 August 2023 | | | Serial No. : 911 | | | |
| Reference Standard Gas | | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | | Cylinder No. : D711839 | | | |
| Certified Date : 14 March 2024 | | Expired Date : 14 March 2032 | | Cylinder Conc. : 4,580 ppm | | |
| Calibrating Condition | | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.6 | °C | |
| % RH | | | | | | 50 |
| Calibration Setting | | | | | | |
| Span Set Point | Initial Reading (Before Adj.), PPM | | | Final Reading (After Adj.), PPM | | |
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | | |
| Zero | 0 | -0.10 | - | 0 | | |
| CO Span | 40.00 | 39.91 | -0.225 | 40.00 | | |
| API Model 300E CO Analyzer Check List | | | | | | |
| Parameter | Observed Value | Units | Nominal Range | | | |
| Range | 50 | PPM | 0-1000 ppm | | | |
| Stability | 0.10 | PPM | ± 1 ppm With Zero Air | | | |
| CO Measure | 4015.4 | mV | 2500-4800 mV | | | |
| CO Reference | 3946.9 | mV | 2500-4800 mV | | | |
| Measure/Reference Ratio | 1.180 | - | 1.1-1.3 W/Zero Air | | | |
| Sample Pressure | 28.7 | In-Hg-A | ~2" ± Ambient Absolute Pressure | | | |
| Sample Flow | 807 | CC/Min | 800 ± 10% | | | |
| Sample Temperature | 48.3 | °C | 48 ± 4 | | | |
| Bench Temperature | 48.0 | °C | 48 ± 2 | | | |
| Wheel Temperature | 68.2 | °C | 68 ± 2 | | | |
| Box Temperature | 30.9 | °C | Ambient Temp + 7 ± 10 | | | |
| Photo-Drive | 3046.4 | mV | 250 mV to 4750 mV | | | |
| Slope | 1.017 | - | 1.0 ± 0.3 | | | |
| Offset | 0.2 | - | 0 ± 0.3 | | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|--|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>July 4, 2024</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>January 4, 2025</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>January 4, 2024</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>December 30, 2024</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>September 30, 2024</u> |
| <u>VIS Wavecal solution</u> | <u>N930-2946</u> | <u>January 30, 2025</u> |
| <u>Instrument Cal. STD4</u> | <u>N930-0221</u> | <u>November 30, 2024</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 4, 2024**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

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

☐ OK

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

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : July 4, 2024

| PARAMETER | | SPECIFICATION | | FINAL VALUE | |
|---|-----------|-------------------|----------------|----------------|-----|
| Spectral Resolution : UV | As | 193.696 nm | ≤ 0.007 | <u>0.00550</u> | |
| | Ni | 231.604 nm | ≤ 0.008 | <u>0.00714</u> | |
| | Ni | 341.476 nm | ≤ 0.012 | <u>0.00790</u> | |
| Spectral Resolution : VIS | La | 408.672 nm | ≤ 0.020 | <u>0.01655</u> | |
| | Ba | 455.403 nm | ≤ 0.025 | <u>0.02391</u> | |
| Precision | | | | | |
| | As | 193.656 nm | % RSD < 1.0 | <u>0.72</u> | % |
| | Zn | 213.856 nm | % RSD < 1.0 | <u>0.66</u> | % |
| | Mn | 257.610 nm | % RSD < 1.0 | <u>0.30</u> | % |
| | La | 379.478 nm | % RSD < 1.0 | <u>0.98</u> | % |
| | Ba | 455.403 nm | % RSD < 1.0 | <u>0.95</u> | % |
| | Ba | 493.408 nm | % RSD < 1.0 | <u>0.78</u> | % |
| Detection Limits : Axial | Tl | 190.080 nm | 3(sd) | <u>6.22</u> | ppb |
| | As | 193.696 nm | 3(sd) | <u>6.44</u> | ppb |
| | Pb | 220.353 nm | 3(sd) | <u>2.06</u> | ppb |
| Detection Limits : Radial | As | 193.696 nm | 3(sd) | <u>78.26</u> | ppb |
| | Zn | 213.856 nm | 3(sd) | <u>2.07</u> | ppb |
| | Mn | 257.610 nm | 3(sd) | <u>0.52</u> | ppb |
| | La | 379.478 nm | 3(sd) | <u>2.63</u> | ppb |
| | Ba | 455.403 nm | 3(sd) | <u>0.08</u> | ppb |
| | Ba | 493.408 nm | 3(sd) | <u>0.75</u> | ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd | 226.502 nm | ≤ 150 ppb | <u>64.72</u> | |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn | 257.610 nm | ≤ 45 ppb | <u>15.04</u> | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 4, 2024**Remarks :**

Commissioning follow as commissioning performance sheets.

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

☒

meets

☐

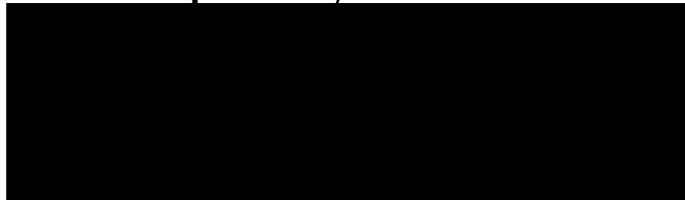
does not meet

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:



ลำดับที่ 2

คุณภาพอากาศในบรรยากาศ



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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 | 06/05/2024 | y = 1.193x-4.091 | 0.999 |
| B36 | B36 | 10/05/2024 | y = 1.172x-3.010 | 0.998 |
| B37 | B37 | 06/05/2024 | y = 1.212x-2.588 | 1.000 |
| B38 | B38 | 06/05/2024 | y = 1.187x-3.844 | 0.997 |
| B39 | B39 | 06/05/2024 | y = 1.178x-0.811 | 0.999 |
| B40 | B40 | 06/05/2024 | y = 1.221x-5.480 | 0.998 |
| B41 | B41 | 06/05/2024 | y = 1.219x-4.443 | 0.997 |
| B42 | B42 | 07/05/2024 | y = 1.167x-2.748 | 0.997 |
| B43 | B43 | 07/05/2024 | y = 1.161x-0.034 | 0.999 |
| B44 | B44 | 07/05/2024 | y = 1.249x-4.278 | 0.999 |
| R01 | R01 | 07/05/2024 | y = 1.183x-4.631 | 0.997 |
| R02 | R02 | 07/05/2024 | y = 1.237x-5.919 | 0.998 |
| R03 | R03 | 07/05/2024 | y = 1.234x-7.377 | 1.000 |
| R04 | R04 | 10/05/2024 | y = 1.250x-6.680 | 0.996 |
| R05 | R05 | 10/05/2024 | y = 1.176x-4.403 | 0.999 |
| R06 | R06 | 06/05/2024 | y = 1.195x-4.419 | 0.999 |
| R07 | R07 | 06/05/2024 | y = 1.061x+1.385 | 0.999 |
| R08 | R08 | 06/05/2024 | y = 1.169x-1.426 | 0.999 |
| R09 | R09 | 06/05/2024 | y = 1.150x-0.930 | 0.998 |
| R10 | R10 | 06/05/2024 | y = 1.246x-6.734 | 0.999 |
| R11 | R11 | 06/05/2024 | y = 1.171x-2.938 | 0.999 |
| R12 | R12 | 10/05/2024 | y = 1.149x-3.415 | 0.998 |
| R13 | R13 | 10/05/2024 | y = 1.158x-3.158 | 0.999 |
| R14 | R14 | 10/05/2024 | y = 1.236x-4.390 | 1.000 |
| R15 | R15 | 06/05/2024 | y = 1.229x-7.704 | 0.998 |
| R16 | R16 | 06/05/2024 | y = 1.242x-7.570 | 0.998 |
| R17 | R17 | 07/05/2024 | y = 1.211x-5.039 | 0.998 |
| R18 | R18 | 07/05/2024 | y = 1.226x-5.530 | 0.999 |
| R19 | R19 | 07/05/2024 | y = 1.185x-4.311 | 0.999 |
| R20 | R20 | 09/05/2024 | y = 1.193x-4.417 | 1.000 |



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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 | 06/05/2024 | y = 1.174x-4.049 | 0.999 |
| R02 | R02 | 06/05/2024 | y = 1.205x-3.581 | 0.998 |
| R03 | R03 | 07/05/2024 | y = 1.235x-6.580 | 0.999 |
| R04 | R04 | 10/05/2024 | y = 1.165x-5.072 | 0.998 |
| R05 | R05 | 10/05/2024 | y = 1.211x-6.165 | 0.997 |
| R06 | R06 | 06/05/2024 | y = 1.203x-3.045 | 0.998 |
| R07 | R07 | 06/05/2024 | y = 1.195x-3.082 | 0.997 |
| R08 | R08 | 06/05/2024 | y = 1.229x-5.593 | 0.999 |
| R09 | R09 | 06/05/2024 | y = 1.223x-4.946 | 0.997 |
| R10 | R10 | 09/05/2024 | y = 1.169x-3.241 | 0.999 |
| R11 | R11 | 07/05/2024 | y = 1.228x-2.749 | 0.997 |
| R12 | R12 | 10/05/2024 | y = 1.226x-6.607 | 0.996 |
| R13 | R13 | 09/05/2024 | y = 1.154x-1.960 | 0.998 |
| R14 | R14 | 06/05/2024 | y = 1.205x-4.415 | 0.998 |
| R15 | R15 | 06/05/2024 | y = 1.199x-3.887 | 0.998 |
| R16 | R16 | 06/05/2024 | y = 1.168x-3.045 | 0.998 |
| R17 | R17 | 06/05/2024 | y = 1.140x-0.557 | 0.997 |
| R18 | R18 | 06/05/2024 | y = 1.165x-3.692 | 0.998 |
| R19 | R19 | 06/05/2024 | y = 1.157x-0.982 | 0.999 |
| R20 | R20 | 06/05/2024 | y = 1.177x-5.526 | 1.000 |



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CALIBRATION REPORT

NON-DISPERSIVE INFRARED CO ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 300E

NO. CO-B02

SERIAL NO. 956

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D711839

Certified Date : 14 March 2024

Expired Date : 14 March 2032

Cylinder Conc. : 4,580 PPM

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span Set Point | Initial Reading (Before Adj.),PPM | | | Final Reading (After Adj.),PPM |
|-------------------|-----------------------------------|-------------------|-------|--------------------------------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response |
| Zero | 0 | 0.11 | - | 0 |
| CO Span | 40.00 | 40.09 | 0.225 | 40.00 |

