

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือ



บริษัท เอกเสคคิวทิฟ เทรดดิง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
TEL. (662) 515-0145-50 FAX. (662) 515-0144 www.etlthai.com E-mail : info@etlthai.com

ที่ RA 033/23

ใบรายงานผลการปรับเทียบ

ชื่อผู้ขอรับบริการ : บริษัท ไออาร์พีซี จำกัด (มหาชน)

ที่อยู่ : 299 หมู่ 5 ถนนสุขุมวิท ตำบลเชิงเนิน อำเภอเมืองระยอง จังหวัดระยอง 21000

ปรับเทียบที่ : บริษัท เอกเสคคิวทิฟ เทรดดิง จำกัด

ที่อยู่ : 48/194-5 ซอย ประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวง/เขตลาดพร้าว กรุงเทพฯ 10230

รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

สภาวะแวดล้อม :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี

อุณหภูมิ : $(25 \pm 3) ^\circ\text{C}$

ผลิตภัณฑ์ : RAE Systems

ความชื้นสัมพัทธ์ : $(24 \pm 15) \%$

รุ่น : MiniRAE3000

ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

หมายเลขเครื่อง : 592-001193

วันที่ปรับเทียบมาตรฐาน : 7 มีนาคม 2566

วันที่ครบกำหนดการปรับเทียบ : 7 มีนาคม 2567

วิธีการปรับเทียบมาตรฐาน : ปรับเทียบ โดยใช้ Standard Reference Gas ผลิตภัณฑ์ CALGAZ.

- Isobutylene Standard Gas 100 ppm; Lot number 304-402257108-1.

- Isobutylene Standard Gas 1000 ppm; Lot number 304-402250416-1.

ผลการปรับเทียบมาตรฐาน

| Sensor Type | Reference Concentration | Before Cal. | After Cal. | Error Reading | Result |
|-------------|---------------------------------|-------------|------------|---------------|--------|
| PID | 0 ppm (Air Zero) | 0.0 ppm | 0.0 ppm | 0.0 ppm | Pass |
| PID | 100 ppm (Isobutylene 100 ppm) | 85.0 ppm | 100.0 ppm | 0.0 ppm | Pass |
| PID | 1000 ppm (Isobutylene 1000 ppm) | 899.5 ppm | 991.8 ppm | 8.2 ppm | Pass |

Flow Rate of Pump : 480 cc/min.

Accuracy : $\pm 2 \%$ at calibration point

ผลการสอบเทียบ/ปรับเทียบ ณ โรงงานเฉพาะของและราชการหรือหน่วยงาน

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ

EXECUTIVE TRADING LIMITED 48/194-5 SOI PRADITMANUTHAM 19, PRADITMANUTHAM ROAD, LATPHRAO, BANGKOK 10230



บริษัท เอกเสคคิวทิฟ เทรดดิง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
TEL. (662) 515-0145-50 FAX. (662) 515-0144 www.etlthai.com E-mail : info@etlthai.com

No. RA 033/23

Certificate of Calibration

Customer : IRPC Public Company Limited.

Address : 169 Moo 9, Suk Sawat 45, Suk Sawat Road, Bang Kru, Phra Pradaeng, Samut Prakan 10130
Thailand.

Calibration location : Executive Trading Limited.

Address : 48/194-5 Soi Praditmanutham 19, Pradit Manutham Road, Latphrao, Bangkok 10230

Tools :

Environmental Condition :

Instrument : Gas Detector

Temperature : $(25 \pm 3) ^\circ\text{C}$

Product : RAE Systems

Relative Humidity : $(24 \pm 15) \%$

Model Name : MiniRAE3000

Pressure : 760 mmHg

Serial Number : 592-001193

Date of Calibration : March 7, 2023

Due Date of Calibration : March 7, 2024

Calibration Method : This instrument has been calibrated using calibration gases. Test and calibration data is
On file with Executive trading limited.

Reference Standard : - Isobutylene Standard Gas 100 ppm; Lot number 304-402257108-1.

- Isobutylene Standard Gas 1000 ppm; Lot number 304-402250416-1.

Test Result

| Sensor Type | Reference Concentration | Before Cal. | After Cal. | Error Reading | Result |
|-------------|---------------------------------|-------------|------------|---------------|--------|
| PID | 0 ppm (Air Zero) | 0.0 ppm | 0.0 ppm | 0.0 ppm | Pass |
| PID | 100 ppm (Isobutylene 100 ppm) | 85.0 ppm | 100.0 ppm | 0.0 ppm | Pass |
| PID | 1000 ppm (Isobutylene 1000 ppm) | 899.5 ppm | 991.8 ppm | 8.2 ppm | Pass |

Flow Rate of Pump : 480 cc/min.

Accuracy : $\pm 2 \%$ at calibration point

The results relate only to the items tested or calibrated.