API Model 300E CO Analyzer Check list

| Parameter | Observed Value | Units | Nominal Range |
|-------------------------|----------------|---------|---------------------------------|
| RANGE | 50 | PPM | 0-1000 ppm |
| STABILITY | 0.10 | PPM | < 1 ppm with zero air |
| CO MEASURE | 4015.8 | mV | 2500-4800 mV |
| CO REFERENCE | 3948.2 | mV | 2500-4800 mV |
| MEASURE/REFERENCE RATIO | 1.180 | - | 1.1-1.3 w/zero air |
| SAMPLE PRESSURE | 28.5 | In-Hg-A | ~2" < ambient absolute pressure |
| SAMPLE FLOW | 805 | cc/min | 800 ± 10% |
| SAMPLE TEMPERATURE | 48.5 | °C | 48 ± 4 |
| BENCH TEMPERATURE | 48.2 | °C | 48 ± 2 |
| WHEEL TEMPERATURE | 68.4 | °C | 68 ± 2 |
| BOX TEMPERATURE | 30.7 | °C | Ambient temp + 7 ± 10 |
| PHOTO-DRIVE | 3043.2 | mV | 250 mV to 4750 mV |
| SLOPE | 1.017 | - | 1.0 ± 0.3 |
| OFFSET | 0.2 | - | 0 ± 0.3 |



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CALIBRATION REPORT

NON-DISPERSIVE INFRARED CO ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 300E

NO. CO-B04

SERIAL NO. 1352

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D711839

Certified Date : 14 March 2024

Expired Date : 14 March 2032

Cylinder Conc. : 4,580 PPM

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span Set Point | Initial Reading (Before Adj.),PPM | | | Final Reading (After Adj.),PPM |
|-------------------|-----------------------------------|-------------------|-------|--------------------------------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response |
| Zero | 0 | 0.11 | - | 0 |
| CO Span | 40.00 | 40.05 | 0.125 | 40.00 |

API Model 300E CO Analyzer Check list

| Parameter | Observed Value | Units | Nominal Range |
|-------------------------|----------------|---------|---------------------------------|
| RANGE | 50 | PPM | 0-1000 ppm |
| STABILITY | 0.10 | PPM | < 1 ppm with zero air |
| CO MEASURE | 4015.3 | mV | 2500-4800 mV |
| CO REFERENCE | 3949.6 | mV | 2500-4800 mV |
| MEASURE/REFERENCE RATIO | 1.179 | - | 1.1-1.3 w/zero air |
| SAMPLE PRESSURE | 28.6 | In-Hg-A | ~2" < ambient absolute pressure |
| SAMPLE FLOW | 809 | cc/min | 800 ± 10% |
| SAMPLE TEMPERATURE | 48.4 | °C | 48 ± 4 |
| BENCH TEMPERATURE | 48.1 | °C | 48 ± 2 |
| WHEEL TEMPERATURE | 68.2 | °C | 68 ± 2 |
| BOX TEMPERATURE | 30.8 | °C | Ambient temp + 7 ± 10 |
| PHOTO-DRIVE | 3031.4 | mV | 250 mV to 4750 mV |
| SLOPE | 1.017 | - | 1.0 ± 0.3 |
| OFFSET | 0.2 | - | 0 ± 0.3 |



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CALIBRATION REPORT

NON-DISPERSIVE INFRARED CO ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 300E

NO. CO-R02

SERIAL NO. 171-S

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D711839

Certified Date : 14 March 2024

Expired Date : 14 March 2032

Cylinder Conc. : 4,580 PPM

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span | Initial Reading (Before Adj.),PPM | | | Final Reading (After Adj.),PPM |
|-----------|-----------------------------------|-------------------|--------|--------------------------------|
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response |
| Zero | 0 | 0.10 | - | 0 |
| CO Span | 40.00 | 39.96 | -0.100 | 40.00 |

API Model 300E CO Analyzer Check list

| Parameter | Observed Value | Units | Nominal Range |
|-------------------------|----------------|---------|---------------------------------|
| RANGE | 50 | PPM | 0-1000 ppm |
| STABILITY | 0.10 | PPM | < 1 ppm with zero air |
| CO MEASURE | 4017.1 | mV | 2500-4800 mV |
| CO REFERENCE | 3949.3 | mV | 2500-4800 mV |
| MEASURE/REFERENCE RATIO | 1.180 | - | 1.1-1.3 w/zero air |
| SAMPLE PRESSURE | 28.4 | In-Hg-A | ~2" < ambient absolute pressure |
| SAMPLE FLOW | 810 | cc/min | 800 ± 10% |
| SAMPLE TEMPERATURE | 48.2 | °C | 48 ± 4 |
| BENCH TEMPERATURE | 48.0 | °C | 48 ± 2 |
| WHEEL TEMPERATURE | 68.4 | °C | 68 ± 2 |
| BOX TEMPERATURE | 30.6 | °C | Ambient temp + 7 ± 10 |
| PHOTO-DRIVE | 3043.9 | mV | 250 mV to 4750 mV |
| SLOPE | 1.017 | - | 1.0 ± 0.3 |
| OFFSET | 0.2 | - | 0 ± 0.3 |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr.Peera Detudom)



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CALIBRATION REPORT

NON-DISPERSIVE INFRARED CO ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 300E

NO. CO-R03

SERIAL NO. 1352

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D711839

Certified Date : 14 March 2024

Expired Date : 14 March 2032

Cylinder Conc. : 4,580 PPM

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span Set Point | Initial Reading (Before Adj.),PPM | | | Final Reading (After Adj.),PPM |
|-------------------|-----------------------------------|-------------------|--------|--------------------------------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response |
| Zero | 0 | 0.10 | - | 0 |
| CO Span | 40.00 | 39.94 | -0.150 | 40.00 |

API Model 300E CO Analyzer Check list

| Parameter | Observed Value | Units | Nominal Range |
|-------------------------|----------------|---------|---------------------------------|
| RANGE | 50 | PPM | 0-1000 ppm |
| STABILITY | 0.10 | PPM | < 1 ppm with zero air |
| CO MEASURE | 4014.9 | mV | 2500-4800 mV |
| CO REFERENCE | 3047.7 | mV | 2500-4800 mV |
| MEASURE/REFERENCE RATIO | 1.528 | - | 1.1-1.3 w/zero air |
| SAMPLE PRESSURE | 28.7 | In-Hg-A | ~2" < ambient absolute pressure |
| SAMPLE FLOW | 804 | cc/min | 800 ± 10% |
| SAMPLE TEMPERATURE | 48.4 | °C | 48 ± 4 |
| BENCH TEMPERATURE | 48.2 | °C | 48 ± 2 |
| WHEEL TEMPERATURE | 68.3 | °C | 68 ± 2 |
| BOX TEMPERATURE | 30.7 | °C | Ambient temp + 7 ± 10 |
| PHOTO-DRIVE | 3046.7 | mV | 250 mV to 4750 mV |
| SLOPE | 1.317 | - | 1.0 ± 0.3 |
| OFFSET | 0.2 | - | 0 ± 0.3 |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr.Peera Detudom)



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 200E

NO. NOX-B06

SERIAL NO. 2286

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span Set Point | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
|----------------------|-----------------------------------|-------------------|-------|--------------------------------|-------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 400.1 | 0.025 | 400.0 | 1.008 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.011 |

API Model 200E NO_x Analyzer Check List

| Test Values | Observed Value | Units | Nominal Range |
|---------------------------|----------------|---------|----------------------------|
| RANGE | 500 | PPB | 500 standard |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air |
| SAMPLE FLOW | 504 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.3 | mV | -20 - 150 |
| AZERO | 94.1 | mV | -20 - 150 |
| HVPS | 671 | V | 420 - 900 constant |
| RCELL TEMP | 50.5 | °C | 50 ± 1 |
| BOX TEMP | 29.2 | °C | 8 - 48 |
| PMT TEMP | 7.4 | °C | 7 ± 2 |
| MOLY TEMP | 314.7 | °C | 315 ± 5 |
| RCELL PRESS | 8.3 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.4 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.008 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.011 | - | 1.0 ± 0.3 |
| NO Offset | 1.6 | 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 :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(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@spscon.com, www.spscon.com

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : TML-41M

NO. NOX-B21

SERIAL NO. N02374

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure : 1011 mmbar

Temp. : 24.5 °C

% RH : 49

CALIBRATION SETTING

| Span 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 | 399.7 | -0.075 | 400.0 | 1.006 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.010 |

API Model TML-41M 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 | 507 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.1 | mV | -20 - 150 |
| AZERO | 93.9 | mV | -20 - 150 |
| HVPS | 670 | V | 420 - 900 constant |
| RCELL TEMP | 50.2 | °C | 50 ± 1 |
| BOX TEMP | 29.1 | °C | 8 - 48 |
| PMT TEMP | 7.0 | °C | 7 ± 2 |
| MOLY TEMP | 315.1 | °C | 315 ± 5 |
| RCELL PRESS | 8.5 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.7 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.006 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.010 | - | 1.0 ± 0.3 |
| NO Offset | 1.3 | mV | -20 to +150 |
| NO _x Offset | 0.9 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr.Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 200E

NO. NOX-R02

SERIAL NO. 2285

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

CALIBRATION SETTING

| Span 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 | 1.010 |
| NO _x Span | 400 | 400.3 | 0.075 | 400.0 | 1.013 |

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 | 103.4 | mV | -20 - 150 |
| AZERO | 94.2 | mV | -20 - 150 |
| HVPS | 675 | 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 | 314.9 | °C | 315 ± 5 |
| RCELL PRESS | 8.2 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.5 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.010 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.013 | - | 1.0 ± 0.3 |
| NO Offset | 1.7 | mV | -20 to +150 |
| NO _x Offset | 1.0 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr.Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 27 May 2024

BRAND : API

MODEL : 200E

NO. NOX-R04

SERIAL NO. 4411

Calibrator (Dilution System)

Brand : Teledyne

Model : 700

Last Cal. Date : 30 October 2023

Serial No. : 421

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure : 1011 mmbar

Temp. : 24.5 °C

% RH : 49

CALIBRATION SETTING

| Span Set Point | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
|----------------------|-----------------------------------|-------------------|--------|--------------------------------|-------|
| | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 399.8 | -0.050 | 400.0 | 1.005 |
| NO _x Span | 400 | 399.9 | -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 | 509 | cc/min | 500 ± 50 |
| OZONE FLOW | 79 | cc/min | 80 ± 15 |
| PMT | 103.0 | mV | -20 - 150 |
| AZERO | 93.7 | mV | -20 - 150 |
| HVPS | 669 | V | 420 - 900 constant |
| RCELL TEMP | 50.0 | °C | 50 ± 1 |
| BOX TEMP | 28.8 | °C | 8 - 48 |
| PMT TEMP | 7.1 | °C | 7 ± 2 |
| MOLY TEMP | 315.4 | °C | 315 ± 5 |
| RCELL PRESS | 8.4 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.6 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.005 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.008 | - | 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 :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Mr. Peera Detudom

(Mr.Peera Detudom)



CERTIFICATE No : 24M2227

REFERENCE No : 72448-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905


ID No : BA05/50

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 08-Mar-24

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 14-Mar-24

RECEIVED DATE : 08-Mar-24



CERTIFICATE No : 24M2227

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA05/50 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25°C \pm 1°C RELATIVE HUMIDITY : 53 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE 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