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

EXECUTIVE TRADING LIMITED 48/194-5 SOI PRADITMANUTHAM 19, PRADITMANUTHAM ROAD, LATPHRAO, BANGKOK 10230



บริษัท เอกเสคคิวทิฟ เทคดิง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
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ที่ RA 033/23

ใบรายงานการตรวจเช็คเครื่องตรวจวัดก๊าซ รุ่น MiniREA3000

หมายเลขเครื่อง : 592-001193

วันที่ตรวจเช็ค : 7 มีนาคม 2566

| ลำดับที่ | รายละเอียดการตรวจสอบ | RAW COUNT | | สรุป | หมายเหตุ |
|----------|----------------------|-------------|-------|------------|----------|
| | | REF. | REAL | | |
| 1. | PID RAW COUNT | | | | |
| | Ch.H | 10000-62500 | 48079 | ■ YES □ NO | |
| | Ch.L | <62500 | 52722 | ■ YES □ NO | |
| 2. | Lamp | >40 | 48 | ■ YES □ NO | |

| ลำดับที่ | รายละเอียดการตรวจซ่อม | การแก้ไข | สรุป | หมายเหตุ |
|----------|-----------------------|-----------------|------------|-------------|
| 1. | Motor Pump | Check flow rate | ■ YES □ NO | 480 cc/min. |
| 2. | Buzzer | - | ■ YES □ NO | - |
| 3. | Li-ion Battery | - | ■ YES □ NO | - |
| 4. | Key Pad | | | |
| | Y/+ | - | ■ YES □ NO | - |
| | N/- | - | ■ YES □ NO | - |
| | MODE | - | ■ YES □ NO | - |
| 5. | LCD Display | - | ■ YES □ NO | - |
| 6. | Light Sensor | - | ■ YES □ NO | - |
| 7. | Pocket Clip | - | □ YES □ NO | - |
| 8. | PC Port | - | ■ YES □ NO | - |
| 9. | Slim Rubber Boot | - | ■ YES □ NO | - |
| 10. | Tube adapter assembly | - | □ YES □ NO | - |

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับระบุไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



CERTIFICATE OF ANALYSIS

Date: November 8, 2021
PO Number: 0000020821
Lot Number: 304-402257108-1

Customer: CalGaz Internl LLC

Use Before: 11/08/2025

| Component | Requested Concentration | Analytical Result (+/- 2%) |
|-------------|-------------------------|----------------------------|
| Isobutylene | 100 PPM | 100.5 PPM |
| Air | Balance | Balance |

Cylinder Size: 3.6 Cu. Ft.
Contents: 103 Liter

Valve: 5/8" -18UNF
Pressure: 1000 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.



CERTIFICATE OF ANALYSIS

Date: November 8, 2021
Order Number: 0000020821
Lot Number: 304-402250416-1

Customer: CalGaz Internl LLC
Use Before: 11/08/2025

| Component | Requested Concentration | Analytical Result (+/- 2%) |
|--------------------|-------------------------|----------------------------|
| Isobutylene Air | 1000 PPM Balance | 995 PPM Balance |

Cylinder Size: 1.2 Cu. Ft.
Contents: 34 Liter

Valve: CGA 600
Pressure: 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

Honeywell

Honeywell Analytics – Singapore Office
17 Changi Business Park Central 1
Singapore 486073
Cert Ref: 00698

CERTIFICATE of Attendance

It is hereby certified that

Mr Surinthorn Sainate
(Executive Trading Limited)

has successfully completed the

RAE Service Training Course

Conducted by

HONEYWELL

on **2nd August 2022**

Service Engineer / Technical Trainer
Date of Issue : 2nd August 2022
Certificate valid for 2 years from date of issue

PETRO-INSTRUMENTS CORP., LTD.

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

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

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

DOC. NUMBER CMV-S23-0034

SERVICE REPORT

REPORT DATE June 21, 2023

| | | |
|--------------------------------------|----------------------------|-------------------------------|
| EQUIPMENT: | SERIAL NUMBER / TAG NUMBER | BRAND / MANUFACTURER |
| Multi Water Quality Checker, U-5000G | RAAGSEN3 | HORIBA |
| CUSTOMER NAME: | LACATION: | JOB NUMBER / REQUESTED NUMBER |
| IRPC PUBLIC COMPANY LIMITED | rayong | JD2300281-002 |

SCOPE OF WORK / REASON FOR VISIT

Repair and Calibration

FOUND FAILURE & CORRECTIVE ACTION DETAILS

1. ตรวจเช็คสภาพเครื่อง Multi Water Quality Checker

- Meter Model: U-5000G S/N: RAAGSEN3 สามารถใช้งานได้ปกติ
- Probe Model: U-53 S/N: V39CGM6 พบว่า **Sensor Turbidity** ไม่สามารถใช้งานได้
- Sensor pH,COND,ORP,DO ใช้งานได้ปกติ

2. ทำการ Cleaning sensor ทุก parameter

- เติม Internal Solution (KCl) ใน Reference sensor

3. ปรับเทียบ Auto Calibration ด้วย Buffer pH 4

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

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

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

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

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

WORK CONCLUSION

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

TIME SPENT (HOURS)

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

SERVICE CREW

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

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



63/14-15, 67/35-36, Soi Petchkasem7, 7/1, Petchkasem Rd,

Walthapra, Bangkokyai, Bangkok 10600 Thailand.

Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CALIBRATION REPORT

Calibration No: WQM-01102023

Page 1 of 2 pages

| | |
|------------------|---|
| MEASUREMENT ITEM | : Multi parameter Water Quality Meter |
| MANUFACTURER | : HORIBA |
| MODEL/TYPE | : Display: U-5000G : Probe: U-53 |
| SERIAL NUMBER | : Display: RAAGSEN3 : Probe: V39CGM6U |
| ID No. | : - |
| CUSTOMER | : IRPC Public Company Limited 555/2, Energy Complex, Building B, 10th Floor, Vibhavadi Rangsit Road, Chatuchak, Bangkok 10900 |

MEASUREMENT DATE : Oct 25, 2023
ISSUED DATE : Oct 25, 2023

ENVIRONMENTAL CONDITIONS:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^\circ\text{C}$, relative humidity of $(50 \pm 15)\%$, and atmospheric pressure of (1008.8 ± 0.5) hPa.

MEASUREMENT METHOD:

1. The Water Quality meter, Unit Under Calibration (UUC) was calibrated by automatic calibration mode for Conductivity, Turbidity and Dissolved Oxygen (DO) by comparison method with pH 4.01 standard buffer solution.
2. Manual calibration mode was used for calibrated a multi-point pH by comparison with standard buffer solution pH 4.01, 7.00, 10.01. Temperature was calibrated by comparison method with standard digital thermometer in temperature source.

REFERENCE STANDARD EQUIPMENT:

| Equipment: | Model | Serial/Lot No. | Due date. |
|--------------------------------------|------------------|----------------|---------------|
| 1. pH 4.01 standard buffer solution | 500-4 | S0323/01 | Jan 16, 2025 |
| 2. pH 7.00 standard buffer solution | 500-7 | S5022/01 | Dec 03, 2024 |
| 3. pH 10.01 standard buffer solution | 500-10 | S5022/01 | Dec 16, 2024 |
| 4. Standard Temperature Probe | STS-100 A500 | 667682-09 | Mar 28, 2024 |
| 5. Digital Temperature Indicator | DTI-1000-A MK II | 671407-00591 | July 22, 2023 |
| 6. Refrigerated calibration bath | PD15RCAL-A126 | 1B1670666 | Jan 17, 2024 |

Calibrated by

- ☐ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol
☒ Miss Ruangrumpai Phoommit

THIS CALIBRATION REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Continuation of Calibration Report Number

Calibration No: WQM-01102023

Page 2 of 2 pages

MEASUREMENT RESULTS: ☒ With Adjustment ☐ Without Adjustment

Table 1: Results of automatic calibration of Conductivity, Turbidity and DO by pH 4.01 standard buffer solution are reported in the table below.

| Expected Conductivity (mS/cm) | UUC* _{Reading} (before) (mS/cm) | UUC* _{Reading} (after) (mS/cm) | Error (mS/cm) |
|----------------------------------|---|--|------------------|
| 4.49 | 5.13 | 4.54 | 0.05 |

| Expected Turbidity (NTU) | UUC* _{Reading} (before) (NTU) | UUC* _{Reading} (after) (NTU) | Error (NTU) |
|-----------------------------|---|--|----------------|
| 0.0 | 0.00 | 0.00 | 0.00 |

| Expected DO concentration (mg/L) | UUC* _{Reading} (before) (mg/L) | UUC* _{Reading} (after) (mg/L) | Error (mg/L) |
|-------------------------------------|--|---|-----------------|
| 8.92 | 10.38 | 8.74 | -0.18 |

Table 2: Results of Manual calibration of pH and Temperature are reported in the table below.

| Standard buffer solution (pH) | UUC* _{Reading} (before) (pH) | UUC* _{Reading} (after) (pH) | Error (pH) |
|----------------------------------|--|---|---------------|
| 4.01 | 3.61 | 3.97 | -0.04 |
| 7.00 | 7.38 | 7.15 | 0.15 |
| 10.01 | 9.52 | 10.18 | 0.17 |

| Standard Temperature Reading (°C) | UUC* _{Reading} (before) (°C) | UUC* _{Reading} (after) (°C) | Error (°C) |
|--------------------------------------|--|---|---------------|
| 25.043 | 22.78 | 24.99 | -0.05 |

UUC* Unit Under Calibration

Noted: 1. The Unit under calibration was warmed up for 30 minute prior to the calibration being performed.

2. The report is valid only to the item calibrated on date and place of calibration.





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพมหานคร 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jomol, Chatuchak, Bangkok 10900
Tel : (662) 939-4270-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

| CALIBRATION REPORT | | | | | |
|--|--------------------------------------|-------------------|--------------------------------|--------------------------------|-------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 05 November 2023 | BRAND : | API | MODEL : | 100E |
| NO. | SO ₂ -R02 | SERIAL NO. | 3431 | | |
| Calibrator (Dilution System) | | | | | |
| Brand | : API | | Model | : 700 | |
| Last Cal. Date | : 08 August 2023 | | Serial No. | : 911 | |
| Reference Standard Gas | | | | | |
| Standard Gas | : Sulphur Dioxide (SO ₂) | | Cylinder No. | : A00814SK | |
| Certified Date | : 21 June 2021 | | Expired Date | : 21 June 2029 | |
| Cylinder Conc. | : 49.8 ppm | | | | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| % RH | 49 | | | | |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Diff | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| SO ₂ Span | 400.0 | 400.2 | 0.050 | 400.0 | 1.013 |
| API Model 100E SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.5 | in-Hg | 25-35 | | |
| SAMPLE FLOW | 657 | cc/min | 650 ± 10% | | |
| PMT | 103.4 | mV | -20-150 with Zero Air | | |
| UV LAMP | 3041.5 | mV | 1000-4900 | | |
| STR. LGT | 61.7 | PPB | <100 | | |
| DRK PMT | 63.1 | mV | -50 - 200 | | |
| DRK LMP | 58.0 | mV | -50 - 200 | | |
| HVPS | 670 | V | 550-900 constant | | |
| DCPS | 2526 | mV | 2500 ± 200 | | |
| RCCELL TEMP | 50.3 | °C | 50 ± 1 | | |
| BOX TEMP | 29.4 | °C | 5-40 | | |
| PMT TEMP | 7.5 | °C | 7 ± 2.0 | | |
| SO ₂ Span Conc | 400 | PPB | 20-20,000 | | |
| SO ₂ Slope | 1.013 | - | 1.0 ± 0.3 | | |
| SO ₂ Offset | 22.1 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพมหานคร 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jomol, Chatuchak, Bangkok 10900
Tel : (662) 939-4270-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