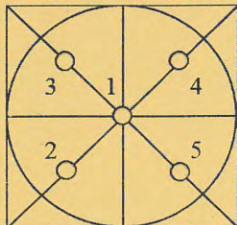
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00 | 0.00000 | 0.00000 | 0.000065 |
| 0.02 | 0.02001 | -0.00001 | 0.000065 |
| 0.10 | 0.10002 | -0.00002 | 0.000066 |
| 0.20 | 0.20001 | -0.00001 | 0.000066 |
| 0.50 | 0.50001 | -0.00001 | 0.000065 |
| 1.00 | 1.00003 | -0.00003 | 0.000066 |
| 2.00 | 2.00001 | -0.00001 | 0.000067 |
| 5.00 | 5.00001 | -0.00001 | 0.000068 |
| 10.00 | 9.99994 | 0.00006 | 0.000070 |
| 20.00 | 20.00008 | -0.00008 | 0.000078 |
| 50.00 | 50.0000 | 0.0000 | 0.00013 |
| 100.00 | 100.0001 | -0.0001 | 0.00019 |
| 120.00 | 120.0001 | -0.0001 | 0.00022 |

5. OFF CENTER LOADING ERROR



| POINT | READING (g) |
|--------------------|-------------|
| 1 | 50.0000 |
| 2 | 50.0000 |
| 3 | 50.0000 |
| 4 | 50.0000 |
| 5 | 50.0000 |
| OFF-CENTER LOADING | 0.0000 |

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

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

END OF CALIBRATION REPORT



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|--|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>July 4, 2024</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>January 4, 2025</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>January 4, 2024</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>December 30, 2024</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>September 30, 2024</u> |
| <u>VIS Wavecal solution</u> | <u>N930-2946</u> | <u>January 30, 2025</u> |
| <u>Instrument Cal. STD4</u> | <u>N930-0221</u> | <u>November 30, 2024</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 4, 2024**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

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

☐ OK

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

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : July 4, 2024

| PARAMETER | | SPECIFICATION | | FINAL VALUE | |
|---|-----------|-------------------|----------------|----------------|-----|
| Spectral Resolution : UV | As | 193.696 nm | ≤ 0.007 | <u>0.00550</u> | |
| | Ni | 231.604 nm | ≤ 0.008 | <u>0.00714</u> | |
| | Ni | 341.476 nm | ≤ 0.012 | <u>0.00790</u> | |
| Spectral Resolution : VIS | La | 408.672 nm | ≤ 0.020 | <u>0.01655</u> | |
| | Ba | 455.403 nm | ≤ 0.025 | <u>0.02391</u> | |
| Precision | | | | | |
| | As | 193.656 nm | % RSD < 1.0 | <u>0.72</u> | % |
| | Zn | 213.856 nm | % RSD < 1.0 | <u>0.66</u> | % |
| | Mn | 257.610 nm | % RSD < 1.0 | <u>0.30</u> | % |
| | La | 379.478 nm | % RSD < 1.0 | <u>0.98</u> | % |
| | Ba | 455.403 nm | % RSD < 1.0 | <u>0.95</u> | % |
| | Ba | 493.408 nm | % RSD < 1.0 | <u>0.78</u> | % |
| Detection Limits : Axial | Tl | 190.080 nm | 3(sd) | <u>6.22</u> | ppb |
| | As | 193.696 nm | 3(sd) | <u>6.44</u> | ppb |
| | Pb | 220.353 nm | 3(sd) | <u>2.06</u> | ppb |
| Detection Limits : Radial | As | 193.696 nm | 3(sd) | <u>78.26</u> | ppb |
| | Zn | 213.856 nm | 3(sd) | <u>2.07</u> | ppb |
| | Mn | 257.610 nm | 3(sd) | <u>0.52</u> | ppb |
| | La | 379.478 nm | 3(sd) | <u>2.63</u> | ppb |
| | Ba | 455.403 nm | 3(sd) | <u>0.08</u> | ppb |
| | Ba | 493.408 nm | 3(sd) | <u>0.75</u> | ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd | 226.502 nm | ≤ 150 ppb | <u>64.72</u> | |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn | 257.610 nm | ≤ 45 ppb | <u>15.04</u> | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 4, 2024**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:**

(Wiphan Promlumda)

Service Engineer

ลำดับที่ 3

คุณภาพน้ำใต้ดิน



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584



CERTIFICATE No : 23E8494
REFERENCE No : 70413-1


PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER
MANUFACTURER : HANNA
MODEL : HI 3512
SERIAL No : TH118035
ID No : pH04/56
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 : 06-Sep-23

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 06-Sep-23

RECEIVED DATE : 31-Aug-23

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



QUALITY CALIBRATION CO.,LTD.

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

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

CERTIFICATE No : 23E8494

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : HANNA
ID No : pH04/56
RECEIVED DATE : 31-Aug-23
AMBIENT TEMPERATURE : 23 ° C ± 3 ° C
MODEL : HI 3512
SERIAL NUMBER : TH118035
CALIBRATION DATE : 06-Sep-23
RELATIVE HUMIDITY : 50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

- 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
- REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT | MODEL | SERIAL No/ LOT No | CERTIFICATE No | DUE DATE |
|---------------------------|----------|----------------------|----------------|-----------|
| 1) pH STANDARD SOLUTION | 00651-06 | CC767907 | 4880-13836406 | 29-Dec-24 |
| 2) pH STANDARD SOLUTION | 00651-08 | CC765602 | 4881-13757019 | 18-Nov-24 |
| 3) pH STANDARD SOLUTION | 00651-10 | CC767180 | 4882-13813369 | 14-Dec-24 |
| 4) PROCESS CALIBRATOR | CA150 | 91S6079 | 23E1312 | 19-Apr-24 |
| 5) BATH | 260014 | 1247 48074 | 22T9870 | 13-Sep-23 |
| 6) THERMOMETER WITH PROBE | 421504 | 55000379 | 22T9904 | 13-Sep-23 |

- THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
- 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 $k = 2.303 \text{ RT/F} = 59 \text{ mV/pH}$

| mV APPLIED | UUC READING (mV) | CORRECTION (mV) | UUC READING (pH) | UNCERTAINTY OF MEASUREMENT (± mV) | COVERAGE FACTOR k |
|---------------|---------------------|--------------------|---------------------|---|-------------------------|
| 414.11 | 414.6 | -0.49 | -0.290 | 0.15 | 2.00 |
| 354.95 | 355.4 | -0.45 | 0.741 | 0.15 | 2.00 |
| 295.80 | 296.3 | -0.50 | 1.773 | 0.15 | 2.00 |
| 236.64 | 237.1 | -0.46 | 2.804 | 0.15 | 2.00 |
| 177.48 | 177.9 | -0.42 | 3.835 | 0.15 | 2.00 |
| 118.32 | 118.7 | -0.38 | 4.867 | 0.15 | 2.00 |
| 59.16 | 59.6 | -0.44 | 5.898 | 0.15 | 2.00 |
| 0.00 | 0.4 | -0.40 | 6.930 | 0.15 | 2.00 |
| -59.16 | -58.8 | -0.36 | 7.961 | 0.15 | 2.00 |
| -118.32 | -117.9 | -0.42 | 8.992 | 0.15 | 2.00 |
| -177.48 | -177.1 | -0.38 | 10.024 | 0.15 | 2.00 |
| -236.64 | -236.3 | -0.34 | 11.055 | 0.15 | 2.00 |
| -295.80 | -295.5 | -0.30 | 12.087 | 0.15 | 2.00 |
| -354.95 | -354.6 | -0.35 | 13.118 | 0.15 | 2.00 |
| -414.11 | -413.8 | -0.31 | 14.149 | 0.15 | 2.00 |

END OF CALIBRATION REPORT PAGE 2 OF 3



QUALITY CALIBRATION CO.,LTD.

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

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

CERTIFICATE No : 23E8494

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 |
|--|---------------------|--------------------|-------------------------------|--|-------------------------|
| 4.006 | 4.006 | 0.000 | 4.015 | 0.012 | 2.00 |
| 7.000 | 7.000 | 0.000 | 6.914 | 0.012 | 2.00 |
| 10.008 | 10.010 | -0.002 | 9.996 | 0.014 | 2.00 |

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 |
|--|--------------------------------|-------------------------------|-------------------------------|--|-------------------------|
| 25.005 | 25.0 | 0.005 | --- | 0.0085 | 2.00 |

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 OF CALIBRATION

FOR

NOMENCLATURE : CONDUCTIVITY METER
MANUFACTURER : METTLER TOLEDO
MODEL / TYPE : SEVEN COMPACT S230
SERIAL NO. : C141708983/5821320179
CLID. NO. : 272300452
JOB CONTROL NO. : 230211016445

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

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 15 February 2023

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

Calibrated By : Sukgasem Seehanart
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
15 February 2023



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

Certificate No. Q23016445

F3-011-04/01-12

page 1 of 4



@clccalibration

REPORT OF CALIBRATION

FOR

| | | |
|---------------------|---|-----------------------|
| NOMENCLATURE | : | CONDUCTIVITY METER |
| MANUFACTURER | : | METTLER TOLEDO |
| MODEL / TYPE | : | SEVEN COMPACT S230 |
| SERIAL NO. | : | C141708983/5821320179 |
| DATE OF CALIBRATION | : | 13 February 2023 |

ENVIRONMENT CONDITIONS :

Temperature : $(25 \pm 2.5) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \% \text{ RH}$

PROCEDURE USED :

This instrument [Conductivity Meter] was calibrated under procedure No. **WI-305-130**. The calibration was performed by direct measurement with Certified Reference Material (CRM) and Reference Material (RM) .

This instrument [Temperature] was calibrated under procedure No. **WI-305-244**. The calibration was performed by Comparison with Calibration Bath, Precision Thermometer and IPRT which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. Potassium Chloride Solution (nominal 1.41 mS/cm , nominal 12.8 mS/cm)
2. Conductivity Solution , Hanna Product Code HI 7033L Lot Number 6436.
3. Calibration Bath, Kambic Model OB-22/2 ULT S/N. 17115653.
4. Precision Thermometer, ASL Model F250 S/N. 1334023800.
5. IPRT, ASL Model T100-250-1D S/N. L0193A-1-1.



TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through Merck Co., Ltd.

Certificate No. HC02139203 , HC04515254. Due Date 30 June 2023 , 30 November 2023.

2. The measurements are traceable to International System of Units (SI) , through Hanna instruments.

Certificate No. 12E12 , Due Date May 2024 .

3. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.

Certificate No. Q22130792, Due Date 05 January 2024.

4. The measurements are traceable to International System of Units (SI) , through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0823/65, Due Date 22 August 2023.

5. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).

Certificate No. TT-0166-22, Due Date 01 December 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of Conductivity Meter.