| CALIBRATION REPORT | | | | | |
|--|--------------------------------------|-------------------|--------------------------------|--------------------------------|--------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 05 November 2023 | BRAND : | TELEDYNE | MODEL : | TML-60 |
| NO. | SO ₂ -R08 | SERIAL NO. | TRS1064 | | |
| Calibrator (Dilution System) | | | | | |
| Brand | : API | | Model | : 700 | |
| Last Cal. Date | : 08 August 2023 | | Serial No. | : 911 | |
| Reference Standard Gas | | | | | |
| Standard Gas | : Sulphur Dioxide (SO ₂) | | Cylinder No. | : A00814SK | |
| Certified Date | : 21 June 2021 | | Expired Date | : 21 June 2029 | |
| Cylinder Conc. | : 49.8 ppm | | | | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| % RH | 49 | | | | |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Diff | Analyzer Response | Slope |
| Zero | 0 | 0.10 | - | 0 | - |
| SO ₂ Span | 400.0 | 399.8 | -0.050 | 400.0 | 1.009 |
| API Model TML-60 SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.4 | in-Hg | 25-35 | | |
| SAMPLE FLOW | 655 | cc/min | 650 ± 10% | | |
| PMT | 103.2 | mV | -20-150 with Zero Air | | |
| UV LAMP | 3037.8 | mV | 1000-4900 | | |
| STR. LGT | 61.5 | PPB | <100 | | |
| DRK PMT | 63.0 | mV | -50 - 200 | | |
| DRK LMP | 57.8 | mV | -50 - 200 | | |
| HVPS | 673 | V | 550-900 constant | | |
| DCPS | 2518 | mV | 2500 ± 200 | | |
| RCCELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 29.1 | °C | 5-40 | | |
| PMT TEMP | 7.3 | °C | 7 ± 2.0 | | |
| SO ₂ Span Conc | 400 | PPB | 20-20,000 | | |
| SO ₂ Slope | 1.009 | - | 1.0 ± 0.3 | | |
| SO ₂ Offset | 21.8 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |



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

| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 05 November 2023 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-B16 | SERIAL NO. | 249 | | |
| Calibrator (Dilution System) | | | | | |
| Brand : | API | Model : | 700 | | |
| Last Cal. Date : | 08 August 2023 | Serial No. : | 911 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : | Nitric Oxide (NO) | Cylinder No. : | D636192 | | |
| Certified Date : | 20 April 2022 | Expired Date : | 20 April 2024 | Cylinder Conc. : | 49.1 ppm |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | | % RH | 49 | |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 399.7 | -0.075 | 400.0 | 1.006 |
| NO _x Span | 400 | 399.9 | -0.025 | 400.0 | 1.010 |
| API Model 200E NO _x Analyzer Check List | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 500 standard | | |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air | | |
| SAMPLE FLOW | 506 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 78 | cc/min | 80 ± 15 | | |
| PMT | 103.2 | mV | -20 - 150 | | |
| AZERO | 94.0 | mV | -20 - 150 | | |
| HVPS | 672 | V | 420 - 900 constant | | |
| RCCELL TEMP | 50.3 | °C | 50 ± 1 | | |
| BOX TEMP | 29.1 | °C | 8 - 48 | | |
| PMT TEMP | 7.4 | °C | 7 ± 2 | | |
| MOLY TEMP | 315.3 | °C | 315 ± 5 | | |
| RCCELL 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 | 1.006 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.010 | - | 1.0 ± 0.3 | | |
| NO Offset | 1.2 | mV | -20 to +150 | | |
| NO _x Offset | 0.8 | mV | -20 to 150 | | |
| Stability at Zero | 0.1 | PPB | < 0.2 | | |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas | | |



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 05 November 2023 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-R07 | SERIAL NO. | 4468 | | |
| Calibrator (Dilution System) | | | | | |
| Brand : | API | Model : | 700 | | |
| Last Cal. Date : | 08 August 2023 | Serial No. : | 911 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : | Nitric Oxide (NO) | Cylinder No. : | D636192 | | |
| Certified Date : | 20 April 2022 | Expired Date : | 20 April 2024 | Cylinder Conc. : | 49.1 ppm |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | | % RH | 49 | |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Dif | Analyzer Response | Slope |
| Zero | 0 | 0.10 | - | 0 | - |
| NO Span | 400 | 399.9 | -0.025 | 400.0 | 1.008 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.012 |
| 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 | 508 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 78 | cc/min | 80 ± 15 | | |
| PMT | 103.3 | mV | -20 - 150 | | |
| AZERO | 94.1 | mV | -20 - 150 | | |
| HVPS | 670 | V | 420 - 900 constant | | |
| RCCELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 29.4 | °C | 8 - 48 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2 | | |
| MOLY TEMP | 314.7 | °C | 315 ± 5 | | |
| RCCELL 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 | 1.008 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.012 | - | 1.0 ± 0.3 | | |
| NO Offset | 1.5 | mV | -20 to +150 | | |
| NO _x Offset | 0.9 | mV | -20 to 150 | | |
| Stability at Zero | 0.1 | PPB | < 0.2 | | |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas | | |



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Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

| Console Data | | Calibration Data | | |
|--------------|------------|------------------|-------|--------------------------------------|
| No. | Serial No. | Date | y | DH _g (mmH ₂ O) |
| B01 | 1563 | 04/09/2023 | 0.997 | 50.11 |
| B02 | 8002514 | 06/09/2023 | 1.002 | 49.25 |
| B03 | 1503016 | 05/09/2023 | 0.998 | 50.44 |
| B04 | 00006659 | 05/09/2023 | 1.004 | 49.37 |
| B05 | 00007428 | 05/09/2023 | 0.996 | 49.77 |
| R01 | 1561 | 06/09/2023 | 1.004 | 49.86 |
| R02 | 8002513 | 08/09/2023 | 1.005 | 50.36 |
| R03 | 1570 | 07/09/2023 | 0.997 | 49.55 |
| R04 | 8002519 | 04/09/2023 | 1.004 | 49.69 |
| R05 | 1503015 | 07/09/2023 | 0.999 | 50.08 |

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

Accept Value of DH_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 |
| B36 | S | 0.99 | 01/08/2023 | 0.85 | 0.84 |
| B37 | S | 0.99 | 02/08/2023 | 0.84 | 0.84 |
| B38 | S | 0.99 | 03/08/2023 | 0.84 | 0.83 |
| B39 | S | 0.99 | 03/08/2023 | 0.84 | 0.84 |
| B40 | S | 0.99 | 01/08/2023 | 0.85 | 0.84 |
| B41 | S | 0.99 | 02/08/2023 | 0.84 | 0.85 |
| B44 | S | 0.99 | 01/08/2023 | 0.84 | 0.84 |
| B45 | S | 0.99 | 01/08/2023 | 0.85 | 0.84 |
| B46 | S | 0.99 | 01/08/2023 | 0.84 | 0.85 |
| B47 | S | 0.99 | 01/08/2023 | 0.84 | 0.84 |
| B48 | S | 0.99 | 01/08/2023 | 0.84 | 0.85 |
| B49 | S | 0.99 | 03/08/2023 | 0.85 | 0.84 |
| B54 | S | 0.99 | 03/08/2023 | 0.83 | 0.84 |
| B56 | S | 0.99 | 03/08/2023 | 0.84 | 0.85 |
| B57 | S | 0.99 | 03/08/2023 | 0.84 | 0.83 |
| B58 | S | 0.99 | 03/08/2023 | 0.85 | 0.84 |

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



CALIBRATION LABORATORY CO., LTD.

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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-3]
CLID. NO. : 212201114
JOB CONTROL NO. : 230725081569

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.

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By :

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

Certificate No. Q23081569

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-3]
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. Q23081569

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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 | -16.66 | -16.69 | -4.9 | -4.9 | +0.1 | +0.1 |
| -10 | -33.79 | -33.79 | -10.0 | -10.0 | 0.0 | 0.0 |
| -15 | -50.76 | -50.76 | -15.0 | -15.0 | 0.0 | 0.0 |
| -20 | -67.79 | -67.82 | -20.0 | -20.0 | 0.0 | 0.0 |
| -25 | -84.68 | -84.72 | -25.0 | -25.0 | 0.0 | 0.0 |
| -30 | -101.51 | -101.51 | -30.0 | -30.0 | 0.0 | 0.0 |