CALIBRATION DATA

1. Conductivity Solution Test @ 25°C

| Standard Conductivity Solution | DUC Reading | Uncertainty of Measurement | k Factor |
|--------------------------------|--------------------------------------|----------------------------|----------|
| *84.00 µS/cm | 84.04 µS/cm [Cell Constant 0.548589] | ± 1.00 µS/cm | 2,00 |
| 1412.0 µS/cm | 1413 µS/cm [Cell Constant 0.548589] | ± 21.0 µS/cm | 2,00 |
| 12.85 mS/cm | 12.88 mS/cm [Cell Constant 0.573538] | ± 0.19 mS/cm | 2,00 |

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

The Scope of Accredited TISI Certificate No. 23-LB0092 Issue 01 Page 138 of 138

*2. Temperature Result [Probe Conductivity]

| Immersion depth (mm) | Actual Temperature (°C) | DUC Reading (°C) | Correction (°C) | Uncertainty ± (°C) |
|----------------------|---------------------------|--------------------|-------------------|----------------------|
| 100 | 25.00 | 25.0 | 0.00 | 0.07 |

Note. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of $k = 2,00$.

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

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

End of Certificate





CERTIFICATE No : 23M2442

REFERENCE No : 68471-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843


ID No : BA 09/61

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY :  PONGSAK J.

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23



CERTIFICATE No : 23M2442

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW
MANUFACTURER : SARTORIUS S/N : 36591843
ID No : BA 09/61 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

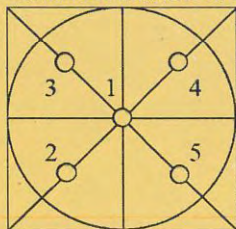
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.0 | 0.0000 | 0.0000 | 0.000058 |
| 0.1 | 0.1000 | 0.0000 | 0.000059 |
| 0.2 | 0.2000 | 0.0000 | 0.000059 |
| 0.5 | 0.5000 | 0.0000 | 0.000060 |
| 1.0 | 1.0000 | 0.0000 | 0.000060 |
| 2.0 | 2.0000 | 0.0000 | 0.000061 |
| 5.0 | 5.0000 | 0.0000 | 0.000063 |
| 10.0 | 10.0000 | 0.0000 | 0.000067 |
| 20.0 | 20.0001 | -0.0001 | 0.000073 |
| 50.0 | 50.0000 | 0.0000 | 0.00011 |
| 100.0 | 100.0001 | -0.0001 | 0.00019 |
| 200.0 | 200.0000 | 0.0000 | 0.00032 |

5. OFF CENTER LOADING ERROR



| POINT | READING (g) |
|--------------------|-------------|
| 1 | 100.0000 |
| 2 | 99.9999 |
| 3 | 99.9998 |
| 4 | 100.0001 |
| 5 | 100.0000 |
| OFF-CENTER LOADING | 0.0002 |

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

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

END OF CALIBRATION REPORT

SITHIPORN 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@sithiporn.com http://www.sithiporn.com

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages : 1 of 3

Calibration Certificate

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

Calibrated by :

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. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Certified reference materials

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

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

| 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 | 361.3 | 0.05 | 0.16 | 2.00 |
| | 467.82 | 468.0 | 0.18 | 0.16 | 2.00 |
| | 536.56 | 536.6 | 0.04 | 0.16 | 2.00 |
| | 640.50 | 640.4 | -0.10 | 0.16 | 2.00 |
| RM-DL | 740.09 | 740.0 | -0.09 | 0.16 | 2.00 |
| | 864.94 | 865.0 | 0.06 | 0.16 | 2.00 |

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

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

Result of calibration : Photometric Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

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

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

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

**Specific Acceptance :

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

**Stray light not TISI Accredited

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

End of Calibration Certificate



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwaek Rd. Bangpai Bangkac Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



CALIBRATION CERTIFICATE

Certificate No. : S2023090437-0003

Date Issued : 28-Sep-23

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,
Bangkok 10900

Equipment : Incubator

Manufacturer : BINDER

Model : BD 115

Serial No. : 12-16967

ID No./Tag No. : IN 05/56

Date Received : 22-Sep-23

Date Calibrated : 22-Sep-23

Calibrated by : Mr. Jame Khaothong

Calibration Method or Calibration Procedure Used

Standard method : CP-05 TLAS G-20.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

This certificate may not be reproduced other than in full except with the prior written approval of the Miracle International Technology Company Limited.

Approved by:

Sarayuth T.
(Mr. Sarayuth Tochua)



Page 1 of 2

Certificate No. : S2023090437-0003

Environment : Ambient Temperature : Start record 24.3 °C, Stop record 24.5 °C

Relative Humidity : Start record 54.8 %RH, Stop record 54.6 %RH

| Calibration Temperature (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Stability ¹ (°C) | Measured Uniformity ² (°C) | Overall Variation ³ (°C) |
|---------------------------------|-----------------------------|--------------------------------|---|--|--|
| 35 | 35.0 | 35.0 | 0.08 | 0.17 | 0.31 |
| 41.5 | 41.5 | 41.5 | 0.04 | 0.18 | 0.25 |

Without adjustment

| Calibration Temperature (°C) | STD No. 1 (°C) | STD No. 2 (°C) | STD No. 3 (°C) | STD No. 4 (°C) | STD No. 5 (°C) | STD No. 6 (°C) | STD No. 7 (°C) | STD No. 8 (°C) | STD No. 9 (°C) | Uncertainty ⁴ ±°C |
|---------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------------------|
| 35 | 34.83 | 34.85 | 34.97 | 34.82 | 34.84 | 34.95 | 34.90 | 34.80 | 34.93 | 0.23 |
| 41.5 | 41.36 | 41.38 | 41.46 | 41.32 | 41.28 | 41.48 | 41.40 | 41.33 | 41.44 | 0.23 |

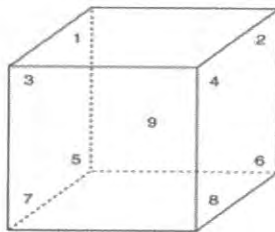
| Calibration Temperature (°C) | MPE (±°C) | Pass / Fail with Guard Band | | | | | | | | |
|---------------------------------|--------------|--------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | | No. 1 (°C) | No. 2 (°C) | No. 3 (°C) | No. 4 (°C) | No. 5 (°C) | No. 6 (°C) | No. 7 (°C) | No. 8 (°C) | No. 9 (°C) |
| 35.00 | 0.5 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| 41.50 | 0.5 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

Pass = $|\text{error}| + |\text{uncertainty}| \leq |\text{MPE}|$

Fail = $|\text{error}| + |\text{uncertainty}| > |\text{MPE}|$

Note : Probe No. 9 is Reference Probe

Setting Air Fresh No. 0



Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. L202306247-001 for Data Acquisition STD-286 Module 1 Serial No. MY44023139, Due 24-Dec-23

Notes : 1. The temperature stability is the one-half of greatest maximum difference of measured temperatures at any one probe.

2. The temperature uniformity is the maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time.

3. Overall variation is the difference of maximum and minimum measured temperatures throughout observation time.

4. The uncertainty of measurement is included temperature stability.

5. The temperature uniformity, stability, overall variation and indicating temperature is applicable to all air or gas filled temperature controlled enclosures at atmospheric pressure.

End of Certificate

**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 : 23T2448

REFERENCE No : 68471-8

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : WATER BATH

MANUFACTURER : MEMMERT

MODEL : WNB29

SERIAL No : L614.0123


ID No : WB 05/58

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 : CHAICHARN CH.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 
PONGSAK J.

ISSUED DATE : 17-Mar-23

RECEIVED DATE : 10-Mar-23

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



CERTIFICATE No : 23T2448

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : WATER BATH
MANUFACTURER : MEMMERT
ID NUMBER : WB 05/58
RECEIVED DATE : 10-Mar-23
AMBIENT TEMPERATURE : 26 °C ± 1 °C
MODEL : WNB29
SERIAL NUMBER : L614.0123
CALIBRATION DATE : 10-Mar-23
RELATIVE HUMIDITY : 51 %RH ± 10 % RH

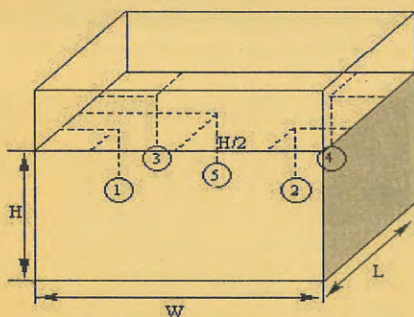
CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.
2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT | MODEL | SERIAL No | CERTIFICATE No | DUE DATE |
|-------------------------|-------|-----------|----------------|-----------|
| 1) DATA LOGGER WITH RTD | 2625A | 6603614 | 22T7514 | 05-Jul-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 QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



PROBE INSTALLATION
POSITION IN THE BATH

GENERAL INFORMATION

| |
|---|
| Overall Variation of Ambient Temperature around the Bath (°C) : 0.9 |
| Overall Variation of Line Voltage (V) : 0 |
| Instrument Condition : Normal |

BATH PERFORMANCE

| Controller Temperature (°C) | Temperature Stability (±°C) | Radius Uniformity (°C) | Axial Uniformity (°C) | Overall Variation (°C) |
|-----------------------------|-----------------------------|------------------------|-----------------------|------------------------|
| 50.4 | 0.12 | 0.14 | 0.15 | 0.34 |
| 60.4 | 0.18 | 0.23 | 0.19 | 0.50 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|-------|-------|-------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | Ref. 5 | |
| 50.4 | 50.4 | 49.45 | 49.42 | 49.36 | 49.32 | 49.42 | 0.19 |
| 60.4 | 60.4 | 60.17 | 60.20 | 60.06 | 59.97 | 60.18 | 0.25 |

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

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



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|--|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>January 4, 2024</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>July 4, 2024</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>July 6, 2023</u> | |
| User Name: <u>K.Phenpha Vipasthawatt</u> | Visit Number: <u>2 of 2</u> | |
| Phone: <u>083-9269252</u> | PerkinElmer Phone: <u>02-719-6420 ext 206</u> | |
| Fax: <u>02-513-4221</u> | PerkinElmer Fax: <u>02-318-5597</u> | |

| CONFIGURATION TESTED | | ACCESSORIES/COMPONENT NOT INCLUDED |
|------------------------------|---------------------------|------------------------------------|
| MODEL | SERIAL NUMBER | |
| <u>OPTIMA 5300DV</u> | <u>077C7042401</u> | |
| TESTED EQUIPMENT | CALIBRATION NUMBER | EXPIRATION |
| <u>IPV Methods</u> | | |
| TEST STANDARD USED | PART NUMBER | EXPIRATION DATE |
| <u>Multielement Standard</u> | <u>N069-1579</u> | <u>December 30, 2024</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>March 30, 2024</u> |
| <u>VIS Wavecal solution</u> | <u>N930-2946</u> | <u>February 28, 2024</u> |
| <u>Instrument Cal. STD4</u> | <u>N930-0221</u> | <u>November 30, 2024</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** January 4, 2024**1. MECHANICAL CHECKS**