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. Q23081569

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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 \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 |
| R01 | SKC | 224-PCXR4 | 602467 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,499 | 1,999 | 1.010x - 22.581 | 0.999 |
| R02 | SKC | 224-PCXR4 | 626450 | 06/10/2023 | 1,000 | 2,000 | 3,000 | 996 | 1,493 | 1,986 | 0.992x + 3.742 | 1.000 |
| R03 | SKC | 224-PCXR4 | 691592 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 989 | 1,495 | 1,994 | 0.999x - 6.866 | 1.000 |
| R04 | SKC | 224-PCXR4 | 691672 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,989 | 0.991x + 5.421 | 1.000 |
| R05 | SKC | 224-PCXR4 | 798470 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,495 | 1,995 | 1.005x - 18.995 | 0.999 |
| R06 | SKC | 224-PCXR4 | 798456 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,488 | 1,987 | 0.986x + 13.398 | 1.000 |
| R07 | SKC | 224-PCXR4 | 798480 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,497 | 1,998 | 1.009x - 21.689 | 0.999 |
| R08 | SKC | 224-PCXR4 | 883215 | 05/10/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,500 | 1,990 | 0.995x + 3.109 | 1.000 |
| R09 | SKC | 224-PCXR4 | 034650 | 05/10/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,497 | 1,996 | 1.008x - 21.526 | 0.999 |
| R10 | SKC | 224-PCXR4 | 091765 | 05/10/2023 | 1,000 | 1,500 | 2,000 | 996 | 1,493 | 1,994 | 1.000x - 6.596 | 1.000 |
| R11 | SKC | 224-PCXR4 | 091763 | 04/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,983 | 0.998x - 9.346 | 0.999 |
| R12 | SKC | 224-PCXR4 | 091568 | 04/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,497 | 1,999 | 1.009x - 21.948 | 0.999 |
| R13 | SKC | 224-PCXR4 | 091638 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,495 | 1,986 | 0.993x + 2.981 | 1.000 |
| R14 | SKC | 224-PCXR4 | 091764 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 2,000 | 1.012x - 26.788 | 0.999 |
| R15 | SKC | 224-PCXR8 | 529457 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,492 | 1,987 | 0.994x + 1.457 | 1.000 |
| R16 | SKC | 224-PCXR8 | 529643 | 04/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,498 | 1,997 | 1.007x - 17.908 | 0.999 |
| R17 | SKC | 224-PCXR8 | 529645 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,496 | 1,998 | 1.011x - 25.546 | 0.999 |
| R18 | SKC | 224-PCXR8 | 566756 | 03/10/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,490 | 1,989 | 0.995x - 1.759 | 1.000 |
| R19 | SKC | 224-PCXR8 | 566802 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,496 | 1,999 | 1.010x - 22.864 | 0.999 |
| R20 | SKC | 224-PCXR8 | 529089 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,506 | 1,996 | 1.008x - 22.151 | 0.999 |
| R21 | SKC | 224-PCXR8 | 665728 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,486 | 1,994 | 1.002x - 11.842 | 1.000 |
| R22 | SKC | 224-PCXR8 | 707444 | 03/10/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,500 | 1,999 | 1.007x - 18.171 | 0.999 |
| R23 | SKC | 224-PCXR8 | 761067 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,488 | 1,993 | 0.992x + 5.744 | 1.000 |
| R24 | SKC | 224-PCXR8 | 707893 | 05/10/2023 | 1,000 | 1,500 | 2,000 | 994 | 1,505 | 1,996 | 1.005x - 15.010 | 0.999 |
| R25 | SKC | 224-PCXR8 | 761052 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,495 | 1,989 | 0.991x + 5.640 | 1.000 |
| R26 | SKC | 224-PCXR8 | 707956 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 1,010 | 1,497 | 2,002 | 0.999x - 2.874 | 0.999 |
| R27 | SKC | 224-PCXR8 | 707398 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 1,001 | 1,496 | 1,997 | 1.008x - 20.237 | 0.999 |
| R28 | SKC | 224-PCXR8 | 707481 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 993 | 1,506 | 1,995 | 1.002x - 10.719 | 1.000 |
| R29 | SKC | 224-PCXR8 | 707402 | 04/10/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,495 | 1,989 | 0.995x + 1.091 | 1.000 |
| R30 | SKC | 224-PCXR8 | 093811 | 04/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,992 | 0.997x - 0.693 | 1.000 |
| R31 | SKC | 224-PCXR8 | 093183 | 06/10/2023 | 1,000 | 1,500 | 2,000 | 999 | 1,502 | 1,997 | 0.988x + 9.127 | 0.999 |
| R32 | SKC | 224-PCXR8 | 671950 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,994 | 0.998x - 3.451 | 1.000 |
| R33 | SKC | 224-PCXR4 | 626254 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 992 | 1,503 | 1,995 | 1.011x - 30.016 | 0.999 |
| R34 | SKC | 224-PCXR4 | 626131 | 03/10/2023 | 1,000 | 1,500 | 2,000 | 990 | 1,499 | 1,997 | 1.014x - 32.986 | 0.999 |
| R35 | SKC | 224-PCXR8 | 707460 | 07/10/2023 | 1,000 | 1,500 | 2,000 | 990 | 1,501 | 1,997 | 1.005x - 15.898 | 1.000 |
| R36 | SKC | 224-PCXR8 | 707446 | 05/10/2023 | 1,000 | 1,500 | 2,000 | 1,000 | 1,497 | 1,997 | 1.002x - 7.547 | 1.000 |
| R37 | SKC | 224-PCXR8 | 707432 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 995 | 1,498 | 1,995 | 0.999x - 4.856 | 1.000 |
| R38 | SKC | 224-PCXR8 | 707349 | 02/10/2023 | 1,000 | 1,500 | 2,000 | 991 | 1,496 | 1,992 | 1.000x - 7.364 | 1.000 |



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscs.com, www.spscs.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.) | | | y | R ² |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | | |
| H-R01 | Dwyer | VFB-65 | 02/10/2023 | 500 | 1,000 | 2,000 | 502.9 | 994.2 | 1977.4 | 1.003x - 7.740 | 0.999 |
| H-R02 | Dwyer | VFB-65 | 06/10/2023 | 500 | 1,000 | 2,000 | 495.9 | 996.6 | 2008.4 | 0.995x + 3.124 | 1.000 |
| H-R03 | Dwyer | VFB-65 | 04/10/2023 | 500 | 1,000 | 2,000 | 504.3 | 990.1 | 1969.6 | 0.987x + 9.890 | 1.000 |
| H-R04 | Dwyer | VFB-65 | 02/10/2023 | 500 | 1,000 | 2,000 | 496.9 | 986.1 | 2006.2 | 1.004x - 15.756 | 0.999 |
| H-R05 | Dwyer | VFB-65 | 03/10/2023 | 500 | 1,000 | 2,000 | 503.1 | 991.3 | 2014.3 | 1.000x - 1.636 | 1.000 |
| H-R06 | Dwyer | VFB-65 | 05/10/2023 | 500 | 1,000 | 2,000 | 499.2 | 997.2 | 1974.6 | 0.994x + 3.662 | 0.999 |



QUALITY CALIBRATION CO.,LTD.
235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com



CERTIFICATE No : 23M2441
REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XS105DU
SERIAL No : 1126422905
ID No : BA 05/50
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.
CALIBRATION DATE : 10-Mar-23

APPROVED BY :
ISSUED DATE :
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.