A. Inspect and clean all fans and filters.

☐ OK

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

☐ OK

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

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK**2. OPTICAL CHECKS**

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK**3. COOLING SYSTEM CHECKS**

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A**4. PERFORMANCE CHECKS**

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : January 4, 2024

| PARAMETER | | SPECIFICATION | | FINAL VALUE | |
|----------------------------------|---------------|---------------|-------|-------------|-----|
| Spectral Resolution : UV | As 193.696 nm | ≤ 0.007 | | 0.00529 | |
| | Ni 231.604 nm | ≤ 0.008 | | 0.00672 | |
| | Ni 341.476 nm | ≤ 0.012 | | 0.00793 | |
| Spectral Resolution : VIS | La 408.672 nm | ≤ 0.020 | | 0.01588 | |
| | Ba 455.403 nm | ≤ 0.025 | | 0.02280 | |
| Precision | | | | | |
| | As 193.656 nm | % RSD | < 1.0 | 0.92 | % |
| | Zn 213.856 nm | % RSD | < 1.0 | 0.95 | % |
| | Mn 257.610 nm | % RSD | < 1.0 | 0.75 | % |
| | La 379.478 nm | % RSD | < 1.0 | 0.44 | % |
| | Ba 455.403 nm | % RSD | < 1.0 | 0.46 | % |
| | Ba 493.408 nm | % RSD | < 1.0 | 0.37 | % |
| Detection Limits : Axial | Tl 190.080 nm | 3(sd) | | 19.99 | ppb |
| | As 193.696 nm | 3(sd) | | 26.66 | ppb |
| | Pb 220.353 nm | 3(sd) | | 1.81 | ppb |
| Detection Limits : Radial | As 193.696 nm | 3(sd) | | 38.21 | ppb |
| | Zn 213.856 nm | 3(sd) | | 2.48 | ppb |
| | Mn 257.610 nm | 3(sd) | | 0.59 | ppb |
| | La 379.478 nm | 3(sd) | | 5.52 | ppb |
| | Ba 455.403 nm | 3(sd) | | 0.13 | ppb |
| | Ba 493.408 nm | 3(sd) | | 1.08 | ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd 226.502 nm | ≤ 150 ppb | | 141.47 | |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn 257.610 nm | ≤ 45 ppb | | 29.04 | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED January 4, 2024**Remarks :**

Commissioning follow as commissioning performance sheets.

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



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

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

Service Department PerkinElmer Ltd.**Authorized Representative:**

(Mr. Wiphan Promlumda)

Service Engineer



PinAAcle 900T Preventive Maintenance Report


Company Name: S.P.S. Consulting Service Co.,Ltd.


Instrument Location: AAS Room

Instrument Serial No.: PTCS14111103

Date: 04-Jan-2024

PinAAcle 900T Preventive Maintenance (PM)

| | | | |
|--|---|--|-------------|
| Company Name: | S.P.S. Consulting Service Co.,Ltd. | | |
| Address (Instrument Location): | 7, Soi Phaholyothin 24, Phaholyothin Road , Ladyao, Khet Jatujak,Bangkok,  | | |
| Serial Number: | PTCS14111103 | PM Number: | 1OF2 |
| Customer Name (if applicable): | K PHENPA | Telephone Number: | |
| Customer Support Engineer Name: | WIPHAN | Service Order Number: | WO-02602325 |
| Date PM Performed: (DD-MMM-YYYY) | 04-Jan-2024 | Next PM Due Date: (DD-MMM-YYYY) | 04-Jul-2024 |
| Standard Labor Hours to Complete PM : | | 5 hours | |

| Part Number | Release | Publication Date |  |
|----------------|---------|------------------|---|
| 09370143 Rev.8 | A | January 2018 | |

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

| Component / Specific Model | Serial # | Configuration Notes |
|----------------------------|----------|---------------------|
| | | |
| | | |
| | | |
| | | |

Parts Lists

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

| Additional Reagents and Standards Required for PM | | | | |
|---|---------------------------|---------|-------------|-------------------------|
| Part Number (if applicable) | Description | Quality | Batch/Lot # | Expired Date (MM/YY) |
| N9300183 | 1000 mg/L Copper Standard | AR | 26-87CYUY1 | 30-Jan-2024 |
| N9300244 | GFAAS Mixed Standard | AR | 58-142CRY1 | 30-Oct-2024 |

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

| Additional Tools Required for PM | | | |
|----------------------------------|-----------------------------|----------|----------------|
| Part Number (if applicable) | Description | Quantity | Serial # |
| N1013000 | 0.2A Neutral density filter | 1 | MG0-252 |
| N1013002 | 1.0A Neutral density filter | 1 | MG2-358 |
| B3100652 Or N9307029 | Electronic Flow Meter | 1 | N/A |
| B0505495 | Test Jig | 1 | N/A |
| 03030997 | System 2 EDL Driver | 1 | 03030997 |
| N3050605 | As System 2 EDL | 1 | 16148 |
| N3050121 | Cu Lumina HCL | 1 | 092216-010130 |
| N3050109 | Ba Lumina HCL | 1 | 1-2416--040160 |
| N3050139 | K Lumina HCL | 1 | 110716-010060 |
| N3050152 | Ni Lumina HCL | 1 | 100516-030190 |
| N3050119 | Cr Lumina HCL | 1 | 091911-020150 |

Procedure Checklist

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

1. General:

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

2. PC Instrument Software:

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

3. Mechanical:

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

3.1 Flame Technique

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

3.2 THGA Technique

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

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

4. Electrical:

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

5. Optics:

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

6. Gasses:

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

7. Flame Interlock Check:

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

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

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

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

| Parameter | Specification | Certificate Value at 553.6 nm (Abs.) | Test Results | Pass/Fail |
|-----------------|-----------------|---|--------------|-----------|
| 1.0 A ND Filter | ± 5% from Cert. | | 0.1789 | Passed |
| 0.2 A ND Filter | ± 5% from Cert. | | 1.0186 | Passed |

8.2 Baseline Noise at 1.0 Absorbance with Barium

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0017 | Passed |

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

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

8.4 D₂ Background Compensation with Copper

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0084 | Passed |

8.5 AA-BG Baseline Noise with Copper

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.005 | 0.0004 | Passed |

8.6 AA-BG Baseline Noise with Arsenic

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.005 | 0.0013 | Passed |

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

| Standard Copper Sensitivity | Specification | Results (Abs.) | Pass/Fail |
|---|----------------|----------------|----------------|
| 5 mg/L Sensitivity SS Neb (if applicable) | > 0.250 Abs. | N/A | Not Applicable |
| 2 mg/L Sensitivity HS Neb (if applicable) | > 0.250 Abs. | 0.4241 | Passed |

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

| Parameter | Specification | Test Results | Pass/Fail |
|--------------------|----------------------------|--------------|-----------|
| Internal Flow Rate | 250 mL/min \pm 25 mL/min | 251 | Passed |
| External Flow Rate | 100 mL/min \pm 10 mL/min | 102 | Passed |

9.2 Chromium Baseline Noise

Description: Signal to noise check.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|-------------------|---------|-----------|
| Baseline Noise | ≤ 0.005 Abs. | 0.0008 | Passed |
| Standard Deviation | ≤ 0.005 | 0.0003 | Passed |

9.3 Chromium Characteristic Mass and Precision

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

| Parameter | Specification | Results | Pass/Fail |
|------------------|--------------------------|---------|-----------|
| Cr m_0 Results | ≤ 7.0 pg/0.0044 A-s | 6.2 | Passed |
| Precision | ≤ 2.0 % | 0.61 | Passed |

9.4 Copper Characteristic Mass and Zeeman Ratio

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------------|----------------------|---------|-----------|
| Cu m ₀ Result | ≤ 16.5 pg/0.0044 A-s | 13.6 | Passed |
| Zeeman Ratio | 0.52 ± 0.04 | 0.544 | Passed |

10. Review:

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

Additional Comments

| Additional Comments Regarding the PM | |
|--------------------------------------|--|
| Zeeman Ratio | $= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1602}{0.2940}$ $= 0.544$ |

Review

| | |
|---|--|
| <p><i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.</i></p> <p><i>This PinAAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i></p> | |
| Review of Preventive Maintenance: | |
| Authorized PerkinElmer Representative: | Date: 04-Jan-2024 <small>(DD-MMM-YYYY)</small> |
| Authorized Customer Representative: | Date: 04-Jan-2024 <small>(DD-MMM-YYYY)</small> |

ลำดับที่ 4

ระดับเสียงในบรรยากาศ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304

MTC No. EEL. BP. 109/0267

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

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/N4106495.
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 : 22 Feb. 2024

Date of Calibration : 4 Mar. 2024

1 / 2 ✓

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

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

FM.BL.MTC.002 Rev.4

Head Office

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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

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Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

Request No. 21-67/0304

MTC No. EEL. BP. 109/0267

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 2 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 93.85 | -0.15 | ± 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 | 999.9 | -0.1 | ± 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 | 1.65 | ± 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)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 4 Mar. 2024

Date of Issue : 5 Mar. 2024

Ref : 2011267022200795001

End of Certificate

2 / 2

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

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

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Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th



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

Noise R_295/24

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 | 04 March 2024 |
| | | Due Date | 04 March 2025 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-R20 | ACO | 6236 | 00182003 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R25 | ACO | 6236 | 00192037 | 27 May 2024 | 94.0 | 93.9 |
| ACO-R44 | ACO | 6236 | 00192056 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R48 | ACO | 6236 | 00192060 | 27 May 2024 | 93.9 | 93.9 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.85 ± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr.Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)

Request No. 21-67/0304

MTC No. EEL. BP. 110/0267

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 : Cirrus

Model : CR:515

Serial No. : 92002

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 Feb. 2024

Date of Calibration : 5 Mar. 2024

1 / 2

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

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304

MTC No. EEL. BP. 110/0267

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 | 94.04 | 0.04 | ± 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 | 1000.3 | 0.3 | ± 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 | 1.70 | ± 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. Weerachai Deechaiyae)

Approved by :


(Mr. Prawate Kluaypa)
Director

Date of Calibration : 5 Mar. 2024

Date of Issue : 6 Mar. 2024

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011267022200795002

End of Certificate

2 / 2

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FM.BL.MTC.002 Rev.4

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7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
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Noise R_295-1/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|----------------|------------------|---------------|
| Brand | CIRRUS | Number | AC-CR01/63 |
| Model | CR515 | Serial No. | 92002 |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 05 March 2024 |
| | | Due Date | 05 March 2025 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|--------|--------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| CR-B10 | Cirrus | CR161B | G301407 | 27 May 2024 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 94.04 ± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)

ลำดับที่ 5

ระดับเสียงในสถานประกอบการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0304

MTC No. EEL. BP. 109/0267

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

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/N4106495.
 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 : 22 Feb. 2024

Date of Calibration : 4 Mar. 2024

1 / 2 ✓

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E-mail : sumalee@tistr.or.th

Request No. 21-67/0304

MTC No. EEL. BP. 109/0267

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 2 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 93.85 | -0.15 | ± 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 | 999.9 | -0.1 | ± 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 | 1.65 | ± 0.50 | $\pm 4.0\%$ |

Note : 1. No adjustment.

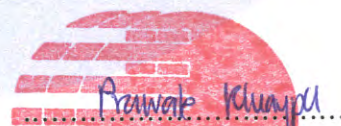
2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :


(Mr. Weerachai Deechaiyae)

Approved by :


(Mr. Prawate Kluaypa)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 4 Mar. 2024

Date of Issue : 5 Mar. 2024

Ref : 2011267022200795001

End of Certificate

2 / 2

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Noise R_088/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

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

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-R14 | ACO | 6236 | 00172061 | 14 February 2024 | 94.0 | 94.0 |
| ACO-R18 | ACO | 6236 | 00172065 | 14 February 2024 | 94.0 | 94.0 |
| ACO-R20 | ACO | 6236 | 00182003 | 14 February 2024 | 94.0 | 94.0 |
| ACO-R29 | ACO | 6236 | 00192041 | 14 February 2024 | 94.1 | 94.0 |
| ACO-R30 | ACO | 6236 | 00192042 | 14 February 2024 | 94.0 | 94.0 |
| ACO-R31 | ACO | 6236 | 00192043 | 14 February 2024 | 94.0 | 94.0 |
| ACO-R32 | ACO | 6236 | 00192044 | 14 February 2024 | 94.1 | 94.0 |
| ACO-R34 | ACO | 6236 | 00192046 | 14 February 2024 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.94 ± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr.Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Noise R_109/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

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

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-R51 | ACO | 6236 | 00192063 | 22 February 2024 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.94 ± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr.Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Noise R_311/24

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 | 04 March 2024 |
| | | Due Date | 04 March 2025 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|-------|-------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| ACO-B43 | ACO | 6236 | 00192034 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R40 | ACO | 6236 | 00192052 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R41 | ACO | 6236 | 00192053 | 27 May 2024 | 94.0 | 93.9 |
| ACO-R50 | ACO | 6236 | 00192062 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R51 | ACO | 6236 | 00192063 | 27 May 2024 | 93.9 | 93.9 |
| ACO-R52 | ACO | 6236 | 00192064 | 27 May 2024 | 94.0 | 93.9 |
| NL 21-B01 | RION | NL-21 | 00554245 | 27 May 2024 | 93.9 | 93.9 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.85 ± 0.10 dB | |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr. Peera Detudom)



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0639

MTC No. EEL. BP. 39/0866

CALIBRATION CERTIFICATE

Submitted by : S.P.S Consulting Services 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 : SVANTEK

Model : SV34

Serial No. : 33137

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 Bruel&Kjaer 4180 S/N 2633526.

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 : 11 Aug. 2023

Date of Calibration : 22 Aug. 2023

1 / 2

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FM.BL.MTC.002 Rev.4

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Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

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Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0639

MTC No. EEL. BP. 39/0866

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 | 113.53 | -0.47 | ± 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

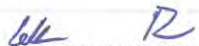
| Standard Microphone Type | Measured Total distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class 2 |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 0.39 | ± 0.50 | $\pm 4.0\%$ |

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)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Aug. 2023

Date of Issue : 24 Aug. 2023

Ref : 2011266081103146002

End of Certificate

2 / 2

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Noise Dose R_089/24

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|-----------------|------------------|----------------|
| Brand | SVANTEK | Number | SV 01/60 |
| Model | SV34 | Serial No. | 33137 |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 22 August 2023 |
| | | Due Date | 22 August 2024 |

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 | 14 February 2024 | 113.5 | 113.5 |
| NMD-R05 | SVANTEK | SV-104IS | 60155 | 14 February 2024 | 113.6 | 113.5 |
| NMD-R06 | SVANTEK | SV-104IS | 60146 | 14 February 2024 | 113.5 | 113.5 |
| NMD-R13 | SVANTEK | SV-104IS | 63438 | 14 February 2024 | 113.5 | 113.5 |
| NMD-R20 | SVANTEK | SV-104IS | 70035 | 14 February 2024 | 113.6 | 113.5 |
| NMD-R22 | SVANTEK | SV-104IS | 80801 | 14 February 2024 | 113.5 | 113.5 |
| NMD-R26 | SVANTEK | SV-104IS | 80836 | 14 February 2024 | 113.5 | 113.5 |
| NMD-R35 | SVANTEK | SV-104IS | 80873 | 14 February 2024 | 113.5 | 113.5 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 113.53± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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Noise Dose R_110/24

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|-----------------|------------------|----------------|
| Brand | SVANTEK | Number | SV 01/60 |
| Model | SV34 | Serial No. | 33137 |
| Calibration Range | 114 dB, 1000 Hz | Last Calibration | 22 August 2023 |
| | | Due Date | 22 August 2024 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|---------|----------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| NMD-R13 | SVANTEK | SV-104IS | 63438 | 22 February 2024 | 113.5 | 113.5 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 113.53± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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Noise Dose R_312/24

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand SVANTEK

Number SV 01/60

Model SV34

Serial No. 33137

Calibration Range 114 dB, 1000 Hz

Last Calibration 22 August 2023

Due Date 22 August 2024

Calibration Data

Sound Level Meter Data

Calibration Data

| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
|--|---------|----------|------------|-------------|---------------------|------------------|
| | | | | | Before Adjustment | After Adjustment |
| NMD-B03 | SVANTEK | SV-104IS | 80852 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B04 | SVANTEK | SV-104IS | 80854 | 27 May 2024 | 113.6 | 113.5 |
| NMD-B05 | SVANTEK | SV-104IS | 80856 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B08 | SVANTEK | SV-104IS | 80818 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B10 | SVANTEK | SV-104IS | 80830 | 27 May 2024 | 113.6 | 113.5 |
| NMD-B12 | SVANTEK | SV-104IS | 80832 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B13 | SVANTEK | SV-104IS | 80834 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B14 | SVANTEK | SV-104IS | 80875 | 27 May 2024 | 113.5 | 113.5 |
| NMD-B17 | SVANTEK | SV-104IS | 106122 | 27 May 2024 | 113.6 | 113.5 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 113.53± 0.10 dB | |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)

ลำดับที่ 6

คุณภาพอากาศในสถานประกอบการ



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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 |
| B01 | SKC | 224-PCXR4 | 262101 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,496 | 1,998 | 1.001x - 3.430 | 1.000 |
| B02 | SKC | 224-PCXR4 | 626166 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,506 | 2,000 | 1.007x - 16.572 | 0.999 |
| B03 | SKC | 224-PCXR4 | 612968 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,498 | 2,004 | 1.008x - 13.756 | 1.000 |
| B04 | SKC | 224-PCXR4 | 602804 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,511 | 1,993 | 0.997x + 4.427 | 1.000 |
| B05 | SKC | 224-PCXR4 | 612693 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,005 | 1,510 | 2,002 | 1.009x - 16.400 | 0.999 |
| B06 | SKC | 224-PCXR4 | 262188 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,510 | 2,004 | 1.005x - 8.687 | 0.999 |
| B07 | SKC | 224-PCXR4 | 626262 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,500 | 1,996 | 0.995x + 4.930 | 1.000 |
| B08 | SKC | 224-PCXR4 | 626100 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,508 | 2,002 | 1.011x - 19.679 | 0.999 |
| B09 | SKC | 224-PCXR4 | 626479 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,499 | 1,994 | 0.994x + 3.159 | 1.000 |
| B10 | SKC | 224-PCXR4 | 091950 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,512 | 2,000 | 1.015x - 30.041 | 0.998 |
| B11 | SKC | 224-PCXR8 | 564315 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,494 | 2,000 | 1.006x - 10.717 | 1.000 |
| B12 | SKC | 224-PCXR4 | 034656 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,005 | 1,511 | 2,002 | 1.008x - 14.857 | 0.999 |
| B13 | SKC | 224-PCXR4 | 602073 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,501 | 1,997 | 0.998x + 2.728 | 1.000 |
| B14 | SKC | 224-PCXR4 | 626313 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,991 | 0.994x + 4.411 | 1.000 |
| B15 | SKC | 224-PCXR4 | 626474 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,505 | 2,003 | 1.009x - 16.951 | 0.999 |
| B16 | SKC | 224-PCXR4 | 626477 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,502 | 2,000 | 1.005x - 13.936 | 1.000 |
| B17 | SKC | 224-PCXR4 | 626860 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,990 | 0.995x + 3.681 | 1.000 |
| B18 | SKC | 224-PCXR4 | 691484 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,506 | 2,001 | 1.007x - 12.627 | 0.999 |
| B19 | SKC | 224-PCXR4 | 691599 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,507 | 1,997 | 1.003x - 4.519 | 1.000 |
| B20 | SKC | 224-PCXR4 | 691587 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,514 | 1,999 | 1.013x - 27.943 | 0.998 |
| B21 | SKC | 224-PCXR4 | 691531 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,498 | 1,993 | 0.996x - 1.121 | 1.000 |
| B22 | SKC | 224-PCXR4 | 691654 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,005 | 1.013x - 23.316 | 0.999 |
| B23 | SKC | 224-PCXR4 | 798393 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,506 | 1,999 | 1.014x - 28.370 | 0.999 |
| B24 | SKC | 224-PCXR4 | 626363 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,505 | 2,003 | 1.016x - 28.805 | 0.999 |
| B25 | SKC | 224-PCXR4 | 798489 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,494 | 2,002 | 0.999x - 1.300 | 1.000 |
| B26 | SKC | 224-PCXR4 | 798479 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 1,997 | 0.998x + 2.010 | 1.000 |
| B27 | SKC | 224-PCXR4 | 691673 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,505 | 2,001 | 1.014x - 28.031 | 0.999 |
| B28 | SKC | 224-PCXR4 | 691570 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,498 | 2,000 | 1.007x - 15.352 | 0.999 |
| B29 | SKC | 224-PCXR4 | 626472 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,496 | 2,003 | 1.003x - 5.903 | 1.000 |
| B30 | SKC | 224-PCXR4 | 691489 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,005 | 1,511 | 2,005 | 1.007x - 8.527 | 0.999 |
| B31 | SKC | 224-PCXR4 | 691509 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 991 | 1,495 | 1,998 | 1.006x - 14.067 | 1.000 |
| B32 | SKC | 224-PCXR4 | 091567 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,504 | 1,999 | 1.013x - 26.659 | 0.999 |
| B33 | SKC | 224-PCXR4 | 091756 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,500 | 1,995 | 1.000x - 2.836 | 1.000 |
| B34 | SKC | 224-PCXR4 | 612962 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,503 | 2,001 | 1.006x - 11.243 | 0.999 |
| B35 | SKC | 224-PCXR4 | 602682 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,496 | 1,995 | 0.998x - 2.772 | 1.000 |
| B36 | SKC | 224-PCXR4 | 626164 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,506 | 2,000 | 1.006x - 14.159 | 0.999 |
| B37 | SKC | 224-PCXR4 | 626256 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,507 | 1,998 | 1.010x - 23.269 | 0.999 |
| B38 | SKC | 224-PCXR4 | 626167 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,496 | 1,997 | 1.004x - 7.259 | 1.000 |
| B39 | SKC | 224-PCXR4 | 034637 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,007 | 1,499 | 2,000 | 1.003x - 11.120 | 0.999 |
| B40 | SKC | 224-PCXR4 | 798349 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,506 | 2,001 | 1.013x - 26.810 | 0.999 |