**QUALITY CALIBRATION CO.,LTD.**

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

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

www.qcalibration.com

CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
 MANUFACTURER : METTLER TOLEDO S/N : 1126422905
 ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
 AIR PRESSURE : 1010mbar ± 1mbar CALIBRATION DATE : 10-Mar-23
 AMBIENT TEMPERATURE : 23° C ± 1° C RELATIVE HUMIDITY : 49 %RH ± 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-1-151 | 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 (±g) |
|-------------------|---------------------|----------------|------------------|
| 0.00 | 0.00000 | 0.00000 | 0.000039 |
| 0.02 | 0.02000 | 0.00000 | 0.000039 |
| 0.10 | 0.10000 | 0.00000 | 0.000039 |
| 0.20 | 0.20001 | -0.00001 | 0.000040 |
| 0.50 | 0.50001 | -0.00001 | 0.000040 |
| 1.00 | 1.00000 | 0.00000 | 0.000041 |
| 2.00 | 2.00003 | -0.00003 | 0.000042 |
| 5.00 | 5.00001 | -0.00001 | 0.000046 |
| 10.00 | 10.00003 | -0.00003 | 0.000053 |
| 20.00 | 20.00005 | -0.00005 | 0.000067 |
| 50.00 | 50.00001 | -0.00001 | 0.00011 |
| 100.00 | 100.00001 | -0.00001 | 0.00019 |
| 200.00 | 200.00001 | -0.00001 | 0.00032 |

5. OFF CENTER LOADING ERROR

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

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

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY 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, Bangbunru, 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 |
| 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 ≤ 1.0 T(%), Absorbance ≥ 2.0 A

**Stray light not TISI Accredited

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

End of Calibration Certificate



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอย ฟาหะโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 539-4370-72, Fax : (662) 513-4321, E-mail : sales@spicon.com, www.spicon.com

| Calibration Report | | | | | |
|---------------------------------------|------------------------------------|-------------------|---------------------------------|---------------------------------|-----------|
| Non-Dispersive Infrared CO Analyzer | | | | | |
| Date : | 06 September 2023 | 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. : | D196045 | | |
| Certified Date : | 16 April 2022 | Expired Date : | 15 April 2024 | Cylinder Conc. : | 4,570 ppm |
| Calibrating Condition | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.6 | °C |
| | | | % RH | 49 | |
| Calibration Setting | | | | | |
| Span | Initial Reading (Before Adj.), PPM | | | Final Reading (After Adj.), PPM | |
| Set Point | Expected Concentration | Analyzer Response | %Diff | Analyzer Response | |
| Zero | 0 | -0.10 | - | 0 | |
| CO Span | 40.00 | 39.95 | -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 | 4015.1 | 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 | 28.7 | 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 | 68.4 | °C | 68 ± 2 | | |
| Box Temperature | 30.8 | °C | Ambient Temp + 7 ± 10 | | |
| Photo-Drive | 3040.3 | 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 : S.P.S.Consulting Service Co.,Ltd **Date Tested:** July 6, 2023
Address : 7 Soi Phaholyothin 24 **Period** 6 Months
Phaholyothin Road **Recommendation Recertification**
Jompol Chatuchak, Bangkok 10900 **Recertification Due:** January 6, 2024
Date Last Certified: January 11, 2023
User Name: K.Phenpha Vipphasthawatt **Visit Number:** 1 of 2
Phone: 083-9269252 **PerkinElmer Phone:** 02-719-6420 ext 206
Fax: 02-513-4221 **PerkinElmer Fax:** 02-318-5597

CONFIGURATION TESTED

MODEL
OPTIMA 5300DV

SERIAL NUMBER
077C7042401

TESTED EQUIPMENT

IPV Methods

CALIBRATION NUMBER

ACCESSORIES/COMPONENT NOT INCLUDED

EXPIRATION

TEST STANDARD USED

Multielement Standard
Wavecal Solution
VIS Wavecal solution
Instrument Cal. STD4

PART NUMBER

N069-1579
N058-2152
N930-2946
N930-0221

EXPIRATION DATE

October 30, 2023
September 30, 2023
August 30, 2023
November 30, 2023

CUSTOMER SUPPLIED

2 % HNO3
10 % HNO3

COMMENTS

CUSTOMER INITIALS



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401 DATE TESTED July 6, 2023

1. MECHANICAL CHECKS

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

2. OPTICAL CHECKS

- A. Inspect and clean all optical components. ☐ OK
- B. As required, check and replace all purgefilters. ☐ OK
- C. Recheck optical alignment. ☐ OK

3. COOLING SYSTEM CHECKS

- A. Perform preventive maintenance on chiller. ☐ OK
- B. Flush out the chiller every year. ☐ N/A