Calibrated by :

Adul Dangklom
(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 $^{\circ}\text{C}$
Pressure : 1010 \pm 15 mmbar

| Personal Pump Data | | | | Calibration Data | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Serial No. | Date | Flow Rate (mL/min) | | | | | | Value From Calibration Curve | |
| | | | | | Setting | | | Actual (Q std.) | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| R01 | SKC | 224-PCXR4 | 602467 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 2,006 | 1.009x – 15.012 | 1.000 |
| R02 | SKC | 224-PCXR4 | 626450 | 04/04/2024 | 1,000 | 2,000 | 3,000 | 999 | 1,497 | 1,989 | 0.988x + 13.944 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,006 | 1,498 | 2,005 | 1.011x – 20.963 | 0.999 |
| R04 | SKC | 224-PCXR4 | 691672 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,995 | 0.996x + 0.630 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,508 | 1,998 | 1.010x – 23.496 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,500 | 1,997 | 1.001x – 5.085 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,491 | 2,002 | 1.009x – 17.230 | 1.000 |
| R08 | SKC | 224-PCXR4 | 883215 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,010 | 1,502 | 2,007 | 1.001x + 0.255 | 1.000 |
| R09 | SKC | 224-PCXR4 | 034650 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,503 | 2,003 | 1.017x – 34.105 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,996 | 1.001x - 3.929 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,001 | 1.010x – 21.251 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,500 | 2,002 | 1.004x – 9.014 | 1.000 |
| R13 | SKC | 224-PCXR4 | 091638 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,503 | 1,993 | 0.990x + 13.944 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,501 | 1,998 | 1.013x – 27.899 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,003 | 1.005x – 8.870 | 1.000 |
| R16 | SKC | 224-PCXR8 | 529643 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,497 | 1,995 | 1.000x – 4.367 | 1.000 |
| R17 | SKC | 224-PCXR8 | 529645 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,507 | 2,003 | 1.012x – 23.233 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,499 | 1,999 | 1.002x – 7.159 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,497 | 2,002 | 1.011x – 21.211 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,501 | 2,004 | 1.013x – 24.274 | 1.000 |
| R21 | SKC | 224-PCXR8 | 665728 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,496 | 1,998 | 0.999x – 1.264 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,004 | 1.006x – 10.948 | 1.000 |
| R23 | SKC | 224-PCXR8 | 761067 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,493 | 1,992 | 0.994x + 2.840 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,507 | 1,998 | 1.006x – 14.466 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,009 | 1,494 | 1,996 | 0.987x + 17.592 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,004 | 1.009x – 15.934 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,502 | 2,003 | 1.008x – 17.956 | 1.000 |
| R28 | SKC | 224-PCXR8 | 707481 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,003 | 1.012x – 22.471 | 0.999 |
| R29 | SKC | 224-PCXR8 | 707402 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,005 | 1,495 | 1,992 | 0.987x + 16.057 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,995 | 0.997x + 0.921 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,504 | 2,001 | 1.001x – 1.723 | 1.000 |
| R32 | SKC | 224-PCXR8 | 671950 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,502 | 1,996 | 0.997x + 3.418 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,499 | 2,001 | 1.010x – 22.367 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,501 | 2,005 | 1.008x – 14.071 | 1.000 |
| R35 | SKC | 224-PCXR8 | 707460 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,496 | 1,996 | 0.997x + 1.671 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,000 | 1.010x – 20.385 | 0.999 |
| R37 | SKC | 224-PCXR8 | 707432 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,497 | 1,999 | 0.997x + 1.683 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 04/04/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,499 | 2,000 | 1.000x – 3.701 | 1.000 |
| R39 | SKC | 224-PCXR8 | 761095 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,496 | 1,993 | 0.996x + 2.987 | 1.000 |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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

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 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,499 | 1,997 | 1.011x - 23.404 | 0.999 |
| R41 | SKC | 224-PCXR4 | 626140 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,507 | 1,999 | 1.013x - 27.249 | 0.999 |
| R42 | SKC | 224-PCXR4 | 626463 | 02/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,495 | 1,998 | 0.998x + 1.113 | 1.000 |
| R43 | SKC | 224-PCXR4 | 626129 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,503 | 2,004 | 1.010x - 18.786 | 0.999 |
| R44 | SKC | 224-PCXR4 | 602753 | 05/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,494 | 1,992 | 0.993x + 5.576 | 1.000 |
| R45 | SKC | 224-PCXR4 | 626137 | 09/04/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,507 | 2,004 | 1.011x - 21.270 | 1.000 |
| R47 | SKC | 224-PCXR4 | A129234 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,509 | 2,001 | 1.014x - 28.446 | 0.999 |
| R48 | SKC | 224-PCXR4 | A129253 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,494 | 1,999 | 0.999x - 0.164 | 1.000 |
| R49 | SKC | 224-PCXR4 | A129168 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,005 | 1.012x - 21.059 | 0.999 |
| R50 | SKC | 224-PCXR4 | A129282 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,496 | 1,993 | 0.995x + 2.808 | 1.000 |
| R51 | SKC | 224-PCXR4 | A129284 | 08/04/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,505 | 2,002 | 1.005x - 10.182 | 1.000 |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



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

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data | | | Calibration Data | | | | | | | | |
|----------------|-------|--------|------------------|---------------------|-------|-------|-----------------|--------|--------|------------------------------|----------------|
| No. | Brand | Model | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | Flow Rate (Reading) | | | Actual (Q std.) | | | | |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² |
| H-R01 | Dwyer | VFB-65 | 02/04/2024 | 500 | 1,000 | 2,000 | 502.7 | 995.4 | 1981.1 | 0.999x – 2.801 | 0.999 |
| H-R02 | Dwyer | VFB-65 | 04/04/2024 | 500 | 1,000 | 2,000 | 501.2 | 1000.7 | 1990.7 | 1.000x – 1.869 | 1.000 |
| H-R03 | Dwyer | VFB-65 | 09/04/2024 | 500 | 1,000 | 2,000 | 502.1 | 993.7 | 1998.1 | 0.992x + 5.811 | 1.000 |
| H-R04 | Dwyer | VFB-65 | 08/04/2024 | 500 | 1,000 | 2,000 | 497.2 | 993.8 | 2015.1 | 1.006x – 10.146 | 1.000 |
| H-R05 | Dwyer | VFB-65 | 05/04/2024 | 500 | 1,000 | 2,000 | 500.1 | 995.3 | 1991.1 | 1.001x – 3.418 | 1.000 |
| H-R06 | Dwyer | VFB-65 | 05/04/2024 | 500 | 1,000 | 2,000 | 503.6 | 996.6 | 1984.2 | 1.000x – 2.517 | 0.999 |

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | | |
|---|--|--|
| Customer : <u>S.P.S.Consulting Service Co.,Ltd</u> | Date Tested: <u>January 4, 2024</u> | |
| | Recommendation Recertification | |
| Address : <u>7 Soi Phaholyothin 24</u> | Period <u>6</u> Months | |
| <u>Paholyothin Road</u> | Recertification Due: <u>July 4, 2024</u> | |
| <u>Jompol Chatuchak, Bangkok 1090</u> | Date Last Certified: <u>July 6, 2023</u> | |
| User Name: <u>K.Phenpha Vipasthawatt</u> | Visit Number: <u>2 of 2</u> | |
| Phone: <u>083-9269252</u> | PerkinElmer Phone: <u>02-719-6420 ext 206</u> | |
| Fax: <u>02-513-4221</u> | PerkinElmer Fax: <u>02-318-5597</u> | |

| CONFIGURATION TESTED | | ACCESSORIES/COMPONENT NOT INCLUDED |
|------------------------------|---------------------------|------------------------------------|
| MODEL | SERIAL NUMBER | |
| <u>OPTIMA 5300DV</u> | <u>077C7042401</u> | |
| TESTED EQUIPMENT | CALIBRATION NUMBER | EXPIRATION |
| <u>IPV Methods</u> | | |
| TEST STANDARD USED | PART NUMBER | EXPIRATION DATE |
| <u>Multielement Standard</u> | <u>N069-1579</u> | <u>December 30, 2024</u> |
| <u>Wavecal Solution</u> | <u>N058-2152</u> | <u>March 30, 2024</u> |
| <u>VIS Wavecal solution</u> | <u>N930-2946</u> | <u>February 28, 2024</u> |
| <u>Instrument Cal. STD4</u> | <u>N930-0221</u> | <u>November 30, 2024</u> |
| CUSTOMER SUPPLIED | COMMENTS | CUSTOMER INITIALS |
| <u>2 % HNO3</u> | | |
| <u>10 % HNO3</u> | | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401
DATE TESTED January 4, 2024
1. MECHANICAL CHECKS

A. Inspect and clean all fans and filters.

☐ OK

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

☐ OK

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

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK

2. OPTICAL CHECKS

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK

3. COOLING SYSTEM CHECKS

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A

4. PERFORMANCE CHECKS

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : January 4, 2024

| PARAMETER | SPECIFICATION | | | FINAL VALUE | |
|----------------------------------|---------------|------------|----------------|----------------|-----|
| Spectral Resolution : UV | As | 193.696 nm | ≤ 0.007 | <u>0.00529</u> | |
| | Ni | 231.604 nm | ≤ 0.008 | <u>0.00672</u> | |
| | Ni | 341.476 nm | ≤ 0.012 | <u>0.00793</u> | |
| Spectral Resolution : VIS | La | 408.672 nm | ≤ 0.020 | <u>0.01588</u> | |
| | Ba | 455.403 nm | ≤ 0.025 | <u>0.02280</u> | |
| Precision | | | | | |
| | As | 193.656 nm | % RSD < 1.0 | <u>0.92</u> | % |
| | Zn | 213.856 nm | % RSD < 1.0 | <u>0.95</u> | % |
| | Mn | 257.610 nm | % RSD < 1.0 | <u>0.75</u> | % |
| | La | 379.478 nm | % RSD < 1.0 | <u>0.44</u> | % |
| | Ba | 455.403 nm | % RSD < 1.0 | <u>0.46</u> | % |
| | Ba | 493.408 nm | % RSD < 1.0 | <u>0.37</u> | % |
| Detection Limits : Axial | Tl | 190.080 nm | 3(sd) | <u>19.99</u> | ppb |
| | As | 193.696 nm | 3(sd) | <u>26.66</u> | ppb |
| | Pb | 220.353 nm | 3(sd) | <u>1.81</u> | ppb |
| Detection Limits : Radial | As | 193.696 nm | 3(sd) | <u>38.21</u> | ppb |
| | Zn | 213.856 nm | 3(sd) | <u>2.48</u> | ppb |
| | Mn | 257.610 nm | 3(sd) | <u>0.59</u> | ppb |
| | La | 379.478 nm | 3(sd) | <u>5.52</u> | ppb |
| | Ba | 455.403 nm | 3(sd) | <u>0.13</u> | ppb |
| | Ba | 493.408 nm | 3(sd) | <u>1.08</u> | ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd | 226.502 nm | ≤ 150 ppb | <u>141.47</u> | |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn | 257.610 nm | ≤ 45 ppb | <u>29.04</u> | |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED January 4, 2024**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