4. PERFORMANCE CHECKS

- A. Torch View Alignment. ☐ OK
- B. Wavelength Calibration. ☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401 DATE TESTED : July 6, 2023

| PARAMETER | SPECIFICATION | | | FINAL VALUE |
|----------------------------------|---------------|------------|-------------|-------------|
| Spectral Resolution : UV | As | 193.696 nm | ≤ 0.007 | 0.00534 |
| | Ni | 231.604 nm | ≤ 0.008 | 0.00682 |
| | Ni | 341.476 nm | ≤ 0.012 | 0.00794 |
| Spectral Resolution : VIS | La | 408.672 nm | ≤ 0.020 | 0.01613 |
| | Ba | 455.403 nm | ≤ 0.025 | 0.02282 |
| Precision | As | 193.656 nm | % RSD < 1.0 | 0.23 % |
| | Zn | 213.856 nm | % RSD < 1.0 | 0.09 % |
| | Mn | 257.610 nm | % RSD < 1.0 | 0.58 % |
| | La | 379.478 nm | % RSD < 1.0 | 0.38 % |
| | Ba | 455.403 nm | % RSD < 1.0 | 0.42 % |
| | Ba | 493.408 nm | % RSD < 1.0 | 0.41 % |
| Detection Limits : Axial | Ti | 190.080 nm | 3(sd) | 2.37 ppb |
| | As | 193.696 nm | 3(sd) | 6.78 ppb |
| | Pb | 220.353 nm | 3(sd) | 0.82 ppb |
| Detection Limits : Radial | As | 193.696 nm | 3(sd) | 23.56 ppb |
| | Zn | 213.856 nm | 3(sd) | 2.85 ppb |
| | Mn | 257.610 nm | 3(sd) | 3.66 ppb |
| | La | 379.478 nm | 3(sd) | 5.10 ppb |
| | Ba | 455.403 nm | 3(sd) | 0.12 ppb |
| | Ba | 493.408 nm | 3(sd) | 1.17 ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd | 226.502 nm | ≤ 150 ppb | 117.07 |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn | 257.610 nm | ≤ 45 ppb | 22.09 |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401 **DATE TESTED** July 6, 2023

Remarks :

Commissioning follow as commissioning performance sheets.

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



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

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

PinAAcle 900T Preventive Maintenance (PM)

| | | | |
|--|--|--|--------------|
| Company Name: | SPS Consulting Service Co., Ltd. | | |
| Address (Instrument Location): | 7 Soi Phaholyothin 24, Phaholyothin Rd. Jompol, Bangkok, 10900 | | |
| Serial Number: | PTCS14111103 | PM Number: | 2/2 |
| Customer Name (if applicable): | K. Phenpha | Telephone Number: | 083-926-9252 |
| Customer Support Engineer Name: | K. Duang | Service Order Number: | WO-02419478 |
| Date PM Performed: (DD-MMM-YYYY) | 29-Jun-2023 | Next PM Due Date: (DD-MMM-YYYY) | 29-Dec-2023 |
| Standard Labor Hours to Complete PM : | | 5 hours | |

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

Scope

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

The customer should save their method before the PM begins.

General Instructions:

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

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Component List

| Component / Specific Model | Serial # | Configuration Notes |
|----------------------------|--------------|---------------------|
| AS900 | AS91514B1002 | Winlab32 |
| | | |
| | | |
| | | |

Parts Lists

| Parts Included with the PM | | |
|-----------------------------|---|----------|
| Part Number (if applicable) | Description | Quantity |
| B0501696 | Fan Filters | N/A |
| B3002013 | THGA Contact Cylinders | N/A |
| 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) | N/A |
| N9301714 | Replacement Acetylene Filter Cartridge | N/A |
| TH001022 | Replacement Air Filter Cartridge | N/A |

| Additional Reagents and Standards Required for PM | | | | |
|---|---------------------------|---------|-------------|----------------------|
| Part Number (if applicable) | Description | Quality | Batch/Lot # | Expired Date (MM/YY) |
| N9300183 | 1000 mg/L Copper Standard | AR | 26-87CUY1 | 30-Jan-2024 |
| N9300244 | GFAAS Mixed Standard | AR | 56-21CRY1 | 30-Jun-2023 |

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

Additional Tools Required for PM

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

Procedure Checklist

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

1. General:

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

2. PC Instrument Software:

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

3. Mechanical:

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

3.1 Flame Technique

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

3.2 THGA Technique

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

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

4. Electrical:

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

5. Optics:

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

6. Gasses:

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

7. Flame Interlock Check:

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

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

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

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

| Parameter | Specification | Certificate Value at 553.6 nm (Abs.) | Test Results | Pass/Fail |
|-----------------|-----------------|--------------------------------------|--------------|-----------|
| 1.0 A ND Filter | ± 5% from Cert. | 0.9798 | 0.9877 | Passed |
| 0.2 A ND Filter | ± 5% from Cert. | 0.2042 | 0.1985 | 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 | 0.0016 | 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 | 0.0044 | 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 | 0.0001 | 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. | NA | Not Applicable |
| 2 mg/L Sensitivity HS Neb (if applicable) | > 0.250 Abs. | 0.3421 | 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 ± 25 mL/min | 255 | Passed |
| External Flow Rate | 100 mL/min ± 10 mL/min | 105 | Passed |

9.2 Chromium Baseline Noise

Description: Signal to noise check.

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Baseline Noise | ≤ 0.005 Abs. | 0.0005 | Passed |
| Standard Deviation | ≤ 0.005 | 0.0004 | Passed |

9.3 Chromium Characteristic Mass and Precision

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

| Parameter | Specification | Results | Pass/Fail |
|---------------------------|---------------------|---------|-----------|
| Cr m ₀ Results | ≤ 7.0 pg/0.0044 A-s | 5.8 | Passed |
| Precision | ≤ 2.0 % | 1.18 | 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 | 0.52 | 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

=

Atomic Signal (Peak area)

Atomic Signal (Peak area) + Background Signal (Peak area)

=

0.1614

0.1614+0.1448

=

0.52

Review