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

| Calibration Report | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|-------|
| Non-Dispersive Infrared CO Analyzer | | | | | |
| Date : | 09 May 2024 | Brand : | API | Model : | 300E |
| No. | CO-R02 | | | Serial No. | 171-S |
| Calibrator (Dilution System) | | | | | |
| Brand : API | | | Model : 700 | | |
| Last Cal. Date : 08 August 2023 | | | Serial No. : 911 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | | Cylinder No. : D711839 | | |
| Certified Date : 14 March 2024 | | Expired Date : 14 March 2032 | | Cylinder Conc. : 4,580 ppm | |
| Calibrating Condition | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | | | % RH | 48 |
| Calibration Setting | | | | | |
| Span | Initial Reading (Before Adj.), PPM | | | Final Reading (After Adj.), PPM | |
| Set Point | Expected Concentration | Analyzer Response | | %Dif | |
| Zero | 0 | -0.10 | | - | |
| CO Span | 40.00 | 40.05 | | 0.125 | |
| API Model 300E CO Analyzer Check List | | | | | |
| Parameter | Observed Value | Units | Nominal Range | | |
| Range | 50 | PPM | 0-1000 ppm | | |
| Stability | 0.10 | PPM | < 1 ppm With Zero Air | | |
| CO Measure | 4016.2 | mV | 2500-4800 mV | | |
| CO Reference | 3948.8 | mV | 2500-4800 mV | | |
| Measure/Reference Ratio | 1.180 | - | 1.1-1.3 W/Zero Air | | |
| Sample Pressure | 28.5 | In-Hg-A | ~2" < Ambient Absolute Pressure | | |
| Sample Flow | 808 | CC/Min | 800 ± 10% | | |
| Sample Temperature | 48.4 | °C | 48 ± 4 | | |
| Bench Temperature | 48.2 | °C | 48 ± 2 | | |
| Wheel Temperature | 68.3 | °C | 68 ± 2 | | |
| Box Temperature | 30.8 | °C | Ambient Temp + 7 ± 10 | | |
| Photo-Drive | 3045.7 | mV | 250 mV to 4750 mV | | |
| Slope | 1.017 | - | 1.0 ± 0.3 | | |
| Offset | 0.2 | - | 0 ± 0.3 | | |

Calibrated by :

Adul Dangklom

(Mr.Adul Dangklom)

Approved by :

Peera Detudom

(Mr. Peera Detudom)

ลำดับที่ 7

ระดับความร้อนในสถานประกอบการ



Certificate of Calibration

Certificate Number : SPR23090267-4

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 36

Serial Number : TEN040005

ID. Number : R04

Environmental Conditions

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

Received Date : 18 Sep 2023

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

Calibration Date : 18 Sep 2023

Location of Calibration : In-Lab

Recommend Due Date : 18 Sep 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 19 Sep 2023

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Lapon Naimpoung

Calibration Officer

Approved by :

(Mr.Nirut Loha)

Authorized Signatory



Calibration Report

Certificate Number : SPR23090267-4

Page : 2 of 3

Reference Standards

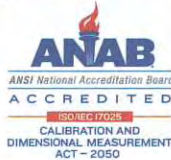
| Equipment Name | Model | Serial No. | Certificate No. | Due. Date |
|-------------------|--------|------------|-----------------|-------------|
| Humidity Chamber | TH-80S | N/A | SPR23010480-5 | 22 Feb 2024 |
| THERMO-HYGROMETER | 5020A | A47046 | QR23-0176 | 26 Jan 2024 |

Traceability

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

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

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23090267-4

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Humidity Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Note:

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

Measurement Uncertainty

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

- End of Certificate -



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

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

Heat R039_1

Heat Stress WBGT Meter Verification Report

Verification Data

| | | | |
|----------------------------|----------------------------|---------------------|-----------------|
| Heat Stress WBGT Meter No. | : R04 | Verification Date | : 19 April 2024 |
| Brand | : Quest Technologies | Ambient Temp. | : 24.5 °C |
| Model | : QUESTemp ^o 36 | Barometric Pressure | : 1011 mmbar |
| Serial No. | : TEN040005 | Relative Humidity | : 49 % |

Verification Module (Electronic Sensor Check) :

Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C

Result of Verification : Without Adjustment

Wet Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 12.5 | 12.5 | 0.0 | ± 0.5 |

Dry Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 47.1 | 47.2 | -0.1 | ± 0.5 |

Globe Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 69.3 | 69.3 | 0.0 | ± 0.5 |

UUC* = UNIT UNDER CALIBRATION

Verified by :

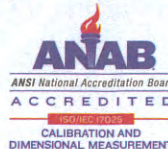
Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24030285-6

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Metrosonics

Model : hs-32

Serial Number : MCD070035

ID. Number : R05

Environmental Conditions

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

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

Location of Calibration : In-Lab

Calibration Procedure : SP-CPT-04-13

Received Date : 19 Mar 2024

Calibration Date : 20 Mar 2024

Recommend Due Date : 20 Mar 2025

Date of Issue : 21 Mar 2024

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr. Navaporn Uengseng

Calibration Officer

Approved by :

(Ms. Bussakorn Chaikaew)

Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24030285-6

Page : 2 of 3

Reference Standards

| Equipment Name | Model | Serial No. | Certificate No. | Due. Date |
|-------------------|--------|------------|-----------------|-------------|
| Humidity Chamber | TH-80S | N/A | SPR24020149-7 | 23 Feb 2025 |
| THERMO-HYGROMETER | 5020A | A47046 | QR24-0167 | 26 Jan 2025 |

Traceability

This certification is traceable to the International System of Unit maintained at :
SP Metrology - SP Metrology system (Thailand) Co.Ltd.
Quality Reborn Co., Ltd



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR24030285-6

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|--------|-------------------|
| 30.0 | 30.012 | 29.7 | -0.312 | 0.20 |
| 35.0 | 35.010 | 34.7 | -0.310 | 0.20 |
| 40.0 | 40.015 | 39.8 | -0.215 | 0.20 |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|--------|-------------------|
| 30.0 | 30.012 | 29.8 | -0.212 | 0.20 |
| 35.0 | 35.010 | 34.8 | -0.210 | 0.20 |
| 40.0 | 40.015 | 39.8 | -0.215 | 0.20 |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Humidity Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|------------------|------------------|-------------|--------|-------------------|
| 30.0 | 30.012 | 29.6 | -0.412 | 0.20 |
| 35.0 | 35.010 | 34.7 | -0.310 | 0.20 |
| 40.0 | 40.015 | 39.7 | -0.315 | 0.20 |

Note :

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

Measurement Uncertainty

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

- End of Certificate -



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

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

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

Heat R039_2

Heat Stress WBGT Meter Verification Report

Verification Data

| | | | |
|----------------------------|---------------|---------------------|-----------------|
| Heat Stress WBGT Meter No. | : R05 | Verification Date | : 19 April 2024 |
| Brand | : METROSONICS | Ambient Temp. | : 24.5 °C |
| Model | : hs-32 | Barometric Pressure | : 1011 mmbar |
| Serial No. | : MCD070035 | Relative Humidity | : 49 % |

Verification Module (Electronic Sensor Check) :

Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C

Result of Verification : Without Adjustment

Wet Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 12.5 | 12.6 | -0.1 | ± 0.5 |

Dry Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 47.1 | 47.1 | 0.0 | ± 0.5 |

Globe Probe Temperature Measurement

| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
|----------------------------------|-------------------|-----------------|----------------------|
| 69.3 | 69.2 | 0.1 | ± 0.5 |

UUC* = UNIT UNDER CALIBRATION

Verified by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)



Certificate of Calibration

Certificate Number : SPR23090267-2

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Metrosonics

Model : hs-32

Serial Number : MCD070028

ID. Number : R06

Environmental Conditions

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

Received Date : 18 Sep 2023

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

Calibration Date : 18 Sep 2023

Location of Calibration : In-Lab

Recommend Due Date : 18 Sep 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 19 Sep 2023

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Lapon Naimpoung

Calibration Officer

Approved by :

(Mr.Nirut Loha)

Authorized Signatory



Calibration Report

Certificate Number : SPR23090267-2

Page : 2 of 3

Reference Standards

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

Traceability

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

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

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23090267-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

| Temperature Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|---------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

| Humidity Setting | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|------------------|------------------|-------------|-------|-------------------|
| 30.0 | 30.014 | 30.1 | 0.086 | 0.20 |
| 35.0 | 35.012 | 35.1 | 0.088 | 0.20 |
| 40.0 | 40.013 | 40.1 | 0.087 | 0.20 |

Note:

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

Measurement Uncertainty

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

- End of Certificate -



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Heat R039_3

| Heat Stress WBGT Meter Verification Report | | | |
|--|-------------------|---------------------|----------------------|
| Verification Data | | | |
| Heat Stress WBGT Meter No. | : R06 | Verification Date | : 19 April 2024 |
| Brand | : METROSONICS | Ambient Temp. | : 24.5 °C |
| Model | : hs-32 | Barometric Pressure | : 1011 mmbar |
| Serial No. | : MCD070028 | Relative Humidity | : 49 % |
| Verification Module (Electronic Sensor Check) : | | | |
| Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C | | | |
| Result of Verification : Without Adjustment | | | |
| Wet Probe Temperature Measurement | | | |
| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
| 12.5 | 12.6 | -0.1 | ± 0.5 |
| Dry Probe Temperature Measurement | | | |
| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
| 47.1 | 47.1 | 0.0 | ± 0.5 |
| Globe Probe Temperature Measurement | | | |
| Verification Module Reading (°C) | UUC* Reading (°C) | Correction (°C) | Tolerance Limit (°C) |
| 69.3 | 69.3 | 0.0 | ± 0.5 |
| UUC* = UNIT UNDER CALIBRATION | | | |

Verified by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

Peera Detudom
(Mr. Peera Detudom)